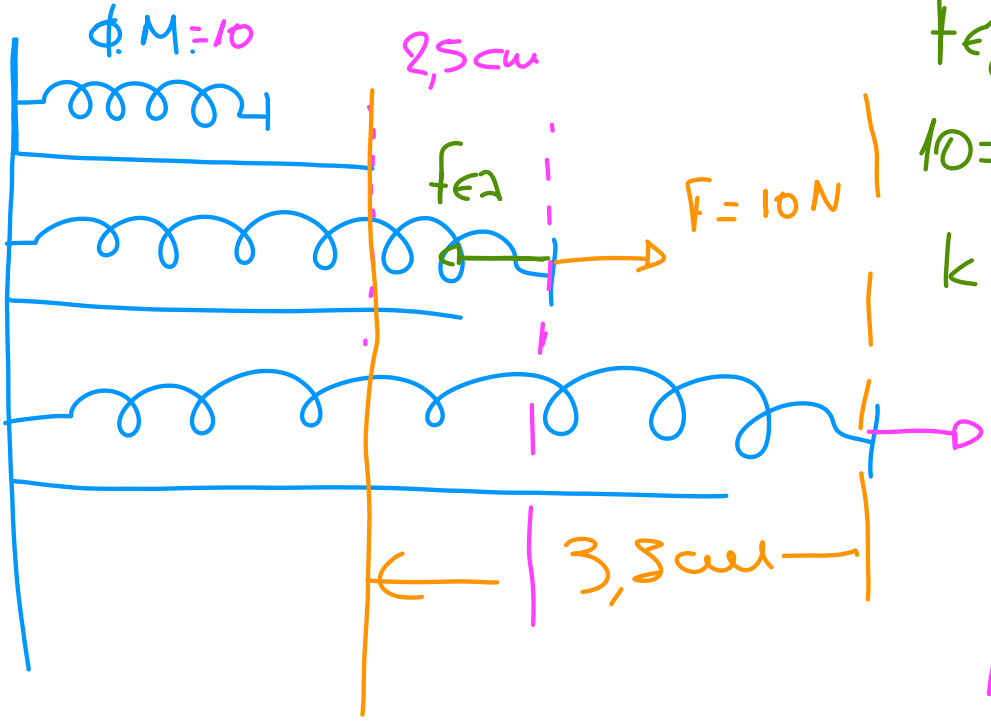
2.9



$F_{ελ}=10N$

$f_{ελ}=kX$

$10=k\cdot 0,025$

$k=400\ N/m$

f'

$f'=k\cdot x'$

$f'=400\cdot 0,035$

$f'=14\ N$

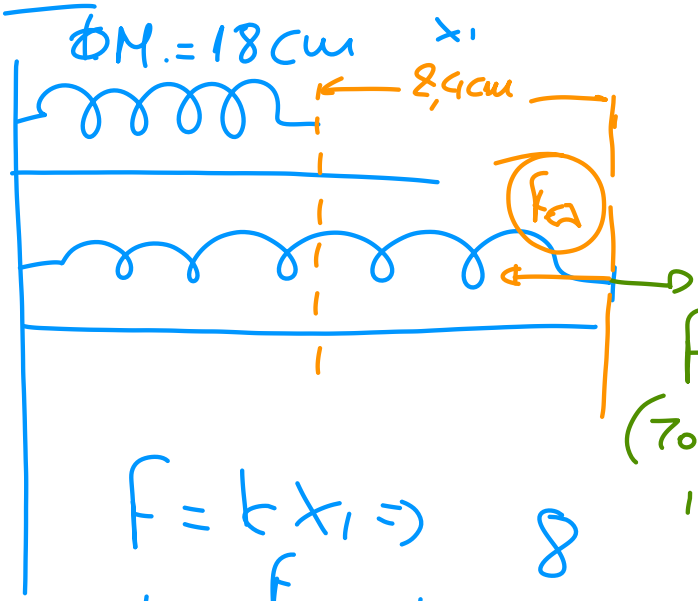
2.10

$F=kx \Rightarrow$

$F=100\cdot 0,05$

$F=5\ N$

2.11



$F=f_{ελ}$

(το ελατήριο ισορροπεί)

$F=kx_1 \Rightarrow$

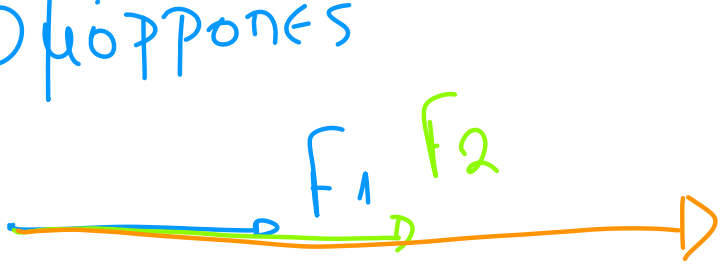
$k=\frac{F}{x_1} \Rightarrow k=\frac{8}{2,4\cdot 10^{-2}}=\frac{100}{3}\ N/m$

