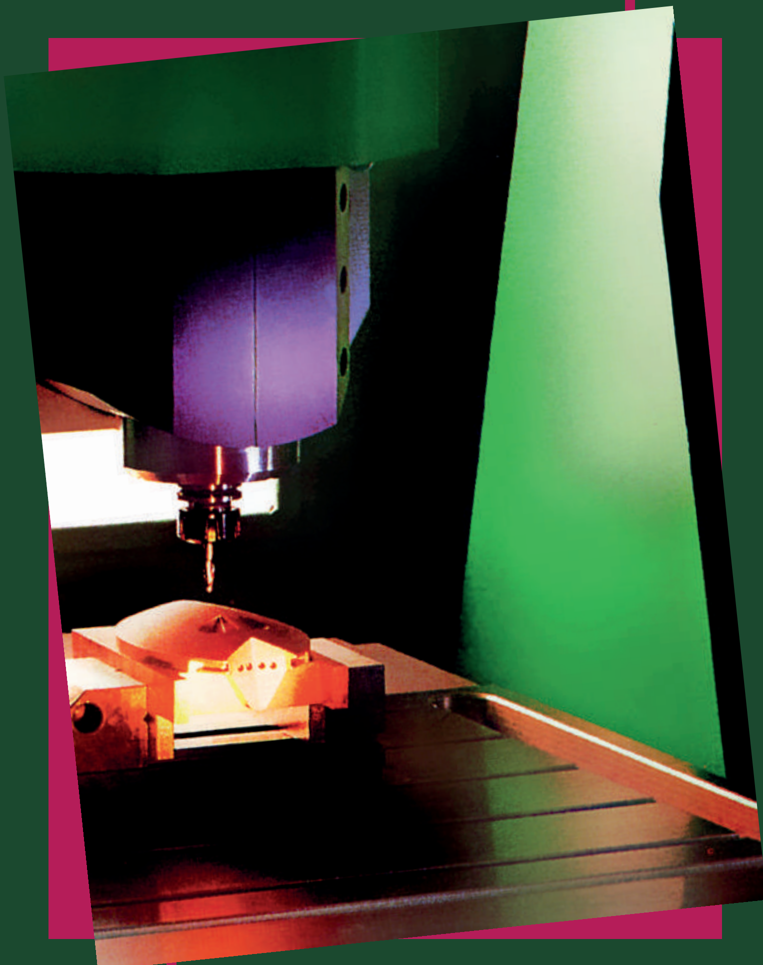
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ
ΙΝΣΤΙΤΟΥΤΟ ΕΚΠΑΙΔΕΥΤΙΚΗΣ ΠΟΛΙΤΙΚΗΣ

ΑΓΓΛΙΚΑ

ΤΟΜΕΑΣ ΜΗΧΑΝΟΛΟΓΙΑΣ



Β΄ ΕΠΑ.Λ.

VOCATIONAL LANGUAGE LEARNING

COURSEBOOK FOR MECHANICAL ENGINEERING TECHNICIANS

ΙΝΣΤΙΤΟΥΤΟ ΤΕΧΝΟΛΟΓΙΑΣ ΥΠΟΛΟΓΙΣΤΩΝ ΚΑΙ ΕΚΔΟΣΕΩΝ «ΔΙΟΦΑΝΤΟΣ»

English for
MECHANICAL ENGINEERING
TECHNICIANS

ΣΤΟΙΧΕΙΑ ΑΡΧΙΚΗΣ ΕΚΔΟΣΗΣ

ΟΜΑΔΑ ΕΡΓΑΣΙΑΣ

Επικεφαλής
Διαμαντίδου Αγγελική
Σχολικός Σύμβουλος Κλ. Π.Ε. 6

Διαμόρφωση Κειμένων – Επεξεργασία Ασκήσεων
Σουβλάκη Αλεξάνδρα
Εκπαιδευτικός Κλ. Π.Ε. 6

Το βιβλίο αυτό διαμορφώθηκε με βάση τα αντίστοιχα βιβλία του Τεχνικού Λυκείου: • «Coursebook for Mechanical Engineering Technicians»
• «Heating – Refrigeration – Air Conditioning»
της Ομάδας Εργασίας της Β΄ φάσης συγγραφής που απετελείτο από τους:

Επικεφαλής
Διαμαντίδου Αγγελική
Σχολικός Σύμβουλος
Κλ. Π.Ε. 6

Υπεύθυνος Πληροφοριών Ειδικότητας
Ασημακόπουλος Αντώνιος
Σχολικός Σύμβουλος Κλ. Π.Ε. 17

Διαμόρφωση Κειμένων – Επεξεργασία Ασκήσεων
Εκπαιδευτικοί του Κλ. Π.Ε. 6

Σπυροπούλου Μαρία για το:
«Coursebook for
Mechanical Engineering Technicians»

Σουβλάκη Αλεξάνδρα για τα:
1. «Coursebook for Mechanical Engineering Technicians»
2. «Heating - Refrigeration - Air Conditioning»

ΣΤΟΙΧΕΙΑ ΕΠΑΝΕΚΔΟΣΗΣ

Η επανέκδοση του παρόντος βιβλίου πραγματοποιήθηκε από το Ινστιτούτο Τεχνολογίας Υπολογιστών & Εκδόσεων «Διόφαντος» μέσω ψηφιακής μακέτας.

ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ
ΙΝΣΤΙΤΟΥΤΟ ΕΚΠΑΙΔΕΥΤΙΚΗΣ ΠΟΛΙΤΙΚΗΣ

Διαμαντίδου Αγγελική **Σουβλάκη Αλεξάνδρα**

Η συγγραφή και η επιστημονική επιμέλεια του βιβλίου πραγματοποιήθηκε
υπό την αιγίδα του Παιδαγωγικού Ινστιτούτου

VOCATIONAL LANGUAGE LEARNING

English for
MECHANICAL ENGINEERING
TECHNICIANS

Β΄ ΕΠΑ.Λ.

ΤΟΜΕΑΣ ΜΗΧΑΝΟΛΟΓΙΑΣ

Teaching Material for
Students of Technical and Vocational Schools

ΙΝΣΤΙΤΟΥΤΟ ΤΕΧΝΟΛΟΓΙΑΣ ΥΠΟΛΟΓΙΣΤΩΝ ΚΑΙ ΕΚΔΟΣΕΩΝ
«ΔΙΟΦΑΝΤΟΣ»

Ευχαριστίες

Ευχαριστούμε θερμά:

1. Τις Εταιρείες και Αντιπροσωπείες των Εταιρειών:
ΑΛΜΕ, Rotring, Pelikan, Staedler, Faber Castell, Hewlett Packard, IBM, Ροή, Willo, Grundfos, FACOM, USAG, UNIOR, WIGAM, COMAP, PHILCO, Kelvinator, DAIKIN, SANYO, GENEO-TOSHIBA, INTERKLIMA, FUTJITSU, MITSUBISHI, PANASONIC - UNICLIMA, Φυρογένης, Ράδιο-Κορασίδη, Ράδιο-Αθήνα, Αποστόλου, Πιλάλη, Μηχανική Αθηνών, Παρετζόγλου, Αφοί Σαρακάκη, MERCEDES BENZ - Λαινόπουλος Α.Ε., Biamax A.E.B.E., Ford Motor Hellas – I.E. Κοντέλλης Α.Ε., που μας έδωσαν την άδεια να χρησιμοποιήσουμε φωτογραφικό υλικό από τα διαφημιστικά έντυπα που εκδίδουν, καθώς και αποσπάσματα κειμένων από εγχειρίδια λειτουργίας, εγκατάστασης, συντήρησης και επισκευής των ειδών τους.

2. Τους υπεύθυνους των Μεταφραστικών Τμημάτων, Δημοσίων Σχέσεων και Προώθησης Προϊόντων των παραπάνω Εταιρειών για την προθυμία τους να μας εξυπηρετήσουν και το άφθονο υλικό που μας έστειλαν, ιδιαίτερα δε τους κ.κ. Σακελλαρίου (Ford Motor Hellas – I.E. Κοντέλλης), Καράμπελα (Biamax A.E.), Λαπαθιώτη (Ι.Ε. Σαρακάκη), Ανέστη (Grundfos) και Κουρτζή (Φυρογένης Α.Ε.) που κατανάλωσαν αρκετό από τον πολύτιμο χρόνο τους, με αξιοθαύμαστη υπομονή, για να μας ενημερώσουν και λύσουν απορίες μας σε θέματα που αφορούν τον τομέα τους.

3. Τους Εκδοτικούς Οίκους Longman Hellas, Automobile Association Developments Limited και Readers Digest Association που μας παραχώρησαν την άδεια να χρησιμοποιήσουμε φωτογραφικό υλικό από τα έντυπα που εκδίδουν.

4. Τους συναδέλφους του 1ου ΤΕΛ Γαλατσίου Α. Κουκά και Ι. Κυτάγια, τον συνάδελφο Παναγιώτη Παναγιωτίδη της 1ης ΤΕΣ Αμαρουσίου, και τον Μηχανολόγο Μηχανικό Ι. Διακάτο (υπεύθυνο της εταιρείας ΑΞΩΝ ΕΠΕ) για τις πληροφορίες και το υλικό που μας έδωσαν.

5. Τη συνάδελφο Ισμήνη Παναγούλια εκπαιδευτικό του 22ου Γυμνασίου Αθηνών και τον τεχνικό φωτογραφίας κ. Ι. Κοκκίνη για τη φωτογράφηση και εκτύπωση υλικού απαραίτητου για τις ανάγκες του βιβλίου.

Η τελική επιλογή του φωτογραφικού υλικού που χρησιμοποιήθηκε έγινε με βάση τις διδακτικές και αισθητικές ανάγκες του βιβλίου.

Η Ομάδα Εργασίας

Για το Μαθητή

Το βιβλίο αυτό δεν έχει σκοπό να σας διδάξει το αντικείμενο της ειδικότητάς σας, αλλά να καλύψει βασικές ανάγκες σας στην ξένη γλώσσα για να σας βοηθήσει να αντιμετωπίσετε καταστάσεις που θα συναντήσετε στο μέλλον σαν επαγγελματίες, π.χ. να διαβάσετε ένα διαφημιστικό φυλλάδιο, οδηγίες χρήσης, εγκατάστασης, ή επισκευής μηχανημάτων, να παραγγείλετε ένα εξάρτημα, να ζητήσετε ή να δώσετε πληροφορίες σε έναν αλλοδαπό συνάδελφο, προϊστάμενο, κλπ.

Δεδομένου ότι οι ώρες της ξένης γλώσσας στη σχολή σας είναι πολύ περιορισμένες, αναγκαστικά έγινε μια πολύ αυστηρή επιλογή στην ύλη που συμπεριλήφθηκε. Τα θέματα που επιλέχθηκαν, ωστόσο, περιλαμβάνουν ένα βασικό λεξιλόγιο που μπορεί να αποτελέσει το κλειδί για την στοιχειώδη κατανόηση ενός κειμένου, την πραγματοποίηση μιας απλής προφορικής ή γραπτής επικοινωνίας, και, κυρίως, αφετηρία για παραπέρα γνώση, που σύντομα θα διαπιστώσετε πόσο σας είναι απαραίτητη για να αντιμετωπίσετε τις αυξημένες ανάγκες της εποχής μας.

Καθώς το βιβλίο απευθύνεται σε όλες σχεδόν τις ειδικότητες του Μηχανολογικού τομέα*, περιλαμβάνει ύλη που πιθανόν να αφορά την ειδικότητά σας σε διάφορα κεφάλαια των ενοτήτων που το απαρτίζουν. Θα πρέπει λοιπόν, να ξεφυλλίσετε το βιβλίο, να εντοπίσετε τα θέματα που σας ενδιαφέρουν και να καταρτίσετε, σε συνεργασία με τον καθηγητή σας, έναν κατάλογο κεφαλαίων που θεωρείτε χρήσιμο να διδαχθείτε. Μην ξεχνάτε πως στο θέμα αυτό εσείς έχετε τον πρώτο λόγο και πως ο καθηγητής σας δεν είναι δυνατό να γνωρίζει σε βάθος το αντικείμενο όλων των ειδικοτήτων που διδάσκονται στη σχολή σας. Αφού εντοπίσετε τα θέματα που σας ενδιαφέρουν, είναι σκόπιμο να τα ιεραρχήσετε έτσι που να εξασφαλίσετε ότι, έστω και αν χαθούν ώρες ή προχωρήσετε με πιο αργούς ρυθμούς από όσο αρχικά υπολογίζατε, σίγουρα θα διδαχθείτε αυτά που σας είναι περισσότερο χρήσιμα.

Στο τέλος του βιβλίου σας υπάρχει παράρτημα (APPENDIX) με χρήσιμες πληροφορίες (λεξιλόγιο, ανώμαλα ρήματα, τύπους επιστολών, πίνακες με χρήσιμες εκφράσεις, σημαντικά γραμματικά φαινόμενα που σας δυσκολεύουν...) που καλό θα είναι να εξερευνήσετε για να μπορείτε να ανατρέξετε όποτε σας χρειάζεται.

Η Ομάδα Εργασίας

* Εξαιρούνται οι ειδικότητες των Τεχνιτών Αμαξωμάτων, των Τεχνιτών Εγκαταστάσεων Ύδρευσης-Θέρμανσης και των Μηχανοσυνθετών Αεροσκαφών, τις ανάγκες των οποίων αυτό το βιβλίο καλύπτει ελάχιστα, και για τους οποίους θα γραφτούν ξεχωριστά βιβλία.

PREFACE

This book aims at helping the students of Technical and Vocational Schools, who are specializing in one of the various specialities related to the Mechanical Engineering field, become able to function adequately in situations they will need to use the English language in their future jobs.

A needs analysis showed that such situations will be: reading authentic published materials in their area (articles, catalogues, advertisements, instruction manuals, safety precautions, business letters...), asking for or giving information related to their speciality, understanding instructions given to them orally, describing a procedure, writing letters to order a product, complain, apply for a job, etc.

The book is designed to cover approximately sixty teaching hours for each of the specialities of the schools mentioned above, and is intended for students who have had pre- to intermediate level courses in English, have been exposed to the main structures of the language and have a certain active vocabulary, but function, both conversationally and in writing, at a low level as they make many mistakes in lexicon and grammar.

Since the students will mostly use the language to read technical texts, the main purpose of the book is to build the reading comprehension skill and help them acquire a basic vocabulary in their area, as well as to help them overcome any difficulties they may have with those syntactical and grammatical features that occur frequently in the target situation (Wh- questions, passive voice, etc.). Such features have been given particular emphasis in the book.

Although the focus is on reading comprehension, the book also aims at practising listening, speaking and writing, as this will reinforce the development of the reading skill and prepare the students better to function effectively in the situations they will need to use the language.

The texts are authentic and at approximately the same level of difficulty. They have been chosen with the help of a subject specialist from a variety of sources (books, magazines, brochures, instruction manuals, advertisements, etc.) taking into consideration the students current knowledge of the subject and their needs in their future job. Bearing also in mind the students' language level, some texts have been simplified and adapted to meet the needs of the average student in the large mixed-ability classes of the Technical and Vocational Schools.

Motivation was also taken into account when selecting and exploiting the texts since experience has shown that, if the texts are not motivating, the interest in the language is lost. So, the book contains a variety of different text and exercise types, tasks and illustrations aiming at engaging the students' interest and enabling them to discover the learning strategies that suit them best to help them become effective language learners and take a greater responsibility for their own learning.

The exercises are designed to teach and not to test. They can be classified into two main categories: those designed to develop comprehension of technical texts and help the students acquire the vocabulary presented, and those focusing on grammatical and syntactical points.

The exercises that accompany the readings teach reading skills such as locating information, finding the main idea of a text, skimming or scanning to locate specific information, understanding information, either stated directly or implied in the text, or deducing concepts from either directly or indirectly stated information, understanding relations between parts of the text, deducing meanings of new lexical items from context, etc.

In most exercises, even if the students are asked simply to say if an answer is true or false, they are also asked to explain their choice, refer to the part of the text that led them to the answer, correct the wrong information, etc. This approach aims at raising the students' interest to the task and engaging their thinking capacity to make learning more effective. Furthermore, this can encourage genuine communication among the students, or between them and the teacher, providing additional opportunities for language practice and making the classroom more student centred.

Since one of the main aims of this book is to provide the students with a high-frequency technical vocabulary to use as a tool to communicate in the target situation, it includes lots of vocabulary exercises. Their object is to provide the students with enough practice to help them commit the new meanings to memory and make the new vocabulary active, and to provide them with strategies to use to expand their vocabulary in a continuous basis.

Focus exercises in the book ("Expressing....") present and practise those of the language functions contained in the reading texts that are readily associated with the English the students will need to communicate in their field. These exercises usually include some examples taken from the reading and are followed by practice exercises to enable the students to progress from identifying the function to using it. Most of these exercises are accompanied by a table that lists the most widely used sentence patterns the function may be expressed in, and an explanation of the function, which the students will find in the «Language Functions» section in the APPENDIX.

The book also includes some grammar exercises, where the most frequently occuring grammatical structures in technical English are practised, to help the learners brush up their knowledge and overcome their difficulties. Most of these exercises are accompanied with a short presentation of the phenomenon being practised, (mostly in the form of tables presenting its structure and use), and a few examples, in the «Grammar» section in the APPENDIX. It is up to the teacher to decide how s/he will exploit this section to best meet his/her students' needs. If necessary, it can be used for reference or for self-study by individual students under the teacher's guidance.

At the end of most units or chapters in the book, there are production exercises in the form of communicative activities for oral or writing practice, to provide the learners with the opportunity to reinforce their overall competence by applying the language, ideas and vocabulary presented in the texts. They also offer the students the chance to practise in communicative situations similar to the ones they will find themselves in, in the future. Such situations are: developing paragraphs or longer texts, writing business letters, performing telephone conversations, writing a report, an application form or a curriculum vitae, negociating with a customer, etc.

Apart from the activities and exercises described previously, a number of listening activities have also been included in the book. They aim at training the students in a variety of specific listening skills to reinforce their oral comprehension of the language, consolidate what they have learned and help them find solution to various listening problems that may arise in the target situation.

At the end of this material, there is an APPENDIX that contains, apart from the «Language Functions» and «Grammar» sections mentioned above, a glossary including technical and subtechnical terms, useful mathematical terms and expressions, as well as some model letters with useful expressions and guidelines on letter-writing, which the students can refer to when writing formal letters.

The Student's Book is accompanied by a Teacher's booklet including the answers to the exercises, suggestions and notes to the teacher on the way to approach certain activities and all the texts for the listening activities.

As regards the methodological approach to be followed in teaching this material, we would like to point out that, since ESP belongs to the broader context of ELT, the main task of the ESP teacher is not to teach the subject but the language and consequently s/he should follow the same methodological principles applied to the teaching of G.E.

Η Ομάδα Εργασίας

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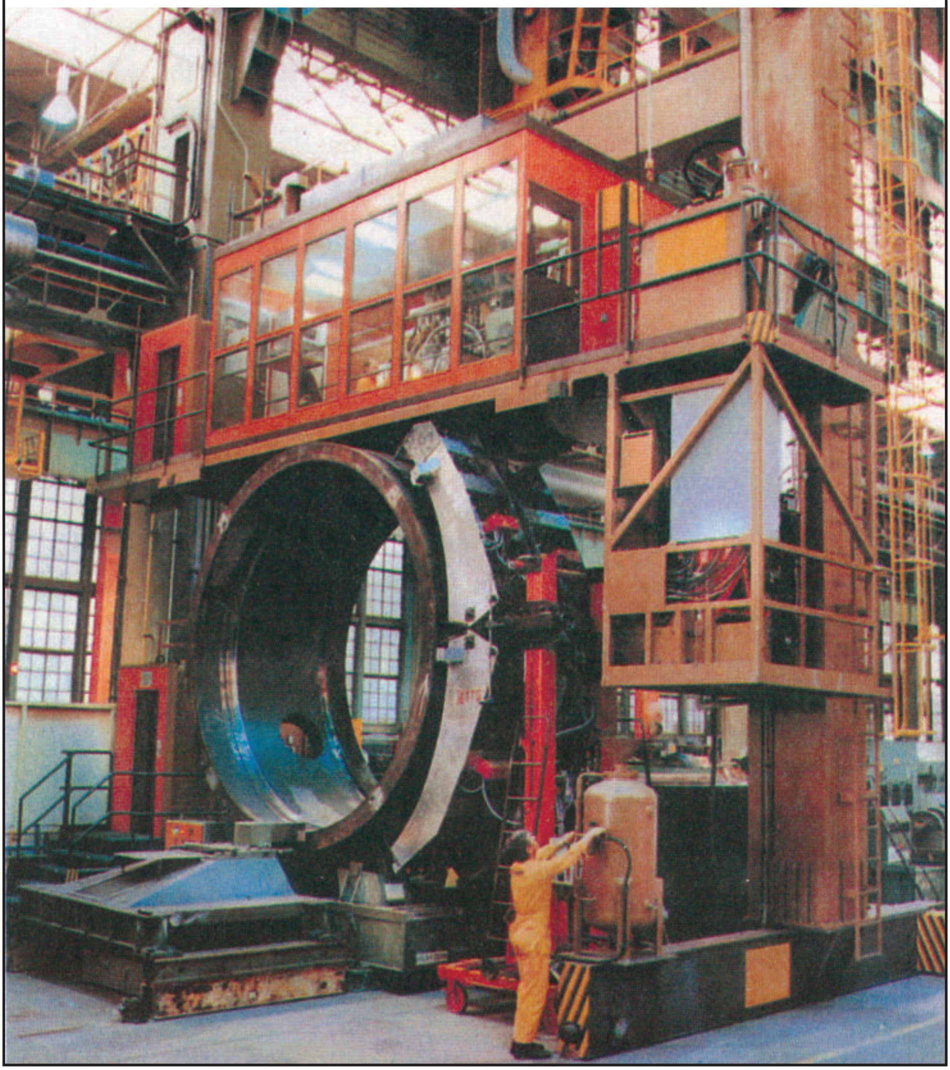
APPENDIX

UNIT 1

MECHANICAL ENGINEERING TECHNICIANS



MECHANICAL ENGINEERING

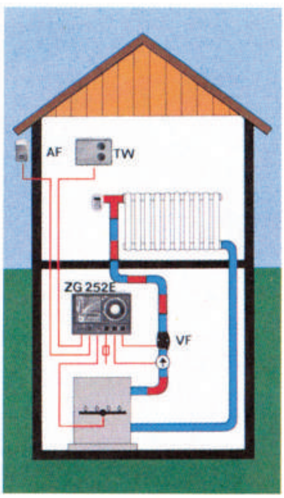
You have decided to become a technician in one of the various areas of the mechanical engineering field. As the development of modern civilisation is largely based on the services of mechanical engineers and mechanical engineering technicians, whatever your choice, the branch you are specialising in will secure you a first-class job, interesting and well-paid. A job in which ability and skill are recognized and rewarded. Well, how much do you know about Mechanical Engineering?

Use your knowledge to carry out the tasks below. Discuss your answers in class.

TASK 1

A. Label the following items. Choose the appropriate term from the list.

portable CD player machine tool telephone engine aircraft plan of a house lorry spacecraft ship TV set refrigerator air conditioner heating system ventilator microwave oven lift electric cooker electric power plant refrigerator truck iron radar escalator

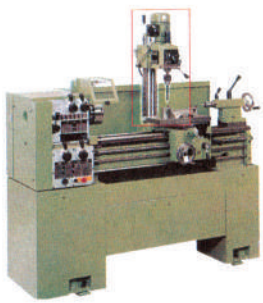


1. ____________________

2. ____________________

3. ____________________

4. ____________________



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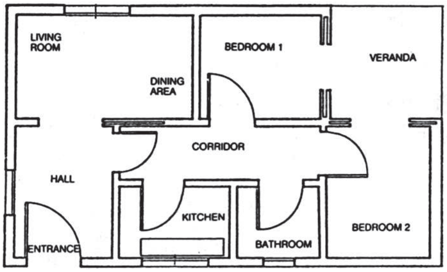
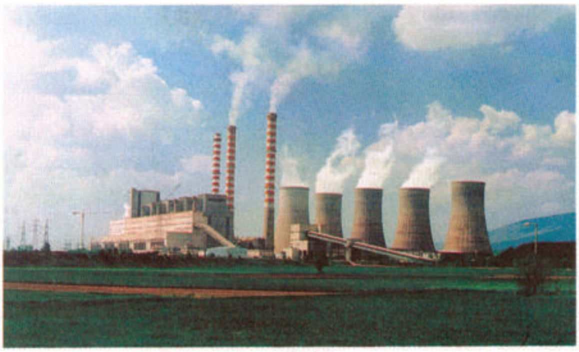


6. ____________________

7. ____________________

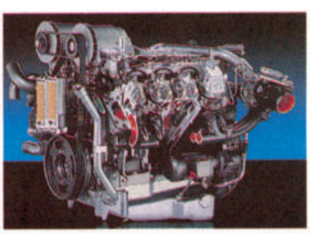


8. ____________________

9. ____________________

10. ____________________

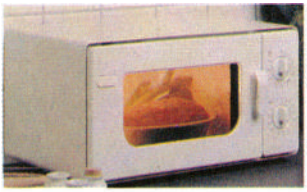
11. ____________________



12. ____________________

13. ____________________

14. ____________________



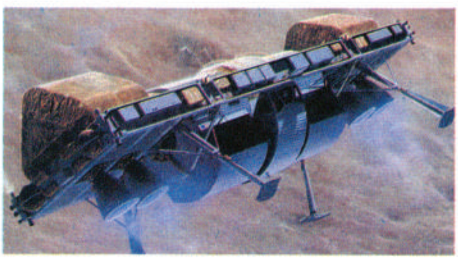
15. ____________________

16. ____________________

17. ____________________

18. ____________________

19. ____________________



20. ____________________

21. ____________________

22. ____________________

B. **Which of the items in ps 16-18 are related to the field of mechanical engineering? Tick appropriately.**

TASK 2

Mechanical Engineering is also related to some of the following fields. Which ones? Tick.

education
transport
building construction
entertainment
industry
aviation
air pollution
central heating
photography
shipbuilding industry

accounting
space exploration
ventilation
telecommunications
fire protection
health services
computer studies
electric power generation
food preservation.

Shipbuilding industy

TASK 3

Complete the sentences with words from the list to present the activities performed by mechanical engineers and mechanical engineering technicians.

engines machines tools metals machine tools means of transport precision instruments lifts and escalators heating systems refrigeration systems air-conditioning systems ventilating systems

Mechanical engineers and mechanical engineering technicians:

- design ______________________
- construct ______________________
- install ______________________
- adjust ______________________
- maintain ______________________
- repair ______________________
- operate ______________________
- use ______________________
- cut ______________________
- shape ______________________
- join ______________________

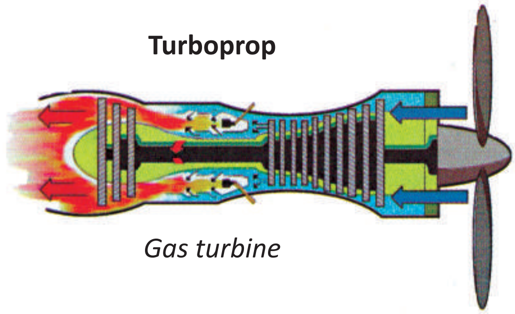
Read the text which follows and check your answers to the previous tasks.

MECHANICAL ENGINEERING TECHNICIANS AND THEIR SERVICES

1. ____________________________________

Mechanical engineers and mechanical engineering technicians are in demand in every kind of industry, in all public services and utilities (e.g. telecommunications, electric power supply, transport, etc.), in space exploration, as well as in the installation and maintenance of heating, refrigeration, ventilating and air-conditioning systems.

They design, maintain and adjust the engines that move cars, ships, trains, aeroplanes, spacecraft* and also the engines (steam, hydraulic or gas turbines, diesel engines...) that run generators in electric power plants.



Turboprop

Gas turbine

Tractor

They deal with the design, development, installation, operation and maintenance of the many thousands of machines used in industry, as well as with the design and construction of tools which are necessary to work and shape metal and to construct machines. Transport also requires their services. They design and build ships, freight and passenger trains, aeroplanes, cars, coaches, vans, lorries, tractors, etc. They also install lifts and escalators for vertical transportation in buildings.

Coach

Passenger train

---

* - craft is both the singular and plural form of the word

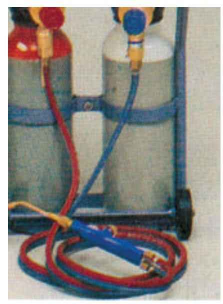
Mechanical engineers and mechanical engineering technicians are needed in the manufacture of refrigeration and ventilating equipment that will serve industrial purposes (e.g. in food preservation), and provide comfort in factories, buildings, and means of transport. They design and build refrigerator trucks for the transportation of perishable products and are responsible for the ventilating and refrigerating systems used in restaurants, hotels, markets, etc.
Another important task is to develop and install proper heating and air-conditioning systems in buildings, homes, industrial plants, cars, buses, coaches, passenger trains, and aircraft. Such systems will maintain the desired inside temperature under the most unfavourable weather conditions.

2. ______________________________

The technicians engaged in the field of mechanical engineering must be well trained and highly skilled so as to perform difficult work activities, such as to adjust and repair all types of machines and engines, to operate machine tools, to cut, shape and join metals, or to install and maintain heating, refrigeration, ventilation and air-conditioning systems. They must, as a result, work with accuracy and be able to use precision measuring instruments, handtools and welding equipment skilfully. They should also have a certain knowledge of Mathematics, be familiar with the properties of metals, and be able to read and produce drawings.

Drawing

Precision measuring instument



Welding equipment

3. ______________________________

As a result, since they are indispensable to modern industry and transportation, a lot of exciting and well-paid jobs are available for the well trained mechanical engineering technician. Some of them are: bench- and sheet-metal worker, tool hardener, machinist, CNC machine tool operator, machine shop supervisor, welder, plumber, heating, refrigeration and air-conditioning systems installer and maintenance technician, car mechanic, aircraft engineer, ship engineer, etc.

EXERCISES

1. The above text is divided into three thematic areas. Choose the appropriate heading for each one from the list below and write it in the space provided.

1. Career opportunities and specialities
2. Areas for employment – Services
3. Tasks and requirements

2. As mechanical engineering technicians you will have to construct, adjust, maintain, install.... engines, machines and equipment of various kinds. Do you know what these words mean? **Match them with the appropriate definition.**

GROUP A

1. engine	a) a piece of equipment which uses electricity or an engine to do a particular kind of work
2. machine	b) the things needed or used for a particular purpose
3. tool	c) a machine driven by power that cuts, shapes or finishes metal
4. machine tool	d) a machine that produces power or motion
5. equipment	e) an object, usually made of metal, used by technicians, workers, etc. to do a particular work

GROUP B

1. to design	a) to make, create, build something
2. to develop	b) to make something work
3. to construct	c) to design and produce an object, system, etc.
4. to adjust	d) to keep something in good condition by regularly checking and repairing it
5. to maintain	e) to plan and make a drawing of an object, machine, etc. from which it can be made
6. to repair	f) to regulate someting, e.g. an engine, so that it becomes more effective
7. to operate	g) to put something at its appropriate place and make it ready to operate
8. to install	h) to make something that isn't working properly, work properly again

GROUP C

1. welding equipment	a) the activity and system of carrying people and things from one place to another
2. passenger train	b) a train on which goods are transported
3. transport(ation)	c) equipment used to join metals with the use of heat
4. freight train	d) tools and devices used for measuring
5. measuring instrument	e) a train designed to carry people who are travelling

3. Complete the diagram

Mechanical Engineering Technicians' Working Fields

- In__________y — in the construction of:
  - a) en________ for: means of tr________, space________ and ________ plants
  - b) ________, tools, machine ________
  - c) h________, r________, v________, a____ - ________ equipment
  - d) lifts and ________
- Public Services / Utilities — such as:
  - a) gas, wa______, e________ power supply
  - b) tr________ by cars, trains ...
  - c) t________ (radio, telephony...)
- Ins__________n — of:
  - a) machines
  - b) ________ and escalators
  - c) ________, ________, ________, ____ - ________ systems
- Operation and M__________ — of:
  - a) engines, m________, m________ t______
  - b) lifts and e________
  - c) ________, ________, ________, ____ -________ systems,
- C__________ng Shaping J__________ — of: → m________s

4. Identify the words defined below.

1. __________: factory which produces electric energy
2. __________: a moving staircase on which people move up and down
3. __________: device that takes people up and down in another floor inside buildings.
4. ____________________: system that lowers the temperature in a space to preserve foods
5. ________________: system allowing fresh air to get into a room or building

5. Make lists of the:

A. Engines used in power plants: ....

....

B. Systems and equipment controlling the inside temperature and the movement of air: ....

....

6. A. Use the table to make meaningful sentences.

- Mechanical engineers... (and)
- Mechanical engineering technicians

are employed in
are needed to
are required in
are engaged in
deal with
are in demand in

transport(ation)
develop / the development of...
maintain / the maintenance of...
adjust / the adjustment of...
telecommunications
aviation
car construction (industry)
shipbuilding (industry)
the construction of...
the generation of electricity
electric power plants
design / the design of....
the manufacture / production of...
telephony
install / the installation of....
cut, shape, join metals

B. Write five (5) of the sentences you have made in the space provided below.

....

....

....

....

....

....

7. Vehicles, ships and aircraft

It is useful to know the correct term for the various types of cars, trains, ships and aeroplanes. So,

A. Read the definitions below and in the spaces provided, write the equivalent term for each vehicle, ship or aeroplane in your mother tongue.

- **aircraft carrier =** a warship with a long, flat deck where aircraft can take off and land (________________)
- **airliner =** a large aeroplane used for carrying passengers (________________)
- **ferry(boat) =** a boat that transports passengers and vehicles across rivers or short stretches of sea (________________)
- **freighter =** a large ship or aeroplane designed for carrying freight (=goods, cargo). If a ship, it is also called cargo ship (________________)
- **liner** = ship used to carry passengers (________________)
- **ocean liner** = large ship on which people travel long distances, or go on holiday cruises (________________)
- **pick-up truck =** a small truck with low sides that can be easily loaded and unloaded, used mainly by farmers and some technicians (________________)
- **tanker =** a very large ship or lorry, an aircraft or railway vehicle used for transporting large quantities of gas or liquid, e.g. oil (________________)
- **transporter =** a large vehicle or aeroplane used for carrying very large or heavy objects, e.g. cars (________________)
- **warplane =** an aeroplane specially designed to be used in war to attack other aeroplanes or drop bombs (________________)
- **warship / battleship =** a ship with guns used for fighting in wars (________________)
- **van =** a small or medium-sized road vehicle with one row of seats and a space for carrying goods behind (________________)
- **coach =** a large, comfortable bus or a train waggon that carries passengers (________________)
- **submarine =** a ship that can travel under the surface of the sea (________________)

B. Label the pictures.

e.g. *cement mixer*

1. ______________________

2. ______________________

3. ______________________

4. ______________________

5. ______________________

6. ______________________

7. ______________________

8. ______________________

9. ______________________

10. ______________________

11. ______________________

12. ______________________

13. ______________________

14. ______________________

C. Classify the various types of cars, trains, ships and aeroplanes under the columns below.

Cars: sports car, jeep, bus, ...

....

Ships: fishing boat, yacht, ...

....

Aircraft: helicopter, ...

Trains

....

....

Train waggons	
luggage car	passenger car/coach
sleeper	freight car
refreshment car	refrigerator car
dining car	

8. Taking your information from the text, complete the sentences below.

- The technicians engaged in the field of mechanical engineering must be: .... and ....
- They must be able to:

–......................... } machines and engines
–.........................

–......................... machine tools

–.........................
– .... } metals
– ....

– .... } heating, ………………………, …………………..
– .... } and ……………………… systems

– .... { – .... measuring ....
– .... and
– ……………………… equipment

–......................... } drawings
–.........................

• They must:

– have .... of { .... and / the .... of ....

– .... with accuracy

9. A. Identify the job described in each of the paragraphs below. (The last paragraph of the text will help you).

	Description	
1.	A person who designs engines, machines, etc. and supervises their maintenance.	
2.	Someone whose job involves skilled practical work with scientific equipment; a highily skilled craftsman* or mechanic.	**e.g.** *technician*
3.	A person whose task is to check if all the activities in the machine shop are done correctly.	
4.	A person who makes, controls, repairs machinery, or operates a machine in a factory.	
5.	Someone whose job is to repair car engines.	
6.	A person who connects and repairs pipes, baths, toilets, etc.	
7.	Someone whose job is to operate machine tools, either conventional or CNC.	
8.	A skilled person involved in joining metals with the use of heat.	
9.	Someone who makes metal pieces with hand tools on the bench.	
10.	Someone who makes various objects from large, flat, thin metal pieces (sheets).	
11.	A person who is responsible for maintaining the engine of a ship.	
12.	Someone who installs and maintains refrigeration systems.	
13.	A technician who adjusts and repairs aircraft engines.	

* A man who makes things skilfully with his hands.

10. Write the Greek equivalent to the following English terms.

industry = ...

public services and utilities = ...

means of transport = ...

telecommunications = ...

electric power supply = ...

food preservation = ...

power plant = ...

machine tool = ...

welding equipment = ...

precision measuring instrument = ...

gas turbine = ...

steam turbine = ...

diesel engine = ...

Listening Activity

STEP 1

It has been said that the history of civilization is the history of engineering. How much do you know about it?

Read the statements below and tick the correct alternative.

1. The word engineer was first used in the

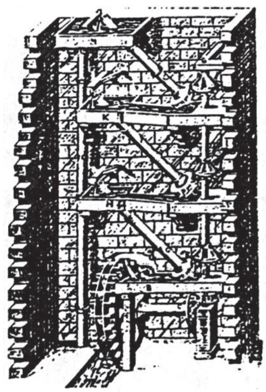
- □ a. ancient times.
- □ b. middle ages.
- □ c. Renaissance.

2. It comes from a(n)

- □ a. ancient Egyptian word.
- □ b. ancient Greek word.
- □ c. Latin word.

3. The first great engineers of the ancient world were the

- □ a. Babylonians, Egyptians and Greeks.
- □ b. Romans, Germans and Celts.
- □ c. Mayas, Incas and Vikings.



Screw pump

4. Archimedes invented the screw pump, a device for
- ☐ a. joining thick metal pieces.
- ☐ b. lifting water.
- ☐ c. lifting stones.

5. A Roman aqueduct is a kind of long bridge with arches which carries
- ☐ a. water.
- ☐ b. olive oil.
- ☐ c. wine.

Aqueduct

6. In the 17th and 18th century scientists made lots of important discoveries. Which of the scientists below lived in these (17th and 18th) centuries? Tick.

- ☐ a. Nobel
- ☐ b. Galileo
- ☐ c. Einstein
- ☐ d. Hook
- ☐ e. Newton
- ☐ f. Otto
- ☐ g. Pascal
- ☐ h. Leornando Da Vinci

7. The foundations of modern engineering science were laid in the 17th and 18th century by
- ☐ a. American scientists.
- ☐ b. German and Spanish scientists.
- ☐ c. French and English scientists.

STEP 2

You are going to listen to a text presenting the history of Engineering. Check your answers in STEP 1 and correct any mistakes.

STEP 3

On the next page, there is the same text. There are, however, lots of misprints. They have been located and underlined, but not corrected. **Listen to the text, and correct the mistakes.**

History of Engineering

The word “engineer” was unknown in ancient tiles. It first appeared in Middle Apes. It comes from the Latin word “ingenium”, meaning mental power or *invertion.*

The Babylonians, Egyptians and Greeks were the thirst great engineers of the ancient word. The most famous among them was Archimedes, a great scientist, mathematician and invention who lived in the 3rd century BC in Sicily. He invented many minds of military engines and also the screw lump, a device for lifting water.

The Romans were excellent engineers. They exploited the knowledge and emperience of the Greeks and made lots of loads, bridges, aqueducts and large public buildings.

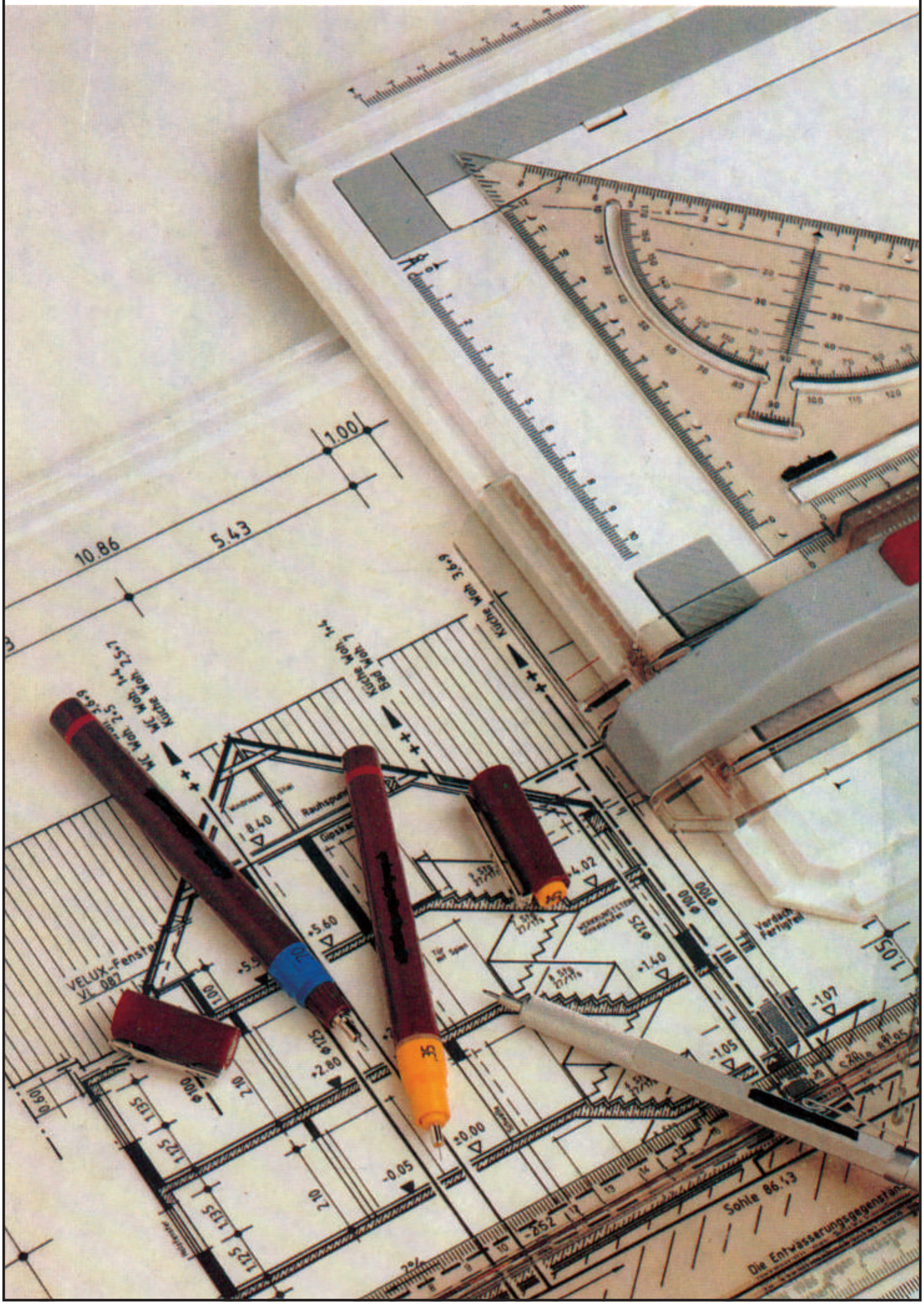
Engineering was greately developed in the 17th and 18th century, when some great scientists made lots of unimportant discoveries in the field of mechanics. Among these were Galileo, Hook, Newron, Pascal, etc. French and English engineers of the 17th and 18th century said, thus, the basis of modern engineering science.

In the 19th and 20th century, scientists have male wonderful discoveries and inventions, indeed, but engineers have achieved rear technological miracles.

> *“Science is the king of the world today, but engineering is the power behind the throne”*
>
> **Philip Pollock**

UNIT 2

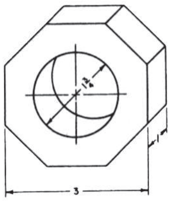
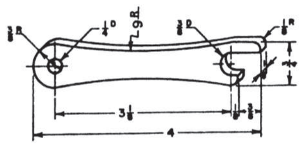
DRAFTING



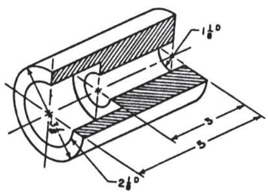
DRAFTING

TASK 1

Read the text and find out how drafting is characterised. Write the characterisations in the spaces provided and comment on them.

A hexagonal spacer  *A bottle opener* 

Drafting is characterised as:



A bearing

1. ....
   ....
2. ....
3. ....
4. ....
5. ....
6. ....

Drafting is more important in our everyday lives than we sometimes realize. The houses we live in, the cars, aeroplanes, ships, machines and tools we use have all been developed from drawings presenting the designer's ideas on paper.

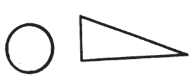
The idea of an engineer or an inventor for a new product will be given in the form of freehand sketches presenting the shape, size and specifications of the new product. From these sketches, more detailed drawings will be prepared which will provide technicians and workers with all the information they need in the construction or servicing of an object.

Drafting is a process of thinking, planning and setting thoughts down on paper in graphic form. It is a means of communication, a language not spoken, a «graphic language», a system of:

• lines: _________ , ______ – ______ – ______ , – – – – – – – – – , ...

• symbols: 

• sizes: ¦← 6 mm →¦

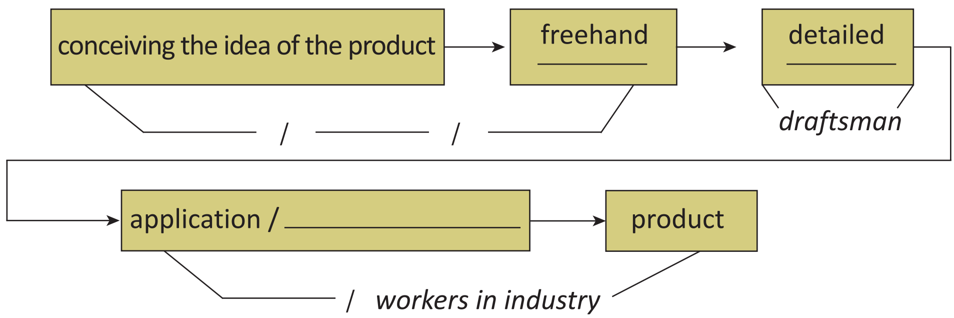
• shapes: 

It is an international language that every technical person uses to communicate his ideas clearly to others trained to understand it.

As most products before being produced are first given shape on a drawing, drafting is also called «the language of industry». A good knowledge of this language is essential to the skilled worker, the technician and the engineer.

TASK 2

Complete the boxes in the flowchart below with the stages followed to develop a new product. In the space provided under the boxes, write the person responsible for these stages.



TASK 3

Match terms with definitions.

1. Freehand sketching
2. Designing
3. Drafting
4. Drawing

a) Conceiving the original idea of a product and setting it down on a piece of paper in the form of sketches presenting its shape, size and specifications.

b) A graphic representation of the creator's ideas on a paper.

c) The technique of making a drawing without the use of instruments.

d) The process of making detailed representations of the creator's ideas for a product with a pencil, pen and special instruments on a paper, or using a CAD program on the computer.

TASK 4

Complete the missing words.

Verb	**Action**	**Person**	**Product**
______	______	______	design
draw	{ ______ drawing	{ draftsman drafter	______

GEOMETRIC CONSTRUCTIONS

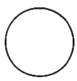
All things have a shape which is made up of lines combined in various ways. When drafting, a technician is required to draw these lines in order to record the shape of objects on the paper. The knowledge of the structure of geometric forms and how they can be recorded on drawings is one of his everyday tools. In addition, as engineers, technicians or drafters* discuss possible solutions to drafting problems, lines, shapes and their dimensions become part of their everyday vocabulary.

A. Lines

There are three principal types of lines:

straight

curved 

circular 

A line may be:

continuous

broken

dotted

chain

A straight line can be characterized as:

 horizontal

 vertical

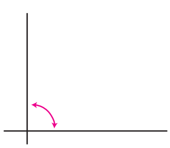
 inclined

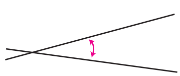
 parallel

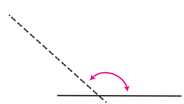
 perpendicular

B. Angles

When two lines intersect (= cross one another) they form angles. There are three types of angles:

 right

 acute

 obtuse

* Also draughtsmen in British English (B.E.), or draftsmen in American English (A.E.).

PRACTICE

Fill in the blanks in the following sentences.

1. 

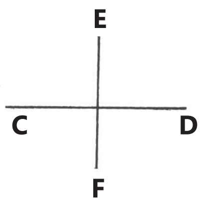
This is a ________, ________ line.

2. 

This line is a ________, ________ one.

3. 

AB is a ________, ________, ________ line.

4. 

Both CD and EF are ________, ________ lines.
EF is ________________ to CD.
As EF intersects CD, four ______ angles are formed.

5. 

Line GH is a ________, ________ line, while
IJ is a ________, ________ one.

6. 

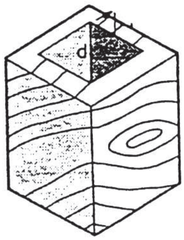
Both KL and MN are ________, ________ lines.
KL is ________ while MN ________.
Line KL is ________ to MN.

7. 

The shortest distance between two points (A-B) is a ________ line.

8. An angle of 90 degrees (90°) is called a(n) ________ angle. One of less than 90 degrees (<90°) is called ________, while one greater than 90 degrees (>90°) is a(n) ________ angle.

9.  To draw this flask you should combine __________ and __________ lines.

10.  To make a box, you need many __________ lines, while to draw a ball, you need only a __________ one.

C. Planes and Solids

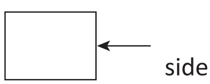
Most of the English terms for geometrical shapes are derived from Greek.

PRACTICE

1. Use the following words to name the shapes below.

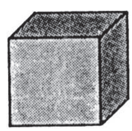
octagon	triangular pyramid	rhombus	cylinder
ellipse	trapezium	rectangular prism	ovoid
cube	square	sphere	semicircle
circle	hexagonal prism	square pyramid	hemisphere
cone	triangle	hexagon	rectangle

Planes



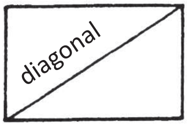
1. __________

Solids

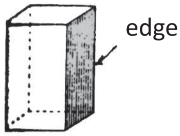


1. __________

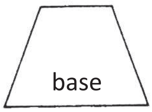
Planes	Solids



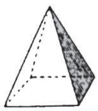
2. ____________



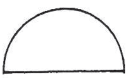
2. ____________



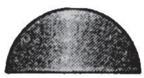
4. ____________



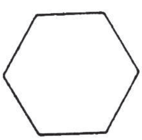
4. ____________



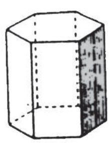
6. ____________



6. ____________

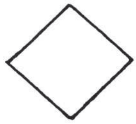


8. ____________

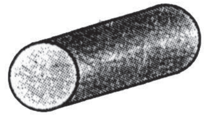


8. ____________

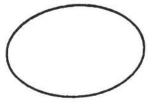
Planes	Solids



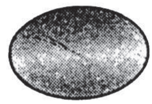
3. ____________



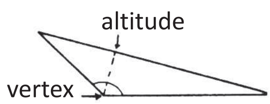
3. ____________



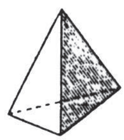
5. ____________



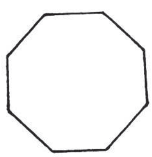
5. ____________



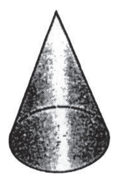
7. ____________



7. ____________

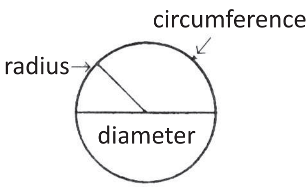


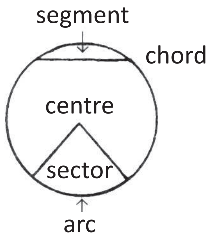
9. ____________

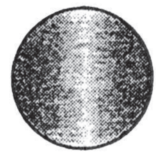


9. ____________

Planes **Solids**







10. ____________ *11.* ____________

2. Complete the table with the English or Greek equivalent term accordingly.

ENGLISH	GREEK
____________________	πεντάγωνο
____________________	πολύγωνο
____________________	παραλληλόγραμμο
____________________	τριγωνικό πρίσμα
____________________	ρομβοειδές
____________________	τραπεζοειδές
quadrilateral	____________________
equilateral triangle	____________________
scalene triangle	____________________
____________________	ισοσκελές τρίγωνο
right-angled triangle	____________________
____________________	οξυγώνιο τρίγωνο
____________________	αμβλυγώνιο τρίγωνο
hypotenuse	____________________
____________________	διαγώνιος
____________________	διάμετρος
____________________	κέντρο (κύκλου π.χ.)
____________________	κορυφή (τριγώνου π.χ.)

3. Are you good at geometry?
Identify the shapes defined in the sentences below. Choose from the list.

rectangle	parallelograms	trapezoid	quadrilaterals	circumference
square	isosceles triangle	rhombus	right-angled triangle	circle
scalene triangle	chord	trapezium	equilateral triangle	radius

1. ______________________
   A triangle with two equal sides and two equal angles.
2. ______________________
   They are polygons whose opposite sides are parallel and equal in length.
3. ______________________
   Its length can be found by multiplying the diameter by 3.1416.
4. ______________________
   A triangle which has three equal sides and three equal angles.
5. ______________________
   It has four equal (90°) angles and four sides of two different lengths. Its opposite sides are parallel and equal.
6. ______________________
   It has four equal sides all the same lenght and no 90° angles. Its opposite sides are parallel.
7. ______________________
   It is the distance from the centre of a circle to any point of its circumference.
8. ______________________
   A triangle that has no equal sides or angles.
9. ______________________
   It has four equal sides that form four right angles.
10. ______________________
   They are polygons that have four straight sides.
11. ______________________
   A quadrilateral shape which has only two parallel sides.
12. ______________________
   It is a closed curve all points of which are at an equal distance from a centre point.
13. ______________________
   It is a quadrilateral which has no parallel sides.
14. ______________________
   A straight line that crosses the circle in two points.
15. ______________________
   One of its three angles is 90°.

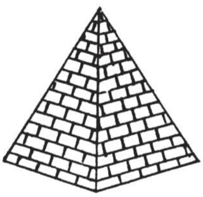
4. Complete the table below with the missing words.

Noun	Adjective
________	square
________	cubic
rectangle	________
________	triangular
ellipse	________
hexagon	________
heptagon	________
________	rhomboid

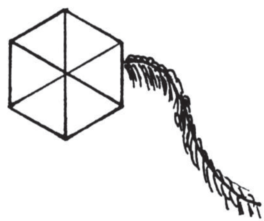
Noun	Adjective
circle	________
________	spherical
hemisphere	________
________	prismatic
________	conical
cylinder	________
pyramid	________
trapezium	________

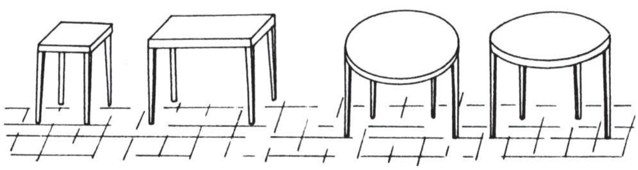
5. Use the correct adjective to describe the following objects.

1. The tombs of the ancient Egyptian kings were ________ in shape.



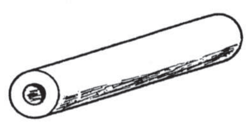
2. Kites in Greece usually have a ________ shape.





3. A table may be ________, ________, ________, or ________.

4. A ball is a sphere. It is ________ in shape.

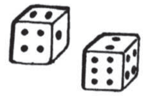


5. A tube is ________

6. Most traffic signs are ____________.

7. The upper part of this glass is ____________.

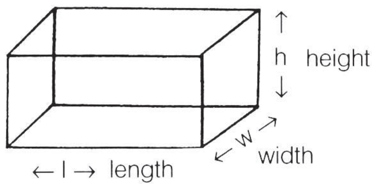
8. Dice are ____________ in shape.

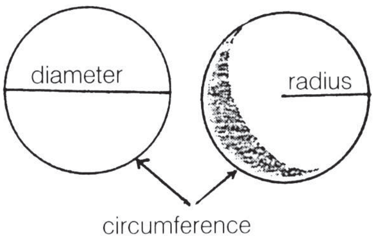


D. Dimensions

All objects have dimensions which should be taken into serious consideration when drawing.

Three are the dimensions that determine the size of an object: its length(l), its width (w) and its height (h), which are sometimes referred to as depth (d) or thickness (t).





Dimensions tell us how long, wide, high, deep or thick an object is.

The size of circular or spherical objects is determined by its circumference and its radius or its diameter.

In most parts of the world, dimensions are measured in the metric system, that is, in millimetres (mm), centimetres (cm), metres (m) or kilometres (km).

In U.S.A., U.K.*, Austalia and some other countries, however, the English system is still in use. In these countries, dimensions are measured in inches (in), feet (ft), yards (yd), or miles (mi).**

Area is measured either in square millimetres (mm^2), centimetres (cm^2), metres (m^2), etc., or in square inches (in^2), feet (ft^2), etc.

Volume is measured either in cubic millimetres (mm^3), centimetres (cm^3), metres (m^3), centimetres (cm^3), or in cubic inches (in^3), feet (ft^3), yards (y^3), etc. accordingly.

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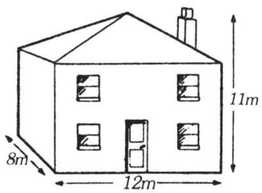
* U.S.A. = United States of America.
U.K. = United Kingdom (= England, Wales, Scotland and Northern Ireland).

** You can find more about these two systems and their units in the Appendix at the end of the book.

PRACTICE

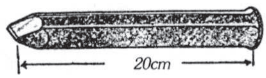
Read out the dimensions of the objects below following the patterns given in the examples.



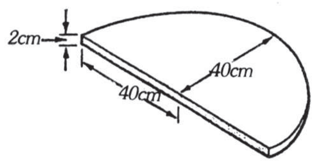
Examples

a) This house has a height of 11m, a length of 12m and a width of 8m.
b) The length of this house is 12m, its width 8m and its height 11m.
c) This house is 12m long, 8m wide and 11m high.

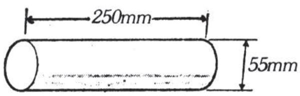
1. Chisel



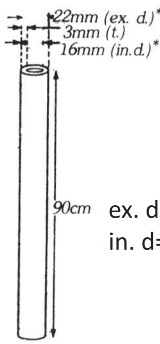
2. Semicircular shelf



3. Metal rod

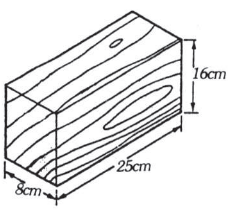


4. Steel tube

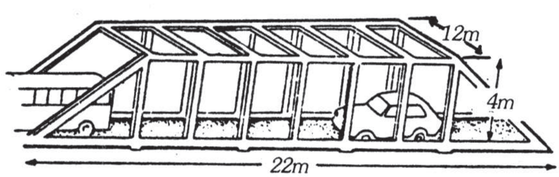


ex. d=external diameter
in. d=internal diameter

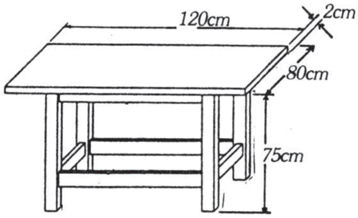
5. Wooden block



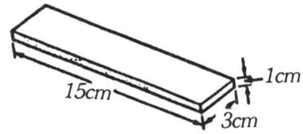
6. Metal bridge



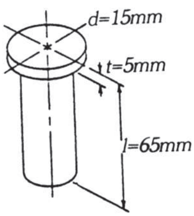
7. Work bench



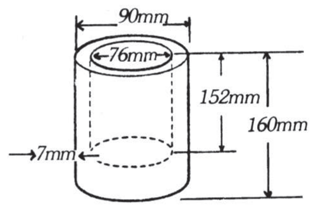
8. Steel bar



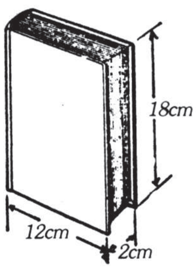
9. Rivet



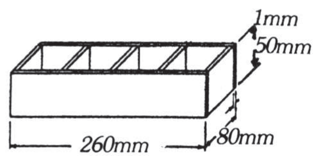
10. Cylindrical metal container



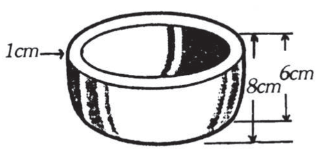
11. Book



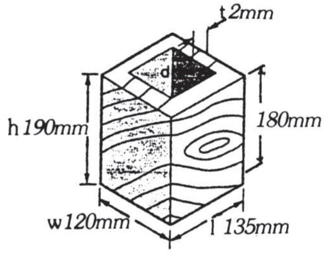
12. Nail box



13. Wooden bowl



14. Wooden box



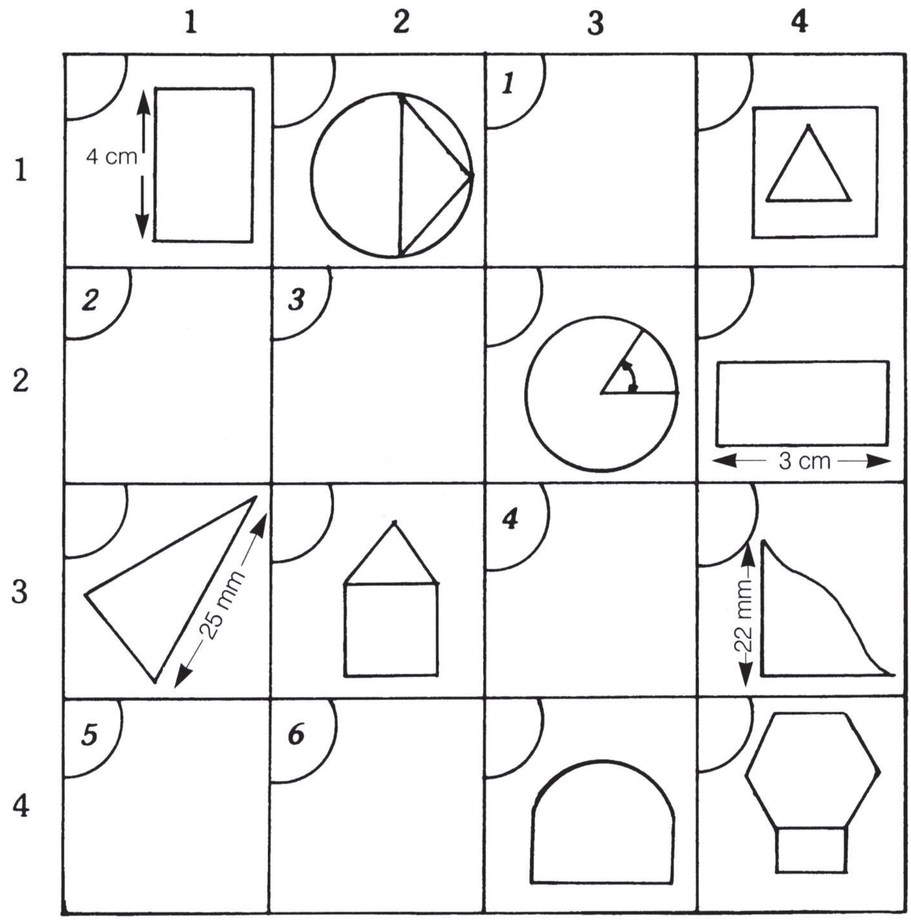
Can you identify the following theorem?

The hypotenuse equals the square root of the sum of the squares of the other two sides.

Now say it in Greek.

Listening Activity

A. Familiarise yourself with the figures in the boxes below. Listen to their description and write a number in the space provided on the top left side of each box, to show the order they are described.



B. Listen to the instructions and in the empty boxes of the above table, draw the shapes described in the order you hear them.

DRAFTING MEDIA

Read the paragraph that follows and answer the question:

Which factors determine the quality of a drawing?

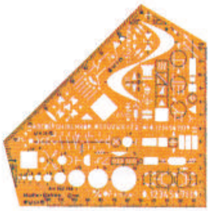
The quality of a drawing greatly depends on drafting instruments. As there is a great variety of drafting tools available, the selection of the proper tool for the particular job is important. The skilfulness of the drafter, as well as the quality of the instruments he uses, are also factors affecting drawing. And don't forget that time is money and good tools save time.

Below you can see some of the mostly used drawing tools. **Match them with their use.** More than one tools may have the same use.

1. 

Rule(r)s (with scales) / Scales

a) ______________________ are used to draw horizontal, parallel and perpendicular lines.

2. 

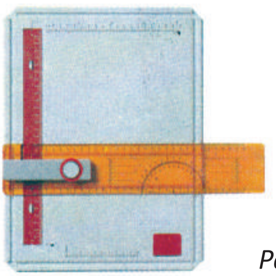
Templates

b) ______________________ are commonly used with the T-square and the parallel rule to draw angles of various degrees.

3. 

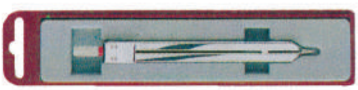
Triangles / Set squares

c) ______________________ are used to draw straight lines of specific length. They permit the enlargement or reduction of a drawing.

4. 

Parallel rulers

d) ______________________ are used to guide the pencil when drawing the various shapes and sizes they include.

5. 

Dividers

e) ______________________ are used to speed up drafting time since the T-square, the triangles, the drafting scale and the protractor are assembled into one instrument.

6. 

Irregular curves

f) ______________________ are used to draw circles or arcs.

7. 

Protractors

g) ______________________ are used to draw lines with permanent ink.

8. 

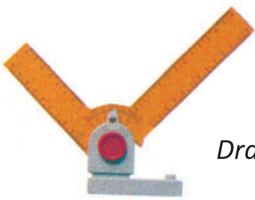
Drawing pens

h) ______________________ are used to draw non-circular curves.

9. 

Compasses

i) ______________________ are used to measure degrees of angles.

10. 

Drafting heads

j) ______________________ are used to transfer distances from one part of a drawing to another, or to divide distances in equal parts.

EXPRESSING USEFULNESS

We can express usefulness (what something is used for) using the patterns below.

...is/are	used useful necessary needed	for + gerund to + infinitive
we use...		to + infinitive

Examples

- *The parallel rule(r) is used for drawing parallel horizontal and perpendicular lines.*
- We *use the parallel rule(r) to draw parallel horizontal and perpendicular lines.*

Use the information in the previous exercise to make similar sentences.

Which drawing tool do the following features belong to? Tick appropriately as in the example.

	Drawing board	Parallel ruler T-square	Drafting/ Tracing paper	Drafting heads	Templates	Irregular curves	Compasses	Set squares/ Triangles	Drawing pens	Dividers	Ruler Scales
It serves as a base to hold e.g. drafting triangles.											
On the edges of the tool, there are markings, such as inches or millimetres. (=scales)											
They are available in clear and coloured plastic.											
There are many different kinds available with standard forms such as circles, squares, ellipses, letters, electrical symbols, etc.											
They have a pin in one end and a pencil or inking device in the other.											
They have pins in both legs.											
They have a variety of point sizes for inking.											
They are thin, flat, plastic tools that have openings of various shapes and sizes.											
It is available in a wide range of qualities, (strenght, translucency, cost, etc.).											

	Drawing board	Parallel ruler T-square	Drafting/ Tracing paper	Drafting heads	Templates	Irregular curves	Compasses	Set squares/ Triangles	Drawing pens	Dividers	Ruler Scales
It is a rectangular board with straight edges and a smooth drawing surface.											
They come in 45° and 30°- 60° angles.											
It can be used for both pencil and ink drawing.											
It is sold in sheet and roll forms.											
They are a combination of several drafting tools (T-square, triangles, scale, protractor).											
It moves up and down on the drawing board while remaining always in parallel position to two of the board’s edges.											
They consist of curves of various types.											
They have largely replaced the drafting compasses as a tool for drawing circles.											
They facilitate drawing and speed up drafting time.											

Writing Activity

Choose two drafting instruments and write a paragraph for each, to describe its use and features. The previous exercises will help you. Combine your sentences using personal pronouns (it, they...), relative pronouns (which, that...) and linking words (and, also, too, because, besides...). Also, make any other necessary changes.

Example
The drafting heads are drawing instruments (which are) used to speed up / for speeding up drafting time. They are a combination of several drafting tools since the T-square, the triangles, the drafting scale and the protractor are assembled into one instrument.

Listening Activity

During a lesson on mechanical drawing, the teacher gave the students a photocopy with instructions for good and effective drawing. However, the photocopier had a problem and the students had difficulty in reading some of the words.
Listen to the instructions and complete the missing words.

Strive for neatness and accuracy in all drafting problems

— 1. Protect your drawing with an extra .... of paper when lettering or dimensioning.
— 2. Don't press the .... on the paper while measuring, so as not to puncture it with the points.
— 3. Keep a soft, clean .... available at all times.
— 4.. Remove .... dust from drawings with a brush.
— 5. Sketch .... problems on scrap paper first.
— 6. Clean your T-square and .... with a soft eraser and cloth regularly.
— 7. Hold the T-square firmly against the working edge of the drawing ....
— 8. Keep your hands clean in order to produce clean and .... drawings.
— 9. Don't make a large hole in your paper with the .... point.
— 10. Don't slide .... over the drawing. Lift to move.

FOLLOW UP

1. Some of the above instructions refer to cleanliness (C); others are tips for neat (N) and effective (E) drawing. **Read them and put a C, N or E accordingly in the spaces provided on the left of each instruction.**

2. When the teacher wrote the instructions, he was in a hurry, so he was unnecessarily imperative. **Rephrase the instructions using expressions from the table below to make them sound less imperative (as pieces of advice).**

Expressions to help you

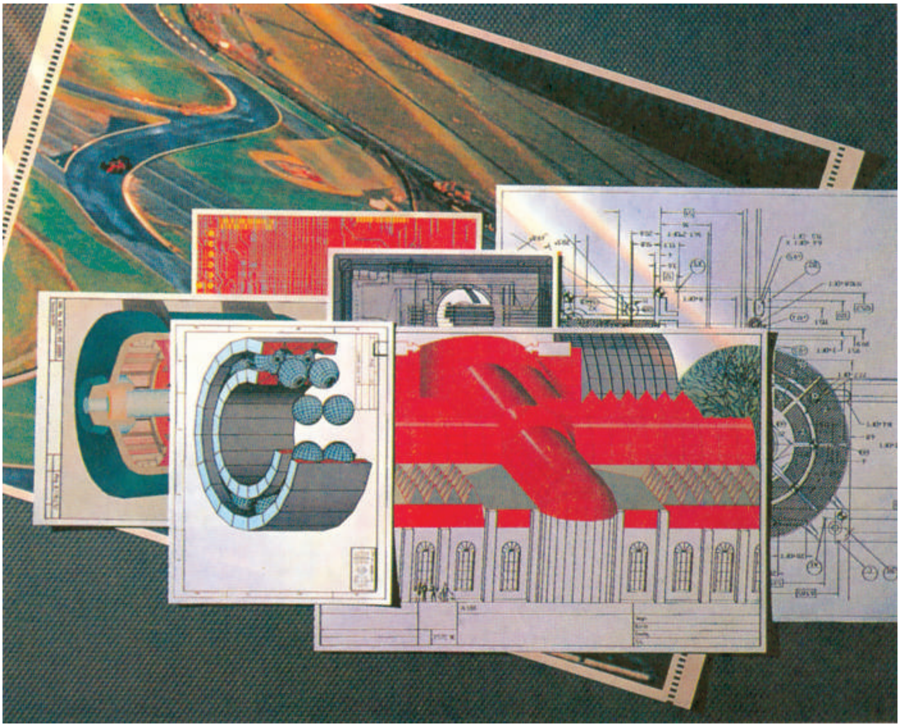
• You should / shouldn't...	• Be careful to / not to...
• Take care to / not to...	• Make sure you / that...
• Try to / not to...	• You'd better...
• You ought to...	• Avoid + gerund

Examples

- *Take care to protect your drawing with an extra sheet of paper when lettering or dimensioning.*
- *Avoid pressing the dividers on the paper while measuring, so as not to puncture it with the points.*

PLOTTERS AND CAD

The development of plotters opens new horizons for designing and drafting since plotters will soon become a drafting tool indispensable to any engineer, designer, or draftsman. But, **what is a plotter?**



Choose the correct definition.

A plotter is

□ a) a machine that produces drawings manually controlled by the drafter.

□ b) a computer which makes drawings according to data provided to it by the drafter.

□ c) an electronic graphics device connected to, and controlled by a computer which prints drawings in ink.

If you are not sure, read the text that follows and find out.

As in other fields, computers have also brought about a revolution to engineering design and graphics.
Exploiting Computer-Aided Design (CAD), engineers, designers and draftsmen can now solve complex designing and drafting problems more rapidly and accurately. Using the mathematical analysis and graphics produced by a computer, they can rapidly analyse and design products which are viewed on a monitor and can be revised before the final copy of the drawing is produced. They can also store the drawing and its data to recall and modify it for future use. CAD is quickly replacing not only the drawing board and other drafting instruments, but also the traditional files for storing drawings. The drawings are now stored in digital form, on which corrections and revisions can be made any time, so that a new copy is ready to be printed on the plotter.
Computer-aided graphics systems, comprising computers, software (programs) and graphics devices such as plotters, produce drawings of better quality, and often at a lower cost than the cost of the conventional drawing.
Since CAD saves time, money and space, it is essential that engineers, technicians and drafters are prepared to use computers and plotters in their everyday work, if they want to meet the future requirements of their job.

EXERCISES

1. Answer the questions

1. What is CAD?
2. What does a CAD system comprise?
3. Is it possible to get an idea of the drawing and make corrections, if necessary, before printing it? How?
4. Is it difficult to modify an old drawing for future use?
5. Are old drawings made by CAD and their data stored in graphical form on paper?
6. What are the advantages of using CAD?
7. According to the text, «CAD saves time, money and space». How is this achieved? Explain.
8. Why should all engineers and drafters learn to use CAD?

2. By the term «computer», most people mean not only the central processing unit but also other devices connected to it.
Label the pictures of these devices choosing the appropriate term from the list below.

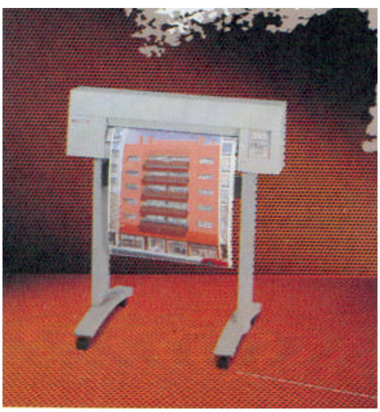
Central Processing Unit (CPU) keyboard plotter mouse scanner printer monitor

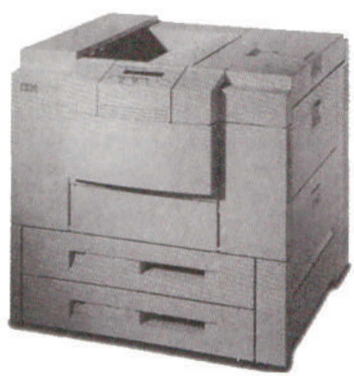
1. ____________________

2. ____________________

3. ____________________

4. ____________________





5. ____________________

6. ____________________

7. ____________________

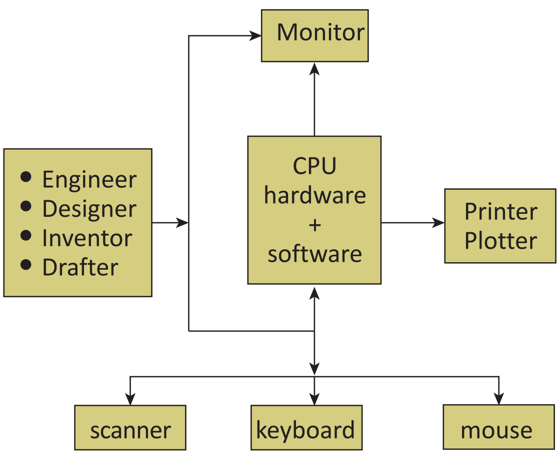
3. The diagram below shows the procedure followed when producing a drawing by using CAD. The information in the boxes around the diagram describes the function of the various devices involved in this procedure.
Draw arrows to show which device each piece of information is related to.

Drawings+texts are viewed and processed

Produces copies of drawings in ink

Data are processed, stored, recalled and modified

Provide data and instructions to the CPU



Used to print texts, or other information

Produces copies of texts taking instructions from the CPU

Records drawings or texts and inserts them to the CPU in digital form

Inserts data, gives instructions for processing, storing, recalling, modifying, printing drawings

4. Match words with definitions.

GROUP A

1. hardware
2. software
3. file
4. data
5. revision
6. conventional
7. essential
8. requirement

a. a box or a folder in which documents are kept
b. a method or equipment that has been in use for a long time
c. in computers, it refers to the machine, that is, the electric circuit and the electronic equipment in them
d. the process of changing something to improve, update or adapt it for a particular purpose
e. a quality or qualification you must have in order to be allowed to do something or to be suitable for something
f. extremely important or absolutely necessary
g. computer programs
h. information in the form of facts, statistics, etc. that you can analyse

GROUP B

1. to exploit
2. to recall
3. to modify
4. to replace
5. to store
6. to comprise
7. to view
8. to print

a. to stop using a thing and put something else in its place
b. to have a number of things as parts or members
c. to put something in a container or other place and leave it there until it is needed
d. to give commands to a computer to bring a drawing or document back to see or revise it
e. to look at something or inspect it for a particular purpose
f. to use something well in order to achieve something or gain an advantage from it
g. to change something slightly so as to improve it
h. to produce a copy of a drawing or document by means of a plotter or printer

5. When using computers, some of the verbs in GROUP B above become part of your everyday vocabulary. **Choose the appropriate word to fill in the gaps in the following sentences.**

When you finish a drawing or document, you usually want to inspect it to see how it looks, that is to __________ (1) it on the screen. If necessary, you make some changes to improve it, that is you __________ (2) it, and then you command the computer to __________ (3) it, so as to take a copy of it.
In case you will need this drawing or document for future use, you command the computer to «save» it, that is to __________ (4) it in its memory.
If you want to make some changes to an old drawing or document, you command the computer to «retrieve» it, that is, to __________ (5) it, so that you

can ______________ (6) it. When the revision is over, you command the computer to ______________ (7) the old document or drawing with the new one.

6. Make groups of similar in meaning words.

common	change	basic	correct	demand	usual	correction
important	habitual	need	exact	review	necessary	ordinary
qualification	precise	traditional				

accurate	essential	conventional
______________	______________	______________
______________	______________	______________
______________	______________	______________
		______________
		______________

revision	requirement
______________	______________
______________	______________
______________	______________

7. Persuading a friend

A friend of yours doesn't like computers. He believes it is a waste of time and money to learn how to draw using CAD or to buy a computer and the other necessary devices.

A. Use the table below and try to make him change his mind.

Expressions to help you prepare your arguments

You ought to/should/had better If I were you, I would ... There is no doubt that you should... By CAD you can / may / could / might / be able to...	exploit use / buy learn / train take advantage of solve complex drafting problems more rapidly, accurately recall and modify drawings easily
(in order) to/so that/so as to...	get copies of drawings simply / quickly / at any time
because / as / since...	produce drawings of better quality increase productivity/save time / space/keep office clean and tidy
otherwise...	(not) find a well-paid job easily

Example

There is no doubt that you should learn how to use CAD. Otherwise, you'll have difficulty in finding a well-paid job.

B. Write five of your arguments, those you consider the most important.

……

……

……

……

……

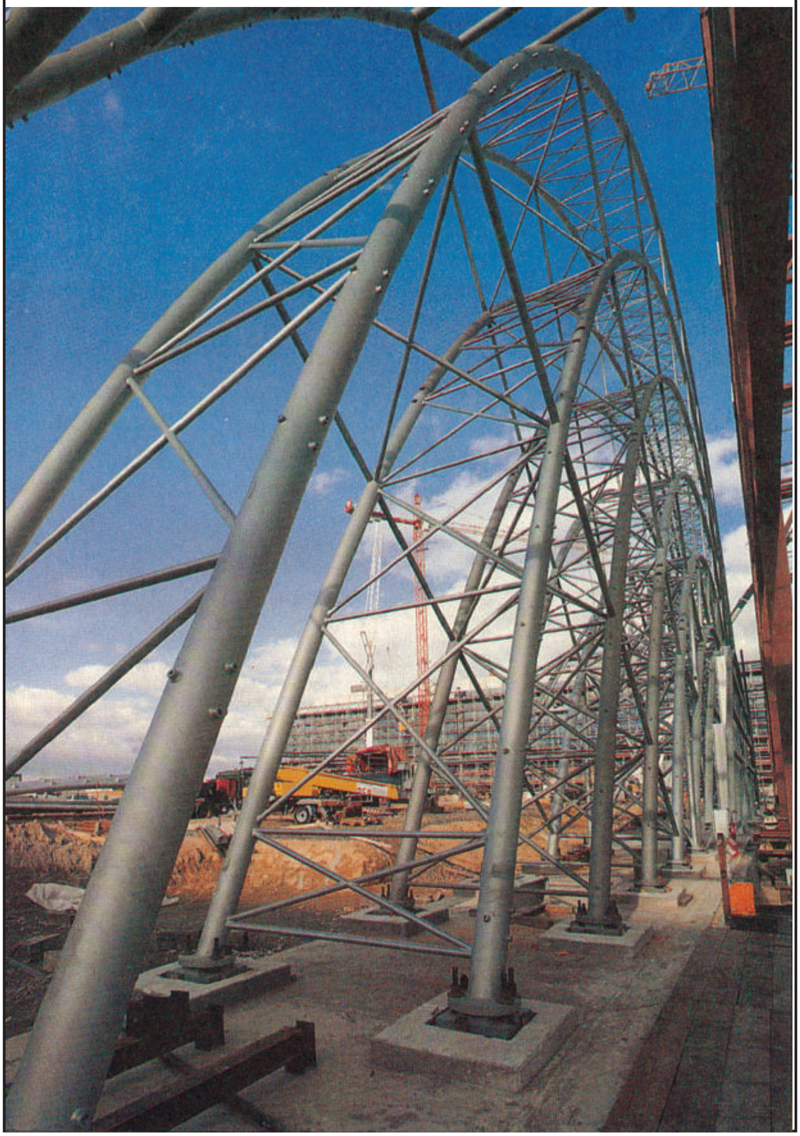
……

……

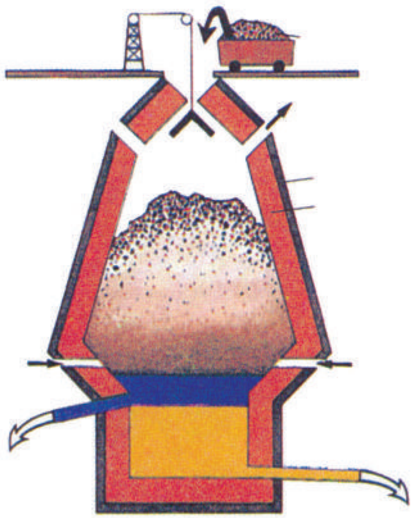
……

……

METALS



METALS EXTRACTION AND ALLOYS

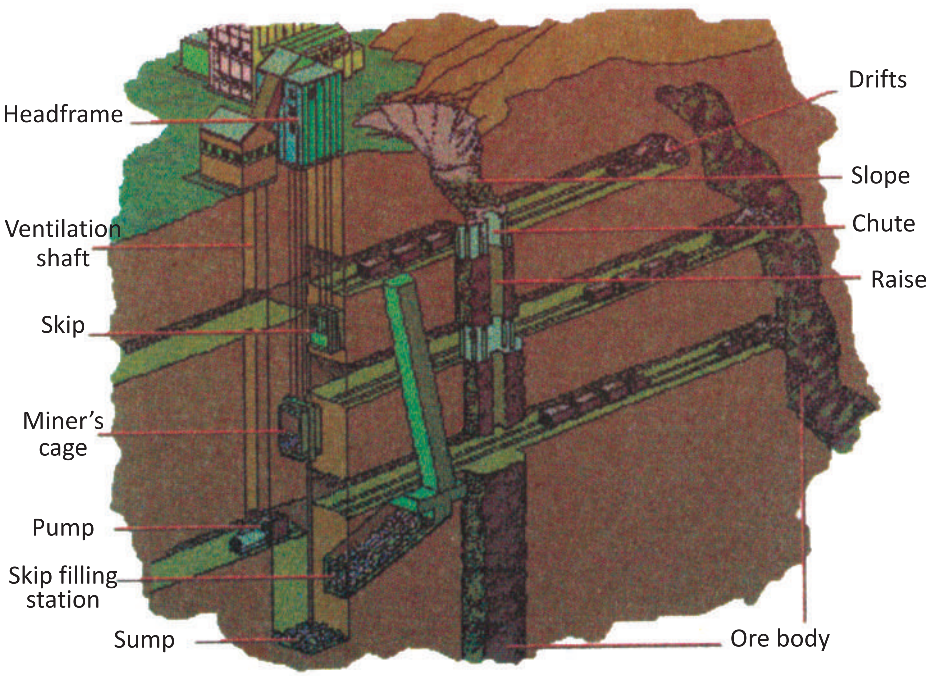


A blast furnace

Metals have played an important role in the development of modern society. Life as it is today would be... impossible without them.

