The scientific investigation

Duration: 10 hours **Weighting: 20%**

The IA requirement is the same for biology, chemistry and physics. The IA, worth 20% of the final assessment, consists of one task—the scientific investigation.

The scientific investigation is an open-ended task in which the student gathers and analyses data in order to answer their own formulated research question.

The outcome of the scientific investigation will be assessed through the form of a written report. The maximum overall word count for the report is 3,000 words.

The following are not included in the word count.

- Charts and diagrams
- Data tables
- Equations, formulas and calculations
- Citations/references (whether parenthetical, numbered, footnotes or endnotes)
- Bibliography
- Headers

The following details should be stated at the start of the report.

- Title of the investigation
- Candidate's personal code (alphanumeric, for example, xyz123)
- All group members' personal codes (if applicable)
- Number of words

There is no requirement to include a cover page or a contents page.

Facilitating the scientific investigation

The research question should be of interest to the student, but it is not necessary that it encompasses concepts beyond those described by the understandings within the guide.

The scientific investigation undertaken must have sufficient extent and depth to allow for all the descriptors of the assessment criteria to be meaningfully addressed.

The investigation of the research question must involve the collection and analysis of quantitative data that should be supported by qualitative observations where appropriate.

The scientific investigation allows a wide range of techniques for data gathering and analysis to be employed. The approaches that could be used in isolation or in conjunction with each other are as follows.

- Hands-on practical laboratory work
- Fieldwork
- Use of a spreadsheet for analysis and modelling
- Extraction and analysis of data from a database
- Use of a simulation

Developing the research question

Each student is expected to formulate, investigate and answer a unique research question, seeking advice from their teacher.

A student must not present the same set of raw data as another student.

Methodology for individual work

Each student develops their own methodology to answer their individual research question. The student investigates by:

manipulating an independent variable
or
selecting variables during fieldwork
or
selecting different data from external databases.

The student might seek support from peers when collecting data.

Assessing the scientific investigation

The performance in IA is marked against common assessment criteria, with a total mark out of 24. Student work is internally assessed by the teacher and externally moderated by the IB.

The four assessment criteria are as follows.

- Research design
- Data analysis
- Conclusion
- Evaluation

Each assessment criterion has level descriptors describing specific achievement levels, together with an appropriate range of marks. The level descriptors concentrate on positive achievement.

Only whole numbers must be recorded; partial marks (fractions and decimals) are not acceptable.

The criteria should be considered independently. A student who attains a high achievement level in relation to one criterion will not necessarily attain high achievement levels in relation to the other criteria. Similarly, a student who attains a low achievement level for one criterion will not necessarily attain low achievement levels for the other criteria.

Internal assessment criteria

There are four IA criteria for the scientific investigation. The marks and weightings are as follows

Criterion	Maximum number of marks available	Weighting (%)
Research design	6	25
Data analysis	6	25
Conclusion	6	25
Evaluation	6	25
Total	**24**	**100**

Research design

This criterion assesses the extent to which the student effectively communicates the methodology (purpose and practice) used to address the research question.

Marks	Level descriptor
0	The report does not reach the standard described by the descriptors below.
1–2	● The research question is stated without context. ● Methodological considerations associated with collecting data relevant to the research question are stated. ● The description of the methodology for collecting or selecting data lacks the detail to allow for the investigation to be reproduced.
3–4	● The research question is outlined within a broad context. ● Methodological considerations associated with collecting relevant and sufficient data to answer the research question are described. ● The description of the methodology for collecting or selecting data allows for the investigation to be reproduced with few ambiguities or omissions.
5–6	The research question is described within a specific and appropriate context. Methodological considerations associated with collecting relevant and sufficient data to answer the research question are explained. The description of the methodology for collecting or selecting data allows for the investigation to be reproduced.