$F=k\cdot x_2 \Rightarrow$

$F=\frac{100}{3}\cdot 7=\frac{700}{3}\ N$

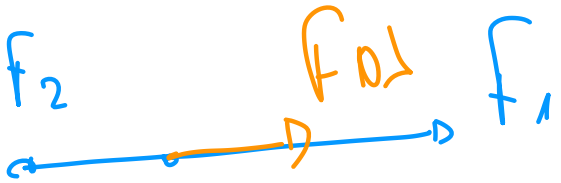
Σύνθεση Δυνάμεων

i) Ομόρροπες



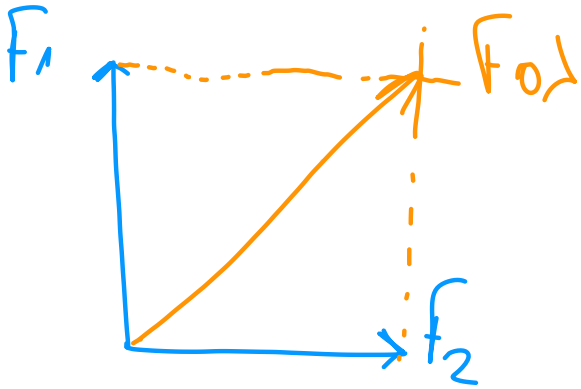
$$F_{ολ} = F_1 + F_2$$

ii) Αντίρροπες



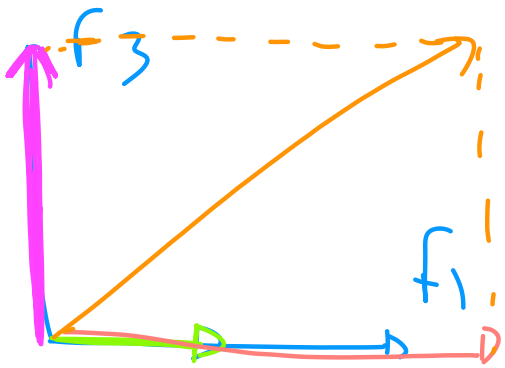
$$\Sigma F = F_1 - F_2$$

iii) Κάθετες



$$F_{ολ} = \sqrt{F_1^2 + F_2^2}$$

ΕΦΑΡΜΟΓΗ



$F_3 = 5N$

$F_{0\lambda} \quad F_1 = 2N$

$F_2 = 7N$

$F_{0\lambda(x)} = F_1 + F_2$

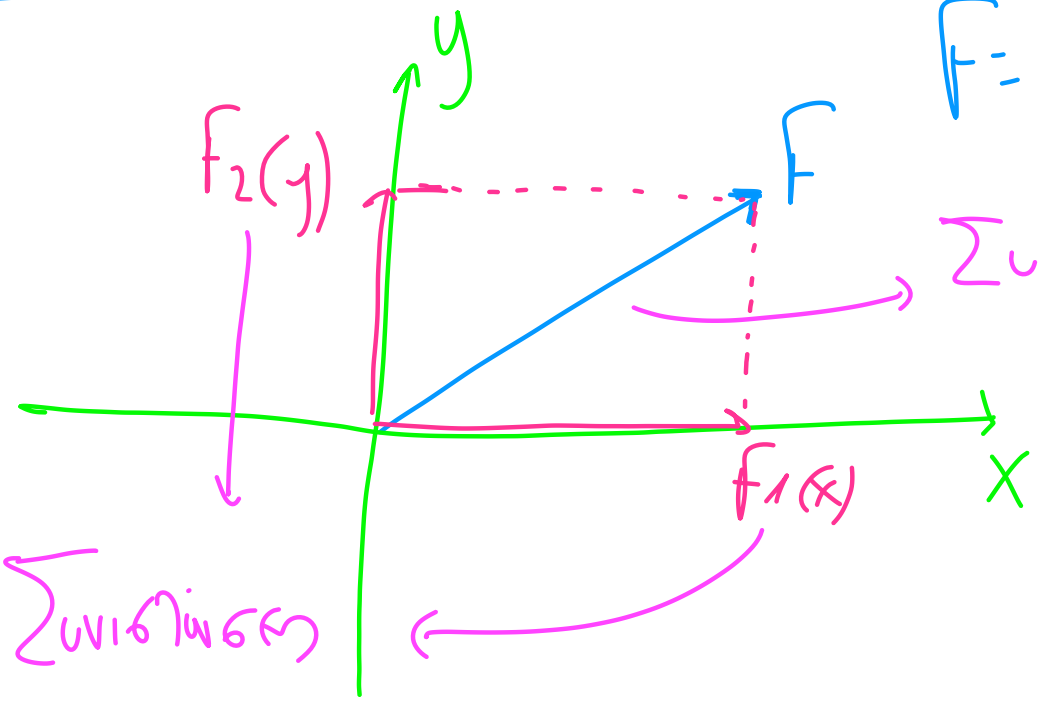
$F_{0\lambda(x)} = 2 + 7 = 9N$

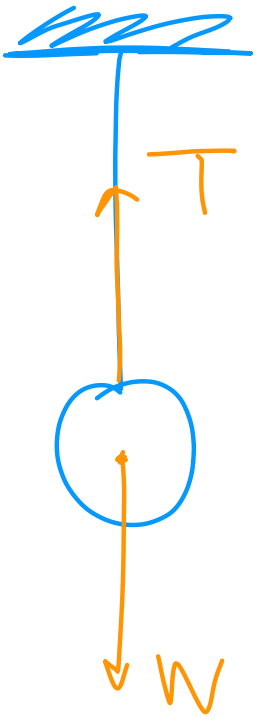
$F_{0\lambda} = \sqrt{F_{0\lambda(x)}^2 + F_3^2} =$