Metals are the most common element mined from earth. They are normally found in an ore, that is as a part of a piece of rock. Most metals, e.g. iron, are extracted from the ore by means of heat in a tall metal tower called blast furnace. Others, e.g. aluminium, are extracted by an electrical process.

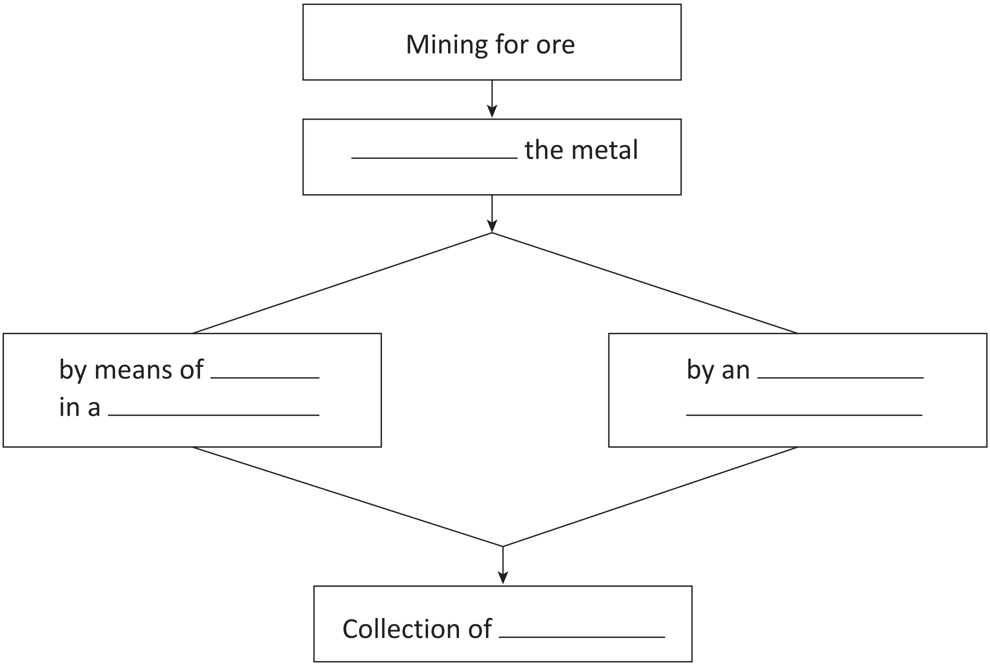
When two or more metals are melted and mixed together, they form a combination which is called an alloy. Examples of alloys are brass and bronze, which are composed of copper and zinc or tin respectively. Alloys are usually stronger than pure metals.



A mine

EXERCISES

1. Complete the diagram.

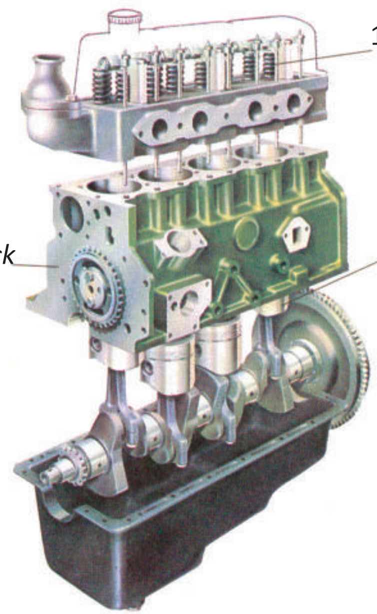


2. Identify the words defined below and write them in the spaces provided. Say the Greek equivalent term for each one of them.

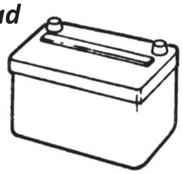
1. The process of changing something from a solid to a liquid by heating it: __________
2. Rock or earth from which metal can be obtained: __________
3. Getting something from other materials by using industrial or chemical processes: __________
4. The process of obtaining something from the ground by digging holes and tunnels: __________
5. An enclosed space in which iron ore is heated under pressure so that it melts and the pure iron metal separates out and can be collected: __________
6. Metals not mixed with others: __________
7. A metal that is made by mixing two or more types of metals together: __________
8. A series of actions carried out in order to achieve a particular result; a method: __________

METALS WIDELY USED

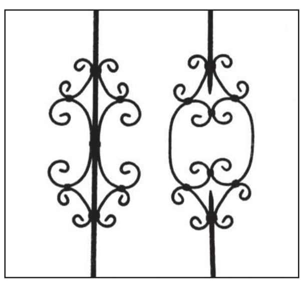
In order to design and construct metal objects, you should become familiar with some of the most commonly used metals. It will also be necessary for you to know something about the properties of metals.
Some of the most common metals are presented below.



lead



4. *Battery*



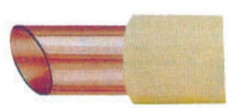
wrought iron

5. *Railings*

aluminium
copper
brass
tin

6. *Rivets*

copper



7. *Tube*

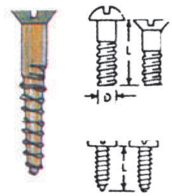
bronze

8. *Head*

steel

9. *Hammer*

steel
brass
aluminium



10. *Screws*

zinc-chromium plated steel

11. *Socket*

gold

12. *Earrings*

silver

13. *Cutlery*

brass

14. *Musical instrument*

nickel

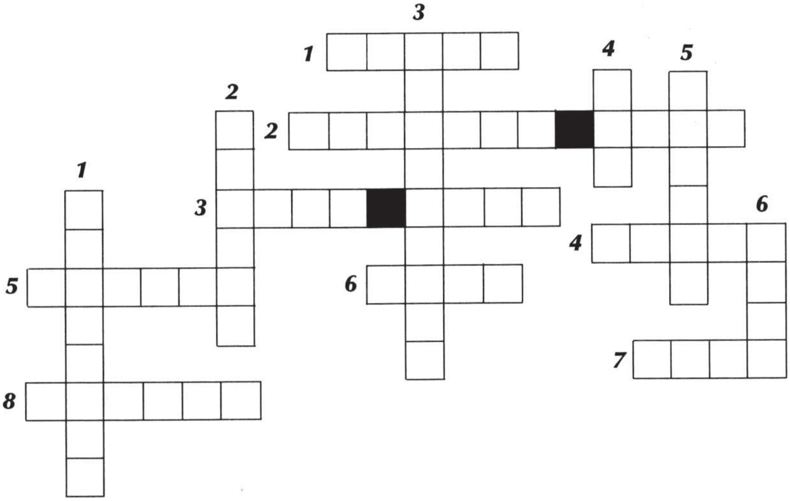
15. *Tap*

EXERCISES

1. Say what each of the previous objects is made of.

e.g. *The engine block is made of cast iron.*

2. Complete the crossword puzzle with the English equivalent of the Greek words below it.



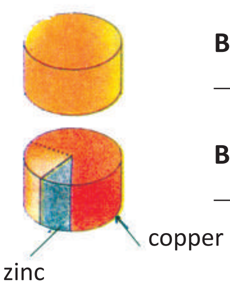
Across

1. Ορείχαλκος (μείγμα χαλκού και ψευδάργυρου)
2. Σφυρήλατος σίδηρος
3. Χυτοσίδηρος
4. Ατσάλι
5. Ορείχαλκος (μείγμα χαλκού, κασσίτερου και ψευδάργυρου)
6. Ψευδάργυρος
7. Χρυσός
8. Ασήμι/άργυρος

Down

1. Χρώμιο
2. Νικέλιο
3. Αλουμίνιο
4. Κασσίτερος
5. Χαλκός
6. Μόλυβδος

3. What metals are brass and bronze composed of?



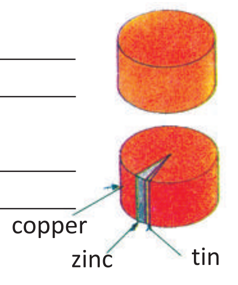
Brass

Brass is composed of ______________________________

____

Bronze is composed of _____________________________

____



Bronze

CLASSIFICATION OF METALS

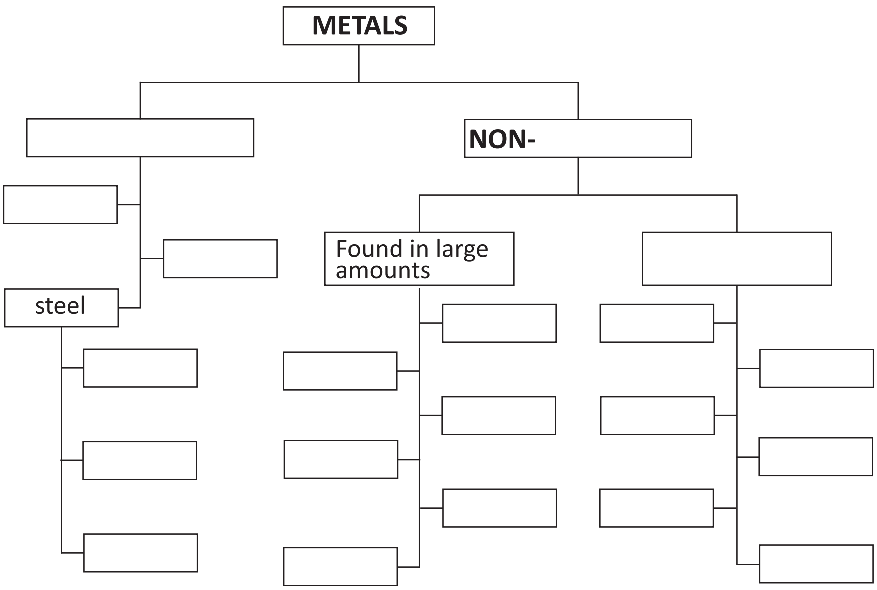
Metals are classified into two major categories. The ferrous metals, which consist mainly of iron, and the non-ferrous, which do not include iron. Ferrous metals are usually alloyed with carbon because it increases the strength of iron. Variations of carbon content can make very great differences in the properties of metals, thus determining their use.

An example is steel which, according to the content of carbon, can be distinguished into low or mild, medium and high-carbon steel. The higher the content of carbon, the harder the steel becomes.

In the non-ferrous metals belong metals which are found in large amounts, such as zinc, aluminium, copper, lead, tin and nickel, and also cadmium, chromium, platinum, mercury, gold, silver, etc., which are found in small amounts only.

EXERCISES

1. Complete the following diagram.



2. EXPRESSING PARALLEL INCREASE

A. Write the comparative form of the following adjectives.

high ______	much ______	skilful ______
easy ______	many ______	durable ______

soon ____________ little ____________ malleable ____________
hard ____________ good ____________ ductile ____________
big ____________ bad ____________ difficult ____________

B. Using the cues below make sentences as in the example.

e.g. *(high) the carbon content / (hard) the steel becomes*
The higher the carbon content (is), the harder the steel (becomes).*

1. (skilful) the draftsman / (good) his drawings
2. (good) the quality of drawing instruments / (good) the drawings
3. (high) the carbon content in steel / (strong) the tools become
4. (sharp) a knife / (little) effort is required when cutting
5. (skilful) a worker / (easy) to find a job
6. (fast) a car goes / (dangerous) it becomes

CLASSIFYING

Use expressions from the appropriate table in the "Language Functions" section in the APPENDIX, to make sentences out of the cues below.

Examples

- *A triangle is a type of geometrical shape.*
- *Ferrous metals can be classified / classed into those found in large amounts and those found in small amounts.*
- *There are three types of matter: solids, liquids and gases.*

1. Tools → hand tools and machine tools
2. Metals → ferrous and non-ferrous
3. Hammers → hand tools widely used by technicians
4. Copper → non-ferrous metals
5. Refrigerator trucks → trucks
6. Geometrical shapes → solids and planes
7. Prisms → solids
8. Oxygen → gas
9. Coal, lignite, turf and oil → fossil fuels
10. Set squares → drafting instruments
11. Steel → alloy
12. Platinum, gold and silver → non-ferrous metals found in small amounts
13. Technical and Vocational schools → Secondary Education schools
14. Matter → organic and inorganic

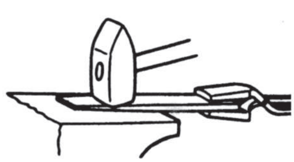
* The verb «to be» is usually omitted in sentences expressing parallel increase.

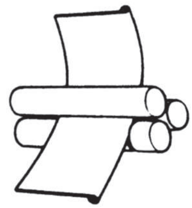
METAL PROPERTIES

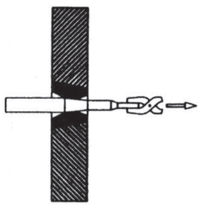
Metals have various properties, the most important of which are:

Malleability

If a metal is malleable, it can be hammered and pressed into a new shape. A malleable material does not break easily under pressure, so it can be rolled into sheets. Gold is extremely malleable. Copper is also very malleable and so is lead.

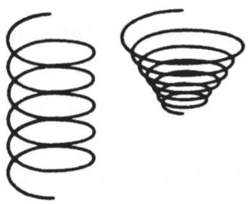






Ductility

A ductile metal can be stretched into another shape. It is easy to draw a ductile metal into wires. The metal does not break and it retains its new shape. One of the most ductile metals is copper. Tin and aluminium are also very ductile.



Elasticity

An elastic material stretches easily under stress. However, when the stress is removed, it does not retain its new shape but it regains its original one. Among the metals, some alloys of steel are quite elastic.

Durability

A durable material resists corrosion. It is corrosion resistant. Among the metals, chromium and platinum are extremely durable. Gold and aluminium are quite durable, too.

EXERCISES

The text above includes some terms extremely useful to every technician who works with metal. **Carry out the following exercises to become familiar with these terms.**

1. Write the properties of the following metals as presented in the text.

Metals	Properties
copper	
tin	
gold	
chromium	
aluminium	
steel	
lead	
platinum	

2. Write the English and Greek term for each of the metal properties defined below.

1. __________________ - __________________
   The ability of a metal to be stretched without breaking and to retain its new shape

2. __________________ - __________________
   The ability of a metal to resist corrosion

3. __________________ - __________________
   The ability of a metal to be shaped when cold by hammering or rolling out without breaking and to keep its new shape

4. __________________ - __________________
   The ability of a metal to return to its original shape

3. In the spaces provided in the table, next to each Greek term, write: a) its equivalent English term (noun) and b) the corresponding verb.

GREEK TERM	ENGLISH TERM	
	Noun	**Verb**
ένταση, τάση		
πίεση, θλίψη		
ένταση, έκταση, εφελκυσμός		
διάβρωση		
αντίσταση	**e.g.** *resistance*	

4. A. Identify the defined verbs.

1. If you ____________ something, you get it back again (e.g. as a metal gets back its original shape).
2. If you ____________ something, you continue to have that thing, shape, property, etc. (e.g. as a ductile metal its new shape).
3. If you exercise or ____________ power, stress, pressure, etc. on something, you use it or put it into effect to achieve something.
4. If you ____________ something from somewhere or from a person or thing (e.g. stress from a metal), you take it away or off, or you get rid of it.
5. If someone or something ____________ a damage of some kind, (e.g. as a durable metal corrosion), they remain unharmed or undamaged by it.

B. Which of the above verbs has:

1. a similar meaning to the verb: a) draw?____________
   b) oppose?____________
2. the opposite meaning to the verb a) remove?____________
   b) loose?____________

5. The paragraph below presents the differences between malleable and ductile metals. Fill in the gaps with the missing information.

Missing information

• stretching	• change shape without breaking
• retain	• regains its original shape
• hammering or pressing	• rolled into sheets
• stretched into wires	

Malleable and ductile metals can ________________(1).
In a malleable metal, the change of the shape can be made by ________________(2), whereas in a ductile, by ________________(3). A malleable material can be ________________(4), while a ductile one can be ________________(5). After being hammered, pressed, stretched, etc., malleable and ductile metals ________________6) their new shape. An elastic metal, on the other hand, when the exerted stress is removed, ________________(7).

6. The table indicates to what degree the various metals below have each of the three properties. Study it.

Metal	Malleability	Ductility	Durability
lead	3	1	2
chromium	2	2	4
zinc	3	2	3
cast iron	-	-	1
nickel	2	3	2
brass	2	2	3
steel	2	1	1
bronze	2	2	4
tin	3	3	3

Note
4 extremely
3 very
2 quite
1 not very
- not at all

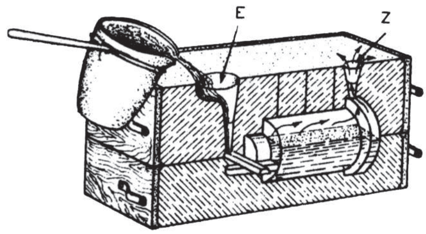
Use the table to comment on the above metals and their properties.

Examples

- *Lead is not very ductile, but it is more ductile than cast iron.*
- *Brass is quite ductile.*
- *Nickel is not so durable / is less durable than brass.*

CASTINGS AND HEAT TREATMENT OF METALS

Most of the metal products we use contain cast parts which are produced in the foundry. Examples of such products are car engines, boilers, pumps, compressors, etc.
The process of producing metal objects in the foundry by pouring molten metal into a mould is called founding. Articles produced by founding are called castings. Examples of castings are tools.



Foundry

Depending on their use, castings, as all metal objects, must have certain characteristics, e.g. hardness and toughness. To obtain these characteristics, they are often specially heat treated with various operations, such as hardening, tempering, annealing and surface hardening.

Hardening is a process of heating metal to a certain temperature and then quenching (=cooling) it in a suitable medium, such as water, oil, etc. in order to make it harder.

Tempering is a process often used with hardened steel tools to remove a certain degree of hardness and brittleness from the metal and increase its toughness.

Annealing is the opposite of the hardening process. It is used to soften metal to make it easier to machine, cut or shape it.

Surface or case hardening is the hardening of the outer surface of metal parts by adding a small amount of carbon. Only low-carbon steel and wrought iron can be surface hardened.

EXERCISES

1. Match words with definitions.

1. brittle	a) a place where metal or glass is melted and formed into a particular shape
2. treatment	b) a container used to form something into a particular shape
3. tough	c) something that is hard but breaks easily
4. foundry	d) something strong and difficult to break or cut
5. mould	e) process followed to obtain a desired result

2. Choose the appropriate form of the bold-typed words to fill in the gaps.

1. **harden - hardness - hard**

a) The ____________ of metals greatly depends on the amount of carbon they contain.

b) A very ____________ tool breaks easily.

c) We add carbon to metals to ____________ them.

2. **brittleness - brittle**

a) To remove some ____________ from tools, we apply the tempering process.
b) Ice is a ____________ material.

3. **toughen-toughness - tough**

a) ____________ rubber is needed for tyres.
b) To ____________ metals, we apply the tempering process.
c) A special treatment is applied to increase the ____________ of the leather.

4. **soften - softness - soft**

a) Her handbag is made of ____________ leather.
b) Heat ____________ metals.
c) Velvet is famous for its ____________ .

3. Which process of heat treatment does the information on the left column of the table belong to? Tick appropriately.

	Hardening	**Tempering**	**Annealing**	**Surface hardening**
1. The metal is softened.				
2. It is applied to low-carbon steel and wrought iron.				
3. A degree of hardness and brittleness is removed.				
4. Carbon is added to the surface of the metal part.				
5. Hardness is added to the metal.				
6. The metal becomes easier to machine and shape.				
7. It is applied to hardened steel tools.				
8. It is applied when a hard surface is needed.				
9. It is the opposite of hardening.				
10. It increases the toughness of steel tools.				

4. Complete the crossword puzzle with the English equivalent to the words below.

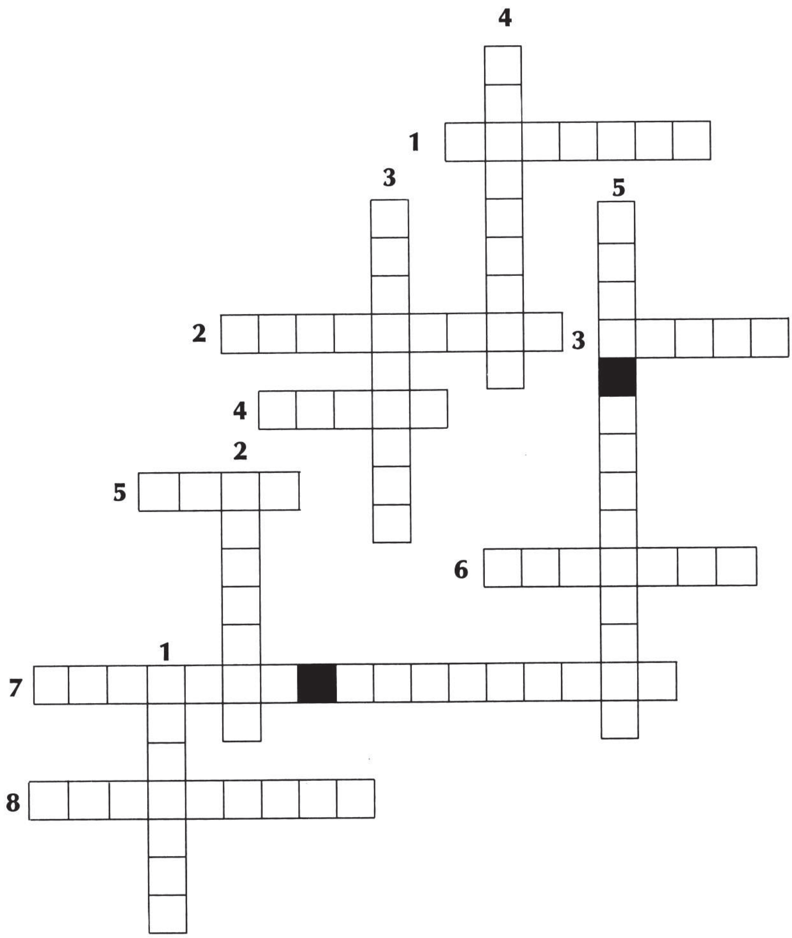
Across

1. εύθραυστος
2. ανόπτηση, βαφή χάλυβα
3. ανθεκτικός, σκληρός
4. μήτρα, πρότυπο, καλούπι
5. μαλακός, απαλός
6. χύσιμο μετάλλου, χυτό μέρος
7. επιφανειακή σκλήρυνση μετάλλου
8. εμβάπτιση μετάλλου με βαφή

Down

1. χυτήριο
2. κάμινος, κλίβανος, φούρνος
3. ξεπύρωμα, επαναφορά, βραδεία ψύξη
4. σκλήρυνση, βαφή μετάλλου
5. θερμική κατεργασία μετάλλων

Crossword puzzle



5. *ACTIVE – PASSIVE VOICE*

Underline the correct verb form.

1. I *have decided / have been decided* to become a plumber.
2. The development of our civilisation *bases largely / is largely based* on the services of the mechanical engineering technicians.
3. In the mechanical engineering field, ability and skill *recognise and reward / are recognised and rewarded*.
4. Machine tools *have brought / have been brought* a revolution to metal working industry.
5. The pipes *have joined / have been joined* securely.
6. A refrigeration technician *installs and maintains / is installed and maintained* refrigeration and air-conditioning systems.
7. Most tools *produce / are produced* by founding.
8. The car mechanic *adjusted / was adjusted* the carburettor yesterday.
9. Traditional drawing will soon *replace / be replaced* by Computer Assisted Drawing (CAD)
10. Thousands of cars *import / are imported* from Japan every year.
11. Mechanical engineers *design / are designed* engines and machines and *supervise / are supervised* their maintenance.

6. The sentences below are in the passive voice. Form the verbs in parentheses appropriately.

1. Mechanical engineering technicians (need) ______________________ in the manufacture of ventilation equipment.
2. Most metal products (develop) ______________________ from drawings presenting the designer's idea on paper.
3. In most parts of the world, dimensions (measure) ________________ in the metric system.
4. A ductile metal can (stretch) ____________________ into wires easily and when the stress (remove) _________________ it retains its new shape.
5. The plotter (control) _________________ by a computer.
6. My car (make) _______________________ in France.
7. The machine (repair) __________________ first thing tomorrow morning.
8. The screw pump, a clever device for lifting water, (invent) ____________ __________ by Archimedes.
9. Metals (extract) ____________________ from the ore by means of heat.
10. The properties of metals (determine) ______________________ by the carbon content in them.

WORKING WITH METAL

BENCH AND SHEET METAL TOOLS

square

rod

bar

sheet

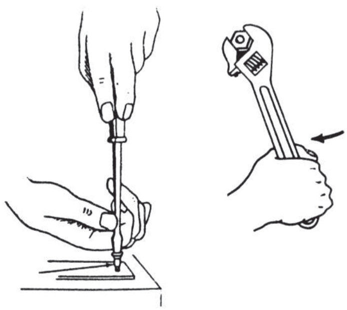
Bench and sheet metal is used in every area of our life. It is available in the form of rods, squares, flat bars and sheet stock of various sizes and thicknesses. It is usually worked cold with hand tools and a few machines such as the drill press, the grinder, the mechanical saw, etc.

Bench and sheet metal work is needed in the manufacture of airplanes, cars, ships, trains, metal furniture and household appliances, and also in the construction and installation of heating, ventilation, refrigeration and air-conditioning equipment.

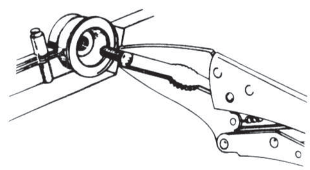
Since working bench or sheet metal with hand tools is often more difficult than operating some machines, excellent job opportunities are offered to workers who can use hand metal tools correctly.

A metal worker must be able to perform skilfully various work activities, such as the ones illustrated below.

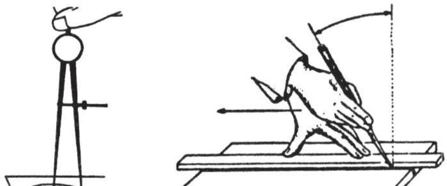
Work Activities



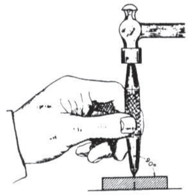
1. *Screwing/ unscrewing, tightening or loosening screws, bolts, nuts....*



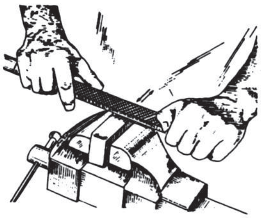
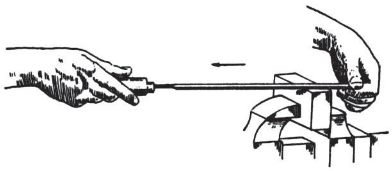
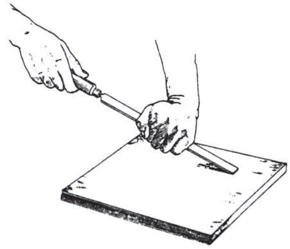
2. *Gripping metal pieces, pipes and other small objects*



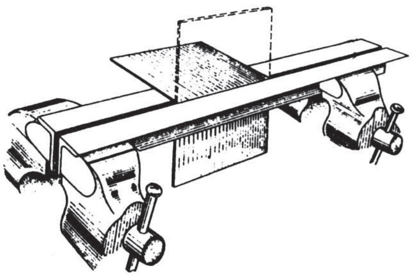
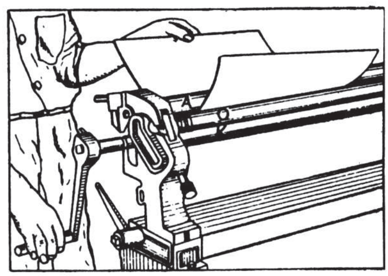
3. *Scribing lines or circles on metal surfaces*



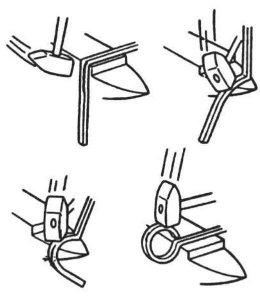
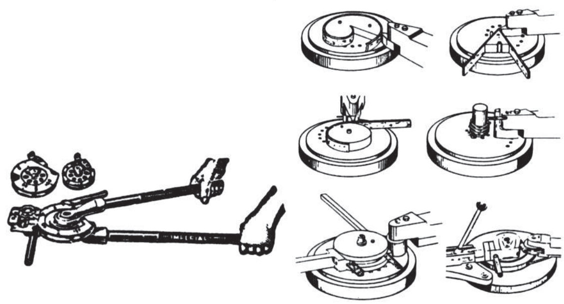
4. *Marking or starting a hole*

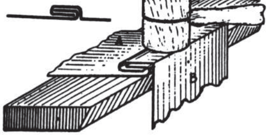
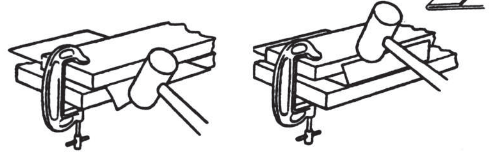
5. *Draw filing* 6. *Filing* 7. *Scraping metal surfaces*

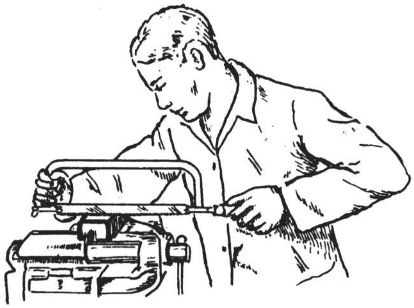
8. *Bending metal sheets* 9. *Forming sheets of metal /making rolls*

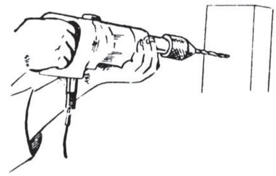
10. *Forging* 11. *Making bends on metal rods, bars, tubes or wires*

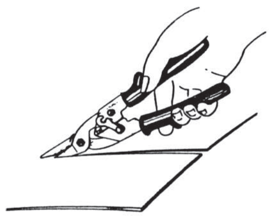
12. *Making seams* 13. *Hemming*



14. *Cutting pieces of metal*

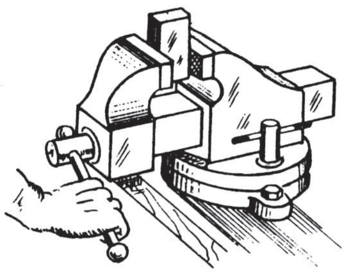


15. *Cutting holes in metal pieces (drilling)*

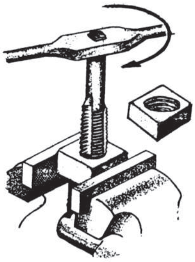


16. *Shearing thin sheets of metal*

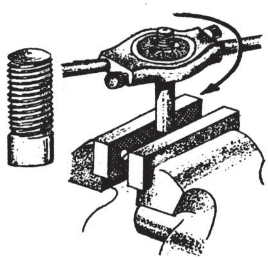
17. *Cutting tubes*



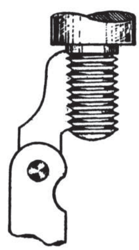
18. *Holding workpieces*



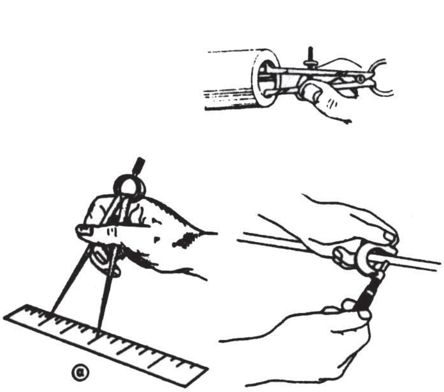
19. *Cutting internal threads*



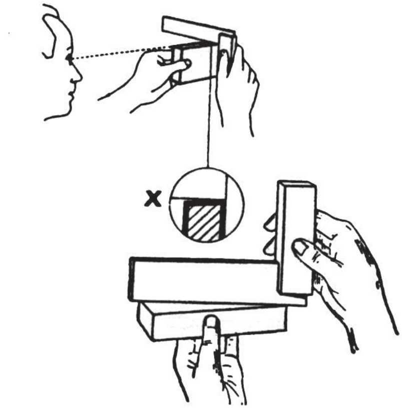
20. *Making external threads*



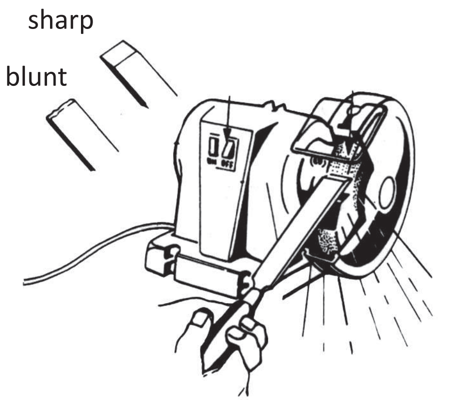
21. *Measuring threads*



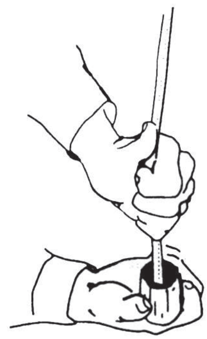
22. *Taking measurements*



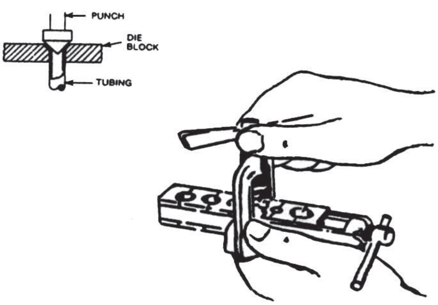
23. *Checking right angles*



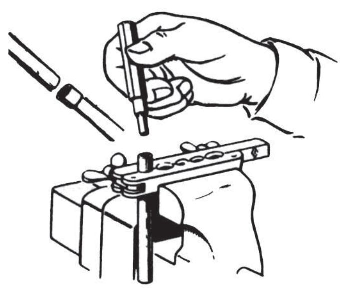
24. *Grinding blunt (=dull edged) tools*



25. *Removing burrs from tubes*



26. *Flaring tubes*

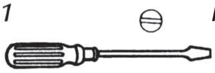
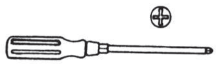
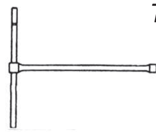
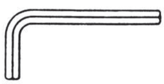
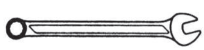
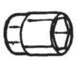
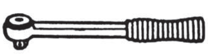


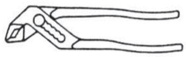
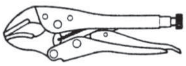
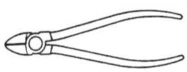
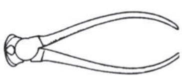
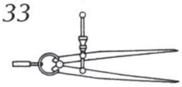
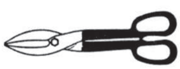
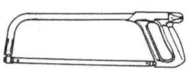
27. *Swaging tubes*

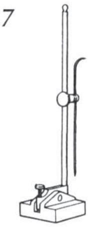
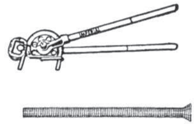
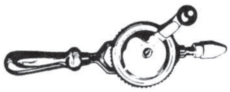
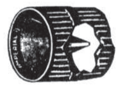
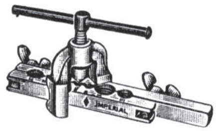
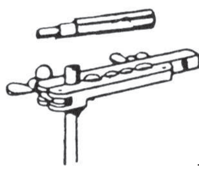
To perform all these activities, a technician must be able to use a wide variety of tools skilfully.

Below you can see the most common hand and measuring tools, machines and accessories as they are presented in the catalogue of a large tools manufacturing company.

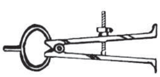
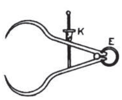
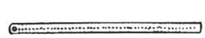
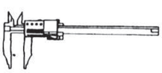
HAND TOOLS

1  *Flat-tip screwdrivers* ________	9  *Swivel handles* ________
2  *Cross-point/Phillips screwdrivers* ________	10  *Extensions* ________
3  *Offset screwdrivers* ________	11  *Tee handles* ________
4  *Automatic/Retaining screwdrivers* ________	12  *Open-ended wrenches* ________
5  *Allen-hex sockets* ________	13  *Ring wrenches* ________
6  *Socket spanners / spinners* ________	14  *Combination wrenches* ________
7  *Sockets* ________	15  *Adjustable wrenches* ________
8  *Ratchets* ________	16  *Pipe adjustable/Monkey wrenches* ________

17		Combination/Universal pliers ______	27		Pipe/Tube cutters ______
18		Flat-nose pliers ______	28		Taps ______
19		Round-nose pliers ______	29		Dies ______
20		Adjustable pliers ______	30		Scrapers ______
21		Lock-grip pliers ______	31		Files ______
22		Side cutters ______	32		Scribers ______
23		End cutters ______	33		Dividers ______
24		Tin snips/Shears ______	34		Punches ______
25		Hacksaws/Metal saws ______	35		Ball peen hammers ______
26		(Cold) chisels ______	36		Mallets ______

37 *Surface gauges* 	41 *Tube and spring benders* 
38 *Hand drill* 	42 *Reamers* 
39 *Hand groovers* 	43 *Flaring tools* 
40 *(Refrigeration) Service valves ratchets* 	44 *Swaging tools* 

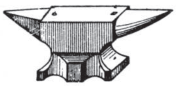
MEASURING TOOLS

1 *Internal / Inside calipers* 	4 *Micrometers* 
2 *External / Outside calipers* 	5 *Steel rules* 
3 *Vernier calipers* 	6 *Screw-pitch gauges* 

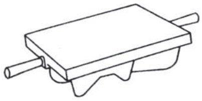
OTHER EQUIPMENT

1 *Forging tongs*

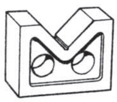
2 *Anvils*



3 *Surface plates*



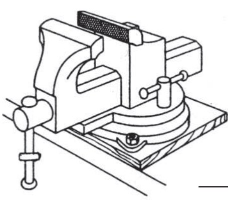
4 *Vee blocks*



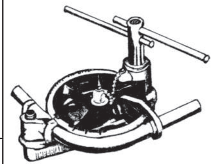
5 *Try squares*

6 *Clamps*

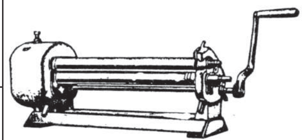
7 *Vices*



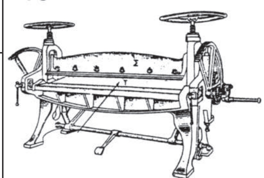
8 *Bending machines*



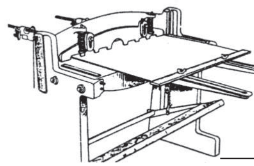
9 *Forming machines/Rolls*



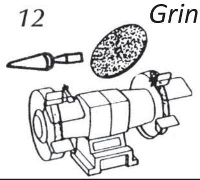
10 *Bar folders*



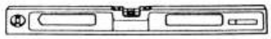
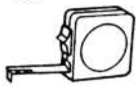
11 *Squaring shears*



12 *Grinders-Polishers-Buffers*



13 *Impact wrenches*

14		*Electric drills*
15		*Drill presses*
16		*Steel brushes*
17		*Spirit levels*
18		*Oilers*
19		*Folding rules*
20		*Flexible tapes*

EXERCISES

1. **Go through the catalogue of the tools manufacturing company and in the spaces provided, write the Greek equivalent term for the various items in it.**

2. **Name the tools, instruments or machines used to carry out each of the activities illustrated on ps. 80-83.**

Examples

- *Tightening or loosening screws with flat-tip, cross-point, offset or retaining screwdrivers.*
- *Forming rolls using a/on a forming machine.*

3. **Classify the tools and other equipment in the following categories, according to their use.**

Threading **Scribing/Marking** **Drilling**

Expanding tube ends

Holding / Gripping	Tightening / Loosening	

Cutting	Measuring	Bending/Forming (making bends, loops, angles, herms, seams, rolls)

4. Label the pictures below to check how many words for tools you can remember. Then, look through the catalogue to find the words you have forgotten.

A.

1 ______

2 ______

3 ______

4 ______

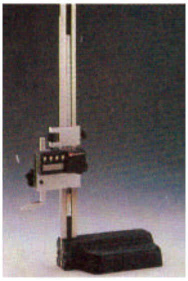
5 ______

6 ______

B.

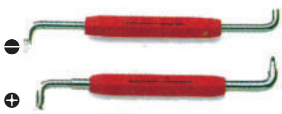
1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________
15. ______________________
16. ______________________
17. ______________________
18. ______________________
19. ______________________
20. ______________________

C.



1 ______________________

2 ______________________



3 ______________________

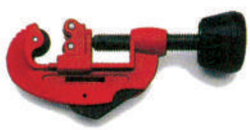
4 cordless ______________

5 ______________________

6 ______________________

7 ______________________

8 ______________________

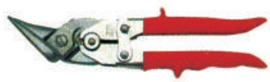


9 ______________________

10 ______________________

11 ______________________

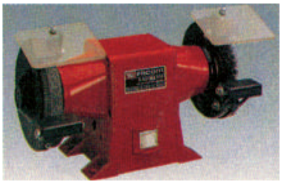
12 ______________________



13 ______________________

14 ______________________

15 ______________________



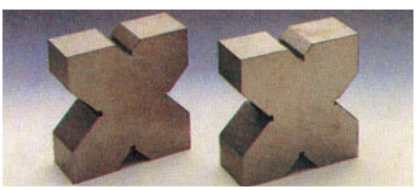
16 ____________________

17 ____________________

18 ____________________

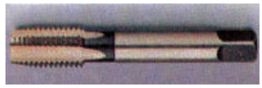
19 ____________________

20 ____________________

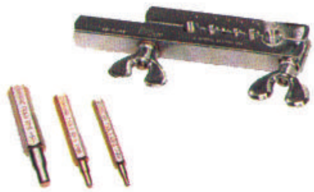


21 ____________________

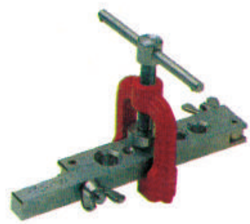
22 ____________________



23 ____________________



24 ____________________



25 ____________________

26 ____________________

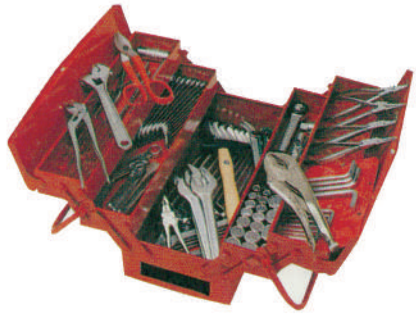
5. A. Place a tick in the appropriate column(s) to show the use of the following tools.

	USE							
TOOLS	**cutting**	**measuring**	**gripping holding**	**screwing tightening loosening**	**drilling scribing**	**threading**	**filing**	**hammering striking**
scribers					✓			
forging tongs								
socket spanners								
vices								
dies								
universal pliers								
steel rules								
wrenches								
dividers								
files								
mallets								
chisels								
calipers								

	USE							
TOOLS	cutting	measuring	gripping holding	screwing tightening loosening	drilling scribing	threading	bending folding	hammering striking
monkey wrenches								
screwdrivers								
tube cutters								
lock-grip pliers								
tube benders								
shears								
clamps								
taps								
adjustable pliers								
hacksaws								
screw pitch gauges								
adjustable wrenches								
drills								
bending machines								

B. Use the grid to make sentences as in the examples.

- *We can cut rods of metal (by) using (a) hacksaw(s).*
- *To cut rods of metal we (can) use (a) hacksaw(s).*
- *(A/The) hacksaw(s) is/are used to cut / for cutting rods of metal.*



6. Use the tables to make meaningful sentences.

A. Bench and sheet metal workers use a(n):		
1. forming machine 2. drill 3. punch 4. dies 5. surface gauge 6. mallet 7. bending machine	to for	a. cut threads on the external surface of metal rods, bolts or pipes. b. making bends on rods and bars, and also for bending, hemming or seaming sheet metal. c. curving sheet metal and forming cylinders of various diameters. d. start holes on metal to make drilling easier. e. making bends on rods, bars and tubes. f. scribing lines parallel to a surface or vertical to another line. g. cut holes in solid metal.

B. Technicians in the mechanical engineering field use a (n):		
1. reamer 2. tap 3. vice 4. vee blocks 5. calipers 6. tin snips 7. lock-grip pliers 8. tube bender	to for	a. take internal or external measurements. b. gripping objects or holding pieces of metal steady. c. bending tubes. d. cut threads on the internal surface of nuts or pipes. e. cutting thin metal sheets. f. set objects on them for marking. g. remove burrs from the internal and external surface of metal pipes. h. hold pieces of metal tightly while working on them.

7. Match the two columns.

A. For Heating-Refrigeration and Air-conditioning Technicians and Plumbers

A

1. We use chisels to
2. Flaring tools are used to
3. With flat-tip screwdrivers,
4. Use a screw-pitch gauge to
5. Files are useful for
6. Swaging tools are used to
7. Tee handles give
8. Metal workers use the squaring shears to
9. We often use grinding machines for
10. A bar folder is used for
11. Use a pipe adjustable wrench for
12. Refrigeration systems technicians use a refrigeration service valves ratchet for

B

a. find the number of threads per inch.
b. opening or closing the service valves of compressors as required.
c. holding pipes or fastening and loosening fittings.
d. cut sheets of metal, shear off rivets and split rusted nuts from bolts, especially in hard-to-get-to places.
e. bending metal sheets, making hems, or turning an edge to receive a wire.
f. cut large sheets of metal.
g. spread the lips of a tube outwards in order to make a joint with a fitting.
h. a better grip and save effort during repetitive work, or provide extra power.
i. cutting, smoothing and removing small amounts of metal.
j. grinding dull-edged tools, e.g. chisels. By fixing another wheel they can also do polishing or buffing.
k. we can screw slot-head screws.
l. expand the end of a tube so as to permit another tube of the same diameter to be inserted into it and form a joint.

B. For technicians of the other specialities

A

1. We use chisels to
2. Forging tongs are used for
3. With flat-tip screwdrivers,
4. Use a screw-pitch gauge to
5. Files are useful for
6. Scrapers are used for
7. Tee handles give
8. Metal workers use try squares to
9. We often use grinding machines for
10. A bar folder is used for
11. Use a surface plate to

B

a. find the number of threads per inch.
b. scraping metal surfaces to clean or make them smooth.
c. check flat surfaces.
d. cut sheets of metal, shear off rivets and split rusted nuts from bolts, especially in hard-to-get-to places.
e. bending metal sheets, making hems, or turning an edge to receive a wire.
f. check right angles on metal pieces.
g. holding pieces of metal while forging or heat treating them.
h. a better grip and save effort during repetitive work, or provide extra power.
i. cutting, smoothing and removing small amounts of metal.
j. grinding dull-edged tools, e.g. chisels. By fixing another wheel they can also do polishing or buffing.
k. we can screw slot-head screws.

GERUND

> *When a verb comes immediately after a preposition, it has to be in the gerund (verb + -ing) form.*

Choose the appropriate verbs from the list below, put them in the right form and fill in the gaps in the sentences.

break	replace	take	hear	operate	multiply	service
cut	join	make	get up	use		

1. I am looking forward to ________________ from you soon.
2. He is thinking of ________________ his old electric drill with an impact wrench.
3. It's the first time he uses the squaring shears and is afraid of ________________ a mistake.
4. The circumference of a circle is found by ________________ the diameter by 3.1416.
5. The calipers are used for ________________ measurements.
6. Before ________________ a circle on a metal sheet, you must scribe it with the dividers.
7. He managed to make that difficult bend on the metal rod without __________ it.

8. He went on ______________ the hammer although its handle was cracked.
9. Some techniques of ______________ metals with a heat source are quite difficult and demand good training and long experience.
10. He is very experienced in ______________ machine tools.
11. As he has been used to ______________ late, he finds it difficult to wake up at six so as to be at work on time.
12. We attended a seminar on ______________ the new models of air-conditioning units.

Listening Activity

STEP 1

Your teacher will read some statements referring to the use of various tools. Some of them are correct. Some others are not.
Listen to the statements and tick the appropriate column (correct-wrong).

No	STATEMENTS		Correct tool to be used
	Correct	Wrong	
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

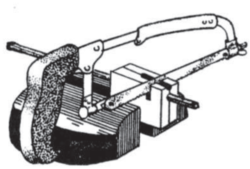
How many statements were correct? How many were wrong? Which ones?

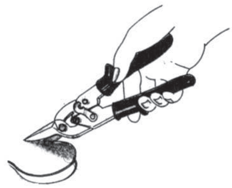
STEP 2

Listen to the statements again and correct the wrong ones by writing the correct tool to be used in each case, in the 3rd column of the above table.

Oral Practice

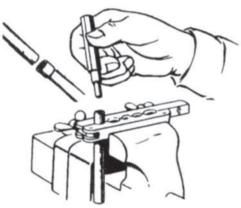
WHAT SHOULD YOU DO...
(jobs + tools)

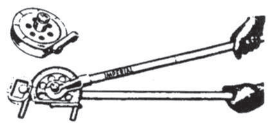




1\. ..... to cut a 50 mm piece from a long iron bar?

2\. ..... to cut a circular piece of 160 mm diameter from a metal sheet?





3\. ..... to cut a 60 cm long copper tube and prepare it to be connected to: a) another tube of the same diameter at one end and b) a flared-type fitting at the other. The tube must be bent 20 cm from its flared end. The bent must be 90°.

Work in pairs. Decide on the activities you should perform and the tools you should use to carry out the above projects. Discuss your answers in class.

Writing Activity

Choose one of the above three work activities and write a paragraph describing the steps you will/would/should/must follow and the tools you will/ ... use to carry it out. Don't forget to use linking words to join your sentences.

Expressions to help you

first, / second, / finally, ... next, / then, / after that, ... before / after + gerund	I	will / would... should ... must / have to...

USING HAND TOOLS CORRECTLY

The safety of the user and the quality of his job greatly depend on the correct use and maintenance of the tools he uses. The instructions below may prove useful.

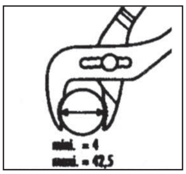
TASK 1

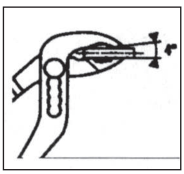
Read the instructions, and, in the spaces provided, write if they refer to: a) the safety of the user (S), b) the maintenance (M), or c) the correct use (C.U.) of the tool. Bear in mind that some instructions may belong to more than one of the above caregories.

Satisfactory results require good tools. Safe results require good engineering practice.

Instructions

A. Pliers





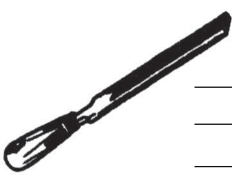
When using pliers:

______ 1. Select the correct size and type for the job.

______ 2. Be careful when holding a component with a pair of pliers while heating it. The nose of pliers must not get hot.

______ 3. Avoid finger traps when a sudden release occurs.

B. Files



When using files:

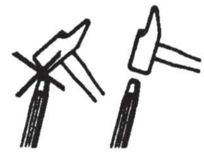
______ 1. Select the correct one according to the size and kind of the job to be done and the material to be filed.

______ 2. Don't use a file without a handle.

______ 3. Don't use a file as a lever.

______ 4. Never hammer on a file.

C. Hammers



When using hammers:

______ 1. Select the right type, weight and size for each job.

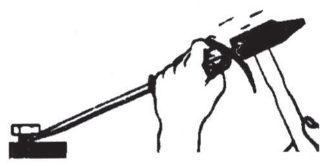
______ 2. Ensure that its handle is not cracked and that the head is securely attached to its shaft.

______ 3. Don't use the shaft as a lever.

______ 4. Never hammer on another hammer or tools not designed to be hammered, such as wrenches, files, screwdrivers, etc.

______ 5. Discard a hammer if it is excessively worn or has a domed head.

Always replace tools which, as a result of incorrect use, have lost their original characteristics.



D. Screwdrivers

When using screwdrivers:

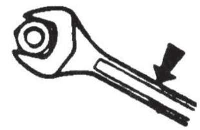
______ 1. Select the correct size and blade for the job.

______ 2. Keep the handle free from oil or grease.

______ 3. Don't use screwdrivers as levers or chisels and don't strike them with a hammer.

______ 4. Keep their blades sharp.

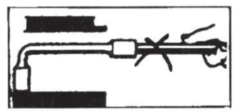
E. Wrenches, sockets and ratchets

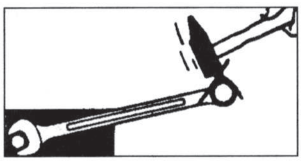


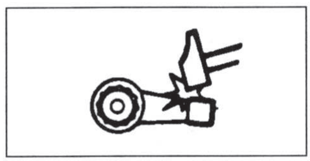
When using wrenches, sockets or ratchets:

1. Ensure a wrench is dead square on the fastened head.
2. Don’t overload sockets.
3. Never fit «hand use» sockets or other bits and accessories to a machine impact tool.

4. Make sure the turning parts of your ratchet wrench remain well lubricated.
5. Avoid extending a wrench or a ratchet.
6. Never hammer on a wrench or a ratchet.

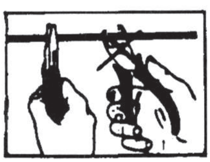






If you use tools outside their specifications, you are taking risks and endangering others.

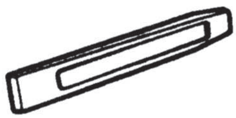
F. Cutters and snips



When using cutters and snips:

1. Keep their cutting edges sharp.
2. Keep the pivot oiled.
3. Make sure the cutting edges of the side or bolt cutters are at right angles to the items you are cutting.
4. Don’t use snips to cut wires, bolts, rivets or nails. Remember that they are sheet metal tools.
5. Keep the blades closed when the snips or cutters are not used.

G. Chisels and punches



When using chisels and punches:

______ 1. Keep the point of punches and the edge of chisels sharp.

______ 2. Avoid overheating when grinding them.

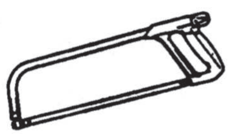
______ 3. Always grind mushroom heads and burrs off chisels and punches.

______ 4. Don't use them as levers.

Tools last a long time if they are not overloaded, so choose a tool with a rated capacity within your range of applications.

H. Saws

When using saws:



______ 1. Select the correct blade for the job.

______ 2. Make regular checks of the blades' sharpness and teeth.

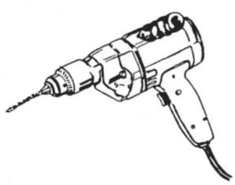
______ 3. Don't use blades outside their frames.

______ 4. Fasten them securely to their attachment.

______ 5. Keep them free of rust.

______ 6. Return saws to their special boxes after use.

I. Drills



When using drills:

______ 1. Select the correct size for the job.

______ 2. Ensure that their lips are sharp and properly ground.

______ 3. Don't use them as levers, or to stir paint.

B. Check your answers. If there are any different opinions, discuss them in class.

TASK 2

Read the instructions again and say which of them apply to the use of more than one tools.

TASK 3

EXPRESSING CAUSE/PURPOSE

Why are the instructions (for the correct use of tools) given? Choose reasons from the table to justify each instruction.

as because since	a) it/they may slip. b) the tool(s) may break. c) it/they will become soft and useless. d) this will send chips of metal flying.
to so as (not) to in order to	e) prevent an injury/accident. f) secure firm grip of the tool(s). g) ensure its/their long life. h) to achieve optimum performance of the tool and satisfactory results from your job.

Examples

- *A1: Select the correct size and type of pliers for the job, so as to achieve optimum performance of the tool and satisfactory results from your job.*
- *A2: Be careful when holding a component with a pair of pliers because, if they get hot, they'll become soft and useless.*

TASK 4

REPORTING INSTRUCTIONS

When your teacher gave the instructions concerning the correct use of hand tools, one of your classmates was absent. Your teacher asked you to inform him. **Choose three tools and inform your classmate about the teacher's instructions.**

Expressions to help you

He	told us advised us warned us reminded us		to... / not to... to try to... / to avoid + gerund... always to... / never to... to be careful when... to ... / not to ... to make sure we... / (that) the ...
He	said insisted warned us reminded us	that	we must / should / mustn't / shouldn't... it is dangerous to ... if / when ...

Examples

- *He told us to select the correct size and type of pliers for each job.*
- *He reminded/warned us not to overheat chisels when grinding them.*
- *He said that we shouldn't/should never use a file without a handle.*

UNIT 5

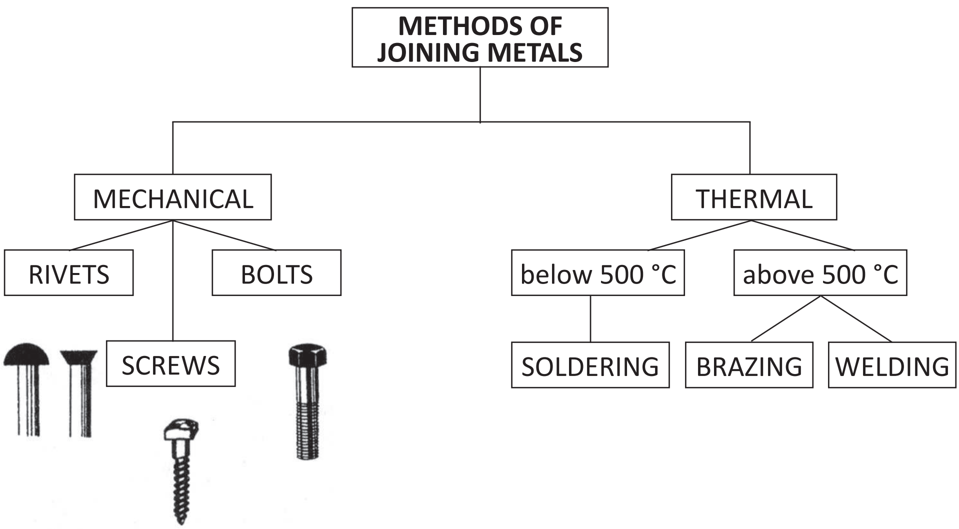
JOINING METALS

METHODS OF JOINING METALS

When making metal constructions, it is often necessary to fasten or join metals. The metals can be castings, sheets, iron bars, tubes, etc. The pieces to be joined may be composed of the same or of different metals and they may be joined either permanently or temporarily. There are various methods of joining metals to choose from, depending on the requirements of the construction.
The diagram below presents the basic classifications of these methods.

TASK 1

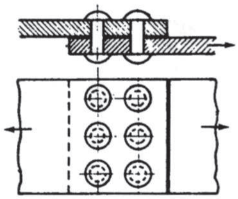
Study the diagram and then complete the text that follows.

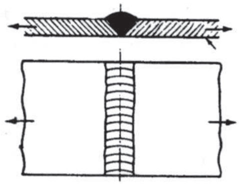


There are two methods of joining metals. The ____________ and the __________.
In the mechanical method, metals are joined by using fastening devices such as __________, ___________ and ____________, while in the __________, by using a heat source.
__________ are used for holding pieces permanently. _________ and _________, on the other hand, for making temporary joints, or if the _________ requires occasional adjustment.
According to the temperature of the heat source used, the thermal method is distinguished into ____________, ____________ and ____________.

TASK 2

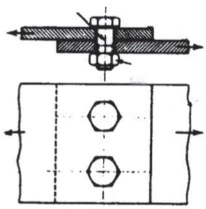
In the spaces provided under each picture, write if the method illustrated is mechanical or thermal.

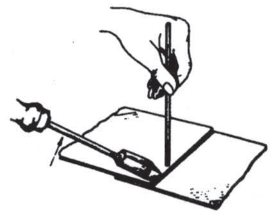




2. ______________________

1. ______________________





3. ______________________

4. ______________________

JOINING METALS WITH A HEAT SOURCE

Joining metal parts, metal sheets and aluminium, copper or steel tubing is a routine task for every technician in the mechanical engineering field. It requires a knowledge of the properties of metals, a steady hand, and skilfulness in using the appropriate equipment. A good technician, therefore, must be well trained in all the techniques used.

Filler metals in various forms

The selection of the appropriate technique depends on the kind of material to be joined, its thickness, and the nature of the bond.

In some techniques, the pieces to be joined (base metals) are melted at the area of the joint and let to flow together in it. In these techniques, very high temperatures are required. In other techniques, the base metals are not melted. The pieces are joined by means of a filler metal which is melted and let to flow in the joint.

Filler metals can be found in wire form (in rolls), or in the form of rods and electrodes. The melting point of the filler metals, that is the temperature at which they change to a liquid, is always lower than that of the base metals.

TASK 1

Answer the questions.

1. Which abilities are required from a technician in order to make strong joints?
2. What does the selection of the appropriate technique for a certain joint depend on?
3. What are the base metals and what the filler metals?
4. Is it possible to make a joint without using a filler metal?
5. Which techniques require higher temperatures; those in which a filler metal is used or those in which the base metals are melted at the point of the joint?
6. Which form are the filler metals available in?
7. Whose melting point is higher, the base metals' or the fillers'?

TASK 2

In the spaces provided, write the Greek term for the various techniques of joining metals with a heat source.

a. melting both metal pieces at the point to be joined: ____________________

____

b. using a filler metal to join the pieces: ____________________

____

c. melting both the base metals and the filler: ____________________

____

d. heating the base metals at the point to be joined (at a temperature slightly lower than their melting point) and pressing them at that point: ____________________

____

e. joining pieces composed of the same metal: ____________________

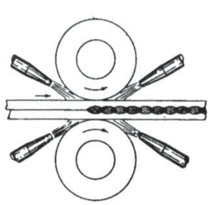
____

f. joining pieces composed of different metals: ____________________

____

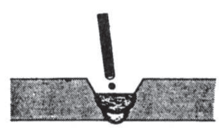
TASK 3

Relate the pictures below to the techniques described in TASK 2.



e.g. Picture 1 corresponds to technique (d)

Picture 2 ____________________ ____________________



Picture 3 ____________________

Picture 4 ____________________

SOLDERING - BRAZING - WELDING

TASK 1

Depending on the temperature and the kind of filler used, thermal methods can be distinguished in soldering, brazing or welding. The paragraphs below give a brief definition of these methods. **Read them and identify the process defined.**

Soldering

1. ____________________
It is the process of joining metals at temperatures above 500 °C using alloys of copper and silver, phosphorus or other metal as a filler.

2. ____________________
It is the process of joining metals at very high temperatures, either by using a filler or by heating (fusing) the base metals to their melting point.

3. ____________________
It is the process of joining two or more metal pieces by means of a filler (solder) which is an alloy of tin and lead, antimony or other metal having a low melting point (below 500 °C).

Welding

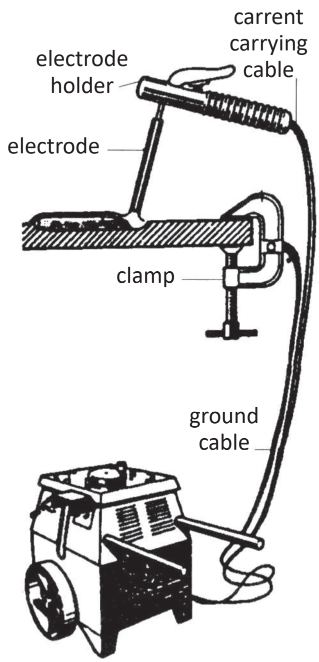
Brazing

TASK 2

How much do you know about soldering, brazing and welding? Check your knowledge. **Find the answer to each of the following questions.**

QUESTIONS

1. Which are the most widely used techniques in the three thermal methods?
2. What kind of filler is used in soldering?
3. Which is the alternative term for gas brazing and welding?
4. What is melted in gas soldering and gas brazing; the filler or the base metals?
5. In which form are the fillers used in gas brazing and gas welding?
6. Which methods are used to make most tubing connections nowadays?
7. Why is electric welding also called arc welding?
8. Which gases are used to create the flame in gas brazing and welding?
9. How are the metal pieces joined in arc welding?
10. What is used to create the flame in gas soldering?
11. Which method produces stronger bonds and is used to join both similar and dissimilar metals; soldering or brazing?
12. Are the filler metals heated or melted directly by the heat source in soldering and brazing?



Welding machine

ANSWERS

a. In the form of rods.

b. Oxygen and acetylene or oxygen and MAPP gas. In gas brazing, however, we sometimes use only acetylene or MAPP gas*.

c. Brazing.

d. No, they aren't. It is the base metals which are heated. The filler melts when it comes in contact with the heated base metals.**

e. Liquid propane, air acetylene or MAPP gas.

f. Because in this technique, the metals are melted by the heat produced by an electric arc.

g. Only the filler is melted.

* A mixture of various gases at certain proportions. It is used either alone (e.g. in soldering) or mixed with oxygen (in joints that require high temperatures).

** In some brazing operations, however, when the filler's melting point is high, we also heat it a little to make it melt faster.

h. The high temperature of the arc melts the base metals. The electrode used to create the arc also melts and serves as the filler rod for the joint.

i. They are also called oxyacetylene brazing or welding.

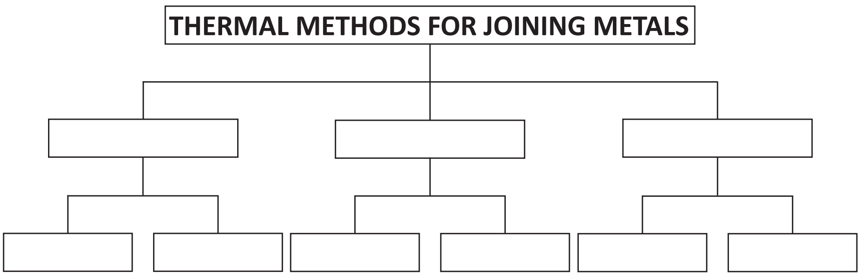
j. Those in which the heat is produced by burning gases, and those in which the heat is produced by electric current. As a result, the most widely used methods are: a) gas soldering, brazing and welding, and b) electric soldering, brazing and welding.

k. Soldering or brazing, because the joints made by these methods are strong and don’t cost much. Soldering is mostly used for connecting water pipes and drains, while brazing for refrigeration tubing.

l. An alloy of tin and lead, antimony or other metal having a low melting point (below 500 °C), which is called solder.

TASK 3

Complete the diagram below with the various techniques used to join metals with a heat source.



TASK 4

The following sentences are wrong. Correct them.

1. To join two metal pieces by soldering, we heat the base metals at a temperature above 500 °C and when they melt, we let them flow in the joint.
2. In arc welding, the heat needed to join the metals is produced by a flame created by oxygen and acetylene or MAPP gas.
3. The appropriate temperature for joining two metals by brazing is below 500 °C.
4. In soldering, the heat used to join the metals is produced by burning propane and oxygene or MAPP gas.
5. In soldering and brazing, the melting point of the base metals is lower than the melting point of the filler used.
6. In gas welding, the gases used to produce the flame are acetylene and MAPP gas.
7. In gas welding, the base metals are never melted.
8. In soldering, we don’t heat the base metals directly. We heat only the filler.

Writing Activity

The short text below includes all the information given in this unit about welding. **Fill in the missing words and then, write a similar text about either soldering or brazing.**

WELDING

Welding is one of the methods used to join metals with a _________ ____________ . In this method, a very high ______________ (above 500 °C) is required to heat the ________ metals or / and the __________ to their melting __________ . There are two welding ____________: the ______________ welding and the ____________ welding.
In gas welding, two ________ are used to create the flame which melts the metals: _________________ and ____________ . As a result, the technique is also called ______________ _________. Sometimes, instead of acetylene, _________ gas is used. In electric welding, an ____________ is used to create the ________ and reach the high temperatures required. The electrode also melts and serves as a ________ rod for the joint. This technique is also called _________ ____________.

EQUIPMENT USED IN THE VARIOUS TECHNIQUES

Below you can see the equipment used in the various techniques of joining metals with a heat source. Combining the information from the pictures with the rest of the information provided in this unit, **carry out the two tasks that follow.**

Gas soldering equipment

Torch used with propane

Gauge and propane pressure regulator

Bottle with propane

Portable propane bottle

Gas brazing and welding equipment

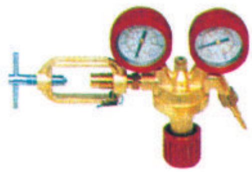
Portable MAPP gas bottles suitable for gas soldering or brazing

Torch acetylene valve

Portable set for gas brazing and welding. The cylinder contains MAPP gas

Torch suitable for gas brazing or welding

Cylinder with acetylene



Gauges and acetylene pressure regulator

Cylinder with oxygen

Gauges and oxygen pressure regulator

Torch oxygen valve

Hoses

Machine used for electric brazing and welding

Electric soldering equipment

Soldering iron

Soldering gun

TASK 1

Complete the table.

		SOLDERING	BRAZING	WELDING
FILLERS				• welding rods • ____________________ (alloys of various metals)
GASES				
EQUIPMENT	GAS			
	ELECTRIC		electric brazing machine	

TASK 2

Write the method(s) or technique(s) related to the following:

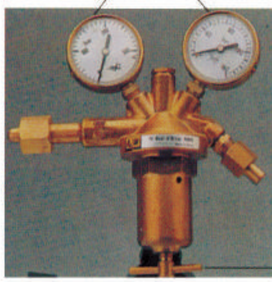
Tempe-rature	(1) below 500 °C: ______________________________ (2) above 500 °C: ______________________________
Method	(1) melting of the base metals: ______________________ (2) an alloy of tin and lead as a filler: ________________ (3) alloys of copper as a filler: ______________________ (4) an electrode as a filler: ________________________
Equipment	(1) an electric machine: __________________________ (2) a gas torch: _________________________________ (3) an electric iron or gun: ________________________ (4) cylinder(s) with gas: __________________________
Heat Source	(1) air acetylene: ______________________________ (2) liquid propane: _____________________________ (3) mixture of oxygen and acetylene: _______________ (4) MAPP gas (alone): ___________________________ (5) mixture of oxygen and MAPP gas: _______________

Writing Activity — Description

Use the information given below to write a short text describing the equipment used in oxyacetylene brazing and welding.

One indicates the gas pressure in the cylinder. The other, the amount of pressure in the hose.

Set of gauges (manometers)



Gas pressure regulators regulate the pressure of the gas flow in the hoses from the cylinders to the torch.

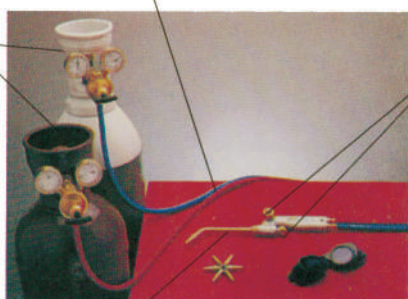
gas pressure regulator

One carries oxygen (green/ blue), the other carries acetylene (red).

Torch gas valves regulate the proportion of oxygen and acetylene in the mixture that flows through the torch.

hoses

cylinders



torch gas valves

One contains oxygen, the other acetylene.

Acetylene valve regulates the size of the flame. Oxygen valve regulates the flame's temperature.

torch

In the torch, the gases are mixed and the flame is produced.

Expressions to help you

is / are ... equipped with...	either... or
one... while the other...	that / which / whose...
that is,...	also / too / as well...

Start like this:

The equipment used in gas welding consists mainly of two cylinders that contain

………

………

………

………

………

………

………

………

………

………

………

………

FOLLOW UP

Use the table to make meaningful sentences.

1. Two regulators 2. Two manometers 3. The hoses 4. Screws and bolts 5. Rivets 6. A heat source 7. The gas valves on the torch 8. Welding rods 9. Acetylene and oxygen	is / are • needed • used	to in order to for	a. regulate the proportion of oxygen and acetylene in the torch. b. carrying the gases from the cylinders to the torch. c. control the pressure of the gas flow in the hoses. d. make temporary joints. e. carry out soldering, brazing and welding. f. making strong joints. g. produce the flame in gas welding. h. indicate the amount of pressure in the hoses and cylinders. i. holding metal pieces together permanently.

Listening Activity

A. For Heating, Refrigeration, Air-conditioning Technicians and Plumbers

STEP 1

Listen to the text and decide:

Flux does not clean metal. It helps to keep it clean.

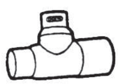
1. If the text presents
   a. the advantages of the thermal method of joining metals.
   b. the steps of a procedure.
   c. the technical characteristics of a welding machine.
2. Which the described technique is.

STEP 2

Work with your partner. Read the text and fill in as many gaps as you can with the appropriate verb. All the verbs you need are included in the list below. One is used twice.

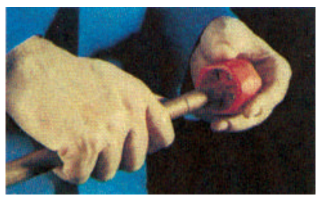
apply	handle	tap	clean	wash	get	heat	remember	feed
	allow	support	remove	cut	touch	forget		

Cutting the tube



Fitting

Wire brush



Removing the burrs with a reamer

To make a tube-to-fitting connection, follow the instructions below. First, ________ the tube to the desired length. ________ the burrs with a reamer or a file. Next, ________ both the outside of the tube and the inside of the fitting with a clean wire brush, or a clean sandpaper or sandcloth. Clean surfaces guarantee a strong, leakproof bond. Then, ________ the correct flux for the job and ________ it to the outside of the tube. Don't ________ to assemble the tube and the fitting and ________ them firmly, so that they will not

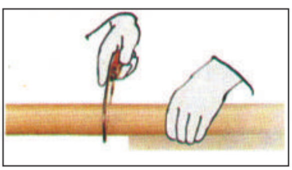
move during the soldering operation. Everything is ready now.
__________________ the joint with the torch. After a while, __________________ the solder to the heated fitting. If it melts, the proper temperature has been reached.
__________________, then, the flame and __________________ solder to the joint, at one or two points, until a ring of solder appears at the end of the fitting.
Don't forget to __________________ the fitting with a mallet while soldering, so as to distribute the solder evenly in the joint. Also, each time you put some solder on the joint, __________________ to wipe the surfaces with a clean cloth or brush to remove any dirt.
__________________ to cool. Don't __________________ the pieces until the solder has cooled and hardened. Finally, __________________ off all the traces of the flux from the soldered area with water and a brush.

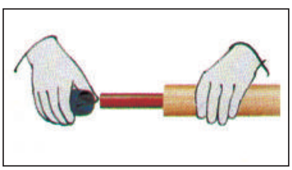
STEP 3

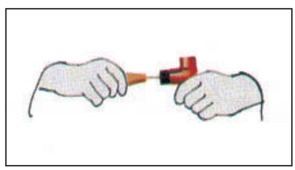
Your teacher is going to read the same text with all the gaps completed. Listen to it and make sure that the verbs you have used to fill in the gaps are correct. Also, fill in the rest of the gaps with the suitable verbs. If necessary, listen to the text again.

FOLLOW UP

1. The pictures below will be used in a manual to illustrate the steps of the procedure followed in gas soldering. **Use the information in the above text to write the appropriate instructions in the space provided under each picture.**







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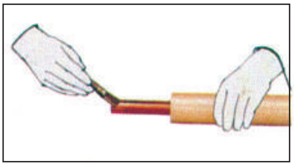
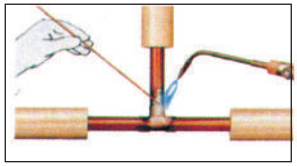
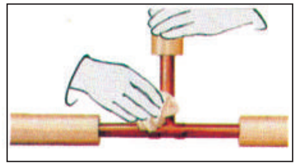




2. Vocabulary exercises

A. Look through the text in STEP 2 to find the words defined below.

1. Small pieces of metal produced when cutting, drilling or grinding metal objects; chips: __________
2. Take something away or off: __________________
3. Make larger or greater in size: __________________
4. Something that is well sealed or joined (e.g. the joint of two pipes), so that no liquid or air can escape from it. __________________
5. Hit with quick, light blows: __________________
6. In equal amounts: __________________
7. Small amounts of something left somewhere (e.g. flux or filler on a surface), signs of it: __________________

B. Make pairs of synonyms out of the two lists below.

A	B
tube	securely; steadily
desired	fit
edge	pipe
guarantee	scatter
bond	required, wanted
apply	end, lips
assemble	ensure
firmly	rub
distribute	joint
wipe	spread; put

Joining Tubes by Brazing

TASK

The instructions below describe the steps followed to join two tubes of the same diameter by gas brazing. They are given in jumbled order. **Write numbers in the space provided in front of each step to show their correct order in the procedure.**

____ Cool the joint with water. ____ Fit the joint securely and support all its parts, so that they will not move. ____ Use a swaging tool to expand the edge of one of the tubes to be joined. ____ Apply the brazing filler rod to the heated parts. Do not heat it with the torch. ____ Remove burrs with a file or reamer. ____ Clean the joint thoroughly using warm water and a brush. ____ Apply clean flux as recommended for the brazing alloy to be used. ____ Heat the joint evenly to the recommended temperature. Keep the torch moving constantly in a «figure eight» motion. If heating a copper-to-steel joint, heat the copper first. (It takes more heat as it carries it away faster). ____ Clean the surfaces to be joined thoroughly with stainless steel wool or wire. ____ Cut the tubes to the desired length. ____ Watch carefully for a poor adhesion (dark, cup-shaped areas) and make the necessary corrections during the brazing operation.

TASK 2

Compare the two procedures of joining metals (by soldering and by brazing) described. Spot their main similarities and differences.

Expressions to help you.

In case of similarity	
In both procedures, In both... and..., In..., like in..., In..., (the same) as in...,	we must/have to... we use/apply/etc.

In case of difference		
When / In..., we...	while / whereas but on the other hand,	when / in.... we...
In..., unlike in..., we...		

Listening Activity

B. For Welders and the rest of the specialities

Flux does not clean metal. It helps to keep it clean.

STEP 1

Listen to the text and decide:

1. If the text presents
   a. the advantages of the thermal method of joining metals.
   b. the steps of a procedure.
   c. the technical characteristics of a welding machine.
2. Which the described technique is.

STEP 2

Work with your partner. Read the text and fill in as many gaps as you can, choosing verbs from the list below.

avoid	select	wash	apply	arrange	heat	adjust	continue
clean	check	set	dip				

To join the two pieces of metal, first ______________ the surfaces to be brazed with a liquid cleaner or an abrasive cloth and ______________ them close together to ensure a strong seam or joint. Then, ______________ the proper size tip for the job and attach it to the torch. Also, select the recommended flux and rod size for the job.

__________ up the oxyacetylene equipment and light the torch. __________ the torch to a neutral flame and moving it in a small arc motion, __________ heat to the metals being joined until they are red hot. __________ the end of the brazing rod slightly and __________ in the flux causing it to cling to the rod. Holding the rod just ahead of the flame, continue to heat the metal pieces until the brazing rod melts and flows on the pieces being brazed.

After the proper temperature has been reached, ______________ brazing across the joint. Keep your torch in motion to prevent hot spots. ______________ overheating, as this may cause a weak joint.

Don't touch or handle the joined pieces until the metals at the joint have cooled and hardened. Finally, ______________ off all traces of the flux on the brazed area with running water and ______________ the joint. A properly brazed joint should have a bright shiny colour.

STEP 3

Your teacher is going to read the same text with all the gaps completed. Listen to it and make sure that the verbs you have used to fill in the gaps are correct. Also, fill in the rest of the gaps with the suitable verbs. If necessary, listen to the text again.

FOLLOW UP

Find how the sentences or phrases below are expressed in the text.
1. To clean the metal surfaces, use a special cloth with a rough surface which is used to clean hard surfaces.
2. Put the appropriate size tip to the torch and fasten it.
3. Chek the oxyacetylene equipment and make it ready for use.
4. Regulate the torch gas valves so as to get the size and temperature of flame required for the job.
5. Direct the heat to the surface of the metal pieces being joined.
6. Put the filler rod in the flux for a short time.
7. ...until the flux is stuck on / is attatched to the filler rod.
8. ...to make sure that no spots on the surface of the joint are overheated.

Arc welding

TASK 1

The instructions below describe the steps followed to join two metal pieces by arc welding. They are given in jumbled order. **Write numbers in the space provided in front of each instruction to show their correct order in the procedure.**

_____ Turn the machine on and bring the electrode within a few centimetres from the workpiece.

_____ After you have obtained the arc, keep the electrode within 1.5 to 3.2 mm from the metal being welded moving it in a straight direction, smoothly and evenly. As the electrode burns shorter, keep feeding it to the workpiece to maintain the correct arc length.

_____ Adjust the welding machine to the appropriate amperage.

_____ Clean the surfaces to be welded with an abrasive cloth.

_____ Place the proper electrode in the holder and clamp the ground cable to the metal to be welded or to the metal table where the workpiece is placed.

_____ Holding the hot metal with a pair of tongs, clean the joint with a special hammer and a steel brush to remove chips.

_____ Arrange the surfaces to be joined close together.

_____ Start an arc by striking the work piece with the electrode as you strike a match. Then, raise the electrode slightly to form and maintain the arc.

TASK 2

Arrange the numbered instructions under the following headings:
1. Preparation for welding: **e.g.** *Instructions 1, ...*
2. Welding the joint:
3. Finishing the joint:

TASK 3

Below are some additional instructions closely related to the arc welding procedure described above.

A. Read them and say if they refer to: a) the safety of the welder, or b) the quality of the job.

1. Use clamps, if necessary, to hold the pieces in place securely.
2. Wear arc welding gloves, an apron, sleeves and a face shield to protect you from the intense light and heat and prevent burning your eyes, skin and clothes.
3. Keep the electrode moving while starting the arc, to prevent it from sticking to the workpiece.
4. Be careful. The correct welding speed is most important.
5. While welding, make sure you get the deepest penetration possible in the joint.

B. Find which step of the procedure the above instructions are related to and insert them in the appropriate place in the procedure.

TASK 4

Compare the two procedures of joining metal pieces (by gas brazing and by arc welding) described. Spot their main similarities and differences.

Expressions to help you.

In case of similarity

In both procedures,
In both... and...,
In..., like in...,
In..., (the same) as in...,

} we must/have to...
we use/apply/etc.

In case of difference

When / In..., we... { while / but / on the other hand, } when / in.... we...

In..., unlike in..., we...

Writing Activity

You are the Production Manager of «H.C.R. Ltd», a company manufacturing commercial refrigerators. The company is also responsible for the installation and servicing of the systems produced.

In this field, metal cutting and, of course, gas soldering, brazing and, sometimes, welding is a daily routine. As the business is growing fast, you need to buy some additional equipment.

Last month, you visited the International Fair of Brussels where you had the opportunity to see the new gas welding equipment manufactured by ELAG. You were impressed by its high quality and performance, and also by its flexibility, that made it suitable for your specific job requirements. So, you decided to write a letter to the company and ask:

a) for a complete catalogue of the company's equipment and accessories with their technical characteristics,

b) for the price list of the company's products, and

c) if there is a representative of the company in Greece to ask for advice about the exact equipment and accessories you should buy and to whom you should place your order.

Address your letter to: The Sales Manager, ELAG B.C. Co. Ltd, 86 St. Thomas st., Edinburgh, Scotland U.K.

POINTS TO REMEMBER WHEN WRITING A FORMAL LETTER

- **Be polite:** Avoid imperatives when asking for something. Use expressions like: «I would be grateful if...», «Could you please», «I would like to know...», «Please, let me know if / that / when...», instead.
- If you **don't know** the name of the receiver (addressee):
  - **Start** your letter with: «Dear Sir / Sirs / Madam / Madams» and
  - **End** it with: «Yours faithfully / truly*» or «Faithfully / Truly* / Very truly*yours».
- If **you know** the name of the addressee:
  - **Start** your letter with: Dear Mr / Mrs / Miss / Ms** *(his / her name)* ....
  - **End** it with: «Yours sincerely» or «Sincerely yours».
- **Common phrases** to **close** the letter are: «I look / am looking forward to meeting / hearing from you soon», «Please let us hear from you as soon as possible», «I would particularly like to know about...»
- **At the end** of the letter:
  - **Put** your signature.
  - **Write** your name in full, below your signature.
  - **Add:** Mr, Mrs, Miss or Ms after your name in parenthesis to help the addressee know how you would like to be addressed.
  - **State** your occupation / post in the firm below your name.

* More common in American English.