Clarifications for research design
A research question with context should contain reference to the dependent and independent variables or two correlated variables, include a concise description of the system in which the research question is embedded, and include background theory of direct relevance. Methodological considerations include: ● the selection of the methods for measuring the dependent and independent variables ● the selection of the databases or model and the sampling of data ● the decisions regarding the scope, quantity and quality of measurements (e.g. the range, interval or frequency of the independent variable, repetition and precision of measurements) ● the identification of control variables and the choice of method of their control ● the recognition of any safety, ethical or environmental issues that needed to be taken into account. The description of the methodology refers to presenting sufficiently detailed information (such as specific materials used and precise procedural steps) while avoiding unnecessary or repetitive information, so that the reader may readily understand how the methodology was implemented and could in principle repeat the investigation.

Data analysis

This criterion assesses the extent to which the student's report provides evidence that the student has recorded, processed and presented the data in ways that are relevant to the research question

Marks	Level descriptor
0	The report does not reach a standard described by the descriptors below.
1–2	The recording and processing of the data is communicated but is neither clear nor precise. The recording and processing of data shows limited evidence of the consideration of uncertainties. Some processing of data relevant to addressing the research question is carried out but with major omissions, inaccuracies or inconsistencies.
3–4	The communication of the recording and processing of the data is either clear or precise. The recording and processing of data shows evidence of a consideration of uncertainties but with some significant omissions or inaccuracies. The processing of data relevant to addressing the research question is carried out but with some significant omissions, inaccuracies or inconsistencies.

5–6	The communication of the recording and processing of the data is both clear and precise. The recording and processing of data shows evidence of an appropriate consideration of uncertainties. The processing of data relevant to addressing the research question is carried out appropriately and accurately.

.

Clarifications for data analysis
Data refers to quantitative data or a combination of both quantitative and qualitative data. **Communication** ● Clear communication means that the method of processing can be understood easily. ● Precise communication refers to following conventions correctly, such as those relating to the annotation of graphs and tables or the use of units, decimal places and significant figures. Consideration of uncertainties is subject specific and further guidance is given in the *Chemistry teacher support material*. Major omissions, inaccuracies or inconsistencies impede the possibility of drawing a valid conclusion that addresses the research question. Significant omissions, inaccuracies or inconsistencies allow the possibility of drawing a conclusion that addresses the research question but with some limit to its validity or detail.

Conclusion

This criterion assesses the extent to which the student successfully answers their research question with regard to their analysis and the accepted scientific context.

Marks	Level descriptor
0	The report does not reach a standard described by the descriptors below.
1–2	A conclusion is stated that is relevant to the research question but is not supported by the analysis presented. The conclusion makes superficial comparison to the accepted scientific context.
3–4	A conclusion is described that is relevant to the research question but is not fully consistent with the analysis presented. A conclusion is described that makes some relevant comparison to the accepted scientific context.
5–6	A conclusion is justified that is relevant to the research question and fully consistent with the analysis presented. A conclusion is justified through relevant comparison to the accepted scientific context.

Clarifications for conclusion
A conclusion that is fully consistent requires the interpretation of processed data including associated uncertainties. Scientific context refers to information that could come from published material (paper or online), published values, course notes, textbooks or other outside sources. The citation of published materials must be sufficiently detailed to allow these sources to be traceable.

Evaluation

This criterion assesses the extent to which the student's report provides evidence of evaluation of the investigation methodology and has suggested improvements.

Marks	Level descriptor
0	The report does not reach a standard described by the descriptors below.
1–2	The report states generic methodological weaknesses or limitations. Realistic improvements to the investigation are stated.
3–4	The report describes specific methodological weaknesses or limitations. Realistic improvements to the investigation that are relevant to the identified weaknesses or limitations, are described.
5–6	The report explains the relative impact of specific methodological weaknesses or limitations. Realistic improvements to the investigation, that are relevant to the identified weaknesses or limitations, are explained.

Clarifications for evaluation
Generic is general to many methodologies and not specifically relevant to the methodology of the investigation being evaluated. Methodological refers to the overall approach to the investigation of the research question as well as procedural steps. Weaknesses could relate to issues regarding the control of variables, the precision of measurement or the variation in the data. Limitations could refer to how the conclusion is limited in scope by the range of the data collected, the confines of the system or the applicability of assumptions made.