$F_{0\lambda} = \sqrt{9^2 + 5^2} = \sqrt{81+25} = \sqrt{106}\ N$

ΣΥΝΙΣΤΩΣΕΣ ΔΥΝΑΜΕΩΝ

$F = \sqrt{F_1(x)^2 + F_2(y)^2}$

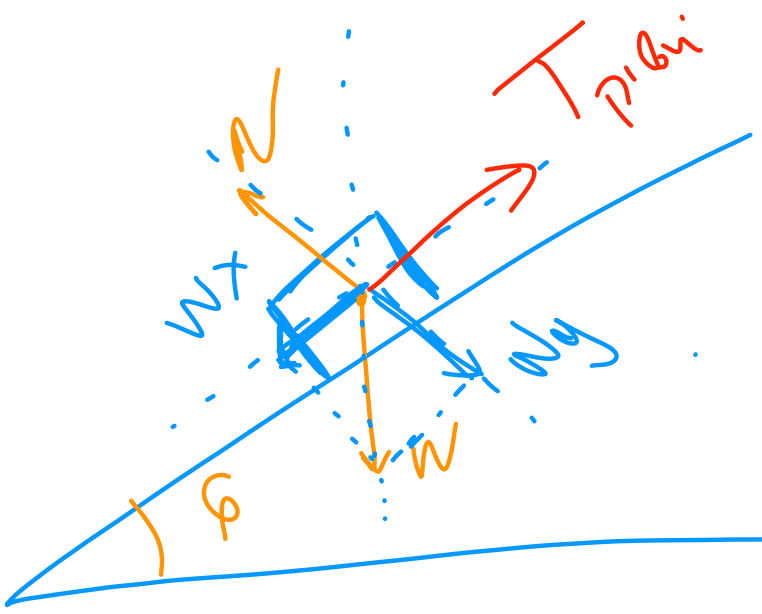




$\Sigma F = 0$

$W - T = 0 \Rightarrow$

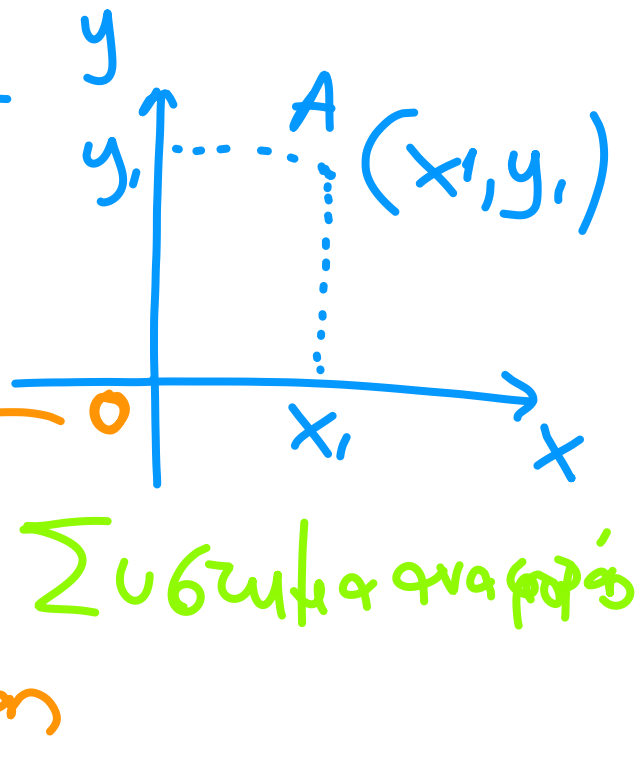
$W = T$



$W_y = N$

ΚΙΝΗΣΗ

Θέση →



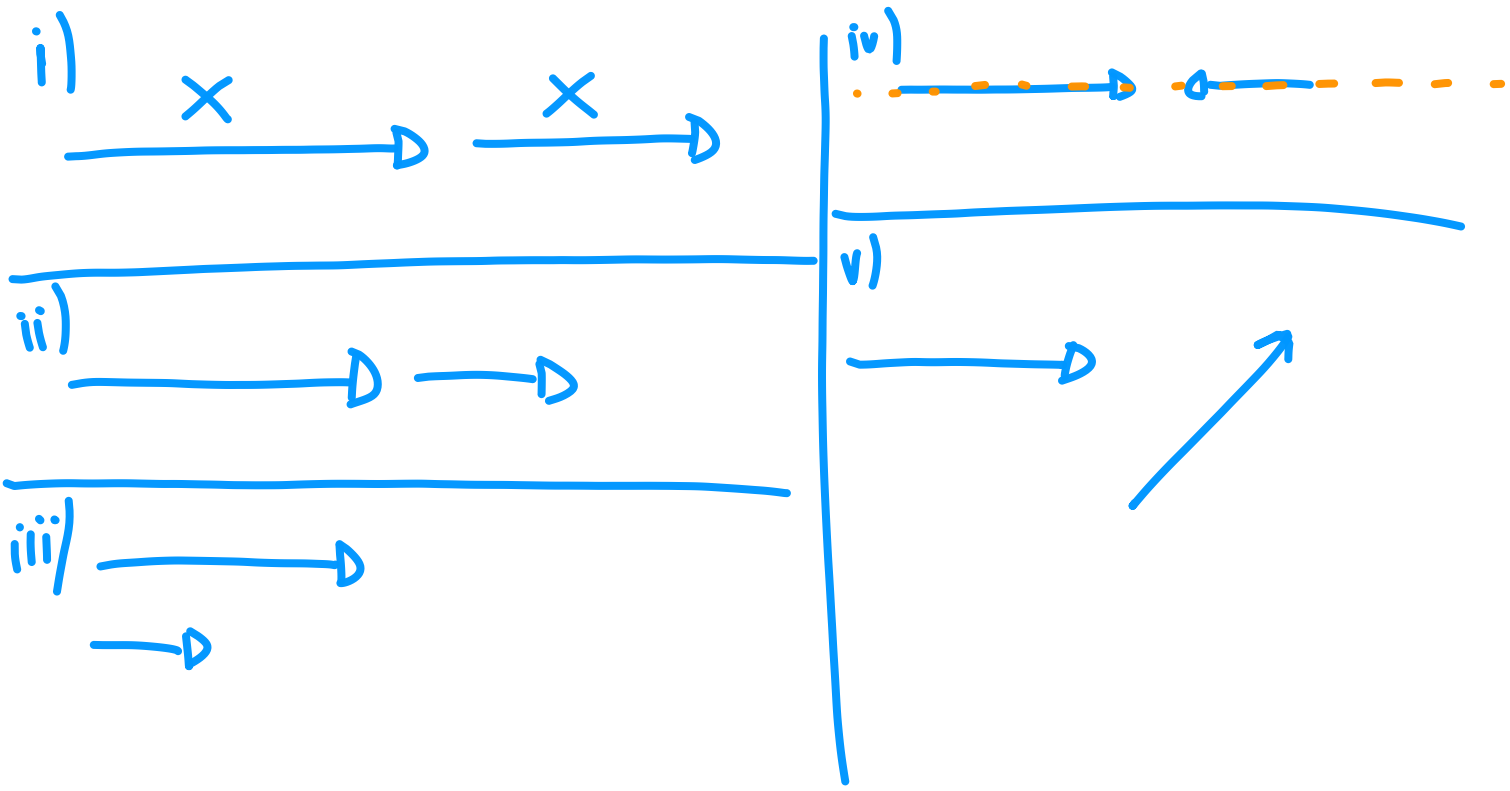
ΜΟΝΟΜΕΤΡΑ - ΔΙΑΝΥΣΜΑΤΙΚΑ ΜΕΓΕΘΗ

Μονόμετρα: χρόνος, μάζα

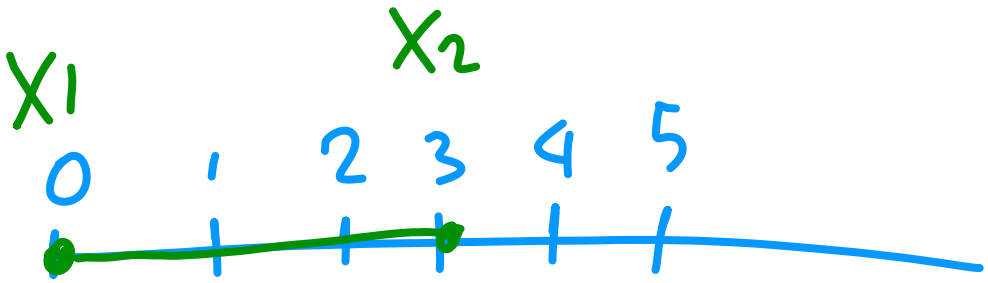
Διανυσματικά: ταχύτητα, επιτάχυνση

Κατεύθυνση → διεύθυνση

→ φορά



ΜΕΤΑΤΟΠΙΣΗ



$$\Delta x = x_2 - x_1$$

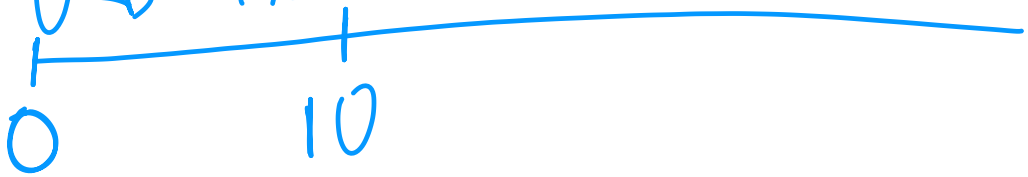
Μετατόπιση

ΕΥΘΥΓΡΑΜΜΗ ΟΜΑΛΗ ΚΙΝΗΣΗ