** Use Ms if you don't know whether the woman is married or single.

ADDRESEE'S ADDRESS

SENDER'S ADDRESS

DATE

Dear ____________,

§ 1 → I am

§ 2 → Last summer I visited your stand at

§ 3 → I would be grateful if you could send me a

§ 4 → I would also like to know if

§ 5 → I am looking

Yours

Signature

Name in full

Occupation / Post

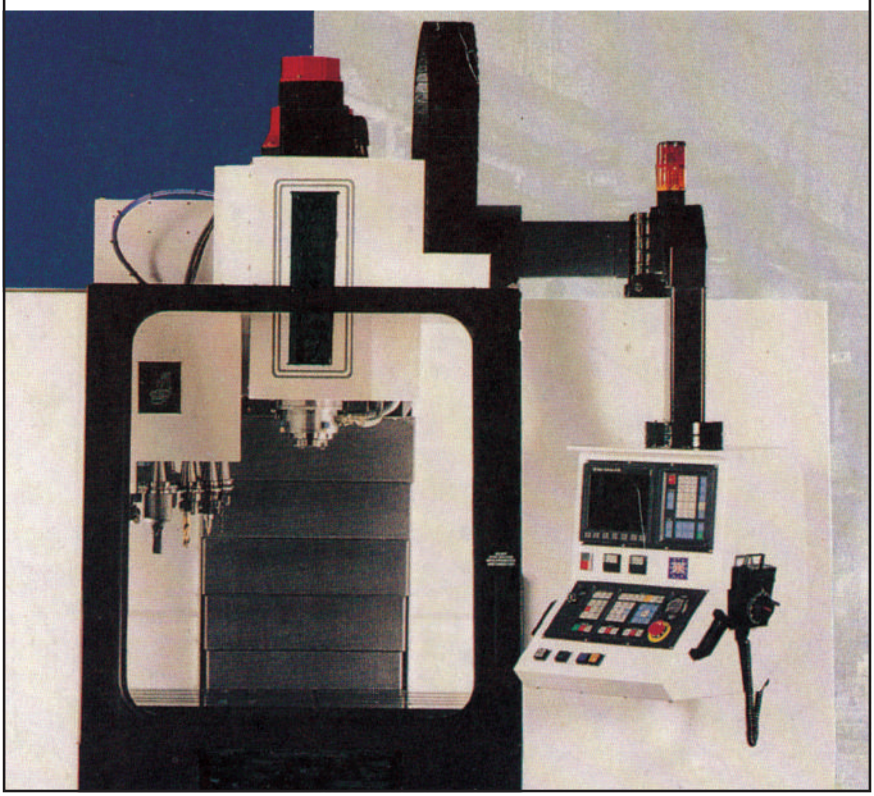
SAFETY SAYS:

- Never play or get careless when using the gas brazing or welding equipment. Combustible gas and a fire must be handled carefully.
- Always use the spark lighter to light the torch. Never use a match.
- Turn off the torch if it becomes necessary to change the position of workpieces or when you have completed the operation. Always hung the torch carefully.
- When opening cylinder valves stand to one side of the regulator gauges.
- Avoid breathing fumes from the sal-amoniac; they cause headaches and injure the lungs.
- Carefully check the specifications of the brazing alloy used. If it contains any amount of cadmium, be SURE that the work space is well ventilated and that none of the fumes are inhaled or come in contact with the eyes or skin. Cadmium fumes are very poisonous.
- All air must be removed from the tubing being brazed. This can be done best by purging the tubing with a nonflammable gas such as carbon dioxide or nitrogen to eliminate the hazard of an explosion*. Never use a refrigerant, oxygen or compressed air.
- Never look at the arc with a naked eye. The arc may burn your eyes severely.

* If there is any oil inside the tubing, the heat of the torch may cause this oil to vaporize. Oil vapour mixed with air will explode if ignited.

UNIT 6

MACHINE TOOLS

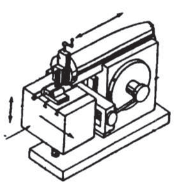


FROM STONE TOOLS TO CNC

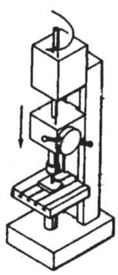
Man passing through the stone, bronze, iron and machine age has reached the age of computer. During his course through time, he has improved his standards of living and increased his productivity thanks to the development of the various tools and machines he has constructed.

In the beginning of time man had only his hands as tools.
Then, he learned to turn stones into useful tools.

Later he produced better, more effective tools, first out of bronze and iron and next out of steel.

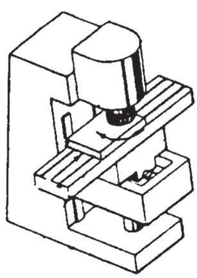


Plane

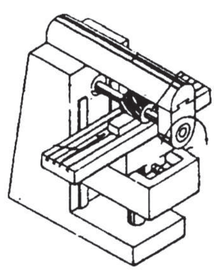


Drilling Machine

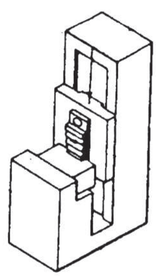
In his attempt to achieve higher precision and improved production rates, man finally manufactured machine tools. So, mechanical saws, drills, planes, lathes, grinding and milling machines, broachers, etc. were invented.



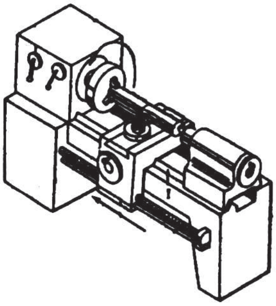
Vertical Milling Machine



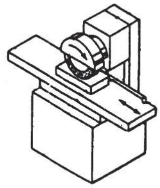
Horizontal Milling Machine



Broacher

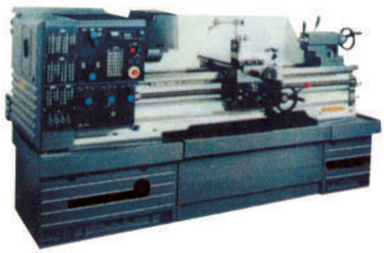


Lathe

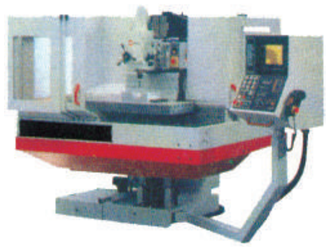


Grinding Machine

The new horizons opened by electronics and computer technology have recently led to a further development of these machine tools. The new NC and CNC cutting machines (milling and single-spindle drilling machines, lathes, turning* and machining centres) have enabled industry to produce metal parts with such accuracy, efficiency and reliability, and at such a great speed and close tolerances one could hardly dream of some years ago.



Machining Centre



Turning (and chucking) Centre

EXERCISES

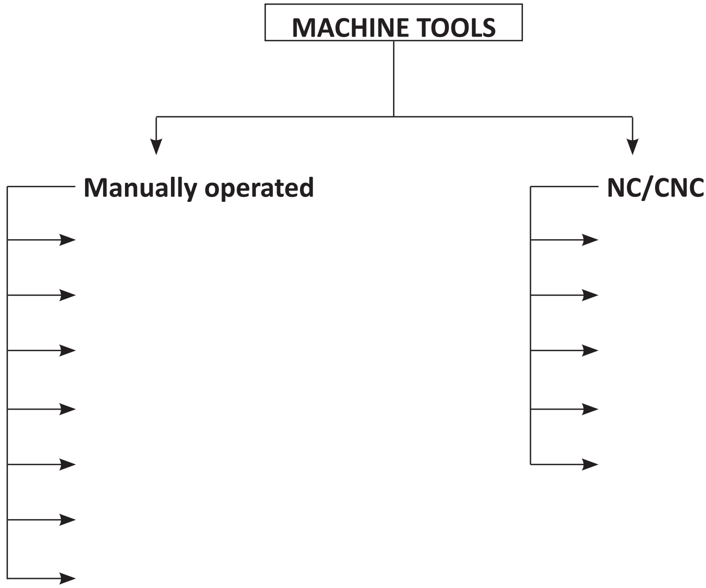
1. A. Match the tools with the age they belong to.

Tools	**Ages**	
1. Machine tools	a) Stone age	______
2. Tools made of iron	b) Computer age	______
3. Tools made of stone	c) Bronze age	______
4. NC/CNC machine tools	d) Machine age	______
5. Tools made of steel	e) Iron age	______
6. Tools made of bronze	f) Steel age	______

B. Use the spaces provided to number the ages according to their historical order.

* also referred as turning and chucking centres

2. **Complete the diagram with the types of machine tools mentioned in the text.**



3. **Tick the correct alternative.**

1. All machine tools, either manually operated or computer controlled are:
   a) forging machines
   b) cutting machines
   c) forming machines

2. «NC and CNC machine tools are capable of machining to very close tolerances» means that:
   a) they reduce production costs.
   b) their products are made very quickly.
   c) their products are characterized by high precision / accuracy.

4. **Write the English equivalent term for the machine tools below.**

1. μηχανοκίνητο δράπανο: ....
2. μηχανή αυλακώσεως: ....
3. μηχανοκίνητο πριόνι: ....
4. τόρνος: ....
5. εργαλειομηχανή πολλαπλών κατεργασιών για αντικείμενα εκ περιστροφής/ τόρνος πολλαπλών κατεργασιών: ....
   ....

6. κατακόρυφη φρέζα: ....

7. μηχάνημα λειάνσεως - ακονίσματος: ....

8. πλάνη: ....

9. οριζόντια φρέζα: ....

10. εργαλειομηχανή πολλαπλών κατεργασιών για πρισματικά αντικείμενα: ....
....

5. Answer the questions.

1. Has the development of hand and machine tools affected our lives? How?
2. What led man to the invention of machine tools?
3. What are the advantages of NC and CNC machine tools compared to the conventional ones?

6. Make groups of words similar in meaning.

advance	make	period	effort	fabricate	discover	lately	ability
improve	age	precision	progress	create	invent	try	time
manufacture	develop	standard	design	attempt	epoch	produce	
accuracy	efficiency	degree	construct	correctness	rate	skill	
exactness	proportion	recently	effectiveness				

progress	produce	rate
___	___	___
___	___	___
___	___	___
	___	
	___	

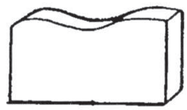
efficiency	accuracy	age
___	___	___
___	___	___
___	___	___

invent	attempt	recently
___	___	___
___	___	
___		

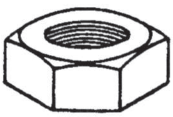
MACHINE TOOLS PRODUCTS AND OPERATIONS

1. A lot of the most widely used metal parts are manufactured on machine tools.
Tick those of the items below that are products of such machines.


1. Spring


2. Curved part

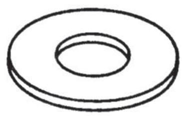

3. Fitting (angle)


4. Nut

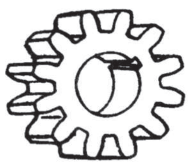

5. Bush

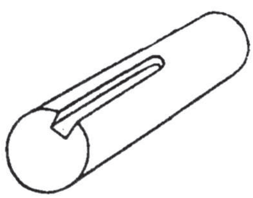

6. Bolt


7. Angular plate


8. Washer


9. Tin rivet

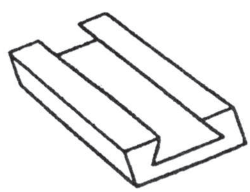

10. Gear


11. Shaft

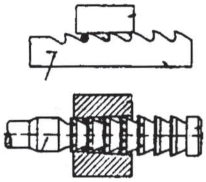

12. Threaded part

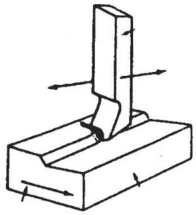

13. Screw

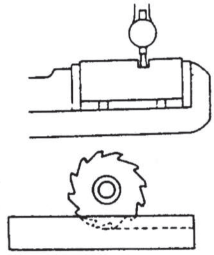

14. Nail

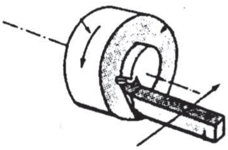

15. Angular part

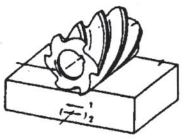
2. The pictures below illustrate various operations of the machine tools.
A. Write the equivalent Greek term for each operation.

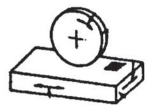

1. Broaching

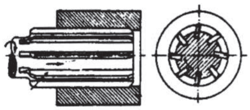

2. Planing

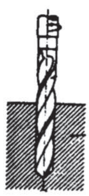

3. Cutting a slot

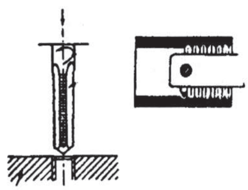

4. Facing

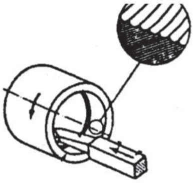

5. Milling

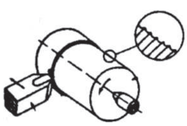

6. Grinding

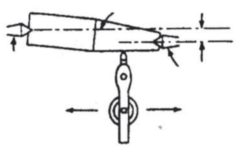

7. Reaming


8. Drilling


9. Theading


10. Boring

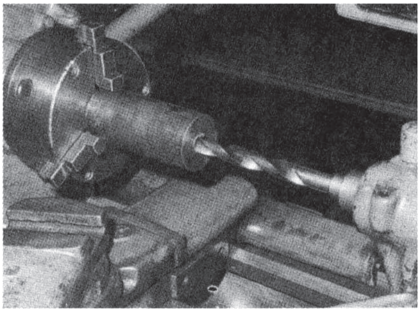

11. Turning


12. Cutting/turning a taper

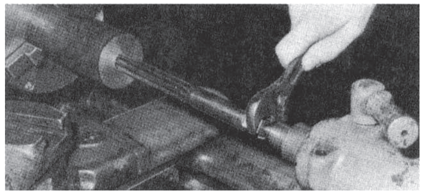
B. Say how each operation is performed.

e.g. *Broaching can be* [*carried out* / *performed* / *done*] *with / on a broacher*

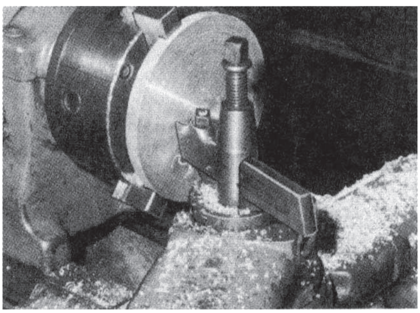
3. Identify the operations illustrated in the pictures below.



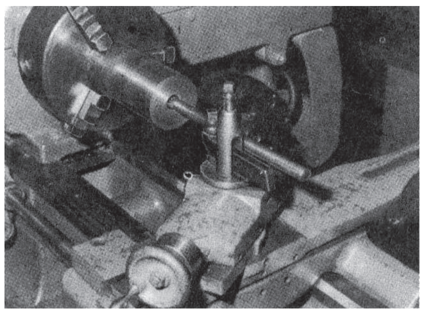
1.________________________



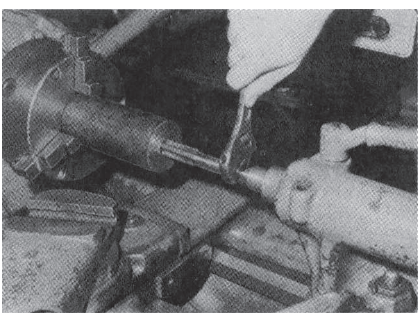
2.________________________



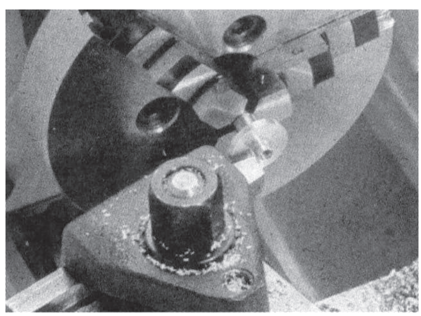
3.________________________



4.________________________



5.________________________

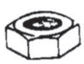
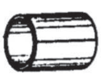


6.________________________

4. Which machine tools are described below?

1. A ____________________ is one of the most productive machine tools. It is very efficient in producing round parts, but it can also produce square, hexagonal and irregular ones. It can perform many operations including facing, cutting off, turning tapered sections, cutting threads, drilling, boring, reaming and also filing and polishing.
2. The ____________________ is one of the most versatile machine tools used to cut straight, angular or irregular surfaces, slots, grooves and gear teeth.
3. A ____________________ is used to cut off amounts of metal from the surface of a workpiece by moving the cutting tool forward and backward.
4. The ____________________ is a machine tool used to cut holes in metal pieces.

5. In the table below, write the main operations performed and the machine tools used to produce the following parts.

Parts	Operations performed	Machine tools used
1.  bolts	**e.g.** *cutting off,*	
2.  shafts		
3.  gears		
4.  nuts		
5.  bushes		

6. Identify the operation described.

1. ____________________ is the operation performed to cut a hole of a standard diameter in a metal piece.
2. ____________________ is used for producing angular or curved cuts, single or double slots in the external surface of a workpiece.
3. ____________________ is the operation of removing an amount of metal from

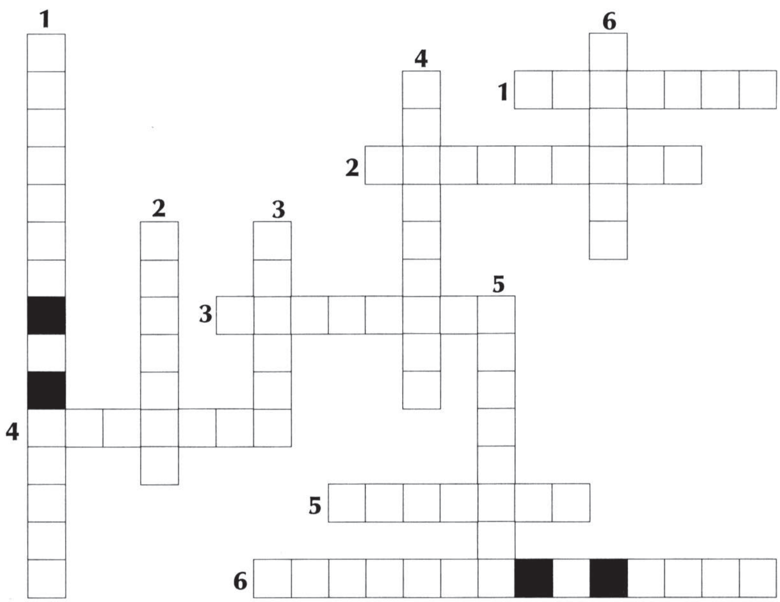
the end (face) of a workpiece to shape it.

4. ____________________ is carried out with a rotating wheel, to finish a produced part and make its surface smooth.
5. ____________________ is the operation of enlarging a previously cut hole to the desired accurate size.
6. ____________________ is the operation of removing an amount of metal from the upper surface of a metal piece with a cutting tool which moves forward and backward.
7. ____________________ is the operation performed with a special cutting tool on a cylindrical workpiece to produce threaded parts.
8. ____________________ is the operation of accurately sizing and producing a good surface finish in the inside of a hole previously drilled or bored.
9. ____________________ is used for producing complicated internal shapes, cutting slots, etc.

7. *Crossword puzzle*

Across
1. Γλύφανση
2. Αυλάκωση
3. Τρυπάνισμα
4. Διαμήκης εξωτερική τόρνευση
5. Πλάνισμα
6. Διάνοιξη αύλακος/σχισμής

Down
1. Κωνικό τορνάρισμα
2. Φρεζάρισμα
3. Διαμήκης εσωτερική διάνοιξη
4. Κοχλιοτόμηση
5. Λείανση
6. Μετωπική τόρνευση



Mr John Assimakopoulos and his partners have decided to buy a new lathe, a plane and a milling machine to modernize their machine shop. They have recently seen an advertisement of Selco Company in an English magazine, and found the machine tools it manufactures meeting their requirements and the prices reasonable. As they don't know if there is a representative of the company in Greece, they have decided to place their order to the Sales Manager of the company in England on the terms quoted in the price list.
Write the letter to the Sales Manager to place your order.

Cues to help you

1. State reasons for writing the letter
2. Mention the products you have decided to order (models, quantity, etc).
3. State a time limit for delivery.
4. Ask them to inform you about the exact date of delivery well in advance.

The address is:

The Sales Manager

Selco Company Ltd

10 Cromwell st.

Kensington

London N.W. 3B 5HC

England

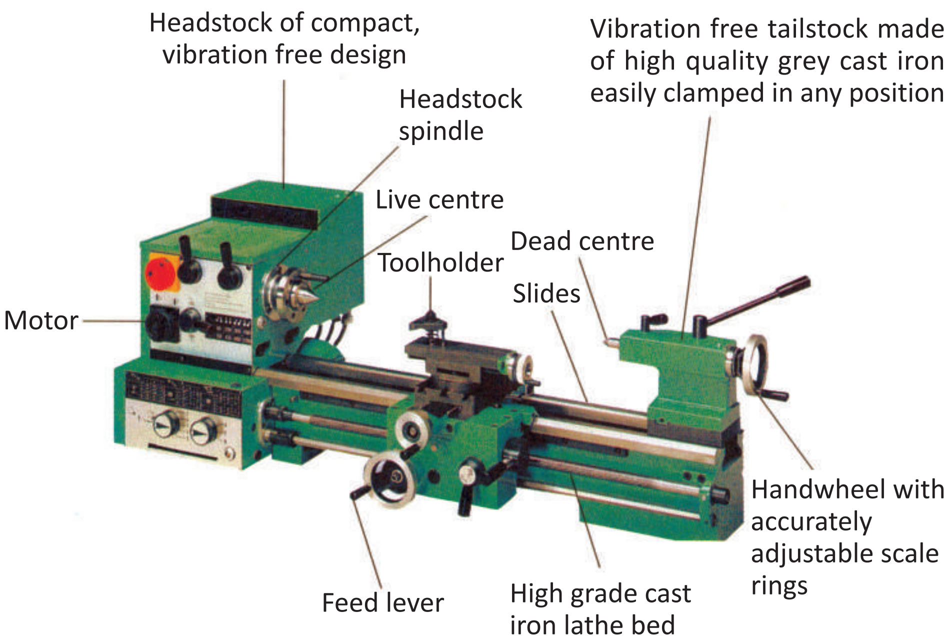
THE LATHE AND ITS PARTS

Because of their versatility and the wide range of operations they can perform, lathes are one of the most widely used machine tools, indispensable to any machine shop.

Since lathes and the other machine tools are imported in Greece from abroad, most operation manuals are in English. It is, therefore, useful to know the English term for their parts, so as to be able to understand the instructions in the manuals.

The picture below is taken from such a manual. It presents the main parts of the lathe and their characteristics.

Study it carefully and carry out the exercises that follow.

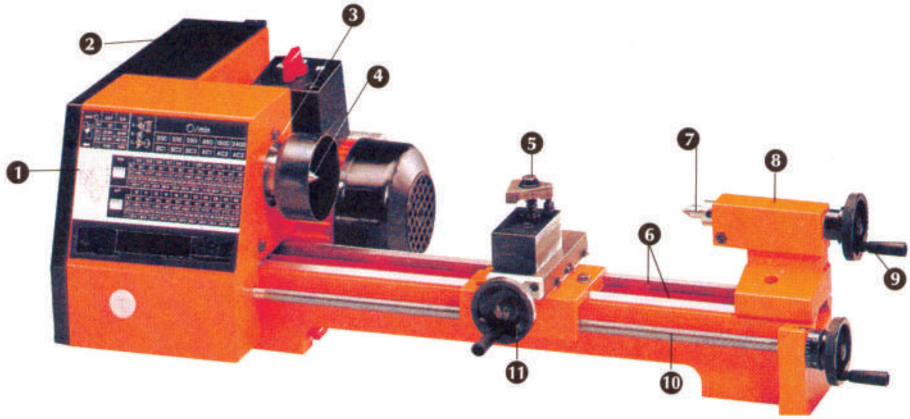


EXERCISES

1. Make a list of the parts of the lathe above and then, write the equivalent Greek term for each one.

1. **e.g.** *motor = (ηλεκτρο)κινητήρας*

2. Label the parts of the lathe in the picture.



1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....
11. ....

3. Write the characteristics of the parts of the lathe as presented in the manual.

1. Headstock of ______ design

2. Tailstock
   - of ______ design
   - made of ______
   - ______

3. Bed of ______

4. Handwheel ______

4. Find words or phrases in the characteristics of the lathe's parts which mean:

1. A design / construction that consists of parts firmly joined, fitted, or fastened: ______
2. Rapid and continuous movement to and from tremble: ______

3. An accessory in the form of a circle that can be accurately set to different positions or sizes: ____________________
4. A part that is easily put or fastened in various positions firmly and tightly: _________________
5. These parts are made of a high quality metal and are having high standards: _________________
6. It is specially constructed so that it doesn't shake when the machine is in operation: ____________________

5. Identify the part of the lathe described.

1. The ____________________ is the part of the lathe on which the cutting tools are fastened.
2. The two metal rods on which the toolholder and the tailstock move are the ____________________.
3. The _________________ is the part of the lathe where the workpieces are fastened. Its spindle turns rotating the piece to be cut.
4. The ________________ is an electrical machine used to rotate the spindle which holds the metal pieces to be machined.
5. The _______________ supports the other end of the long cylindrical pieces fastened on the live centre.
6. The _______________ controls the amount that the cutting tool advances into a workpiece, that is, the amount of metal removed from it.
7. By turning the ____________________, the tailstock moves on the slides.

6. Make meaningful sentences by matching their parts.

1. Machinists, mechanics and other technicians need a lathe
2. Using a lathe we can make
3. The handwheel is equipped with
4. A good lathe is the most important factor
5. What matters in a lathe is
6. The bed and tailstock of the lathe in the picture
7. Its tailstock and headstock
8. Machine tools produce parts

a. for the shape, size and precision of the work produced on it.
b. are made of high quality cast iron.
c. faster, more accurately and at a lower cost than hand tools.
d. bolts, shafts, nuts, bushes, threaded parts, etc.
e. the quality of its parts.
f. for turning, facing, boring, reaming and threading metal parts.
g. are designed to absorb vibration.
h. accurately adjustable scale rings.

7. *ACTIVE – PASSIVE VOICE*

Decide if the sentences below should be in the active or in the passive voice and form the verbs in parentheses in the appropriate active or passive tense. (See the «Grammar» section in the APPENDIX)

1. The cutting tools (fasten) ____________________ on the toolholder of the lathe.
2. The tailstock and the toolholder of the lathe (move) ____________ on the slides.
3. The cutting tools used on machine tools (make) ____________________ of steel.
4. The tool has become dull, so it must (sharpen) ____________________.
5. Before starting welding you must (choose) ____________________ the appropriate electrode for the job.
6. In the future, thanks to the new developments in computer technology, most factories (control) ____________________ by computers.
7. By fixing another wheel, grinders can also (do) ____________________ polishing and buffing.
8. The metal construction (fix) ____________________ in place with bolts and nuts only five minutes ago.
9. When everybody had finished, the teacher (check) ____________________ all the metal parts produced by the students on the milling machine.
10. He (use) ____________________ a grinder to sharpen the chisel.
11. CNC machine tools widely (accept) ____________________ all over the world and soon (replace)____________________ conventional machines due to their accuracy, versatility and productivity.
12. The surfaces of the metal pieces to be joined should (clean) ______________ with a sandparer or sandcloth.

8. Find nine parts of the lathe hidden horizontally, vertically or diagonally in this word square.

R	B	T	H	T	A	I	L	S	T	O	C	K
H	R	A	D	S	Y	B	I	N	O	G	E	F
B	E	M	O	T	O	R	L	L	O	B	L	E
A	H	A	N	D	W	H	E	E	L	A	N	E
S	S	P	D	E	O	G	I	C	H	E	R	D
P	A	F	B	S	M	E	N	O	O	Y	F	L
I	D	O	L	L	T	I	U	H	L	T	A	E
N	E	R	A	I	Q	O	F	I	D	E	V	V
D	L	E	M	D	A	U	C	R	E	Z	D	E
L	A	T	H	E	B	E	D	K	R	U	A	R
E	S	A	O	S	T	I	K	E	Z	X	I	O

NC AND CNC MACHINE TOOLS

(Numerical Control - Computerized numerical control)

Introduction

Read the text that follows and answer the questions.

1. Which characteristics of NC machine tools have brought tremendous changes in the metal working industry?
2. When was NC first introduced?
3. What is NC?
4. What are the applications of NC and CNC?

During the last decades, NC and CNC machine tools have been widely accepted all over the world. Thanks to their accuracy, reliability, productivity and repeatability, they have brought such tremendous changes in the metal working industry that we can speak of a second industrial revolution.
NC was first introduced in the mid 50's as a means of guiding machine tools through various motions automatically, without human assistance.
Besides machine tools, NC and CNC are now used on welding machines and inspection systems and also in most manufacturing and assembly processes:

What do the bold-typed words or phrases mean? Tick the correct answer.

1. NC and CNC machine tools have been widely accepted thanks to their **productivity...**

   Their ability
   ☐ a) to produce precise parts
   ☐ b) to opeate automatically
   ☐ c) to produce a large number of parts in a short time

2. NC and CNC machine tools have been widely accepted thanks to their **repeatability...**

   Their ability
   ☐ a) to produce large numbers of identical parts (=similar parts at the same degree of accuracy)
   ☐ b) to receive a large number of instructions
   ☐ c) to display the dimensions of the machined parts on a screen

3. NC is now used to **inspection systems...**

   Systems
   ☐ a) speeding up
   ☐ b) programming
   ☐ c) supervising
   } the operation of the machine

4. NC is now used in **assembly processes...**
   a) processes of disconnecting parts
   b) procedures carried out to put parts together (e.g. of a machine)
   c) operations of checking the production

THE FUNCTION OF NC AND CNC

PRE-READING TASKS

1. Familiarize yourself with the questions below. Then, go through the paragraphs about NC and CNC machine tools that follow and find which paragraph includes the answer to each question. **In the space provided at the end of each question, write the number of the paragraph that includes the information asked.**

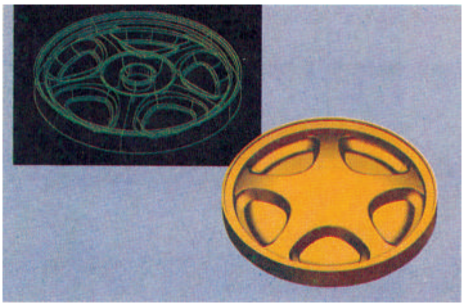
Questions

1. What is the function of the MCU in a CNC machine tool? _____
2. What potentials have the developments in the automatically controlled machines and the advances in computer technology opened to industry? _____
3. What is NC? _____
4. How are machine tools guided to find the cutting points? _____

2. **After you have matched paragraphs with questions, read the paragraphs carefully and answer the questions.**

1. ______________________________

Numerical control (NC) is the operation of a machine by a series of coded instructions that consist of numbers, letters of the alphabet and symbols listed in a logical order. The instructions refer to the specific dimensions, shapes and sizes of the products, the positions of the cutting points and also to the operations and motions which the machine will perform. In CNC, all this information is put into a program (the part program) through data processing in a computer which is either built in the Machine Control Unit (MCU) or it is connected to it. This program loaded into the CNC computer's memory makes the control unit «think». Any revisions of the program can be made at the machine and the changes can be stored for future use.



Drawing produced by CAD

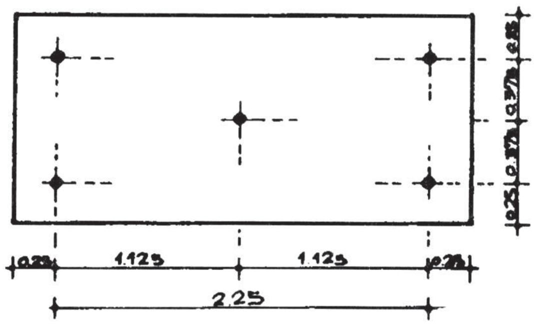
2. ______________________________

The MCU is the most important part in the total NC operation. Its function is to convert the coded instructions of the part program into a series of pulses of electric current which control the machine's motors and servomechanisms in order to produce the designed metal parts. Thanks to the development of computer technology, the MCUs have nowadays been developed from the bulky vacuum tube units of 1950's to flexible, easier programmed and operated units including a computer, a monitor and a keyboard.

Machine control unit (MCU)

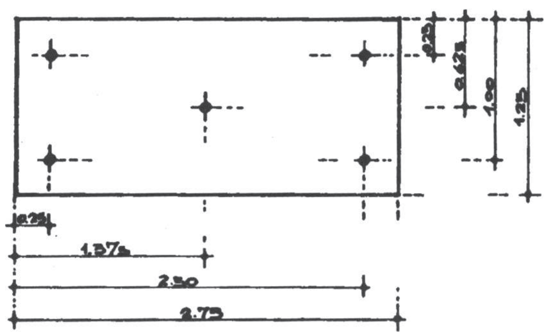
3. ______________________________

The dimensions and positions / locations of the cutting points on a workpiece are given to the NC machine tool in two systems: the Incremental and the Absolute.
In the incremental positioning system, dimensions or positions are given each time from the previous cutting point. The disadvantage of this system is that if an error is made in any location, it will be carried over to all the cutting locations after this point.



Incremental positioning system

In the absolute positioning system, all dimensions or positions are given from a zero reference point, as shown in the picture. The advantage of this system over the incremental is that if there is an error in a position, it will not be carried over to the next positions.



Absolute positioning system

4. ______________________________

The development of the automatically controlled machines (by numerical control) and the tremendous advances in computer technology have opened new potentials to industry. It is now possible to program and control the operations of a complete manufacturing plant by a computer communication network (CAM = Computer Assisted Manufacturing), thus making the automated and unattended factory a reality. This will further increase productivity and improve the quality of products resulting in the so-called second industrial revolution.

EXERCISES

1. **Give headings to the paragraphs of the text. Write them in the spaces provided over each paragraph.**

2. **Greek words in the English language**

Many English words have derived from the Greek language. Are there any in the above text? Find them.
e.g. *series = σειρά / ακολουθία*

....	....
....	....
....	....
....	....
....	....
....	....

3. **Find the terms or phrases used in the text to express the following:**

1st paragraph

a) A number of instructions arranged in a certain order. They are used to express information in a form that a computer can understand: ____________________

b) The places where the machine tool must cut the metal to construct the designed metal part: ____________________

c) The program which is created in a computer and gives the NC/CNC machine tool the necessary instructions that will control it to produce the designed metal part: ____________________

d) The activity of putting data into a computer and giving it the appropriate instructions that will enable it to solve problems, provide us with information, drawings, etc.: ____________________

e) A computer which is included in the MCU as part of it: ____________________

f) A system of instructions which is put / inserted in the part of the computer where information is stored: ____________________

g) Any revisions of the part program can be put in the computer's memory and kept there until they are needed: ____________________

2nd paragraph

Temporary icreases in the level of electric current: ____________________

3rd paragraph

a) Method of finding the exact point at which a cutting operation is to be performed by a machine tool on a metal part: ______________________

b) A mistake made at the positioning of a cutting point will continue to exist to all the cutting points that follow, which will all be at the wrong location: ______________________

c) A fixed location on a metal part from which we measure all the dimensions in order to find the cutting points (when using the absolute positioning system): ______________________

4th paragraph

a) Machine tools that operate controlled by a computer program, not by people: ______________________

b) The great progress made in computer technology has created new possibilities for industry to become more effective, productive and successful in the future: ______________________

c) A number of computers that are connected and operate together as a system: ______________________

d) The process of using computers in industry to control the operation of the machines that manufacture the products: ______________________

e) A large industrial plant which operates controlled by a system of computers. Because of that, only few workers are needed in the manufacturing process: ______________________

f) This will result in producing more products than before and of a better quality: ______________________

g) Such important changes/ advances have occured in industry, that the manufacturing processes have changed completely: ______________________

4. Answer the questions.

1. What does the part program consist of?
2. What sort of information is given to the NC/CNC machine by the coded instructions of the part program?
3. What makes the control unit of a CNC machine «think»?
4. Is it possible to revise the part program for future use?
5. What does the MCU of a CNC machine tool include?
6. What were the first machine control units like?
7. Which positioning system is better? Why?
8. What is the effect of the new technological developments on industry?

5. Match words with definitions.

1. unattended
2. bulky
3. improve
4. flexible
5. disadvantage
6. potential
7. increase
8. series

a) able to change easily and adapt to different conditions
b) a number of things or events that come one after the other
c) large and heavy, difficult to move or deal with
d) a characteristic that makes something less useful or successful than other things
e) to make something greater in number, level or amount
f) not being watched or looked after
g) the necessary abilities or qualities to become successful or useful in the future
h) to make something better

6. Make pairs of synonyms, by matching the words in column A with those in column B.

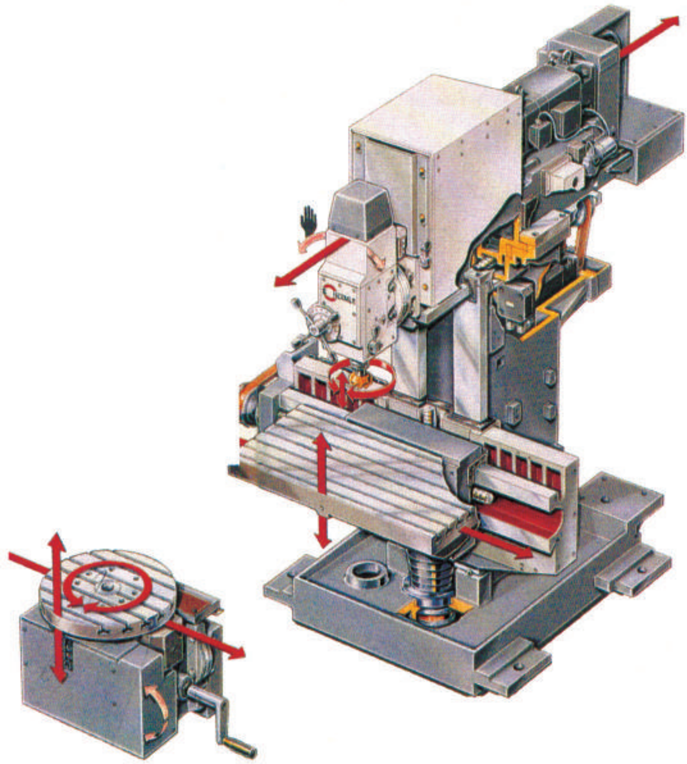
A	B
motion	progress
plant	data
information	change
total	movement
revision	possibility
error	whole
reality	mistake
advance	factory
potential	fact

7. Arrange the words below under the appropriate column.

productivity absolute motors reliability incremental servomechanisms repeatability accuracy controls flexibility machine control unit

Properties of NC /CNC machine tools	Parts of machine tools	Positioning systems

FEATURES OF NC/CNC MACHINES



Introduction

Do you know the answer to these questions? If not, read the text that follows and find out.

1. Why do NC/CNC machine tools represent a large investment for any industry?
2. What has made NC/CNC machines so widely accepted throughout the world?
3. Which feature makes these machines able to perform a great variety of machining operations in only one set up?

Industry always aims at producing better products at lower prices in order to gain a bigger share of the market. As a result NC/CNC machine tools, which help improve productivity and reduce manufacturing costs, represent a large investment for any industry.

Among the various types of these machines, the most flexible are the turning and machining centres. Thanks to their accuracy and their ability to use up to six axes of motion, they can perform a great variety of machining operations on all sides of a workpiece in only one set up. In this way, they drastically eliminate scrap and can produce complex cuts, which are impossible on any conventional machine.

Deducing the meaning of unknown words.

When reading a text in a foreign language, you very often have a lot of unknown words. Nevertheless, you can understand what the text is about and you are able to get not only general, but also specific information. You can also deduce the meaning of some of the unknown words you have come across in it. Try it.

Go through the text to identify the words or phrases defined below.

1. ______________ : to have the plan or intention; to want and try to do something
2. ____________________________ : to attract more customers, sell more products and thus make a bigger profit
3. ______________ : money spent on buying equipment which is considered useful and profitable as it can increase productivity and improve the quality of products
4. ________________ : the loading and fastening of a workpiece on a machine tool
5. _________________ : to make something as little as possible; to reduce it to the smallest possible amount; to minimize it
6. _____________ : useless pieces of metal which remain after the machining of a workpiece; chip; waste

The Most Important Features of CNC Machines

The text which follows includes useful information about some of the most important features which have made NC/CNC machine tools so widely accepted throughout the world. These features are related to the following:

1. Tooling systems
2. Workholding devices
3. Chip removal
4. Machine operation monitoring systems
5. Loading and unloading of workpieces

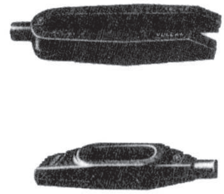
What do you think they refer to? Match them with the explanations below.

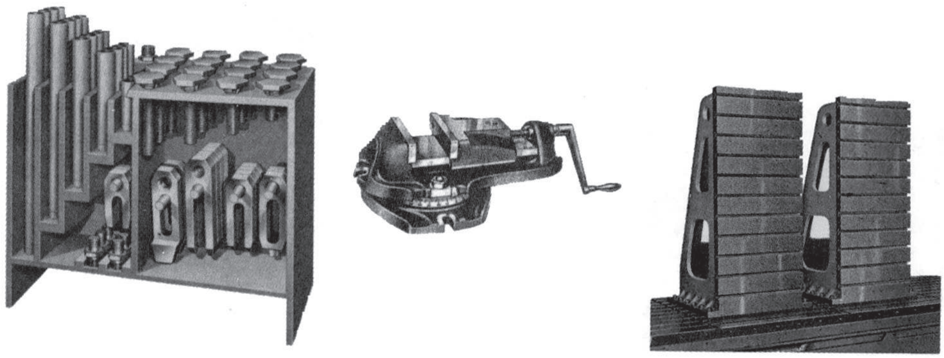
a. Devices and mechanisms used to put the metal pieces to be machined at their appropriate place on the table of the machine tool and hold them there securely during machining operations
b. Devices used to load workpieces on the machine and remove the finished parts from it
c. Systems and devices used to remove a tool from the machine and insert a new one for the next machining operation
d. Devices used to remove scrap (= the pieces of metal that are cut off when machining the workpieces) from the machine.
e. Systems that check the operation of the machine or/and the produced parts

Read the text, check your answers to the previous task and give titles to the thematic areas the text is divided into. Write the titles in the spaces provided.

1.____________________________________

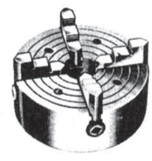
The expensive jigs and fixtures used on the conventional machine tools have been replaced by new simpler and more versatile ones, which reduce both the storage space required and the cost necessary for their design and manufacture. They can locate workpieces more accurately and hold them more securely eliminating chatter.





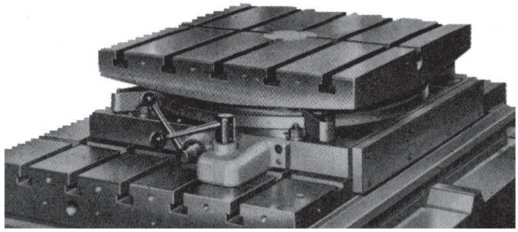
Jigs and fixtures used to hold workpieces

There is also a great variety of new chuck types which have higher gripping forces, are very accurate and can easily handle the wide range of shapes and sizes of the workpieces machined on turning centres.

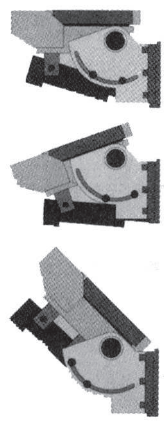


Chuck

The design of all these new workholding devices also makes the loading and unloading of workpieces on the machine table easier and more rapid.



Machine table



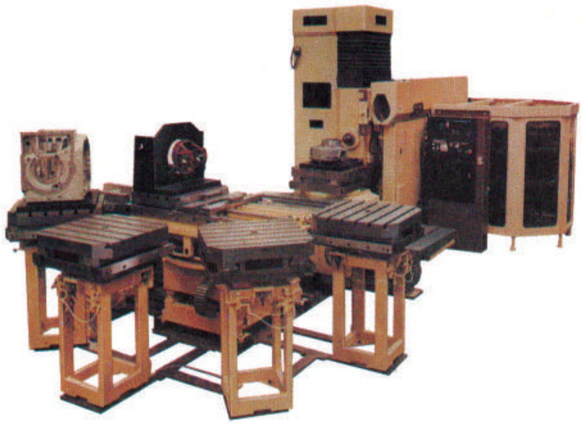
Swivelling rotary table

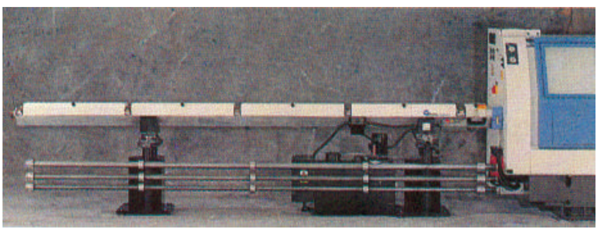
2. ______________________

It is very important to reduce the time spent on changing workpieces on the machine. Large pieces are usually fastened on pallets and placed on special storage devices near the machine. The pallet with the machined part is automatically unloaded from the table and another pallet from the storage device is loaded very quickly. For smaller pieces, robot loaders are used.

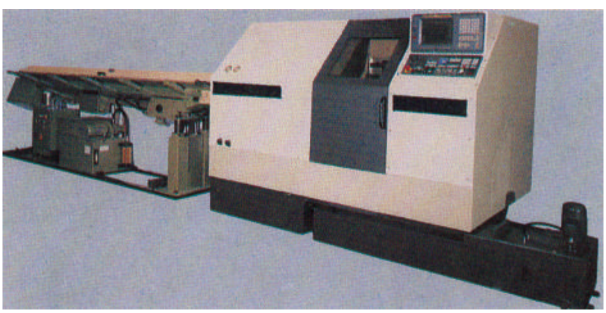
There is also a number of options, specially designed for turning and chucking centres, such as bar feeders, part loaders/unloaders and parts catchers.

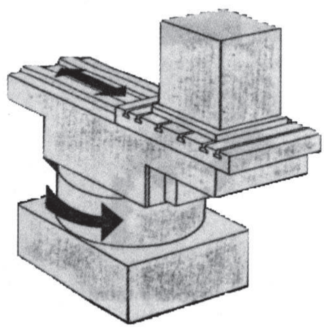
Pallet changing system





Bar feeder



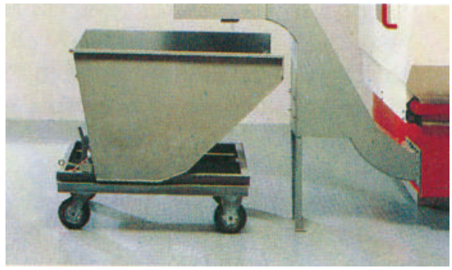


Parts catcher

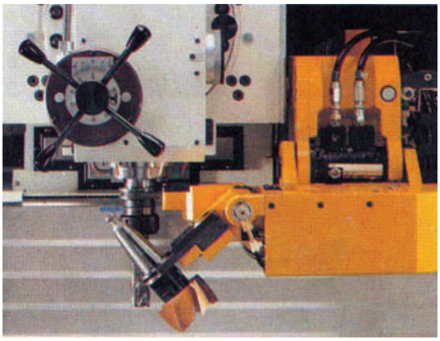
Pallet changer

3. ______________________________

Another optional device used to reduce the non-machining time is the chip conveyor. It removes the chips from the machine and places them into containers for storage and recycling.



Chip I swarf conveyor

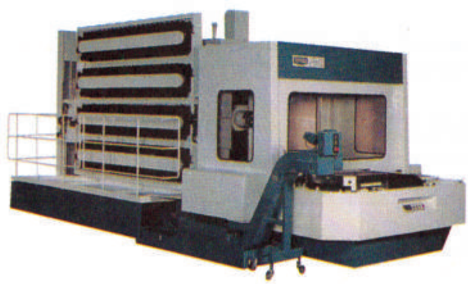


Tool changer

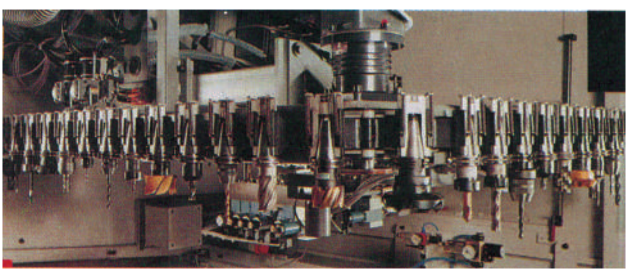
4. ______________________________

To save time and increase productivity, it is important to insert the variety of cutting tools into the machine spindle quickly and accurately. To achieve this, all the tools to be needed during a shift's work are placed into specific pocket locations in the machine's tool-storage magazine.

Tool-storage magazines are special devices, such as the chain coneyors or the revolving turrets, which are located on or near the machine. These devices can store up to 120 tools. The automatic tool changers or robots, which most modern machines are equipped with, remove the previous tool, select a new one from the machine tool-storage magazine and insert it into the spindle in less than 6 seconds.

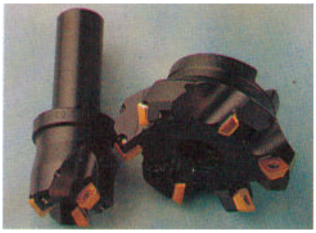


Tool-storage magazine

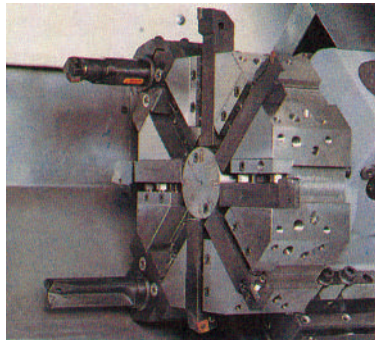


Tool-storage magazine in the form of chain conveyor

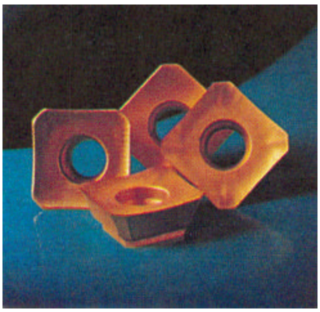
Turning centres are usually equipped with two multi-tool revolving turrets which can take up to 16, or even 18, tools each, thus making the tool changing process very quick. The two turrets operate independently and can machine the same workpiece simultaneously on both diameters or sides.



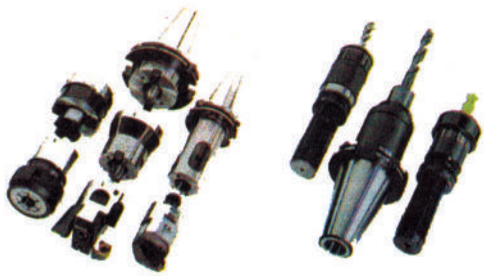
Cutting heads with inserts



A revolving turret



Inserts, the modern CNC cutting tools



Special toolholders used to insert the cutting tool into the machine spindle

5. ______________________________

Most modern NC/CNC machine tools also have:

a) A tool monitoring system which can detect and inform the operator when a cutting tool is worn or broken and needs replacing. In some cases, the system automatically reduces the speed or feed* to compensate for the dullness of the cutting tool.

b) An in-progress gauging system which helps monitor what is happening to both workpieces and tools during machining operations. Besides detecting worn or broken tools, it can compensate for tool wear or thermal growth and control the flow of coolant. It also makes possible the inspection of machined parts while they are still in the machine, between machining operations.

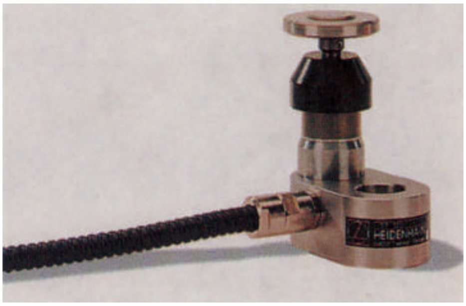
---

*1. Speed: the number of revolutions that the spindle of a machine tool makes in one minute of operation.

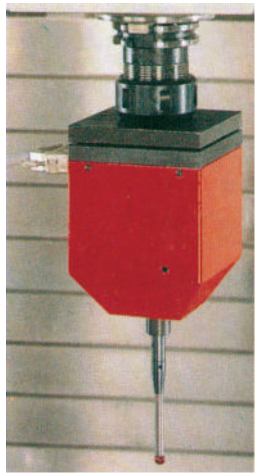
2. Feed: the amount that a cutting tool advances into the workpiece. It controls the amount and rate at which a metal is removed from a workpiece.

Both systems provide better tool and machine protection, help reduce operator errors and inspection time, and improve machine productivity and performance.

Thanks to all the above innovations NC/CNC machine tools demand less attention from the operator, so that only one operator can attend to more than one machines. In this way, manufacturing costs are further reduced, while at the same time, productivity is greatly increased.



Touch probe used to check tools for wear and breakage



Probe stylus used to inspect workpieces between two machining operations

EXERCISES

1. Deducing the meaning of unknown words.

A. Find the English equivalent to the following Greek terms.

1st thematic area

1. (ιδιο)συσκευές για πρόσδεση των προς κατεργασία κομματιών στις εργαλειομηχανές ψηφιακού ελέγχου: ____________________
2. κομμάτια για κατεργασία: ____________________
3. τζόγος, λάσκο, παίξιμο: ____________________
4. σφιγκτήρας, τσοκ (τόρνου, δράπανου): ____________________
5. μεγάλη ποικιλία/ευρεία γκάμα: ____________________
6. συσκευές πρόσδεσης αντικειμένων για κατεργασία: ____________________
7. τράπεζα εργαλειομηχανής: ____________________

2nd thematic area

1. συσκευή όπου στερεώνονται τα προς κατεργασία αντικείμενα που τοποθετούνται στην τράπεζα της εργαλειομηχανής και απομακρύνονται απ' αυτήν με αυτόματο μηχανισμό / παλέτα: ______________________
2. απομάκρυνση κατεργασμένου κομματιού από την εργαλειομηχανή: ______________________
3. φόρτωση κομματιού για επεξεργασία σε εργαλειομηχανή: ______________

3rd thematic area

1. νεκρός χρόνος: ______________________
2. συσκευή απομάκρυνσης και μεταφοράς απόβλητου /γρεζιών: ____________
3. ανακύκλωση: ______________________

4th thematic area

1. κοπτικά εργαλεία: ______________________
2. βάρδια: ______________________
3. μηχανισμός/συσκευή τοποθέτησης εργαλείων / εργαλειοφορείο CNC εργαλειομηχανής: ______________________
4. περιστρεφόμενο, κυκλικού σχήματος εργαλειοφορείο/ρεβόλβερ/μύλος/τουρέλα: ______________________
5. μηχανισμός ή εξάρτημα εναλλαγής εργαλείων: ______________________

5th thematic area

1. σύστημα ελέγχου εργαλείων: ______________________
2. φθαρμένο, αμβλυμένο εργαλείο: ______________________
3. αντισταθμίζω: ______________________
4. σύστημα ελέγχου εργαλείων και κομματιών στη διάρκεια της κατεργασίας: ____
5. ανάπτυξη θερμότητας: ______________________
6. ψυκτική ουσία / ψυκτικό (υγρό): ______________________
7. κόστος κατασκευής: ______________________

B. Look through the text to find the words or phrases defined below.

1st thematic area

1. to put something in a particular place: ______________________
2. to reduce something to the lowest possible level: ______________________
3. power or forces exercised on an object to hold it tightly: ___________________
4. to have the ability to deal with something successfully: ___________________

2nd thematic area

1. to make less: ______________________
2. finished part: ______________________
3. a number of items one can choose from: ______________________

3rd thematic area

1. to take something away from a place: ______________________
2. large boxes used for storing or transporting things: __________________

4th thematic area

1. to succeed in doing something: ______________________
2. at the same time: ______________________

5th thematic area

1. happening while the machine is in operation / during machining operations: ______________________
2. to regularly check a process: ______________________
3. the process of looking carefully at every part of an object to check that it is all right: ______________________
4. new things or methods of doing something: ______________________
5. to give care to / deal with something: ______________________

2. Identify the workholding device described.

Devices

1. Parts catcher
2. Parts loader/unloader
3. Robot loader
4. Bar feeder

a) It places individual workpieces into the machine and removes the finished parts from it.

b) It is capable of handling long bars, thus eliminating the loading of individual parts.

c) It catches the finished parts and removes them from the machine.

d) It communicates with the MCU and is capable of doing a variety of different operations, such as loading/un-loading parts, removing workpieces from pallets conveying parts to gauging stations or storage places, changing chuck jaws, etc.

3. Classify the devices or systems used in CNC machines in categories as follows:

a) Workholding devices: ....

b) Workpieces loaders / unloaders: ....
....

c) Chip removing devices: ....

d) Tool-storage devices: ....
....
e) Tool-changing devices: ....
f) Monitoring systems: ....

4. Are the sentences below true or false?

1. Machining centres can operate on up to 6 axes of motion, so they can perform complex operations on a workpiece in only one setup.
2. The new jigs and fixtures are more complicated and demand more storage space.
3. The design of the new workholding devices reduces loading and unloading time.
4. Robots can load workpieces and change tools and chuck jaws, and they can also perform some machining operations.
5. To remove a tool and insert a new one in the spindle, a tool changer needs no more than 4 seconds.
6. A large tool-storage magazine can take up to 120 tools, while a revolving turret up to 18.
7. The two independently operating turrets of a turning centre can machine the inside and outside surface of a workpiece simultaneously.
8. Part catchers belong to the tool-changing devices.
9. Tool-monitoring systems can control the flow of coolant and inspect the cutting tools and machined parts in the machine.
10. More than one CNC machine tools can be attended to by only one operator.

5. Write the features of NC/CNC machine tools which:

a) increase machine utilisation time: ....
....
....
....
....
....
....
....
....
....
b) reduce storage-space requirements: ....
....
c) provide better tool and machine protection: ....
....
....

d) increase the accuracy of the machined parts: **e.g.** *the use of computers to produce the part program,* ....
....
....
....

e) reduce production costs:..
....
....
....
....

6. Answer the questions.

1. What are the advantages of the CNC workholding devices?
2. How is the loading and unloading of large workpieces achieved?
3. What is usually used to load/unload small-size workpieces?
4. Do the new tool-storage and tool-changing devices save time and increase productivity? Why?
5. Which is the most common tool-storage device used in turning and chucking centres?
6. What must be done to compensate for the dullness of a cutting tool?
7. Why do in-progress gauging systems reduce inspection time?
8. Why does the demand for reduced operator attendance decrease production costs?

7. Write the comparative degree of the adjectives or adverbs in parentheses to state the advantages of CNC machine tools over the conventional ones.

1. Cutting tools can be replaced (quickly) ____________________ .
2. Even small parts can be produced (good, rapidly and economically) ______________, ____________________ and ____________________ .
3. Tooling and inspection costs are (low) ____________________ .
4. Tool monitoring systems guarantee (long) ________________ tool life.
5. In CNC machine tools, (much) ______________ time is spent on machining the part and (little) ______________ on loading and unloading workpieces, changing tools and making trial cuts.
6. Complex forms can be machined (easily and accurately) ________________ and ____________________ .
7. CNC machine tools are (flexible, versatile) ________________ and__________ than the conventional ones.
8. Because of the simplicity of the new workholding devices (few) __________ jigs, fixtures or chucks are required.

9. CNC machine tools guarantee (high) ________________ production rates.
10. A metal parts producing industry which uses CNC machine tools efficiently can gain a (big) ____________________________ share of the market.

8. Odd-one out

1. revolve rotate turn recycle	2. additional flexible versatile adjustable	3. reduce eliminate increase minimize
4. monitor identify inspect check	5. proceed achieve fulfill succeed	6. option collection choice preference

9. Make pairs of:

A. Synonyms

require	supply
aim	dull
rapid	complicated
reduce	power
eliminate	costly
complex	demand
characteristic	intend
expensive	place
equip	minimize
locate	decrease
force	feature
worn	quick

B. Antonyms

easy	slow
rapid	different
conventional	complicated
reduce	modern
simple	place
remove	sharp
same	increase
dull	difficult

10. EXPRESSING CAUSE / REASON → RESULT / CONSEQUENCE

Join the sentences to express cause / reason → result / consequence. Use the appropriate expressions and make any necessary changes. The table in the «FUNCTIONS» section at the end of your book will help you.

1. More operations can be performed on a workpiece in only one setup.
   CNC machine tools have greatly increased production rates.
2. Machining centres can use up to 6 axes of motion.
   They can produce more complex forms.
3. CNC machine tools can automatically select speed and feed.
   They guarantee longer life of the cutting tools.
4. NC machines are characterized by accuracy and flexibility.

They reduce the amount of scrap.
5. CNC machines use chip conveyors.
   They don't have to stop operating to remove chips.
6. The two turrets can machine a part simultaneously.
   Production time is greatly reduced.
7. The new tool-changing devices can change a tool in less than 6 sec.
   Non-productive time has been drastically decreased.
8. The new jigs and fixtures hold the workpieces more securely.
   The quality of the produced parts has been improved.
9. CNC machine tools operate automatically.
   Fewer operators are needed to attend their performance.
10. The new chucks provide higher gripping forces and accuracy. Turning centres can meet the demand for heavier metal removal rates and higher spindle speeds.

Listening Activity

STEP 1

You are going to listen to an extract from a lecture given during a seminar on CNC machine tools. **Listen to the first part of it and say what exactly the lecture was about.**

STEP 2

The headings below present the main ideas of the thematic areas of the lecture. **Familiarize yourself with them and, while listening to the rest of the lecture, number the headings in the order you hear the thematic areas they correspond to.**

Headings

_____ Improved accuracy and repeatability
_____ Increased productivity
_____ Fewer errors, less attendance
_____ Increased operator's safety
_____ Fewer and less costly workholding devices
_____ Complex forms production
_____ Scrap reduction
_____ Longer life of the machine

Writing Activity — Letter of application

John Panou, a 26-year-old machine tool operator, has recently left his job because he plans to go to England to study and work there. Some days ago, he saw an advertisement in the newspaper «The Independent» about a post that seemed to meet his demands; so, he decided to write a letter to the company expressing interest in the post.

Imagine that you are John and write the letter by making the necessary changes and additions to the following sets of words and phrases. (Form the verbs in the appropriate tense, add pronouns, prepositions, articles, etc).

28 Pendelis St.
Lamia 260 72
Greece

The Personnel Manager
Blacksmith's Machine Shop
256 Queen's Street
Brighton
England

22nd April 2000

Dear sir,

I see advertisement / «The Independent» 18th April / CNC machine tool operator / your machine shop Brighton.
I write letter / because be interested above post / and think have right qualifications.
I be 26 years old, / not married.
I receive Certificate Greek Technical and Vocational School / where I specialized operating machine tools, / 8 years ago.
When discharged army, / I attend one-year training course / programming and operating CNC machine tools. After that, I work / CNC machine shop Athens / for five years.
I speak English fluently. / I get FCE 3 years ago / and as supervisor / my last job be English, / I have a lot practice / language.
Reason I leave previous job / be want work England / improve knowledge language / and extend experience / programming and operating CNC machine tools. / I also think / attending University there.
Mr. Robertson, / supervisor last job, / kindly agree / provide me letters of recommendation, / photocopy of which I enclose.
Next week I be England / and stay there a month. / So I hope you could arrange interview / which I have opportunity / give any further information you may wish.
Hoping you consider application favourably, / I look forward / hearing you soon.

Yours faithfully,
Signature

John Panou
Machine tool operator

SAFETY AT WORK

SAFETY AT WORK

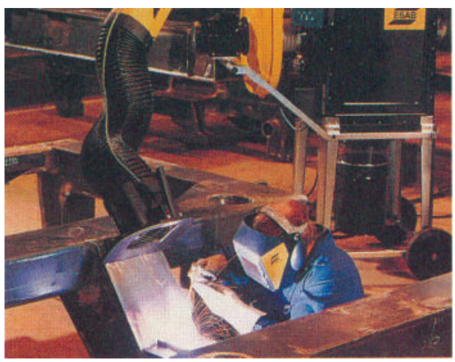
PRE-QUESTIONS

- Which is the main cause of most accidents in the metal working field?
- How can these accidents be prevented?

Read the text which follows and find out.

Working with metal, either with hand or with machine tools is, sometimes, dangerous. Many fatal accidents occur because of ignorance; others are due to carelessness. Records show that most minor accidents are caused by incorrect use of hand tools, or tools which haven't been kept in good condition. Thus, bear always in mind that safe practices and proper methods are **for you** and not just «for the other fellows». And never forget that to prevent accidents and secure the health, safety and welfare of all persons at work, safety precautions should always be respected. So:

- Don't be engaged in any work activity, unless you have the technical knowledge and expertise to carry it out.
- Always keep the work space clean and orderly, so as to provide a safe place for work.
- Use tools correctly; do not use them if they are not in a proper condition.
- Always dress properly for the job to be done.



Proper dressing for the job to be done (overall, fire-proof gloves, face shield and shop cup)

Are you aware of the risks you run, so as to avoid injuries or fatal accidents at work? **Check it. Tick the correct statements in the table below.**

	STATEMENTS	
1.	Sharp tools must always be carried with their points or sharp edges pointing down.	
2.	Long hair can be caught in moving machinery, so it should be tied or covered.	
3.	It is possible to use hand bits (sockets, drills, screwdrivers) to a power tool on condition that they are locked properly before turning the power on.	
4.	It is not necessary to wear eye protection when drilling, grinding, buffing or hammering.	
5.	One had better wear hand protection when there is a danger of flying chips.	
6.	Safety goggles, and an overall is sufficient protection when electric brazing or welding.	
7.	Portable electric hand tools must always be grounded and plugs should never be removed by pulling on the cord.	
8.	Sleeves should be rolled above elbows when working on a machine tool, the rolls, a bar folder, the squaring shears or other moving machinery.	
9.	If one is extremely careful, he doesn’t have to remove his watch and other jewellery when working with moving machinery.	
10.	Standing on a wet spot when using electric powered tools should be avoided.	
11.	The only safe way to light the torch, when joining metals using gas as a heat source, is to use the spark lighter.	
12.	It’s not so dangerous to inhale cadmium fumes if the workspace is well ventilated.	

Read the “Safety Precautions” on the next page, check your answers above and correct the wrong statements.

....

....

....

....

....

....

....

SAFETY PRECAUTIONS

Head / face shields

Mask

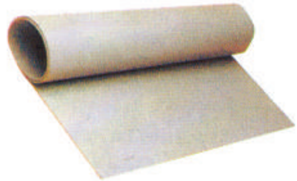
Safety glasses

1. When working with moving machinery:
   - Tie long hair or wear a shop cap.
   - Always remove your watch, rings and other pieces of jewellery.
   - Roll your sleeves up and fasten all buttons.
   - Remove coats, sweaters and jackets.

   Otherwise, they may be caught in the machine causing serious accidents.
2. Wear special protective clothes (overall or apron) when working with machine tools or in the foundry, and when forging, brazing or welding.
3. Wear safety glasses or goggles when gas brazing or welding, or when there is a danger of flying chips.
4. Always wear a face shield during electric brazing or welding. The arc can burn your eyes severely.
5. Wear hand protection (special gloves) when hammering or welding and when using grinders or impact wrenches.
6. Wear breathing protection (mask) as a precautionary measure against fine dust from dry sanding when gas brazing or welding and also when working in the foundry.
7. Prefer cadmium-free brazing fillers. Cadmium fumes are very poisonous. Never inhale them.
8. Always use the spark lighter to light the torch when gas soldering, brazing or welding. Never use a match.
9. Never use oxygen when testing for leaks. Use a non-flammable gas*.
10. Keep the blades closed when cutters or snips are not being used.
11. Never carry sharp or pointed tools in your pocket.
12. Always carry tools with their points or sharp edges pointing down or wrapped.

* Any oil in contact with oxygen under pressure may form an explosive mixture.

13. Before using a power tool, check the cord, connections, plug and switch to be sure they are in good condition.
14. Use only suitable bits to your power tools and lock them properly before turning the power on.
15. Always ground portable electric hand tools.
16. When working with electrically powered tools:
    - Don't stand on a wet spot.
    - Don't touch plumbing or other grounded objects.
    - Be sure your hands are dry.



Plastic mat

Goggles

Gloves

Helmet

EXERCISES

1. Classify the safety precautions according to what they refer to.

a. Hand tools: **e.g.** *Instruction numbers: 10,*

b. Proper appearance in the machine shop:

c. Power tools:

d. Protective clothing and accessories:

e. Joining metals with a heat source:

2. Classify the instructions according to what their omission may result in.

Fatal accident	Serious injury	Minor accident
e.g. *10*	*10*	

3. **Make meaningful sentences by joining their parts.**

A

1. A non-flammable gas should be used
2. When using electric hand tools, you risk being electrocuted
3. Your feet may be injured
4. Loose clothing may be caught in moving machinery,
5. You risk cuts and scratches
6. To carry pointed or sharp tools safely,
7. To protect your clothing,
8. Falls may occur
9. It is advisable
10. You shouldn't be engaged in any work activity

B

a. you'd better wrap their points, blades and cutting edges, first.
b. so fasten all your buttons.
c. always wear overalls or aprons when working with metal.
d. if your hands are wet.
e. to wear a mask when gas brazing or welding.
f. if you wear lightweight shoes in the workshop.
g. if you don't have the necessary knowledge or expertise to carry it out.
h. when you carry sharp tools in your pockets.
i. if there is oil or grease on the floor of the machine shop.
j. when testing for leaks.

4. **Say during which work activities you run the risk of:**

a. an injury in the eyes: **e.g.** *while hammering*
b. scratches and cuts:
c. being electrocuted:
d. being caught in moving machinery:
e. sustaining a burn:

5. **Classify the safety equipment used by metal workers under the following categories:**

a. head (long hair, eye and face) protection:
b. hand protection:
c. breathing protection:
d. clothing protection:

6. **Match the following with words or phrases:**

A. In the introductory paragraph

1. to take place; happen: ______________
2. lack of knowledge: ______________
3. written account of facts, events, etc: ______________
4. less important: ______________
5. right; correct; suitable: ______________
6. to ensure; to make certain / safe / reliable: ______________

7. condition of having good health, comfortable living and working conditions: _______________
8. to take part; undertake; get involved into: _______________
9. expert knowledge and skill: _______________
10. tidy; well arranged; in good order: _______________

B. In the «Safety precautions»

1. protective device for the head or face: _______________
2. to put round, cover, fold as a covering for protection: _______________
3. to breath in; to take something, e.g. air, into your lungs: _______________
4. material or substance that catches fire and burns easily: _______________
5. a risk; something that can be dangerous; the possibility of an accident or other undesirable results: _______________
6. sudden, violent burst of energy (e.g. caused by a bomb or burning gases), which is usually accompanied by a very loud noise: _______________
7. to connect an electric apparatus, tool, etc, with the ground (to earth it) as a safety precaution against electric shock: _______________
8. the pipes, water tanks, etc. in a building: _______________

7. Drawing information from the «Safety Precautions» make sentences beginning with:
- It is a safe practice to...
- It isn't safe to...
- It is dangerous to...

Examples

It's a safe practice to remove your watch when working with moving machinery.
It isn't safe to stand in a wet spot while using electric powered tools.
It is dangerous to carry sharp tools in your pocket.

8. Fill in the gaps with the suitable preposition. Choose from the list.

in	on	with	up	to	of	into	from	as

1. For many years SHAFF has supplied its customers ____________ drafting media of excellent quality.
2. Hundreds of workers have been engaged ____________ the construction of the new highway.
3. Most metals are extracted ____________ earth ____________ an ore. They are classified ____________ two major categories: the ferrous and the non-ferrous metals.
4. Drawing instruments were still made ____________ wood thirty years ago.

5. It's the best lathe ____________ the market.
6. I'm interested ____________ buying a new electronic plotter.
7. Gold is an extremely durable metal, that is, it is resistant ____________ corrosion.
8. Depending ____________ the amount of carbon added ____________ iron, steel is classed ____________ high-, medium- and low-carbon steel.
9. Drafting heads speed ____________ drafting time.
10. He has recently equipped his workshop ____________ a new gas welding equipment.

EXPRESSING OBLIGATION / NECESSITY

Complete the sentences with the suitable verb (must, should, have to...), to express the kind of obligation required. Justify your choice.
(See the appropriate table in the «Language Functions» section in the APPENDIX)

1. All technicians ____________ be informed about the new products on the market and their specifications.
2. A technician ____________ always practise safe working procedures.
3. «On hearing the fire alarm, all personnel ____________ leave the building immediately», said the fire brigade officer.
4. «For your safety, you ____________ always ground portable electric tools», is written in the instructions manual.
5. Technicians ____________ be willing to do a fair share of manual work.
6. You ____________ see that film; it's fantastic.
7. A technician ____________ be sociable, cooperative, honest and sincere.
8. «I'm glad I don't ____________ work today», said my father.
9. «You ____________ wear an overall in the workshop to protect your clothing», suggested the supervisor.
10. Most technicians ____________ be strong enough to work under conditions that require muscular action.
11. «We ____________ hurry, or we miss the train», his friend warned.
12. «As there is water on the floor, we ____________ wear rubber shoes if we are to use ungrounded power tools», said John.
13. «You ____________ n't smoke near the petrol pump. It's very dangerous», said the man.
14. «If we want to increase our productivity, we ____________ buy new machinery», my partner insisted.

Listening Activity

You are going to listen to the description of three serious accidents as they were announced on the local TV news.

Familiarize yourself with the first three columns of the table below. Listen to the announcement and write the number of the corresponding accident in the space provided on the left of each piece of information. Then, listen to the announcement again and do the same with the other two columns.

I. For Heating, Refrigeration, Air - conditioning systems Technicians and Plumbers.

<table>
<tr><th colspan="3">Person's who had the accident:</th></tr>
<tr><th>Name</th><th>Occupation</th><th></th></tr>
<tr><td>—— David Taylor
—— John Peterson
—— Andrew Smith</td><td>—— Refrigeration systems technician
—— Ventilating systems technician
—— Heating systems technician</td><td>—— Electric shock
—— Fracture at thigh bone
—— Burn in the eye</td></tr>
</table>

<table>
<tr><th>Activity at the time of the accident</th><th>Indications of the accident's cause</th></tr>
<tr><td>—— was arc welding a steel construction in a store house.
—— was drilling to replace a leaking pipe of a heating system.
—— was repairing a faulty ventilation system in a garage.</td><td>—— Grease was found on the floor.
—— His face shield was found on a shelf.
—— He was found dead on the wet floor holding the electric drill.</td></tr>
</table>

II. For Welders and the rest of the specialities.

<table>
<tr><th colspan="3">Person's who had the accident:</th></tr>
<tr><th>Name</th><th>Occupation</th><th>Accident</th></tr>
<tr><td>—— David Taylor
—— John Peterson
—— Andrew Smith</td><td>—— Trainee welder
—— Machine-tool operator
—— Metal worker</td><td>—— Electric shock
—— Hand caught in lathe
—— Burn in the eye</td></tr>
</table>

<table>
<tr><th>Activity at the time of the accident</th><th>Indications of the accident's cause</th></tr>
<tr><td>—— was arc welding a steel construction in a store house.
—— was drilling to replace a leaking pipe of the heating system.
—— was making bolts in a lathe.</td><td>—— Pieces of his sleeve were found in the lathe.
—— His face shield was found on a shelf.
—— He was found dead on the wet floor holding the electric drill.</td></tr>
</table>

FOLLOW UP

In the boxes below, you will find the causes of the three accidents.

1. Match causes with accidents.

A	After investigation, it was found that the electric drill he used was not grounded. **__ accident**	**C (I)***	He hadn't cleaned the grease from the floor. **__ accident**
B	He wasn't wearing face protection. **__ accident**	**C (II)****	He hadn't rolled his sleeves up. **__ accident**

2. All three accidents occured due to carelessness on the part of the person who had the accident. **Say what the serious error of the three persons was. Use the following patterns:**

- Mr …….. had an accident because he (*S. Past / S. Present Perfect*)…………………………………………
- Since Mr …….. was (*Past Progressive*)………………………, he should / shouldn't have + p.p.
- The accident wouldn't have happened if Mr …….. had / hadn't + p.p.

3rd CONDITIONAL

(See the «Grammar» section in the APPENDIX)

If + Past Perfect → would / could / might → have + p.p.

1. The sentences below belong to the 3rd type of conditional sentences. **Write the correct form of the verbs in parentheses.**

1. If he (be) ______________ more careful, he (not have) __________________________ an electric shock.
2. If they (follow) ________________ the instructions, the accident (not happen) ____ .

---

* For the Heating, Refrigeration, Air-Conditioning Technicians and Plumbers.
** For Welders and the rest of the specialities.

3. If you (read) ______________ the specifications, you (buy) ______________ some other model to meet your requirements.
4. If he (not carry) ________________ the tin snips in his pocket, he (not cut) __________________________ his hand.
5. If you (surface harden) ______________ the chisel, it (not break) ___________ __________________________ .
6. If you (equip) ______________________ your business with CNC machine tools, you (increase) ________________________ your productivity.
7. If they (make) ____________ the construction of aluminium, it (be) __________________ more durable.
8. If the operators (not make) _______________ so many mistakes, the accident (not occur) ________________________________ .
9. Is she (come) ____________ on time, we (not miss) ________________________ the train.
10. If I (not drink) _______________________ so much wine last night, I (not have) ____________________________ this awful headache.

2. **Make 3rd conditional sentences out of the following situations.**

e.g. *He didn't clean the grease from the floor. He slipped and broke his leg.*
- *If he had cleaned the grease from the floor, he wouldn't have slipped and broken his leg.*

1. He didn't replace the cracked handle of the hammer. It broke causing a serious accident.

   ....

   ....

2. They didn't start new factories. Many people were unemployed at my parents' time.

   ....

   ....

3. I didn't know she was coming. I didn't meet her at the airport.

   ....

   ....

4. He didn't have enough money then. He didn't buy the model he liked so much.

   ....

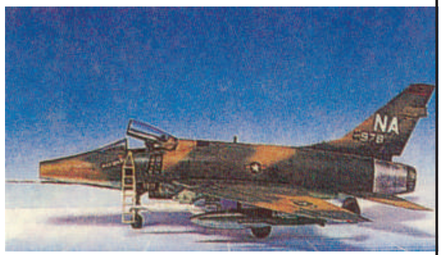
   ....

5. We didn't notice the road sign. We took the wrong direction.

   ....

   ....

HEAT ENGINES



Introduction

Are the following sentences true (T) or false (F)?

1. Heat engines use mechanical energy to produce heat.______
2. Transport and our industrial development are based on heat engines.______
3. There are two main categories of heat engines: the internal combustion engines and the external combustion engines.______
4. In an internal combustion engine, combustion takes place inside the engine (internally).______
5. The most widely used heat engines are the external combustion ones.______
6. Nowadays, internal combustion engines have gradually been replaced by external combustion engines and are mostly used in power plants to produce electricity.______

Read the short text that follows and check your answers.

HEAT ENGINES

Heat engines use the energy of heat to produce mechanical energy. They are used almost everywhere: to spin the wheels of industry, to move cars, ships, trains, aeroplanes... Our industrial development is based on them. Our everyday life without them would be hardly imaginable.

Heat engines are distinguished into two main categories: the external combustion engines and the internal combustion engines. In an external combustion engine, combustion takes place outside the engine (extrernally). In an internal combustion engine, on the other hand, combustion takes place inside the engine (internally).

Until the 50's, external combustion engines were widely used in factories, trains and ships, but since then they have gradually been replaced by diesel engines. Now a days they are mostly used in power plants to produce electricity.

EXERCISES

Which words in the text can be replaced by the ones below?

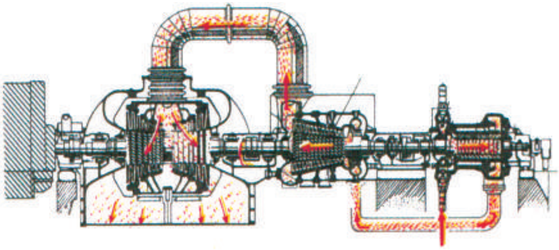
to create	____________	classified	____________
to rotate	____________	occurs; happens	____________
aircraft	____________	progressively	____________
progress	____________	to generate	____________

Make pairs of antonyms out of the two groups below.

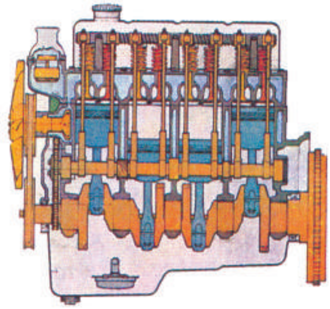
A. heat, nowhere, without, easily, internal, outside, gradually

B. external, everywhere, hardly, cold, inside, suddenly, with

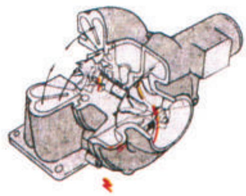
Below are illustrated some of the most widely used heat engines. Say the equivalent Greek term for each one of them.



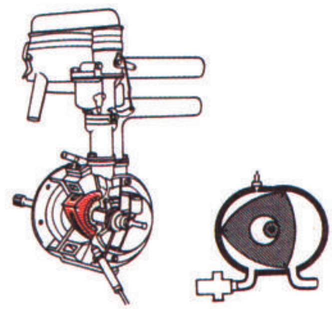
EXTERNAL COMBUSTION STEAM TURBINE ENGINE



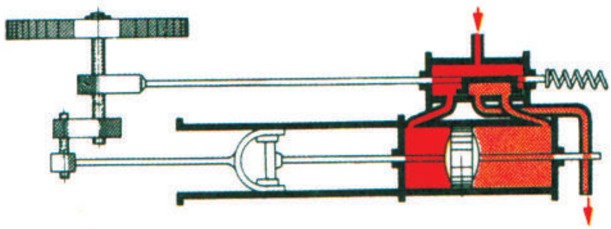
INTERNAL COMBUSTION RECIPROCATING ENGINE



INTERNAL COMBUSTION TURBINE ENGINE



INTERNAL COMBUSTION ROTARY ENGINE (WANKEL)



EXTERNAL COMBUSTION RECIPROCATING STEAM ENGINE

Do you know this?

- Experiments with internal combustion started in the 17th century. The first fuel that the various inventors tried was gunpowder.
- Today's internal combustion engine was made possible the second half of the 19th century thanks to the development of petroleum products.
- The first marketable ICE was made by a German inventor, Nikolaus August Otto.
- The Otto engine was adapted so that it could be used for moving vehicles by another German, Gottlieb Daimler.
- Automobiles appeared first in Europe, and then in the USA, by 1900.
- The diesel engine was named so for its German inventor, Rudolf Diesel.
- The first aeroplanes had a radial engine and used gasoline as fuel.

INTERNAL COMBUSTION ENGINES (I.C.E.)

According to the type of fuel used, I.C.E. are distinguished into:
a) the Gasoline or Petrol Engines, and
b) the Diesel-oil Engines.
Both types are widely used in the various means of transport.

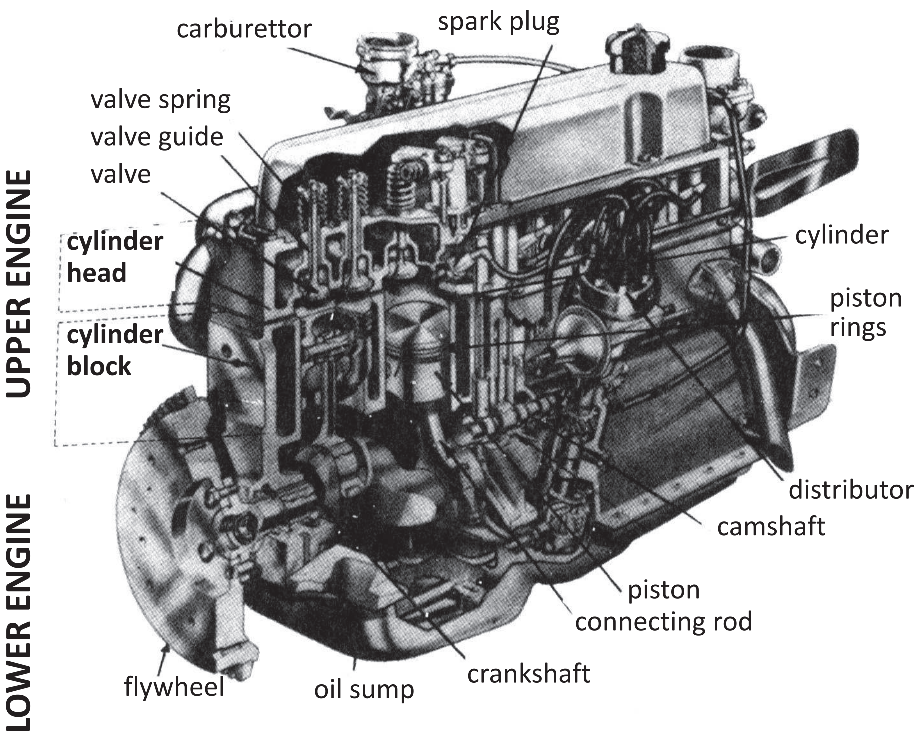
I. GASOLINE / PETROL ENGINES

THE STRUCTURE OF THE GASOLINE ENGINE

The engine of a car is a typical gasoline engine. Thanks to the developments in computer technology, its structure has changed a lot in the past few years. It is useful, however, to know how the engine was before these changes occured. The reason is that thousands of cars with such an engine are still in use and need frequent repair and adjustment.

TASK 1

Look at the picture below and say the Greek equivalent term for the parts of the engine illustrated in the picture.



TASK 2

Taking your information from the picture, fill in the gaps in the passage which follows.

UPPER ENGINE

Cylinder head

The main parts of the upper engine are the ________ ________ and the ________ ________ .
The carburettor, the spark plugs, the valve springs, the valve guides and the ________ are included in the ________ ________ . The valves operate with the help of the camshaft.

Cylinder block

The tubes which are cut in the cylinder block are the cylinders. Each ________ contains a piston. The ________ reciprocate, or move up and down inside the cylinders. Each piston is equipped with three rings. The function of the ________ ________ is to fill the gap between the ________ and the cylinder wall.