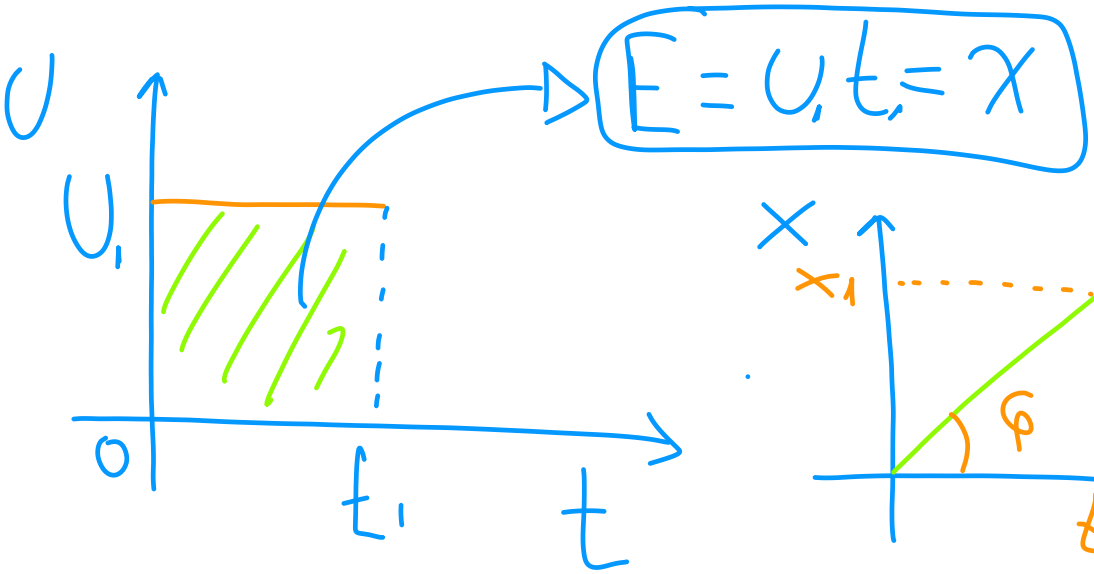
$x = U \cdot t \quad (x_0 = 0)$ | $x = x_0 + Ut$ $(x_0 \neq 0)$

$U = \frac{x}{t}$

$x \to m$, $U \to m/s$



ΕΞΙΣΩΣΗ ΚΙΝΗΣΗΣ



$E = U_1 t_1 = x$

$\varepsilon\varphi\varphi = \frac{x_1}{t_1} = U$

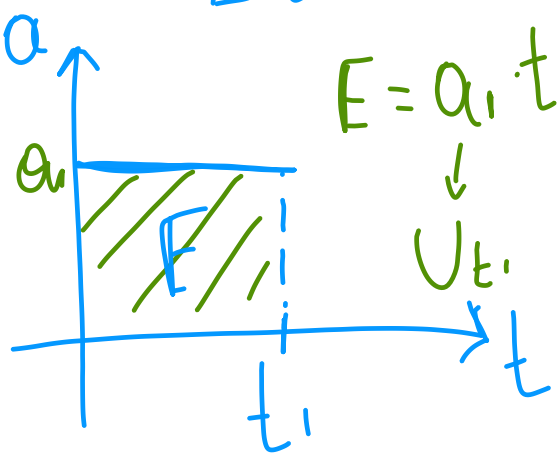
ΜΕΣΗ ΤΑΧΥΤΗΤΑ

$U = \frac{x_{ολ}}{t_{ολ}}$

Ευθύγραμμη Ομαλά Επιταχυνόμενη Κίνηση

Επιτάχυνση → $a\ (m/s^2)$

$a = \frac{\Delta U}{\Delta t}$ (Ρυθμός Μεταβολής της Ταχύτητας)

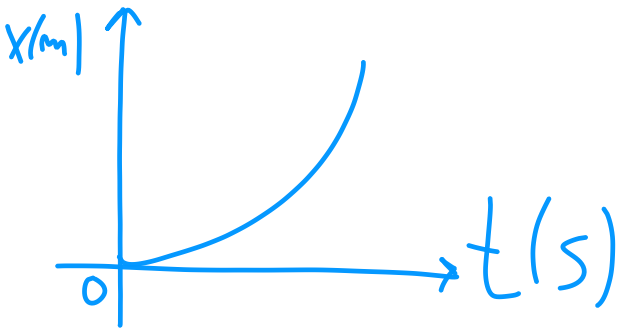


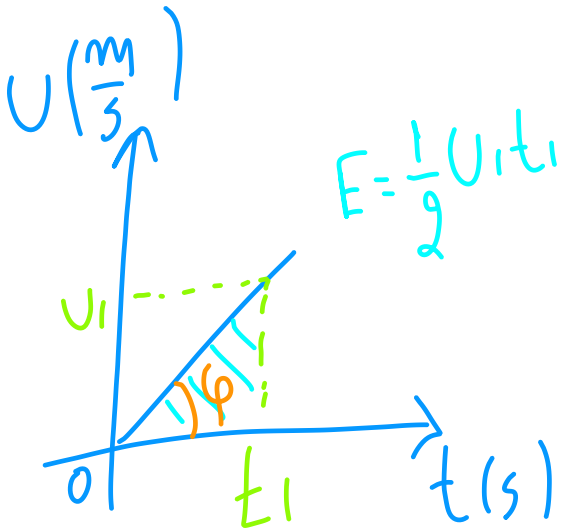
$U_0 = 0$ (αρχική ταχύτητα)

$U = a \cdot t$

Μετατόπιση (x)

$x = \frac{1}{2} a t^2$





$E = \frac{1}{2} U_1 t_1 \Rightarrow E = \frac{1}{2} a_1 \cdot t_1 \cdot t_1$

$E = \frac{1}{2} a_1 \cdot t_1^2 = x$

$\varepsilon\varphi\varphi = \frac{U_1 - 0}{t_1 - 0} = a$

$v_0 \neq 0$

$v = v_0 + at$

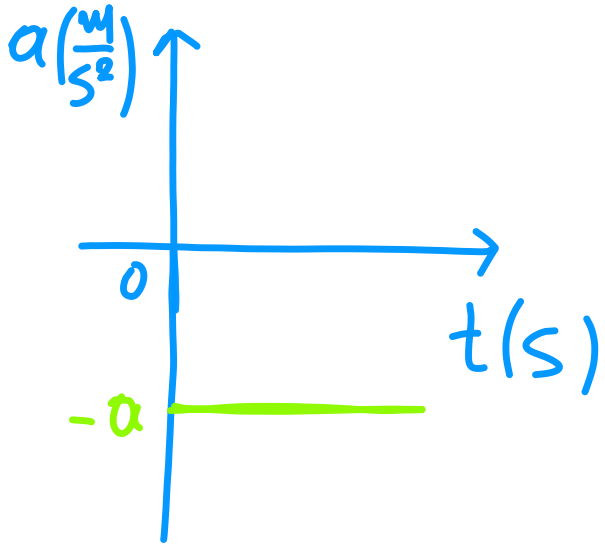
$tg\varphi = a$

$E = X \Rightarrow E =$

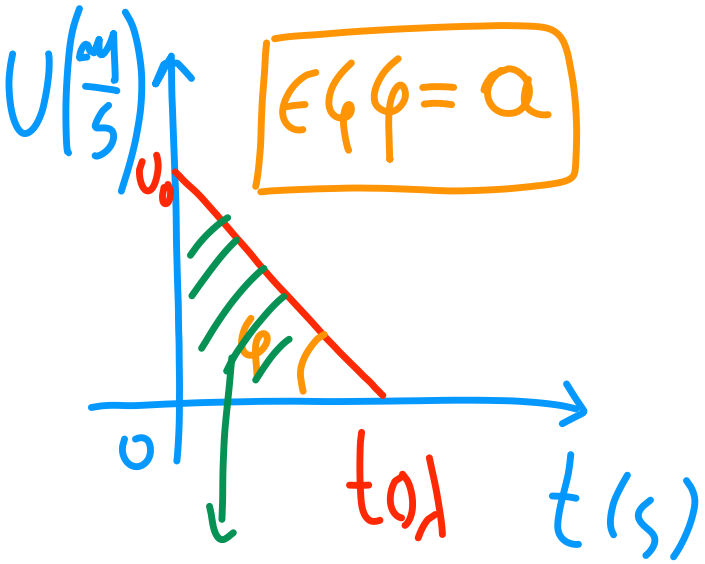
$$E = \frac{(v_0 + v_1) \cdot t_1}{2}$$

ΟΜΑΛΑ ΕΠΙΒΡΑΔΥΝΟΜΕΝΗ ΚΙΝΗΣΗ

$$a = \frac{\Delta U}{\Delta t} < 0$$

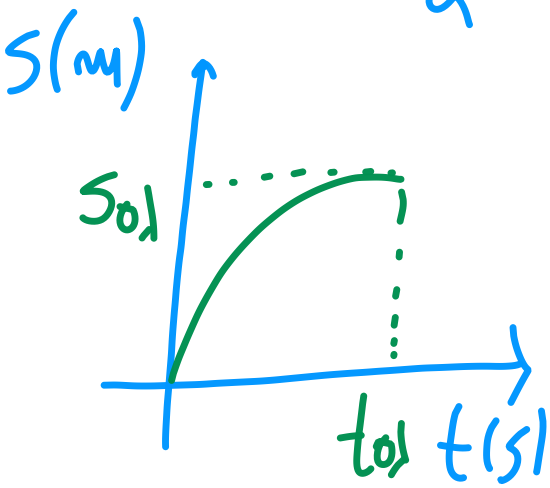


$$U = U_0 - at$$



$$\varepsilon\varphi = a$$

$$S = U_0 t - \frac{1}{2} a t^2$$



$$\varepsilon = S_{0\lambda}$$

$$S_{0\lambda} = \frac{U_0^2}{2a}$$

$$t_{0\lambda} = \frac{U_0}{a}$$

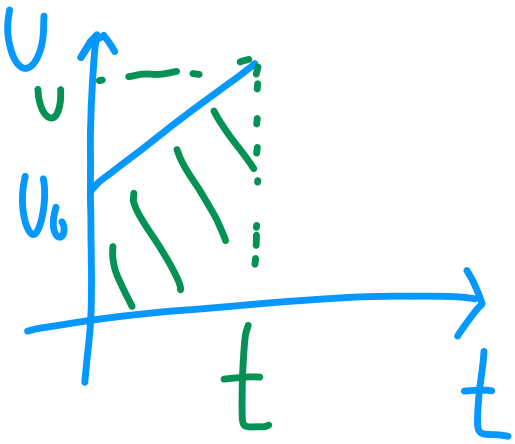
4.4 Διαλέξτε δύο από τους παρακάτω τύπους και αποδείξτε τους:

α) $\upsilon=\upsilon_0+\alpha t$

β) $s=\upsilon_0 t+\frac{1}{2}\alpha t^2$

γ) $\upsilon=\sqrt{\upsilon_0^2+2\alpha s}$

δ) $s_{O\lambda}=\frac{\upsilon_0^2}{2|\alpha|}$



$$E=\frac{(\upsilon_0+\upsilon)\cdot t}{2}\Rightarrow$$

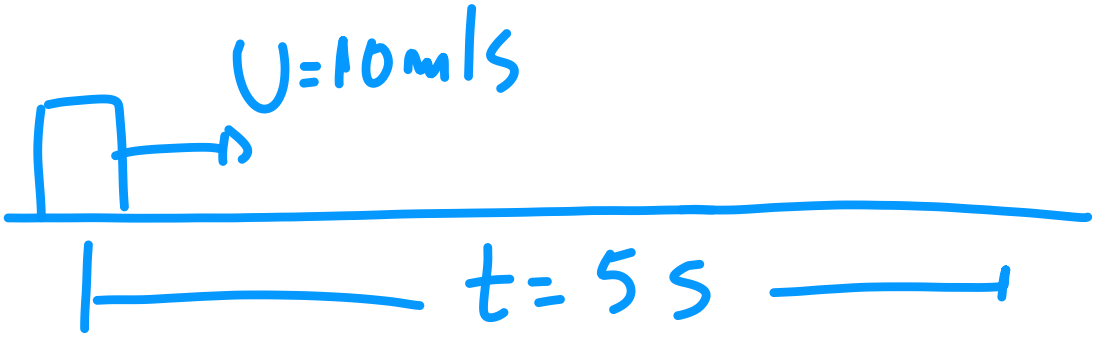
$$E=\frac{\upsilon_0 t}{2}+\frac{\upsilon\cdot t}{2}\Rightarrow$$

$$E=\frac{\upsilon_0 t}{2}+\frac{(\upsilon_0-\alpha t)\cdot t}{2}$$

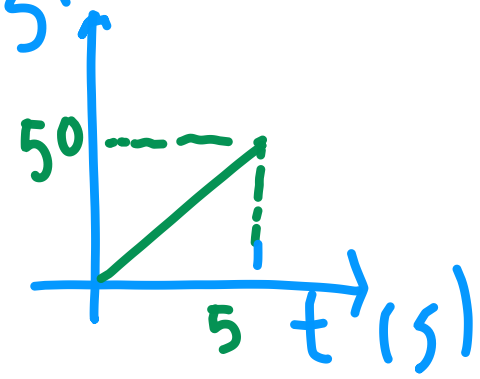
$$E=\frac{\upsilon_0 t}{2}+\frac{\upsilon_0 t}{2}-\frac{1}{2}\alpha t^2$$

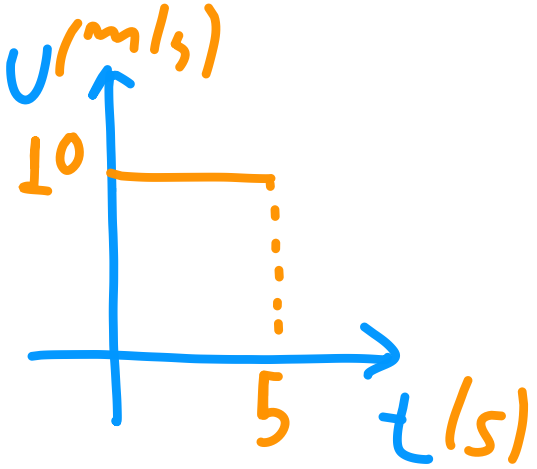
$$E=\upsilon_0 t-\frac{1}{2}\alpha t^2=S$$

Επαναληψη



$S = \upsilon \cdot t \Rightarrow S = 10 \cdot 5 = 50m$





4.11 Όχημα κινούμενο ευθύγραμμα με ταχύτητα υ=10 m/s αρχίζει να επιταχύνεται με σταθερή επιτάχυνση α, και, αφού διανύσει διάστημα s=50m, η ταχύτητά του διπλασιάζεται. Ζητούνται τα εξής:

α) η επιτάχυνση του κινητού

β) τα διαγράμματα (υ-t), (s-t), (α-t).