LOWER ENGINE

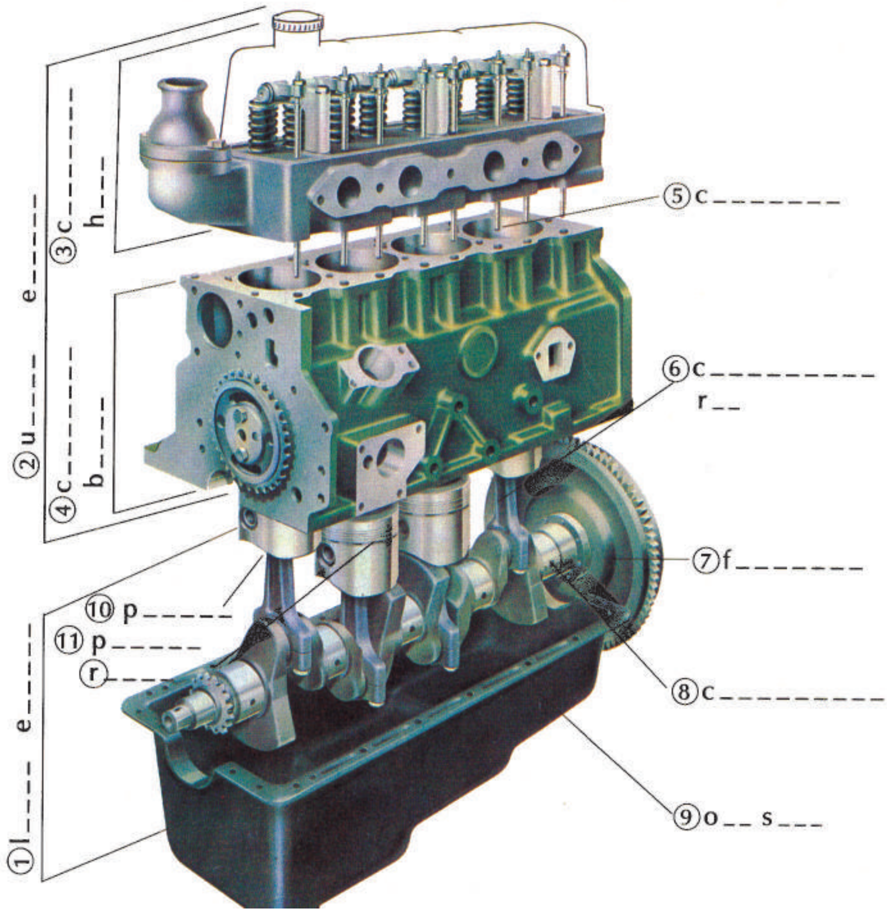
At the ________ ________ the connecting rods, which are made of forged steel, connect the pistons to the crankshaft. When the pistons reciprocate, the ________ ________ turn the ________ which is free to rotate. So, the piston's reciprocating motion is converted into rotary motion. The rotary motion of the ________________ is transferred outside the engine to the wheels via the ________ .
At the bottom of the engine is the ______ ________ . It contains the oil which is pumped inside the engine to lubricate its moving parts to reduce friction.

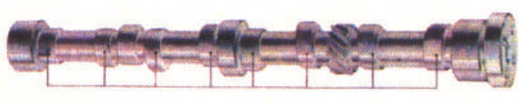
EXERCISES

1. Answer the questions.

1. Which engines are called Internal Combustion Engines and where are they used?
2. Name the main parts of the cylinder head.
3. How do the valves operate?
4. Is the motion of the piston rotary or reciprocating?
5. What are the piston rings used for?
6. Which part of the lower engine connects the pistons to the crankshaft?
7. By means of what is the piston's reciprocating motion changed into rotary motion?
8. How is the motion of the crankshaft transmitted outside the engine?
9. By means of what are the moving parts of the engine lubricated?
10. Why is it necessary to lubricate them?

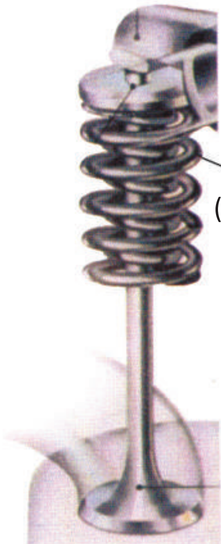
2. **Label the parts of the gasoline engine in the pictures below:**





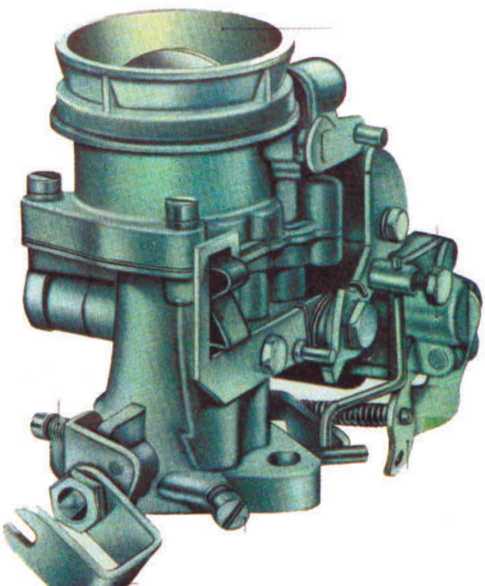
(12) c _ _ _ _ _ _ _ _ _

(13) s _ _ _ _ _ p _ _ _ _

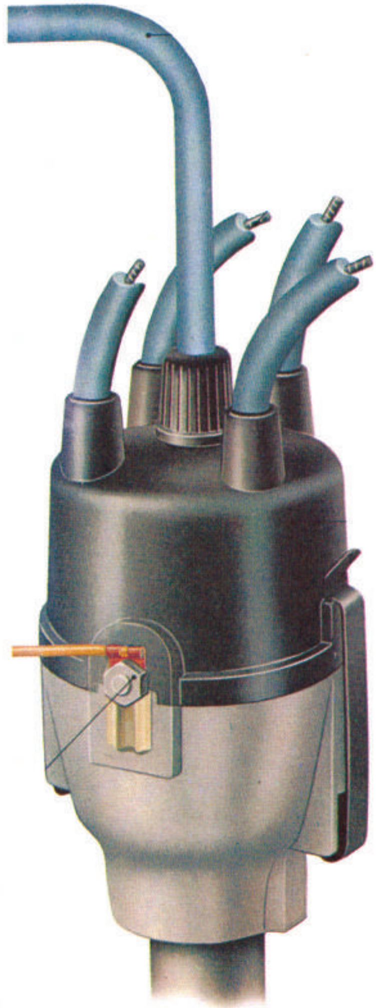


(15) v _ _ _ _ _
s _ _ _ _ _ _

(14) v _ _ _ _ _

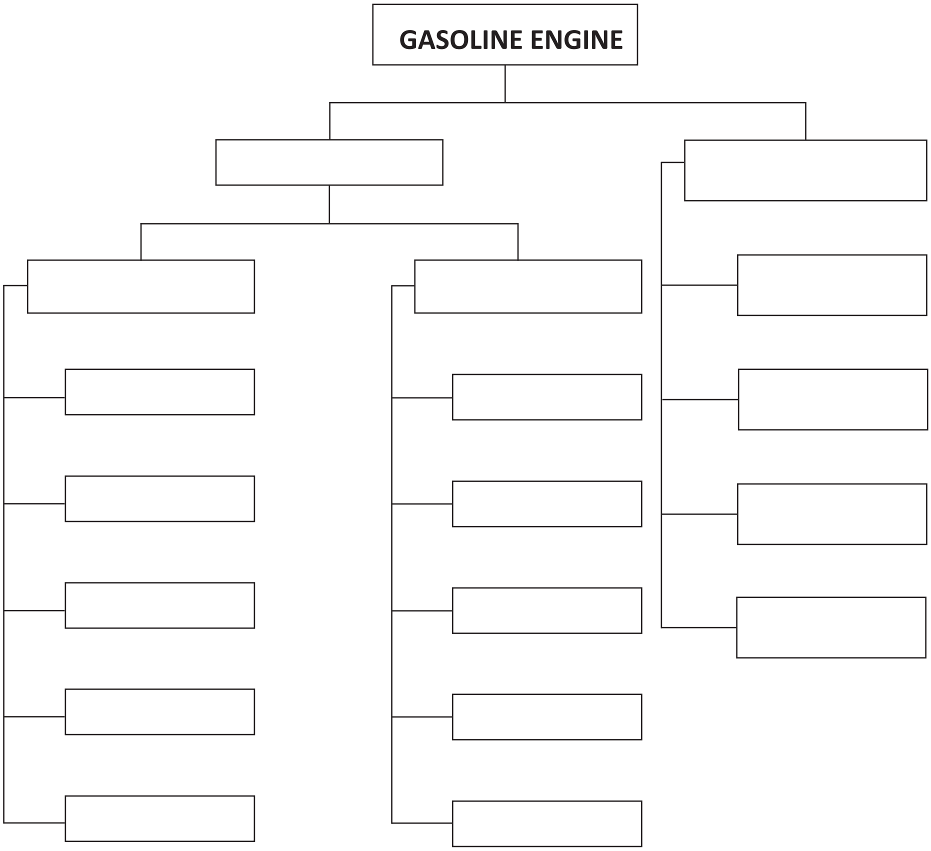


(16) c _ _ _ _ _ _ _ _ _ _ _



(17) d _ _ _ _ _ _ _ _ _ _ _

3. **Complete the diagram with the parts of the gasoline engine, as illustrated in the picture on p. 176.**

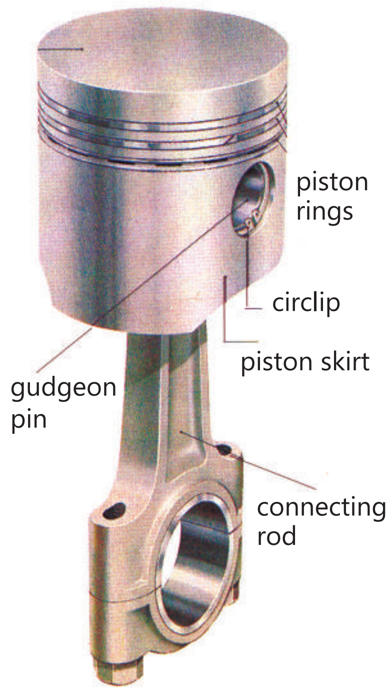


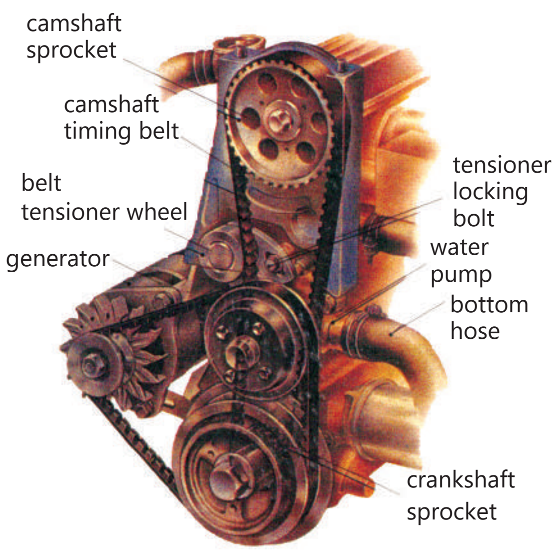
Additional Information about the Engine

In the boxes below, you will find some additional information concerning the various parts of an engine. **Identify the part of the engine to which the information included in each box refers and fill in the gaps.**

1. While flowing through the moving parts of the engine, the oil also absorbs part of the heat produced by combustion, thus cooling the engine.
The oil is collected into the ____________ .
It has a thin casing of pressed steel or cast aluminium, with a large surface area to help release the absorbed heat to the surrounding air.

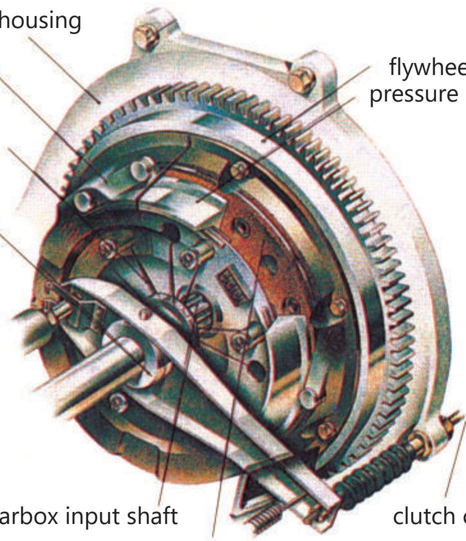
2. The ____________ fill the gap between the pistons and the cylinder wall in order to prevent the pressure of combustion from escaping past the piston. This would cause loss of power. They are made of cast iron or hardened steel.





3. The ____________________ is driven by the crankshaft by means of a chain, or a rubber belt. It runs at half the crankshaft speed and in most engines, it is used to drive the distributor.

4. One end of the ____________ is bolted to the crankshaft. Its other end is connected to the clutch. Its outer edge has gear teeth which are engaged to the starter motor. The starter motor turns the flywheel which, in turn, rotates the crankshaft and starts the engine.



5. The ____________ are made from a heat-resisting material, usually high-temperature alloy steel. Their number, arrangement and operation vary greatly depending on the engine type. The greater their number per cylinder, the higher the efficiency of the engine.

6. The piston is linked to the connecting rod via the _________ _________. This allows the piston to move up and down, while the connecting rod pivots from side to side.

7. When a car is running at maximum speed, each____________ must reciprocate inside the cylinder about a hundred times a second. As a result, pistons must be very strong and at the same time light. To satisfy these demands, pistons in most cars are made of an aluminium alloy.

EXERCISES

1. Write the English equivalent to the following Greek terms.

περίβλημα, θήκη, κέλυφος: ____________________
απώλεια ισχύος: ________________________________
ιμάντας: ____________________
συμπλέκτης, αμπραγιάζ: ____________________
σύστημα οδόντων: ____________________
ροοστάτης κινητήρα, μοτέρ εκκίνησης, μίζα: ________________________________
διάταξη: ____________________
απόδοση: ____________________
π(ε)ίρος εμβόλου: ____________________

2. The information in the sentences below is wrong. Correct it.

1. The valves are made of high-temperature aluminium alloy.
2. The operation of the valves is controlled by the crankshaft.
3. The fewer the valves per cylinder, the higher the efficiency of the engine.
4. The camshaft rotates at double the crankshaft speed and drives the carburettor.
5. Pistons may reciprocate inside the cylinder more than two hundred times a second.
6. Pistons are made of cast iron and have four rings of forged iron each.
7. The piston rings allow the pressure of combustion to escape from the cylinder, to prevent an explosion.
8. The pistons are linked to the connecting rods via the piston rigns.
9. The gudgeon pin allows the piston to rotate while the crankshaft pivots from side to side.
10. To be strong enough, the connecting rods are made of forged aluminium.
11. The gear teeth at the outer edge of the flywheel are engaged to the crankshaft.
12. One side of the flywheel is bolted to the camshaft, and the other is connected to the gear box.
13. Besides lubricating the moving parts of the engine, the oil raises the temperature in the engine to increase its efficiency.
14. The reservoir where the lubricating oil is contained has a thick casing of wrought iron.

3. Match words with definitions.

GROUP A

1. casing	a. to take measures so as to ensure that something undesirable will not happen
2. surrounding	b. to take in, e.g. heat, light, knowledge
3. to prevent	c. process of burning
4. to drive	d. being all around
5. to absorb	e. to allow something to go; to set it free
6. to release	f. covering; protective wrapping
7. combustion	g. to supply the power or motion that makes something work or move

GROUP B

1. to escape	a. act of losing or having lost something
2. light	b. to fasten with bolts
3. heat resisting	c. to get or run away from somewhere
4. loss	d. to join; connect; fasten
5. to link	e. not been harmed or affected by heat
6. to bolt	f. to go round; turn on a central pin or point
7. to pivot	g. not heavy

4. Choose words from Exercise 3 to fill in the gaps in the sentences below. Put them in the appropriate form.

1. The flywheel ____________ the crankshaft to the clutch.
2. To ____________ an accident, you must be very careful when working with moving machinery.
3. In a water-cooled car, the water in the radiator ____________ heat from the engine and ____________ it to the ____________ air.
4. According to the ____________ of their cylinders, engines are distinguished into various types, such as vee, in-line, radial, etc.
5. As they were carrying it, the motor fell and its ____________ cracked.
6. Because of the high temperatures that develop in it, the engine must be made of a ____________ material.
7. Steam turbines or reciprocating steam engines are used in power stations to ____________ the generators that produce electricity.
8. Thanks to the gudgeon pin, the connecting rod ____________ from side to side, thus converting the reciprocating motion of the piston to the rotary motion of the crankshaft.

9. The technician ____________ the motor in place with four bolts and nuts on each side.
10. Any ____________ of power from the engine decreases its efficiency.

5. Fill in the gaps with the appropriate preposition. Choose from the list.

to	with	on	from	into	of	in	by means of	through

1. To convert metres ____________ millimetres, you must multipty by 1,000.
2. Cylinders may be equipped ____________ two, three or four valves each, depending ____________ the model.
3. Motion is transferred ________ the crankshaft ________ the clutch ____________ the flywheel.
4. I.C.E. can be classified ________ gasoline and diesel engines.
5. Their parents finally succeeded ________ preventing them ________ getting married so young.
6. The casing of the oil sump is usually made ________ pressed steel.
7. Water flows back to the reservoir ________ narrow copper pipes.
8. Diesel engines belong ________ the internal combustion engines.

WORD FORMATION – The prefix trans-

You have often come across words beginning with trans- (e.g. transmit, transfer). Have you ever thought what it means?

A. Choose the correct alternative.

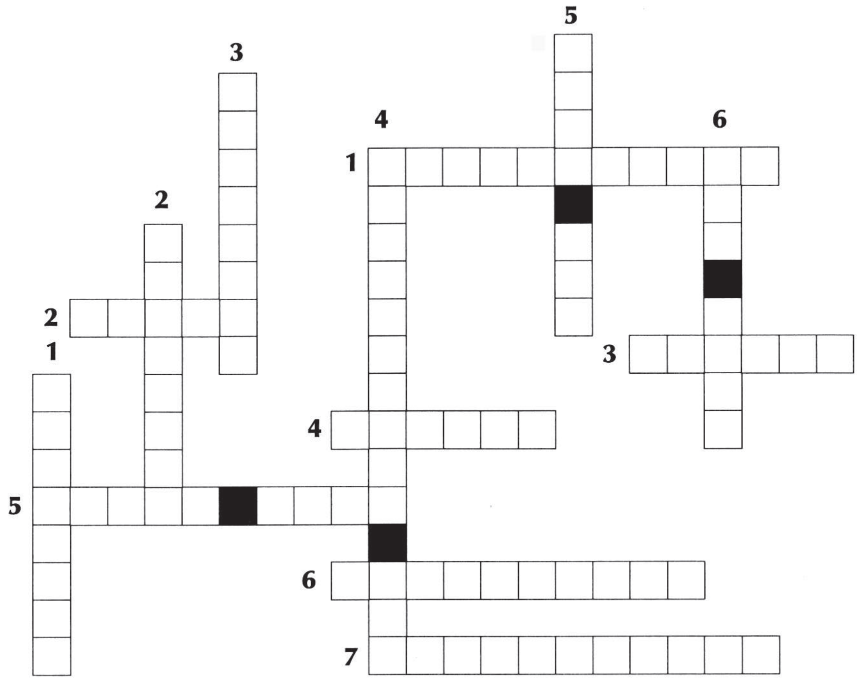
a) far, off
trans- = b) across, on the other side of, beyond
c) in the interior, inside

B. Form as many words beginning with trans- as you can.

....
....
....
....
....
....

Crossword puzzle

Complete the puzzle with the English equivalent to the Greek terms below.



Across

1. Εξαερωτήρας/καρμπυρατέρ
2. Βαλβίδα
3. Αμπραγιάζ / συμπλέκτης
4. Έμβολο / πιστόνι
5. Μπουζί
6. Στροφαλοφόρος άξονας
7. Διανομέας / ντιστριμπυτέρ

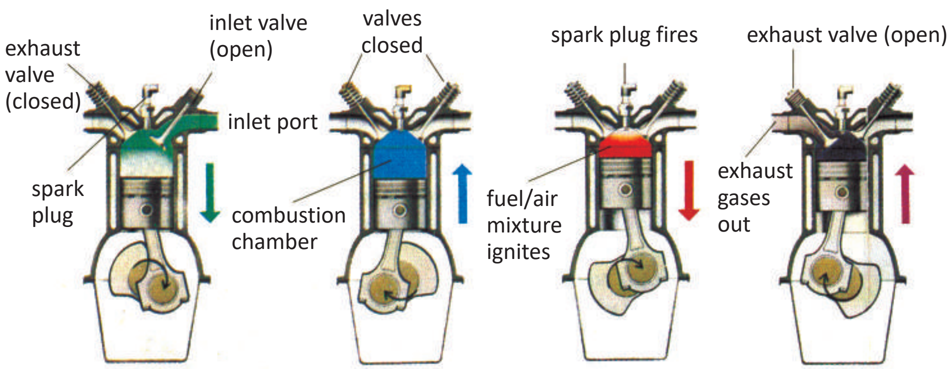
Down

1. Εκκεντροφόρος άξονας
2. Κύλινδρος
3. Σφόνδυλος / βολάν
4. Διωστήρας / μπιέλα
5. Κιβώτιο ταχυτήτων
6. Λεκάνη

THE CYCLE OF OPERATION OF A FOUR-STROKE ENGINE

Most cars work on the four-stroke principle. This means that to produce one pulse of power, the piston must slide up and down in the cylinder four times. Each upward or downward movement of the piston is called stroke and performs a separate function.

The pictures below illustrate the function of the four strokes: induction, compression, power and exhaust.



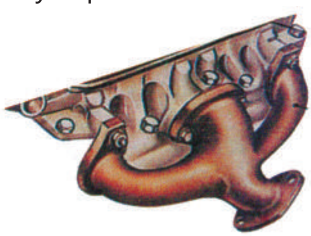
Induction stroke *Compression stroke* *Power stroke* *Exhaust stroke*

TASK

The four paragraphs below describe the function of the four strokes in a 4 stroke engine. **Read them, identify the stoke described in each paragraph and write it as a heading in the space provided. Also, number the paragraphs in the order the strokes take place. The pictures above will help you.**

____________________ **stroke**

Both valves remain closed. The piston moves up compressing the fuel/air mixture in the combustion chamber, while at the same time the heat produced by the compression fully vaporizes the mixture.



Manifold

____________________ **stroke**

The inlet valve remains shut. The exhaust valve opens and the piston rises to expel the burnt gases from the cylinder through the exhaust port, manifold and pipe. As soon as the piston reaches the top of its stroke, the exhaust valve closes while the intake opens again to let the new fuel/air mixture enter the cylinder. So, the cycle restarts with another induction stroke.

___________________ **stroke**

The inlet valve opens. Driven by the crankshaft, the piston moves down sucking in the engine a mixture of fuel and air from the carburettor. The mixture enters the cylinder travelling through the inlet manifold and port, past the open intake valve. As soon as the piston reaches the bottom of its stroke, the inlet valve closes again driven by the camshaft. During this stroke the exhaust valve remains closed.

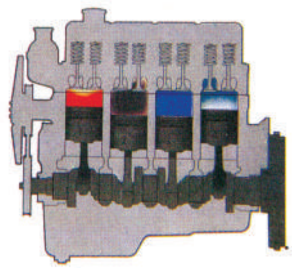
___________________ **stroke**

Both valves are shut. Just before the piston reaches the Top Dead Centre (TDC), that is the top of its stroke, a spark from the spark plug, which is fitted at the top of the cylider head, ignites the mixture and combustion takes place. The expansion of the burning gases drives the piston down again and rotates the crankshaft half a turn.

Do you know this?

Firing order

In a four-cylinder engine, the order the cylinders fire is not 1-2-3-4, but either 1-2-4-3 or 1-3-4-2. In this way, the stress exercised on the crankshaft by the firing cylinders and the vibration of the engine are reduced.



EXERCISES

1. Match the Greek terms with their English equivalent.

1. χρόνος εισαγωγής	a. exhaust stroke
2. χρόνος συμπίεσης	b. combustion chamber
3. χρόνος καύσης - εκτόνωσης	c. induction stroke
4. χρόνος εξαγωγής	d. burnt gases
5. συλλέκτης	e. power stroke
6. θάλαμος καύσης	f. ignition
7. καυσαέρια	g. expansion
8. διαστολή, εκτόνωση	h. manifold
9. ανάφλεξη	i. compression stroke

2. Look through the text to find alternative expressions to the following. Write them in the spaces provided.

1. Intake/__________ manifold, port, valve
2. Outlet /__________ manifold, port, valve
3. Intake /__________ stroke
4. Combustion /__________ stroke

3. Answer the questions.

1. What is produced every four (2 downward and 2 upward) movements of the piston?
2. Is gasoline alone drawn into the combustion chamber?
3. Why does the inlet valve open in the induction stroke?
4. Where and how is the fuel/air mixture fully vaporized?
5. What is the T.D.C.?
6. In which part of the cylinder is the fuel/air mixture ignited?
7. Is the fuel self-ignited in a gasoline engine?
8. How is the piston driven down after ignition?
9. How are the burnt gases expelled from the cylinder?
10. What does the term «firing order» mean?

Do you know this?

Loss of power
In most cars, only a third of the power produced by combustion in the engine goes to driving the wheels. The rest is lost through friction in the engine and through heat in the exhaust and cooling systems.

4. Complete the missing information.

1. To enter the cylinder, the fuel/air mixture starts from the __________ and travels ____ .
2. To get out of the car, the burnt gases pass ______________________ ____ .
3. The piston moves down during the ______________________ and up during the ____ .
4. Both valves are closed during the ______________________ .
5. The inlet valve is open and the exhaust closed ______________________ ____ .
6. On the exhaust stroke the __________ valve is __________, while the __________ valve is __________ .
7. When the gases are heated, they expand and ______________________ .

5. Look at the picture next to the note about the firing order in a four-cylinder engine (p. 188), and

a) Identify the stroke each cylinder of this engine is on.

Cylinder 1: ____________________ Cylinder 3: ____________________

Cylinder 2: ____________________ Cylinder 4: ____________________

b) Write the firing order of the cylinders in this engine.

Do you know this?

Power output The more fuel/air mixture that can be drawn into the cylinders and the more it is compressed by the pistons, the greater the power output of the engine.

6. Look through the text to find the words which mean:

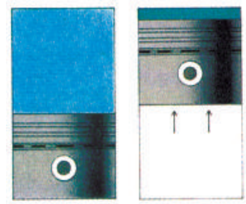
1. to draw into: ________________
2. to press something so that it takes less space: ________________
3. to convert a liquid into a gas: ________________
4. a flash of light: ________________
5. fixed, located: ________________
6. to take fire and start burning: ________________
7. to move upward, to reach a higher level or position: ________________
8. to send out or away by force: ________________

7. Use words from Exercise 6 to fill in the gaps in the sentences below. Make any necessary changes.

1. After what he did, I wasn't surprised to hear that John was ________________ from school.
2. A cigarette thrown from a car window is enough to ________________ dry leaves and grass and start a fire in the forest.
3. ________________ are produced when striking hard metal and stone.
4. When the piston slides down on the induction stroke, it ________________ air and fuel in the cylinder.
5. When water is heated over 100 °C, it ________________ and becomes steam.
6. Prices will soon ________________ again.
7. When the piston moves up on the compression stroke, it ________________ the fuel/air mixture in the combustion chamber.
8. Three rings are ________________ on the upper part of the piston.

Do you know this?

Compression ratio
The amount that the fuel-and-air mixture is compressed in the cylinder is called the «compression ratio». It is the difference between the volume of the f/a mixture drawn in and the volume of the f/a mixture after it has been compressed.
The average family car has a ratio of about 8:1 that is, the upward movement of the piston reduces the mixture to one-eighth its original volume.



Before / After
the mixture has been compressed

8. SHOWING TIME RELATIONSHIPS

Time markers show the sequence of events, that is, which action/event takes place before or after another, which actions occur simultaneously, etc. See how this is achieved in the text below.

Choose time markers from the list to fill in the gaps in the text.

During	At the time	Then	Immediately after that	As soon as	Next
At the same time	While	First	Following	At exactly the moment	

________ (1) the inlet valve opens. ________ (2), the piston starts sliding down. ________ (3) its downward movement fuel and air mixture is drawn from the carburettor into the cylinder. ________ (4) the piston completes this stroke, the inlet valve is closed. The piston ________ (5), starts rising, thus compressing the fuel/air mixture in the cylinder. ________ (6) that the piston is at the top of its stroke, the mixture is ignited by a spark from the spark plug, and combustion takes place. ________ (7) the compression and combustion strokes, both valves remain shut. ________ (8), the piston moves down again driven by the expanded gases. ________ (9), the exhaust valve opens and the piston starts rising once more, driven by the crankshaft. ________ (10) the piston is rising, it pushes the burnt gases out of the cylinder. ________ (11) that the piston reaches the top of its stroke, the exhaust valve is closed while the inlet opens again.

Listening Activities

In the two Listening Activities below, you will be given some additional information concerning the operation of a car engine.

Listening Activity I

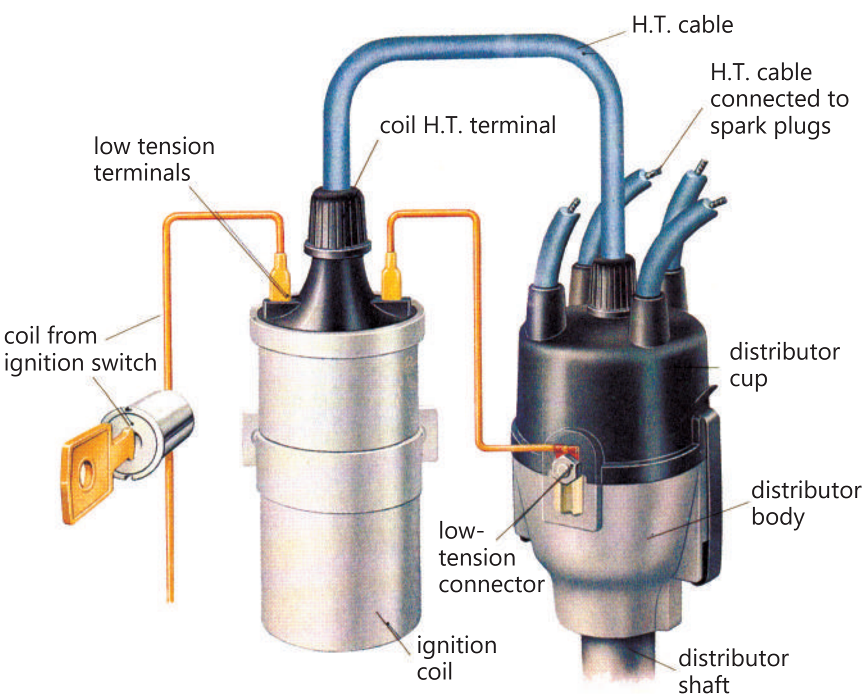
Car's ………………..

TASK 1

Look at the picture below and guess what the information in the text of Listening Activity I will be about. Choose the correct alternative and write it as a title in the space provided above.

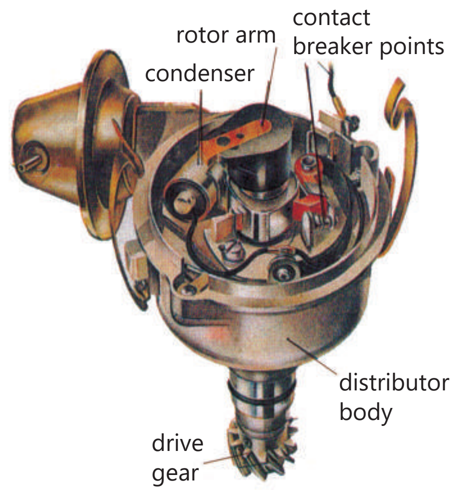
The text will be about the

- □ a) fuel system
- □ b) lubrication system
- □ c) ignition system
- □ d) cooling system
- □ e) transmission system



TASK 2

Read the text silently to familiarize yourself with it.



The fuel ignition system belongs to the engine's electrical equipment. Its normal function is to provide the high-voltage sparks which ignite the combustible fuel/air mixture in the four cylinders. It consists of the ignition coil, the distributor and the spark plugs.

The ignition coil is a step-up pulse transformer which converts the 12V low-tension DC current produced by the car's battery to the high-tension A.C. current (over 10,000V) required to produce the electric sparks.

The conversion of the low to a very high-voltage current is mainly achieved with the help of the contact breaker which is fitted in the distributor cup. The contact breaker is, in fact, an on/off switch which produces pulses of electric current by interrupting the central circuit. When its contacts are opened, high-voltage current is generated into the engine's ignition coil. The contact breaker points are designed to continuously open and close a great number of times very quickly (about 10 million times every 1,000 miles).

The high-tension (HT) current, which was previously produced in the coil, is sent back to the distributor rotor arm through an H.T. flexible cable with thick plastic insulation. Inside the distributor cup, the rotor arm, driven by the rotating camshaft, distributes the current coming from the ignition coil to each one spark plug in the correct firing order through insulated H.T. cables firmly connected to them.

The main function of the spark plugs is to convert the high-voltage pulses produced in the coil ignition system into sparks within the combustion chamber.

TASK 3

Look through the text and complete the table below with the missing Greek or English ter.

ENGLISH TERMS	GREEK TERMS
ignition coil	______________
______________	μετασχηματιστής ανόδου τάσης
Alternating current (AC)	______________
______________	Συνεχές ρεύμα

high tension / voltage	______________
______________	χαμηλή τάση
contact breaker	______________
______________	σημεία επαφής πλατινών
______________	ράουλο διανομέα
electric circuit	______________
cable	______________
______________	μόνωση

TASK 4

Your teacher is going to read another version of the same text. In his/her version, some of the words included in your text are omitted. **Try to identify them while listening to his/her text and cross them out.**

FOLLOW UP

1. Answer the questions.

1. What is the usefulness of the ignition system in a car's engine?
2. Into which part of the ignition system is the low-voltage current changed into a high-voltage one?
3. What is the function of the contact breaker?
4. How is the H.T. current distributed to the spark plugs?
5. Why do you think the cables connecting the distributor to the coil, and the spark plugs to the distributor have a thick insulation?

2. Make pairs of synonyms

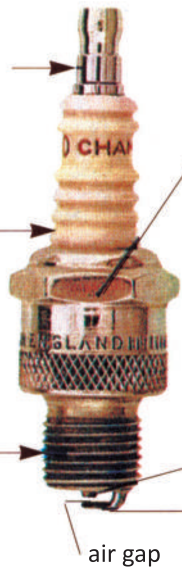
Group A		Group B	
provide	basically	fit	fast; rapidly
convert	indeed	generate	before
consist	needed	great	right; appropriate
required	obtain; succeed	quickly	large
mainly	change	previously	securely
achieve	comprise	correct	fix
in fact	supply; give	firmly	produce

Listening Activity II

How the spark is produced

TASK 1

Familiarize yourself with the picture of the spark plug below.



TASK 2

Your teacher is going to present the parts and function of the spark plug. **While listening to him/her, use the spaces provided in the picture to write the missing part of the terms.**

TASK 3

Listen to the text again and:

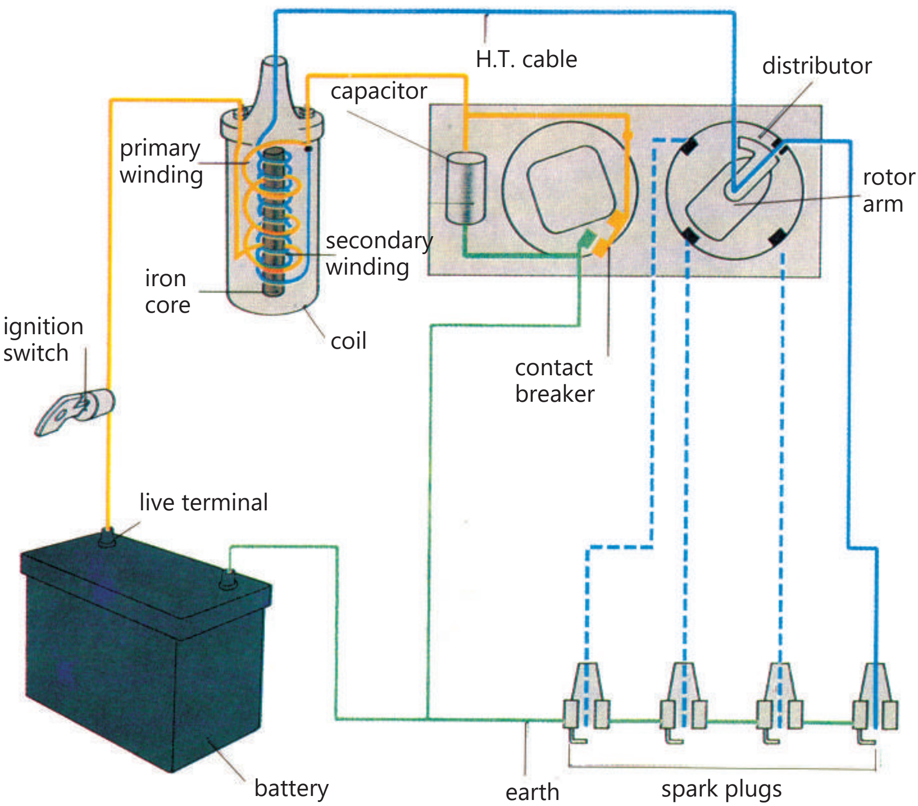
a) Answer the question:

Is the spark itself that ignites the fuel, or the heat produced by it?

b) Complete the sentence.

The spark is produced when the ____________________ flowing down the ____________________ jumps across the small ____________________ to the ____________________.

How the ignition system operates



Complete the text taking your information from the table below.

Missing information

a) the contact breaker points are opened
b) to the spark plug's centre electrode
c) through the HT cable that connects the coil to the distributor
d) driven by the crankshaft
e) connected to the same cylinder's spark plug
f) driven by the camshaft

As the starter motor turns the engine, one of the pistons, ____________ (1), rises to compress the fuel/air mixture at the top of its cylinder. At the same time, the shaft in the distributor, ________________________ (2), turns so that the rotor arm points at the HT cable which is ____________________________ ____________ (3). Just before the piston reaches the TDC, ______________ ________________ (4) creating a high voltage in the ignition coil. The HT current flows ____ ___________ (5), passes across the rotor arm and, along the plug's HT cable, flows ________________ _______________________ (6) to produce the spark.

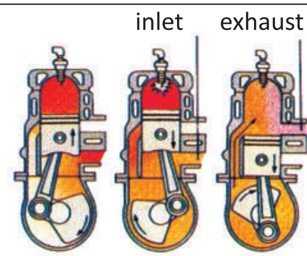
Do you know this?

Electronic ignition
To avoid often adjustment and maintenance of the contact-breaker points and achieve tighter control of the ignition systems, manufacturers have developed electronic ignition. Electronic ignition systems, instead of a contact breaker, have a transistor which operates as a solid-state switch turned on and off by a magnetic sensor or a photoelectric device fitted in the distributor.

Do you know this?

Two-stroke engines

Two-stroke engines don't have valves. They have ports which are uncovered as the piston moves down. They fire on every downward movement of the piston. As a result, the crankshaft turns only once in each cycle. Two-stroke engines are less efficient than four-stroke ones.



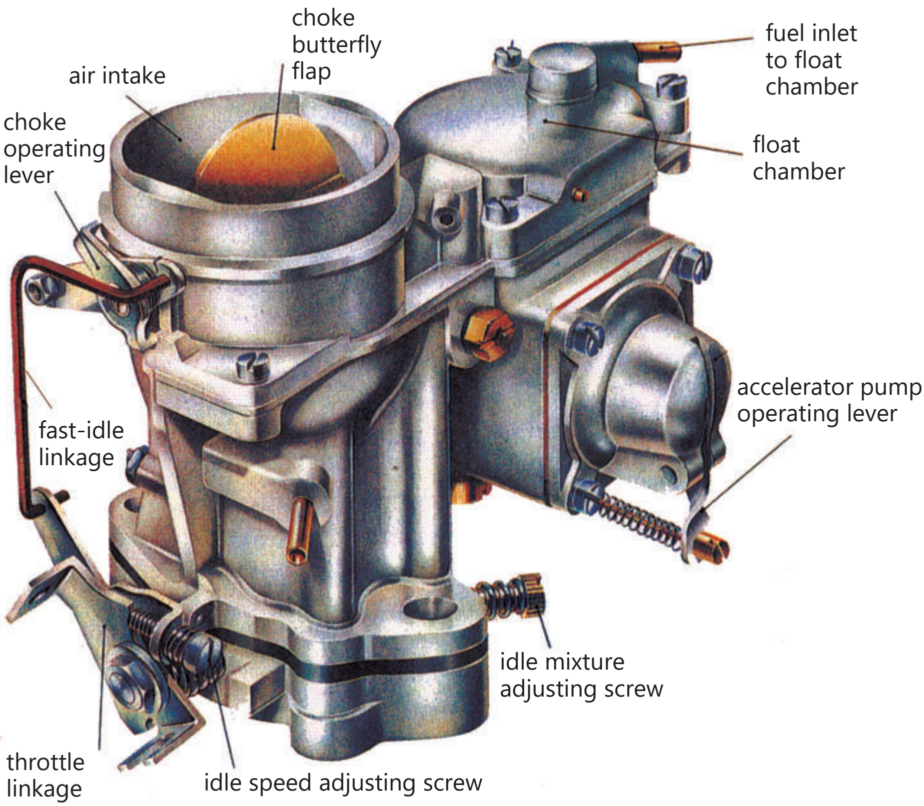
FUEL SYSTEM

Introduction

PRE-QUESTIONS

Read the short text below and answer the questions.

1. What is the function of the fuel system?
2. Which factors determine the precise ratio of fuel and air needed by the engine?
3. In which part of the engine are fuel and air mixed in the appropriate proportions?



To produce combustion, an I.C.E. needs not only fuel but also air. The precise ratio of fuel and air needed depends on a number of factors which are related to the engine's running conditions. Under steady load conditions, for instance, the engine needs a mixture ratio of about 15 parts air to one part petrol. For a cold starting, it needs a richer mixture, sometimes as rich as 1:1. During hard acceleration a mixture of 12:1 is necessary, while a much weaker mixture ratio is needed when the engine is idling.
Over-rich and over-weak mixtures must be avoided as they both reduce engine's output and efficiency.
The part of the engine where gasoline and air are mixed in the correct proportions in order to ignite and burn efficiently is the carburettor.

EXERCISES

1. Match the two columns.

Driving situations	Engine's running conditions
1. The driver wants to pass by another car, which is moving at almost the same speed, so he starts speeding up.	a. steady load conditions
2. The car has been running at almost the same speed for many kilometres.	b. cold starting
3. The driver is waiting for an old man to cross the road with the engine running.	c. hard acceleration
4. Early in a cold winter morning, the driver turns the ignition switch and the engine starts running.	d. (the engine is) idling

2. Correct the wrong information in the sentences below.

1. To produce combustion, an I.C.E. needs only gasoline.
2. The precise ratio of fuel and air needed depends on the weather and the temperature of the surrounding air.
3. For a cold starting, the engine needs a very weak fuel/air mixture.
4. When the engine is idling, it needs a richer fuel/air mixture than when it is running under steady load conditions.
5. An over-weak fuel/air mixture increases the engine's output.

3. Arrange the engine's running conditions according to the f/a mixture ratio they require.

1. ____________________ rich mixture
2. ____________________
3. ____________________
4. ____________________ weak mixture

4. Look through the text to find the words which mean:

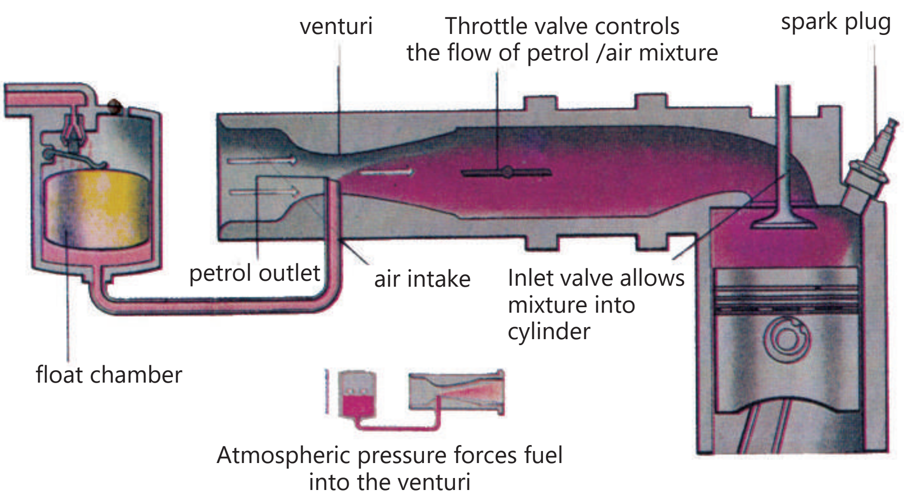
1. a material that is burned to provide heat or power: ____________
2. exact; definite; accurate: ____________
3. how much of each material (e.g. of fuel and air) there is in a mixture; the relationship between the amounts of the two materials/their proportion in it: ____________
4. a situation without interruptions or changes: ____________
5. for example: ____________
6. increase of speed; getting faster and faster: ____________
7. the engine is running slowly and quietly because it is not in grear, and the car is not moving: ____________
8. not strong, powerful or effective: ____________

The Carburettor

PRE-QUESTIONS

The text which follows describes how a carburettor operates. Read it and answer the questions below.

1. On which strokes does the engine suck air?
2. What is the «carburettor barrel»?
3. What is the «venturi» in a carburettor, and how does it function?
4. How is the speed of the car controlled?

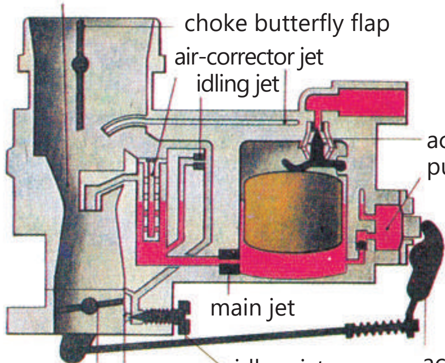


All carburettors operate on the same principle: the venturi effect.
The air drawn into the engine on the induction strokes passes through the main bore of the carburettor, known as «the carburettor barrel». At one point, the diameter of the barrel is reduced. This narrow part is called «the venturi».
When the air flow that enters the engine meets the venturi, it speeds up creating a slight vacuum. Petrol from the fuel tank is pumped to the float chamber, which is a small reservoir in the carburettor assembly, connected by a small drilling (a jet)* to the narrowest part of the venturi.
While the engine is running, it sucks air. The vacuum created in the venturi draws petrol from the drilling in the air stream. As the fuel enters the air stream, it is broken down in tiny droplets by the air flow in the carburettor barrel.

---

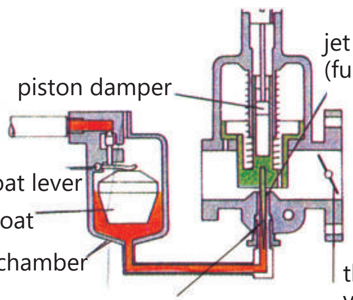
* In a carburettor, the jet is simply a tube (drilling) through which the fuel flows.

The car’s speed is regulated by the amount of fuel/air mixture drawn into the engine, which is controlled by a pivoted disk, the throttle valve, usually called simply «the throttle». The throttle is connected to the accelerator pedal.
The attempt to provide the engine with exactly the correct mixture ratio under every running condition has led to the development of various carburettor types, such as the fixed jet/choke, the variable jet/choke carburettor, the compound and the twinchoke carburettor, or the multiple carburettors, each serving one or more cylinders.

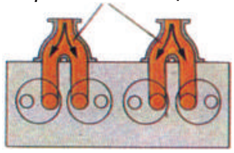


Fixed jet carburettor
It requires many different jets and circuits to supply the engine with the correct mixture ratio under the various running conditions of the engine and, as a result, it is very complicated.

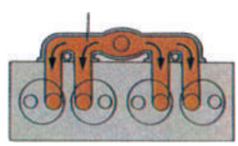
Variable choke carburettor
It has only one jet. It achieves to produce the correct fuel/air mixture by altering the size of the venturi according to the air flow.



Multiple carburettors
The engine has two or more carburettors, each serving one or more of the engine’s cylinders. As a result, less complex inlet manifolds are used, the equal supply of fuel to all cylinders is ensured, and the efficiency of the engine is increased.



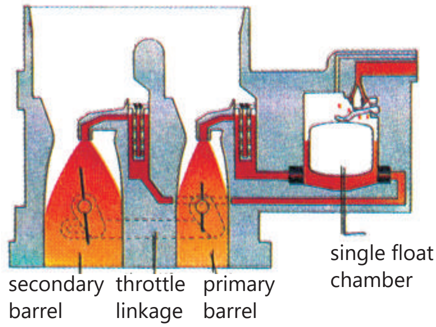
Single inlet manifold

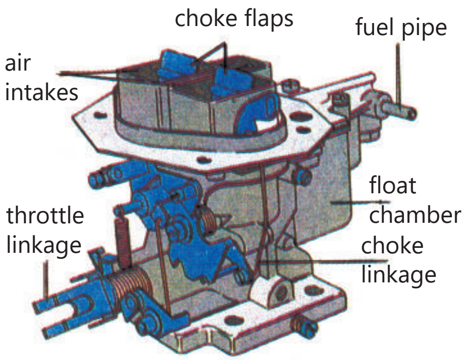


Separate inlet manifolds

Compound twin-choke carburettor

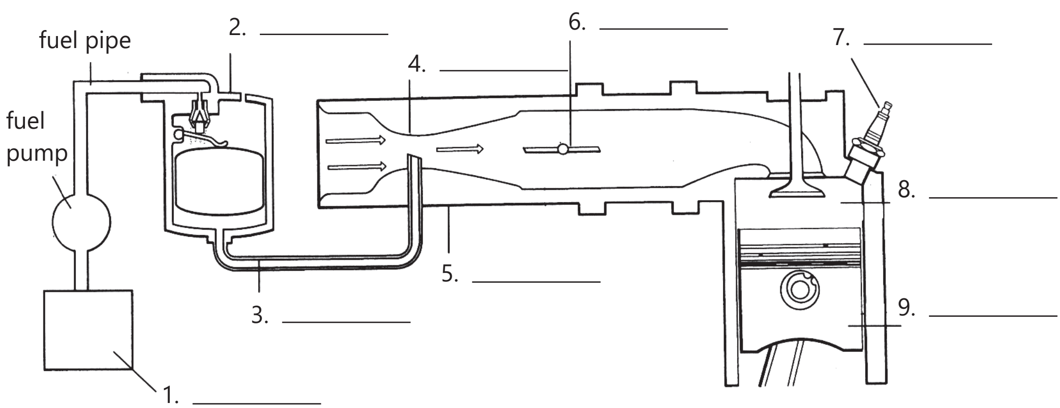
It has two or more barrels side by side. It is of the fixed jet type and, in fact, it consists of two carburettors in one assembly.





EXERCISES

1. Label the parts of the fuel system illustrated in the schematic diagram below.



2. **Complete the missing information in the diagram below.**

- Gasoline from the f_____ t_____ is pumped to the f__________ c_____.
- On the i_____ strokes, a_____ is drawn into the c__________ b_____.

When the air meets the v_____, it speeds up and a v_____ is created.

Atmospheric pressure forces the f_____ from the f_____ c__________ through the j_____ into the b_____.

The f_____ vaporises and is mixed with the a_____.

3. **Are the following statements true or false? Correct the false ones.**

1. The main bore of the carburettor, known as «carburettor barrel», is, in fact, a tube of large diameter. _____
2. Gasoline is pumped from the float chamber to the fuel tank, which is a reservoir in the carburettor assembly. _____
3. Before the venturi, a mixture of gasoline and air flows through the carburettor barrel; after the venturi, only gasoline flows through it (the barrel). _____
4. The vacuum created as the incoming air meets the venturi draws fuel from the float chamber in the carburettor barrel. _____
5. Air enters the carburettor barrel flowing through a narrow tube called «jet». _____
6. When the fuel meets the air stream flowing through the barrel, it is broken down into tiny droplets. _____
7. The speed of a car is controlled by the amount of air drawn into the engine, which is regulated by the throttle. _____
8. As the driver steps on the accelerator pedal, the throttle lets more fuel/air mixture pass into the engine. _____

4. **Find words in the text which mean:**

1. to draw in: __________
2. space completely empty, from which the air has been drawn out: __________
3. something made up of various parts put together: __________
4. continuous flow of liquid, persons, things: __________
5. a very small amount of liquid that looks like a little ball; a very small drop: __________
6. to control systematically; to adjust a mechanism so as to get the desired result: __________
7. effort: __________

5. Identify the carburettor types by their characteristics.

1. It consists of one float chamber but two barrels side by side in one assembly: ______________________________
2. In order to provide the engine with the appropriate fuel/air mixture for every running condition, it has many jets and circuits, and, as a result, it is very complicated: ______________________________
3. Every single cylinder is served by a separate carburettor. The inlet manifolds of these carburettors are less complicated, while the equal supply of all cylinders with fuel is ensured: ______________________________
4. Although it has only one jet, it can supply the engine with the appropriate f/a mixture by changing the size of the venturi according to the air flow: ___________________________________

6. Arrange the following words in groups according to their meaning.

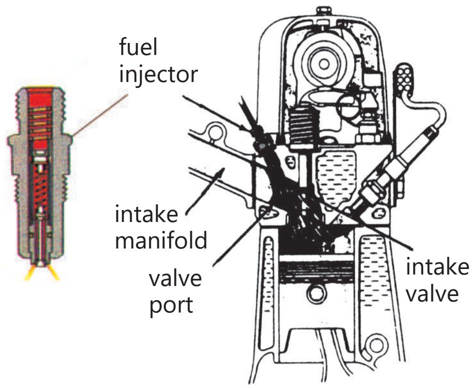
appropriate	control	constant	located	drilling	miniature	tube
precise	combine	jet	fixed	microscopic	fitted	link	small
accurate	unchanged	fix	reservoir	pipe	correct	continuous
positioned	adjust	little	tank	join	placed	hole

bore	tiny	mounted	exact
__________	__________	__________	__________
__________	__________	__________	__________
__________	__________	__________	__________
__________	__________	__________	__________
__________		__________	

steady	connect	regulate	container
__________	__________	__________	__________
__________	__________	__________	__________
__________	__________	__________	
__________			

Electronic Fuel Injection

In an attempt to save fuel and reduce air pollution, manufacturers have developed new fuel systems, which can provide the engine with exactly the correct proportion of fuel-and-air mixture for every running condition. This has led to the development of fuel injection, first mechanical, then electronic.

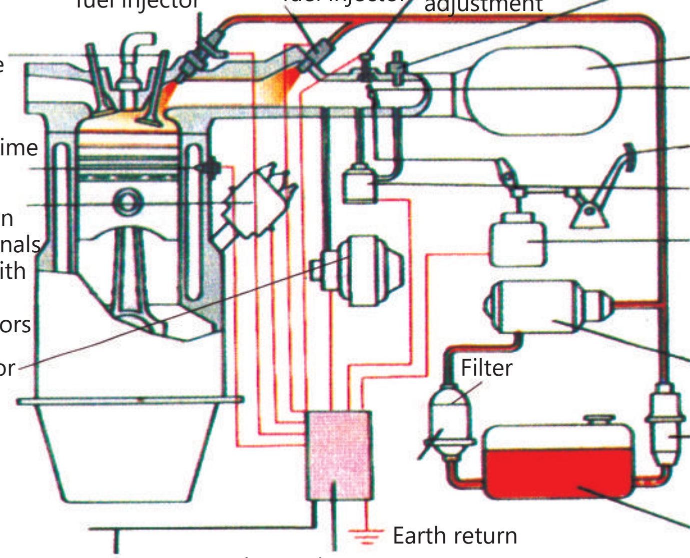


Cars equipped with a fuel injection system, instead of carburettors, have injectors which forcibly spray the required quantity of fuel directly into either the inlet manifold or the inlet port or the cylinder, depending on the manufacturer.

As the fuel speeds through the nozzle of the injector, it is atomized, that is, it is broken into mistlike droplets which readily mix with the incoming air stream.

Depending on the system, the injectors either inject fuel for short repeated periods of time (intermittent system), or feed the engine with fuel continuously during its operation (continuous injection system).

The duration of injection and the amount of fuel injected are governed by an electronic control unit, which is a computer connected to sensors that monitor the various functions of the engine and feed the control unit



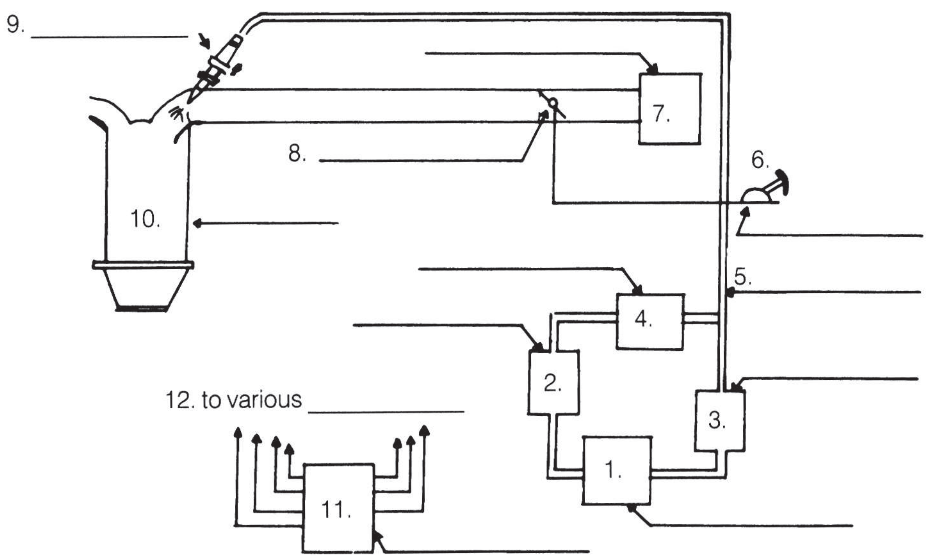
with the necessary information. Cars with electronic fuel injection systems are also equipped with an electrically controlled fuel pump to provide the necessary pressure that will send the gasoline from the fuel tank to the injectors, and a fuel-pressure regulator which limits the pressure to the fuel lines.

EXERCISES

1. Below are the Greek terms for the main parts of a fuel injection system. Write their English equivalent.

Greek terms	English terms
1. Μονάδα ελέγχου	1. ______________________
2. Πεντάλι γκαζιού	2. ______________________
3. Δοχείο βενζίνης	3. ______________________
4. Σωλήνες / γραμμές διέλευσης καυσίμου	4. ______________________
5. Εγχυτήρας / μπεκ	5. ______________________
6. Ρυθμιστής πίεσης καυσίμου	6. ______________________
7. Φίλτρο αέρα	7. ______________________
8. Αισθητήρες	8. ______________________
9. Φίλτρο καυσίμου	9. ______________________
10. Ηλεκτρική αντλία βενζίνης	10. ______________________
11. Εμφρακτική βαλβίδα / πεταλούδα	11. ______________________

2. Label the schematic diagram below with the English term for each part of the presented fuel injection system.



3. Answer the questions.

1. What is the advantage of fuel injection over the conventional fuel systems?
2. Which types of fuel injection are mentioned in the text?
3. Do cars equipped with fuel injection have carburettors?
4. How does the fuel enter the engine in cars equipped with a fuel injection system?
5. Where is the fuel mixed with air in these cars?
6. What happens when the gasoline is sprayed by the injectors?
7. How is the injection of fuel controlled in cars with electronic fuel injection?
8. What is the use of the fuel pump and the fuel regulator?

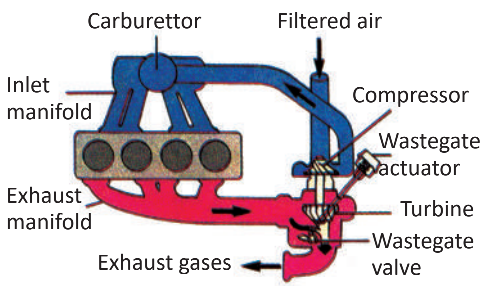
4. Look through the text to find the words that can be replaced by the following:

1. to use, spend, consume less: ____________________
2. which have; having: ____________________
3. strongly; powerfully: ____________________
4. straightly; immediately: ____________________
5. flows quickly: ____________________
6. easily; quickly, without difficulty: ____________________
7. constantly: ____________________
8. provide: ____________________
9. reduces; lessens: ____________________
10. pipes: ____________________

Do you know this?

Turbochargers

A turbocharger consists of a turbine which is fitted in the exhaust manifold and, as a result, is driven by the gases released through it (the manifold). The turbine is connected to a compressor which delivers air under pressure to the carburettor or injection system. Compressing the air means that more oxygen enters the combustion chamber on the intake stroke. The oxygen, mixed with the appropriate quantity of fuel, delivers more power to the engine. As a result, an engine equipped with a turbocharger can get as much as 30% more power than a conventional engine and has a lower compression ratio.



5. Find the words in the text which mean:

1. the process of making the air dirty and dangerous with poisonous chemicals: ____________________
2. metal end of a hose or device through which a stream of liquid or air flows: ____________________
3. water vapour in the air; light fog: ____________________
4. stopping at intervals; stopping and starting again: ____________________
5. an electronic device which consists of a pre-programmed computer and controls the function of a system: ____________________
6. to check regularly: ____________________

6. Make pairs of synonyms out of the two lists below.

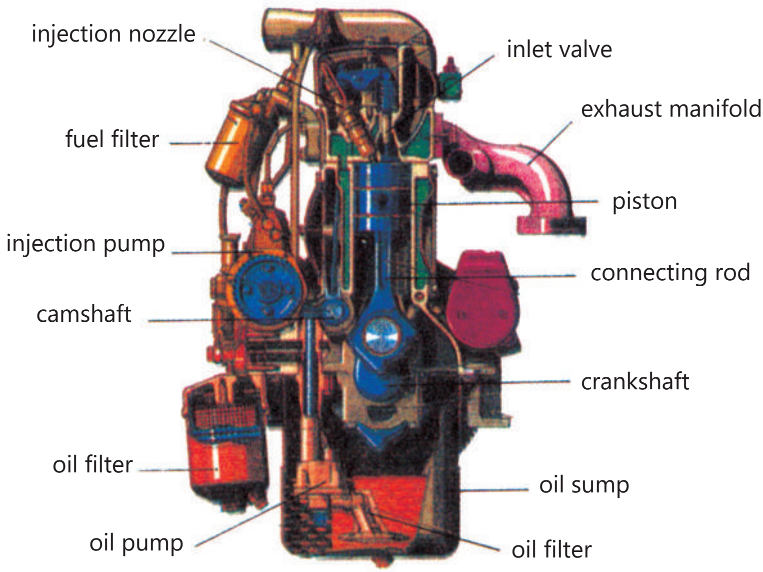
A	**B**
attempt	economize*
provide	effort
save	needed
quantity	control
inject	check
atomize*	spray
govern	supply
monitor	minimize*
reduce	vaporize*
required	amount

* also spelled: atomise, economise, vaporise in British English

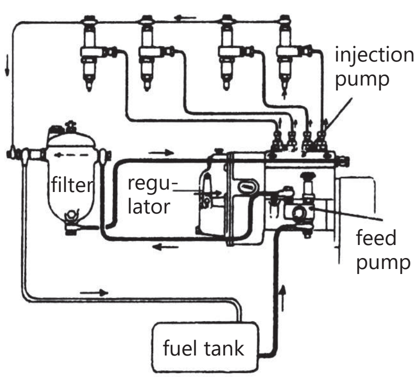
DIESEL (-OIL) ENGINES

Diesel engines are widely used in the various means of transport, particularly in trains, ships and trucks. They are also used in power plants to produce electricity.

Diesel, like petrol engines, belong to the Internal Combustion Engines and they have a lot in common. Their mechanical parts, for instance, are almost the same.



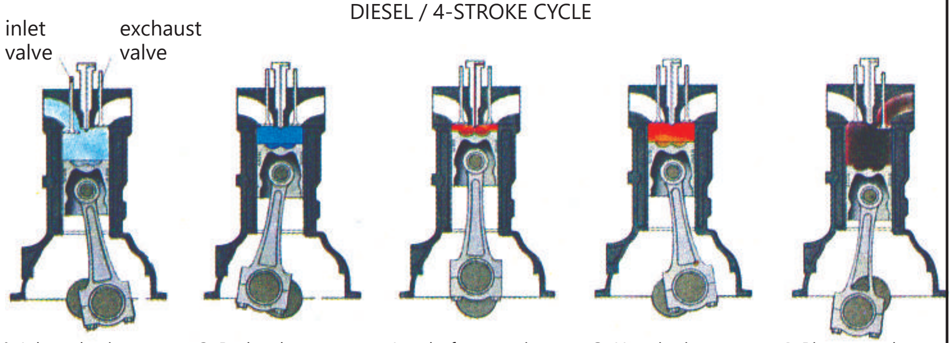
The essential difference between them is that they use a different type of fuel. The petrol engine uses gasoline but the diesel engine uses diesel oil. As a result, they operate differently.



The main difference in operation is that the gasoline engine admits a mixture of fuel and air, while the diesel engine admits only air during the induction strokes. This air is compressed by the piston and its temperature becomes very high, above the self-ignition point of the fuel.

At about the end of the compression stoke, a fine spray of fuel is injected through an injector directly into the cylinder. As the fuel intermixes with the high temperature air, it is automatically ignited, and so combustion occurs. The diesel engine, therefore, has no carburettor, distributor or spark plugs.

DIESEL / 4-STROKE CYCLE



1. Inlet valve is open, exhaust valve closed. Air enters cylinder, and inlet valve closes

2. Both valves are closed, piston rises to compress air in combustion chamber

Just before maximum compression, fuel is squirted into chamber to vaporise in hot air.

3. Heat ignites the mixture which expands and forces the piston down.

4. Piston reaches bottom and rises as exhaust valve opens Gases escape.

The disadvantages of diesel engines compared to gasoline ones, are: higher initial cost, noisier operation, slower acceleration, and lower maximum speed. Despite their disadvantages, however, due to their very high compression ratio which results in greater efficiency and lower fuel consumption, diesel engines have become popular and are being fitted in an increasing number of private cars.

EXERCISES

1. Answer the questions.

1. What is the main difference between diesel-oil and gasoline engines?
2. Do fuel and air enter the engine at the same time in a diesel engine?
3. Why do diesel-oil engines have neither a carburettor nor a fuel ignition system?
4. What are the advantages of gasoline engines over the diesel-oil ones?
5. Why are diesel-oil engines characterised as energy saving?

2. Match the following with words or phrases in the text.

1. main / basic: ____________________
2. allows to enter / lets in: ____________________
3. the temperature at which a fuel ignites automatically / by itself: ___________
4. mixes together: ____________________

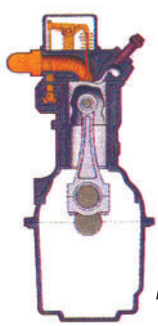
5. higher production costs: ____________________
6. it needs less fuel to operate; it is energy (fuel) saving: ____________________
7. more and more people prefer them: ____________________
8. cars used only by their owners, not by the public, like buses, trucks and taxis are: ____________________

3. Which type of I.C.E. do the following items belong to? Tick appropriately as in the example.

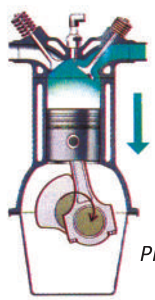
ITEMS		GASOLINE ENGINE		DIESEL-OIL ENGINE
		Conventional	**With fuel injection**	
PARTS	Cylinders	✓	✓	✓
	Pistons			
	Connecting rods			
	Crankshaft			
	Camshaft			
	Flywheel			
	Oil sump			
	Valves			
	Spark plugs			
	Injectors			
	Carburettor			
	Distributor			
	Ignition coil			
	Contact breaker			
	Fuel tank			
	Fuel pump			
	Fuel filter			
	Electronic control unit			
FUEL	Gasoline/petrol			
	Diesel (-oil)			

ITEMS		GASOLINE ENGINE		DIESEL-OIL ENGINE
		Conventional	With fuel injection	
OPERATION	Fuel and air enter the cylinder intermixed			
	Air and fuel enter the cylinder on different strokes			
	Fuel and air are mixed in the carburettor			
	The fuel is injected directly into the cylinder			
	Fuel is injected to the inlet manifold or port and mixed with air			
	The fuel is self-ignited			
	The fuel is ignited by means of a spark			
PROPERTIES	Higher initial cost			
	Noisier operation			
	Slower acceleration			
	Higher maximum speed			
	Lower compression ratio			
	Greater efficiency			
	Lower fuel consumption			

4. Which type of engine (gasoline or diesel) does each of the two cylinders illustrated below belong to? Give reasons.



Picture A



Picture B

5. Complete the following table with the similarities and differences of the three engine types (parts, fuel and operation, not properties).

SIMILARITIES	DIFFERENCES		
	GASOLINE ENGINE		DIESEL-OIL ENGINE
	Conventional	With fuel injection	
cylinders	spark plugs	spark plugs	________

6. Use the above table to compare the three types of I.C.E. as in the examples.

- ***All*** *three engines have cylinders.*
- ***Both*** *conventional and fuel injection engines have spark plugs.*
- ***Only*** *conventional gasoline engines have carburettors.*
- *In diesel engines, the fuel is self-ignited* { ***but/while/whereas*** / ***on the contrary*** / ***on the other hand*** } *in gasoline engines, it is ignited by means of a spark.*

7. COMPARING (Presenting similarities and differences)

Apart from the expressions you have used in Exercise 6, some other words or phrases widely used when comparing two items are:

In case of	
Similarity	**Difference**
like similar (to) the same as as + adjective + as	unlike is different / differs (from) instead (of) not so/as + adjective + as

Examples

- *The cylinder of a gasoline engine is the same as/similar to that of a diesel engine.*
- *Like gasoline engines, diesel engines belong to the I.C.E.*
- *Unlike four-stroke engines, two-stroke ones have only ports in their cylinders.*
- *Four-stroke engines have valves; two-stroke ones have ports, instead.*
- *The distributor of an engine with electronic ignition is different from that of a conventional engine. It has a transistor instead of a contact breaker.*
- *A gasoline engine is not so energy saving.*

Use expressions from either the above table or the previous exercise (6), to make sentences out of the cues below.

1. Turbine steam engines ↔ gasoline engines (E.C.E. - I.C.E.)
   e.g. *Turbine steam engines belong to the E.C.E. Gasoline engines, on the other hand, belong to the I.C.E.*
2. Engine without ↔ with a turbocharger (efficient)
3. E.C.E. ↔ I.C.E. (used in automobiles)
4. Gasoline ↔ diesel-oil engine (mechanical parts)
5. In turbine steam engine ↔ reciprocating steam engine (type of motion heat is converted: rotary-reciprocating)
6. Operation of conventional ↔ CNC machine tools (complex)
7. Bolts and rivets ↔ brazing and welding (join metal pieces temporarily ↔ permanently)
8. Gasoline ↔ diesel engines (lubrication system)
9. Conventional ↔ CNC machine tools (controlled by a computer)
10. Wankel ↔ Otto engines (I.C.E.)
11. The fuel/air mixture the engine needs under steady load conditions ↔ for a cold starting (rich)
12. Conventional gasoline engines ↔ engines equipped with fuel injection (save fuel and reduce air pollution).

Writing Activity

Taking your information from the tables, texts and notes in this unit, write a text comparing Diesel-oil and Gasoline Engines (with and without fuel injection).

Ideas to include

- Classification
- Use
- Main similarities
- Main differences
- Comparison of properties

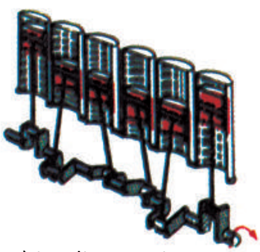
} of the two types of engines

Don't forget
- to split your text into paragraphs.
- to use linking words to connect your sentences and paragraphs.

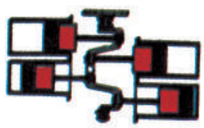
NOTES on I.C.E.

NOTE 2

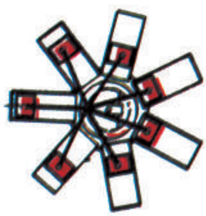
According to the **arrangement of cylinders,** engines are classified as:



a) in - line engines



b) horizontally opposed engines



c) radial engines

d) Vee engines

NOTE 1

According to the **number of cylinders,** engines are classified as:
a) single - cylinder engines
b) multi-cylinder engines

NOTE 3

According to the **number of strokes,** engines are classified as:
a) two - stroke engines
b) four - stroke engines

CLASSIFYING

Use expressions from the appropriate table in the «Language Functions» section in the APPENDIX of your book, to make sentences out of the cues below.

1. Mechanical drills → machine tools
2. Tools → hand tools and machine tools
3. Metals → ferrous and non-ferrous
4. Copper → non-ferrous metals
5. Wrenches → tools commonly used by machinists
6. External combustion engines → turbine steam engines and reciprocating steam engines
7. Diesel engines → reciprocating ICE
8. Heat engines → E.C.E and I.C.E.
9. 2-stroke engines → gasoline reciprocating I.C.E.
10. Wankel and Otto engines → internal combustion engines
11. Fastening devices → bolts, rivets and screws
12. Oxygen → gas
13. Ignition coil → pulse transformer
14. Wood, coal, lignite, turf, oil → fossil fuels

GENERAL EXERCISES

1. Identify the part of the engine described.

1.	It is made from aluminium alloy. It slides inside the cylinder driven either by the combustion of the fuel/ air mixture or by the crankshaft.	
2.	It is driven by the crankshaft. It drives the distributor and opens or closes the valves at the appropriate time.	
3.	It is made of cast iron. The tubes where the pistons reciprocate are cut in it.	
4.	It links the piston with the crankshaft converting the reciprocating motion of the one to the rotary movement of the other.	
5.	There are two, three or four in each cylinder. When opened, they let either the fuel/air mixture in, or the exhaust gases out of the cylinder.	

6.	It transfers the motion of the pistons to the flywheel.	
7.	It contains the oil needed to lubricate and cool the engine.	
8.	It is an electric motor used to start the engine.	
9.	It produces the sparks which ignite the fuel/air mixture.	
10.	It is the part of the fuel system that sprays fuel to the cylinders.	
11.	Driven by the starter motor, it turns the crankshaft in order to move the pistons and start the engine. It also transfers the rotary motion of the crankshaft outside the engine, to the wheels.	
12.	It is driven by the camshaft. It distributes H.T. current to the spark plugs and ensures that the sparks are created exactly when they are needed.	
13.	Operating on the venturi effect, it mixes the fuel with air in the correct proportions for every running condition of the engine. Cars with fuel injection don't have one.	

2. **Complete the sentences in the tables below.**

A.	The function of a(n) / the	ignition system control unit fuel pump injector contact breaker piston rings exhaust manifold fuel regulator	is to...

B.	The	upper engine fuel system of the diesel engine ignition system of a conventional gasoline engine lower engine fuel system of a conventional petrol engine carburettor	consists of...

3. **Form compound nouns by matching the two columns.**

Group A

spark	valve
piston	nozzle
inlet	injection
connecting	plug
cylinder	ring
combustion	block
injection	chamber
fuel	rod

Group B

oil	manifold
fuel	breaker
exhaust	sump
ignition	arm
rotor	pump
contact	regulator
gudgeon	coil
pressure	pin

4. **Ask questions to which the following sentences are the answers. Begin your questions with the words in parentheses.** (See the Wh__ questions, in the "Grammar" section in the APPENDIX).

1. In the internal combustion engines, combustion takes place inside the engine. (Where)
2. The main parts of the upper engine are the cylinder head and the cylinder block. (Which)
3. The pistons move up and down inside the cylinder. (How/Where)
4. As the piston rises, it compresses the fuel/air mixture in the combustion chamber (When/What)
5. The piston moves up to expel burnt gases. (Why)
6. Soon after the induction stroke, the inlet valve closes. (When)
7. At about the end of the compression stroke, a fine spray of fuel is injected into the cylinder (When/What/Where).
8. The rotor arm distributes the H.T. current to the spark plugs. (Which part of the distributor/Where)
9. In gasoline engines, the fuel is ignited by means of a spark (How)
10. Contact breaker points open and close about 10 million times every 1,000 miles. (How many times).
11. As the HT current jumps the air gap from the centre to the side electrode, a spark is created. (How/When)
12. In modern cars, the timing of the spark is controlled by the microprocessor which monitors all the functions of the engine. (How)

5. ***ACTIVE – PASSIVE VOICE?*** (See about the Passive Voice in the "Grammar" section in the APPENDIX)

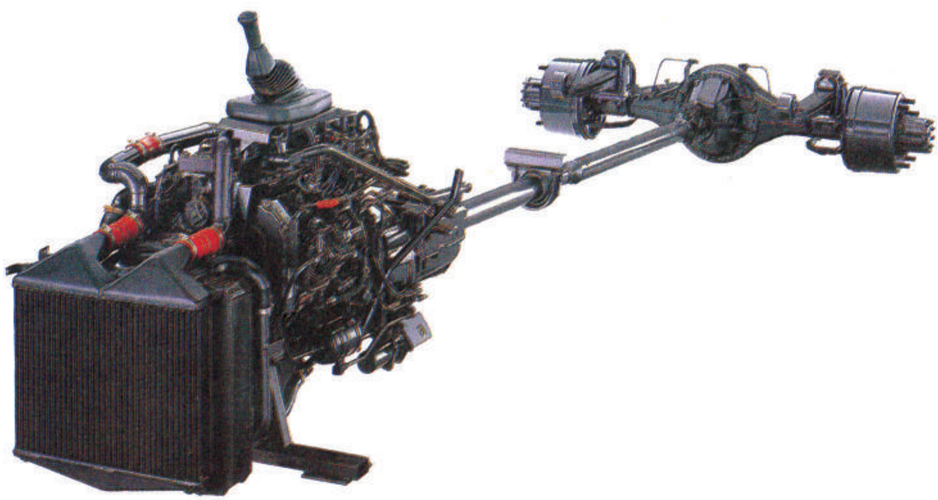
A. Underline the correct verb form (active or passive).

1. The piston rings *fill* / *are filled* the gap between the piston and the cylinder wall.
2. The amount and duration of injection *control* / *is controlled* by a computer.
3. The pressure of combustion *forces* / *is forced* the piston down the cylinder.

4. The fuel/air mixture *compresses* / *is compressed* in the combustion chamber by the rising piston.
5. The rotor arm in the distributor *drives* / *is driven* by the camshaft.
6. Unlike gasoline engines, it is the high temperature of the compressed air that *ignites* / *is ignited* the fuel in the cylinder of a diesel engine, not a spark.

B. Decide which voice (active or passive) the following sentences are in, and form the verbs in parentheses appropriately.

1. The fuel regulator (regulate) ________________ the pressure in the fuel lines.
2. The burnt gases (expell) ________________ from the cylinder by the rising piston.
3. The connecting rod (convert) ________________ the reciprocating motion of the piston into the rotary motion of the crankshaft.
4. The expansion of burning gases (drive) ________________ the piston down.
5. In a steam power plant, heat energy (convert) ________________ into mechanical energy by a turbine steam engine.
6. In gasoline engines, the fuel/air mixture (ignite) ________________ by a spark.
7. The flywheel (transmit) ________________ the rotary motion of the crankshaft to the wheels.
8. The picture (show) ________________ a simple power plant.
9. When the compressed air has reached the self-ignition point of diesel, a fine spray of fuel (inject) ________________ in the cylinder by the injection nozzle.
10. In modern cars, the functions of the engine (monitor) ________________ by a computer.



ARE YOU A GOOD MECHANIC?

Check your knowledge about car engines.

A. Are the following statements true (T) or false (F)? Tick the appropriate column.

	STATEMENTS	T	F	CORRECT ANSWER
	I.C.E.			
1.	The cylinder head is a part of the lower engine.			
2.	Most engines have the cylinders cut in the cylinder block.			
3.	According to the arrangement of cylinders, I.C.E. are distinguished into in-line, radial, horizontally opposed and vee engines.			
4.	The connecting rod moves inside the cylinder.			
5.	The piston rings fill the gap between the crankshaft and the cylinder wall.			
6.	The connecting rod is linked to the flywheel by means of the gudgeon pin.			
7.	The pistons' reciprocating motion is changed into rotary by means of the valve springs.			
8.	The valves are opened or closed by the camshaft.			
9.	The valves open and close ports in the cylinders.			
10.	The crankshaft is driven by the camshaft.			
11.	The flywheel is connected to the gear box through the ignition coil.			
	The 4-stroke cycle of operation in the petrol engine			
12.	During the induction stroke, the exhaust valve is open and the inlet closed.			
13.	The mixture of air and fuel enters the cylinder on the compression stroke.			
14.	Ignition occurs on the power stroke.			
15.	The fuel and air mixture is ignited by means of a spark.			
16.	During the compression and power strokes, both valves are open.			

	STATEMENTS	T	F	CORRECT ANSWER
17.	The piston moves down during the intake and power strokes.			
18.	As the piston moves down, it sucks fuel and air in the cylinder, and as it moves up, it expels burnt gases out of it.			
	The ignition and fuel system in petrol engines			
19.	The ignition coil converts the HT current produced by the battery to a 12V low-tension current.			
20.	The ignition coil is a step-up pulse transformer.			
21.	The contact breaker is an on/off switch which produces pulses of current.			
22.	The rotor arm, driven by the camshaft, distributes the current to the spark plugs.			
23.	In cars with electronic ingition, the distributor has a transistor instead of a contact breaker.			
24.	Gasoline engines use diesel-oil as fuel.			
25.	The operation of the carburettor is based on the venturi effect.			
26.	A jet is a tube through which the air enters the carburettor barrel.			
27.	Engines equipped with fuel injection have carburettors but no distributors.			
28.	The fuel injection is controlled by various sensors.			
29.	The control unit in an electronic ignition system is a computer.			
30.	In conventional petrol engines, fuel and air are mixed in the cylinder.			
31.	Fuel injection reduces the car’s efficiency.			
	Diesel-oil engines			
32.	The diesel engine admits a mixture of fuel and air during the induction strokes.			
33.	In a diesel engine, the temperature of the compressed air is below the self-ignition point of the fuel.			

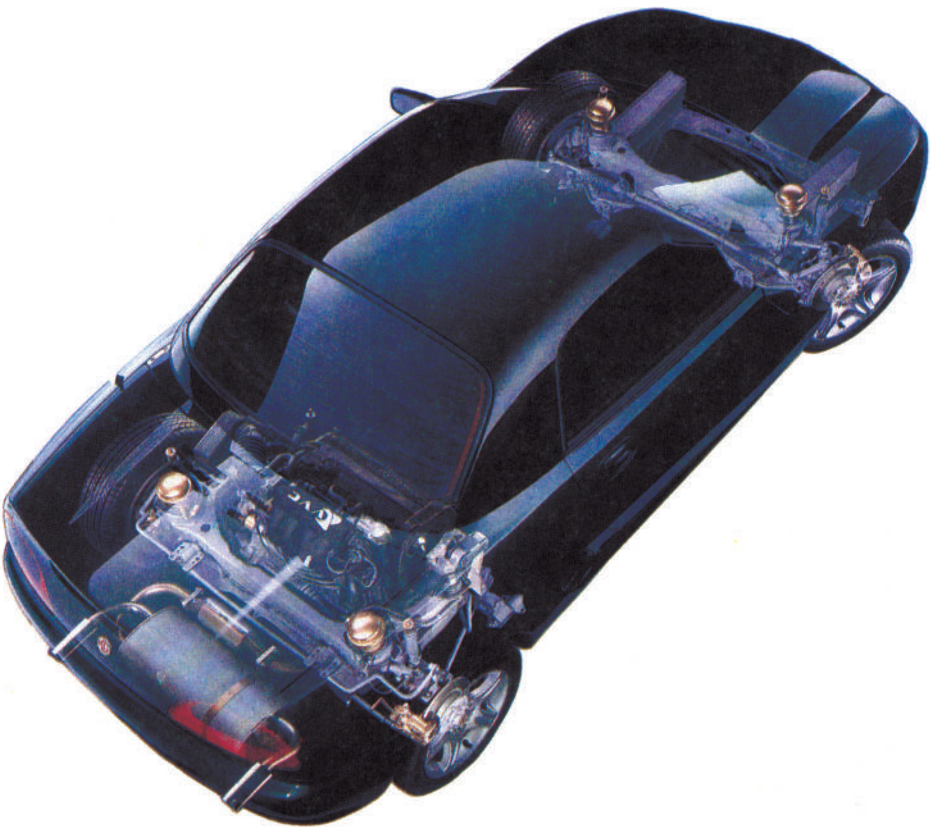
	STATEMENTS	T	F	CORRECT ANSWER
34.	In a diesel engine, the fuel is sprayed in the cylinder at the end of the induction stroke.			
35.	In a diesel engine, the fuel is self-ignited.			
36.	Diesel engines have carburettors and distributors, but no spark plugs.			
37.	The operation of a diesel engine is less noisy than that of a gasoline engine.			
38.	Gasoline engines have higher maximum speed than diesel engines.			
39.	Diesel engines have a higher compression ratio and consume less fuel than petrol engines.			
40.	A gasoline engine has a slower acceleration than a diesel one.			

B. Check your answers with the help of your teacher. How many were correct? Tick the third column.

How did you score?

40-35 Congratulations! you are an excellent mechanic!
35-28 You are a very good mechanic!
28-16 You are quite good. Keep trying.
18- 8 You are not bad, but you have to study hard.
8-10 Oh dear! You must repeat the unit.

THE CAR

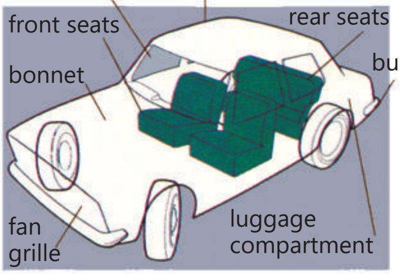


TAKING A DECISION ABOUT A CAR

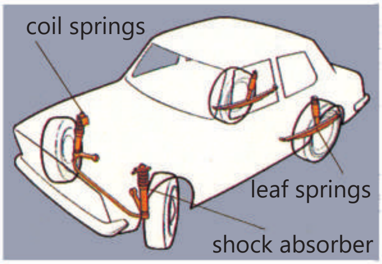
Mr. Grivas lives and works in England. He teaches at a school for Greek students in London. He is about to buy a family car but it's very difficult to choose one because he doesn't know the English terms for cars, their systems and parts. So, he has decided to buy a magazine about cars to get an idea.

Here's what he saw in it!

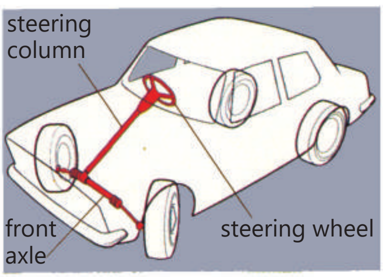
COLLECTING INFORMATION ABOUT CAR MECHANICS



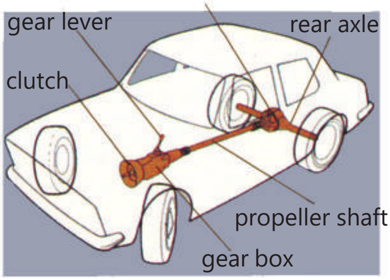
- **Bodywork**



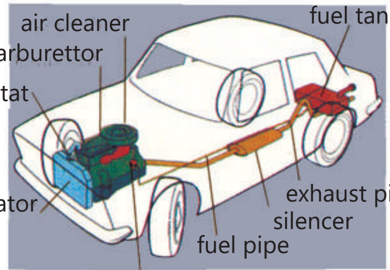
- **Suspension System**



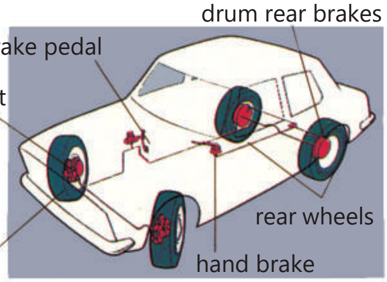
- **Steering system**



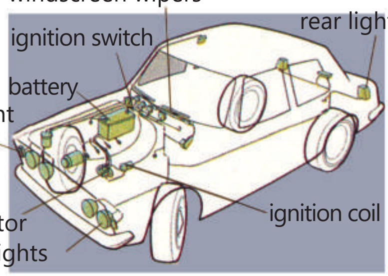
- **Transmission System**



- **Engine**
- **Fuel system**
- **Coolling system**
- **Lubrication system**



- **Braking system**
- **Wheels**



- **Electrical System**

Mr. Grivas got confused. The information was too much and difficult to understand. The mass of tubes, pipes, wires and components under the bonnet of a car can really present a confusing picture. Indeed, a car, including its engine, is assembled of more than 12,000 different parts made of a variety of materials such as steel, glass, nickel and nylon!...

This is what Mr. Grivas did to make the information clear. **Do the same!**

1. Write down the English term for the various car systems and say their Greek equivalent.

1. ____________________	5. ____________________
2. ____________________	6. ____________________
3. ____________________	7. ____________________
4. ____________________	8. ____________________

2. List the parts of the various car systems:

STEERING SYSTEM:

....

SUSPENSION SYSTEM:

....

COOLING SYSTEM:

....

BRAKING SYSTEM:

....

ELECTRICAL SYSTEM:

....

....

....

FUEL SYSTEM:

....

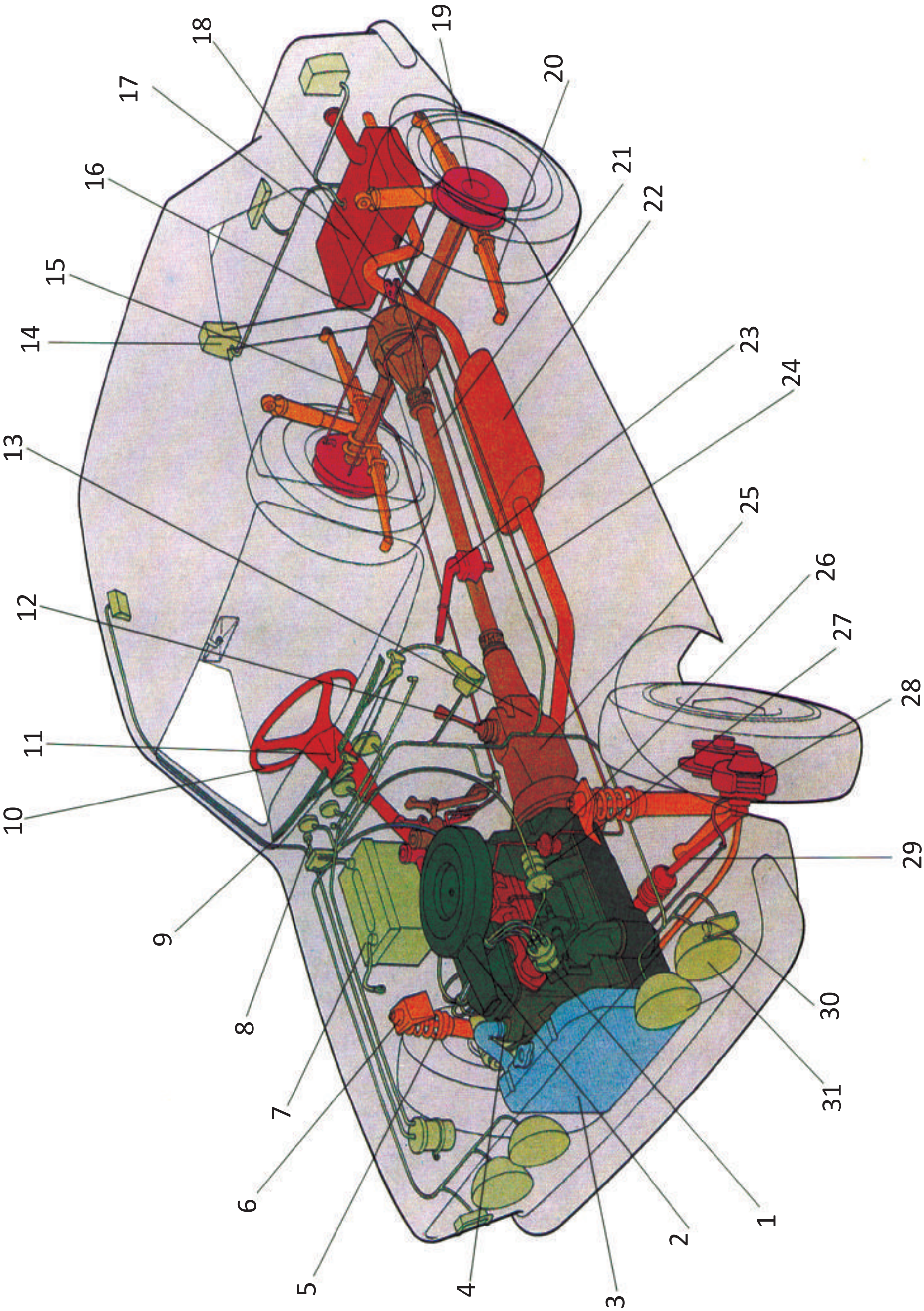
....

....

TRANSMISSION SYSTEM:

....

3. **Label the picture with the parts of the car.**

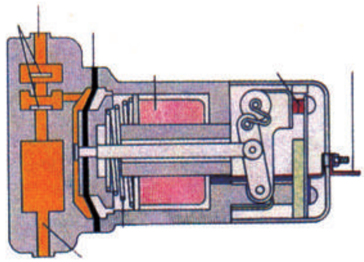


4. Complete the table with the missing term.

English term	Greek term
1. ______________	δοχείο / ντεπόζιτο βενζίνης
2. ______________	αντλία βενζίνης
3. fuel pipe	______________
4. air cleaner	______________
5. ______________	αναμικτήρας / καρμπυρατέρ
6. silencer / muffler	______________
7. ______________	εξάτμιση
8. ignition switch	______________
9. ______________	συσσωρευτής / μπαταρία
10. ______________	πηνίο ανάφλεξης
11. ______________	διανομέας
12. head lights	______________
13. ______________	πίσω φώτα
14. flash light	______________
15. windscreen wipers	______________
16. ______________	ψυγείο
17. thermostat	______________
18. ______________	τιμόνι
19. ______________	άξονας / κολώνα τιμονιού
20. front axle	______________
21. ______________	πίσω άξονας
22. differential	______________
23. propeller shaft	______________
24. ______________	συμπλέκτης/ αμπραγιάζ
25. gear box	______________
26. ______________	μοχλός ταχυτήτων
27. ______________	σπειροειδή / ελικοειδή ελατήρια
28. leaf springs	______________
29. ______________	αποσβεστήρας κραδασμών/ αμορτισέρ
30. disc brakes	δισκόφρενα
31. ______________	ταμπούρα
32. ______________	πέδη στάθμευσης / χειρόφρενο

5. Check your knowledge. Identify the parts or systems of the car described below. Choose the appropriate terms from the list and write them in the spaces provided over each paragraph.

transmission system	propeller shaft	ignition system	brakes
fuel pump	starter motor	differential	



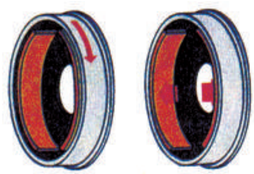
Electric fuel pump

1.________________________

It is a set of gears whose role is to allow for differences in speed between the driven wheels, when the car is running.

2.________________________

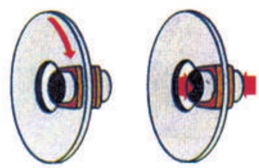
It is used to push the fuel under fairly low pressure to the carburettor.



Drum brake action

3.________________________

It provides the high voltage sparks which ignite the fuel-and-air mixture in the cylinders.



Disc brake action

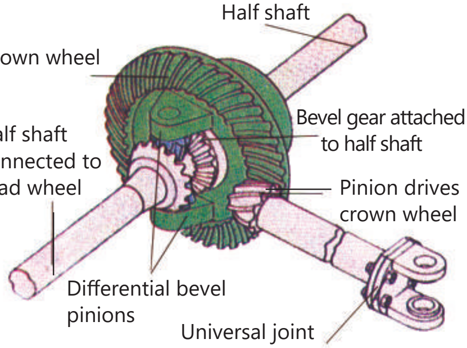
Propeller shaft

4.________________________

It is a system which takes power from the engine and conveys it to the wheels, either to two or to all four of them. It consists of various mechanical components.

5.________________________

It consists of an electric motor mounted on the side of the engine which, by drawing a heavy current from the battery, starts the engine.



Differential

6.________________________

They slow down or stop the car with the help of a material exercising friction on a metal disc or a drum which turns with the wheels.

7.________________________

It is a steel tube with a universal joint at each end which connects the gearbox to the final drive transmitting the full power of the engine to it.

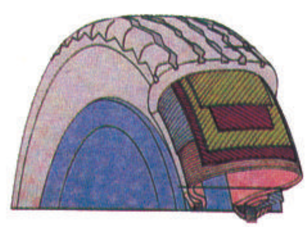
6. Match the sentences below with the part or system of the car (included in the box) they refer to.

Parts – Systems

a. Handbrake: **e.g.** *sentences 7, 12, 16*
b. Clutch: ____, ____
c. Gearbox: ____, ____
d. Steering column: ____, ____
e. Suspension system: ____, ____, ____
f. Battery: ____, ____
g. Tyres: ____, ____, ____

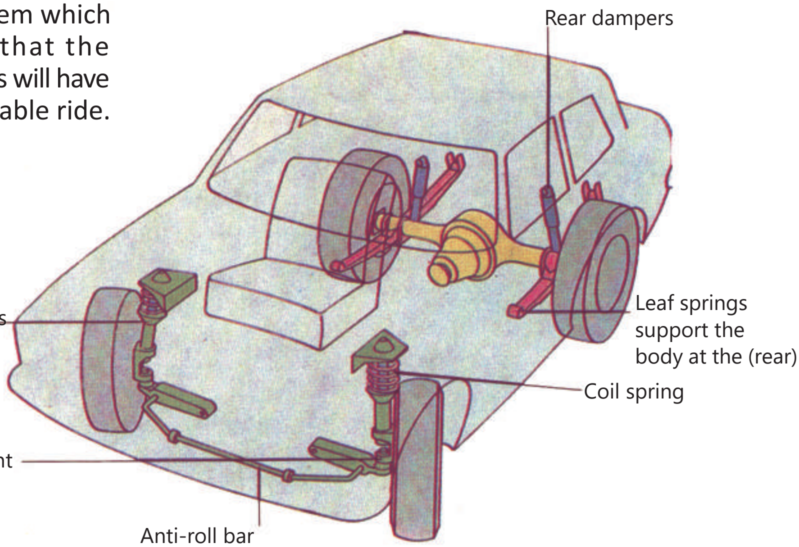
1. It is charged while the engine is running, and provides the vehicle's electrical needs while the engine is stopped.

2. They are rubber rings filled with air and fitted around the wheels.



Tyre

3. It is a system which ensures that the passengers will have a comfortable ride.

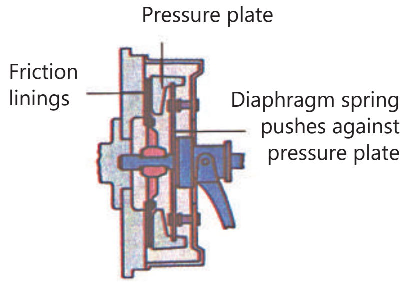


Suspension systems

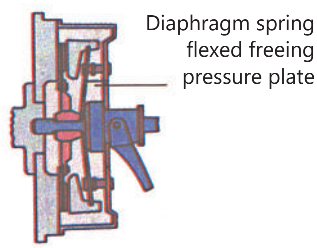
4. It is usually operated either hydraulically or by a cable.

5. The most popular type is a manual one, which offers five choices of gear ratio and the reverse.

6. It disconnects the engine from the road wheels when the driver is changing gear (speed) or bringing the car to a stop.



Clutch engaged

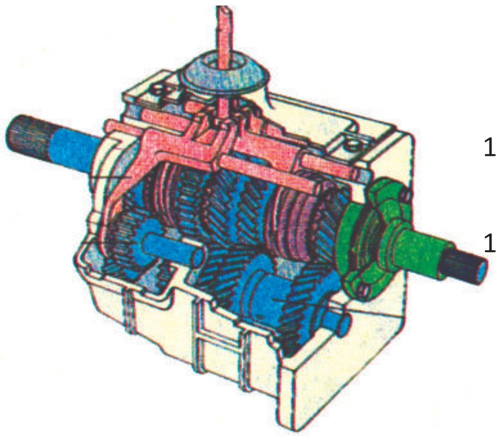


Clutch disengaged

How a diaphragm clutch operates

7. It operates on two wheels only, usually the rear ones.

8. Its function in the car is to keep the engine working at its most efficient speed under all conditions. This is done with the help of a lever which engages the appropriate gear.

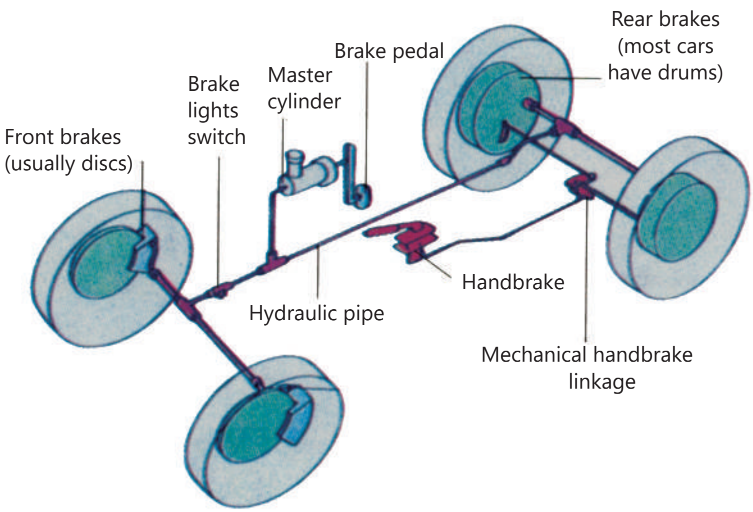


Gearbox

9. It is a shaft which connects the steering wheel to the road wheels through the steering mechanism.

10. They are the only contact of the car with the road.

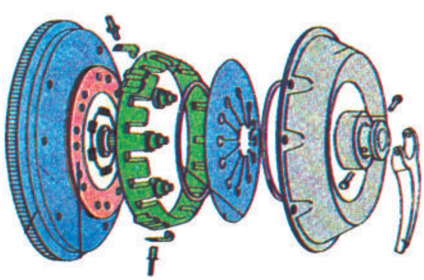
11. It produces the very high current demanded by the starter motor to restart the engine.



Braking system

12. It is worked by pulling a lever.

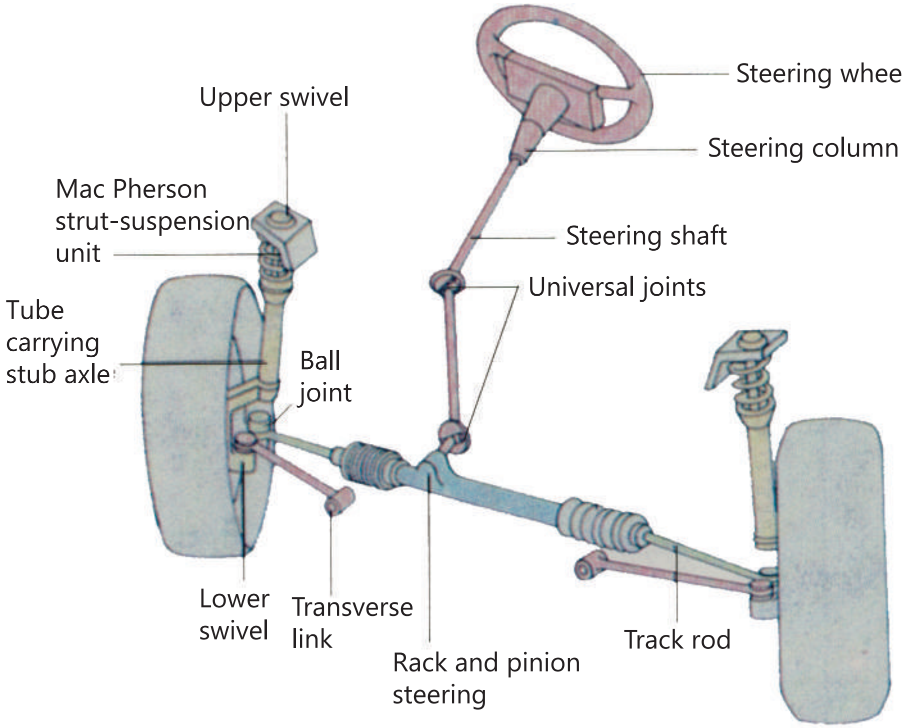
13. It consists of springs (leaf, coil) or a torsion bar and dampers, commonly known as shock absorbers, fitted between the wheels and the bodywork.



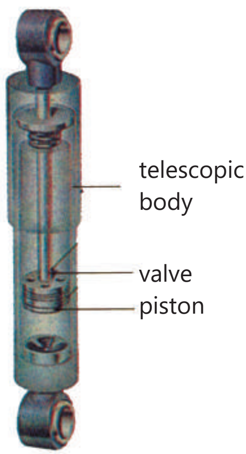
The parts of a diaphragm clutch

14. They are able to carry the full weight of the car and passengers. They must grip the road under all conditions and last a long time.

15. It is a part of the system which allows the car to change direction.



Steering system



Shock absorber

16. It prevents the car from moving when it is parked. It can also bring the car to a halt if the footbrake fails.

17. Its function is to absorb the shocks caused by the irregularities in the road.

7. Write the equivalent English term.

1. τριβή: ____________________
2. ταχύτητα: ____________________
3. η «όπισθεν» (ταχύτητα): ____________________
4. αρθρωτός / σπαστός σύνδεσμος, σταυρός (Καρντάν): ____________________
5. συρματόσχοινο, ντίζα: ____________________
6. μοχλός: ____________________
7. τα ελαστικά (επίσωτρα), λάστιχα: ____________________
8. αντιστρεπτικές ράβδοι / δοκοί: ____________________
9. αποσβεστήρες κραδασμών, αμορτισέρ: ____________________

8. Make pairs of synonyms.

A. Verbs

provide	transfer
allow	carry
convey	supply
ensure	permit
turn	draw
transmit	secure
pull	rotate

B. Nouns

choice	axle
component	shock absorber
damper	option
joint	condition
halt	part
shaft	bond; link
situation	stop

Writing Activity

Provide a full description of each part or system of the car, by joining the sentences referring to it in Exercise 6, in a coherent paragraph. (Use linking words, relative pronouns, etc. to join your sentences)

e.g. *The handbrake is worked by pulling a lever and prevents the car from moving when it is parked or brings it to a halt if the footbrake fails. It operates on two wheels only, and usually on the rear ones.*

Examining Specifications

In the same magazine, various car models and their specifications were included. Here are Mr. Grivas' favourite models.

MODEL	AMX 80	CIEN 3L	MAJERO
Engine	4 cylinder, 16-valve, 4-stroke in-line engine. Spherical combustion chamber. **Cubic capacity:** 1,766 c.c. **Output:** 88.5 HP/DIN at 5,500 r.p.m. **Torque:** 140 Nm at 4,000 r.p.m. **Compression ratio:** 9.5:1 **Top speed:** 200 km/h **Acceleration:** 0-100 km in 11.1 s	4-cylinder, 12-valve, 4-stroke opposed engine. Spherical combustion chamber Cubic capacity: 1,299 c.c. Output: 65HP/DIN at 5,500 r.p.m. Torque: 96 Nm at 3.500 r.p.m. Compression ratio: 8.7:1 Top speed: 170 km/h Acceleration: 0-100 km in 13.8s	4-cylinder, 16-valve, 4 stroke in-line engine. Cublic capacity: 2,555 c.c. Output 103HP/DIN at 4,500 r.p.m. Torque: 192 Nm at 2,500 r.p.m. Compression ratio: 8.2:1 Top speed: 160 km/h Acceleration: 0-100 km in 13.6s
Cooling system	**Water cooled**	**Air cooled**	Water cooled
Fuel system **Ingition** **Fuel consumption**	Electronic fuel injection **Electronic fuel ignition** Catalytic converter **Unleaded gasoline** Fuel tank capacity: 52 litres At a constant 90 km:6.5 l At a constant 120 km: 8 l In city traffic: 9.6 l	Electronic carburettor with fully **automatic choke** and **magnetic impulse transistorized ignition** Catalytic converter. Unleaded gasoline Fuel tank capacity: 47 litres At a constant 90 km:5 l At a constant 120 km: 7 l In city traffic: 8.51	Electronic carburettor with magnetic impulse transistorized ignition. Catalytic converter Unleaded gasoline Fuel tank capacity: 60 litres At a constant 90 km: 7.4 l At a constant 120 km: 10.5 l In city traffic: 12 l
Transmission	4-gear automatic transmission, electronically controlled Engine at the front Front wheel drive	**Cable operated single-plate diaphragm dry clutch** 5-speed **synchromesh** gear box. Engine at the fornt, power transmission to front wheels	Hydraulically actuated **single-plate diaphragm dry clutch with plate spring** Engine at the front, **power transmission to four wheels**

MODEL	AMX 80	CIEN 3L	MAJERO
Steering system	**Power steering** (rack and pinion) Safety steering column **Adjustable steering column**	**Rack and pinion steering** Safety steering column Adjustable steering column	Rack and pinion steering Safety steering column
Suspension	Independent front and rear suspension with shock absorbers **(McPherson struts)**	**Hydropneumatic** independent suspension on all 4 wheels. Height actuators for height adjustment.	Independent front and rear suspension on all four wheels
Brakes	Dual-circuit braking system with brake servo-mechanism Front: single-cylinder, caliper disc brakes Rear: drum brakes Handbrake acting mechanically on rear wheels	Dual-circuit braking system with disc brakes on all 4 wheels and brake servomechanism. Also antiblock (ABS) brakes. Handbrake acting mechanically on rear wheels	Dual-circuit braking system with brake servo-mechanism Front: **single-cylinder, caliper disc brakes** Rear: drum brakes Handbrake acting mechanically on rear wheels
General	Lenght: 4,325 mm, Width: 1,645 mm Height: 1,380 mm Luggage compartment capacity: 485 l Weight unladen: 1,000-1,200 Kg. max. Maximum load: 460 kg Maximum roof load: 70 kg 2-door/ 4-door Driver and passenger airbags Electrically operated door mirrors Engine immobilizer and ultrasonic security system Air conditioner	Length: 4,195 mm, Width: 1,626 mm Height: 1,394 mm Luggage compartment capacity: 435 l and with rear seat folded 766 l Weight unladen: 920 kg Maximum load: 450 kg Maximum roof load: 60kg 4-door / Hatchback Driver and passenger airbags Electrically operated door mirors Engine immobilizer, security system and air conditioner optional	Length: 3,995 mm, Width: 1,680 mm Height: 1,820 mm **Luggage compartment capacity:** 540 l Weight unladen: 1,803 kg Maximum load: 707 kg **Maximum roof load:** 100 kg 2 door / Hatchback Engine immobilizer Ultrasonic security system
Service **Price**	Authorized dealers and service, only in cities and large towns. Spare parts available but delivery usually after 20 days 20,500 £	Authorized dealers and service in every town, even in small villages. **Spare parts** available but expensive. 14,000 £	Authorized dealers and service practically everywhere Fairly cheap spare parts 25,000 £

The specifications of the various models confused Mr. Grivas again. As there were a lot of unknown words, he found it difficult to understand important pieces of information. So, he decided to look the unknown words up in a dictionary. **Do the same.**

Look up the bold-typed words in an English - Greek dictionary or in the Glossary section of this book, and complete the table below.

ENGLISH	**GREEK**
e.g. cubic capacity	κυβική χωρητικότητα
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....

To decide which car to buy, Mr Grivas compared the three models. **Do the same.**

Examples

- *Both AMX 80 and CIEN 3L have spherical combustion chambers.*
- *Only MAJERO has power transmission to four wheels.*
- *All of them have dual-circuit braking system.*
- *MAJERO is heavier than CIEN 3L.*

TAKING THE FINAL DECISION

After Mr. Grivas had examined the advantages and disadvantages of the various systems of the three models, and had taken into consideration the amount of money he could afford, he decided to buy the CIEN 3L model.

Below you can see how he described the car in his letter to a friend, who is very fond of cars and knows a lot about them.

While Mr. Grivas was writing the letter, he left blank spaces to copy some of the items included in the table of specifications.

Choose the appropriate items from the table of specifications, to help Mr Grivas complete the blanks in his letter.

23 J.Smith st.
London SW6
England

27 May 1999

Dear Peter,

I am writing to let you know that I finally bought the car we were talking about when I was in Athens. It is the CIEN 3L. I can hardly find words to describe it. If CIEN's aim was to achieve beauty, there is no doubt that they succeeded through this model.

To begin with, this .... - cylinder, twelve - .... , four- .... , ... engine car is characterized by plenty of modern and innovative details. It is a front- .... , ... -drive model, with a powerful engine and light body and a five-speed .... gear box. It has an .... carburetor with .... ignition. Its .... capacity is 1,299 c.c. and its output .... - at .... It has a .... of 170 km/h and accelerates from 0 to 100 km in ....

Its overall .... is 4,195 mm, while its .... of 1,626mm allows plenty of rear space for the passengers. Its .... compartment is large and with the .... folded, its .... reaches the .... l.

The .... independent .... on all four wheels makes the car suitable for long trips, as this ensures that the passengers will have a comfortable ride.

The .... braking system, with .... brakes on .... wheels,and .... guarantee maximum safety.

Let me now refer to some of the innovative details I mentioned at the beginning of my letter:

Both the front seats and the steering column are .... to adjust to the preferred driving position, while the door mirrors are .... , which I find very convenient.

The car is equipped with a .... streering column and full-size .... airbags to protect both the face and the upper torso in a forward impact, while the adjustable headrests give protection in a rear impact.

Finally, the engine .... and the clever design of the .... system give the highest levels of protection against theft.

These are the most attractive characteristics of 3L. And a last thing that is worth mentioning: CIEN 3L is the best car among those I could afford to buy.

To sum up, I can say that the 3L is a great-looking mid-sized family car with a fine engine and pleasant steering. It is exactly the kind of model on which CIEN has built its reputation. We all enjoy driving it!

I look forward to seeing you soon.

Best wishes
John

TASK

Make a list of the features of CIEN 3L as presented in Mr. Grivas' letter.

1. **Type of car:**..
2. **Engine:** ....
....
....
3. **Fuel ignition system:** ....
....
....

4. **Transmission:** ....
....
5. **Suspension:** ....
6. **Braking system:** ....
....
....
7. **Features that guarantee the safety of the passengers:** ....
....
....
8. **Features that protect the car against theft:** ....
....
9. **Features that ensure the convenience of the driver and a comfortable ride:**
....
....
....
10. **Space for luggage:** ....
....

THE IDEAL CAR

TASK1

Which specifications should characterize the ideal car?
Discuss it with your partner, fill in the table and present your ideal car in class. Give reasons for your choices.

Expressions to help you

I'd like my car to have / be...
My favourite car would be / have...
The ideal car for me would / should be / have...

MODEL	SPECIFICATIONS
Engine	
Cooling System	
Fuel System Ignition Fuel Consumption	
Transmission	
Steering System	
Suspension	
Brakes	
Electrics	
General	
Service	
Price	

TASK 2

What sort of car would you like to buy?
Combine the following adjectives to state your preference.

red	water cooled	Italian	convertible
green	air cooled	German	sports
black	five-speed	Japanese	family
white	fuel injection	American	4-door
blue	1,500 c.c.	French	hatchback
yellow	petrol-engined	Russian	saloon
brown	diesel-engined	Spanish	2-door

e.g. *I'd like to buy a red, petrol-engined, German sports car.*

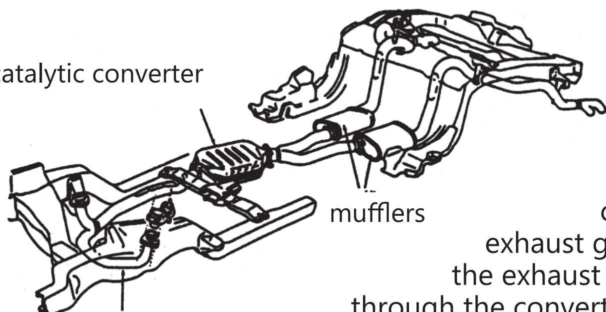
THE CATALYTIC CONVERTER

As environmental pollution has been growing the last decades, the demand for reduction of air pollution has become increasingly urgent. Technology tries to find solutions to the problem. The installation of catalytic converters in modern cars is one of them.

Below, follows a text about catalytic converters. **Read it and answer the questions.**

1. Why do cars add to the air pollution?
2. What is a catalytic converter?
3. What is a catalyst?
4. Where is the catalytic converter located?

In the last stage of the operation cycle of the gasoline engine, when the exhaust valve opens, the fuel is still not completely burned. As a result, pollutants such as hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx) are released into the atmosphere seriously adding to the air pollution. To reduce the level of auto emissions, a number of emission controls have been developed. One of them is the catalytic converter. The substance (platinum, palladium, rhodium) contained in the catalytic converter is called catalyst.

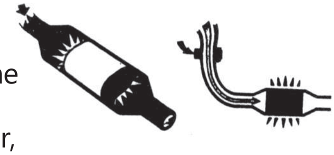


The catalytic converter is inserted into the exhaust system between the exhaust manifold and the silencer. It ensures continuous burning of the exhaust gases as they pass through the exhaust system. As hot gases pass through the converter they come into contact with the catalyst. The catalyst causes a rapid rise in the temperature of the exhaust gases causing the hydrocarbons, carbon monoxide and, to some extent, oxides of nitrogen to change through an oxidizing process (chemical reaction) into harmless water vapour, carbon dioxide, etc. It is considered that the catalytic converter reduces pollutants' emission in a proportion of 90 - 95%.

The catalyst is not consumed or changed by the chemical reaction it causes and, as a result, if it is not exposed to any damage, the life of the converter theoretically can last the life of a car, its usual service life, however, is indicated as a minimum of 80,000 km.

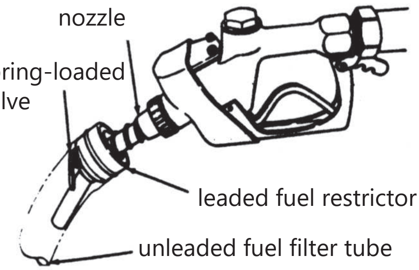
The main causes which damage the catalyst are the use of rich in lead fuel and overheating. So:

- Do not allow unburned fuel to enter the converter, as this may cause fires and other serious problems.



Unburned fuel Overheating

• Do not use leaded fuel in catalytic converter equipped cars, as this may cause damage to both the converter and the engine, resulting in poor engine performance.



To prevent accidental use of leaded fuel, the opening of the fuel tank of the car is equipped with a restrictor. All unleaded-fuel pumps have a special small-size nozzle, that passes through this restrictor.

EXERCISES

1. Below, you are given the main ideas of the paragraphs of the text. Write them as headings in the space provided above the paragraph each idea corresponds to.

- Function of the catalytic converter
- Usefulness of the catalytic converter
- Prevention of damages to the catalyst
- Catalyst service life

2. Answer the questions.

1. Three basic emission controls have been developed to reduce the level of auto emissions: the Internal Engine, the External Engine and the Fuel System Vapour Control. Which of the three types does the catalytic converter belong to?
2. What are the semi-burned gases changed into when they pass through the converter? How is this achieved?
3. How long can a converter last?
4. What should be avoided to prevent damage to the catalyst?
5. Which device ensures the use of the appropriate fuel in cars equipped with a catalytic converter?

3. Match words or phrases with definitions.

1. pollutant	a. it is put in a situation which may damage it
2. it is released	b. a device which sets limits and prevents something
3. auto emissions	c. partly; not entirely
4. to some extent	d. gases of cars released to the air
5. harmless	e. a substance that makes the environment dirty and dangerous to live in
6. it is not consumed	f. it is let to escape from an enclosed space
7. it is exposed to damage	g. not dangerous; not causing harm
8. restrictor	h. it isn’t affected / damaged / destroyed

4. **Word collocations**
Tick appropriately, according to the text.

	monoxide	*fuel*	*valve*	*dioxide*	*emissions*	*pollution*	*vapour*	*reaction*	*manifold*	*gas*	*pump*	*control*	*performance*	*system*
water						✓								
chemical														
unleaded														
exhaust														
air														
auto														
leaded														
emission														
engine														
fuel														
carbon														

5. **Write both the English and Greek terms for the following chemical symbols.**

Element	**English term**	**Greek term**
CO →	____________	____________
CO_2 →	____________	____________
HC →	____________	____________
H_2O →	____________	____________
Pb →	____________	____________

6. **Write the English equivalent to the following Greek terms.**

ρυπογόνος ουσία, ρυπαντής: ____________
ατμοσφαιρική ρύπανση: ____________
έλεγχος εκπομπών (καυσαερίων/ ρυπαντών): ____________

σύστημα εξαγωγής: ____________________
πολλαπλή εξαγωγή: ____________________
σιγαστήρας: ____________________ (also, muffler in Am. E.)
καυσαέρια: ____________________
διαδικασία οξείδωσης: ____________________
χημική αντίδραση: ____________________
αμόλυβδη βενζίνη: ____________________

7. The word «catalyst»

A. Tick the correct answer.

1. What is the origin of the word catalyst?
   a) Latin b) Greek c) Arabic

2. Which subject does it remind you of?
   a) Mathematics b) History c) Chemistry

B. The words in column A below are derivatives of the word catalyst.

a) Match them with their definitions in column B.

b) In the space provided beside each word, write if it is a noun (N), a verb (V), or an adjective (A).

A	B
1. catalysis ____	a) a substance that causes a chemical reaction to take place more quickly
2. catalyse ____	b) the increasing of the rate of a chemical reaction
3. catalyst ____	c) having the property to function as a catalyst
4. catalytic ____	d) to increase the rate of a chemical reaction

Oral Practice

After a session on catalytic converters, the teacher is checking the students' knowledge.

Work in pairs. One of you will take the part of the teacher and the other that of the student. Ask and answer questions about the function, effect, use, location, etc. of the:

a. Catalytic converter
b. Pollutants
c. Catalyst
d. Restrictor

Questions to help you

1. What does the... do?
2. What is the function of the...?
3. What do... cause?
4. What is the use/usefulness of the...?
5. Where is the... fitted?

QUICK DIAGNOSIS

In case your car breaks down or develops a fault and the cause is not directly obvious, the following quick-reference fault-finding chart will help you a) to make a quick diagnosis of the damage and b) to remedy it.

ATTENTION!

Due to misprinting, some items are missing from this fault-finding-chart. They have been printed in a table below it in random order. **Find where in the chart these items should be placed.**

A fault - finding chart at-a-glance

SYMPTOMS	FAULT (CAUSE)	REMEDY
1. Starter does not turn engine	a) ________________ b) Defective battery	a) Recharge battery b) Replace battery
2. Engine turns normally but does not fire	Faulty ignition system	________________
3. ________________	Faulty ignition, or Faulty fuel system	Check components of ignition and fuel system
4. ________________	a) Lack of coolant b) Loose or defective fan belt c) Defective thermostat d) Faulty or leaking water pump	a) Check for leaks and lack of coolant b) Adjust belt tension c) Check fan thermostat and if defective, replace d) Replace faulty water pump
5. Radiator continually requires water	________________	Check and replace hose
6. Engine uses too much petrol	a) Carburettor needs adjusting b) Faulty injectors	a) ________________ ________________ b) ________________ ________________
7. Oil warning light does not go out	________________	Check oil level

SYMPTOMS	FAULT (CAUSE)	REMEDY
8. ________________	Loose or out of balance wheels	a) Tighten wheel nuts b) Check wheel balance
9. Engine runs but car does not move when in gear	________________	a) Check if clutch is correctly assembled b) Replace worn driven (friction) plate c) Replace defective clutch
10. Brakes overheating or smoking	Brakes' shoes binding	________________
11. ________________	Broken brake pipe or leak	Check pipe and replace or repair as necessary
12. Car low at rear	________________	Inflate to correct pressure
13. Steering wheel hard to turn	a) Low front-tyre pressure b) ________________	a) Inflate to correct pressure b) Align correctly
14. ________________	Loose, worn or damaged steering linkages or connections	Tighten or replace parts as necessary
15. ________________	a) Poor connection at battery b) Completely flat battery	a) Clean and tighten connections b) Recharge or replace

Table with the missing information

SYMPTOMS	FAULT (CAUSE)	REMEDY
a) Brakes suddenly fail b) All lamps fail to light c) Engine fires but fails to keep running d) Play in steering e) Car vibrates when running f) Engine overheats	a) Lack of oil b) Battery low in charge or flat c) Wrong tyre pressure d) External leakage in cooling system e) Slipping or failed clutch f) Incorrect wheel alignment	a) Adjust carburettor b) Re-adjust shoes c) Check for spark d) Clean or replace injectors

EXERCISES

1. Look through the "fault-finding chart" to find the phrases which mean:

1. Check how tightly the fan belt is stretched and if loose, tighten it.
2. The car shakes with a very quick movement when it is running.
3. The wheels are not tightly fixed.
4. The clutch plates slide and so, power is not transferred to the wheels.
5. Check if the clutch assembly is correctly fixed and adjusted.
6. The mechanism of the brakes is blocked and so the brake shoes do not allow the wheels to move.
7. The back part of the car is lower than the front one.
8. The driver turns the steering wheel but the wheels do not respond accurately.

2. Match words with definitions.

1. to balance	a) the process of correcting or improving something that is wrong, faulty or harmful
2. to inflate	b) there isn't enough of something or it doesn't exist at all
3. remedy	c) a crack or hole in a pipe through which gas or liquid can pass
4. leak(age)	d) something that is used so much that it has become damaged and unable to be used any more
5. linkage	e) to fill a tyre or a balloon with air
6. lack	f) to fix the wheels of a car so that they are parallel to each other
7. to align	g) to fix something tightly in place so that it remains steady
8. worn	h) the point at which two things are connected. Also, the part that joins two things

3. ELLIPTICAL SPEECH

In technical and scientific language, words and phrases easily understood are often omitted. These are usually articles, verbs, pronouns (personal, relative), the subject or the object of the sentence, etc. Sometimes, even whole sentences are left out. As a result, elliptical speech is not always easily understood and should be developed to make the message clear.

Examples

A. Phrases in elliptical speech

1. Loose, worn or damaged steering system linkage or connections.
2. Check and replace hoses.
3. Faulty ignition.

B. Sentences developed

1. The linkage or the connections of the steering system are loose, worn or damaged.
2. You should check the hoses and, if (they are) faulty, (you should) replace them.
3. There is a faulty ignition. / The ignition is faulty.

PRACTICE

Develop the following phrases.

1. Defective thermostat
2. Poor connection at battery
3. Completely flat battery
4. Inflate tyres to correct pressure
5. Recharge or replace battery
6. Brakes shoes binding
7. Car vibrates when driving
8. External leakage in cooling system

4. Odd-one out

1. faulty flat incorrect defective	2. harmful worn (out) damaged old	3. symptom indication symbol sign
4. linkage connection joint leakage	5. adjust tighten regulate fix	6. remedy correct repalce rectify

5. Translate the following sentences into English. The fault-finding chart will help you.

1. Η μπαταρία είναι τελείως άδεια / «νεκρή». Τι πρέπει να κάνουμε για να την ξαναφορτίσουμε?

   ....
   ....

2. - Η μηχανή γυρνάει κανονικά, αλλά δεν έχει ανάφλεξη.
   - Το πρόβλημα είναι το ελαττωματικό σύστημα ανάφλεξης. Θα το ελέγξω αύριο το πρωί.

   ....
   ....

3. Η ενδεικτική λυχνία του λαδιού δεν σβήνει. Ας ελέγξουμε τη στάθμη του λαδιού.

   ....
   ....

4. Τα φρένα υπερθερμαίνονται επειδή τα τακάκια μπλοκάρουν. Πρέπει να τα ξαναρυθμίσουμε.

   ....
   ....

5. Τα μπροστινά λάστιχα είναι ξεφούσκωτα. Πρόσθεσε αέρα στη σωστή πίεση.

....
....

6. - Το τιμόνι στρίβει δύσκολα.
   - Νομίζω πως το πρόβλημα είναι η κακή ευθυγράμμιση των τροχών.

....
....

7. Ξαφνικά τα φρένα μου δεν πιάνουν. Έλεγξε, σε παρακαλώ μήπως υπάρχει διαρροή στο σωληνάκι.

....
....

8. - Το αυτοκίνητο τρέμει / κοσκινίζει.
   - θα ελέγξω τη ζυγοστάθμιση των τροχών.

....
....

9. - Η μηχανή υπερθερμαίνεται.
   - Νομίζω πως ο ιμάντας του ανεμιστήρα είναι χαλαρός.

....
....

10. - Το τιμόνι έχει τζόγο / λάσκο / παίζει / κοσκινίζει.
    - Φοβάμαι πως τα ακρόμπαρα ή τα σινεμπλόκ είναι χαλαρά ή φθαρμένα.

....
....

Oral Practice

Work with your partner. Ask and answer questions about the various symptoms and their possible cause and remedy. (Follow the patterns indicated in bold-typed letters in the example below and don't forget to develop elliptical speech).

A. What may be the cause if/in case the engine fires but fails to keep running?

B. There may be / Perhaps there is a fault in the ignition system.
or **(Perhaps)** the fuel system **is / may be** faulty.

A. What should be done in that case / then?

B. It should be checked if there is a problem with the components of the ignition and fuel system.
or **The** components of the ignition and fuel system **should be checked for a fault.**

Writing Activity — A short report

Usually, when a technician is asked to maintain or repair a car, he is also asked by his employer to write a report on the procedure he followed. **Imagine that you work in the Sonda Car Repair Workshop. Choose one of the symptoms from the fault-finding-chart and write the report for the car you have just repaired following the pattern below.**

To: The Supervisor of «Sonda Car Repair Workshop»
Kind of job: Repair of Bluebird VG 1,600
Owner of the car: Mr. Peter Christidis
Cost of job: ....

On *(date)* .... I repaired a *(car model)* .... belonging to *(car owner's name)* .... as follows:
The car's / car *(symptom in Past Tense)* ....
....
I examined the possible cause(s) of the damage, that is, if *(the + S. Past / there was / there were)* ....
....
....
I found that the damage was due to *(cause)* ....
....
I *(kind of repair in S. Past)* ....,
.... and so the damage was remedied.

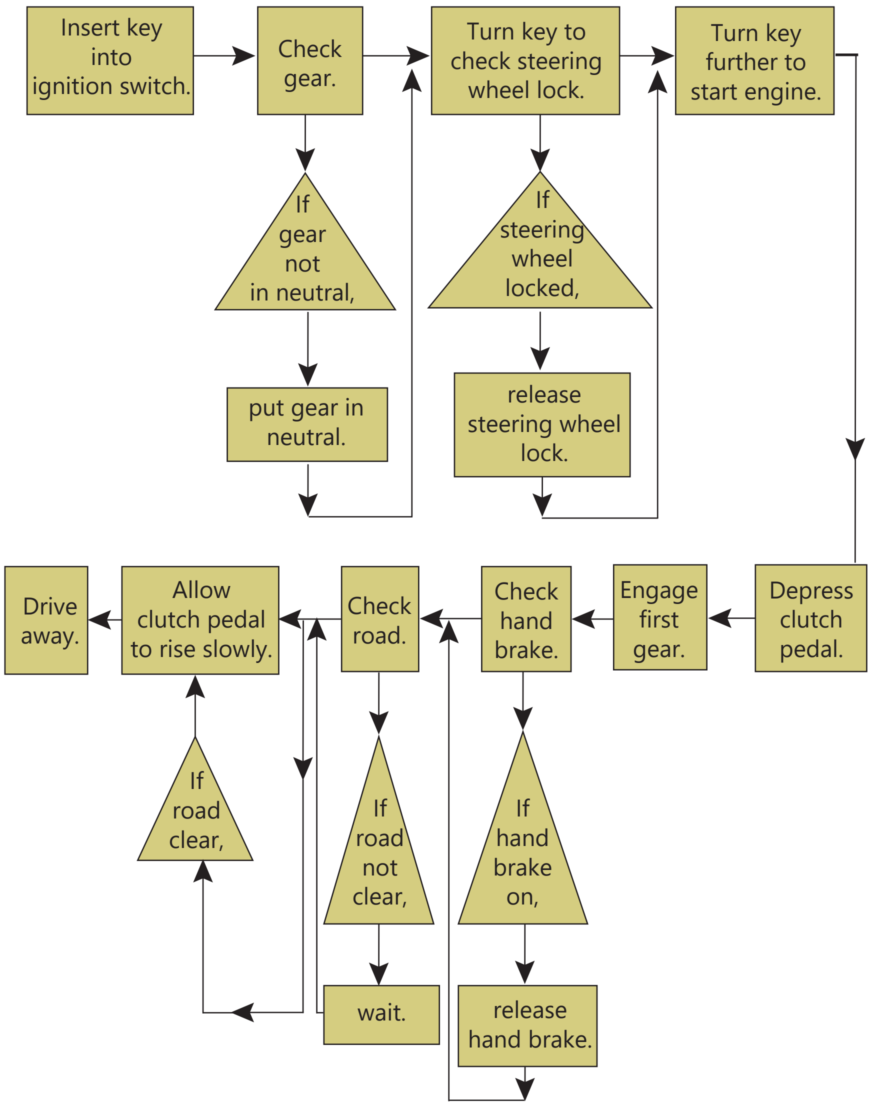
The cost mentioned above includes: a) price of spare parts, b) labour and c) VAT*.

(Signature) ....
.... *(Date)*
....
(Name in full)

* V.A.T. = Value Added Tax (= Φ.Π.Α.)

STARTING A CAR

You are learning how to drive a car. In the first lesson, the driving instructor gave you the following flowchart which presents the procedure of starting a car to familiarize you with it.



Make sentences as in the examples.

- *(The) inserting (of) the key into the ignition system is done before (the) checking (of) the gear.*
- *(The) checking (of) the gear is done after (the) inserting (of) the key into the ignition system.*

Writing Activity — Describing a procedure

Write a step-by-step description of the procedure followed to start a car. Use the Passive Voice, where possible, and linking words (such as: first(ly), second(ly), third(ly), then, after that, next, finally, etc.) to join your sentences.

Start like this:

First, the key should be inserted into the ignition switch. ....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....

Listening Activity

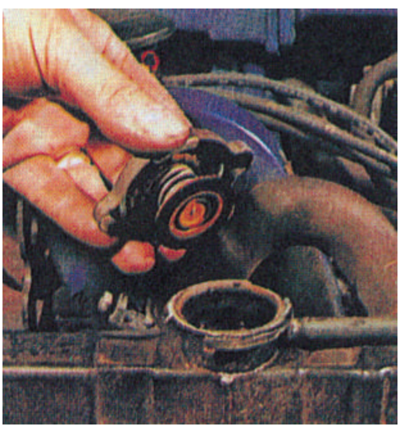
STEP 1

The pictures are related to the text you are going to listen to. What is it about? **Choose the correct of the alternatives below.**

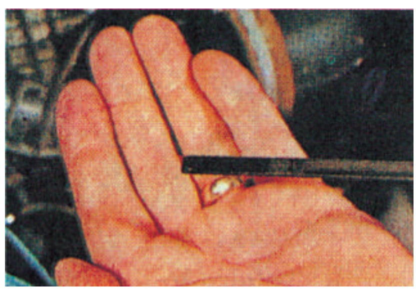
The text is about
- □ a. the changing of a wheel.
- □ b. The specifications of a car.
- □ c. Regular car checks.

1. ______________________

2. ______________________



3. ______________________



4. ______________________

STEP 2

Listen to the text and check your answer.

STEP 3

Listen to the text again and in the spaces provided in the table below, write what each car check refers to.

CAR CHECKS	WHAT IS CHECKED
1st	**e.g.** *engine's oil level*
2nd	
3rd	
4th	
5th	
6th	
7th	

FOLLOW UP

In the spaces provided below the pictures, write the car check each of the pictures illustrates.

GENERAL EXERCISES

1. Use the table to form as many instructions as possible.

apply depress engage start release inflate pull up tighten recharge fire disengage adjust	the	battery gear handbrake tyre engine handbrake lever wheel nuts pedal carburettor

e.g. *Apply the handbrake.*

2. Fill in the gaps with the appropriate prepositions. Choose from the list.

in by inside with to on at from through between of into

1. A fine spray ____________ fuel is injected _________ an injection nozzle _______ the cylinder.
2. The catalyst is not consumed or changed _______ the chemical reaction.
3. _______ the internal combustion engines, combustion takes place _____ the engine.
4. The clutch disconnects the engine _______ the road wheels.
5. Unburnt fuel should not be allowed _______ enter the catalytic converter.
6. The handbrake operates _______ two wheels only.
7. The catalytic converter is located _______ the exhaust manifold and the muffler.
8. The propeller shaft is a steel tube _______ a universal joint _______ each end.
9. Rich _______ lead fuel causes damage _______ the catalyst.
10. The suspension system consists _______ springs and dampers.
11. The petrol and air mixture is ignited _______ the cylinders.
12. The opening _______ the fuel tank is equipped _______ a restrictor.

3. Look through the table of specifications to find words or phrases that characterize the following:

1. ____________ , _______ , _______ , ____________ engine

e.g. *4-cylinder, 4-stroke, 12/16-valve, in-line/opposed engine*

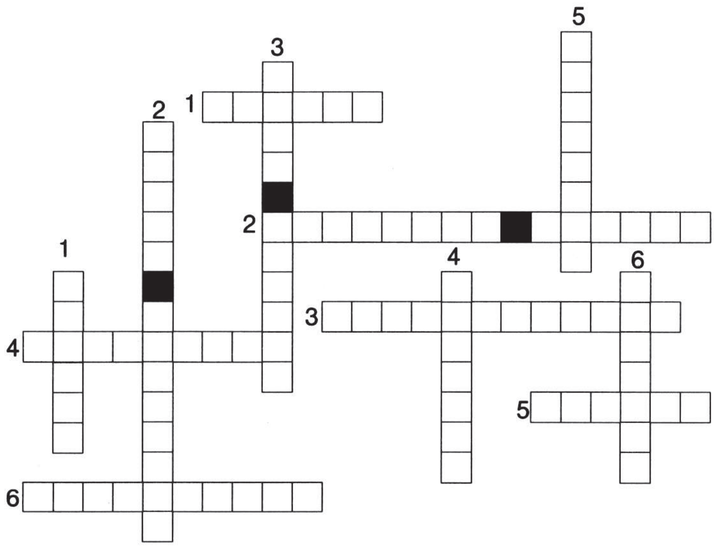
2. ____________ /____________ ignition
3. ____________ /____________ petrol / gasoline
4. ____________ combustion chamber
5. ____________ /____________ steering
6. ____________ gear box
7. ____________ /____ ____________ clutch
8. ____________ /______________________ suspension
9. ____________ service
10. ____________ load
11. ____________ speed
12. ____________ parts
13. ____________, ____________ disc brakes
14. ________________________ braking system

4. Choose verbs from the list to fill in the gaps. All the verbs should be placed in the Passive Voice.

push	take	ignite	convey	stop	offer	engage	draw
slow down	supply						

1. Power ____________ from the engine and ____________ to the wheels through the transmission system.
2. The appropriate gear ____________ with the help of the clutch.
3. While the engine stops, the vehicle's electrical needs ________________________ by the battery.
4. A heavy current ____________ from the battery by the starter motor.
5. The petrol and air mixture ____________ in the cylinders.
6. The car ____________ or ____________ with the help of the brakes.
7. The fuel ____________ to the carburettor or the injectors by the fuel pump.
8. Five choices of gear ratio ____________ by the manual gearbox.

5. Complete the puzzle with the English equivalent of the words below.



Across
1. Συμπλέκτης
2. Άξονας διεύθυνσης/κολώνα τιμονιού
3. Διαφορικό
4. Χειρόφρενο
5. Τροχοί
6. Ανάρτηση

Down
1. Φρένα
2. Αποσβεστήρες κραδασμών, αμορτισέρ
3. Σύστημα καυσίμου
4. Κιβώτιο ταχυτήτων
5. Ψυγείο αυτοκινήτου
6. Μπαταρία

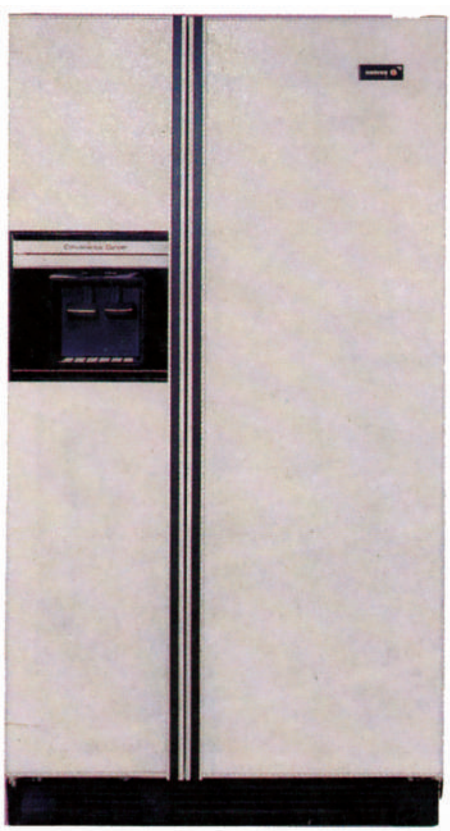
REFRIGERATION

HEAT AND REFRIGERATION

Read the text and answer the questions. Write your answers in the spaces provided.

What is heat?

What is cold?



What is refrigeration?

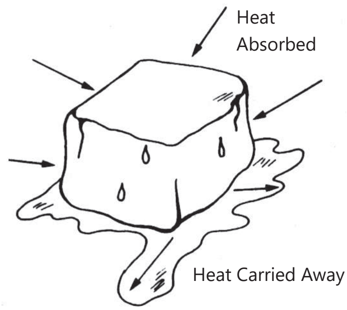
What is refrigeration used for?

Heat is a form of energy. Every object contains heat. When heat is removed from an object or a space, its temperature decreases and so cold is produced. In other words, cold is the absence of heat. The more heat is removed, the colder the object or the space becomes. If all heat is removed, the temperature falls to the absolute zero, that is -273 °C.

The process of removing heat from an object or space, thus lowering its temperature and maintaining it low, is called refrigeration.

Refrigeration is used to preserve perishable foodstuffs and other items, such as pharmaceuticals (cold storage), or to provide a comfortable atmosphere in spaces where people live and work (comfort space cooling).

Low temperatures may be produced when appropriate substances absorb heat in changing state. This may be purely a physical phenomenon, as when a liquid changes into a vapour, or a chemical-physical phenomenon, as when ice melts in the presence of salt.



The quantity of heat abstracted or absorbed is expressed in calories (cal) or British thermal units (BTU). The rate of heat absorption is expressed in tons of refrigeration (TR), in BTU per hour (BTU/h) or in kiloWatts (kw).

EXERCISES

1. Match the two columns to make meaningful sentences.

1. Heat is contained
2. Cold is produced
3. Refrigeration is
4. Cold is
5. The absolute zero is
6. Heat is
7. Cold storage
8. Some substances in changing state
9. The abstracted heat
10. The rate of heat absorption

a. used for cold storage and comfort space cooling.
b. is expressed in TR, BTU/h or kW.
c. a form of energy.
d. absorb heat from the surrounding space and so produce low temperatures.
e. - 273 °C.
f. in every object.
g. is measured in cal or BTU.
h. when heat is removed from an object or space.
i. is used to preserve perishable foods, pharmaceuticals, etc.
j. the absence of heat.

2. A. Underline the following words in the text.

§ 1 : form, removed, decreases, falls
§ 2 : process, lowering, maintaining
§ 3 : items, pharmaceuticals, provide, spaces
§ 4 : appropriate, vapour
§ 5 : expressed, rate

B. Replace each of the underlined words with its synonym from the list below.

places drops medicines kind falls objects measured suitable degree abstracted method gas offer keeping reducing

3. A. Identify the word defined in each of the sententeces below and write it in the space provided. Choose from the list.

cold storage state perishable abstract/remove absorb refrigerate preserve

1. When you talk about the ____________ of a substance, you mean the form it is in, e.g. liquid.
2. If something ____________ a liquid, gas or other substance, it soaks it up or takes it in.
3. If you ____________ something from a place, you take it from there.
4. When you ____________ something, e.g. food, you lower its temperature in order to keep it in a good condition for long.
5. If you ____________ something, e.g. food, you take action to protect it from damage or decay.
6. ____________________ is the process of keeping something in a special place, where the temperature is low, until it is needed.
7. Goods that are __________________ go bad after quite a short length of time.

B. Fill in the gaps with words from the list in A above.

1. Meat and eggs are highly ______________________ and must be put in the fridge before and after cooking.
2. ____________ the fish in the fridge until serving time.
3. Thanks to ____________________ , foods and medicines can be kept in a good condition for long and they can be transported over long distances.
4. Matter can be found in all three ____________ : liquid, solid and gaseous.
5. Refrigeration is obtained when some substances, in changing state, heat from the surrounding air, thus lowering its temperature.
6. If you want to ____________ it longer, put it in the freezer.
7. Ice ____________ heat from the air and melts.

4. Make pairs of antonyms out of the two lists in each group.

GROUP 1

A. absence – heat – remove – decrease – preserve

B. increase – cold – spoil; destroy – presence – keep; add

GROUP 2

A. refrigerate – lower – normal – appropriate – abstract – more

B. absorb; take in – inappropriate – raise – heat – less – abnormal

5. EXPRESSING PARALLEL INCREASE

To express parallel increase, follow the pattern:

The + comparative, → the + comparative

Examples

(much) heat is removed from an object or space / (cold) it becomes
- *The more heat is removed from an object or space, the colder it becomes.*

(much) toxic a substance is / (little) it is used
- *The more toxic a substance is, the less it is used.*

PRACTICE

Use the cues below to make meaningful sentences as in the above examples.

1. (high) the pressure of a liquid is / (high) its temperature becomes.
2. (explosive) a refrigerant is / (little) it is used.
3. (much) heat an object absorbs / (hot) it becomes.
4. (efficient) the heating system / (comfortable) the house.
5. (frequent) the maintenance of a machine is / (long) its life will be.
6. (low) the temperature foods are stored at / (long) they will be preserved.
7. (advanced) a device is / (expensive) it is.
8. (simple) the programming of a device / (friendly) to the user it is.
9. (hot) the weather / (much) water we need.
10. (little) you eat / (healthy) you are.
11. (fast) a car goes / (dangerous) it becomes.
12. (experienced) you are / (easy) you'll find a job.
13. (soon) the new machinery is installed / (good) for the firm.
14. (much) you smoke / (bad) for your health.

METHODS OF REFRIGERATION

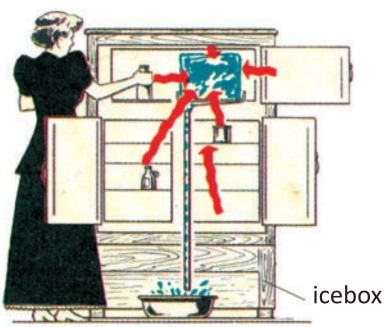
Since the beginning of time various methods have been used to produce refrigeration. The most important are: refrigeration from ice and mechanical refrigeration, which includes the absorption and compression systems.

REFRIGERATION FROM ICE

Refrigeration from ice is the oldest method used to preserve or chill foodstuffs. How much do you know about it?

Answer the questions. Then, read the text which follows and check your answers.

1. When did mechanical refrigerators start replacing iceboxes?
2. What did iceboxes consist of?
3. How is refrigeration achieved when ice is used as a refrigerant?
4. What is dry ice?
5. Is it possible to achieve quantity refrigeration employing this method?



For centuries, ice, natural or manufactured, has been the only source of refrigeration. Its use was widespread until shortly before the First World War, when mechanical refrigerators became available. It is still used to preserve foodstuffs (e.g. fish) for a short time, as well as in areas where electric power is not available. In our country, iceboxes were used until the mid-60's.

Ice owes its effectiveness as a cooling agent to the fact that it has a constant fusion temperature of 0 °C (32 °F). As ice melts under atmospheric pressure, it absorbs heat from the air surrounding it, thus producing refrigeration.

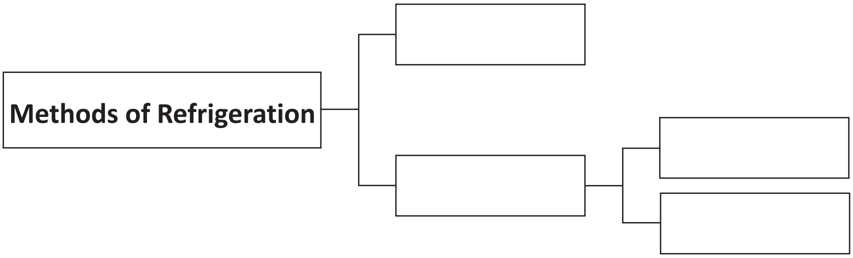
Though simple and cheap, refrigeration from ice has certain disadvantages:

- food cannot be preserved for long,
- the ice compartment of the icebox requires frequent refilling,
- the water from the melting ice has to be drained away frequently.

Another refrigerating material similar to ice is solid carbon dioxide (CO_2), known as «dry ice». At normal atmospheric pressure, it changes directly from the solid to the vapour phase at a temperature of -78.5 °C (-109.5 °F). As a result, dry ice is effective for maintaining products at very low temperatures but, as with ice, it is impossible to obtain fully flexible ranges of temperature or quantity refrigeration with it.

EXERCISES

1. **Complete the diagram with the methods of refrigeration.**



2. **A. Are the statements below true or false? Tick appropriately.**

T	F	Statements
		1. In Greece, iceboxes* were widely used until mid-70's. 2. Ice has a constant fusion temperature of -5 °C. 3. Dry ice is suitable for preserving products at very low temperatures. 4. At normal atmospheric pressure, solid carbon dioxide changes from the vapour to the solid state at -59° C. 5. Ice can produce lower temperatures than dry ice. 6. The ice compartment of an icebox needs regular refilling and the water from the melting ice must be drained frequently. 7. Using ice as a cooling medium, we can obtain fully flexible ranges of refrigeration. 8. Due to the low temperatures it produces, ice can preserve foods for only a short time.

B. Identify the wrong information in the false statements and correct it.

3. **Match words with definitions.**

1. substances which people eat; provisions
2. something that exists or happens over a large area
3. something that happens often
4. something that can change easily and adapt to various conditions or requirements
5. to remove a liquid from a place or object by making it to flow somewhere else
6. a separate part

a. to drain
b. flexible
c. compartment
d. frequent
e. foodstuffs
f. widespread

* Iceboxes are special cupboards equipped with a compartment for putting ice, another for storing foodstuffs and a drawer for gathering the water resulting from the melting ice.

4. **Look through the text to find words with a similar meaning to the following.**

§ 1 not long, a little after or before something: ______________
accessible; handy: ______________
to keep; to maintain in a good condition: ______________

§ 2 efficiency: ______________
refrigerant; refrigerating material: ______________
fixed; steady: ______________
melting: ______________
to take; to draw in: ______________
around: ______________

§ 3 of low cost; not expensive: ______________
drawback: ______________
to need: ______________
often; regular: ______________

§ 4 substance: ______________
usual: ______________
gaseous: ______________
state; form: ______________
to achieve: ______________
variable; versatile: ______________

Writing Activity

Write a short paragraph stating the reasons refrigeration from ice (ice and solid CO_2) cannot achieve flexible ranges of temperature and quantity refrigeration.

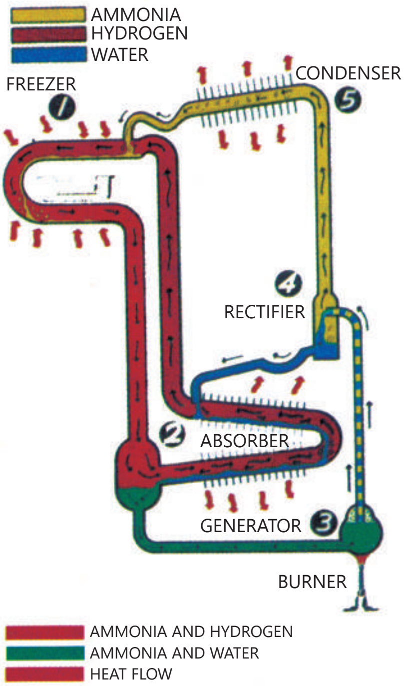
Epxressions to help you

- also / as well / too
- on the contrary / on the other hand
- but / although / however
- both / (n)either... (n)or
- because / as / since
- so / as a result / thus

MECHANICAL REFRIGERATION

In mechanical refrigeration, constant cooling is achieved by the circulation of a refrigerant in a closed system, in which it evaporates to a gas and then condenses back to a liquid in a continuous cycle.

Mechanical refrigeration has completely replaced refrigeration from ice since, with it, we can obtain fully flexible ranges of temperature and produce refrigeration in quantity. There are two main types of mechanical refrigeration: the absorption system and the compression system.



1. The Absorption System

It is now employed largely for heat-operated air-conditioning units, but formerly it was also widely used for heat-operated domestic refrigerators. Nowadays only a few household units, called gas refrigerators, operate on the absorption principle.

In absorption systems, refrigeration is obtained by the use of ammonia (NH_3), water (H_2O) and hydrogen (H) which circulate in a closed system, the main parts of which are: the generator, the condenser, the evaporator and the absorber.

In changing from liquid to gas in the evaporator, ammonia absorbs latent heat from the surrounding metal and thereby refrigeration is achieved.

The reason this method isn't widely used in domestic units is that ammonia is toxic and explosive, the construction of absorption type refrigerators expensive and their maintenance difficult.

2. The Compression System

It is the most widespread method in domestic units for large cold-storage applications and for most air-conditioning units all over the world. It is a highly scientific method with which we can achieve very low temperatures to store large quantities of foodstuffs for long.

Compression systems employ four elements in the refrigeration cycle: the compressor, the condenser, the expansion device and the evaporator. They use a great variety of refrigerants, such as R-12, R-22, R-123, R-134a, ammonia, etc.

As in absorption systems, refrigeration in compression systems is achieved when the liquid refrigerant, in vaporising, absorbs heat from its surroundings.

* The rectifier, also called "separator", separates the water from ammonia. The water flows to the absorber while the ammonia flows to the condenser.

EXERCISES

1. Choose the correct alternative.

1. In mechanical refrigeration, the refrigerant circulates in a *closed* / *open system.*
2. Heat-operated air-conditioning and refrigerating units operate with the heat produced by *electric power* / *coal or lignite* / *gas.*
3. Absorption principle is now employed *largely* / *rarely* in air-conditioning units.
4. Absorption refrigerators use *ice* / *ammonia* / *R-12, 22, etc.* as a cooling medium.
5. Nowadays there are *only a few* / *a lot of* gas refrigerators.
6. Compression systems use *solid carbon dioxide* / *ice* / *R-12, R-22, R-123, R-134a, etc.* as a cooling agent.
7. The cycle of refrigeration in both mechanical refrigeration systems comprises *four* / *five* / *six* main components.
8. The compression system is *wide (widely)* / *rarely* used for cold storage and comfort space cooling.
9. The absorption method is not widely used because the refrigerant it uses *doesn't produce low temperatures* / *is toxic and explosive* / *is expensive.*
10. In mechanical refrigeration, as the refrigerant flows from one component in the refrigeration cycle to the other, it changes from *solid to vapour* / *liquid to vapour* / *solid to liquid.*
11. In both mechanical refrigeration systems (absorption and compression), refrigeration is produced in *the condenser* / *evaporator* / *compressor.*
12. *Only two* / *three* / *all four* components in the refrigeration cycle are the same in the two systems of mechanical refrigeration.

2. Look through the text to find the words that could be replaced with the following:

A. In the «Mechanical Refrigeration»

1. continuous: ______________
2. refrigeration: ______________
3. fluid: ______________
4. fully; entirely: ______________
5. basic: ______________

B. In the «Absorption System»

1. before; in the past: ______________
2. household: ______________
3. components; elements: ______________
4. thus; consequently: ______________

C. In the «Compression System»

1. uses: ______________
2. cooling media: ______________

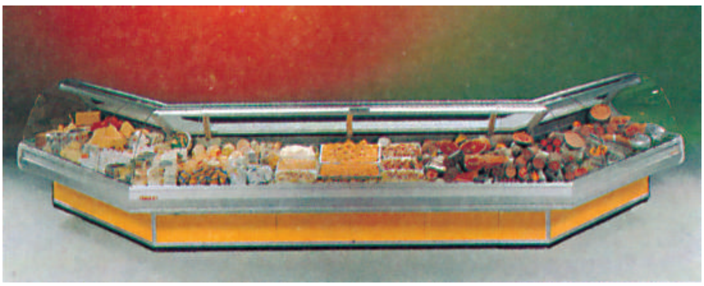
3. Odd-one out

1 latent latter hidden invisible	2 comprise employ apply use	3 kind sort category type
4 achieve obtain fulfill win	5 create produce invent generate	6 operate perform work function

4. Use the information on the three methods of refrigeration and tick the grid appropriately.

CHARACTERISTICS		REFRIGERATION		
		From ice	**Absorption**	**Compression**
1	used if electric power isn't available			
2	widely used for cold storage and comfort space cooling all over the world			
3	used mainly for comfort space cooling			
4	gas is used to heat the refrigerant			
5	refrigeration is achieved without mechanical means			
6	electricity is used as a source of energy			
7	flexible ranges of refrigeration can be obtained			
8	quantity refrigeration is not possible			
9	foodstuffs can be preserved for long			
10	foodstuffs are preserved for short			
11	expensive construction			
12	frequent drainage needed			
13	constant temperature of refrigeration			
14	toxic and explosive refrigerant			
15	frequent refilling with refrigerant needed			
16	difficult maintenance			

CHARACTERISTICS		REFRIGERATION		
		From ice	Absorption	Compression
17	cheap method			
18	ammonia used as a refrigerant			
19	ice used as a refrigerant			
20	R-12, 22, 123, 134-a, etc. used as a cooling agent			
21	the refrigerant circulates in a closed system			
22	its main parts are: the evaporator, the compressor, the condenser and the expansion device			
23	its main parts are: the generator, the condenser, the evaporator and the absorber			



A commercial refrigerator

5. COMPARING

Using the above table and the information in the texts, compare the three methods of refrigeration. (For expressions to use, see the «Language Functions» section in the APPENDIX, at the end of your book)

Examples

- *Flexible ranges of refrigeration can be achieved by either absorption or compression system.*
- *Both mechanical refrigeration systems are used for comfort space cooling.*
- *Absorption systems are used for comfort space cooling. So do compression systems.*
- *Neither absorption nor compression refrigeration uses ice as a cooling medium.*
- *Although absorption systems can achieve flexible ranges of refrigeration, they aren't so widely used as compression systems.*
- *Compression systems have compressors. Absorption systems have absorbers, instead.*

Listening Activity

Words to help you

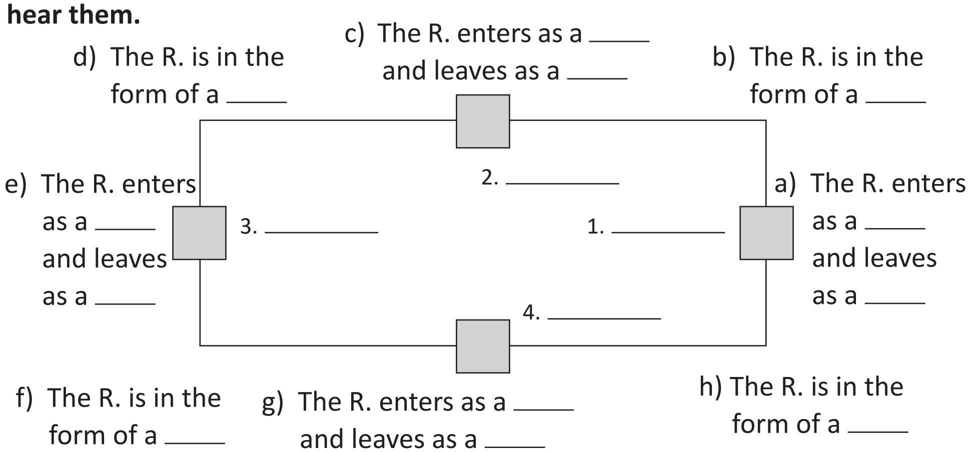
solution: the liquid that results from dissolving a solid or gas in a liquid (e.g. the solution of sugar in tea, of ammonia in water, etc.)
partially: partly, not completely (e.g. a partially cooled refrigerant
weak: not strong (e.g. a weak solution)

STEP 1

Listen to the text and identify the method of refrigeration described.

STEP 2

Familiarize yourself with the diagram below. Listen to the text and in the spaces provided (1-4), write the main parts of the described system in the order you hear them.



STEP 3

Listen to the text again and complete the gaps in the sentences (a-h) of the diagram with the state of the refrigerant (R) in each part of the system. Write: S for solid, L for liquid and G for gas/vapour.

FOLLOW UP

Say the components of the system in which the refrigerant enters and leaves in the same state (=having the same form).

Writing Activity

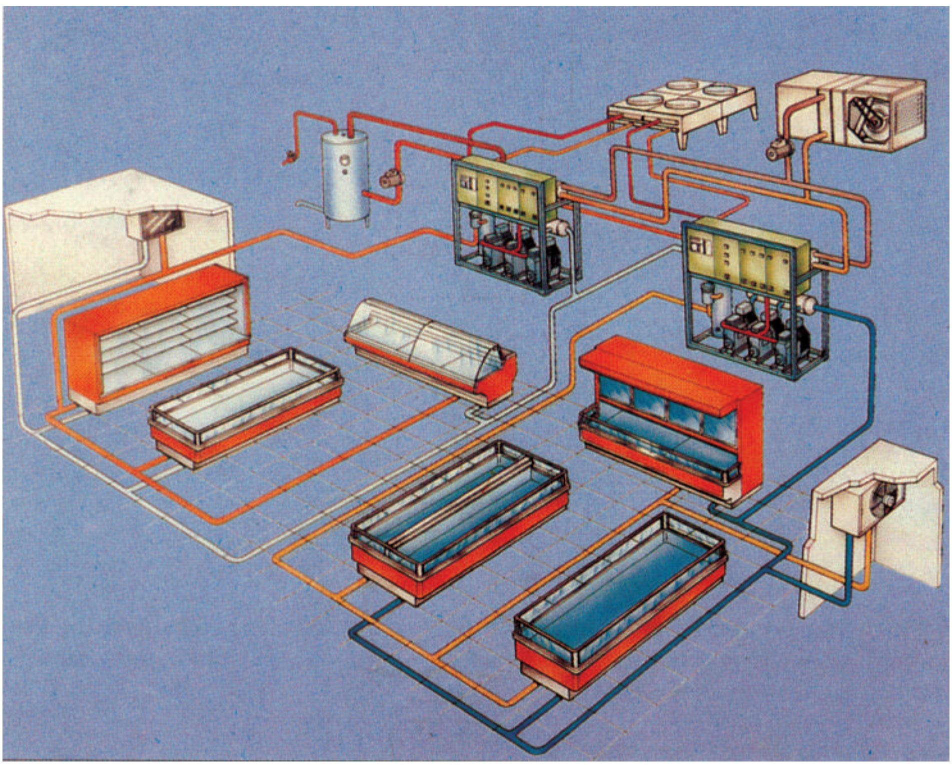
Taking your information from this unit, write a text comparing the three types of refrigeration.

Ideas to include:

- Definition of the term «refrigeration»
- Applications
- Classification of methods and distinction between them
- Main similarities and differences
- Comparison of characteristics

Don't forget to split your text into paragraphs.

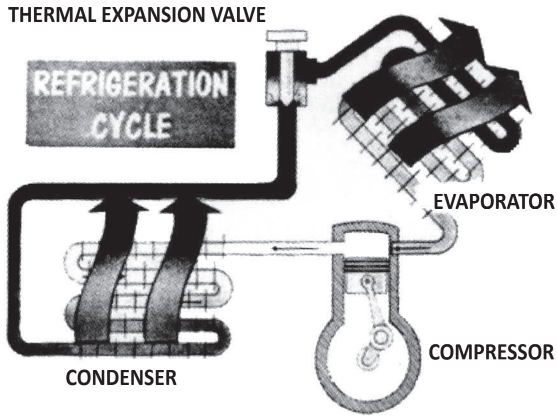
Don't forget to use linking words to join your sentences and paragraphs.

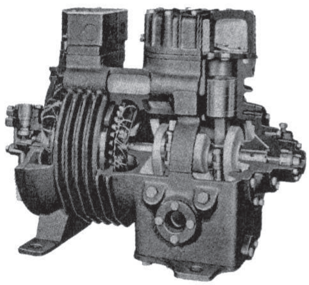


Commercial multi-compressor refrigeration system installed in a super-market

THE REFRIGERATION CYCLE OF THE COMPRESSION SYSTEM

Every compression refrigeration system consists of four basic mechanical components: the compressor, the condenser, the expansion device and the evaporator.

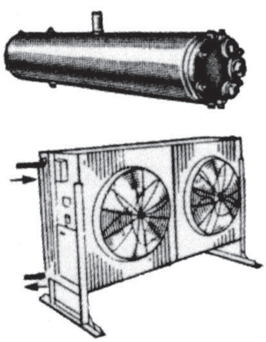




The Compressor

The compressor, which is driven by a motor, is the main part in the compression refrigeration cycle. The main types of compressors used are: the reciprocating, the rotary, the scroll and the centrifugal. The latter is applied to larger capacity units (75 tons of refrigeration and more).

The refrigerant coming from the evaporator in the form of low temperature and pressure gas is drawn in the compressor through the suction valve. The compressor compresses the refrigerant, that is, it raises its pressure (and, as a result, its temperature), and discharges it through the discharge valve to the condenser in the form of a high pressure and temperature gas.

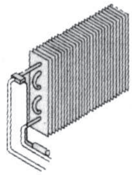


The Condenser

The condenser is an apparatus which extracts sensible and latent heat from the high temperature and pressure vapour refrigerant and rejects it (the heat) into a cooling medium: water, circulating through the condenser in water-cooled systems, or air, in the case of air-cooled installations. In this way, the refrigerant is condensed to a liquid, that is, its temperature drops and it becomes a liquid.

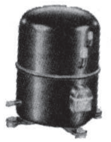
The total amount of rejected heat in the condenser can be expressed in a simple equation: Qev + Qcom = Qcon*.

evaporator



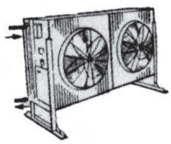
HEAT ADDED HERE (Q_{ev})
PLUS (+)

compressor



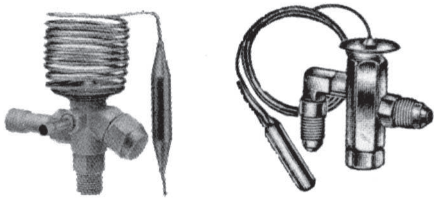
HEAT ADDED HERE (Q_{com})
EQUALS (=)

condenser



HEAT WHICH MUST (Q_{con})
BE REJECTED HERE

Qev.+Qcom.=Qcon.



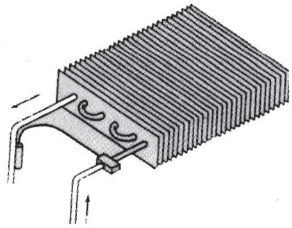
The Expansion Device

The expansion device is an expansion valve, also called throttling valve, or a capillary tube. It is located near the evaporator inlet. It is a means of controlling the flow of the liquid refrigerant into the evaporator. While the liquid refrigerant flows through the expansion valve, its pressure is reduced to the pressure in the evaporator.

The Evaporator

It is the part of the system where refrigeration is achieved. In it, the liquid refrigerant boils or vaporises absorbing heat from brine or water or directly from the surrounding space which is thus cooled. The refrigerant leaves the evaporator in the form of a gas and is drawn back into the compressor.

In a domestic refrigeration system, the evaporator, called freezer, is always placed in an insulated space. In some cases, this space constitutes the whole refrigerator cabinet.



* The amount of heat added in the evaporator (Qev) plus the amount of heat added in the compressor (Qcom) equals the amount of heat which must be rejected in the condenser (Qcon).

EXERCISES

1. Choose the correct alternative.

1. The compressor

a. extracts sensible and latent heat from the high temperature and pressure gas refrigerant.
b. draws in the refrigerant and compresses it.
c. is surrounded by air which acts as a cooling medium.
d. sometimes constitutes the whole refrigerator cabinet.

2. The condenser

a. cools the gas refrigerant and condenses it to a liquid.
b. discharges the refrigerant in the form of a high temperature and pressure gas.
c. is located near the evaporator inlet.
d. is driven by a motor.

3. The expansion device

a. is placed in an insulated space.
b. rejects sensible and latent heat to a cooling medium.
c. is the main part in the refrigeration cycle.
d. controls the flow of the liquid refrigerant.

4. The evaporator

a. discharges the refrigerant to the condenser.
b. uses the water circulating through it as a cooling medium.
c. is the part of the system where refrigeration is achieved.
d. is an expansion valve, also called throttling valve, or a capillary tube.

2. Classify the above sentences under the appropriate component in the table below.

COMPRESSOR	CONDENSER
	e.g. *It extracts sensible and latent heat from the high temperature and pressure gas refrigerant. (1-a)*
EXPANSION DEVICE	**EVAPORATOR**

3. Indentify the component the information in the table below refers to. Write it in the spaces provided in the second column.