$\upsilon = \upsilon_0 + at \Rightarrow$

$20 = 10 + at \Rightarrow$

$10 = at$

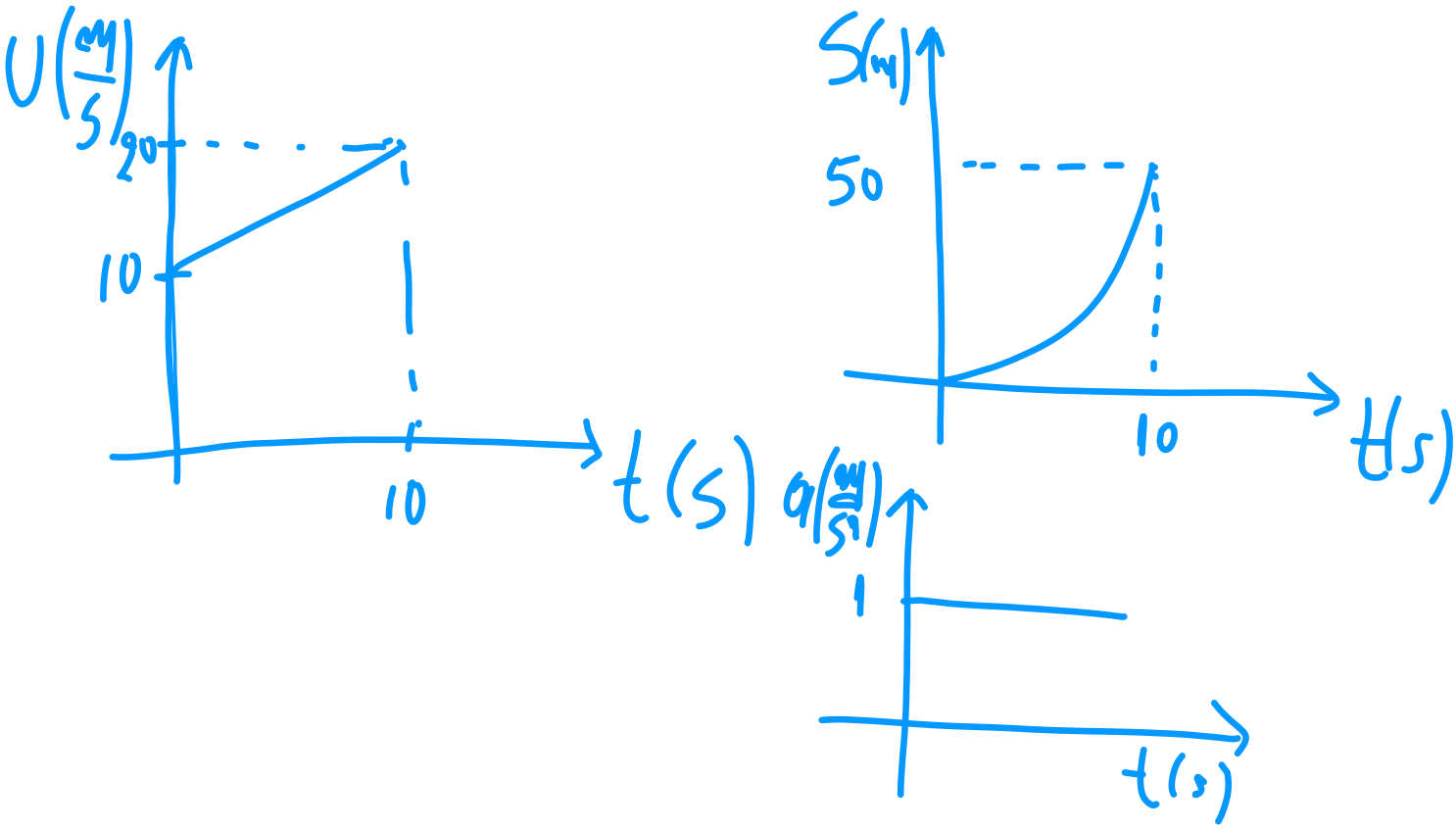
$a = \frac{\Delta \upsilon}{\Delta t} \Rightarrow$

$S = \frac{1}{2} a t^2 \Rightarrow$

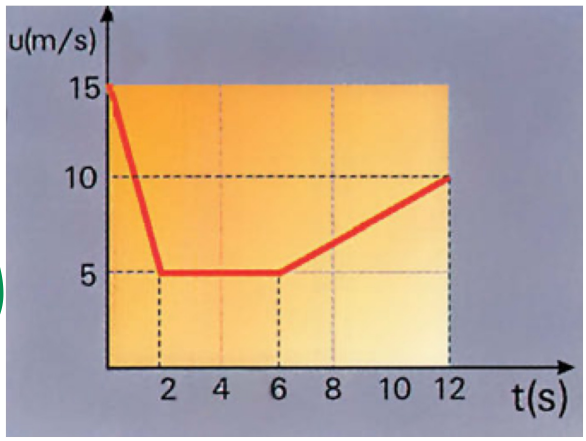
$S = \frac{1}{2} at \cdot t$

$50 = \frac{1}{2} 10 \cdot t \Rightarrow t = 10s$

$a = \frac{20 \cdot 10}{10} = 1 m/s^2$



4.15 Από το παρακάτω διάγραμμα ταχύτητας-χρόνου μιας ευθύγραμμης κίνησης να γίνουν τα διαγράμματα α) διαστήματος- χρόνου (s-t) και β) επιτάχυνσης- χρόνου (α-t).



$S_2 = U_2 \cdot t_2$

$S_2 = 5 \cdot 4 = 20\,m$

$S_3 = U_2 t + \frac{1}{2} a_2 t_3^2$

$S_3 = 5 \cdot 6 + \frac{1}{2} \cdot 5 \cdot 6^2$

$S_3 = 45\,m$

$a_2 = \frac{\Delta U}{\Delta t} = 1$

$a_2 = \frac{10-5}{6} = \frac{5}{6}\ m/s^2$

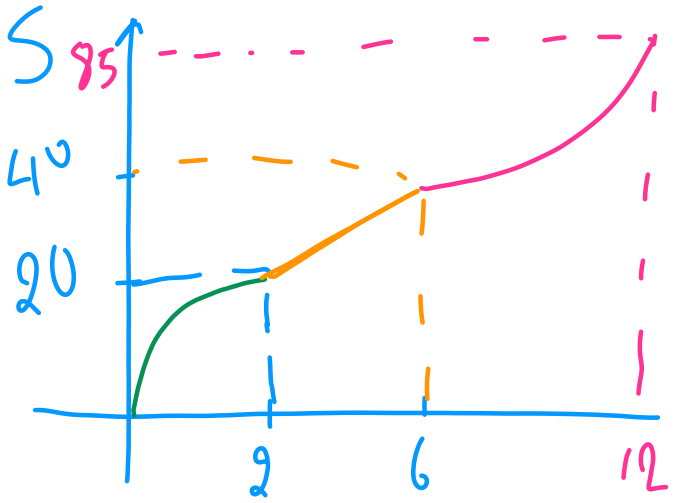
$a_1 = \frac{\Delta U}{\Delta t} \Rightarrow$

$a_1 = \frac{5-15}{2} = \frac{-10}{2} = -5\,\frac{m}{s^2}$

$S_1 = U_1 t - \frac{1}{2} a_1 t^2 \Rightarrow$

$S_1 = 15 \cdot 2 - \frac{1}{2} \cdot 5 \cdot 2^2$

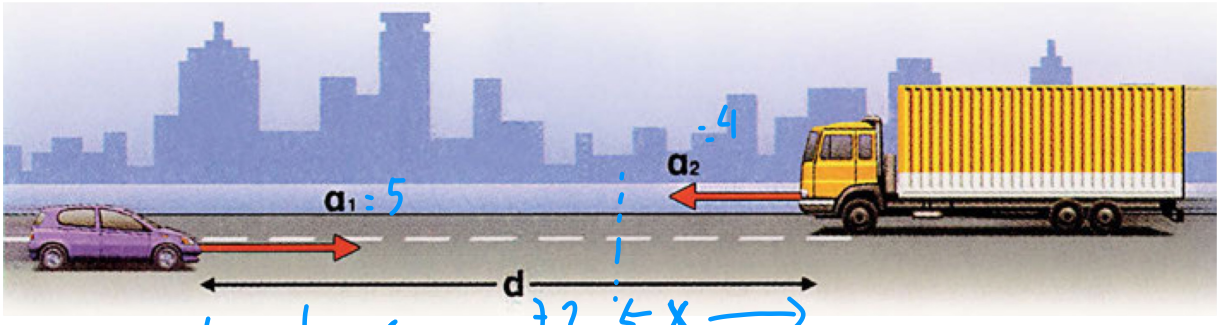
$S_1 = 20\,m$



4.16 Δυο οχήματα αρχίζουν να κινούνται ταυτόχρονα πάνω στην ίδια ευθεία με επιταχύνσεις που έχουν μέτρα $\alpha_1=5m/s^2$ και $\alpha_2=4m/s^2$ αντίστοιχα. Αν αρχικά η απόστασή τους ήταν d=72m και η κίνησή τους είναι αντίρροπη,

α) να βρεθεί πού και πότε θα συναντηθούν τα οχήματα

β) να γίνουν τα διαγράμματα (υ-t), (s-t) και (α-t).



$d-x$ — 72 — x

$$\left.\begin{aligned} d-x &= \frac{1}{2}a_1t^2 \\ x &= \frac{1}{2}a_2t^2 \end{aligned}\right\} \quad \frac{d-x}{x}=\frac{a_1}{a_2} \Rightarrow \frac{72-x}{x}=\frac{5}{4} \Rightarrow$$