Information	Component
It is the component of the system where:	
1. the gas refrigerant becomes liquid.	____________
2. the low pressure and temperature gas refrigerant is changed to a high temperature and pressure gas.	____________
3. the refrigerant is discharged after compression.	____________
4. the pressure of the liquid refrigerant is reduced.	____________
5. the refrigerant becomes a low pressure and temperature gas.	____________
6. the refrigerant flows after leaving the condenser.	____________
7. the liquid refrigerant boils and becomes a gas.	____________
8. the refrigerant is drawn after leaving the evaporator.	____________
9. the refrigerant arrives in the form of a liquid and leaves in the form of a gas.	____________
10. the refrigerant arrives in the form of a gas and leaves in the form of a liquid.	____________

4. Match the words in the lists with their definitions.

GROUP A

a means to extract to suck to expand to reciprocate to compress an apparatus an equation

Definitions

1. to move backwards and forwards in a straight line
2. to draw a liquid or air out of somewhere with a powerful force
3. the equipment (tools, machines, devices) used to do a particular job
4. to obtain a substance from something else by using industrial or chemical processes
5. to press or squeeze something so that it takes less space
6. a mathematical statement saying that two amounts or values are the same/ equal
7. to become larger or greater in size, number or amount
8. a method, instrument or process used to do something

GROUP B

located to condense centrifugal to reject sensible to discharge a medium

Definitions

1. the force that makes objects move outwards when they are spinning around something or travelling in a curve
2. to give or send out something, e.g. liquid, gas, electric current, etc.
3. to throw something away as not good enough to be kept
4. something that is fitted, built, put in a particular space
5. a substance or materical used for a particular purpose or to produce a particular effect
6. something that can be perceived (seen, heard, felt) by the senses, e.g., a fall in the temperature
7. to change a gas or vapour to a liquid by cooling it

5. Choose words from the list to fill in the gaps. Form them appropriately.

List

expand suck reject rise suction extract discharge medium apparatus

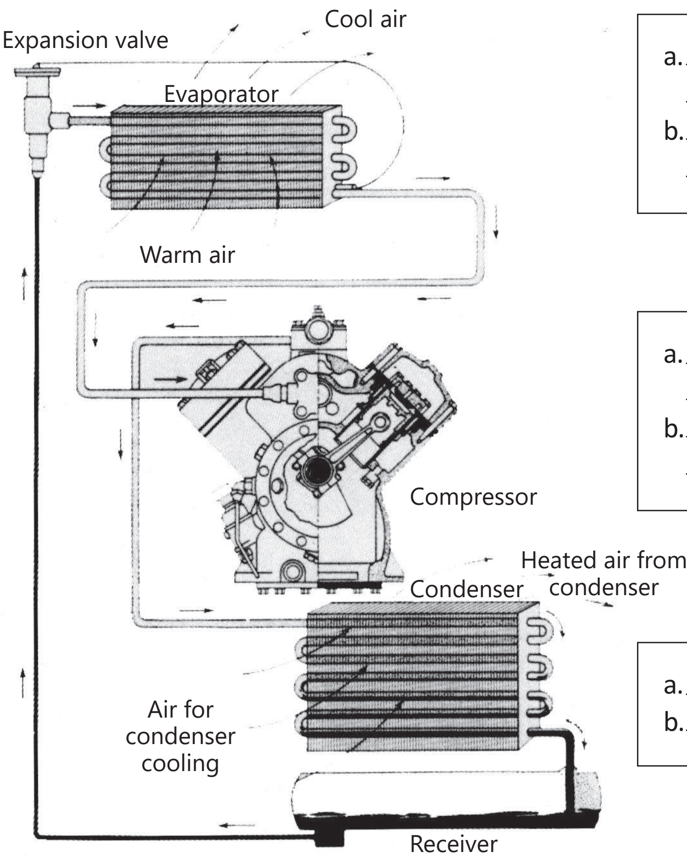
1. Pumps ________________ the liquid in their case through an opening called ________________ port.
2. The part of the mechanical refrigeration cycle where the refrigerant ________________ heat is the condenser.
3. The opening in a pump's casing through which the liquid comes out is called outlet or ________________ port.
4. The condenser is the ________________ which liquefies the refrigerant by cooling it.
5. This method enables us to ________________ citric acid from lemons, oranges and grapefruit easily and at a very low cost.
6. When metals are heated, they ________________ .
7. Water starts boiling when its temperature ________________ to 100 °C.
8. Water is a cooling ________________ used to absorb heat from the refrigerant as it flows through the condenser.

6. Fill in the gaps.

The refrigerant is drawn into the compressor through the s__________n valve in the form of a low t____________e and pressure gas. There, it is compressed, and then d____________d to the c____________r in the form of a h________h temperature and p________e gas. In the condenser, the r__________t rejects h__________t into a cooling m____________m, and so it is condensed to a l________d. Next, the refrigerant flows through the e__________n device, where its pressure is r________d, and enters the e__________r. In there, the refrigerant a_______s heat from the surrounding air or w_______r, boils and becomes a v_______r. Then, it moves back to the c_______r. This process is continuously repeated forming the c______e of operation of the c______n r______________n system.

7. In the boxes below, write one or two sentences describing the function or operation of each component.

a. ____________________
b. ____________________



a. ____________________
____
b. ____________________
____

a. ____________________
____
b. ____________________
____

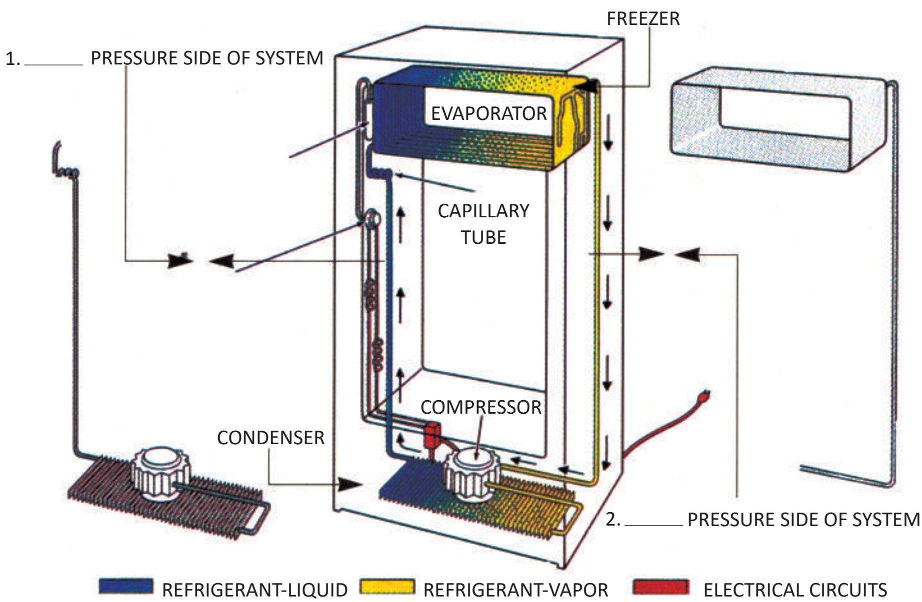
a. ____________________
b. ____________________

HIGH AND LOW-PRESSURE SIDE OF THE COMPRESSION CYCLE

The cycle of operation of the compression refrigeration system consists of a high-pressure side and a low-pressure side.

TASK 1

Identify the two sides of the compression cycle in the picture below.

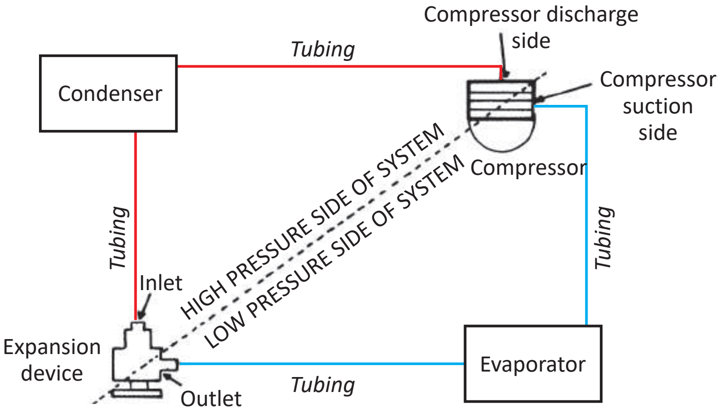


TASK 2

The following paragraph refers to the high-pressure side. Write a similar paragraph describing the low-pressure side. The diagram will help you.

The high-pressure side of the compression cycle

The high-pressure side of the compression cycle includes the compressor discharge side, the tubing from the compressor to the condenser, the condenser and the tubing from the condenser to the inlet part of the expansion valve. In this side, the inlet part of the expansion valve is also included. The high-pressure side is at high temperature and pressure.



The low-pressure side of the compression cycle

....

....

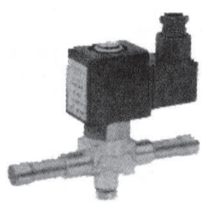
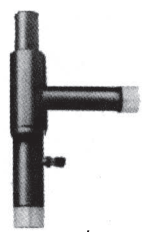
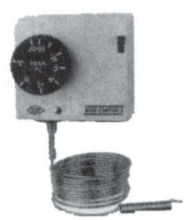
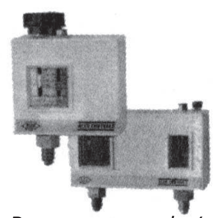
....

....

....

....

ACCESSORIES USED IN COMPRESSION SYSTEMS

 *Solenoid valves*	 *Pressure regulators*	 *Thermostats*
 *Filters and filter driers*	 *Moisture liquid indicators*	 *Pressure controls / Pressostats*

Listening Activity

STEP 1

Listen to the text and give it a title.

STEP 2

Listen to the text again and say how many properties are mentioned in it.

STEP 3

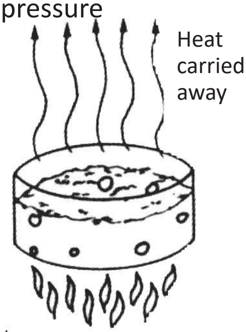
Familiarize yourself with the list of properties below. Listen to the text and underline the correct alternative for each characteristic.

Properties of the ideal refrigerant

A refrigerant should

- have:

1. low / high condensing pressures
2. high / low boiling temperature at atmospheric pressure
3. low / high latent heat of vaporisation
4. high / low specific heat of liquid
5. low / high specific volume of vapour
6. non-corrosive / corrosive action on metals
7. bad / good chemical stability



- be:

8. non-flammable / flammable
9. explosive / non-explosive
10. non-toxic / toxic
11. harmful / harmless to the lubricants in the system

- have:

12. low / high thermal transfer

FOLLOW UP

Arrange the above properties according to what they are related to.

Safety	Efficiency	Long life of the system

6. *ACTIVE – PASSIVE VOICE*

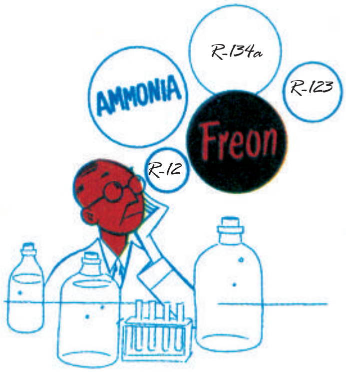
(See about the Passive Voice in the Grammar section in the APPENDIX)

A. Underline the correct verb form (active or passive).

1. The quantity of heat abstracted or absorbed measures / is measured in Refrigeration Tons.
2. At normal atmospheric pressure, solid carbon dioxide changes / is changed directly from the solid to the vapour phase.
3. Food cannot preserve / be preserved for long in an icebox.
4. The ice compartment of the icebox requires / is required frequent refilling.
5. In our country, iceboxes used / were used until the mid-60's.
6. As ice melts / is melted under atmospheric pressure, it absorbs / is absorbed heat from the air surrounding it, and so, refrigeration produces / is produced.
7. Compression systems employ / are employed four elements in the refrigeration cycle.
8. In absorption systems, refrigeration obtains / is obtained by the use of ammonia, water, and hydrogen.
9. While passing through the expansion valve, the pressure and temperature of the refrigerant must reduce / be reduced.
10. In the condenser, the temperature of the refrigerant drops / is dropped and as a result it becomes a liquid.
11. The expansion valve locates / is located near the evaporator inlet.

B. Decide which voice (active or passive) the following sentences are in and form the verbs in parentheses appropriately.

1. The compressor (compress) ________________________ the refrigerant, and (discharge) ________________________ it to the condenser.
2. Refrigeration from ice (replace) ________________________ by mechanical refrigeration, since with it, we can (obtain) ________________ fully flexible ranges of temperature.
3. With air-conditioning units, the condenser heat must (dissipate) ___________________ out of doors.
4. Absorption systems (employ) ________________________ largely for heat-operated air-conditioning units.
5. With compression systems, very low temperatures can (achieve) _______ .
6. The condenser (reject) _______________ heat into a cooling medium.
7. The motor driving the compressor (control) ______________________ by a thermostatic switch.
8. For centuries, ice (be) _______________ the only source of refrigeration.
9. In a mechanical system, the liquid refrigerant (evaporate) ________________ to a gas and then it (condense) ________________________ back to a liquid.
10. The compressor (drive) _________________________ by a motor.



REFRIGERANTS

Refrigerants are the vital working fluids in refrigeration, air-conditioning and heat-pumping systems. They absorb heat from one area, such as a refrigerator unit or an air-conditioned space, and reject it into another, such as outside the unit or outdoors. Without the refrigerant, the refrigeration system is like an engine without fuel, or a human being without blood.

Apart from ammonia, the most widely used refrigerants are the CFCs, the HCFCs, and the HFCs.

The information below will help you understand the text about refrigerants which follows. Read it carefully and, in the spaces provided, **write the Greek equivalent to the terms printed in bold-typed letters.**

Useful information

Carbon (C) ____________ **Hydrogen (H)** ____________

Chlorine (Cl) _________ **Fluorine (Fl)** _________ **Bromine (Br)** ______

element: a substance which cannot be reduced to a simpler one by either physical or chemical means, e.g. oxygen, hydrogen (____________).

atom: the smallest particle of an element which has all the characteristics of the element (____________).

compound: a chemical combination of elements which cannot be separated by physical means, e.g. water (____________).

molecule: the smallest particle of a compound which has all the characteristics of the compound (____________).

halogens: chlorine (Cl), fluorine (Fl) and bromine (Br). Compounds containing them are called halogenated. Of them, chlorine is responsible for destroying atmospheric ozone (____________).

CFC refrigerants: chlorofluorocarbons = compounds of C + Fl + Cl, e.g. R-11, R-12, etc. (___________________________).

HCFC refrigerants: hydrochlorofluorocarbons = compounds of C + Fl + Cl + H, e.g. R-22, R-123, etc. (_____________________)

HFC refrigerants: hydrofluorocarbons = compounds of C + Fl + H, e.g. R-32, R-134a, etc. (_________________________________)

ODP = Ozone Depletion Potential: It is a measure of a material's ability to destroy atmospheric ozone (__________________________________)

(H)GWP = (Halocarbon*) Global Warming Potential: It is a measure of a material's ability to add to the warming of the earth (greenhouse effect) (_____________)

** substance containing carbon (C) and halogens (Cl, Fl, Br)*

TASK 1

Choose the correct alternative.

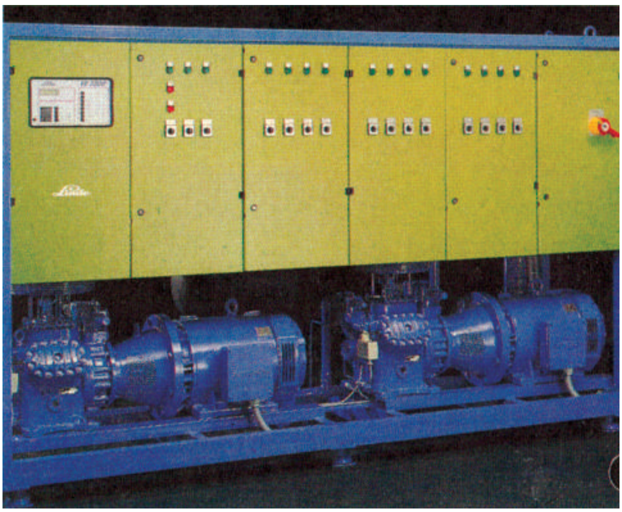
1. The halogens include
   a. hydrogen, chlorine and carbon.
   b. bromine, chlorine and fluorine.
   c. carbon, chlorine and fluorine.

2. CFCs contain
   a. hydrogen, chlorine and carbon.
   b. carbon, chlorine and oxygen.
   c. carbon, fluorine and chlorine.

3. Hydrogen is one of the elements of the
   a. HCFC and HFC refrigerants.
   b. CFCs.
   c. all three types of refrigerants.

4. CFC refrigerants have high ODP values
   a. because of their carbon content.
   b. because of their chlorine content.
   c. because of their fluorine content.

5. Of the three types of refrigerants, those that pose a major threat to the environment are the
   a. HFCs.
   b. HCFCs.
   c. CFCs.



Ammonia (NH3) chiller in industrial application

TASK 2

How much do you know about refrigerants? Answer the questions.

1. Why was the production of CFCs phased out?
2. Which is the most harmful element in the CFC refrigerants?
3. What is the advantage of HCFCs over CFCs?
4. Why are HFCs considered safe for the environment?
5. Why isn't the use of ammonia widespread?

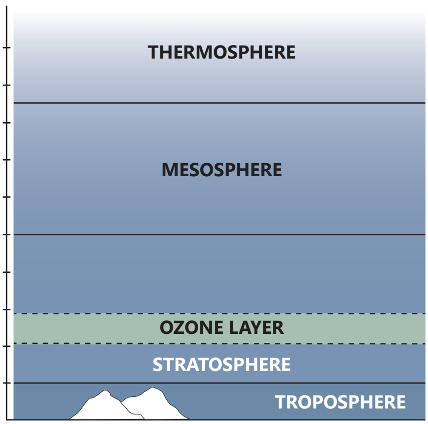
If you can't answer them, read the text which follows. It will help you.

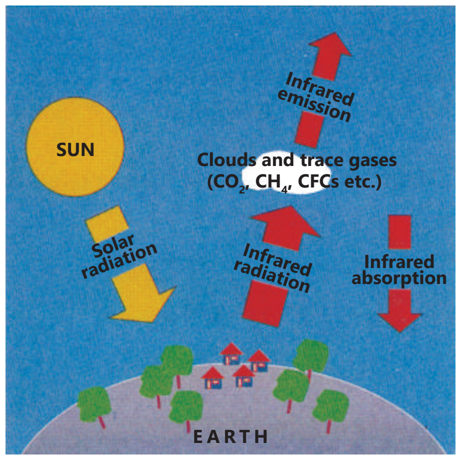
Refrigerants and the Environment

Refrigerants such as CFC-11, 12, 114 and 115, commonly known as «freon», have been used extensively in the refrigeration and air-conditioning industry. It has been found, however, that chlorofluorocarbons are posing a major threat to the global environment.

Because of their great stability, these fully halogenated compounds persist in the atmosphere for many years. In the lower atmosphere, they absorb infrared radiation, thus adding to the warming of the earth and the greenhouse effect. Once in the upper atmosphere, the CFC refrigerant molecule breaks down and releases chlorine which destroys the ozone.

As a result, by international agreement, the production of CFCs was totally phased out on January 1, 1996.





Research showed that by replacing one or more of the halogen atoms with atoms of hydrogen, we can greatly reduce the CFC molecule's atmospheric lifetime, thus lessening its environmental impact. This led to the development of a new generation of refrigerants that contain hydrogen, in addition to the other elements of the CFC compounds. These refrigerants are known as hydrochlorofluorocarbons (HCFCs) and generally have lower ODP and HGWP values than the CFCs they have replaced. Nevertheless, since HCFCs also contain chlorine, their production will be gradually limited and in 2030, they will be totally phased out.

The most widely used HCFCs are: R-22, R-124 (a suitable replacement for R-114), R-502 and R-123 (used as a replacement for R-11).

Nowadays, a new generation of environmentally acceptable refrigerants is being developed. These materials do not contain any chlorine atoms;

therefore, their ODP is zero and their global warming potentials low, while at the same time, they have an acceptable refrigeration capacity. Such compounds are the refrigerants known as hydrofluorocarbons (HFCs).

A good example is R-134a (used as a replacement for R-12, 500 and R-22), and the R-404A (used as a replacement for HCFC R-502).

____

Another refrigerant that is widely used in large, open-type compressors for mechanical and commercial applications is ammonia. It has high refrigeration capacity, low pressure losses in connecting piping, it does not harm mineral oil for lubrication and is non-corrosive to iron and steel. Ammonia is environmentally safe, as it has zero ODP and HGWP values, but its flammability and toxicity offset its advantages.

EXERCISES

1. Use the spaces provided to add a suitable heading to each of the thematic areas the text is split in.

2. Make lists of the most widely used refrigefants.

CFCs	HCFCs	HFCs

3. Answer the questions.

1. What is the action of CFCs in the lower and upper atmosphere?
2. When were CFCs phased out?
3. What is the advantage of replacing halogen atoms with atoms of hydrogen?
4. Which factor led to the decision for the HCFCs' phaseout?
5. What is the advantage of HFCs over the other refrigerants?
6. What are the main advantages of ammonia?

Do you know this?

HCFC-123 has a very short atmospheric lifetime: less than two years. It does have an ODP component but its value is extremely low: 02%, that is, over 98% less than the CFC-11.
In addition, because it is inherently a low-pressure refrigerant, the systems using it can be designed to have extremely low emissions.
HCFC-123 has the highest potential for energy efficiency of all the alternatives.

4. Correct the wrong information in the statements below.

1. Chlorofluorocarbons contain chlorine and have a short lifetime.
2. If some atoms in a halogenated molecule are replaced by hydrogen, the lifespan of the compound is increased and its environmental impact is lessened.
3. CFCs have lower ODP and HGWP values than HCFCs and HFCs.
4. HCFCs have a long lifetime and high ozone depletion potential values.
5. The reason for the total phaseout of HCFC refrigerants on January 31, 2003 is their fluorine content.
6. R-134a belongs to the HCFCs and is a suitable replacement for R-11 and R-114.
7. Ammonia is corrosive to iron and steel.
8. The major advantages of ammonia are its flammability and toxicity.

REFRIGERANT	ODP	HGWP	LIFETIME
CFC-11	1.0	1.0	55 years
CFC-12	1.0	3.05	130 years
HCFC-22	0.05	0.34	15.8 years
HCFC-123	0.016	0.019	1.8 years
HFC-134a	0	0.285	15.6 years

5. Look through the text to find the words or phrases clarified below.

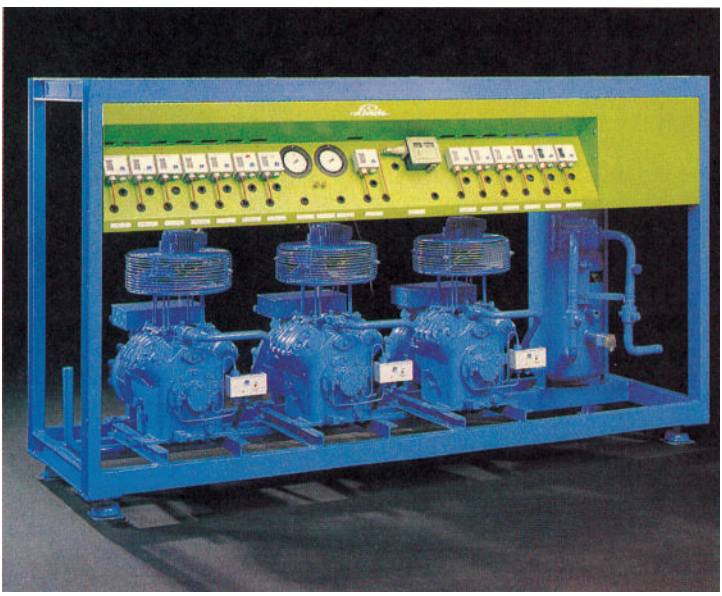
1. to cause a danger to the environment of the Earth: ______________________________
2. property of a chemical substance that tends to remain in the same chemical or atomic state, not to change: ______________________
3. a radiation similar to light which we cannot see without special equipment: ____________________________
4. problem caused by a build-up of gases, such as carbon dioxide, in the air around the Earth. These gases trap the heat from the sun and cause a gradual rise in the temperature of the Earth's atmosphere: ____________________
5. to separate something into the substances which make it up: __________
6. to set free; to let something (e.g. chemical substance) go and enter the surrounding atmosphere: ______________________
7. to stop using or producing something: ______________________
8. a powerful effect that a situation or process has on something: __________
9. a substance, situation or process that doesn't harm the environment: ____ ____________________________

10. property of a refrigerant to be efficient / satisfactory as a cooling medium: ____________________

11. to influence a thing in such a way that any advantages or disadvantages of it are reduced or cancelled out: ______________

6. Match words from the two lists in each group, to make pairs of similar in meaning words.

GROUP A		GROUP B	
harm	widely	application	measure; degree
lessen	stop	depletion	possibility
persist	essensial	lifetime	tubing
suitable	reduce	potential	use
vital	progressively	impact	reduction
gradually	remain	value	efficiency
totally	damage	threat	lifespan
extensively	completely	capacity	effect
phaseout	appropriate	piping	danger



Commercial multi-compressor refrigeration system installed in a supermarket

Discussion **Optional**

Use your knowledge and the information in the book, and talk about refrigerants and their impact on the environment. (State points of view, prepare convincing arguments, suggest solutions)

Expressions to help you

- I think/believe that...
- I am of the opinion that...
- In my opinion / view...
- I suggest + gerund
- I suggest that we, you (should) + inf.
- Why don't we... / Let's...
- (We) must/should/had better...
- As far as it concerns the...
- I'd like to say/point out that...
- I agree/disagree with...
- I insist that.../ on+gerund
- Make yourself clear, please
- I don't quite see/get your point
- To sum up...

TIME FOR FUN

Find ten words hidden horizontally, vertically or diagonally in this word square.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	A	D	O	C	H	L	O	R	I	N	E	M	D	L
2	R	E	H	P	O	A	P	H	A	S	E	O	U	T
3	A	P	D	A	R	K	E	M	O	N	J	L	E	A
4	M	L	I	E	L	E	M	E	N	T	K	E	L	I
5	M	E	C	F	L	O	Q	R	E	N	Y	C	S	A
6	O	T	J	A	I	R	C	O	M	P	O	U	N	D
7	N	I	W	B	R	T	B	A	C	Y	B	L	I	K
8	I	O	G	D	A	B	F	K	R	T	L	E	R	F
9	A	N	E	N	I	L	O	T	A	B	F	S	E	R
10	O	F	L	U	O	R	I	N	E	S	O	Q	Z	E
11	S	U	B	R	E	I	T	R	T	A	B	N	F	O
12	P	O	T	E	N	T	I	A	L	E	M	I	S	N

CHARGING A SYSTEM WITH REFRIGERANT

If no leakage occured, the refrigerant would last throughout the entire life of a refrigeration system. Leakage, however, does occur quite often, especially in large industrial and commercial refrigeration systems and its detection is a major problem for manufacturers and service engineers.
If a leakage is detected, then the system needs recharging with refrigerant. The charging can be done in two ways: either through the low- or through the high-pressure side. Charging through the low-pressure side is easier, so it is the method most commonly used by refrigeration servicemen.

CHARGING THROUGH THE LOW-PRESSURE SIDE

Are you a good refrigeration technician? Tick the correct alternative.

When charging through the low-pressure side:

1. the system is charged through
   a) the suction valve of the compressor
   b) the discharge / outlet valve of the compressor
2. the compressor's discharge valve must be
   a) open
   b) closed
3. the charging cylinder must be
   a) in the upside-down position
   b) in the upright position
4. the refrigerant must be in the form of a
   a) liquid
   b) vapour
5. as long as the system is being charged, the compressor must be
   a) turned on
   b) turned off

Read the description of the charging procedure that follows and check your answers.

Charging station

TOOLS AND EQUIPMENT

Service valve ratchet (wrench)

Gauge manifold / test set

3 charging lines (hoses)

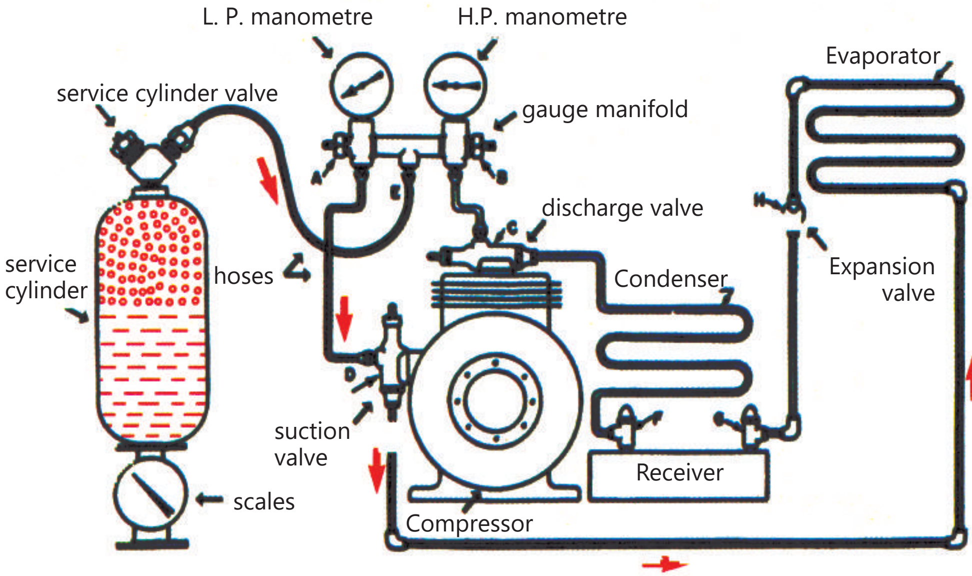
Scales

Leak detector (electronic / or halide torch)

Service / charging cylinder (+refrigerant)

Vacuum pump

Leak detector (halide torch)



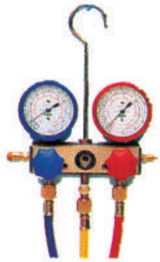
PROCEDURE

1. Connect the gauge manifold to the refrigeration unit. Make sure that the low-pressure manometre hose is connected to the suction valve of the compressor (D), and the high-pressure manometre hose to its discharge valve (C).
2. Connect a vacuum pump to the gauge manifold (port E) and evacuate the refrigeration unit, that is, purge it of any refrigerant remaining in it. Then, disconnect the pump.
3. Make sure that the charging cylinder contains the correct refrigerant.
4. Weigh the cylinder on the scales and write down its weight.
5. Connect the charging cylinder to the gauge manifold (port E).
6. Open the gauge valves A and B, as well as the charging cylinder valve, using a refrigeration service valve ratchet.
7. Purge the air from the charging lines between the charging cylinder and the compressor service valves C and D.
8. Close the gauge test set valve B, and open the compressor service valves C and D.
9. Turn on the electric motor and charge the refrigeration unit for several minutes. Keep watching the weight of the cylinder on the scales. Close the charging cylinder valve only when the proper quantity of refrigerant has been added.
10. Let the unit run for 10-15 minutes. If it runs normally, close the compressor service valves (C and D), as well as the gauge test set valve A, and disconnect the gauge test set from the unit.
11. Make sure that the service valves of the refrigeration unit are in position for normal operation (back-seated).
12. Test for refrigerant leaks with either a halide torch or an electronic leak detector. If no leaks are detected, the unit is ready for operation.

EXERCISES

1. Label the tools and equipment illustrated below.

1. ____________________

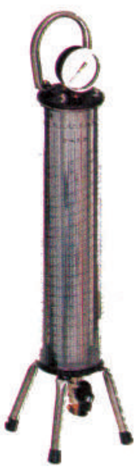


2. ____________________

3. ____________________

4. ____________________

5. ____________________



6. ____________________

7. ____________________

8. ____________________

2. Identify the tool/equipment by its use.

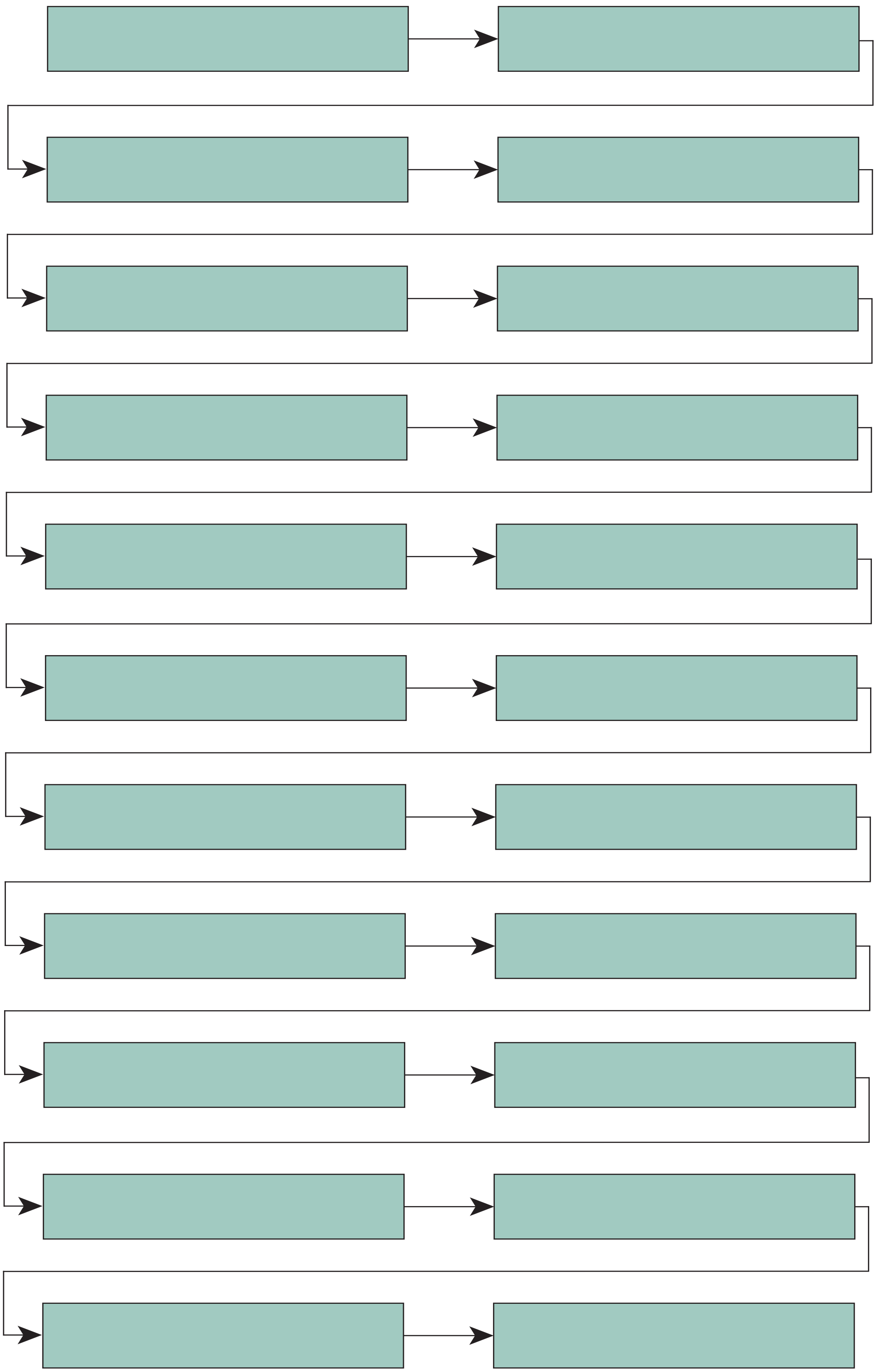
1. It is used for opening and closing the gauge test set and compressor service valves.
2. It removes air, moisture or the refrigerant from the refrigeration unit.
3. It is used to measure the pressure of the low-pressure side of the refrigeration unit.
4. It detects refrigerant leaks.
5. It contains refrigerant for charging refrigeration units.
6. They are used to weigh the charging cylinder.
7. It is used to measure the pressure of the high-pressure side of the refrigeration unit.
8. They are used to connect the service cylinder to the gauge manifold and the gauge manifold to the refrigeration unit.

3. Arrange the steps of the charging procedure under the headings below.

a. Preparation for charging:
b. Charging:
c. Checking - Disconnecting:

4. The steps of the charging procedure through the low-pressure side are given below in jumbled order. **Use the boxes to write them in their correct order. Don’t forget to develop the elliptical speech.**

1. Open gauge valves A and B.
2. Purge air from charging lines between service cylinder and compressor service valves C and D.
3. Evacuate refrigeration unit.
4. Let unit run for 10-15 minutes.
5. Open charging cylinder valve.
6. Disconnect vacuum pump from gauge test set.
7. Weigh charging cylinder on scales.
8. Close charging cylinder valve.
9. Turn on electric motor.
10. Close compressor service valves C and D.
11. Connect vacuum pump to E port of gauge manifold.
12. Connect charging cylinder to E port of gauge manifold.
13. Make sure service cylinder contains correct refrigerant.
14. Keep watching weight of cylinder on scales.
15. Make sure compressor service valves are in position for normal operation.
16. Connect gauge manifold to refrigeration unit.
17. Close gauge manifold valve A.
18. Charge refrigeration unit.
19. Close gauge manifold valve B.
20. Disconnect gauge test set from unit.
21. Test for leaks.
22. Open compressor service valves C and D.



5. SHOWING TIME RELATIONSHIPS

Study the examples.

- *We evacuate the refrigeration system*
- *The evacuating of the refrigeration system is done*

→ ***before*** →

connecting *the charging cylinder to it.*
the charging cylinder ***is connected*** *to it.*

- *We connect the charging cylinder,*
- *The charging cylinder is connected*

→ ***after*** →

evacuating *the refrigeration system,*
the refrigeration system ***is evacuated.***

Make similar sentences to show the time relationship between the steps of the charging procedure.

6. GIVING INSTRUCTIONS

Instructions can be given in various ways. See the «Language Functions» section in the APPENDIX.

Examples

- *Charge the system with R-134a.*
- *You should charge the system with R-134a.*
- *The system should be charged with R-134a.*

Rephrase the following instructions following the examples.

1. Weigh the charging cylinder.
2. Write down the service cylinder weight.
3. Connect the service cylinder to the refrigeration unit.
4. Open the gauge test set valves.
5. Purge the air from the charging lines.
6. Close the gauge test set valve B.
7. Open the compressor service valves.
8. Turn on the electric motor.
9. Charge the unit for several minutes.
10. Disconnect the gauge test set from the system.

7. Choose prepositions from the list to fill in the gaps.

of	down	by	to	on	through	for	in	from

1. The refrigerant is drawn ________ the compressor ________ the suction valve.
2. A mechanical refrigeration system consists ________ four components.
3. The evaporator is surrounded ________ air or water.
4. Connect the service cylinder ________ the refrigeration unit.
5. First, you should check ________ refrigerant leaks, then turn the motor ________ and charge the unit ________ several minutes.
6. Are all the service valves ________ position ________ normal operation?
7. Don't forget to write ________ the weight of the charging cylinder.
8. Refrigerants absorb heat ________ the refrigerator unit and reject it ________ the surrounding air.
9. CFCs persist ________ the atmosphere ________ many years and are posing a major threat ________ the environment.
10. The first generation of refrigerants adds seriously ________ the warming of the earth.
11. R-134a is used as a replacement ________ R-12.
12. First, you should purge the system ________ refrigerant.

Writing Activity — Describing a procedure

Below is the topic of the yesterday's examination paper in the subject «Refrigeration systems and their maintenance»:

A. In the spaces provided in the diagram, label the parts of the refrigeration system and the equipment used for its charging.

B. Fill in the blanks in the box with the most important points to remember when charging a system through the low-pressure side.

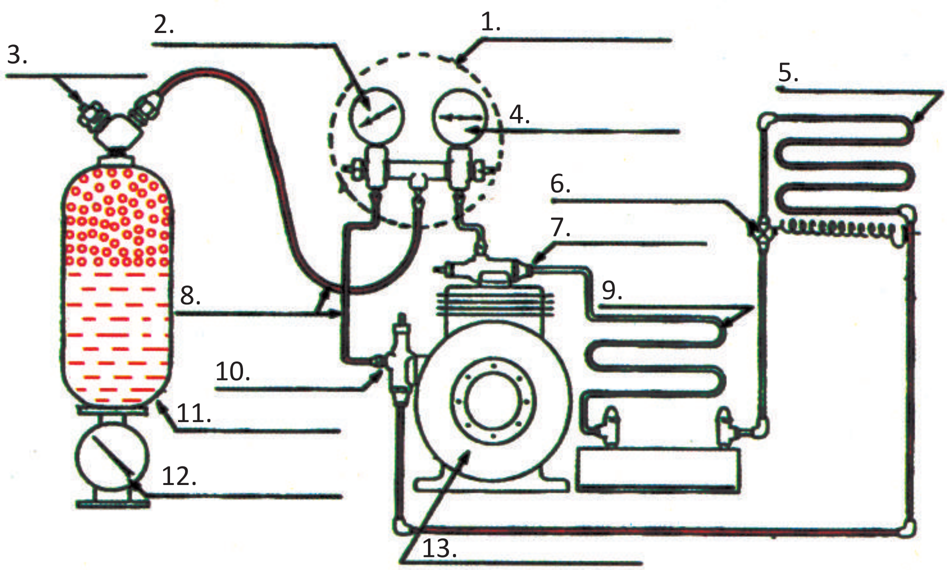
C. Write a step by step description of the procedure followed to charge a refrigeration unit through the low-pressure side.

Imagine that you are one of the students and carry out the tasks.
In the description, use the Passive Voice (when possible) and linking words (first, then, next, after/before (the) + gerund, finally, etc.) to join your sentences.

Class: ____________ **Date:** ______________

Name: ____

A. Label the diagram.



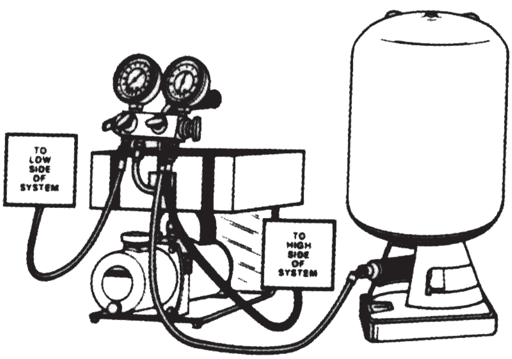
B. Complete the missing information in the box.

IMPORTANT

WHEN CHARGING THROUGH THE LOW-PRESSURE SIDE, MAKE SURE THAT:

- THE SERVICE CYLINDER
  - CONTAINS ______________________________ .
  - IS ______________________________ POSITION.
- THE SYSTEM IS CHARGED THROUGH THE ____________________ VALVE.
- THE COMPRESSOR IS ____________________________ WHILE CHARGING.

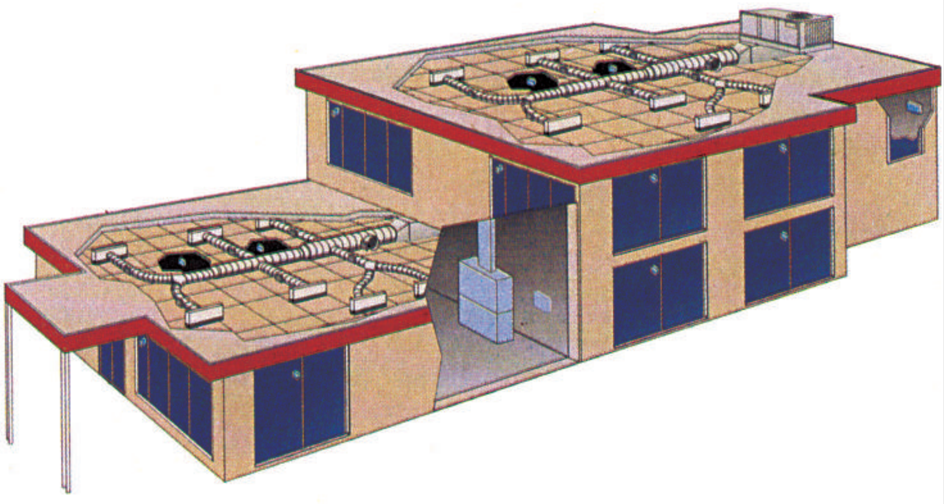
C. Write a step by step description of the procedure.



UNIT 11

AIR CONDITIONING



INTRODUCTION TO AIR CONDITIONING

How much do you know about the development of air conditioning? Answer the questions below.

1. What has man done to find relief from high temperatures?
2. Which principles were applied in comfort space cooling?
3. Which variations of weather did the first air-conditioning systems treat? Cold, or heat and moisture?

Read the text which follows and chech your answers.

Ever since man appeared on earth, he has been trying to protect himself from the elements and to improve his living conditions. One of his primary concerns towards this direction has been to seek relief from cold. So, he has developed various heating systems.

However, heating alone provides control over only one of the variations of climate. Millions of people on earth need relief from heat and humidity rather than from cold. Consequently, it is just as important that we control other variations of climate as well.

Various air-moving systems were used in the past. They weren't very effective, though. At the end of the nineteenth century, man's desire to complete his control over the weather and find relief from heat led to the development of the first ventilation mechanisms.

Arm and leg movement operates series of fins

Man's next step was to apply the principles of refrigeration used in cold storage to space comfort cooling. So, the first summer air-conditioning systems were manufactured. They were quite complicated, cost a lot and their installation and maintenance required considerable exprerience.

Soon, the development of the principles air-conditioning systems operate on led to the modern year-round air conditioners designed to provide relief from both high and low temperatures.

The discovery of the principles of air conditioning is one of the most important events in the 20th century. Today, almost every type of building is air conditioned, and so are most means of transport.

EXERCISES

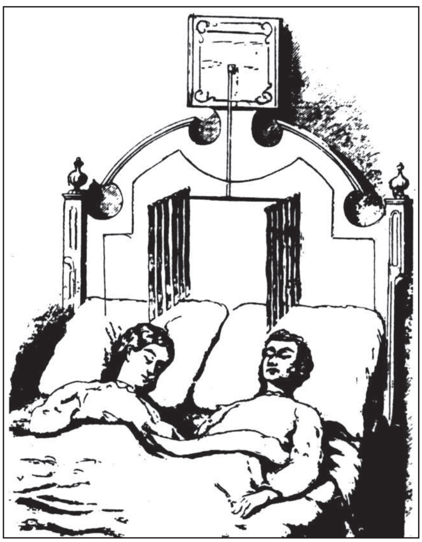
1. Give the text an appropriate heading. Write it in the space provided.

2. Match the paragraphs of the text with the subtitles below.

a) The necessity to treat heat and humidity as well as cold. § ____
b) The emergence of comfort space cooling. § ____
c) Man's efforts to protect himself from the elements. § ____
d) Applications of air-conditioning. § ____
e) Man's first attempts to control high temperatures. § ____
f) Year-round air conditioners. § ____

3. Are the following sentences true or false?

1. Man's attempts to control the weather belong to his efforts to improve his living standards.
2. Mans primary concern was to protect himself from heat. Next, he tried to find relief from cold.
3. Various ventilation mechanisms were designed in the 19th century to provide relief from heat.
4. The employment of the principles of refrigeration to comfort space cooling led to the production of summer air conditioners.
5. It wasn't difficult to install and maintain the first air conditioners.
6. The discovery of the principles of air conditioning was one of the most important events in the 19th century.



Clock mechanism moves fan device

Do you know this?

• In 1500, Leonardo da Vinci built a water-driven fan to ventilate a suite of rooms for the wife of his patron. This was possibly the first attempt to provide an automatic way of changing the conditions of the air in an enclosed space.

• The «punka», a large fan fitted on the ceiling and operated manually by pulling a rope, was another such device. It was used in India for many years.

4. **Choose the appropriate synonym from column B to replace in the text the words given in column A. Underline.**

	Column A **Words in the text**	**Column B** **Words to choose from**
1st paragraph	elements	components – weather
	conditions	standards – requirements
	primary	original – main
	concerns	efforts – troubles
	seek	inquire – search
	relief	comfort – help
3rd paragraph	desire	effort – wish
	led	resulted in – were directed
4th paragraph	apply	use – manage
	complicated	simple – complex
	required	needed – asked
	considerable	little – much

5. **Combine nouns with modifiers as they appear in the text.**

Modifies	**Nouns**
air-conditioning	conditions
cold	concern
year-round	systems
living	mechanisms
ventilation	storage
considerable	space cooling
primary	experience
comfort	air conditioners

Rocking motion operates bellows

6. Arrange the following sentences appropriately, to make a meaningful paragraph. Write a number in the space provided in front of each sentence, to show their order.

_1_ For centuries people complained about high temperatures.

____ At last, man has done something about hot weather, and has done so in a big way.

____ At that time, fans were the only thing that seemed to do any good.

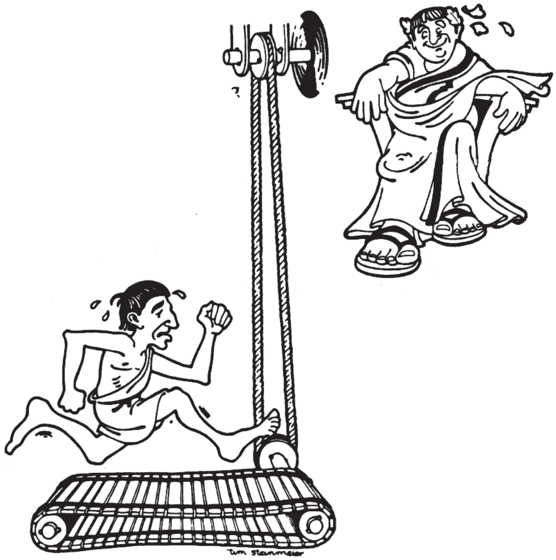
____ As recently as a generation ago, people waving a fan in front of their face during the hot days of summer was a common sight.

____ Unfortunately, nobody could do anything about it successfully.

____ Today, however, the discovery of the air-conditioning principles has made fan waving unnecessary.

____ They have been used since the days of the Pharaohs.

THE ROMAN METHODS...



Do you know this?

- Before 1922 conditioned air was used in industry to produce candy, gum, cheese and matches.
- The first comfort installation was made in a theatre in the U.S.A.
- The first scientific air-conditioning system was used in a printing house.

DEFINING AIR CONDITIONING

Nowadays, millions of people enjoy the comfort of air conditioning. Very few, however, know how air-conditioning systems work, and even fewer understand the basic principles their operation is based on. Well, what is air conditioning, after all?

Air conditioning is defined as a process which introduces air in a building, cools or heats it, cleans and circulates it and also controls its moisture content. Ideally, air conditioning does all these tasks at the same time and on a year-round basis.

Research and experience have clearly proved that to maintain control of the indoor environment so as to have a comfortable and healthy atmosphere in a defined space, five factors should be treated: temperature, relative humidity, that is, the desirable moisture content of the air, movement and cleanliness of the air and ventilation.
The treatment of these factors is determined with the help of some instruments, such as the hygrometer, the psychrometer, the dry- and wet-bulb thermometer, and the anemometer.

Electronic hygrometer

Digital thermometer

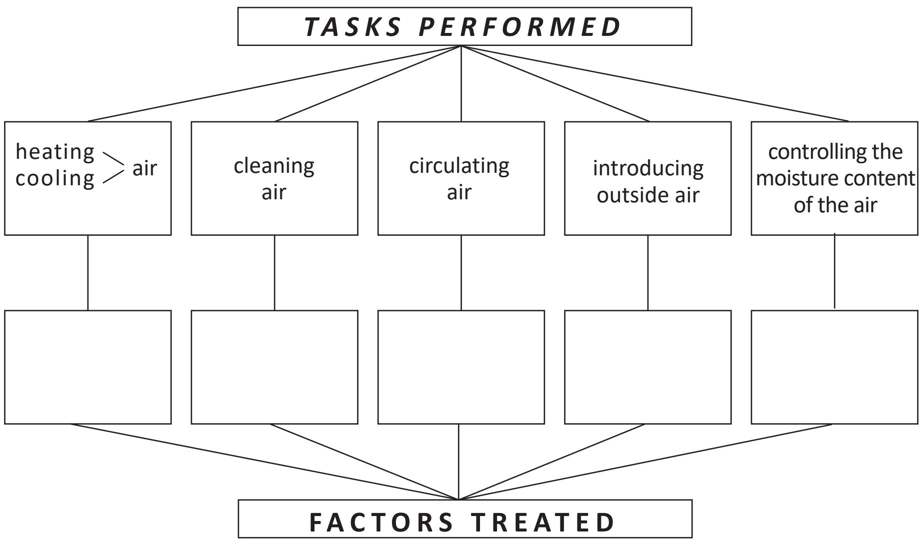
Digital basis anemometer/ velometer

EXERCISES

1. Use the table to make meaningful sentences.

	raises	
	removes	
	circulates	
	controls	
	lowers	
	introduces	

2. Write the factor that corresponds to each task in the air conditioning process.



3. Complete the table on the next page by writing how each factor is treated. Choose from the list.

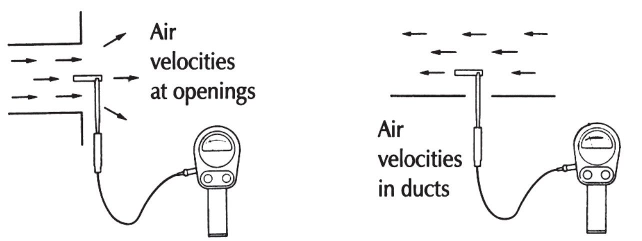
- introducing outside air and displacing the dirty air from the air-conditioned space.
- controlling the circulation of the air
- controlling the moisture content in the air by humidifying or dehumidifying it
- removing or adding heat to the air of the space, that is, cooling or heating it
- filtering

Factors	Treatment
Temperature	
Relative humidity	
Movement of the air	
Cleanliness of the air	
Ventilation	

4. Identify the factor the paragraphs below are related to. Write it in the space provided over each paragraph.

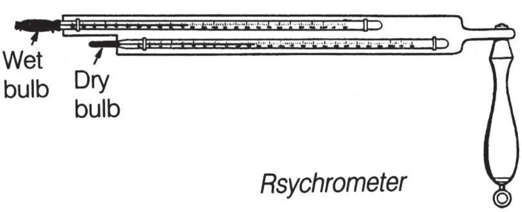
1. ______________________

The air must be circulated uniformly in an air conditioned room. The efficiency of an air-conditioning installation depends greatly on the air distribution system. The velocity of the air in both the air-conditioning system and the space it is installed in is measured by an anemometer, also called velometer.



2. ______________________________

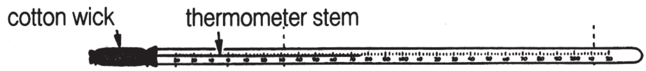
It is the ratio of the actual amount of moisture contained in the air to (= divided by) the maximum amount of moisture that the air can hold at the same temperature. To measure it, we compare the readings of a dry- and a wet-bulb thermometer, or we use either an electronic psychrometer or a hygrometer.



Rsychrometer

Do you know this?

A wet-bulb thermometer is an ordinary thermometer with a sock or cotton wick placed over the bulb. By wetting the sock or cotton and passing air over it, moisture will be evaporated until it balances with the moisture content in the air. The heat absorbed in evaporating this moisture will lower the temperature of the wick. The resultant temperature is indicated by the mercury in the thermometer stem.



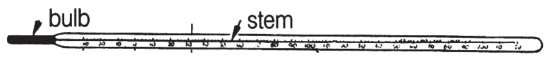
Wet bulb thermometer

3. ______________________

Thanks to it, the dirty air is displaced from a space and replaced with fresh air from outside.

4. ______________________

It causes feelings, such as: cold, cool, warm, hot, etc. It is measured by an ordinary thermometer, usually referred to as a «dry-bulb thermometer».



Dry bulb thermometer

5. ______________________

It is the process of removing inpurities, such as dust, from the air which is introduced in an inhabited space with the use of filtres.

5. Complete the table with the missing words.

ENGLISH	GREEK
principles of operation	____________________
moisture content	____________________
____________________	σχετική υγρασία
air-distribution system	____________________
____________________	εξαερισμός
____________________	ταχύτητα
ratio	____________________
factor	____________________
____________________	μέτρηση οργάνου
anemometer/velometer	____________________
hygrometer	____________________
____________________	ψυχρόμετρο
____________________	θερμόμετρο ξηρού βολβού
wet-bulb thermometer	____________________

Listening Activity I

Useful Vocabulary

perspiration = the liquid which comes out on the surface of our skin when we are hot or frightened
muggy = unpleasantly warm and damp(=wet)

Familiarize yourself with the sentences below. Then, listen to the paragraph your teacher is going to read and underline the correct alternative.

1. The air is called saturated when it contains *half the amount (50%)* / *the total amount (100%)* of the moisture it can hold.
2. Normally, *hot* / *cold* air holds more moisture.
3. When the moisture content of the air is high, perspiration evaporates more *slowly* / *faster* giving us a *feeling of dryness* / *muggy feeling.*
4. When perspiration evaporates, it *adds heat* / *absorbs heat* giving us a sensation of cooling.
5. The more *readily* / *slowly* perspiration evaporates, the *more* / *less* heat it absorbs, and as a result, the *more* / *less* the sensation of cooling it gives us.
6. If the moisture content in the air is lower than *30%* / *40%* of the total amount of moisture it can hold, it causes an unpleasant feeling of dryness to the throat and nose.

FOLLOW UP

1. Match words with definitions.

1. treatment	a) to increase the amount of moisture in the air
2. to dehumidify	b) the amount of water which has been evaporated
3. to displace	c) the way we deal with something
4. inhabited	d) to force something out of a place
5. uniformly	e) to become equal in amount, value or effect
6. to define	f) in the same way or amount, equally
7. moisture content	g) place where people live in
8. to balance	h) to remove moisture from the air
9. to humidify	i) to describe or state clearly what something is

2. Make pairs of synonyms by matching the words from the two lists below.

A. impurity, introduce, humidity, benefit, ordinary, actual

B. true, common, dirt, bring in, moisture, advantage

Listening Activity II

STEP 1

Familiarize yourself with the short text below.
The main cooling job in air conditioning is normally done just like in a gas refrigerator. A large compressor sends the liquid refrigerant through the evaporator where it absorbs latent heat by evaporation. The heat is drawn out of the warm room air, which is circulated over the indoor evaporator, by fans.
The major difference between an air conditioner and a modern domestic refrigerator is that the condenser of the air conditioner, which gets rid of the sensible heat, is located outside the room being cooled. It wouldn't make much sense, first to extract the heat from the air of the air-conditioned space with one unit (the evaporator), and then send that same heat back into the same space again by radiating it from another unit (the condenser).

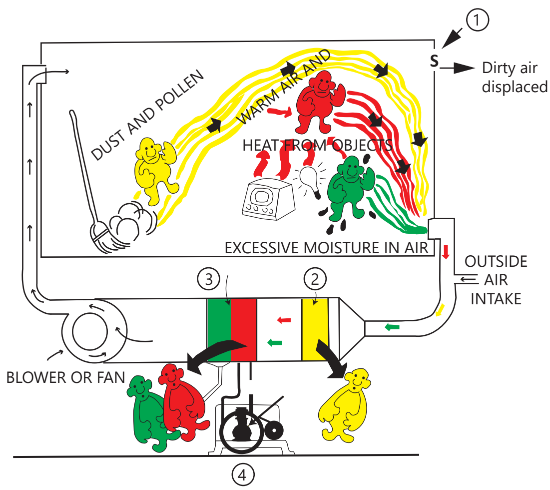
STEP 2

Your teacher is going to read another version of this text. In his / her version, some of the words included in your text are omitted. **Read the text carefully while listening to your teacher and cross out the words you do not hear.**

FOLLOW UP

1. Label the parts of the air-conditioning system.

1. ____________________
2. ____________________
3. ____________________
4. ____________________



2. Answer the questions.

1. Is the air conditioner described in the above text operating in the heating or in the cooling mode?
2. Why is the condenser of air conditioners located outside the room being cooled and not inside it?

AIR-CONDITIONING SYSTEM SELECTION

The selection of the proper size residential, commercial or industrial air-conditioning system is important. Systems which are too small obviously cannot do the job expected. On the other hand, a system which is too large will not give the best performance. To select the appropriate unit or system size, a certain procedure must be followed.

LOAD ESTIMATION

The most important step in this procedure is the load estimation, that is a process through which the H.V.A/C engineer or A/C technician determines the **air-conditioning load**.

The air-conditioning load expresses the amount of heat that must be removed from a certain space to lower the temperature in it **(cooling load)** or that must be added to it in order to heat the space **(heating load)** and so maintain the desired conditions*.

To determine the air-conditioning load in a given space, we must estimate the amount of heat lost from it **(heat loss)** or/and the amount of heat added to the space by various sources **(heat gain).**

The air-conditioning load helps us, next, to determine the **output capacity** (heating or cooling) of the system to be installed.

Both the air-conditioning load and the output capacity of an air-conditioning system are expressed in:

- kilowatts (kW),
- kilocalories per hour (kcal/h), or in
- tons of refrigeration (RT) and
- British thermal units per hour (BTU/h).

IMPORTANT

To maintain the desired conditions in a space:
The heating capacity of the unit selected must be able to handle a load (heating load) that can balance the heat lost from the air-conditioned space (heat loss).
The cooling capacity of the unit must be able to handle a load (cooling load) that can balance the heat added to the air-conditioned space (heat gain).

* For our country, such conditions are:
Temperature: 20° C in winter and 26° C in summer
Relative humidity: 45-50° C.

EXERCISES

1. Write the three main types of air-conditioning systems.

AIR-CONDITIONING SYSTEMS

- [ ] installed in storehouses, restaurants, super markets...
- [ ] installed in factories, machine-shops, workshops, etc.
- [ ] installed in houses, offices, etc.

2. Write the Greek equivalent to the following terms.

load estimate / estimation =
heat loss(es) =
heat gain(s) =
heating load =
cooling load =
air-conditioning load =
(output) heating capacity =
(output) cooling capacity =

3. Which of the above terms are defined below?

1. It refers to the amount of heat added to a space by various sources (e.g. sun radiation): ____________________
2. It is the output capacity an air-conditioning unit must have so as to be able to handle the heating load in a space: ____________________
3. It is the amount of heat that must be removed from a space in order to balance the heat added to it by various sources: ____________________
4. It refers to the amount of heat lost from a space: ____________________
5. It is the output capacity an air-conditioning unit must have to be able to balance the heat gain in a space: ____________________
6. It is the amount of heat that must be added to a space in order to balance the heat lost from it: ____________________

4. Answer the questions.

1. Why is it important to select the correct size of air-conditioning system?
2. What do we mean by the word «size»; capacity or dimensions?
3. What is an «H.V.A/C. engineer»?
4. What is the load estimation?
5. What is the usefulness of the load estimation procedure?
6. What is expressed by the air-conditioning load?
7. Why is the heating capacity associated with the heat loss and the cooling capacity with the heat gain?

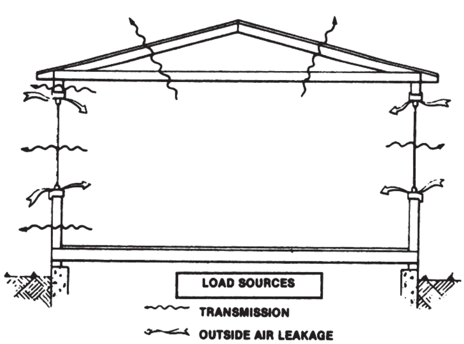
5. Fill in the missing information in the sentences below.

The ______ / ______ capacity of a winter / summer air-conditioning system must be able to handle the ______ / ______ load, so as to balance the ______ / ______

The capacity of a year-round air-conditioning system must be able to handle both the ________ and the ________ load in a space, so as to balance both the ______________ and the ______________.

Load Sources

Heat is added to a space or lost from it due to various factors, which we must take into consideration when estimating the heating or cooling load in it. These factors, which are responsible for the heat loss or heat gain in a space, are referred to as **load sources**. They are distinguished into heating and cooling load sources.



A. Heating load sources

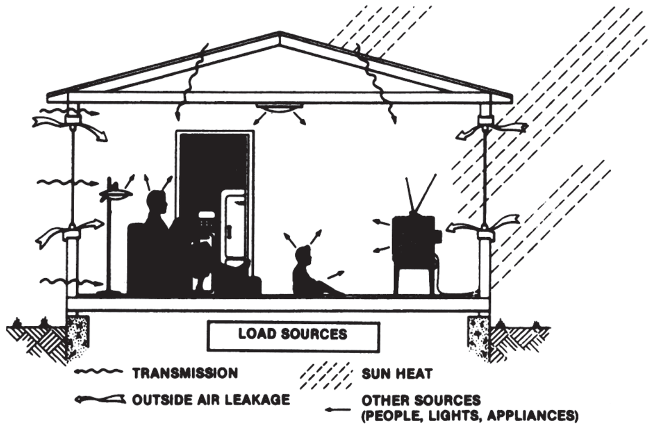
To estimate the heating load, that determines the heating capacity of the unit/system to be installed, two sources are considered:

- Transmission, and
- Outside air (leakage)

B. Cooling load sources

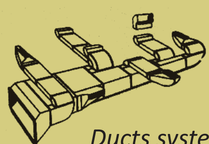
To estimate the cooling load, and as a result the cooling capacity of a unit, besides transmission and outside air, some other sources must also be considered. These sources that increase the temperature and moisture content of the air in the air-conditioned space are:

- Sun radiation
- People
- Electric lights
- Appliances (motors heating elements)



NOTE

By the term **transmission** (also conduction or heat transfer), we mean the flow of heat from a space with high temperature to another with low temperature through the various building materials (walls, floors, roofs, etc.)


Ducts system

The term **outside air** concerns the estimation of the outside air which enters a building either through its various opening (doors and windows) or is introduced through the ducts that connect the air-conditioning unit to the outside air.

Load estimate form

All the calculations made during the load estimation procedure are presented in the load estimate form which, by indicating the major load sources, will lead the H.V.A/C. engineer to determine the capacity of the system to be installed and to proceed to the selection of the appropriate type for the specific space to be air-conditioned.

LOAD ESTIMATE FORM

Customer... Address ....
Buyer.. Installation by ....
Estimate Number .... Estimate by... Date...........................
Equipment Selected: Manufacturer .... Model....................................... Size......................................
Direction House Faces.................. Gross Floor Area .... Gross Inside Volume.............................

Design Condition:	Dry-Bulb Temperature (°C)	Wet-Bulb Temperature (°C)
Outside	35/7	24/4
Inside	26/20	18/14
Difference (Use this value to determine applicable factors).	9/13	6/10

ITEM	**AREA** (in/ft)	**FACTOR** (Circle the factors applicable)				**BTU/TR** Area x Factor
1. (a) WINDOWS, Gain from Sun (Figure all windows for each exposure, but use only the exposure with the largest load)		For glass block, reduce factors by 50%; for storm windows or doubleglass, reduce factors by 15%. No Shading	Inside Shades	Outside Awnings	Load for Each Exposure (Area x Factor)	
Northeast	....	60	25	20	....	
East	....	100	40	25	.... Use	
Southeast	....	75	30	20	.... only	
South	....	75	35	20	.... the	....
Southwest	....	110	45	30	.... largest	
West	....	150	65	45	.... load	
Northwest	....	120	50	35	....	

EXERCISES

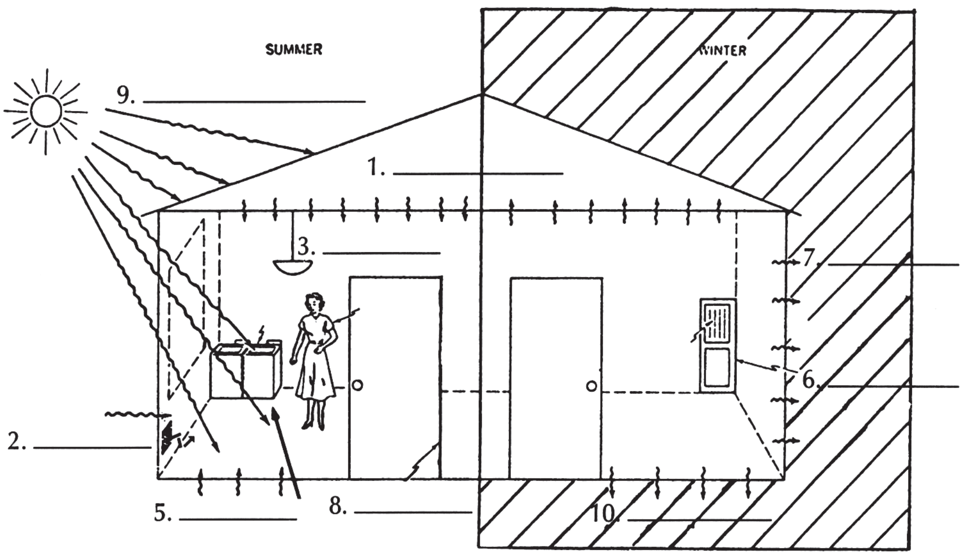
1. Write the Greek equivalent to the following terms.

heating load sources =
cooling load sources =
transmission / conduction / heat transfer =
outside air (leakage) =
sun / solar radiation =
heating season =
cooling season =
load estimating / estimate form =

2. **Which load sources should be considered to determine the capacity of a winter, a summer or a year-round air-conditioning system? Tick appropriately.**

LOAD SOURCES	AIR-CONDITIONING SYSTEM		
	WINTER	SUMMER	YEAR ROUND
Transmission			
Outside air (leakage)			
Sun radiation			
People			
Lights			
Appliances			

3. **Label the load sources in the picture below.**



4. **Identify the terms defined below. Write them in the space provided.**

1. It refers to the fresh air which enters a building either by leakage through its various openings or through the ducts of the air-conditioning system:

   ____

2. It refers to the flow of heat from a high remperature to a low temperature through the various building materials of a house: ____________________

3. It is a form where all the measurements and calculations that help us determine the air-conditioning load are presented: ____________________

5. Underline the correct alternative.

a) The direction of the heat flow (transmission) will be
- *always from the inside to the outside of a building.*
- *always from the outside to the inside, regardless of the season.*
- *either from the inside to the outside of a building or the other-way-round,* depending on the season of the year.

b) When calculating the heating load, transmission concerns the estimation of heat flow from the *inside* / *outside* of a building to the *inside* / *outside,* where the temperature is lower in the cold months. The larger the difference between these two temperatures, the *more* / *less* heat flows to the outside and is lost.

c) In the heating season, the outside air is at a *higher*/*lower* temperature than the air in the air-conditioned space, thus adding to the *heating* / *cooling* load.
In the cooling season, on the other hand, the outside air is at a *higher* / *lower* temperature than the inside air and, as a result, it adds to the *heating* / *cooling* load.

6. Check your knowlege by answering the following questions.
1. Which factors are responsible for the heat losses in a building?
2. Which sources are considered to determine the heating load?
3. How is heat transferred from a space with high temperature to another with low temperature?
4. Which direction does heat flow during summer? From the inside to the outside of a building, or the opposite? Why?
5. How is outside air supplied in a building?
6. Does the outside air cause heat losses or heat gains during the cooling season? Why?
7. Which of the cooling load sources give off moisture, besides raising the temperature in the air-conditioned space?
8. How does the load estimate form help us determine the size of the air-conditioning unit to be installed?

7. Make as many terms as you can by combining the following words:

heat / heating	load	capacity
cooling	estimation	form
air-conditioning	loss	sources
output	gain	season
	system/unit	flow

e.g. *load estimation sources*

System / Unit Selection

To select the most appropriate system for the specific space to be air conditioned, the design engineer must take into consideration the systems available on the market. They are classified into three major categories:

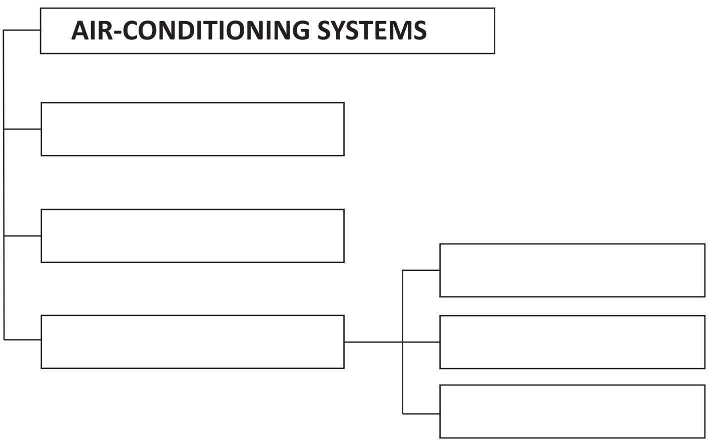
Unitary/window air conditioner

1. **Central station systems,** suitable for installation in large buildings, especially office buildings, exhibition centres, etc.
2. **Unitary / Window systems,** suitable for the air conditioning of a single space, e.g. a room or an office.
3. **Split-type systems** (ceiling-suspended, wall-mounted or floor-standing), suitable for houses, appartments, shops, offices, etc.

Each of the above systems is further distinguished into a great variety of types depending mainly on the arrangement of their components.

EXERCISES

1. Complete the diagram with the main types of air-conditioning systems available on the market.



2. What kind of air-conditioning system would you install:

a) in an office?
b) in a shopping centre?
c) to maintain comfort in the sitting and dining room of an appartment?
d) in a factory?

3. Odd-one out

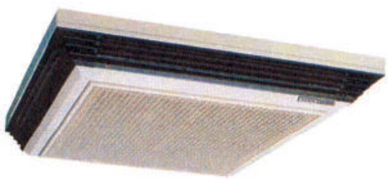
1 size dimension capacity output	2 amount quantity quality proportion	3 practice procedure method process	4 component element part fitting
5 distinguish arrange classify categorize	6 indicate show express extend	7 select prepare choose prefer	8 adjust determine conclude decide

4. PASSIVE VOICE

Turn the sentences into the Passive Voice.

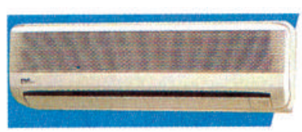
1. We measure the velocity of air with an anemometer.
2. We express the capacity of an air conditioner in kilowatts.
3. They manufactured the first air conditioners in the 30s.
4. The cooling load must balance the heat gains in a space.
5. Scientists discovered the principles on which air-conditioning systems operate in the twentieth century.
6. The technician has just installed a unitary system in Mr. Burton's office.
7. We also refer to transmission as conductivity or heat transfer.
8. We use the psychrometric chart to estimate the conditions of the outside air.
9. By the load estimation procedure, we calculate the heating and cooling load in a space.
10. At the end of the load estimation procedure, the H.V.A/C. engineer determined the capacity of the unit and selected the appropriate air-conditioning model.

Split type air-conditioning systems



Ceiling-suspended type

Floor-standing type

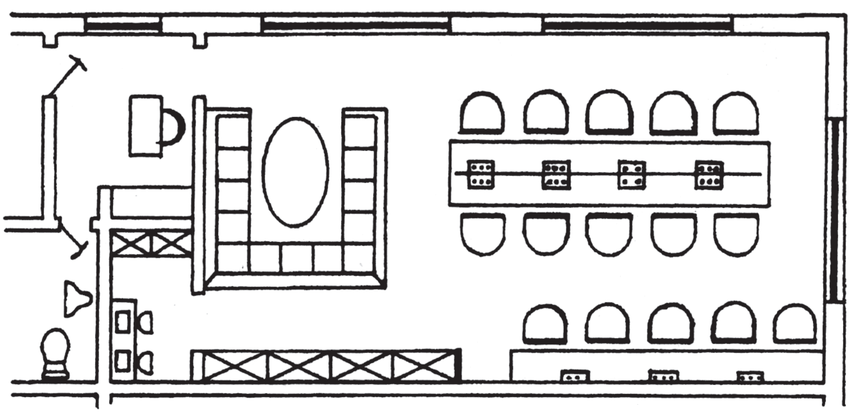


Wall-mounted type

CHOOSING AN AIR CONDITIONER

Mr Inwood, a successful hairdresser, has decided to make some changes in his business: to buy new equipment and new furniture, paint the walls, buy new curtains and fit a new wall-to-wall carpet. He also intends to have a reliable year-round air-conditioning system installed before he reopens his business at the end of the month.

As he didn't know much about air conditioners, he visited INTRAKLIMA Exhibition Centre to ask for advice. Next morning, Mr Green, a specialist in designing and installing air-conditioning systems, visited the space and completed a load estimate form. Two days later, he sent Mr Inwood the following letter:



Burnt Mill Lane
Harlow
Middlessex DM 30 RS

25th May, 2000

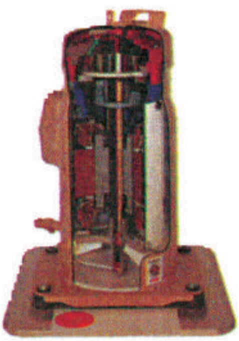
Mr Inwood
6 Harrison st.
Harlow
Middlessex DM 30 RS

Dear Mr Inwood,

After considering your space requirements I am recommending a BIRGIN air conditioner with the following characteristics and specifications:

- heat-pump, split-type system
- ceiling suspended, cassette type
- cooling capacity: 26,600 BTU/h
- heating capacity: 27,600 BTU/h

The above system is specially designed to provide an economical and reliable performance of high quality, while at the same time it guarantees extremely low noise level operation.



SCROLL COMPRESSOR

It consists of two units (an outdoor and an indoor one) connected by narrow refrigerant and control lines.

The outdoor unit is equipped with an air-cooled condenser and a scroll-type compressor which is 10% lighter and 20% smaller than the reciprocating type, specially constructed so as to minimise friction and reduce power consumption.

The indoor unit, thanks to its slim, light and elegant design, is ideal for fitting on the ceiling, thus saving space and providing better air diffusion than the wall-mounted and floor-standing types. Its advanced auto-swing system operates within a range of 0°- 65°.

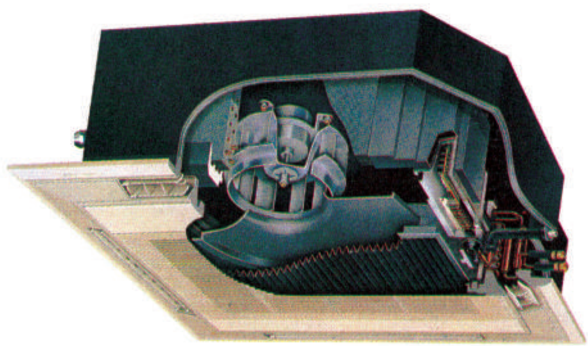
One of the main advantages of this system is the integrated microcomputer control which monitors most of its functions improving reliability and comfort as it guarantees freeze-up protection, detection of any thermistor abnormality, filter clean reminder, self diagnosis, automatic cool/heat changeover and dehumidifying (program dry operation).

The unit is equipped with an easy-to-use wireless remote controller with a liquid crystal display (LCD) which allows the user to control all the functions of the system.
The cost of the complete system, including the installation and the VAT* is 1,200,000 drs. The above offer stands until the end of the month.
We hope that our recommendations meet your requirements and are looking forward to hearing from you soon,

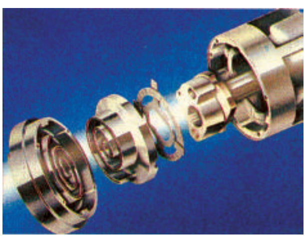
Yours sincerely,

A. Green
H.V.A/C. engineer

P.S. *We would like to inform you that the above model is also available equipped with an inverter system. You should know, however, that, although an inverter reduces the operation costs of the unit as much as 30%, on the other hand, it adds almost 35% to its price.*
Encl. *Functions of the wireless remote controller.*



Ceiling - suspended, cassette type air conditioner



Scroll-type compressor

* V.A.T. = Value Added Tax (=Φ.Π.Α.)

EXERCISES

1. **Read Mr. Green's letter carefully and complete the information in the table below.**

Make: BIRGIN
System: ______________________
Option: model equipped with ______________________

Technical features
Heating capacity: ____________
Cooling capacity: ____________

Indoor unit
Type: ____________________, ________________
Air-diffusion system: __________ operating within a range of ______

Outdoor unit
Condenser: ______________
Compressor: ______________, specially constructed to ___________ ____________ and ______________________________

Operation monitored by (an) ______________________________
which guarantees: a) ______________________________
b) ______________________________
c) ______________________________
d) ______________________________
e) ______________________________
f) ______________________________

Characteristics / Advantages
Performance: _____________, _____________, _____________
Operation: ______ noise _______
Refrigerant and control lines: __________
Functions controlled by means of: ____________________________
Indoor unit design: _____________, _____________, _____________

Price: _____________ drs. (installation and VAT included)

2. Are the following sentences true or false? Correct the false ones.

The recommended air conditioner:

1. is highly recognised for its excellent performance, its reliability and low power consumption.
2. is a heat-pump unitary system that will be fitted on the wall.
3. has a reciprocating compressor.
4. has a multi-flow air-diffusion system.
5. is elegant, quiet, slim and light.
6. can be controlled by a wireless remote controller.
7. if it is equipped with an inverter system, costs 20% more.
8. is equipped with a microprocessor which controls its operation.
9. is offered at a reduced price until the end of the week.

3. Write the equivalent of the terms below in your mother tongue.

heat pump =
inverter system =
split-type system =
air-diffusion =
scroll-type compressor =
reciprocating compressor =
friction =
thermistor =
multi-flow system =
auto-swing system =
integrated microprocessor =
freeze-up protection =
automatic cool/heat changeover =
dehumidifying (program dry operation) =
wireless remote controller =
liquid crystal display =
low noise level operation =
low power consumption =
operation costs =
reliability =

4. Answer the questions.

1. Why has Mr Green suggested a ceiling-suspended air conditioner and not a wall-mounted or floor-standing one?
2. What are the advantages of the scroll-type compressor compared to the reciprocating one?
3. What is the usefulness of the integrated microprocessor?
4. What are the characteristics of the wireless remote controller?
5. Which are the main advantages of the recommended air-conditioning system?

5. Match words with definitions.

1. to improve	a. included in something, e.g. a device, as a part of it; built-in
2. to reciprocate	b. the screen of a device on which information (measurements, functions, etc.) is shown
3. to fit	c. to get, become, or make something better, more effective
4. integrated	d. to put something into a place, to attach or fix it there
5. reliability	e. a lamp or other sign on a device that makes the user remember to do something
6. display	f. the ability of a machine, device, etc. to work successfully, effectively
7. performance	g. to move forwards and backwards as a piston does
8. reminder	h. the ability of a machine, device, etc. to work well, without problems

6. Make pairs of synonyms by matching words from the two columns in each group.

A. Verbs

consider	permit
recommend	show
provide	work
guarantee	control; check
reduce	give
monitor	ensure
allow	fit; place
operate	decrease
display	examine
mount	advise; suggest

B. Nouns, adjectives, adverbs...

constructed	pipe; tube
specialist	anomaly
remote	price
line	perfect
distribution	beautiful
power	energy
abnormality	made; designed
elegant	far; distant
cost	diffusion
ideal	expert

7. Choose the appropriate preposition from the list to fill in the gaps.

by	to	for	on	with	in

1. The operation of air conditioners is based __________ the principles of refrigeration.
2. The output capacity of an air conditioner is expressed __________ kW or BTU/h.
3. The user's commands are transmitted __________ the air-conditioner __________ pressing this button.
4. Most modern air conditioners are equipped __________ an inverter.
5. CFCs add seriously __________ the greenhouse effect.
6. The velocity of the air is measured __________ a velometer.
7. She called Mr Silverson and asked __________ advice.
8. He is a specialist __________ ventilation systems.
9. The price depends __________ the number of accessories you buy.
10. You must replace the filter __________ a new one.

Oral Practice

Mr Inwood, who doesn't know much about air conditioners, had diffucuIty in understanding some of the information in the letter, so he phoned Mr Green to ask for more details.

Work in pairs. Use the information below to prepare the telephone conversation between Mr Green and Mr Inwood. Then, act their dialogue out.

Information to help you prepare Mr Inwood's questions

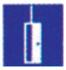
A. Mr Inwood didn't know what a heat pump and an inverter is.
B. He had difficulty in understanding the functions/ modes of the air conditioner listed below:
- a) Automatic cool/heat changeover
- b) Dehumidifying (program dry operation)
- c) Freeze-up protection
- d) Filter clean reminder
- e) Self diagnosis

Information to help you prepare Mr Green's answers to Mr Inwood

Heat pump: It is a type of year-round air-conditioning system in which a 4-way (reversing) valve is used to reverse the refrigerant flow. As a result, a heatpump uses the same equipment to handle both heating and cooling functions. Such a system is much smaller than conventional air conditioners, and its operation on the heating mode is more economical compared to them.

Inverter system: It is a kind of frequency converter like the one integrated in the circulator pump of a heating system). It controls the operation of the compressor adjusting its performance (=its speed) to the temperature requirements of the space. It guarantees around 40% higher efficiency of the unit and 30% less power consumption compared to conventional air conditioners.

Microcomputer controlled functions



a) Automatic cool/heat changeover: This function is controlled by a switch connected to a sensor which senses the difference between the thermostat setting and the ambient temperature*. In case of great temperature variations in a day, the switch automatically selects between heating and cooling mode (= operation) to maintain the desired temperature in the air-conditioned space.

b) Dehumidifying (program dry operation): This microprocessor controlled function enables the unit to determine when it should turn the compressor and indoor fan ON and OFF so as to maintain the appropriate room temperature, humidity and air-flow rate.

c) Freeze-up protection: This function will automatically turn the compressor ON and OFF so as to prevent indoor coil freeze up and protect the compressor from damage. This is achieved thanks to a thermistor, which will shut the unit down when the temperature at the coil drops.

d) Filter clean reminder: Thanks to this microcomputer controlled function which counts hours of operation, the filter clean reminder lamp will come on to indicate that the filters need cleaning.

e) Self diagnosis: Thanks to this function, the microprocessor senses any abnormality or malfunction and immediately warns the user or shuts the system down.

* Temperarure of the air that surrounds operating equipment

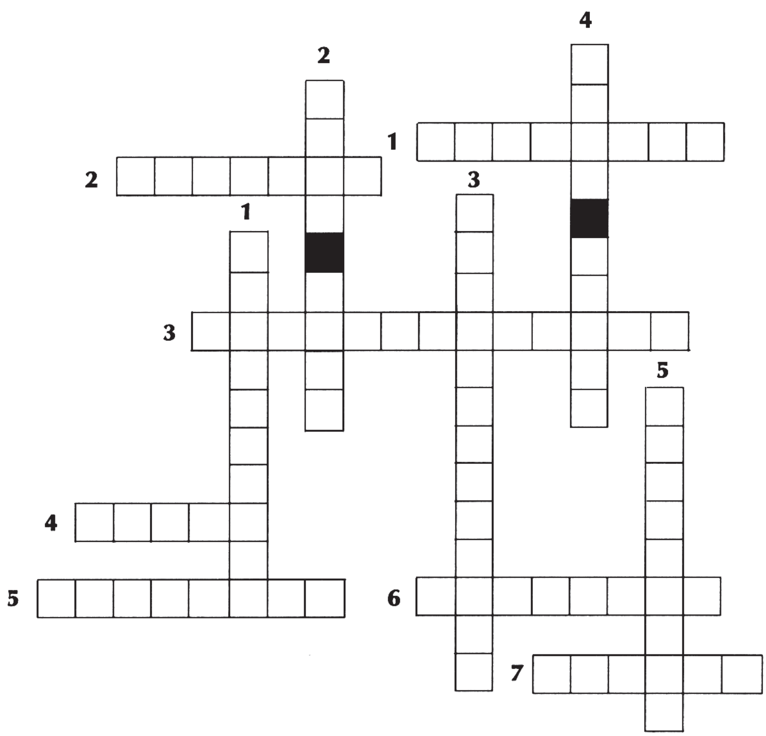
Crossword Puzzle

Across

1. The force that makes it difficult for things to move freely when they are touching each other
2. The part of an instrument, a remote controller, etc. where readings of measurements or information concerning the operation of the device are presented
3. The process of removing moisture from air
4. The air-conditioning system which consists of two units, an indoor and an outdoor *(only the first part of the term)*
5. Characteristics
6. A device that sends signals to an appliance, not connected to it, by wires or cables (e.g. a remote controller)
7. The compressor type of the air-conditioner model Mr Green recommended to Mr Inwood *(only the first part of the term)*

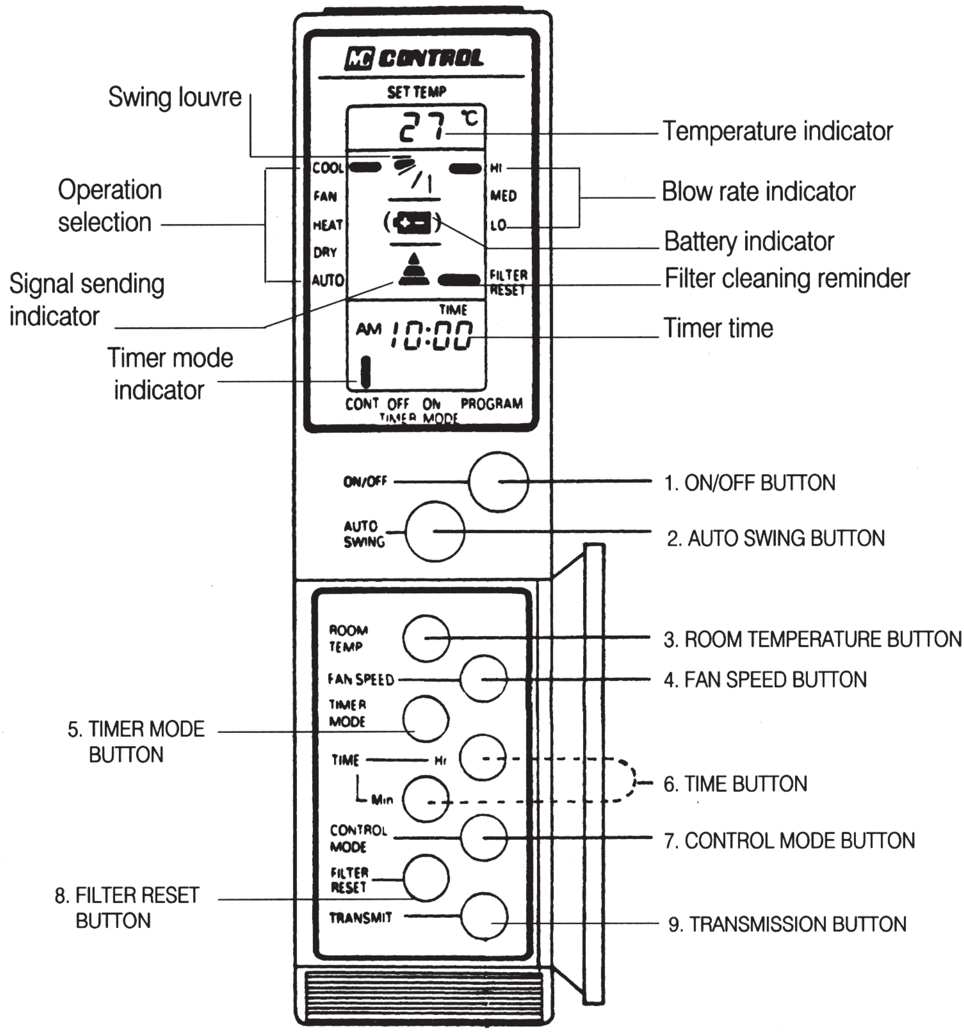
Down

1. An electronic device that protects the compressor from overheating or freezing up
2. An air-conditioning system which uses the same equipment for both the heating and cooling mode
3. A compressor with parts that move backwards and forwards in a straight line, e.g. like the pistons in the cylinder of an engine *(the first part of the term)*
4. A type of air-distribution system with flap(s) that move up and down automatically
5. The process of making something to spread; distribution, e.g. of air



WIRELESS REMOTE CONTROLLER

In the letter he sent to Mr Inwood, Mr Green enclosed a photocopy of a page from the User's Manual which presents the controls and functions of the wireless remote controller*. Here it is.



1. **ON/OFF BUTTON:** It activates or deactivates the air conditioner.
2. **AUTO SWING BUTTON:** When this button is pressed during operation, the swing louvre** starts moving.
3. **ROOM TEMPERATURE BUTTON:** Every time this button is pressed, the temperature rises one degree starting from 18 up to 30° C.
4. **FAN SPEED BUTTON:** Every time this button is pressed, the mode is sequencially changed offering a choice between high (HI), medium (MED) or low (LO) speeds.
5. **TIMER MODE BUTTON:** It turns the timer mode ON or OFF. It offers a selection between: CONT. ← OFF ← ON ← PROGRAM

   CONT. (the unit is started or stopped by the ON/OFF button)
   OFF (to set the time the operation of the unit will stop)
   ON (to set the time the unit will start operating)
   PROGRAM (to set the time the unit will be started and stopped every day)
6. **TIME BUTTON:** It sets the current and the timer operation time (= the time the unit will start or stop operating).
7. **CONTROL MODE BUTTON:** Every time this button is pressed, the operation mode is sequencially changed as follows:
   COOL ← FAN ← HEAT ← DRY ← AUTO
8. **FILTER RESET BUTTON:** It turns off the filter clean reminder sign on the display and restarts the countdown to remind the user that the filter needs cleaning (every 200 hours of operation).
9. **TRANSMISSION BUTTON:** It transmits signal to the unit whenever the setting of any function is changed during operation.

* Also referred to as «remote control».
** A louvre (spelled louver in American English) is a door or window with narrow, flat, slopping pieces of wood, glass, plastic, etc. across its frame; a flap.

TASK 1

Mr Inwood noticed that the picture of the remote controller also presented the indications of the LCD. He thought it would be useful to match these indications with the buttons that set the various operating modes of the unit, so he numbered each indication on the liquid crystal display with the number of the corresponding button. **Do the same.**

TASK 2

Next, Mr Inwood thought that it would be convenient to have a chart presenting the function of the various buttons on the remote controller, so he made the following table. **Tick it appropriately.**

FUNCTIONS		BUTTONS								
		ON/OFF	AUTO-SWING	ROOM TEMPERATURE	FAN SPEED	CONTROL MODE	TIME	TIMER MODE	FILTER RESET	TRANSMISSION
1	It selects the fan speed.									
2	It activates or deactivates the timer mode.									
3	It sets the time in the timer.									
4	It sets the room temperature.									
5	It selects mode of operation.(HEAT-COOL-DRY-AUTO-FAN)									
6	It resets the countdown to remind us the filter needs cleaning.									
7	It operates the swing flap.									
8	It transmits signal to the unit whenever the setting of any function is changed.									
9	It turns the unit ON or OFF.									

TASK 3

On the other side of the page presenting the buttons and indications of the wireless remote controller, there was a list with explanations concerning the various indications on the LCD (see below). Mr Inwood got a bit confused, so he wrote over or next to each explanation the indication the information in it refers to. **Do the same.**

1. ____________________

When this mark is indicated on the display, the flap is moving

2. ____________________

When this mark ( ) is indicated, the battery is near full discharge and should be replaced.

3. ____________________

The set temperature is indicated by this mark: $\boxed{^{\circ}C}$

4. ____________________

This mark starts blinking when the TRANSMISSION BUTTON is pressed to indicate that signal is sent to the unit.

5. This mark is indicated on various selected modes. It displays:
   a) the operating mode of the unit ____________________
   b) the set air-flow rate ____________________
   c) the content of the timer mode ____________________

6. ____________________

If the above mark ( ) is indicated next to the FILTER RESET, it indicates that the filter needs cleaning. It is turned off when the FILTER RESET button is pressed.

DESCRIBING HOW THINGS ARE DONE

Study the patterns:

We can/must + infinitive... *(do this)* by + gerund... *(doing that)* .... is/can be/must be + p.p. *(done)* by + gerund... *(doing that)*

Examples

- *We (can) lower the temperature in a space by removing heat from the air in it.*
- *The temperature in a space is/can be lowered by removing heat from the air in it.*

PRACTICE

1. Use the table in TASK 2 to make sentences as in the above examples.

2. Work with your partner to make five (5) sentences describing how various activities are done.

3. *ASKING Wh_ QUESTIONS*

Use the information in the sentences below to ask questions beginning with the words in parentheses.*

1. Mr Assimakopoulos spent $ 500 to have a wall-mounted air conditioner installed in his office. *(Who / Why / How much)*
2. A compression refrigeration system comprises a compressor, a condenser, an expansion valve and an evaporator. *(What / Which refrigeration system)*
3. David studied Mechanical Engineering at Newcastle University. *(Who / What / Where / Which university)*
4. A central heating installation costs more than 6,000,000 drh. *(What / How much)*
5. Mr Graham's son was killed in an accident two months ago. *(Who / Whose son / When)*
6. It took him three hours to repair the malfunction of the warm-air heater. *(What / How long)*
7. The microprocessor controls most functions of the system. *(What / Which functions)*
8. The relationship between the air properties is presented on the psychrometric chart. *(What / Where)*
9. The air conditioner they bought is equipped with an inverter. *(What -S/O**-)*
10. Ceiling-suspended air conditioners save space. *(Which type / What)*
11. The plenum is fitted on top of the warm air heater. *(What / Where)*
12. A welder must wear a face shield to protect his eyes from sparks. *(Who / What / Why)*
13. Perspiration evaporates more slowly when the air contains a lot of moisture *(When)*
14. Fiona has just seen Tom in the supervisor's office. *(Who -S/O-/Where)*

---

* See Wh_ questions in the Grammar section in the APPENDIX

** S: subject, O: object

INSTALLING A SPLIT-SYSTEM AIR CONDITIONER

Below are the instructions for the installation of a wall-mounted split-type air-conditioning system taken from the manual of a well known firm. **Read the instructions carefully and arrange them as follows:**

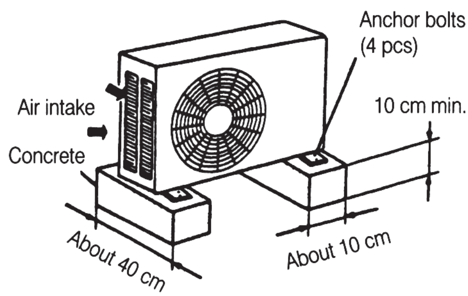
Instructions that are related to the:

a) installation of the indoor unit:
b) installation of the outdoor unit:
c) preparation and connection of the refrigerant tubing:
d) preparation and connection of the electrical wiring:
e) preparation and connection of the drain hose:
f) hole in the wall for the tubes and wires that connect the units:
g) final preparation and testing of the system: **e.g.** *15 (test for leakage),*

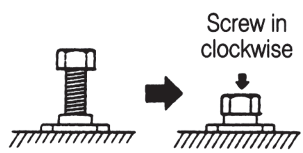
INSTALLATION PROCEDURE

This air-conditioning system meets strict safety and operating standards. As the installer or service technician, it is an important part of your job to install or service the system so that it operates safely and efficiently. So, for a safe installation and trouble-free operation, read the instructions carefully and follow each step of the procedure exactly as shown.

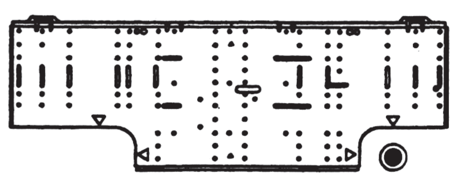
1. Choose the right location for the outdoor unit, provide a solid base and bolt it securely on it.



2. Select the proper position for the indoor unit and remove the rear panel* from it.

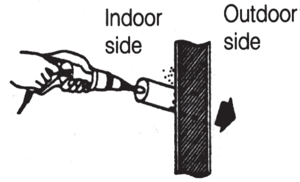


3. Mount the rear panel on the wall making sure it is horizontal and strong enough to hold the weight of the unit.



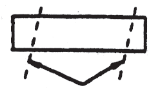
* also called: fixing board or wall clamp.

4. Determine which side of the indoor unit you should make the hole on the wall for the drain hose, the refrigerant tubes and electrical wiring that will connect the two units.

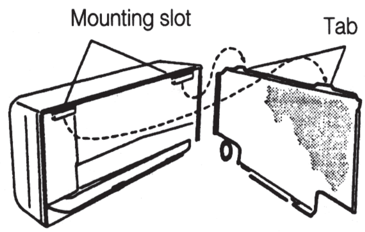


5. Use a key-hole saw to cut the hole on the wall at a slight downward slant to the outdoor unit.

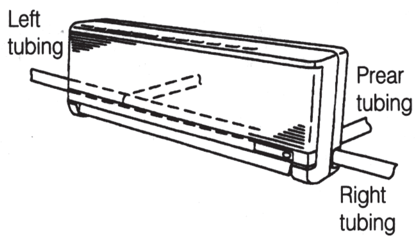
6. Measure the thickness of the wall, cut the PVC pipe 6 mm shorter and insert the pipe in the hole to protect the tubes and wires.



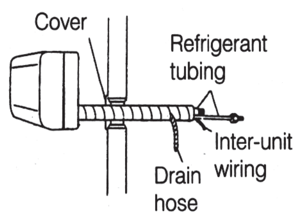
7. Mount the indoor unit on the rear panel.

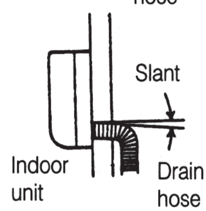


8. Measure carefully the distance between the two units and cut the refrigerant copper tubes, the insulation pipes and the electrical wires at the appropriate length. Also, measure and cut the drain hose, in case an extension is needed.

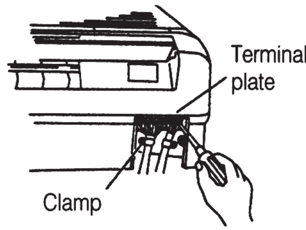


9. Insert the tubes in the insulation pipes, prepare the ends for connection and shape the tubing so that it can easily go into the wall hole. Also, make any other necessary bends.



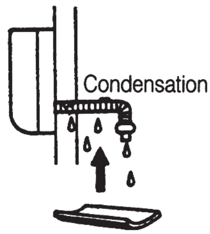


10. Prepare the ends of wires for connection.

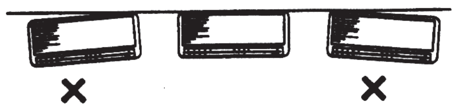


11. Push the wiring, refrigerant tubing and drain hose through the hole in the wall and make the wiring and tubing connections to the indoor unit carefully and securely. Don't forget to ground the unit.

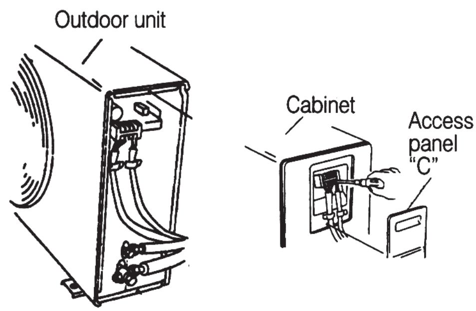
12. Insulate the part of the drain hose that runs in the room to prevent damage from dripping of condensation to floors or furniture.



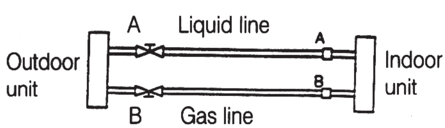
13. Adjust the indoor unit, so it is securely mounted on the rear panel.

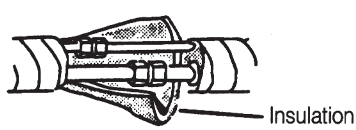


14. Connect first the refrigerant tubing and then the inter-unit wiring and power line to the outdoor unit. Check that all connections are correct, and ground the unit.

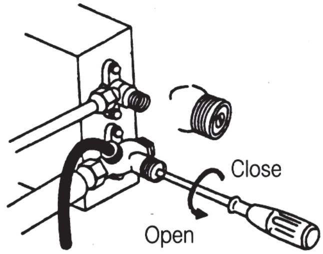


15. Purge the air from the connecting refrigerant pipes and leak test all the joints on the tubing. If there is no leakage, insulate them with the tubing insulation.

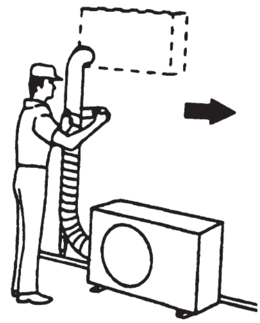




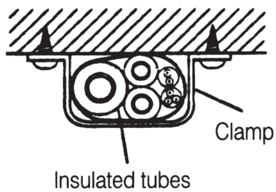
16. Open the service valves to let the refrigerant stored in the outdoor unit flow in the system. If the tubes are longer than 4 m, add the appropriate amount of refrigerant.



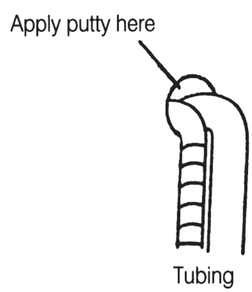
17. Test run the air conditioner and check for refrigerant leaks around the service valves or caps.



18. Wrap the wiring, refrigerant tubing and drain hose together as one bundle with armouring tape, starting the wrapping from the bottom of the outdoor unit to the top of the tubing where it enters the wall and is connected to the indoor unit.



19. Clamp the tubing bundle to the wall using a clamp/saddle approximately every 120 cm.



20. Use putty to seal off the hole in the wall to prevent rain and draught* from entering.

* spelled draft in American English

EXERCISES

1. Match the words (verbs, nouns) with their definitions.

A. Verbs	a) to fold paper, cloth, etc. tightly around something to cover it completely
1. to seal	b) to fall in individual small drops
2. to wrap	c) to fix something on a surface firmly with bolts and nuts
3. to insert	d) to cover an opening with something to prevent air, liquid or other material from getting in or out
4. to bolt	e) to put an object inside something, e.g. a hole
5. to ground	f) to connect an electrical appliance to a wire through which electricity can pass into the ground if something goes wrong with it
6. to drip	

B. Nouns	a) not horizontal; sloping; inclined position
	b) the back part of something
1. putty	c) plastic pipe used to remove water from a space or container
2. draught	d) a stiff white paste used to fix glass panes in place, to seal off holes on the wall, etc.
3. slant	e) a number of things tied or wrapped together
4. condensation	f) small drops of water which are formed when warm water vapour touches a cold surface
5. rear	g) a current of air that comes into a space in an unpleasant way
6. bundle	
7. drain hose	

2. Look through the instructions to find words similar in meaning to the ones below.

to fix (1, 3, 7, 19) ____________, ____________, ____________

place (1, 2) ____________, ____________

stable; strong (1) ____________

external (1) ____________

firmly; safely; tightly (1, 11, 13) ____________

suitable; correct (2, 8, 16) ____________, ____________

internal (2) ____________

board (2, 13) ____________

level (3) ____________

to decide (4) ____________

pipe(s) (4, 8, 9...) ____________, ____________

required (8, 9, 16) ____________, ____________

right (14) ____________

to examine to test (14, 17) ____________

to earth (11, 14) ____________

to remove; to empty (15) ____________

connections (15) ____________

to fold (18) ____________

about; around (19) ____________

current (20) ____________

3. PRESENTING SEQUENCE OF ACTIVITIES

Use the installation instructions to make sentences as in the examples below.

- *Before installing the outdoor unit, (you should) choose the right position for it.*
- *The outdoor unit should be installed (only) after the right position for it is/has been selected.*
- *After selecting the appropriate position for the indoor unit, (you should) remove the rear panel.*
- *The appropriate position for the indoor unit should be selected before the rear panel is removed.*

4. Identify the wrong information in the following sentences and correct it.

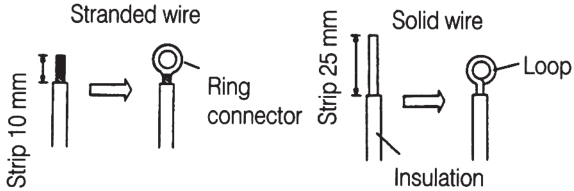
We *wrap the refrigerant tubes and the drain hose as one bundle with armouring tape.*
e.g. *The electrical wires are also included in the bundle.*

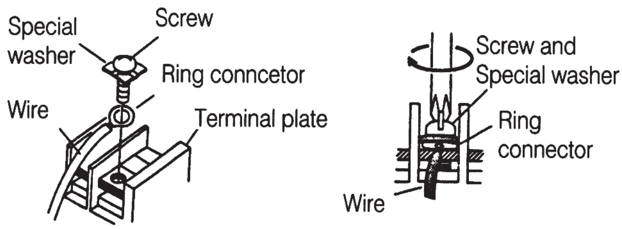
1. The hole on the wall must be cut at a slight upward slant and an iron pipe should be inserted in it to protect the tubes and wires.
2. To prevent damage from dripping of condensation, we should insulate the part of the hose that runs outside the room.
3. After connecting the refrigerant pipes to both units, we insulate them and fix them with saddles on the wall.
4. After completing the connection of the two units, we test run the air-conditioning system and purge the air from the refrigerant tubing.
5. The wrapping of the bundle of tubes and wires with armouring tape should start from the hole in the wall and stop at the bottom of the outdoor unit.
6. The last step in the procedure is to perform a test for leakage.
7. Before operating the unit, we must charge it with refrigerant.

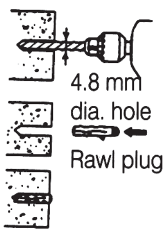
5. **Read the groups of instructions below and say which step of the installation procedure they are related to.**

A

Cut the wiring ends with a cutter or knife and strip the insulation. Using the pliers, either bend the wire to form a loop suitable for the terminal screw or clamp each stripped wire end with a ring connector (depending on the type of wires). Following the wiring diagram, connect the wiring to the corresponding terminals on the terminal plate of the indoor unit, and tighten the terminal screw securely.





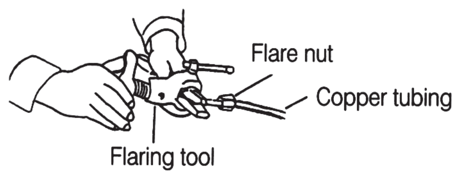


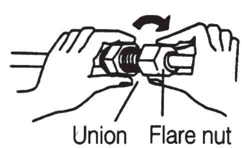
B

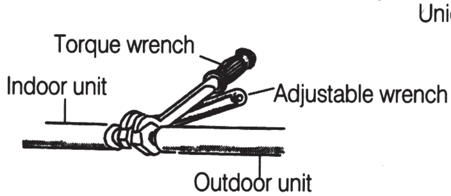
Using the appropriate size drill, make holes in the wall and insert the correct size rawl plugs for the mounting screws. Put the panel in place, double check that it is level and fasten the screws tightly.

C

It is recommended to cut the tubes 30-50 cm longer than the length you estimate. Remove burrs with a tube reamer or file, put the flare nuts on the tubes and make a flare at each end. Using the appropriate wrenches, fasten the nuts tightly to connect the tubes.





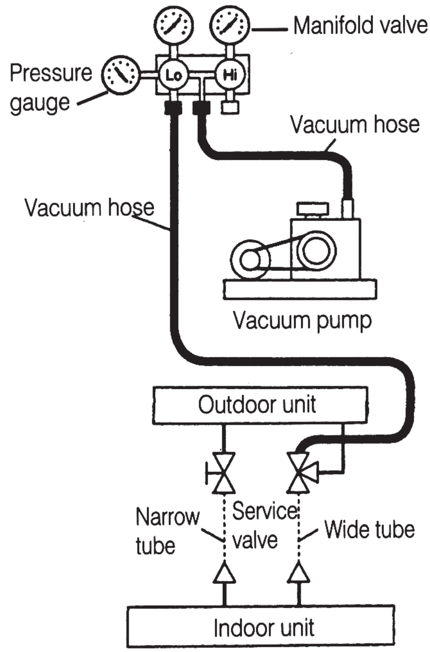


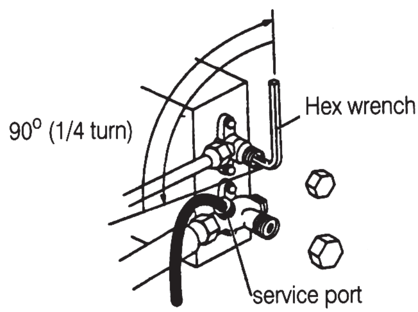
D

As you wrap the bundle with the armouring tape, take care to cover half of each previous tape turn.

E

- Check that both service valves on the outdoor unit are closed.
- Use an adjustable wrench to remove the caps from both service valves.
- Connect a vacum pump and a gauge test set to the service port of the wide tube service valve.
- Open the low-pressure valve of the gauge test set and start the pump.
- Close the valve and stop the pump. With the hex wrench, turn the valve stem on the narrow tube to open it for 10 sec.
- Use the hex wrench to fully open first the wide and next the narrow tube service valve.
- Remove the vacuum pump hose from the wide tube service port and fasten it securely. Also, fasten the caps of the two service valves.





6. Write the Greek equivalent of the following terms.

drain hose =	terminal plate =
extension =	rawl plug =
slant =	burr =
loop =	reamer =
terminal =	flare =
ring connector =	vacuum pump =
wiring diagram =	gauge test set =

Listening Activity

In the first page of the instruction manual, there was a list of the materials, tools and equipment required for the installation of the air-conditioning system. The list is given below, but some words are missing due to missprinting.

Familiarize yourself with the list and then, listen to your teacher and complete the missing words.

A. Tools and equipment required

1. Standard ______________
2. Phillips screwdriver
3. Open ______________ wrenches
4. Electrician's ______________
   or ______________ and wire stripper
5. ______________
6. Flexible ______________
7. Spirit level
8. Hole-cutting ______________ or key-hole saw
9. ______________
10. Drill
11. Tube ______________
12. Reamer or ______________ (for deburring)
13. Tube ______________ tool.
14. Adjustable ______________
15. ______________ wrenches
16. ______________ detector or liquid ______________
17. Vacuum ______________ and gauge test set
18. Charging cylinder

Electrician's knife

Hole-cutting drill key-hole saw

Wire stripper

Tube reamer

B. Additional materials required (not supplied with the unit)

1. Copper tubes and ______________
2. Drain ______________ for extension
3. PVC pipe
4. Tubing ______________
5. Insulated copper ______________
6. Armouring tape
7. ______________
8. Refrigerant lubricant
9. ______________ or saddles
10. Rawl ______________
11. Ring connectors and ______________

Saddles

Ring connectors

Rawl plug

FOLLOW UP

1. Match the following tools and equipment with their synonyms in the list.

1. halide torch – ______________
2. cross-point screwdriver – ______________
3. service cylinder – ______________
4. Allen hex sockets/keys – ______________
5. flat-tip screwdriver – ______________
6. tape measure – ______________
7. level – ______________
8. gauge manifold – ______________
9. pipe cutter – ______________

Portable charging equipment (Vacuum pump, charging cylinder, gauge test set and hoses)

2. EXPRESSING USE/USEFULNESS

Use the patterns below to describe the use/usefulness of the tools, equipment and materials needed in the installation procedure.

- We use/need the *(tool/material)* to + infinitive *(state activity)*
- To + infinitive *(state activity)* we use / need the *(tool/material)*
- The *(tool/material)* is used/needed/required to + inf. *(state activity)*
- The + gerund *(activity)* is done with a/the *(tool/material)*

Examples

- We *use/need the screwdrivers to screw/fasten the screws (in order) to mount the indoor unit on the wall and make the wiring connections.*
- *To mount the indoor unit on the wall and make the wiring connections, we use/need the screwdrivers.*
- *The screwdrivers are used/needed/required to mount the indoor unit on the wall and make the wiring connections.*
- *The fastening of the screws that fix the rear panel is done with the screwdrivers.*

INSTRUCTIONS FOR SAFE AND PROPER INSTALLATION

Apart from the installation procedure, the manual included some warning and caution notices for the safety of the installer and the user, and also some tips and hints for the proper installation of the air-conditioning system.

Read them and say: a) which category/ies the information in each instruction belongs to and b) which installation activity it is related to.

NOTE

WARNING =	unsafe practice that may result in severe personal injury or death
CAUTION =	unsafe practice that may result in personal injury, product or property damage

1

Avoid areas where electrical wiring or water pipes are located.

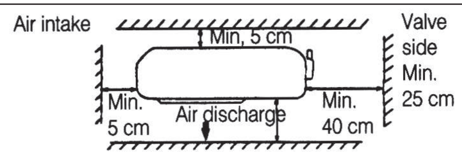
2

Uninsulated drain hoses may damage floors and furniture due to dripping of condensation.

3

Wrong or loose wiring may cause the unit to misoperate or become damaged. No wire should touch the refrigerant tubing, the compressor or any moving part.

4



Avoid

- direct sunlight
- nearby heat sources that may affect performance.

Do choose a place

- from which every corner of the room can be uniformly air conditioned,
- where tubing and drain hose have the shortest run to the outside,
- which allows unrestricted air flow around the unit and room for maintenance.

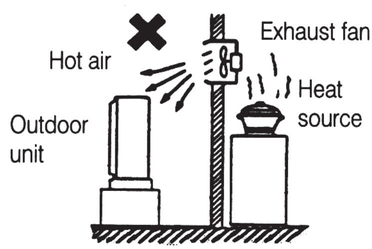
5

Avoid

- direct sunlight,
- heat sources, exhaust fans, etc.
- damp, humid or uneven locations.

Do choose a place

- well ventilated and as cool as possible,
- that allows enough room around the unit for air intake/exhaust and maintenance.



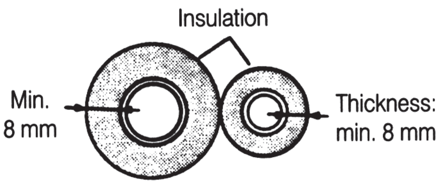
6

Don't forget to apply refrigerant lubricant to the matching surfaces before connecting the tubing. It helps to make a smooth joint and reduces gas leaks.

7

Don't wind the armouring tape too tightly, since this will decrease the heat insulation effect.

8



To prevent heat loss and wet floors due to dripping of condensation, both refrigerant tubes must be well insulated.

9

If air and moisture remain in the refrigerant system:

- the pressure in the system rises,
- the operating cost increases,
- the efficiency drops,
- the moisture in the air may
  - – freeze and block the capillary tube,
  - – corrode the parts of the refrigerant system.

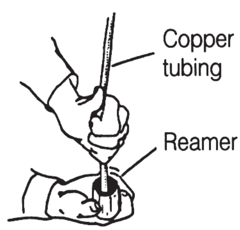
Therefore, they (air and moisture) must be purged completely.

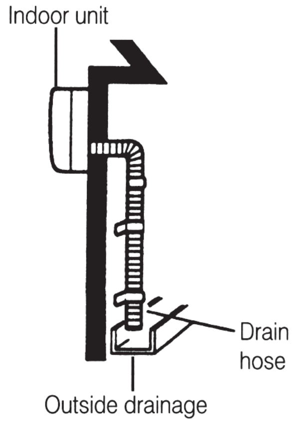
10

Don't apply power to the system or operate it until all tubing and wiring connections have been completed.

11

When reaming, hold the tube end downward and be sure that no copper scraps fall into the tube





12

Be sure that the condensation of the drain hose splits away from the bundle and drips clear of the unit and the tubing.
Also, that the water runoff from the hose doesn't stain the wall or drips to the balcony below or to the road.

13

To avoid the risk of electric shock, both units must be grounded.

Risk of Electric Shock

EXERCISES

1. Look through the instructions for safe and proper installation to identify the words defined below. (The number in front of each definition corresponds to the instruction the defined word is included.)

(3) to work improperly: ____________________

(4) unlimited; free; not blocked by obstacles: ____________________

(5) a) a piece of electrical equipment with revolving blades that carries air and unpleasant smells out of a place: ____________________

b) slightly wet: ____________________

(6) a substance that is applied on metal surfaces or parts to make them move smoothly: ____________________

(7) to wrap something flexible around an object several times: _______________

(8) to take measures so that something unpleasant, dangerous or undesirable does not happen: ____________________

(9) to destroy a metal by chemicals or rust: ____________________

(11) very small pieces of something (e.g. metal) that are no longer useful, so we get rid of them: ____________________

(12) to change the colour; to make coloured patches or dirty marks on a surface: ____________________

2. Fill in the gaps in the sentences below with the words defined in the previous exercise.

1. The burnt gases from combustion in a car's engine are expelled from it through the ________________ pipe.
2. If you work in a ________________ place, or there is water on the floor, make sure the electrical tools you use are grounded.
3. Metal ________________ produced by machine tools, should be gathered and recycled.
4. To ensure that friction is reduced and the machine operates smoothly, apply ________________ to its moving parts every forty hours of operation.
5. When all tests have been completed, ________________ the armouring tape round the bundle of tubing and wiring and fix it with saddles on the wall.
6. He inverted the glass, and the red wine ________________ the tablecloth and his white shirt.
7. I don't know what's wrong, but the hot-air heater ________________ . I think we should call the service technician.
8. The ________________ flow of air in and out of the unit guarantees higher efficiency of the system. So, take care that the filtres are always clean.
9. The ideal refrigerant shouldn't ________________ the metal parts of the system.
10. Fortunately he shut the unit down just in time to ________________ a damage to the compressor.

3. EXPRESSING OBLIGATION / NECESSITY*

Fill in the gaps in the sentences below with the appropriate verb to express obligation / necessity or to give advice. Justify your choice.

e.g. *When reaming, you **should** / **had better** hold the tube end downward so that no copper scraps fall into the tube.*

1. "You ______________ cut the hole on the wall for the tubing and wiring connections before you mount the indoor unit on the rear panel" insisted our teacher.
2. A PVC pipe ______________ be inserted in the hole to protect the wires and tubes.
3. To fix the bundle securely on the wall, you ______________ use a clamp every 100-120 cm.

* See the table in the "Language Functions" section in the APPENDIX

4. Before operating the air conditioner, you ____________ check that both units are horizontal and securely fixed in place.
5. “You ____________ wind the armouring tape around the bundle of tubes and wires starting from the bottom of the outdoor unit.” advised Mr Smith.
6. “If the tubes lenght is over 4 m, you ____________ add refrigerant to the system” is written in the manual.
7. Since loose wiring may cause the unit to misoperate, technicians ________ tighten the terminal screws securely.
8. You ____________ cut the copper tubes 30-50 cm longer than the length you estimate it is required.
9. “To avoid the risk of electric shock, both units ____________ be grounded” said the notice by the terminal plate.
10. To prevent damage on floors and furniture, you ____________ insulate the part of the drain hose that runs in the room.
11. Before releasing the refrigerant in the system, you ____________ purge the air from the connecting tubes.
12. To make a smooth joint and reduce gas leaks, you ____________ apply refrigerant lubricant to the matching surfaces before connecting the tubing.
13. Before determining the position for the hole, you ____________ make sure that no electrical wiring or water pipes are located there.
14. Before operating the air conditioner, you ____________ check that the service valves are closed and their caps fastened tightly.
15. You ____________ install the unit at a location which allows unrestricted air flow around it.

4. REPORTING INSTRUCTIONS

When your teacher explained the procedure for the installation of a split-type air-conditioning system, one of your classmates was absent. Your teacher asked you to inform him.
Work in pairs. Taking your information from the installation procedure on ps. 331-334, the activities described on ps. 337-338 or the tips and notices on ps. 341 -343, inform your partner about the teacher’s instructions. Also, see the table in the Language Functions section of the APPENDIX

Examples

- *He advised us to install the indoor unit to a place where tubing and drain hose have the shortest run to the outside.*
- *He said that we should insulate the part of the drain hose that runs in the room, to prevent damage to floors and furniture.*
- *He warned us that we run the risk to be electrocuted if we apply power to the*

system before all tubing and wiring connections have been completed.

- *He reminded us that, after purging the air from the tubing, we should check the joints for leakage.*

Writing Activity — Letter of application

George Stratigakis, a 26-year-old technician who specialises in installing and maintaining air-conditioning systems, has recently left his job because he is planning to go to England. He wants to find a job and also to study at a university there to become a H.V.A/C. engineer. Some days ago, he saw an advertisement in the English newspaper «The Independent» about a post in a company that manufactures, installs and maintains air-conditioning systems. The post seemed to meet his demands, so he decided to write a letter to the company expressing his interest in it.

Imagine that you are George. Write the letter by making the necessary changes and additions to the following sets of words and phrases. (Form the verbs in the appropriate tense, add pronouns, articles, prepositions, etc.)

Send your letter to: The Personnel Manager
D.K.S. Co.
256 Queen Elisabeth's st.
Liverpool
England

Your address
Date

Addresee and
his address

Dear Sir,

I see advertisement / «The Independent» 18th April / air-conditioning systems technician / your branch in Liverpool.
I write letter / since be interested above post / and think have / right qualifications.
I be 26 years old, / not married.
I finish Technical and Vocational School, / where specialized Air Conditioning systems / 8 years ago.
When discharged from army, / I attend one-year training course / installing and maintaining air-conditioning systems, as well as seminars organised / various air-conditioning systems manufacturing companies. For next 4 years, / I work as air-conditioning systems

installer and maintenance technician / CENTRATHERM company in Crete. / Consequently, acquire quite wide experience on field.
I speak English fluently. / I get FCE 3 years ago / and as supervisor in CENTRATHERM Co. be English, / I have lot practice / language.
Reason I leave / previous job be / I want work England / improve knowledge of language / and extend work experience. / I also plan study / Technical University there / become H.V.A/C. Engineer.
Mr. Robertson, / supervisor in CENTRATHERM Co., / kindly agree / provide me letters of recommendation, / photocopy of which I enclose.
Next week, / I be England / and stay there a month. / So, hope / you can arrange interview / which I have opportunity give / any further information / you may wish.
Address be: Daffodile Lane 5A, London S.E. 36, England.
Hoping you consider / application favourably, / I look forward hearing / you soon.

Yours faithfully,

Signature
Name in full ______________
Occupation ______________

APPENDIX

1. MATHEMATICAL SYMBOLS AND NUMERICAL OPERATIONS

HOW TO READ FIGURES

You read them the same way as in Greek, that is, from the highest to the lowest number. **Don't forget** to add **and** after hundred.

e.g. 8,003,002,678: 8 billion, 3 million, 2 thousand, 6 hundred and seventy eight
573,450,876: 5 hundred and seventy three million, 4 hundred and fifty thousand, 8 hundred and seventy six

HOW TO WRITE WHOLE NUMBERS (INTEGERS) AND DECIMALS

Greek people put a point (.) to show thousands.
e.g. 3.260

English people put a comma (,) instead.
e.g. 3,260

Greek people put a comma (,) to show decimals.
e.g. 7,75 (επτά κόμμα εβδομήντα πέντε)

English people put a decimal point (.) instead.
e.g. 7.75 (seven point seventy five)

HOW TO EXPRESS NUMERICAL OPERATIONS

SYMBOL	VERB	NOUN
+ (plus)	add	addition
- (minus)	subtract	subtraction
x (multiplied by.../times)	multiply	multiplication
: (divided by.../to...)	divide	division
= (equals/makes)		

e.g. 6 + 8 = 14 → six plus eight equals/makes fourteen
16 - 3 = 13 → sixteen minus three equals/makes thirteen
7 x 4 = 28 → seven multiplied by four equals twenty eight, or seven times four makes twenty eight
48 : 8 = 6 → forty eight divided by eight equals six, or forty eight to eight equals six

- The result of an addition is called **sum.**
- The result of a subtraction is called **difference.**
- The result of a multiplication is called **product.**
- The result of a division is called **quotient.**

HOW TO READ FRACTIONS

NOTE

Cardinal Numbers	Ordinal Numbers
1	1st (first)
2	2nd (second)
3	3rd (third)
4	4th (fourth)
5	5th (fifth)
6	6th (sixth)
7	7th (seventh)
etc.	etc.
18	18th (eighteenth)
90	90th (ninetieth)
100	100th (hundredth)
1,000	1,000th (thousandth)
1,000,000	1,000,000th (millionth)

There are four ways to read fractions:

1. Use **cardinal numbers** for the **numerator** (the number above the line) and **ordinal numbers** for the **denominator** (the number below the line).

e.g.

$\frac{1}{6}$ one sixth

$\frac{9}{19}$ nine nineteenths

2. Use: «over» after the numerator.

3. Use: «divided by» after the numerator (which is not very common).

4. Say: «the ratio of *(numerator)*…… to *(denominator)*……».

e.g.

$\frac{5}{7}$
- five over seven
- five divided by seven
- the ratio of five to seven

$\frac{1.2}{6.5}$
- one point two, over six point five
- one point two divided by six point five
- the ratio of one point two, to six point five

HOW TO READ POWERS

Use the patterns:

a) *(number)* to the power *(cardinal number)*

b) *(number)* to the *(ordinal number)*

e.g. 6^8 { six to the (power) eight / six to the eighth 2^5 { two to the (power) five / two to the fifth

Especially for the powers of 2 / 3 we usually say squared / cubed

e.g. * 4^2: four squared, * 8^3: eight cubed

* The number to be raised to a power (e.g. 4 or 8) is called **the base,** while the power the base is raised to (e.g. 2 or 3) is called **the exponent.**

In case of a **negative power,** use the pattern: *(number)* to the *(power)* minus *(ordinal number)*

e.g. 6^{-7} six to the (power) minus seven **(not seventh)**
10^{-4} ten to the (power) minus four **(not fourth)**

HOW TO READ ROOTS

Use the pattern: *(ordinal number)* root of *(cardinal number)*
e.g. * $\sqrt[6]{8}$ sixth root of eight, * $\sqrt[4]{25}$ fourth root of twenty five

Especially for the $\sqrt{}$ / $\sqrt[3]{}$ we usually say square root / cube root

e.g. $\sqrt{6}$ square root six, *$\sqrt[3]{9}$ cube root nine

* The symbol $\sqrt{}$ is called **radical** and the number on the left of it (e.g. the number 3 above), the **index of the radical.**

HOW TO READ MATHEMATICAL SYMBOLS

SYMBOLS	HOW TO READ THEM
$\pm$	...plus or minus...
$\equiv$	...is equivalent to.../identical with...
$\approx$ $\cong$	...is approximately equal to...
$\propto$	...varies as.../is proportional to...
$>$	... is greater than...
$<$	... is less than...
$\geq$	... is greater than or equal to...
$\leq$	... is less than or equal to...
$><$	... is less or greater than...
$\|\alpha\|$	absolute value
%	...per cent
∞	infinity
$f(x)$	f of x /the function of x
[( )]	in brackets/square brackets

2. LANGUAGE FUNCTIONS

NOTE

* Inf. = infinitive p.p. = past participle

EXPRESSING / USE / USEFULNESS / INSTRUMENT

- We + verb / can + inf. ... with a / the ....
– We (can) do this with a / the *(tool / material)*
- We + verb / can + inf. ... (by) using (a) ....
– We (can) do this (by) using (a) *(tool / instrument)*
- We use / need a / the ... to + inf.
– We use / need a / the *(tool / instrument)* to do that
- To + inf. ..., we use / need a / the ...
– To do this, we use / need a / the *(tool / instrument)*
- A / The... is / are used / needed / required to + inf.
– A / The *(tool / instrument)* is used / needed / required to do that *(activity)*
- A / The... is / are used / needed for + gerund...
– A / The *(tool / instrument)* is used / needed for doing that
- (The) + gerund /noun (of...) is / can be / must be done with a / the...
– (The) V+-ing / noun (of) ... is / can be / must be done with a / the *(tool / instrument)*

Examples

- We *(can) test for refrigerant leaks with a halide torch.*
- We *(can) cut metal rods by using a hacksaw.*
- We *use a / the drill to cut holes in solid metal.*
- *To take internal measurements, we need the internal calipers.*
- *To make the wiring connections to the indoor unit, the cross-point screwdrivers are used/needed/required.*
- *The lock-grip pliers are used to hold metal pieces steady.*
- *The two manometres are needed to indicate the amount of pressure in the cylinders.*
- *Dies are used for cutting threads on the surface of metal rods.*
- *The fastening of the screws that fix the rear panel is done with the screwdrivers.*

DESCRIBING HOW THINGS ARE DONE

• We + verb / can + inf. ... – *We do / can do this*	by + gerund
• ... is / can be + p.p. ... – *...is / can be done*	*by doing that*

Examples

– *We (can) lower the temperature in a space by removing heat from the air in it.*
– *The temperature in a space is/can be lowered by removing heat from the air in it.*
– *We (can) control the speed of a car by pressing the accelerator pedal.*
– *The speed of a car is/can be controlled by pressing the accelerator pedal.*

EXPRESSING PURPOSE

- To / In order (not) to + infinitive, ...
- ... to / in order (not) to / so as (not) to + infinitive
- *(Present / Future sentence)* so (that) / in order (that) + present tense / can + inf./ will +inf.
- *(Past sentence)* so (that) / in order (that) + should / could / would / might + inf.

Examples

– *Robots and pallet changing systems are used to load workpieces on the CNC machine tools.*
– *(In order) to increase productivity, you should buy new machinery.*
– *You should get up at six, so as to have enough time to get ready.*
– *I gave him the address so that he could write to the Production Manager.*
– *He left early so that he wouldn't arrive late for the interview.*
– *I'm going to get up at 6:30 so that I don't / won't miss the 7:15 train.*

EXPRESSING PARALLEL INCREASE

The + comparative ...., the + comparative

Examples

– *The more heat is removed from an object or space, the colder it becomes.*
– *The more toxic a substance is, the less it is used.*

GIVING INSTRUCTIONS

- Imperatives
- You'd better + infinitive
- You should/must/have (got) to + inf.
- Don't + imperative
- Avoid + gerund
- You shouldn't/mustn't/needn't + inf.
- You don't have/need /haven't got to + inf.

Examples

– *Charge the system with R-134a.*
– *You should wear a face shield when arc welding.*
– *The system shouldn't be charged with R-134a.*
– *Before test running the unit, you must earth it.*
– *Avoid carrying sharp tools in your pocket.*
– *You'd better put the hacksaw blades in the box.*
– *Don't / you shouldn't pull the electric drill by the cord.*
– *You don't have/need to wear a shop cap if your hair is short.*
– *You mustn't/needn't grind the chisel. I ground it just before we started.*

REPORTING INSTRUCTIONS

Subject (you/he/they...)	told me advised you warned him reminded us		to.../ not to.... to try (not) to.../ to avoid+gerund... always to.../ never to... be careful when... to.../ not to... to make sure we/ (that) the... + present
Subject (I/she/they...	said insisted warned us reminded us	that	we must/should/mustn't/shouldn't + inf. it is dangerous to...

Examples

– *He insisted that we should roll our sleeves up when working with moving machinery.*
– *He warned us that it is dangerous to work with ungrounded power tools.*
– *He reminded us that we should grind the cutting tool every twenty hours of use.*
– *He said that we should be particularly careful when working with the squaring shears.*

COMPARING / CONTRASTING (Presenting similarities and differences)

In case of	
Similarity	**Dissimilarity**
all / both / none / (n)either (of)... both / (n)either (the)... and / (n)or (the)... like / as (the)..., (the)... is / are, etc. ...is / are similar to / identical to... ... is / are the same as (the)... ... is / are as + adjective + as... ... also / too / as well (as)... ...so / neither is / are / do / does / can / has ...	only (the)...is/ has / uses... ...is / has / uses... instead (of...) unlike (the)..., (the)... is / are ... ...is / are dissimilar (to...) / different (from...) ... differ(s) from... ... is / are not as / so + adjective as... ... but / while / whereas / on the contrary on the other hand...

Examples

– *All three engines have cylinders.*
– *Both conventional and fuel injection engines have spark plugs.*
– *Only mechanical refrigeration can achieve flexible ranges of temperature.*
– *In diesel engines, the fuel is self-ignited, but/whereas/while in gasoline engines, it is ignited by means of a spark.*
– *In soldering, the filler rod is an alloy of tin and lead. In brazing, on the other hand, it is an alloy of brass.*
– *The cylinder of a gasoline engine is the same as/similar to that of a diesel engine.*
– *Like gasoline, diesel engines belong to the I.C.E.*
– *Unlike four-stroke engines, two-stroke ones have only ports in their cylinders.*
– *Four-stroke engines have valves; two-stroke enginess have ports, instead.*
– *The distributor of an engine with electronic ignition is different from that of a conventional engine.*
– *A gasoline engine is not so energy saving as a diesel engine is.*
– *Flexible ranges of refrigeration can be achieved by either an absorption or a compression refrigeration system.*
– *Neither absorption nor compression refrigeration uses ice as a cooling medium.*
– *Although absorption systems can achieve flexible ranges of refrigeration, they aren't so widely used as compression systems.*
– *In oxyacetylene brazing, a mixture of oxygen and acetylene is used as a heat source, and so is in oxyacetylene welding.*
– *CFCs contain chlorine, (and) so do HFCs.*
– *He is an excellent technician as his father (was).*

CLASSIFYING

In the table below, there are sentence patterns used to classify an item to the category it belongs to, or to present the various classifications of a general category.

1.	is/are can/could be may/might be should be	categorised classed classified distinguished (sub)divided arranged grouped	as (a) .... into ....
2.	belong to		
3.	is/are	a category a type a kind a form an example a (sub)division	of (a /an) ....
4. There are	....	types categories classes kinds fields	of ....

Examples

– *According to the type of fuel used, car engines are distinguished into gasoline and diesel engines.*
– *Diesel engines are a type of heat engines.*
– *Mechanical saws belong to power tools.*
– *A triangle is a type of geometrical shape.*
– *Non-ferrous metals can be classed into those found in large amounts and those found in small amounts.*
– *There are three types of matter: solids, liquids, gases.*

EXPRESSING OBLIGATION / NECESSITY

Obligation does not always have the same degree of emphasis. It ranges from strong obligation (duty) up to useful advice or suggestion/recommendation and, as a result, it is expressed with the use of different verbs. Study the table.

must / have to Both express strong obligation or necessity and are also used to express emphatic advice. **Must** is often used in written orders or instructions. **e.g.** – *"You must be home by 11 o'clock", my father said.* – *"If you come late again, you'll be fired. You must / have to get up earlier in the morning" my employer said.* – *«Passengers must be at the station 30 min before departure» is written on a sign at the station.* (written instruction) – *You have to wear an overall in the workshop, don't you?* (regulation) – *I have to be home by 11 o'clock. (my parents insist on that)* – *He is a very interesting person. You must meet him.* (emphatic advice) – *You mustn't smoke near the petrol pump.*
should*/ought to Both express obligation or duty, but more gently, not so strongly as must and have to. They are also used to indicate a correct or sensible action, to give advice or remind someone of his duty. **Should** is widely used in formal notices or information sheets. **e.g.** – *You should practise at least two hours a day.* – *On hearing the alarm, visitors should evacuate the building.* – *"You should install the unit far from direct sunlight", was written in the manual.* – *You ought to report the accident.* – *You shouldn't tell lies.* * Should is the most usual form.
had (...'d) better It expresses even less strong obligation. It is used to give a useful advice, to make a suggestion or to warn somebody. It refers to the present or future. **e.g.** – *You'd better wear gloves when hammering on metal objects, to protect your hands from flying chips.* – *You'd better turn the machine off. The motor has overheated.*

EXPRESSING CAUSE / REASON RESULT / CONSEQUENCE

Cause / Reason	Result / Consequence
because of, due to, thanks to + noun as, since, because + sentence	so, as a result, consequently, therefore, thus, (in) this way, for that reason, that is why + sentence

Examples

– *Because of / thanks to the flexible ranges of temperature they can achieve, electric refrigerators are widely used all over the world.*
– *Due to their accuracy, productivity and repeatability, CNC machines have brought tremendous changes in metal working industry.*
– *As / since / because their body consists of sections, cast iron boilers can be easily extended.*
– *Ammonia is toxic and explosive, so / as a result, it is used only with open-type compressors.*
– *CNC machines drastically increase production rates, therefore/ for that reason/ consequently, they represent a large investment for any industry.*
– *CNC machines inspect both cutting tools and workpieces during machining operations, thus reducing non-machining time.*

3. GRAMMAR

SIMPLE TENSES – USE

S. PRESENT *(action repeated in present)* PAST ↓↓↓↓↓ FUTURE PRESENT **e.g.** *SHAFF produces CNC machines.*	**Time markers** always never usually seldom often sometimes every day/week/month...
S. PAST *(action completed in past)* PAST ↓ FUTURE PRESENT **e.g.** *SHAFF produced thousands of CNC machines last year.*	**Time markers** ago before then, when... yesterday last week/month/year...
S. FUTURE *(action to happen in future)* PAST ↓ FUTURE PRESENT **e.g.** *SHAFF will/is going to produce a new model next year.*	**Time markers** tomorrow next week/month/year in a week/month time in the future after...
S. PRESENT PERFECT *(action started in past, not completed yet)* PAST FUTURE PRESENT **e.g.** *SHAFF has recently produced a new model.*	**Time markers** recently, lately already, (not) yet just, ever, never (since, for)
S. PAST PERFECT *(action completed in past before another in past, too)* PAST ↓ FUTURE PRESENT **e.g.** *SHAFF had produced CNC machines long before other companies (did so) in the 60s.*	**Time markers** when + Past → Past Perfect before+gerund→Pa. Perfect already, (not) yet just, ever, never long before...

SIMPLE AND CONTINUOUS TENSES

V = verb of the sentence
Aux. = auxiliary verb
Inf. = infinitive

pp = past participle — regular V +-ed / irregular V 3rd column

A. AFFIRMATIVE FORM

SIMPLE	CONTINUOUS / PROGRESSIVE (to be + V+-ing)
PRESENT Subject + V. in basic form **SOS** 3rd singular +-(e)s – *They adjust car engines.* – *He writes novels.*	**PRESENT** I am/he, she, it is / we, you, they are + V+-ing – *They are adjusting an engine.* – *He is writing an article.*
PAST Subject + Regular V +-ed / Irregular V 2nd column – *They adjusted the engine.* – *He wrote a long article.*	**PAST** I, s/he, it was / we, you, they were + V+-ing – *They were adjusting the engine.* – *He was writing an article, when you came.*
FUTURE Subject + shall / will + inf. *(I, we shall + inf.) Subject + am/is/are going to + inf. – *They are going to adjust it soon.* – *He will write a new article.*	**FUTURE** I, we shall be / You, s/he, they will be + V+-ing – *They will be adjusting it from 4 to 6.* – *He'll be writing the article all afternoon.*
PRESENT PERFECT I, we, you, they + have + pp he, she, it + has + pp – *They have just adjusted it.* – *He has already written it.*	**PRESENT PERFECT** I, we, you, they have been + V+-ing he, she, it has been + V+-ing – *They have been adjusting it for 3 hours.* – *He has been writing it since 7 a.m.*
PAST PERFECT Subject + had + pp – *They had adjusted it long before you asked.* – *He had written 5 novels before he became famous.*	**PAST PERFECT** Subject + had been + V+-ing – *They had been adjusting it for 3 hours before you called.* – *He had been writing the article for 3 hours before you woke up.*

INTERROGATIVE AND NEGATIVE FORMS IN ACTIVE AND PASSIVE VOICE

Sentences are classified into two categories:

	A. Those that have an auxiliary verb	**B. Those that don't have auxiliary verb**
	If the Verb of the sentence is one of the following: **be** (am/is/are/was/were) **have** (have/has/had) **shall/will** (shall/should/will/would) **can** (can/could) **must** **may** (may/might) That is, all active and passive tenses apart from S. Present and S. Past	That is, S. Present and S. Past sentences in Active Voice. They need the verb DO (do/does/did) to form questions and negatives. **S. Present: do/does** – I, we, you, they do – 3rd person singular: s/he, it does * (the ending -s of the V is deleted) **S. Past: did** All persons + did + the V in the basic form =1st column of Irregular V / (the ending -ed deleted in Regular V.)
NEGATIVE	**We simply add not after the verb.** - *They are not playing* - *It isn't used* - *We weren't sleeping* - *I will not (won't) go* - *He has not come yet* - *They haven't been repaired* - *He hadn't called* - *They may not come* - *You shouldn't call him*	**We add do/does/did not before the Verb of the sentence** (which returns to the basic form). – *We live in Kozani.* → We ***don't*** *live in Edessa.* – *He studies Maths.* → *He* ***doesn't*** *study Physics.* – *We worked until 8 p.m.* → *We* ***didn't*** *work till* 9. – *He went to the pub.* → *He* ***didn't*** *go to the cinema.*
INTERROGATIVE	**We bring the verb before the subject, in the beginning of the sentence (inversion).** – *Are they studying?* – *Is he a welder or a drafter?* – *Was he at the party?* – *Were they fixed securely?* – *Will you fix it?* – *Can they adjust it?* – *Has it been replaced?* – *Had they called?*	**We add do/does/did in the beginning of the sentence** (which returns to the basic form). – *I work for CIEN Co.* → ***Do*** *you work for SHAFF?* – *He drives fast.* → ***Does*** *he drive carefully?* – *They replaced the compressor.* → ***Did*** *they replace the motor?* – *They slept late.* → ***Did*** *they sleep well?*

Wh_ questions

Wh- questions are questions beginning with: **why, when, where, who, whose, which, what** and **how** (much / many / long / far...). They are normally **followed by an interrogative verb.**

REMEMBER

We form questions by:
a) changing the position of the subject and the auxiliary verb (be, have, can, must, may, shall/will).
e.g. *He is a H.V.A/C. engineer. → What is he?*
They have bought a new car. → What have they bought?

b) using do/does in present simple and **did** in past simple questions.
e.g. *He studies Physics. → What does he study?*
They went home by bus. → How did they go home?

Examples

– *Why did you charge the system through the high-pressure side?*
– *Which model have they decided to buy?*
– *How does a motor operate?*
– *Where will they have lunch?*
– *How much does this burner cost?*
– *What can they do?*

IMPORTANT

who **which** **what** **whose**	When they are **used to ask about the subject, they are followed by an affirmative verb, not an interrogative.**

Examples

- The Personnel Manager interviewed Peter.

– *Who **interviewed** Peter?*	**Subject (S)**
– *Who **did** the Personnel Manager **interview?***	**Object (O)**

- The dry-bulb thermometer measures temperature.

– *Which instrument **measures** temperature?*	**Subject (S)**
– *What **does** the dry-bulb thermometer **measure?***	**Object (O)**

Passive Voice

Passive voice is very common in English, especially in technical English. As a result, it is useful to know when to use it and how to form it correctly.

I. USE

1. We use the Passive Voice when the activity of the subject is not transferred to anyone or anything, it is only the subject to which something happens.
e.g. *This pump hasn't been used for ages.*

2. It is preferable to use it when:

a) the emphasis in the sentence is rather on the action than on the agent (= the person performing the action or the object that causes it).

***e.g.* –** *Television was invented by a Scot called Logie Baird.*
– *It was fixed in place with bolts and nuts.*

b) the agent is unknown, unimportant, obvious, or it is better not to be mentioned.

e.g. *His car was stolen four days ago.* (We don't know who stole it)
– *She was offered $500 as a reward.* (The person who gave the money to her is unimportant)
– *Million of cars are produced in Japan every year.* (The agent is obvious)
– *The students repoted that during the break a window was broken, but they didn't say who broke it.* (They don't want to say who did it)

c) we describe the steps of a procedure.

e.g. – *Liquid ammonia is heated in the generator and becomes a gas which passes into a condenser where it is cooled and changed into a liquid again.*

3. It is also used in impersonal expressions, such as: it is said / believed / expected / announced / recommended / estimated / considered, etc.

***e.g.* –** *It is estimated that the installation will cost 1,000,000 drs.*
– *It is considered the best ventilator in the market.*

II. FORM

The passive sentence consists of the:

A	B	C
subject	**passive verb**	**agent**

In most passive sentences, the agent is omitted. If it is mentioned, it is introduced with **by** or **with**.*

The passive verb is formed as follows:

verb to be ↓ (put in the appropriate tense) **+** **past participe** ↓ (of the verb of the sentence)

***by** if it shows who or what performs the action, **with** if it shows the means that performs it.

e.g. *He was killed by a stone* (It fell and killed him)

He was killed with a stone (Someone used it to kill him)

Examples

– *Jeans are made of cotton.*
– *America was discovered by Columbus.*
– *Iceboxes have been replaced by electric refrigerators.*
– *The joint must be cleaned with a wet cloth.*

PASSIVE VERBS IN SIMPLE AND CONTINUOUS TENSES

Tense	Structure	Example
S. Present	am/is/are + p.p	*The letter is written*
Pr. Continuous*	am/is/are being + p.p	*The letter is being written*
S. Past	was/were + p.p	*The letter was written*
Past Continuous*	was/were being + p.p	*The letter was being written*
S. Future	shall/will be + p.p	*The letter will be written*
S. Pr. Perfect	have /has been + p.p	*The letter has been written*
S. Past Perfect	had been + p.p	*The letter had been written*
Modal (auxiliary) verbs	can/could, shall/should, will/would, may/might + be + p.p	*The letter can/could be written* *The letter should be written* *The letter will/would be written* *The letter may/might be written*

* Only the Present and the Past continuous tenses are commonly used in Passive Voice. The rest of the continuous tenses are rarely used in it.

III. TURNING ACTIVE SENTENCES INTO PASSIVE

SUBJECT	**ACTIVE VERB**	**OBJECT**
A switch	controls	the speed of the motor.
The speed of the motor	is controlled	by a switch.
SUBJECT	**PASSIVE VERB**	**AGENT**

When changing active sentences into passive:

a. The subject of the active sentence becomes the agent of the passive sentence.
b. The object of the active sentence becomes the subject of the passive sentence.
c. The active verb becomes passive (= verb to be + p.p.)

Examples

Active: *We measure length either in centimetres or in inches.*
Passive: *Length is measured either in centimetres or in inches.*
Active: *Isaak Newton invented the laws of motion.*
Passive: *The laws of motion were invented by Isaac Newton.*
Active: *The technician will repair the pump tomorrow.*
Passive: *The pump will be repaired tomorrow.*
Active: *He hasn't paid the bill yet.*
Passive: *The bill hasn't been paid yet.*

Conditionals

I. 1st Conditional

USE

We use the 1st Conditional to refer to situations that are likely to happen in the future or are true in the present*.

FORM

If + Present →
- Imperative
- Present
- Future (= shall/will + infinitive)
- can, may, must** + infinitive

** In this case, **when** is usually used instead of if, and the:*
if/when + S. Present —> S. Present structure.

*** Also have to, had better...*

Examples

– *If I go to London this weekend, I'll visit the British Museum.*
– *If the weather is good, we can go for a walk in the park.*
– *If we finish early, we may join you at the pub.*
– *If you want to get better marks, you must study harder.*
– *If you need any more money, ask your father.*
– *If you mix yellow and green, you get blue.*
– *When metals are heated over a certain temperature, they melt.*

II. 2nd Conditional

USE

We use the 2nd Conditional to talk about improbable, unreal or imaginary situations in the present or future. It is also used to make a suggestion, give advice or express regret.

FORM

If + Past, →
- would, should, could, might, had to + infinitive

Examples.

– *If I were you, I would buy a four-wheel drive car. (I recommend it to you.)*
– *If I won the first prize, I might stop working. (But probably I will not win it.)*
– *If I had the right tools, I could fix it. (But I don't have them.)*
– *If you got the 7:30 train, you would be in time. (I suggest you should get it.)*

III. 3rd Conditional

USE

We use the 3rd Conditional to talk about unreal past situations; that is, when there isn't a possibility for the action in the main clause (apodosis) to be fulfilled, because the action in the if-clause (hypothesis) didn't happen. It is also used to express relief or regret for something that didn' happen.

FORM

If + Past Perfect, → would / could / might / should } have + p.p.*
(had + p.p.)

* Past participle = regular verb + -ed (walked, repaired) / 3rd column of irregular verbs (written, given)

Examples

– *He is lucky. The train he intended to catch, crashed. If he had caught it, he might have got killed. (But fortunately he didn't catch the train, so he is safe.)*
– *If I had had more money then, I could have bought a better car. (But unfortunately I didn't.)*
– *If I had not been so busy yesterday, I would have joined you at the pub. (But I was very busy until late, so I didn't come.)*
– *She would have gone to the University if she had passed the exams. (But she didn't, so she didn't/can't go to the University.)*

Relative Clauses

A Relative Clause is the part of a sentence which defines or provides information about the person, animal, thing, place or time the speaker/writer refers to. They begin with a relative pronoun as follows:

Pronoun used for	persons	animals things	place	time
who	✓			
which	✓	✓		
that	✓	✓		
whose	✓	✓		
where			✓	
when				✓

Examples

– *The man is a trainee machine-tool operator. He had an accident.*
- *The man who had an / the accident is a trainee machine-tool operator.*

– *CFCs destroy ozone. They include chlorine.*
- *CFCs, which include chlorine, destroy ozone.*

– *You borrowed a flaring tool. It is mine.*
- *The flaring tool that* you borrowed is mine.*

– *The man is an experienced welder. His face shield is on the shelf.*
- *The man whose face shield is on the shelf is an experienced welder.*

– *The technicians installed the air conditioner next to the window. It is over the radiator (= near a direct heat source).*
- *The place where* the technicians installed the air conditioner is near a direct heat source.*

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* The relative pronoun can be omitted in these sentences.

Replacing a sentence with a participle

Present and past participles are often used to replace a sentence.

NOTE

a) When the verb of the sentence replaced is active, the active/present participle* is used.
b) When the verb of the sentence replaced is passive, the past/passive participle** is used.

* Present/Active Participle = verb + ing, e.g. *working, repairing*

** Past / Passive Participle = regular verb + ed, e.g. *worked, repaired* / 3rd column of irregular verbs, e.g. *burnt, melted*

Examples

- *He opened the tool case and took the service valve ratchet.*

– ***Opening*** *the tool case, he took the service valve ratchet.*

- *He fell from the ladder and broke his leg.*

– *He fell from the ladder* ***breaking*** *his leg.*
– ***Falling from*** *the ladder, he broke his leg.*

- *As / Since / Because he feared the motor would overheat, he turned it off.*

– ***Fearing*** *the motor would overheat, he turned it off.*

- *As she didn’t know the language, she had difficulty in finding her way home.*

– ***Not knowing*** *the language, she had difficulty in finding her way home.*

- *Peter entered the boiler house. He was accompanied by the service engineer.*

– *Peter entered the boiler house* ***accompanied*** *by the service engineer.*

4 . LIST OF IRREGULAR VERBS

INFINITIVE	PAST TENSE	PAST PARTICIPLE	INFINITIVE	PAST TENSE	PAST PARTICIPLE
be	was	been	know	knew	known
become	became	become	lead	led	led
begin	began	begun	learn*	learnt	learnt
bend*	bent	bent	leave	left	left
bite	bit	bitten	lend	lent	lent
blow	blew	blown	let	let	let
break	broke	broken	light*	lit	lit
bring	brought	brought	lose	lost	lost
build	built	built	make	made	made
burn*	burnt	burnt	mean	meant	meant
buy	bought	bought	meet	met	met
catch	caught	caught	melt*	melted	molten
choose	chose	chosen	pay	paid	paid
come	came	come	put	put	put
cost*	cost	cost	read	read	read
cut	cut	cut	rend	rent	rent
deal	dealt	dealt	ride	rode	ridden
do	did	done	ring*	rang	rung
draw	drew	drawn	rise	rose	risen
drink	drank	drunk	run	ran	run
drive	drove	driven	say	said	said
eat	ate	eaten	see	saw	seen
fall	fell	fallen	sell	sold	sold
feel	felt	felt	send	sent	sent
find	found	found	shake	shook	shaken
fy	flew	flown	shine*	shone	shone
forget	forgot	forgotten	shoot	shot	shot
forgive	forgave	forgiven	show*	showed	shown
freeze	froze	frozen	shut	shut	shut
get	got	got	sing	sang	sung

INFINITIVE	PAST TENSE	PAST PARTICIPLE
give	gave	given
go	went	gone
grind*	ground	ground
grow	grew	grown
hang*	hung	hung
have	had	had
hear	heard	heard
hide	hid	hidden
hit	hit	hit
hold	held	held
hurt	hurt	hurt
keep	kept	kept
be	was	been
strike	struck	struck
sweep	swept	swept
swim	swam	swum
take	took	taken
teach	taught	taught
tear	tore	torn
tell	told	told

INFINITIVE	PAST TENSE	PAST PARTICIPLE
sink	sank	sunk
sit	sat	sat
sleep	slept	slept
smell*	smelt	smelt
speak	spoke	spoken
spend	spent	spent
spell*	spilt	spilt
spoil*	spoilt	spoilt
spread	spread	spread
spring	sprang	sprung
stand	stood	stood
steal	stole	stolen
think	thought	thought
throw	threw	thrown
understand	understood	understood
wake*	woke	woke/woken
wear	wore	worn
win	won	won
wind	wound	wound
write	wrote	written

NOTE

The verbs marked with an asterisk also form the S. Past tense and the past participle as if they were regular (+ -ed).

5. CHANGES IN SPELLING

Vowels: a, e, i, o, u, y, w
Consonants: b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z

I. When adding the ending -s

1. Instead of adding -s, we add -es to:

a) Nouns / Verbs — ending in: -s, -sh, -ch, -x, -z

e.g.
a bus → buses, a kiss → kisses
I wash → s/he washes
I watch → s/he watches
a box → boxes
I buzz → s/he buzzes

b) Nouns / Verbs — ending in -o before which there is a consonant

e.g. *a hero → heroes,* *a cargo → cargoes*
I do → s/he does, *I go → s/he goes*

but a photo → photos
a studio → studios
a kilo → kilos
a piano → pianos
— nouns of foreign origin or abbreviations

2. In words ending in -y before which there is a consonant, the -y changes to -ie before the ending -s.

e.g. a *body → bodies,* *a city →cities*
I study → h/she studies, *I worry →s/he worries*

but a boy → boys,
a day → days
I enjoy → s/he enjoys,
I buy → s/he buys
— there is a vowel before the -y

3. When the ending -s is added to the following twelve (12) nouns which end in -f or -fe: life, knife, wife, self, shelf, half, thief, leaf, loaf, wolf, calf and sheaf, the -f/fe+s changes to -ves.

e.g. *a half → halves,* *a life → lives,* *a knife → knives*
but roof → roofs, proof → proofs, chief→ chiefs

II. When adding the endings -ed, -er, -est, -ing

1. If a word ends in one -e, we drop this -e before the above endings.

e.g. *live → lived, living,* *prepare → prepared, preparing*
simple → simpler, simplest *large → larger, largest*

but see → seeing (it ends in 2e)
be → being **(exception)**

2. In words ending in -y before which there is a consonant, the -y changes to -i- before the ending -ed, -er, -est, **but not** before -ing (studying, worrying)

e.g. *I study → s/he studies,* *I worry → s/he worries*
easy → easier, easiest, *heavy → heavier, heaviest*

but I play → s/he plays
grey → greyer
there is a vowel before -e

3. When the ending -ing is added to a verb that ends in -ie, the -ie- changes to -y-.

e.g. *lie → lying, die → dying*

4. If a one-syllable word ends in a consonant (apart from -x) before which there is a vowel, the final consonant is doubled when -ed, -er, -est or -ing is added.

e.g. *stop → stopped, stopping,* *drop → dropped, dropping*
big → bigger, biggest, *hot → hotter, hottest*

but fix → fixed, fixing (it ends in -x)

form → formed, forming
dark → darker, darkest
there is another consonant before the final one

5. If a word of more than one syllables, whose final syllable is stressed, ends in a consonant (apart from -x) before which there is a vowel, the final consonant is doubled when -ed, -er, -est or -ing is added.

e.g. *refer → referred, referring,* *begin → beginning*
permit → permitted, permitting

but listen → listened, listening
clever → cleverer, cleverest
the final syllable is not stressed

limit → limited, limiting
order → ordered, ordering
there's another consonant before the final

IMPORTANT

- We never double -y, -w or -x at the end of a word

  e.g. *stay → stayed, staying*
  show → showed, showing
  mix → mixed, mixing

- The -l at the end of a word is doubled in British English, even if the final syllable is not stressed

  e.g. *travel → travelled, travelling*
  expel → expelled, expelling

III. When adding the suffix -ly to adjectives

1. Adjectives ending in -le change the -e- in -y-
e.g. *simple → simply*

2. Adjectives ending in consonant(s) + y change the -y- in -i-
e.g. *angry → angrily*

3. Adjectives ending in -l double the -l-
e.g. *beautiful → beautifully*

6. MODEL LETTERS

1. BUSINESS INQUIRY LETTER
2. LETTER FOR PLACING AN ORDER
3. LETTER OF COMPLAINT
4. INQUIRY LETTER FOR STUDIES
5. LETTERS OF APPLICATION
6. CURRICULUM VITAE

BUSINESS INQUIRY LETTER

SENDER'S ADDRESS
22 Gounari st.
Maroussi
Athens
Greece

DATE 6th February 200...

ADDRESSEE'S

NAME OR The Manager
POSITION Customer Service Department
FIRM SHAFF Co. Ltd
20 Morrison st.
ADDRESS London N.E.
England

SALUTATION Dear sir,

INTRODUCTION

I visited your stand at the International Fair of Thessaloniki last month and I was very impressed by the display of your new line of drafting media.

DEVELOPMENT

Could you, please, send me your catalogue of the complete range of these media with your export price list.

I would also like to inquire whether a demonstration of your new fully developed electronic digital plotter could be arranged here in Greece.

CLOSING §

I look forward to hearing from you soon.

COMPLIMENTARY CLOSE Yours faithfully,

SENDER'S
SIGNATURE Panagopoulos
NAME John Panagopoulos
OCCUPATION Mechanical Engineer

NOTE

INTRODUCTION: Say why you are writing.
DEVELOPMENT: State what you want in detail / what you are asking for / the real reason for writing the letter.
FINAL PARAGRAPH: Write a polite ending.

Useful expressions

- We have heard of your products...
- Please send us prices and samples of...
- Would you, please, let us have your firm's offer for/your catalogue showing...
- We would like to have further details...
- We are interested in buying...

LETTER FOR PLACING AN ORDER

D. THOMSON Co. Ltd,
75 Academias st.,
Athens 105 22
Greece.

20th February 200...

Mr. George Thomas,
Export Manager,
MICOM Ltd
Grays Road,
Navant,
England.

Dear Mr Thomas,

Thank you very much for your letter of 15th January enclosed with your latest catalogue.

We were very satisfied with the last consignement* of your goods and therefore have decided to place the following order:

12 WELDING MACHINES, model 250/23 RC.

As the above mentioned machines are urgently required (before the end of May), we will place the order provided that you arrange for prompt delivery.

As soon as we receive your confirmation and your pro-forma invoice* we will arange for settlement* by banker’s transfer*.

We are looking forward to hearing from you soon.

Yours sincerely

Peter Michelis
Purchasing Manager

** consignment = αποστολή/παραλαβή εμπορευμάτων*
** dispatch = στέλνω, αποστέλλω*
** pro-forma invoice = προτιμολόγιο*
** settlement = εξόφληση, τακτοποίηση λογαριασμού*
** banker’s transfer = τραπεζική μεταβίβαση, έμβασμα*

Useful expressions

- We can accept your offer on these terms and are pleased to place/make an order for...
- With reference to your quotation, we enclose our order for immediate delivery.
- Please supply/send us the undermentioned goods.
- As the goods are urgently required we should be grateful for delivery by... *(date)*
- Please confirm that you can supply this quantity by the required date.

LETTER OF COMPLAINT

86 Tsimiski rd.
Thessaloniki
Greece

15th June 200...

M. Smith Co. Ltd
Pumps Manufacturers
53 Victoria st.
London, S.E. 3
England

Dear Sirs,

We have received the rotary pump No Bs/628 we ordered from you on May 6th.

Unfortunately, I regret to inform you that when I opened the packing case I found that one of the cams of the pump had been cracked and the casing had been scratched.

I would be grateful, therefore, if you would send me a new pump and let me know how I should return the damaged one to you.

I look forward to hearing from you as soon as possible.

Yours faithfully,

Chris Lambrou
Purchasing Manager

Useful expressions

- We are disappointed to find that the quality of the goods you supplied does not correspond to that of the samples submitted.
- This delay is causing us great inconvenience / damage as... / ruined seriously our reputation.
- This order was placed on condition that we received the machines by (e.g. May 1st)
- We shall be compelled to cancel our order if...
- I'm writing concerning a... which I purchased from...
- I feel I must protest about...
- I enclose the receipt and would appreciate a refund / replacement
- In compensation we ask/demand that you refund the full cost of...
- The expenses amount to...
- I hope the matter will receive your prompt attention.
- We would be grateful if you replaced the faulty... the soonest possible at your expense.

INQUIRY LETTER FOR STUDIES

28 Korytsas st.
Aghia Sophia
Piraeus 185 31
Greece

20th February 200...

Durham University
Mechanical Engineering Department
74 Parsons Field House
Durham DH 13JP
England

Dear Sirs,

Last year, I finished a Greek State Technical and Vocational School, Mechanical Engineering Technicians Department, where I specialized in... *(e.g. Heating Systems)* and I am interested in attending an advanced course in Mechanical Engineering at your University.

Could you please send me information about the entry requirements and the content of both a BEng* and an HND** courses as well as any other information you think necessary.

Thanking you in advance, I am looking forward to hearing from you soon.

Yours faithfully,

Costas Papageorgiou

** BEng: Bachelor of Engineering*

*** HND: Higher National Diploma*

LETTER OF APPLICATION (1)

32 Hill st
Glasgow G12
Scotland

29th January 200...

The Personnel Manager
D. Mc Pherson Ltd
17 North st.
Edinburgh Ed 17 BK 17
Scotland

Dear Sir,

With reference to your advertisement in the «Mechanical Engineering» magazine, January 2000, I would like to apply for the position of the welding technician in your firm.

As you will see in my enclosed curriculum vitae, for the past nine months, I have been working for «Pelco Metallic Furniture Factory», where I have developed my skills in welding techniques. I feel, therefore, I would be a suitable candidate for the above post, and I would be grateful if you would give me the opportunity of an interview.

I look forward to hearing from you soon.

Yours faithfully,

George Kambas

Useful expressions

- I have been told by Mr..., whom you are acquainted with, that you are expecting to increase your staff and l would like to apply for one of these positions.
- I have recently heard from... that there is a vacancy for... in your... department.
- Please refer to the enclosed curriculum vitae for further details.
- I would prefer to discuss the question of salary at a personal meeting.
- I would welcome the opportunity to have a personal interview.
- I would be grateful if you could send me further information and application forms.
- References concerning my character and ability can be obtained from my former employer, Mr...

LETTER OF APPLICATION (2)

86 Solomou st.,
Cholargos,
Athens 126 32,
GREECE.

27th April, 200...

The Personnel Manager,
D. Thompson Ltd,
17 North st.,
Birmingham BK 17,
ENGLAND.

Dear Sir,

I saw your advertisement for a welding technician in your firm and I would like to apply for the job.

I am 24 years old, recently discharged from the Army. I have graduated from a state Technical and Vocational School, Mechanical Engineering Technicians Department, in Athens and I am a fully trained welding technician. Before joining the Army I worked for «Pelco Metallic Furniture Factory» for 9 months.

I studied English for 6 years at school and I passed the Cambridge First Certificate exams last year. I have also spent two months in England as a visitor this year, so I can speak English fluently.

I would be grateful if you could give me further information about the nature of the job and the salary you are offering, as well as if you could send me an application form.

I am looking forward to hearing from you soon.

Yours faithfully,

John Kostides

CURRICULUM VITAE

Surname: Kambas
First name: George
Sex: male
Address: 32 Eptanissou st., Kypseli, Athens 128 35 Greece
Tel.: (30 1) 28.32.698
Date of birth: 7th November 199...
Marital status: single
Children: none

Education and qualifications

Sept. 19... - June 19...	Certificate of a three-year State Technical and Vocational School, Mechanical Engineering Technicians' Department, specialty of...
Dec. 19...	Cambridge First Certificate
Sept. 19... - June 19...	Training course on welding techniques

Experience

March 19... - Dec. 19...	«Pelco, Metalic Furniture Factory» (Welding Department) 135 Messogion Ave., Athens, Greece

Military service

Sept. 19... - Oct. 19...	Air Forces

7. GLOSSARY

Σημείωση:

Όρους που αποτελούνται από δύο λέξεις αναζητήστε τους σε εσοχή κάτω από μία από τις δυο λέξεις που τους απαρτίζουν (π.χ. το mechanical engineer θα το βρείτε σε εσοχή κάτω από τη λέξη engineer).

Όρους που αναφέρονται σε αντικείμενα ή έννοιες που αποτελούν είδη / τύπους / υποκατηγορίες μεγαλύτερων ομάδων θα τους βρείτε με αλφαβητική σειρά σε εσοχή κάτω από τη βασική λέξη που εκφράζει το σύνολο των ειδών της ομάδας όπου εντάσσονται: π.χ. τα διάφορα είδη των γαλλικών ή γερμανικών κλειδιών: (open-ended wrench, adjustable wrench, κλπ) θα τα βρείτε κάτω από τη λέξη wrench.

A

absolute = απόλυτος
absolute positioning system = απόλυτο σύστημα αναφοράς για τον εντοπισμό των σημείων κοπής στις εργαλειομηχανές αριθμητικού ελέγχου
absorb = απορροφώ
absorber = απορροφητήρας, αποσβεστήρας, μέσο απορρόφησης
  shock absorber = απορροφητήρας κραδασμών / κρούσεων, αμορτισέρ
absorption refrigeration system = σύστημα ψύξης με απορρόφηση
abstract = αφαιρώ, αφηρημένος, περίληψη
accelerate = επιταχύνω, επαυξάνω
acceleration = επιτάχυνση
accelerator pedal = επιταχυντής, γκάζι, το πεντάλι του γκαζιού
accessory = πρόσθετος, συμπληρωματικός, εξάρτημα, αξεσουάρ
accounting = λογιστική
accuracy = ακρίβεια
accurate = ακριβής
achieve = κατορθώνω, καταφέρνω, επιτελώ, επιτυγχάνω
achievement = κατόρθωμα, επιτυχία, επίτευγμα
act = ενεργώ, δρω, ενέργεια
activity = δραστηριότητα
activate = ενεργοποιώ
adapt = (ανα)προσαρμόζω / -ομαι
adhesion = κόλλημα, (συγ)κόλληση
adjust = τροποποιώ, ρυθμίζω, διευθετώ, ρεγουλάρω, κανονίζω, προσαρμόζω
adjustment = ρύθμιση, προσαρμογή
addressee = παραλήπτης (επιστολής)
admit = δέχομαι, επιτρέπω την είσοδο, παραδέχομαι
advance = προχωρώ, προάγω, προωθώ, προπορεύομαι, πρόοδος
advantage = πλεονέκτημα
affect = επηρεάζω, επιδρώ, έχω επιπτώσεις σε
age = ηλικία, εποχή (π.χ. του χαλκού)
agent = αίτιο, μέσο, παράγοντας, πράκτορας, αντιπρόσωπος
  cooling agent = ψυκτικό μέσο
aim (at/to) = σκοπεύω, στοχεύω, σκοπός
air cleaner = φίλτρο αέρα
air conditioner = κλιματιστική μονάδα/ συσκευή
  ceiling-suspended air conditioner = κλιματιστική μονάδα / συσκευή που τοποθετείται στην οροφή
  floor - standing air conditioner = κλιματιστική μονάδα / συσκευή που τοποθετείται στο δάπεδο, επιδαπέδια
  split (-type) air conditioner = διαιρούμενη κλιματιστική μονάδα
  unitary air conditioner = κλιματιστική μονάδα που περιλαμβάνει όλα τα εξαρτήματα σε ενιαίο μεταλλικό περίβλημα
  wall-mounted air conditioner = κλιματιστική μονάδα / συσκευή που τοποθετείται στον τοίχο
air conditioning = τεχνητή ρύθμιση θερμοκρασίας, κλιματισμός
aircraft = αεροσκάφος
aircraft carrier = αεροπλανοφόρο
airliner = επιβατικό αεροπλάνο
align = βάζω σε σειρά, παρατάσσω, ευθυγραμμίζω τους τροχούς του αυτοκινήτου
alloy = κράμα μετάλλων, αναμ(ε)ιγνύω
allow = επιτρέπω
alter = μεταβάλλω, αλλάζω, μετατρέπω
alternative = εναλλακτικός, εναλλασσόμενος, εναλλαγή
altitude = ύψος
amount = ποσό, ποσότητα, σύνολο
amperage = ένταση ρεύματος, βαθμός αμπέρ, αμπεράζ
angle = γωνία
  acute angle = οξεία γωνία
  obtuse angle = αμβλεία γωνία
  right angle = ορθή γωνία
annealing = βραδεία ψύξη, επαναφορά χάλυβα, ξεπύρωμα, ανόπτηση
annual = ετήσιος
anvil = αμόνι, άκμονας
apparatus = συσκευή, μηχάνημα, όργανο

appliance = συσκευή
application = εφαρμογή, αίτηση
application form = έντυπο αιτήσεως
apply (to) = εφαρμόζω, βάζω, ισχύω, έχω εφαρμογή
apply (for) = κάνω / υποβάλλω αίτηση
appropriate = κατάλληλος, ενδεδειγμένος, ταιριαστός, σωστός
apron = ποδιά, μπροστέλα
aqueduct = αγωγός ύδατος, υδραγωγός, υδραγωγείο
arc = τόξο (γεωμετρικό ή ηλεκτρικό/βολταϊκό), αψίδα
area = εμβαδόν, έκταση, περιοχή, χώρος, τομέας (επαγγελματικός π.χ.)
arrange = διευθετώ, (δια) κανονίζω, διατάσσω, τακτοποιώ, ρυθμίζω
arrangement = διευθέτηση, (διακανονισμός, διάταξη
assemble = συναρμολογώ, συναθροίζω
assembly = συναρμολόγηση, συνδεσμολογία, άρμοση, συγκρότημα, σύνολο, συνάθροιση, συνέλευση
assist = βοηθώ
atomize = διασπώ σε άτομα, μετατρέπω υγρό σε σταγονίδια, ψεκάζω, ραντίζω, εξαερώνω
attempt = επιχειρώ, προσπαθώ, δοκιμάζω, αποπειρώμαι, προσπάθεια
attend = παρακολουθώ, προσέχω, ακούω, παρευρίσκομαι
authorized = εξουσιοδοτημένος
available = διαθέσιμος, υπάρχων
average = μέσος όρος, μέσος, υπολογίζω κατά μέσο όρο
aviation = αεροπλοΐα, αεροπορία
avoid = αποφεύγω
axle = άξονας

B

balance = (εξ)ισορροπώ, ζυγίζω, ζυγοσταθμίζω (τροχούς αυτοκινήτου), ισορροπία, ευστάθεια, εξισορρόπηση, ζυγοστάθμιση, ζυγαριά
bar = ράβδος, μοχλός, σκυτάλη
bar folder = καμπτική μηχανή, στράντζα
bar feeder = συσκευή τοποθέτησης μεταλλικών ράβδων για κατεργασία σε CNC εργαλειομηχανή
barrel = βαρέλι, κάνη όπλου, κύλινδρος, μέτρο χωρητικότητας, βυτίο
base metals = βασικά μέταλλα (για συγκόλληση)
battery = συσσωρευτής, μπαταρία
battleship = πολεμικό πλοίο
bearing = (εφ)έδρανο, τριβέας, φέρον, βάθρο εδράνου, κουζινέτο, ρουλεμάν
ball bearing = ένσφαιρος τριβέας, τριβέας με σφαιρίδια (ρουλεμάν)
belt = ιμάντας, ζώνη
bench = πάγκος εργασίας, τράπεζα εφαρμοστού
bench metal worker = εργάτης εφαρμοστηρίου, εφαρμοστής
bend = κάμπτω, λυγίζω, κάμψη, λύγισμα, καμπή, στροφή δρόμου
bending machine = καμπτική μηχανή, κουρμπαδόρος
blade = λεπίδα, λάμα, πτερύγιο
blast = φύσημα, έκρηξη, εκτόνωση αερίων, ριπή ανέμου
blast furnace = υψικάμινος, χυτήριο
blink = τρεμοσβύνω (για φως), ανοιγοκλείνω τα μάτια
blower = φυσητήρας, φυσερό, ανεμιστήρας
blunt = αμβλύς, στρογγυλεμένος, στομωμένος, μη αιχμηρός
bodywork = αμάξωμα
bolt = κοχλίας, μπουλόνι, σύρτης, ήλος, μανταλώνω, βιδώνω, στερεώνω με κοχλιοφόρο ήλο / μπουλόνι
bond = συνάφεια, σύνδεσμος, συνδέω
bonnet = το κάλυμμα της μηχανής του αυτοκινήτου, καπό
bore = τρυπώ, (δι)ανοίγω οπή, άνοιγμα, εσωτερική διάμετρος
boring = γεω-/διάτρηση, διεύρυνση οπών, εκτόρνευση, εσωτ. τόρνευση
brake = φρενάρω, φρένο, πέδη
  anti - (b)lock brakes = φρένα με μηχανισμό για να μην κολλάνε / μπλο-

κάρουν (ABS)
disc brakes = δισκόφρενα
drum brakes = ταμπούρα
hand brake = χειρόφρενο, πέδη στάθμευσης
single cylinder caliper disc brakes = δισκόφρενα μονού κυλίνδρου
brake shoes = τακάκια φρένων
brass = λευκός ορείχαλκος (ψευδαργύρου), μπρούτζος, χάλκινα πνευστά μουσικά όργανα
brazing = (ετεροφυής σκληρή συγκόλληση με) χαλκοκόλληση, μπρουτζοκόλληση
brine = άλμη, σαλαμούρα
brittle = εύθραυστος
broacher = μηχάνημα αυλακώσεως, «μπρόουτσερ»
brochure = φυλλάδιο, μπροσούρα
bromine = βρώμιο (Br)
bronze = ορείχαλκος κασσιτέρου, μπρού(ν)τζος
brush = βουρτσίζω, βούρτσα, πινέλο
steel brush = ατσαλόβουρτσα
buffer = στιλβωτικός τροχός / μηχανή
bulky = ογκώδης
bumper = προφυλακτήρας αυτοκινήτου
bundle = δέσμη, πάκο, σωρός, μαζεύω σε δέσμη / σωρό
burn = καίω, καίγομαι, κάψιμο, έγκαυμα
burrs = ρινίσματα, λιμαρίδια
bush = αντιτριβικός δακτύλιος, παρέμβυσμα (τριβής, στεγανωτικό), μπούσα, χαρούπα, εσωτερική επένδυση εδράνου

C

cable = χοντρό καλώδιο, παλαμάρι, ντίζα
calculate = εκτιμώ, υπολογίζω
cal(l)ipers = διαβήτης συγκριτικών μετρήσεων με κυρτά άκρα, κο(υ)μπάσο, παχύμετρο
inside / internal calipers = εσωτερικό παχύμετρο
outside / external calipers = εξωτερικό παχύμετρο
vernier calipers = παχύμετρο βερνιέρου, διαβήτης βερνιέρου, βερνιέρος
cam = έκκεντρο, κάμα
camshaft = εκκεντροφόρος άξονας, άτρακτος εκκέντρου
capacity = χωρητικότητα, περιεκτικότητα, ικανότητα / ισχύς απόδοσης μηχανήματος
cooling capacity = ψυκτική ισχύς
cubic capacity = χωρητικότητα σε όγκο, κυβισμός μηχανής
heating capacity = θερμική ισχύς
output (capacity) = απόδοση/ισχύς μηχανήματος
capillary tube = τριχοειδής σωλήνας
carbon = άνθρακας (C)
carburettor = εξανθρακωτήρας, αναμικτήρας, εξαερωτήρας, καρμπυρατέρ
carelessness = απροσεξία, απερισκεψία, αμέλεια, αδιαφορία
carry out = εκτελώ, φέρνω σε πέρας
carry over = μεταφέρω, μεταδίδω
casing = περίβλημα, θήκη, κέλυφος, θάλαμος
cast = χυτός, χύνω (μέταλλο σε καλούπι)
cast iron = χυτοσίδηρος, μαντέμι
casting = χύσιμο μετάλλου, χυτό μέταλλο / κομμάτι
catalyst = καταλύτης
catalytic converter = καταλυτικός μετατροπέας
centre = κέντρο, κωνικό στέλεχος χρησιμοποιούμενο για τη συγκράτηση κυλινδρικών κομματιών για κατεργασία τους σε εργαλειομηχανή
dead centre = μη περιστρεφόμενο κέντρο, πόντα κουκουβάγιας
live centre = το περιστρεφόμενο

κέντρο στο κεφαλάρι του τόρνου
chamber = θάλαμος
charge = φορτίο, φορτίζω, γεμίζω, γομώνω, χρεώνω
charging = φόρτιση, γόμωση, χρέωση
charging/service cylinder = φιάλη φόρτισης (ψυκτικού)
chart = χάρτης, διάγραμμα, καταγραφή, καταγράφω
chatter = μικρομετακινήσεις αντικείμενου/ «παίξιμο», / μπόσικο λόγω χαλαρής συγκράτησης του
chill = ψύχρα, ρίγος, κρυολόγημα, ψυχρός, ψύχω, παγώνω
chip = ρίνισμα, γρέζι/α, σχίζα
chisel = κοπίδι, σμίλη
chlorine = χλώριο (Cl)
chlorofluorocarbons (CFCs) = χλωροφθοράνθρακες
choice = επιλογή
chuck = σφιγκτήρας, τσοκ (τόρνου, δράπανου), μπαστέκα
circuit = κύκλωμα (ηλεκτρικό), γύρος
circulate = κυκλοφορώ
circulation = κυκλοφορία
circumference = περιφέρεια κύκλου
clamp = σφίγγω, σφιγκτήρας, συγκρατώ κομμάτι για κατεργασία
cling = προσκολλώμαι, κρατιέμαι σφικτά
clutch = συμπλέκτης, αμπραγιάζ
  cable-operated clutch = διάφραγμα με συρματόσχοινο (ντίζα)
  single-plate diaphragm dry-clutch = συμπλέκτης μονού δίσκου ξηράς τριβής με διάφραγμα
coach = άμαξα, λεωφορείο μακρινών αποστάσεων (πούλμαν), βαγόνι επιβατών τρένου
code = κώδικας, κρυπτογράφημα, κρυπτογραφώ, κωδικοποιώ
coil = περιελίσσω, σπείρα, έλικα(ς), περιέλιξη, πηνίο, οφιοειδής σωλήνας
cold starting = ψυχρή εκκίνηση
cold storage = ψύξη συντήρησης προϊόντων
combination = συνδυασμός
combine = συνδυάζω, ενώνω
combustion = καύση
combustion chamber = θάλαμος καύσης
comfort = ανακουφίζω, αναπαύω, παρηγορώ, άνεση, βολή, παρηγοριά
comfort space cooling = ψύξη άνεσης εσωτερικών χώρων
commercial = εμπορικός
compact = συμπαγής
compartment = διαμέρισμα, θάλαμος, τμήμα, χώρος
compasses = διαβήτης
compensate = αποζημιώνω, αντισταθμίζω
component = εξάρτημα, (συστατικό) μέρος, απαρτίζον τμήμα, συνιστώσα
composed of = αποτελούμενος, απαρτιζόμενος, συντιθέμενος
compound = συνθέτω, (ανα)μ(ε)ιγνύω, σύνθετος, μ(ε)ίγμα, χημική ένωση, συνθετικό
compress = συμπιέζω, συνθλίβω
compression = συμπίεση, θλίψη, σύμπτυξη
compression ratio = λόγος συμπίεσης
compression refrigeration system = σύστημα ψύξης με συμπίεση
compressor = συμπιεστής
  reciprocating (type) compressor = παλινδρομικός συμπιεστής
  rotary (type) compressor = περιστροφικός συμπιεστής
  scroll (type) compressor = συμπιεστής τύπου κοχλία
comprise = συμπεριλαμβάνω
concern = αφορώ, ενδιαφέρω, υπόθεση, ενδιαφέρον, έγνοια
condensation = υγροποίηση ατμού, συμπύκνωση, ψύξη, υγρασία
condense = συμπυκνώνω (ψύχοντας), ψύχω, υγροποιώ ατμό
condenser = συμπυκνωτής, ψυγείο μηχανών, πυκνωτής, υγροποιητής
condition = κατάσταση, όρος, συνθήκη, προϋπόθεση
conductive = αγώγιμος
conduction/conductivity = αγωγιμότητα
connect = συνδέω

connecting rod = διωστήρας, συνδετήριος άξονας / ράβδος, μπιέλα
consider = θεωρώ, μελετώ, εξετάζω, παίρνω υπόψη, υπολογίζω
considerable = υπολογίσιμος, αξιόλογος
constant = διαρκής, σταθερός, συνεχής, αμετάβλητος, η σταθερά (Μαθ.)
constitute = συνιστώ, αποτελώ συστατικό στοιχείο
construct = κατασκευάζω, κατασκευή
construction = κατασκευή, διάρθρωση / διαμόρφωση κατασκευής
consume = καταναλώνω, σπαταλώ, ξοδεύω
consumption = κατανάλωση
contact = έρχομαι σε επαφή, επικοινωνία, επαφή
contact breaker = αυτόματος διακόπτης, διακόπτης επαφής πλατινών
contact breaker points = σημεία επαφής πλατινών
container = δοχείο
content = περιεχόμενο
contribute = συνεισφέρω, συμβάλλω
control = ελέγχω, ρυθμίζω, χειρίζομαι, έλεγχος, ρύθμιση
  remote control(ler) = τηλεχειριστήριο
conventional = συμβατικός, τυπικός, κοινός, συνηθισμένος
convert = μετατρέπω, αλλάζω
converter = μετατροπέας, μεταλλακτήρας
  catalytic converter = καταλυτικός μετατροπέας
  frequency converter = μετατροπέας συχνότητας
convertible = αυτός που μπορεί να μετατραπεί, καμπριο(λέ) αυτοκίνητο
convey = μεταφέρω, μεταβιβάζω, διοχετεύω
conveyor = μεταφορέας, ατέρμων μεταγωγέας, βαγονέτο, κυλιόμενος διάδρομος
  chip/swarf conveyor = γρεζομεταφορέας
coolant = ψυκτικό, ψυκτική ουσία / μέσο
copper = χαλκός, επιχαλκώνω
cord = χονδρό καλώδιο, σπόγγος, σχοινί
corrode = διαβρώνω, σκουριάζω
corrosion = διάβρωση, σκούριασμα, οξείδωση
corrosive = διαβρωτικός, αυτός που σκουριάζει
cost = στοιχίζω, κοστίζω, κόστος
crack = σπάω, παγίζω, πάγισμα, χαραμάδα, ρωγμή
craftsman = τεχνίτης
crankshaft = στροφαλοφόρος άξονας
cube = κύβος
current = ρεύμα (ηλ.), σημερινός, ο παρών, ο τρέχων (π.χ. χρόνος)
current A.C. (Alternating Current) = εναλλασσόμενο ρεύμα
current D.C. (Direct Current) = συνεχές ρεύμα
curriculum vitae = βιογραφικό σημείωμα
curve = καμπύλη, κυρτότης, καμπυλώνω, κυρτώνω
cutter = κόφτης, κοπτήρας, εγκοπέας
  end cutter = εμπροσθοκόπτης
  pipe/tube cutter = σωληνοκόπτης
  side cutter = πλαγιοκόπτης
cylinder block = συγκρότημα κυλίνδρων, κορμός (μπλοκ) κινητήρα
cylinder head = κεφαλή κυλίνδρων, καπάκι μηχανής

D

damage = βλάπτω, προξενώ ζημιά / βλάβη, καταστρέφω, ζημιά, βλάβη
damper = αποσβεστήρας (κραδασμών), ντάμπερ, αμορτισέρ, διάφραγμα
data = στοιχεία, δεδομένα
deal (with) = ασχολούμαι, ανακατεύομαι, τα βγάζω πέρα, εμπορεύομαι
decrease = ελαττώνω, μειώνω, ελάττωση, μείωση
defective = ελαττωματικός, έχων βλά-

βη, ελλιπής
deduce = συμπεραίνω, συνάγω
define = ορίζω, προσδιορίζω, ερμηνεύω, καθορίζω
definition = ορισμός, ερμηνεία
degree = βαθμός θερμοκρασίας, μοίρα (Γεωμετρ./Γεωγρ.)
dehumidifier = αφυγραντήρας
dehumidifying = αφύγρανση
deliver = παραδίδω, απαλλάσω, ελευθερώνω, διανέμω
demand = απαιτώ, ζητώ, απαίτηση, ζήτηση
denominator = παρονομαστής κλάσματος
depend (on) = εξαρτώμαι
depletion = εξάντληση, εξανέμιση, καταστροφή αποθεμάτων (π.χ. του όζοντος)
  ozone depletion potential (ODP) = συντελεστής καταστροφής όζοντος
design = σχεδιάζω, σχέδιο, σχεδιασμός, σκοπός
desire = επιθυμώ
destroy = καταστρέφω
detail = λεπτομέρεια
detect = ανακαλύπτω, αποκαλύπτω, ανιχνεύω
detector = ανιχνευτής
  leak detector = συσκευή ανίχνευσης διαρροών
determine = ορίζω, προσδιορίζω, καταλήγω, αποφασίζω, καθορίζω
develop = αναπτύσσω, εξελίσσω
development = ανάπτυξη, εξέλιξη
device = συσκευή, μηχανισμός, εφεύρεση, επινόηση
die = πεθαίνω, καλούπι, σφραγίδα, σπειροτόμος εξωτερικών σπειρωμάτων, βιδολόγος, φιλιέρα, κύβος, ζάρι (pl. dice)
differential = διαφορικός, το διαφορικό του αυτοκινήτου
differential pressure = διαφορική πίεση
diffuse = δαχέω, διασκορπίζω
diffusion = διάχυση, διασκόρπιση
  air diffusion/distribution = διανομή/κατανομή αέρα
  auto-swing air-diffusion system = σύστημα αυτόματης διανομής του αέρα / αυτόματης κίνησης περσίδων
  multi-flow air-diffusion system = σύστημα πολλαπλής ροής αέρα
dimension = διάσταση, μέγεθος
dip = βουτάω, χαμηλώνω (φώτα), κατηφορίζω, βουτιά
direct = άμεσος, ευθύς, στρέφω, απευθύνω, διευθύνω, κατευθύνω
disadvantage = μειονέκτημα
discard = αποβάλλω, απορρίπτω, ξεσκαρτάρω
discharge = εκφορτώνω, εκκενώνω, απολύω (από το στρατό π.χ.), εκτονώνω, ξεφορτώνω, αποφορτίζω, εκφόρτωση, εκκένωση, απόλυση, εκβάλλω, εκρέω, εκροή
disengage = αφήνω, αποδεσμεύω, απεμπλέκω, αποσυνδέω
display = δείχνω, εκθέτω, επίδειξη, έκθεση, παρουσίαση πληροφοριών σε οθόνη
distance = απόσταση
distinguish = διακρίνω, ξεχωρίζω
distributor = διανομέας, ντιστριμπιτέρ
distributor contacts = πλατίνες διανομέα
distributor rotor arm = ράουλο διανομέα
dividers = διαστημόμετρο, διαβήτης σχεδίασης/(εγ)χάραξης σε μεταλλική επιφάνεια
domestic = οικιακός
dotted = διάστικτος
double = διπλασιάζω, διπλός
drafter / draftsman / draughtsman (Br. E.) = σχεδιαστής
drafting/draughting (Br. E.) = σχεδίαση, προσχέδιο
drafting media = όργανα σχεδίασης
drain = αποστραγγίζω, αποχετεύω, αποξηραίνω
drain hose = σωλήνας αποστράγγισης

drainage = αποχέτευση, αποστράγγιση, αποξήρανση
draught= ρεύμα (αέρα)
drawback = μειονέκτημα
draw filing = ξεχόνδριασμα, χοντρό λιμάρισμα για στίλβωση επιφάνειας
drawing = ιχνογραφία, σχεδίαση, σχέδιο, σχεδιάγραμμα
draw in(to) = τραβώ μέσα, αναρροφώ
drill = τρυπώ, τρυπανίζω, δράπανο, τρυπάνι, τριβέλι
  electric/power drill = ηλεκτρικό δράπανο/τρυπάνι
  hand drill = χειροδράπανο
  hole-cutting drill = ποτηροτρύπανο
  impact drill = επαναφορτιζόμενο δράπανο
drill press = μηχανοκίνητο δράπανο/τρυπάνι
drip = στάζω, στάξιμο
drive = οδηγώ, μεταδίδω κίνηση, οδήγηση, μετάδοση κίνησης
drop = αφήνω κάτι να πέσει, πέφτω, σταλάζω, πτώση, σταγόνα
dual = διττός, δυαδικός, διπλός
duct = αγωγός
ductile = ελάσιμος, ελατός, εύπλαστος
ductility = ελατότητα
dull = αμβλύνω, αμβλύς, πληκτικός, ανιαρός, ηλίθιος, θαμπός
dullness = αμβλύτητα, βαρεμάρα
durability = στερεότητα, ανθεκτικότητα, διάρκεια, αντοχή
durable = στερεός, ανθεκτικός, διαρκής
duration = διάρκεια

E

earrings = σκουλαρίκια
earth = γη, γειώνω
edge = ακμή, άκρο, παρυφή, χείλος, αιχμή, κόψη
effect = αποτέλεσμα, φαινόμενο, εντύπωση, επίπτωση
effective = αποτελεσματικός, δραστικός, ενεργός
effectiveness = αποτελεσματικότητα
efficiency = αποδοτικότητα, ικανότητα, βαθμός/συντελεστής απόδοσης
  thermal efficiency = θερμική απόδοση
  working efficiency = απόδοση λειτουργίας
efficient = ικανός, δραστήριος, αποδοτικός
electric cooker = ηλεκτρικό μαγειρείο/ηλεκτρική κουζίνα
electric generation = παραγωγή ηλεκτρικής ενέργειας
electric power plant = εργοστάσιο παραγωγής ηλεκτρικής ενέργειας
electric supply = παροχή ηλεκτρικής ενέργειας
electric shock = ηλεκτροπληξία
electrocute = προκαλώ ηλεκτροπληξία
element = στοιχείο (ύλης, φύσης), εξάρτημα, μέρος
  heating element = θερμαντικό στοιχείο, αντίσταση
elevator = ανυψωτήρας βαρών, ανελκυστήρας, ασανσέρ
eliminate = εξαλείφω, αφαιρώ, ελαχιστοποιώ, (εκ)μηδενίζω
emergency = κατάσταση ανάγκης, επείγον περιστατικό
emission = εκπομπή, εκροή, έκδοση
emission control = έλεγχος εκπομπών (ρυπαντών ή καυσαερίων)
employ = απασχολώ, εκμισθώνω, προσλαμβάνω, μεταχειρίζομαι, εφαρμόζω
employment = απασχόληση, εργασία, εκμίσθωση, πρόσληψη
engage = μισθώνω, ασχολούμαι, εμπλέκομαι, προσυμφωνώ, αρραβωνιάζομαι
engine = κινητήρας, μηχανή
  air-cooled engine = αερόψυκτος κινητήρας
  heat engine = θερμοκινητήρας, θερμική μηχανή

in-line engine = κινητήρας εν σειρά
opposed engine = αντικρυστός κινητήρας, «μπόξερ»
radial engine = αστεροειδής κινητήρας
water-cooled engine = υδρόψυκτος κινητήρας
engineer = μηχανικός
design engineer = μηχανικός που κάνει μελέτες εγκαταστάσεων, μελετητής
mechanical engineer = μηχανολόγος μηχανικός
engineering = η μηχανική (επιστήμη, τέχνη)
enormous = τεράστιος
ensure = εξασφαλίζω, σιγουρεύω /-ομαι, ασφαλίζω
entertainment = διασκέδαση, ψυχαγωγικό πρόγραμμα
entirely = εντελώς, τελείως, εξ ολοκλήρου
environment = περιβάλλον
equal = εξισώνω, ίσος, ισοδύναμος, το ισοδύναμο
equation = εξίσωση
equip (with) = εφοδιάζω, εξοπλίζω
equipment = εφόδια, εφοδιασμός, εξοπλισμός, εγκαταστάσεις (συνεργείων, εργαστηρίων, εργοταξίων κ.λπ.)
error = λάθος, σφάλμα
escalator = ανυψωτήρας, κλιμακωτός αναβατήρας, κυλιόμενες σκάλες
essential = ουσιώδης, βασικός, σημαντικός, πρωταρχικός
estimate = εκτιμώ, υπολογίζω
estimation = εκτίμηση, υπολογισμός
evacuate = εκκενώνω, δημιουργώ κενό
evaporate = εξατμίζω/-ομαι, ατμοποιώ/-ούμαι, εξαερώνω/-ομαι
evaporator = εξατμιστής, εξαερωτής, ατμοποιητής, ψύκτης
evenly = ομαλά, εξίσου, ομοιόμορφα
exhaust = εξαντλώ, εξάγω, εξαγωγή, εξάτμιση
exhaust gases = αέρια εξαγωγής, καυσαέρια
exhaust port = θυρίδα εξαγωγής αερίων
expand = διαστέλλω/-ομαι, εκτονώνω/-ομαι, επεκτείνω/-ομαι
expel = εξωθώ, εκδιώκω, αποβάλλω
experience = εμπειρία, πείρα
expertise = επιδεξιότητα, μεγάλη εμπειρία και εξειδικευμένες γνώσεις
exploration = εξερεύνηση
explosive = εκρηκτικός, εκρηκτική ύλη
exponent = εκθέτης δύναμης (Μαθημ.)
expose = εκθέτω
extend = (επ)εκτείνω/-ομαι
extension = προ-/επέκταση, παράταση, εσωτερική γραμμή τηλεφώνου
extensive = εκτεταμένος
external = εξωτερικός
extract = αποσπώ, εξάγω, εξέλκω, βγάζω, εκχύλισμα, απόσταγμα

F

face shield = προστατευτική μάσκα προσώπου, μάσκα οξυγονοκολλητή
facing = μετωπική τόρνευση, «πρόσωπο»
fact = γεγονός
facing = μετωπική τόρνευση/«πρόσωπο»
factor = παράγοντας, συντελεστής
factory = εργοστάσιο
fail = αποτυγχάνω, δεν καταφέρνω, αστοχώ
fan = ριπίζω, ανεμιστήρας, εξαεριστήρας, βεντάλια, βεντιλατέρ
fan grille = μάσκα αυτοκινήτου, στόμιο αναρρόφησης/προσαγωγής εξαεριστήρα
fasten = στερεώνω, προσδένω, σφίγγω
fatal = μοιραίος, θανατηφόρος
fault = σφάλμα, ελάττωμα, ρήγμα
fault-finding chart = πίνακας διάγνωσης βλάβης

faulty = χαρακτηριστικό, τεχνική προδιαγραφή, γνώρισμα
feature = χαρακτηριστικό γνώρισμα
feed = τροφοδοτώ, τροφοδότηση
ferrous = (υπο)σιδηρούχος
field = πεδίο, χωράφι, τομέας
figure = μορφή, εικόνα, ψηφίο, σχήμα, μορφοποιώ, λογαριάζω
file = λιμάρω, ταξινομώ έγγραφα σε φακέλλους, αρχειοθετώ, λίμα, δέσμη χαρτιών, φάκελλος, ντοσιέ, αρχείο
filler (metal / rod) = μέταλλο χρησιμοποιούμενο σαν συγκολλητικό υλικό στις συγκολλήσεις, κόλληση
final drive = τελική σχέση / φάση μετάδοσης κίνησης
firing order = σειρά/τάξη ανάφλεξης / πυροδότησης, κινητήρα
firmly = σταθερά, γερά, ακράδαντα, έντονα
fit = προσαρμόζω, ταιριάζω, εφαρμόζω, εξοπλίζω, κατάλληλος
fitting = άρμοση, εφαρμογή, προσαρμογή, εξάρτημα σύνδεσης σωλήνων
fix = στερεώνω, προσηλώνω, διορθώνω, ρυθμίζω, ορίζω
fixture = εξάρτημα ακίνητο/σταθερό, ιδιοσυσκευή για πρόσδεση των προς κατεργασία κομματιών στις εργαλειομηχανές
flame = φλόγα
flammable / inflammable = εύφλεκτος
flange= στεφανιοειδές παρέμβυσμα, φλάντζα
flap = πτερύγιο
flare = εκχειλώνω, διευρύνω τα άκρα σωλήνος, εκχείλωση
flaring-tool = εκχειλωτικό εργαλείο
flash lights = (εν)δείκτης πορείας, φλας
flat = επίπεδος, επίπεδο, αμβλύς, αβαθύς, ανούσιος
flat battery = ξεφόρτιστη, άδεια, νεκρή μπαταρία
flexibility = ευκαμψία, ευλυγισία, ελαστικότητα, προσαρμοστικότητα
flexible = εύκαμπτος, ευλίγιστος, ελαστικός, ευπροσάρμοστος
float chamber= θάλαμος πλωτήρα
flow = ρέω, ρους, ροή
fluid = υγρό, ρευστό
fluorine = φθόριο (F)
flux = ρευστοποιώ, λιώνω, ειδική ουσία που χρησιμοποιείται στις μαλακές συγκολλήσεις για προφύλαξη από σκούριασμα της περιοχής που θα κασσιτεροποιηθεί, αλοιφή
fold = διπλώνω, πτυχή, δίπλωμα
folding rule = μέτρο πτυσσόμενο
foodstuff(s) = είδη διατροφής, τρόφιμα
force = βιάζω, εξαναγκάζω, δύναμη, ισχύς, βία
forging = σφυρηλάτηση, σφυρήλατο αντικείμενο
forging tongs = λαβίδες καμινευτή, σφυρηλάτησης
form = μορφή, είδος, έντυπο (π.χ. αίτησης), σχηματίζω, συγκροτώ, μορφοποιώ
formely = προηγουμένως, πριν
forming machine = μηχάνημα κυκλικής κάμψης φύλλων μετάλλου, κύλινδροι κάμψης, ρόλλοι
fossil fuels = ορυκτά καύσιμα
founding = χώνευση, χύσιμο μετάλλων
foundry = χυτήριο, χωνευτήριο
freeze = παγώνω, καταψύχω
freeze up protection = αντιπαγωτική προστασία
freezer = καταψύκτης, κατάψυξη
freight = φορτίο
freight train = εμπορικό τραίνο
freighter = φορτηγό πλοίο/αεροπλάνο
frequency = συχνότητα
friction = τριβή, τρίψιμο, προστριβή
friction plate = δίσκος τριβής συμπλέκτη
fuel = καύσιμο, καύσιμη ύλη, θερμαντικό καύσιμο
fumes = αναθυμιάσεις, καπνός, καυσαέρια
function = λειτουργία, έργο, συνάρτη-

ση (Μαθηματικά)
furnace = καμίνι, εστία, κλίβανος, φούρνος, συσκευή θέρμανσης
fuse = λιώνω, τήκω
fusion = τήξη, λιώσιμο

G

gain = κερδίζω, αποκτώ, ωφέλεια, κέρδος, απολαβή
  heat gain = θερμικό κέρδος, προσθήκη θερμικού φορτίου
gauge = υπολογίζω, μετρώ, μέτρο, μετρητής, ενδείκτης
gauge manifold / test set = σετ μανομέτρων, κάσα μανομέτρων
gasoline = βενζίνη
gear = οδοντωτός τροχός, γρανάζι, μηχανισμός μετάδοσης κίνησης, ταχύτητα
gear box = κιβώτιο οδοντωτών τροχών / ταχυτήτων, σαζμάν
gear teeth = «δόντια» οδοντωτού τροχού, γρανάζι
generate = παράγω
generator = γεννήτρια
global warming potential (GWP) = δυναμικότητα πρόκλησης του φαινομένου του θερμοκηπίου
goggles = προστατευτικά/προφυλακτικά γυαλιά
grade = βαθμολογώ, βαθμός, αξίωμα, κλίση, ποιότητα
gradually = βαθμιαία, σταδιακά
greenhouse effect = το φαινόμενο του του θερμοκηπίου
grind = ακονίζω, λειαίνω, κονιορτοποιώ
grinder = μηχάνημα λειάνσεως, λειαντικός τροχός, ακονιστήρι
grip = γαντζώνω, αρπάζω, αρπάγη, γκρίπα, γαντζοτανάλια, (χειρο)λαβή, στόμιο εκροής
groove = χαράζω, εγκοπή, αυλάκι, χαραγή, ράβδωση
ground = έδαφος, γη, τροχισμένος, γειώνω (ηλεκτρική συσκευή)
guarantee = εγγυώμαι, εγγύηση
gudgeon pin = άξονας ποδός διωστήρα, π(ε)ίρος/άξονας εμβόλου
guide = οδηγώ, κατευθύνω, οδηγός, ευθυντηρία

H

hacksaw = σιδηροπρίονο
hair-dressing = κομμωτική τέχνη
halide torch = συσκευή ελέγχου διαρροών συστημάτων ψύξης / λυχνία Χειλάιντε
halocarbons = (υδρογονωμένοι) αλογονάνθρακες
halogen = αλογόνο
hammer = σφυρί, σφυροκοπώ
  ball-peen hammer = σφυρί με ημισφαιρική κεφαλή, σφυρί μπάλλας
hand groover = ειδικό εργαλείο για την πίεση/κλείσιμο ραφών (θηλιαστικών συνδέσεων) και αναδιπλώσεων σε φύλλα μετάλλου
hand tool = εργαλείο χειρός
hand wheel = χειροστρόφαλος, τροχός ρυθμιζόμενος με το χέρι
handle = χειρίζομαι, τα βγάζω πέρα, λαβή, στυλιάρι, χερούλι
  swivel handle = σπαστή (στρεφόμενη) λαβή, σωληνωτό κλειδί με σπαστή λαβή
  tee handle = λαβή σχήματος ταφ
harbour = λιμάνι
hardening = σκλήρυνση, βαφή μετάλλου
harmful = επιβλαβής, επιζήμιος, βλαβερός
harmless = αβλαβής,άκακος
hatchback = τρί-/πεντάθυρο αυτοκίνητο
hazard = κίνδυνος, διακινδυνεύω

head lights = μπροστινά φώτα αυτοκινήτου
headstock = κεφαλή τόρνου, κεφαλάρι
heat = θερμαίνω, ζεσταίνω, θερμότης, ζέστη
heat gain = θερμικό κέρδος, προσθήκη θερμικού φορτίου
heat loss = θερμική απώλεια
heating element = θερμαντικό στοιχείο (ηλεκτρική αντίσταση)
heating system = σύστημα θέρμανσης
  central heating system = σύστημα κεντρικής θέρμανσης
height =ύψος
hem = περίρραμμα, στρίφωμα, ρέλο, αναδιπλώνω τα άκρα, στριφώνω, αναδίπλωση άκρων, στραντζάρισμα
hemi- = ημι-
hose = ελαστικός σωλήνας, μάνικα
household = σπιτικό, νοικοκυριό, οικιακός
humidify = υγραίνω
humidity = υγρασία
  relative humidity = σχετική υγρασία
hydrocarbons = υδρογονάνθρακες
hydrochlorofluorocarbons (HCFC) = υδροχλωροφθοράνθρακες
hydrofluorocarbons (HFC) = υδροφθοράνθρακες
hydraulic = υδραυλικός
hydrogen = υδρογόνο
hygrometer = υγρόμετρο

I

icebox = παγωνιέρα, ψυγείο πάγου
idling = βραδεία λειτουργία κινητήρα «στο ρελαντί»
ignite = αναφλεγώ
ignition = ανάφλεξη
  magnetic impulse transistorised ignition = ηλεκτρονική ανάφλεξη με μεταδότες μαγνητικού τύπου και τρανζίστορ
ignition coil = πηνίο ανάφλεξης, πολλαπλασιαστής
ignition switch = διακόπτης καύσεως, κεντρικός διακόπτης (μπουτόν) εκκίνησης, εκκινητής, μίζα, εκκινητής
ignorance = άγνοια
immobilize = ακινητοποιώ
impact = κρούση, σύγκρουση, πρόσκρουση, επίδραση, επίπτωση
impact tools = κρουστικά εργαλεία (με πεπιεσμένο αέρα)
improve = βελτιώνω
improvement = βελτίωση
impulse = ώθηση
impurity = βρωμιά, ακαθαρσία
in-progress gauging system = σύστημα ελέγχου αιχμηρότητας εργαλείων και ποιότητας προϊόντων που πραγματοποιείται κατά τη διάρκεια της κατεργασίας στις εργαλειομηχανές αριθμητικού ελέγχου
inclined = κεκλιμένος, γυρτός, λοξός
increase = αυξάνω, αύξηση
incremental positioning system = βηματικό σύστημα για τον εντοπισμό των σημείων κοπής στις εργαλειομηχανές αριθμητικού ελέγχου
independent = ανεξάρτητος
index = δείκτης, δείκτης ρίζας (Μαθημ.)
indicate = δείχνω, (υπο)δηλώνω
indicator = (εν)δείκτης
indicator light = ενδεικτική λυχνία
indispensable = απαραίτητος
individual = άτομο, ατομικός, μεμονωμένος
indoor = εσωτερικού χώρου, που τοποθετείται/βρίσκεται στο εσωτερικό κτιρίου
inflate = εμφυσώ, φουσκώνω, εξογκώνω
influence = επιδρώ, επηρεάζω, επιφέρω, επάγω
infrared radiation = υπέρυθρη ακτινοβολία
inhabited = κατοικημένος
inhale = εισπνέω

inherently = εγγενώς, εκ φύσεως, από τη φύση του
injection = έγχυση
injector = εγχυτήρας, ψεκαστήρας, μπεκ
inlet = είσοδος
innovation = νεωτερισμός
innovative = νεωτεριστικός
insert = εισάγω
inserts = κοπτικές αιχμές χρησιμοποιούμενες στις CNC εργαλειομηχανές
inspection = επιθεώρηση, εξέταση, εποπτεία, επίβλεψη
install = εγκαθιστώ, εγκαθιδρύω
installation = εγκατάσταση, εγκαθίδρυση, τοποθέτηση
instruction = οδηγία, διδασκαλία
instrument = όργανο
  measurement instrument = όργανο μέτρησης
insulation = μόνωση
integrated = ενσωματωμένος, ενταγμένος, ολοκληρωμένος
intermittent = διαλείπων, μη συνεχής, διακοπτόμενος
intermix = αναμ(ε)ιγνύω
internal = εσωτερικός
interrupt = διακόπτω
intersect = διατέμνω, διχοτομώ
interview = συνέντευξη, παίρνω συνέντευξη
introduce = εισάγω, συστήνω
inverter = αναστροφέας, μετατροπέας
investigation = έρευνα
investment = επένδυση κεφαλαίων
iron = σίδηρος (Fe), σίδερο, σιδερώνω
irregular = ανώμαλος, ακανόνιστος, άτακτος
irregular curves = καμπυλόγραμμα (όργανο σχεδίασης με καμπύλες)
irregularity = ανωμαλία, ατέλεια
item = αντικείμενο, είδος, κομμάτι

J

jet = σωλήνας προώθησης καυσίμου στο καρμπυρατέρ, αναβρυτήρας, «ζιγκλέρ»
jewellery = κοσμήματα
jig = ιδιοσυσκευή για πρόσδεση των προς κατεργασία κομματιών στις εργαλειομηχανές
join = ενώνω, συνάπτω, σμίγω
joint = σύνδεση, αρμός, άρθρωση, ένωση

K

keyboard = πληκτρολόγιο
kite = χαρταετός

L

lack = στερούμαι, έχω έλλειψη, στέρηση, έλλειψη
last = διαρκώ, τελευταίος
latent = λανθάνων, κρυμμένος
latent heat = λανθάνουσα θερμότητα, θερμότητα υγροποίησης
lathe = τόρνος
lathe bed = κλίνη τόρνου, κρεββάτι/ βάση/κορμός/ στήλη εργαλειομηχανής
lead = οδηγώ, προπορεύομαι, προπορεία, καλώδιο, μόλυβδος (Pb)
leak = διαρρέω, στάζω, ξεφεύγω, διαρροή, εκ/διαφυγή, άνοιγμα, ρωγμή διαρροής
leakage = διαρροή
leakproof = στεγανός
length = μήκος
level = επίπεδος, οριζόντια επιφάνεια, το επίπεδο, στάθμη επιφάνειας
  noise level = στάθμη/επίπεδο θορύβου
lever = μοχλός

feed lever = τροφοδοτικός μοχλός, μοχλός προώσεως τόρνου
lift = ανυψώνω, σηκώνω, αναβατήρας, ανελκυστήρας, ανυψωτήρας, ασανσέρ, άνωση, ύψος (αντλίας)
lighter/spark lighter = αναπτήρας, συσκευή παραγωγής σπινθήρων για άναμα του φλόγιστρου
limit = περιορίζω, όριο
liner = πλοίο της γραμμής
ocean liner = υπερωκεάνειο
link = συνδέω, ενώνω, σύνδεσμος, συνδετήρας, κρίκος
linkage = σύνδεσμος, συνδεσμολογία, μοχλικό σύστημα
liquid = υγρός, το υγρό
load = φορτώνω, φορτίζω, φορτίο, φόρτωμα, φόρτιση, βάρος
air-conditioning load = συνολικό φορτίο θέρμανσης-ψύξης κλιματιστικής εγκατάστασης
cooling load = ψυκτικό φορτίο
heating load = θερμικό φορτίο
load estimate/-tion = υπολογισμός φορτίων κλιματιστικής εγκατάστασης
load sources = πηγές φορτίων (κλιματιστικής εγκατάστασης)
locate = εντοπίζω, βρίσκω (τη θέση), τοποθετώ
location = τοποθεσία, εντοπισμός, θέση
lock = κλειδώνω, στερεώνω, κλειδαριά, κλείστρο, ασφάλεια
loop = θηλιά, βρόχος
loose = χαλαρός, λυτός
loosen = χαλαρώνω, ξελασκάρω
lorry = φορτηγό αυτοκίνητο, καμιόνι
louvre = παραθυρόφυλλο, παντζούρι, πτερύγιο
lubricant = λιπαντικό
lubricate = λιπαίνω, λαδώνω, γρασάρω
luggage = αποσκευές
luggage compartment = χώρος αποσκευών, πορτ-μπαγκάζ

M

machine = μηχανή, μηχάνημα, κατεργάζομαι σε εργαλειομηχανή
machine shop = μηχανουργείο
machine tool = εργαλειομηχανή
machinery = μηχανήματα, μηχανισμός, το σύνολο των μηχανών σε ένα χώρο
machining center = εργαλειομηχανή πολλαπλών κατεργασιών
machinist = μηχανουργός, μηχανοτεχνίτης
MacPherson strut = γόνατο Μακ Φέρσον (τύπος ανάρτησης)
maintain = συντηρώ, διατηρώ, υποστηρίζω
maintenance = συντήρηση
major = μεγαλύτερος, κυριότερος, ταγματάρχης
malfunction = βλάβη, κακή λειτουργία
malleable = ελατός, σφυρήλατος
mallet = μαλακό σφυρί (π.χ. από ξύλο, πλαστικό ή ελαφρό μέταλλο), ματσόλα
manage = καταφέρνω, «τα καταφέρνω», διευθύνω, ελέγχω
manifold = αγωγός, συλλέκτης, συγκρότημα σωληνώσεων εισαγωγής (intake) / εξαγωγής (exhaust) καυσίμου, πολλαπλή εισ/εξαγωγή
manometer = μανόμετρο
manual = χειροκίνητος, εγχειρίδιο, φυλλάδιο
manufacture = κατασκευάζω, κατασκευή, βιομηχανία
mark = σημαδεύω, σημάδι, βαθμός, μαρκάρω
matter = ύλη, πράγμα, υπόθεση, ενδιαφέρον, σημαίνω, έχω σημασία
means = το μέσο, τα μέσα (δυνατότητα), τρόπος
measure =(κατα)μετρώ, μέτρο

measurement = (κατα)μέτρηση, μέτρημα
mechanics = η μηχανική, οι μηχανοτεχνίτες, μηχανικοί (π.χ. αυτοκινήτου)
medium = μέσος, μεσαίος, μέτριος, ενδιάμεσος, μέσο
  cooling medium = ψυκτικό μέσο
meet = συναντώ, υποδέχομαι, συνεδριάζω, ανταποκρίνομαι, ικανοποιώ (ανάγκες, απαιτήσεις, κ.λπ.)
melt = λιώνω, τήκω, διαλύομαι
melting point = σημείο τήξης
mercury = υδράργυρος (Hg)
microprocessor = μικροεπεξεργαστής (ηλεκτρονικός υπολογιστής)
microwave oven = φούρνος μικροκυμάτων
milling = κατεργασία σε φρέζα, φρεζάρισμα, γλύφανση
milling machine = φρέζα, εκγλυφική μηχανή
  milling and drilling machining centre = εργαλειομηχανή πολλαπλών κατεργασιών για πρισματικά αντικείμενα
mine = εξορύσσω, βγάζω μέταλλα, υπονομεύω, υποσκάπτω, μεταλλείο, φουρνέλο, στοά ορυχείου, ορυχείο
minor = μικρός, επουσιώδης, ασήμαντος
misoperate = δυσλειτουργώ, δεν λειτουργώ καλά
mixture = μ(ε)ίγμα mode = τρόπος λειτουργίας, κατάσταση
mode = τρόπος λειτουργίας, κατάσταση
modify = τροποποιώ
molten = λιωμένος
moisture = υγρασία
moisture content = περιεχόμενη υγρασία, (ποσοστό) υγρασίας
molecule = μόριο ύλης
monitor = ελέγχω, (προ)ειδοποιώ, ελεγκτής, οθόνη, μηχανισμός ελέγχου
motion = κίνηση
motor = (ηλεκτρο)κινητήρας, μοτέρ
  starter motor = εκκινητής, ροοστάτης, μίζα, μοτέρ εκκίνησης
mould = μήτρα, καλούπι, πρότυπο, καλουπιάζω, μορφώνω, σχηματοποιώ
mount = στερεώνω, συνδέω, εφαρμόζω, μοντάρω
mounted = συνδεδεμένος, εφαρμοσμένος, μονταρισμένος, στερεωμένος, αναρτημένος
muggy = αποπνικτικός
multiply = πολλαπλασιάζω/-ομαι
mushroom head = παραμορφωμένη κεφαλή κοπιδιού σε σχήμα μανιταριού

N

nail = καρφώνω, καρφί
network = δίκτυο
neutral = ουδέτερος
nitrogen = άζωτο (N)
notice = προσέχω, παρατηρώ, ειδοποίηση, είδηση, σημείωμα
nozzle = ακροφύσιο, στόμιο, ακροσωλήνας, εγχυτήρας, μπεκ
numerator = αριθμητής κλάσματος
numerical control (NC) machine tools = εργαλειομηχανές αριθμητικού/ψηφιακού ελέγχου
nut = περικόχλιο, παξιμάδι, καρύδι

O

obtain = αποκτώ, επιτυγχάνω, λαμβάνω, αποκομίζω
obtuse = αμβλύς
occasional = περιστασιακά, κάπου-κάπου
occur = γίνομαι, συμβαίνω
offset = αντι-/ισο-σταθμίζω, απέχων, τεθλασμένος, αντιστάθμισμα
oil = λάδι, πετρέλαιο, λαδώνω
oil sump = λεκάνη λαδιού, ελαιολεκά-

νη, στροφαλοθάλαμος, κάρτερ
oiler = λαδωτήρι, λαδικό
omission = παράλειψη, αμέλεια
operate = λειτουργώ, χειρίζομαι, εγχειρίζω
operating mode = τρόπος λειτουργίας μηχανήματος/ συσκευής κ.λπ.
operation = λειτουργία, χειρισμός, κατεργασία, εγχείρηση
operator = χειριστής
option = δικαίωμα, δυνατότητα επιλογής
orderly = μεθοδικός, τακτικός, κανονικός
ordinary = κοινός, συνηθισμένος
ore = μετάλλευμα, ορυκτό
original = αρχικός, πρωτότυπος, το πρωτότυπο
output = εξαγωγή, απόδοση, εξαγόμενο, παραγωγή
output capacity = ωφέλιμη ισχύς
overall = τελείως, ολοσχερώς, πλήρης, ευρύχωρο εξωτερικό ένδυμα εργασίας, φόρμα
ovoid = ωοειδής
owe = χρωστάω, οφείλω
oxidising process = διαδικασία οξείδωσης
oxyacetylene brazing/welding = οξυγονοκόλληση

P

pallet = παλλέτα, συσκευή όπου στερεώνονται τα προς κατεργασία αντικείμενα και η οποία στη συνέχεια τοποθετείται στην ακριβή της θέση πάνω στην τράπεζα της εργαλειομηχανής ή απομακρύνεται από αυτήν με αυτόματο μηχανισμό
panel = πίνακας
parallel rule(r) = παραλληλογράφος
part catcher = μηχανισμός απόσπασης των κατεργασμένων αντικειμένων από την τράπεζα εργασίας της εργαλειομηχανής
part loader/unloader = μηχανισμός φόρτωσης-εκφόρτωσης των προς κατεργασία αντικειμένων για την πρόσδεσή τους στην εργαλειομηχανή
partially = εν μέρει
particle = σωματίδιο, μόριο
particular = ιδιαίτερος, συγκεκριμένος, ειδικός
passenger = επιβάτης, επιβατηγός, επιβατικός
perform = εκτελώ, πραγματοποιώ, λειτουργώ, δίνω παράσταση
performance = εκτέλεση, επίδοση, απόδοση, λειτουργία
perishable = ευπαθής, που χαλάει εύκολα
permanent = μόνιμος, διαρκής, σταθερός
permit = επιτρέπω, δίνω άδεια, άδεια
perpendicular = κάθετος
persist = επιμένω, παραμένω
perspiration = ιδρώτας
phase out = αποσύρω σταδιακά, σταδιακή απόσυρση
petrol = βενζίνη (Am. E.)
pick-up truck = μικρό ανοιχτό φορτηγό με καρότσα, «αγροτικό»
pipe / tube = σωλήνας, αγωγός
pipe / tube bender =εργαλείο κάμψης σωλήνων, κουρμπαδόρος
piston = έμβολο, πιστόνι
piston ring = ελατήρια, δακτύλιοι στεγανότητας εμβόλου
pivot = περιστρέφομαι γύρω από άξονα, άξονας περιστροφής, οδηγός
plane = επίπεδος, το επίπεδο (Γεωμ.) πλάνη (εργαλειομηχανή), αεροπλάνο, πλανίζω, ροκανίζω
plant = εργοστάσιο, φυτό, φυτεύω
plate = επιμεταλλώνω, επικαλύπτω, πλάκα, μεταλλικό έλασμα, πιάτο
pliers =τσιμπίδα, τανάλια, πένσα, λαβίδα
  adjustable pliers = λαβίδα (τσιμπίδι) με ρυθμιζόμενο άνοιγμα σιαγώ-

νων, γαντζοτανάλια
combination / universal pliers = πένσα γενικής χρήσης
flat-nose pliers = πλατυτσίμπιδο
lock-grip pliers = τανάλια για συγκράτηση κομματιών, σωλήνων κ.λπ., "σκύλα", γρίπος, αρπάγη
round-nose pliers = μυτοτσίμπιδο με στρογυλλά άκρα, στρογγυλλοτσίμπιδο
plotter = σχεδιαστής (μηχάνημα σχεδίασης), σχεδιογράφος, πλότερ
plug = ρευματολήπτης, φίς, πώμα, τάπα, βούλωμα, στόμιο υδροσωλήνα, βάζω στην πρίζα, βουλώνω
plumber = υδραυλικός
plumbing = σωλήνες κτιρίου, υδραυλική εγκατάσταση, σύστημα σωληνώσεων
plus = σύν, επί πλέον
point = αιχμή, μύτη, άκρο, σημείο, όριο, βαθμός, σκοπός, ζήτημα, (υπο)δείχνω
poisonous = δηλητηριώδης, κακοήθης, φαρμακερός
polish = γυαλίζω, στιλβώνω
pollutant = ρυπογόνος ουσία, ρυπαντής
pollution = μόλυνση, ρύπανση
popular = λαϊκός, δημοφιλής
port = θυρίδα, στόμιο, οπή, δίοδος, λιμάνι, άνοιγμα
portable = φορητός, κινητός, μεταφερόμενος
pose = πόζα, στάση, θέτω, αποτελώ
position = θέση
power = δύναμη, ισχύς, ιπποδύναμη, ενέργεια, δύναμη (Μαθημ.)
horse power (h.p.) = ιπποδύναμη
power output = απόδοση ισχύος
power plant = εργοστάσιο παραγωγής ηλεκτρικής ενέργειας
power tool = ηλεκτρικό εργαλείο
precaution = προφύλαξη, προνοητικότητα
precise = ακριβής
precision = ακρίβεια
preservation = διατήρηση, συντήρηση
preserve = συντηρώ, διατηρώ, προφυλλάσσω
pressostat = πιεσοστάτης, πρεσσοστάτης
pressure = πίεση, θλίψη, τάση
pressure plate = δίσκος (πίεσης) συμπλέκτη/αμπραγιάζ
prevent = (παρ)εμποδίζω, προλαμβάνω (π.χ. ατύχημα)
primary = πρώτιστος, αρχικός, πρωταρχικής σημασίας, βασικός
principle = αρχή (λειτουργίας, ηθικής), νόμος, κανόνας
printer = εκτυπωτής
private = ιδιαίτερος, ιδιωτικός, μυστικός
probe = εξετάζω καλά/λεπτομερώς, συσκευή ελέγχου κατεργασμένων κομματιών ή κοπτικών εργαλείων CNC εργαλειομηχανής, είδος scanner
procedure = τρόπος ενέργειας, αλληλουχία ενεργειών, πορεία, διαδικασία
process = πορεία, μέθοδος, τρόπος, πράξη, κατεργασία, διαδικασία
produce = παράγω, προξενώ, παρουσιάζω (στοιχεία π.χ.)
product = προϊόν
productivity = παραγωγικότητα, αποδοτικότητα
profit = ωφελώ, ωφελούμαι, κερδίζω, κέρδος, ωφέλεια, όφελος
profitable = επωφελής, επικερδής, κερδοφόρος
progress = προοδεύω, προχωρώ, πρόοδος
progressive = προοδευτικός, σταδιακός
propeller shaft =ελικοφόρος/προωθητικός άξονας, άξονας έλικα, άτρακτος μετάδοσης κίνησης
proper = κατάλληλος, πρέπων, αρμόζων, ταιριαστός, ενδεικνυόμενος
property = ιδιοκτησία, ιδιότητα, κυριότητα, περιουσία
proportion = αναλογία, μερίδιο
protect = προστατεύω

protection = προστασία
protractor = μοιρογνωμόνιο, γωνιόμετρο, γωνιογράφος
provide = προμηθεύω, προνοώ, εφοδιάζω, παρέχω
psychrometer = ψυχρόμετρο
public services = δημόσιες υπηρεσίες
public utilities = επιχειρήσεις κοινής ωφέλειας
pull = σύρω, έλκω, τραβώ
pulse = σφυγμός, παλμός, πάλλομαι
pump = αντλώ, αντλία
  heat pump = αντλία θερμότητας
  screw pump = κοχλιοφόρος αντλία
  vacuum pump = αντλία κενού
punch = σφύρα διατρήσεως, ζουμπάς, πόντα, τρυπητήρι
  centre punch = πόντα, στιγέας κέντρου
pure = καθαρός, αγνός
purge = εξαερώνω, αναρροφώ, καθαρίζω
push = ωθώ, σπρώχνω, ώθηση
putty = στόκος

Q

quadrilateral = τετράπλευρο
qualification = προσόν
quality = ποιότητα, ιδιότητα
quantity = ποσότητα
quench = σβήνω, δροσίζω, εμβαπτίζω σε υγρό, «βάφω» χάλυβα

R

radiation = ακτινοβολία
radiator = ψυγείο αυτοκινήτου, θερμοπομπός, καλοριφέρ
radius = ακτίνα
rail = ράβδος, βέργα, σιδηροτροχιά, κιγκλίδωμα, κάγκελο
rail tracks = γραμμές τραίνου, σιδηροτροχιές
railings = κιγκλίδωμα, κάγκελα
railroad / railway = σιδηρόδρομος, σιδηροδρομική γραμμή
raise = υψώνω, σηκώνω, ανεβάζω, ανατρέφω, μεγαλώνω, αυξάνω, αύξηση
range = εμβέλεια, περιοχή μέτρησης, φάσμα, βεληνεκές, γκάμα, σειρά, τάξη
ratchet = αναστολέας, καστάνια, μανέλα, οδοντωτός τροχός αναστολής
rate = τιμή, αξία, βαθμός, τάξη, αναλογία, εκτιμώ, διατιμώ, βαθμολογώ
ratio = λόγος (Μαθημ.), αναλογία
raw plug = ούπατ
reaction = αντίδραση
reading = ένδειξη μέτρησης οργάνου, διάβασμα, ανάγνωση
reamer = εκγλυφίδα, ρίνη, ξέστρον, ξύστρα, ήλος διάνοιξης οπών, αποξέστης, “αλεζουάρ”
reaming = εκτορνεύω, ανοίγω οπή, εκγλύφανση
rear = οπίσθιος, ο/η/το πίσω (π.χ. μέρος)
recall = ανακαλώ, επαναφέρω (στη μνήμη/για επεξεργασία), θυμούμαι
recharge = επαναφορτίζω
reciprocate = παλινδρομώ, ανταλλάσω, ανταποδίδω
reciprocating = παλινδρομικός
recognise = αναγνωρίζω
recommend = συνιστώ
record = καταγράφω, μαγνητοφωνώ, έγγραφο αρχείου, αρχείο, καταγραφή
rectangle = ορθογώνιο παραλληλόγραμμο
recycling = ανακύκλωση
reduce = ελαττώνω, μειώνω
reference = αναφορά, παραπομπή, σύσταση, πληροφορία, σχέση, μνεία

reference point = σημείο αναφοράς
refrigerant = ψυκτικό (μέσο)
refrigerate = ψύχω
refrigeration = ψύξη
refrigeration service valve(s) ratchet (wrench) = καστάνια χειρισμού βαλβίδων συμπιεστή
refrigerator = ψυγείο
regain = ανακτώ, ξαναπαίρνω
regulate = κανονίζω, ρυθμίζω
regulator = ρυθμιστής
reject = απορρίπτω
relation = σχέση, αναφορά, συγγένεια αφήγηση
release = αφήνω, ελευθερώνω, απαλλάσσω, (απ)ελευθέρωση
reliability = αξιοπιστία
remain = απομένω, μένω, παραμένω
remedy = αποκαθιστώ βλάβη, διορθώνω, αποκατάσταση βλάβης, επισκευή
remind = υπενθυμίζω
removable = ο δυνάμενος να μετακινηθεί/αφαιρεθεί/αποσπαστεί
remove = μετακινώ, μετακομίζω, μεταφέρω, αφαιρώ, αποσπώ
Renaissance = Αναγέννηση
repair = επισκευάζω, διορθώνω, επισκευή, επιδιόρθωση
repeatability = ικανότητα παραγωγής πανομοιότυπων προϊόντων
replace = αντικαθιστώ, αναπληρώνω, υποκαθιστώ
represent = αντιπροσωπεύω, συμβολίζω, παρουσιάζω
representative = αντιπροσωπευτικός, αντιπρόσωπος
require = απαιτώ, χρειάζομαι, ζητώ
requirement = ανάγκη, απαίτηση, ζητούμενο, αξίωση
  meet the requirements (of) = πληρώ τις απαιτήσεις / προδιαγραφές
research = έρευνα, μελέτη
reservoir = δεξαμενή, αποθήκη υγρών, ντεπόζιτο, ρεζερβουάρ
reset = ξαναρυθμίζω, ξανατοποθετώ
residential = που έχει κατοικίες, κατοικημένος (χώρος/περιοχή)
resist = αντιστέκομαι, αντέχω
resistance = αντίσταση, αντοχή, ανθεκτικότητα
resistant = ανθεκτικός, αντιστεκόμενος
responsible = υπεύθυνος
restrictor = μειωτής, περιοριστής (π.χ. λαιμού δοχείου βενζίνης ώστε να επιτρέπει μόνο την είσοδο μάνικας αμόλυβδης βενζίνης)
result = επακολουθώ, προκύπτω, καταλήγω, αποτέλεσμα
retain = κρατώ, συγκρατώ, διατηρώ
reverse = αντιστρέφω
reverse gear = οδοντοτροχός/ταχύτητα οπισθοδρομήσεως, «η όπισθεν»
review = ανα-/επιθεωρώ, επανεξετάζω, ανα-/επιθεώρηση, επανεξέταση, επανάληψη, κριτική, ανασκόπηση
revolution = περιφορά, περιστροφή, επανάσταση
revolver = περιστρεφόμενο εργαλειοφορείο εργαλειομηχανής αριθμ. ελέγχου
revolving = περιστροφικός, περιστρεφόμενος
reward = ανταμοιβή, αμοιβή, απολαβή, επιβράβευση, ανταμείβω
ride = ιππεύω, πηγαίνω βόλτα με δίκυκλο, αυτοκίνητο κλπ., ταξιδεύω με όχημα
rise = σηκώνω /-ομαι, (αν-)υψώνω / -ομαι, αυξάνω /-ομαι, ανατέλλω, (αν-)ύψωση, σήκωμα, ανατολή
risk = ριψοκινδυνεύω, κίνδυνος
rivet = ήλος, πιρτσίνι, καρφοβελόνα, ηλώνω, πιρτσινώνω, καθηλώνω
rod = ράβδος, διωστήρας, στέλεχος, μοχλός, βάκτρο
roll = κυλώ, τυλίγω /-ομαι, κύλινδρος, περιστροφή, έλκυστρο, έλαστρο, μποτσάρισμα
rolls = μηχάνημα κυκλικής κάμψης φύλλων μετάλλου, κύλινδροι κάμψης, ρόλοι
rotary = περιστροφικός, περιστρεφόμενος

rotate = περιστρέφω/ -ομαι, γυρίζω
rubber = ελαστικός, καουτσούκ, γομολάστιχα
rule(r) = κανόνας, χάρακας, γνώμονας
    folding rule = πτυσσόμενη μετροταινία
    steel rule = μεταλλικός κανόνας μετρήσεων
running conditions = συνθήκες οδήγησης / λειτουργίας κινητήρα
run off = αδειάζω
rust = σκουριά, οξείδωση, σκουριάζω

S

saddle = κολάρο (εξάρτημα στερέωσης καλωδίων)
safety = ασφάλεια
salary = μισθός
sandcloth = γυαλόχαρτο, σμυριδόπανο
sanding = κοκκοειδή υπολείματα άμμου, ψιλή άμμος, αμμοβολή
sandpaper = γυαλόχαρτο, σμυριδόχαρτο
satisfactory = ικανοποιητικός
saturate = υπερπληρώ, γεμίζω (με υδρατμούς)
saturated = κορεσμένος, υπερπλήρης (με υδρατμούς)
saturation = κορεσμός, υγροποίηση
save = σώζω, (εξ)οικονομώ, αποταμιεύω, γλυτώνω
saw = πριόνι
    key hole/sabre saw = ποτηροτρύπανο
scale = βαθμολογημένη κλίμακα (σχεδίου, χάρτη, χάρακα)
scales = ζυγαριά, πλάστιγγα, βαθμολογημένος κανόνας σχεδίασης
scalene triangle = σκαληνό τρίγωνο
science = επιστήμη
scientific = επιστημονικός
scrap = κομμάτι, υπόλειμμα, πρόχειρο χαρτί, παλιοσίδερα, απορίπτω σαν άχρηστο, απόβλητο
scrape = αποξέω, ξύνω, εξομαλύνω, στρώνω επιφάνεια με ξύσιμο
scraper = ξέστρο, γλυφίδα, αποξεστήρας, ξύστρα, ρασκέτα, αποξέστης, εξισωτής, εξομαλυντήρας
screw = κοχλίας, έλικα(ς), βίδα, βιδώνω
screwdriver = κοχλιοστρόφιο, κατσαβίδι
    cross-point screwdriver = σταυροκατσάβιδο, κατσαβίδι Φίλλιπς
    flat-tip / standard screwdriver = κοινό κατσαβίδι (για βίδες εγκοπής)
    offset screwdriver = στραβοκατσάβιδο, τεθλασμένο / αγκωνωτό κατσαβίδι (με κυρτά άκρα)
    retaining screwdriver = κατσαβίδι με καστάνια
screw-pitch gauge = σπειρ(ωματ)όμετο
scribe = χαράσσω, παραγλυφίζω
scriber = χαράκτης, σημαδευτήρι
scroll = πάπυρος, περγαμηνή, κοχλίας
seam = συναρμόζω, συρράπτω, (συρ)ραφή (ένωση), συναρμογή με επικάλυψη
seat = κάθισμα, θέση, πάγκος
section = τμήμα, τομή, τεμάχιο
sector = τομέας, κυκλικός τομέας
secure = (εξ)ασφαλίζω, σιγουρεύω, ασφαλής, σίγουρος
security = μέτρα ασφαλείας, σιγουριά, ασφάλεια
seek = αναζητώ, ζητάω, ψάχνω
segment = τμήμα (κύκλου)
self- = αυτο-
semi- = ημι-
semi-trailing arms = ημιυστερούντες βραχίονες
sensation = αίσθηση

sensible heat = αισθητή θερμότητα
sensor = αισθητήρας, σένσορας
separate = (δια)χωρίζω/ -ομαι
series = σειρά
service = (εξ)υπηρετώ, φροντίζω, συντηρώ (π.χ. μηχάνημα), υπηρεσία, εξυπηρέτηση, συντήρηση (μηχανήματος), λειτουργία, θητεία (στο στρατό π.χ.)
service / charging cylinder = φιάλη ψυκτικού για φόρτιση συστημάτων ψύξης/κλιματισμού
serviceman = συντηρητής, στρατιωτικός
servomechanism = σερβομηχανισμός, βοηθητικός μηχανισμός που λειτουργεί με υποπίεση
servo-motor = εξυπηρετικός / βοηθητικός κινητήρας
set = τοποθετώ, ορίζω, κανονίζω, ρυθμίζω/επιλέγω τρόπο λειτουργίας συσκευής, δύω, στερεώνω, προσαρμόζω, κατακαθίζω, συλλογή/σειρά εξαρτημάτων, συσκευή, ορισμένος, σταθερός
set squares = τρίγωνα σχεδίασης
set up = τοποθέτηση/πρόσδεση κομματιού σε εργαλειομηχανή
shaft = άξονας, άτρακτος, φρέαρ
  propeller shaft = κεντρικός άξονας, άξονας μετάδοσης κίνησης σχήματος
share = μοιάζω, μετέχω, συμμερίζομαι, μερίδα, μερίδιο, μετοχή
shank = άτρακτος, σφιγκτήρας τρυπανιών, άξονας ειδικής κατασκευής για συγκράτηση κοπτικών εργαλείων/κεφαλών και πρόσδεσή τους σε CNC εργαλειομηχανή
sharp = οξύς, αιχμηρός, κοφτερός
shear = κόβω, ψαλιδίζω, διάτμηση, κόψιμο
shears / tin shears = μεγάλο ψαλίδι, μεταλλοψάλιδο
  squaring shears = μηχανικό ψαλίδι (κοπής φύλλων μετάλλου)
sheet metal = φύλλο μετάλλου, έλασμα, λαμαρίνα
sheet metal worker = ελασματοτεχνίτης, εργαζόμενος στο μεταλλοτεχνείο
shift = βάρδια, αλλαγή, αλλάζω, μετατοπίζω
shipbuilding industry = ναυπηγοεπισκευαστική βιομηχανία
shock = πρόσκρουση, κτύπημα, τράνταγμα, κρούση
side = πλευρά, μέρος, πλάγιος, πλάι
sight glass = οφθαλμίδιο
signal = σήμα
silver = άργυρος (Ag), ασήμι, επαργυρώνω, ασημένιος
simultaneously = συγχρόνως, ταυτόχρονα
size = μέγεθος, ανάστημα, διαστάσεις, ισχύς
skill = επιδεξιότητα, επιτηδειότητα
skil(l)ful = επιδέξιος, επιτήδειος, ικανός
slant = κλίση
slide =γλιστρώ, ολισθητήρας, ολίσθημα, ρυθμιστής, δείκτης
slides = ευθυντηρίες, πρισματοδηγοί, γλίστρες τόρνου
slip = γλιστρώ, ολίσθηση, γλίστρημα
slot = σχισμή
slow down = επιβραδύνω
socket = ρευματοδέκτης, υποδοχή, ακροδέκτης, υπόβαθρο, σωληνωτό κλειδί, καρυδάκι
  Allen-hex socket = κλειδί (τύπου) Αλλεν
  socket spanner/spinner = σωληνωτό κλειδί για (ξε)βίδωμα εξάγωνων παξιμαδιών
software = το λογισμικό μέρος / τα προγράμματα των ηλ. υπολογιστών
solder = κάνω μαλακή συγκόλληση / κασσιτεροκόλληση, καλάι
soldering = μαλακή συγκόλληση, κασσιτεροκόλληση
soldering gun = ηλεκτρικό κολλητήρι κασσιτεροκόλλησης τύπου πιστολιού
soldering iron = κολλητήρι ηλεκτρικής κασσιτεροκόλλησης τύπου ράβδου
solid = το στερεό σώμα (κατάσταση

ύλης / Γεωμ.), στερεός, συμπαγής
source = πηγή
space = χώρος, τόπος, διάστημα
spacecraft = διαστημόπλοιο
spare parts = ανταλλακτικά (εξαρτήματα, μέρη κ.λπ.)
spark = σπινθήρας, σπίθα, σπινθηρίζω
spark lighter = αναπτήρας σπινθήρα φλόγιστρου
spark plug = σπινθηριστής, μπουζί
specialise (in) = (εξ)ειδικεύομαι
special(i)ty = ειδικότητα, ειδικό χαρακτηριστικό, εξειδίκευση
specific = συγκεκριμένος
specification = προσδιορισμός, λεπτομέρεια, διασαφήνιση, προδιαγραφή, χαρακτηριστικό (μηχανής π.χ.)
spin = στριφογυρίζω, περιστρέφω, στροβιλίζω, περιδίνηση, σπινάρισμα, τροχιά
spindle = άτρακτος, άξονας περιστροφής εργαλείου
spirit level = αλφάδι
spot = σημειώνω, κηλιδώνω, στίγμα, κηλίδα, σημείο, τόπος
spray = ψεκάζω, ραντίζω, ράντισμα, ψεκάδες
spring = ελατήριο
    coil springs = σπειροειδή ελατήρια
    leaf springs = ελασματοειδή, ελλειπτικά ελατήρια, φύλλα σούστας, σούστες
spring bender = εύκαμπτο εργαλείο κάμψης σωλήνων, κουρμπαδόρος
square = τετράγωνο, τετραγωνικός, στο τετράγωνο (δύναμη, Μαθημ.)
squeeze = συνθλίβω, στίβω
stage = βαθμός, διαβάθμιση, στάδιο/φάση (διαδικασίας), εξέδρα
stain = κηλίδα, λεκές, λερώνω
stainless steel = ανοξείδωτο ατσάλι
state = εκθέτω, αναφέρω, δηλώνω, κατάσταση, πολιτεία
steady = σταθεροποιώ, σταθερός, αμετάβλητος
steady load conditions = συνθήκες λειτουργίας κινητήρα σταθερού φορτίου
steam = ατμός, υδρατμός, ατμίζω, εξατμίζω
steel = χάλυβας, ατσάλι
steel wool = σύρμα γυαλίσματος/στίλβωσης, ατσαλόσυρμα
steering = διεύθυνση, οδήγηση, σύστημα οδήγησης οχήματος
    rack-and-pinion steering = σύστημα οδήγησης τύπου κρεμαγιέρας
steering column = άξονας, «κολόνα» τιμονιού
    safety steering column = σπαστό τιμόνι με κολόνα ασφαλείας
steering wheel = τιμόνι
stick = κολλάω, χειριστήρια στήλη, κομμάτι ξύλου, ραβδί
storage = αποθήκευση, αποθήκη
store = αποθηκεύω, κατάστημα, μαγαζί, αποθήκη
straight = ευθύς, ίσος, κατ'ευθείαν, αμέσως
strength = ισχύς, δύναμη, στερεότητα αντοχή
stress = ένταση, φορτίο, τάση, πίεση, τόνος, τονίζω, δίνω έμφαση, καταπόνηση
stretch = εκτείνω/-ομαι, τεντώνω/-ομαι, ένταση, έκταση
strip = απογυμνώνω, λωρίδα, ταινία, διάδρομος προσ-/απογείωσης
strike = χτυπώ, χτύπημα, απεργία, απεργώ (be on strike)
stroke = χρόνος κινητήρα, διαδρομή εμβόλου
    compression stroke = χρόνος συμπίεσης
    exhaust stroke = χρόνος εξαγωγής
    induction stroke = χρόνος εισαγωγής, αναρρόφησης
    power stroke = χρόνος καύσης-εκτόνωσης κινητήρα
structure = κατασκευή, δομή, διάρθρωση, υφή, κτίσμα, οικοδομή
submarine = υποβρύχιο
substance = ύλη, ουσία, υπόσταση, περιουσία

suck = αναρροφώ
suction = αναρρόφηση
suitable = αρμόδιος, κατάλληλος, ταιριαστός
superintent = επιβλέπω, εποπτεύω, επιστατώ, διοικώ, διευθύνω
supervise = επιβλέπω, εποπτεύω, επιτηρώ
sypervisor = ο επιβλέπων, επόπτης
supply = προμηθεύω, παρέχω, εφοδιάζω, προμήθεια, εφοδιασμός, παροχή
surface = επιφάνεια, επιφανειακός
surface gauge = υψομετρικός χαράκτης
surface plate = πλάκα εφαρμογής
surrounding = ο περιβάλλων
suspension system = σύστημα ανάρτησης
swage = εκτονώνω τα άκρα σωλήνα
swaging tool = εκτονωτικό εργαλείο
swing = ταλαντεύω, αιωρούμαι
switch = διακόπτης
  solid state switch = ξηρός διακόπτης
swivel handle = σπαστή (στρεφόμενη) λαβή, σωληνωτό κλειδί με σπαστή λαβή
synchromesh gear box = κιβώτιο ταχυτήτων συγχρονισμένης εμπλοκής

T

T square = ταφ σχεδίασης
tailstock = κεντροφορέας, κουκουβάγια τόρνου
tank = δεξαμενή, ντεπόζιτο, δοχείο, ρεζερβουάρ
tanker = δεξαμενόπλοιο, βυτιοφόρο, αυτοκίνητο μεταφοράς καυσίμων
tap = κτυπώ με ελαφρά επαναλαμβανόμενα χτυπήματα, κοχλιοτομέας, κοχλιοτρύπανο, σπειροτόμος εσωτερικών σπειρωμάτων (κολαούζο), κρουνός, βρύση, κάνουλα
tape = ταινία
  armouring tape = προστατευτική ταινία
  flexible tape = εύκαμπτη μετροταινία
taper = μικραίνω, λεπταίνω, καταλήγω σε οξύ άκρο, κοπτήρας, κωνικός διαμορφωτήρας εκκέντρου
technician = τεχνολόγος, τεχνικός, εμπειρογνώμων
tee handle = λαβή σχήματος ταφ
telecommunications = τηλεπικοινωνίες
temperature = θερμοκρασία
  ambient temperature = θερμοκρασία περιβάλλοντος
tempering = βαφή χάλυβα, ανόπτηση, σκλήρυνση, επαναφορά
template = μήτρα, πρότυπο, μοντέλο, περίγραμμα, στένσιλ
temporary = προσωρινός
terminal = ακροδέκτης
theft = κλοπή
thermal growth = ανάπτυξη θερμότητας, διόγκωση λόγω ανόδου θερμοκρασίας
thermistor = θερμοδιακόπτης ασφαλείας
thermometer = θερμόμετρο
  dry-bulb thermometer = θερμόμετρο ξηρού βολβού (κοινό)
  wet-bulb thermometer = θερμόμετρο υγρού βολβού
thickness = πάχος, πυκνότητα
thoroughly = εξονυχιστικά, επιμελώς, εμπεριστατωμένα
thread = σπείρωμα, νήμα, βήμα κοχλία, κοχλιοτομώ, κάνω σπείρωμα
threat = απειλή
throttle (valve) = δικλείδα αερίων, πεταλούδα
throttling valve = εκτονωτική, ρυθμιστική βαλβίδα
tie = δένω, δέσιμο, δεσμός, γραβάτα
tighten = (συ)σφίγγω
timer = χρονοδιακόπτης, ρολόι

tin = κασσιτερώνω, γανώνω, κασσίτερος (Sn), καλάι, τενεκές
tin snips = μεταλλοψάλιδο
tip = μυστική/ιδιαίτερη/χρήσιμη πληροφορία, φιλοδώρημα
tolerance = επιτρεπόμενη ανοχή
    close tolerances = μικρό πεδίο ανοχών
toolchanger = μηχανισμός/εξάρτημα αυτόματης εναλλαγής εργαλείων στις CNC εργαλειομηχανές (π.χ. βραχίονας ή ρομπότ)
toolholder = συγκρατητής εργαλείου, εργαλειοδέτης
tool-storage magazine = εργαλειοφορείο, συσκευή ή μηχανισμός αποθήκευσης εργαλείων των CNC εργαλειομηχανών απ' όπου προσλαμβάνονται για την πρόδεσή τους στη μηχανή και επαναποθηκεύονται μετά τη χρήση τους με το σύστημα αυτόματης εναλλαγής εργαλείων
top = κορυφή, επάνω μέρος, καπάκι
torch = δαυλός, πυρσός, φακός, φλόγιστρο, φλόγα
torque = ροπή στρέψης, στρέψη, τάση (περι)στροφής, δύναμη περιστροφής, κινητήρια ροπή
torsion bar = αντιστρεπτική ράβδος
total = ολικός, ολόκληρο, σύνολο
toughness = σκληρότης, ανθεκτικότης
toxicity = τοξικότητα
tower = πύργος, συσκευή σχήματος πύργου για την αποθήκευση εργαλείων ή αντικειμένων για κατεργασία σε CNC εργαλειομηχανή, τουρέλα
trace = ίχνος, ιχνογραφώ
traditional = παραδοσιακός, συνηθισμένος
traffic = οδική κυκλοφορία
trailing arms = υστερούντες βραχίονες, ψαλίδια
train = γυμνάζω/-ομαι, εξασκώ/-ούμαι, εκπαιδεύω, σύρω, τρένο, ακολουθία, σειρά
trained = εξασκημένος, έμπειρος
transfer = μεταφέρω, μεταβιβάζω, μεταθέτω, μετάθεση, μεταφορά, μεταβίβαση
    heat transfer = αγωγιμότητα, μετάδοση θερμότητας
transfer arm = βραχίωνας αλλαγής εργαλείων σε CNC εργαλειομηχανή
transformer = μετασχηματιστής, μετατροπέας
    step-up transformer = μετασχηματιστής ανόδου τάσης
transmission = αγωγιμότητα, μετάδοση (θερμότητας, κίνησης)
transport(ation) = μεταφέρω, μετακομίζω, μεταφορά (επιβατών, αγαθών) συγκοινωνία
transporter = μεταγωγικό αεροπλάνο, μεγάλο/βαρύ φορτηγό αυτοκίνητο
treat = (μετα)χειρίζομαι, κατεργάζομαι, θεραπεύω
treatment = μεταχείρηση, θεραπεία, κατεργασία
    heat treatment (of metals) = θερμική κατεργασία (μετάλλων)
truck = φορτηγό αυτοκίνητο, καμιόνι
try square = ορθογωνιόμετρο, ελεγκτική γωνία
tube = σωλήνας, αγωγός
tube bender = εργαλείο κάμψης σωλήνων, κουρμπαδόρος
turbine =στρόβιλος
    gas turbine = αεριοστρόβιλος
    steam turbine = ατμοστρόβιλος
turbocharger = υπερσυμπιεστής, υπερ-τροφοδότης
turning = στρέφω, γυρίζω, τορνεύω, στροφή, γύρος, βόλτα, αλλαγή
turning (-and-chucking) center = τόρνος ψηφιακού ελέγχου (CNC) πολλαπλών κατεργασιών για αντικείμενα εκ περιστροφής
turret = πυργίσκος, τουρέλα, περιστρεφόμενο κυκλικού σχήματος εργαλειοφορείο μηχανών ψηφιακού ελέγχου, ρεβόλβερ, μύλος

U

ultrasonic = υπερηχητικός
unattended factory = πλήρως αυτοματοποιημένο εργοστάσιο
unfavourable = αντίξοος, όχι ευνοϊκός
uniform = ενιαίος, ομοιόμορφος, στολή
unit = μονάδα, συγκρότημα, ενότητα
universal joint = αρθρωτός/σπαστός σύνδεσμος
unladen = ξεφόρτωτος, απαλλαγμένος από φορτίο
unleaded gasoline = αμόλυβδη βενζίνη
unload = ξεφορτώνω, απομακρύνω/αποσύρω κατεργασμένο αντικείμενο από εργαλειομηχανή
unless = εκτός αν, παρά μόνο αν, αν δεν
unscrew = ξεβιδώνω
up-side-down = αντεστραμένος, με το πάνω μέρος προς τα κάτω, τα πάνω-κάτω
update = εκσυγχρονίζω

V

vacuum = το κενό
vacuum tube = λυχνία κενού
value = τιμή, αξία, αντίτιμο, εκτιμώ
valve = επιστόμιο, βαλβίδα, δικλείδα
- **discharge valve** = βαλβίδα εκκένωσης, εκτόνωσης, εκροής
- **exhaust valve** = βαλβίδα εξαγωγής αερίων
- **expansion/throttling valve** = εκτονωτική/ρυθμιστική βαλβίδα
- **reversing valve** = βαλβίδα αναστροφής
- **solenoid valve** = σωληνοειδής βαλβίδα
- **suction valve** = βαλβίδα αναρρόφησης
- **thermostatic valve** = θερμοστατική βαλβίδα

van = κλειστό φορτηγό, φορτηγάκι
vaporize = ατμοποιώ, εξατμίζω, εξαερώνω
vapo(u)r = υδρατμός, ατμός
variable = μεταβλητός, ευμετάβλητος
variable jet/choke carburettor = καρμπυρατέρ με έμβολο που δημιουργεί μεταβλητό λαιμό στο σημείο βεντούρι
variation = παρέκκλιση, απόκλιση, μεταβολή, παραλλαγή
vee block = κομμάτι/συγκρότημα/πλάκα εφαρμογής σχήματος V, βάση αξόνων σχήματος V
vehicle = όχημα
velocity = ταχύτητα
velometer / anemometer = ανεμόμετρο, ταχύμετρο
ventilation = (εξ)αερισμός
ventilator = εξαεριστήρας, ανεμιστήρας
versatile = εύστροφος, ευπροσάρμοστος, ευέλικτος, με πολλές ιδιότητες/χρήσεις
vertex = ζενίθ, κορυφή, κατακόρυφο σημείο
vertical = κατακόρυφος, ορθοστάτης, κάθετος
vibration = κραδασμός, ταλάντωση, δόνηση
vibration free = αντικραδασμικός
vice =σφιγκτήρας εφαρμοστού, μέγγενη
view = βλέπω, θεωρώ, άποψη, θεωρία, θέα
vital = ζωτικός
voltage = διαφορά δυναμικού, τάση ηλεκτρικού ρεύματος, βολτάζ
volume = όγκος, τόμος

W

warn = προειδοποιώ
warplane = πολεμικό αεροπλάνο
warship = πολεμικό πλοίο
washer = ροδέλα, παράκυκλος, παρέμβασμα
waste = σπαταλώ, καταναλώνω άσκοπα, σπατάλη, απόβλητος, άχρηστος
water heater = θερμαντήρας νερού, θερμοσίφωνας
weak = αδύναμος, ασθενικός
wear = φορώ, φθείρω, φθορά
weigh = ζυγίζω
weight = βάρος
weld = συγκολλώ μέταλλα
welding = σκληρή συγκόλληση
welfare = ευημερία, καλοπέραση, κοινωνική πρόνοια
well paid = καλοπληρωμένος
wet = υγρός
wheel = τροχός
wick = φυτίλι
widespread = διαδεδομένος
wide = ευρύς, πλατύς, φαρδύς
width = πλάτος
windscreen = ανεμοθώρακας αυτοκινήτου (=μπρος/πίσω τζάμι), παρ μπριζ
windscreen wipers = υαλοκαθαριστήρες
wipe = σκουπίζω, σφουγγίζω
wire = σύρμα, χορδή
wireless = ασύρματος
wiring = καλωδίωση, σύνολο καλωδίων εγκατάστασης/συσκευής
workholding device = συσκευή συγκράτησης/πρόσδεσης των προς κατεργασία αντικειμένων στην τράπεζα εργαλειομηχανής ή σε παλλέτα
workpiece = κομμάτι για κατεργασία
workshop = εργαστήριο (τεχνίτη)
worn = τριμμένος, αμβλυμένος, φθαρμένος
wrap = τυλίγω
wrench = μοχλός περιστροφής για (ξε)βίδωμα μπουλονιών και παξιμαδιών, κλειδί

- **adjustable wrench** = γαλλικό κλειδί, κλειδί με ρυθμιζόμενο άνοιγμα σιαγώνων, γαντζοτανάλια
- **combination wrench** = σύνθετο κλειδί (συνδυασμός γερμανικού και Αμερικάνικου)
- **impact wrench** = επαναφορτιζόμενο εργαλείο βιδώματος (κατσαβίδι, καρυδάκι)
- **open-end(ed) wrench** = κλειδί σταθερού ανοίγματος, γερμανικό κλειδί
- **pipe-adjustable / monkey wrench** = ρυθμιζόμενο κλειδί σωληνώσεων, παπαγάλος, σωληνοκάβουρας
- **ratchet wrench** = κλειδί με καστάνια
- **ring wrench** = πολυγωνικό (κλειστό) κλειδί, Αμερικάνικο

Z

zero = μηδέν
zinc = ψευδάργυρος, τσίγκος (Zn)

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