$$5x = 4(72-x)$$

$$5x+4x = 288$$

$$9x = 288$$

$$x = 31m$$

2) $a = 5\,m/s^2$

$t = 10\,s$

i) s

ii) v

iii) $a-t$, $v-t$, $s-t$

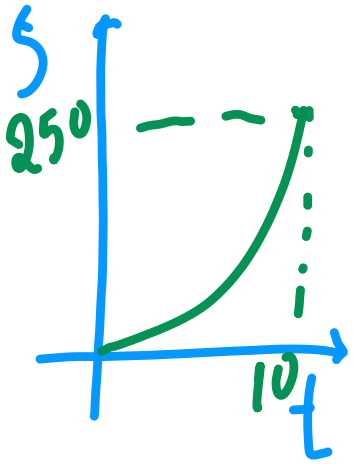
i) $s = \frac{1}{2} a t^2$

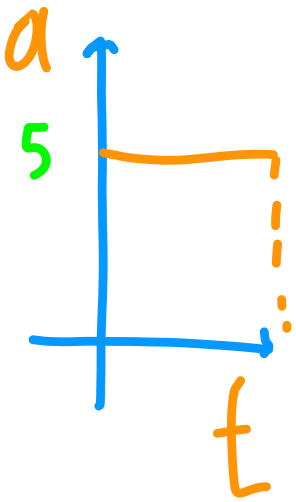
$s = \frac{1}{2} \cdot 5 \cdot 10^2$

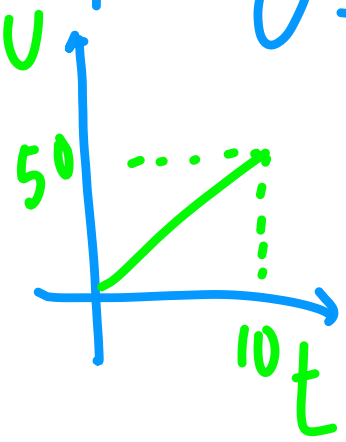
$s = 250\,m$

ii) $v = at$

$v = 5 \cdot 10 = 50\,\frac{m}{s}$







3) $v = 5\,m/s$

$t_{0)} = 5\,s$

a) $s_{0)}$

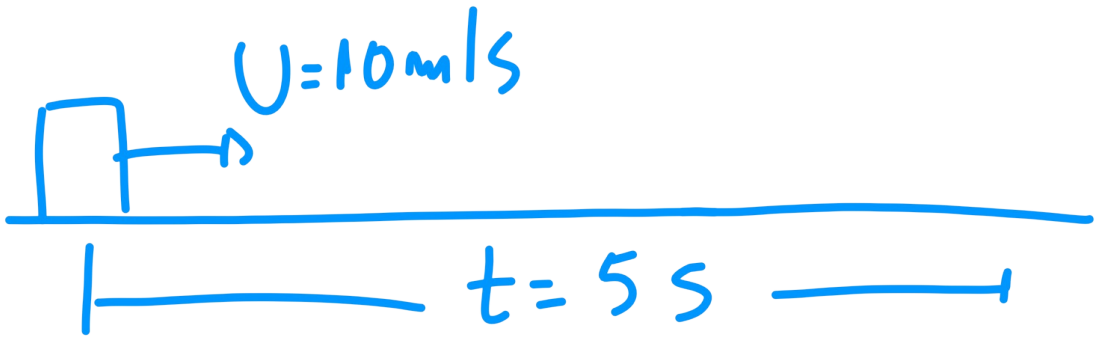
b) a

f) $v-t$

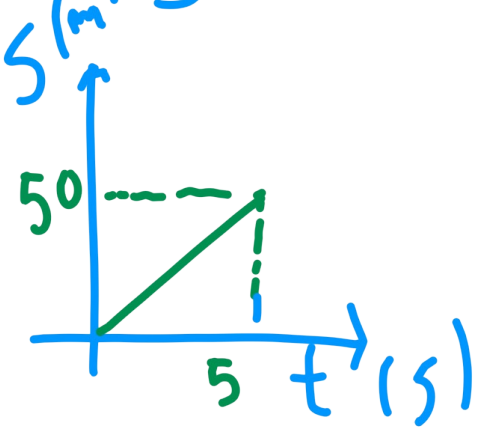
$s-t$

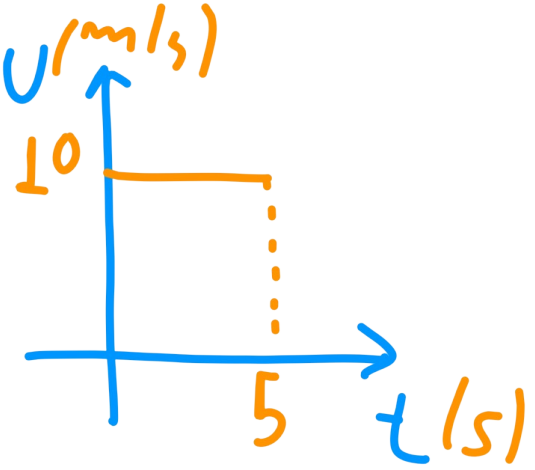
$a-t$

Εφαρμογή



$S = \upsilon \cdot t \Rightarrow S = 10 \cdot 5 = 50m$





Νόμοι του Νεύτωνα

1ος Νόμος

$\Sigma F = 0 \Rightarrow$ $U = 0$

$U = \text{σταθ.}$

2ος Νόμος

$\Sigma F = m a$ → επιτάχυνση (m/s^2)

↓

μάζα (kg)

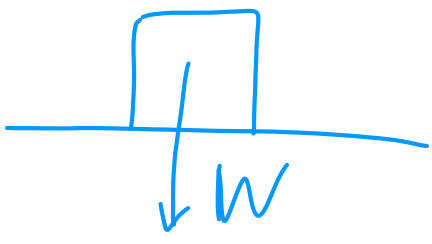
Βάρος: (w)

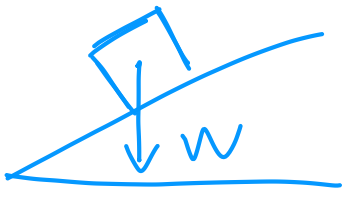
$W = m g$ → επιτάχυνση της βαρύτητας

$10\ m/s^2$

↓

μάζα (kg)





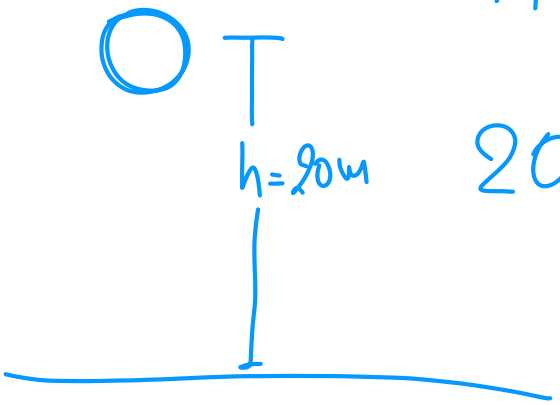
ΕΦΑΡΜΟΓΗ

$m = 2kg$

$h = 20m$

$t = ;$

$U = ;$



$h = \frac{1}{2} g t^2$

$20 = \frac{1}{2} \cdot 10 \cdot t^2$

$t^2 = 4$

$t = 2s$

$U = gt \Rightarrow$

$U = 10 \cdot 2 \Rightarrow U = 20 m/s$

Τριβή

Στατική Τριβή

Το σώμα δε κινείται

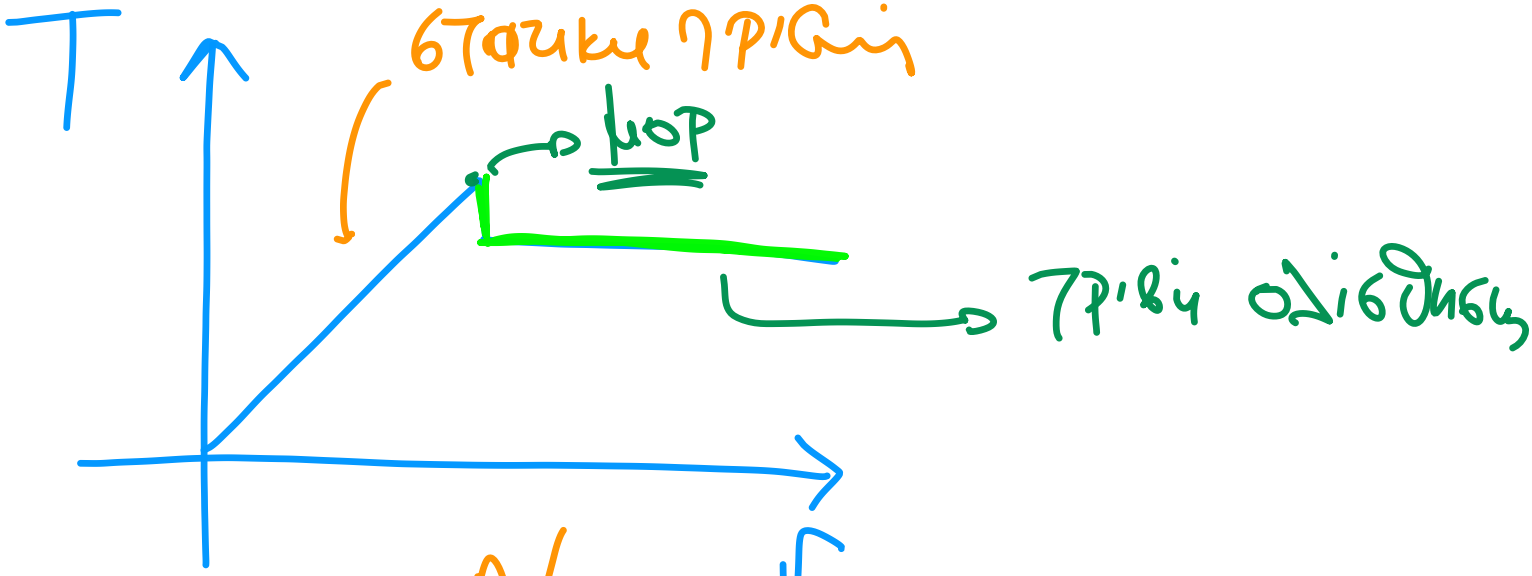
$T = \mu \cdot N$ → ανάλογη εδάφους

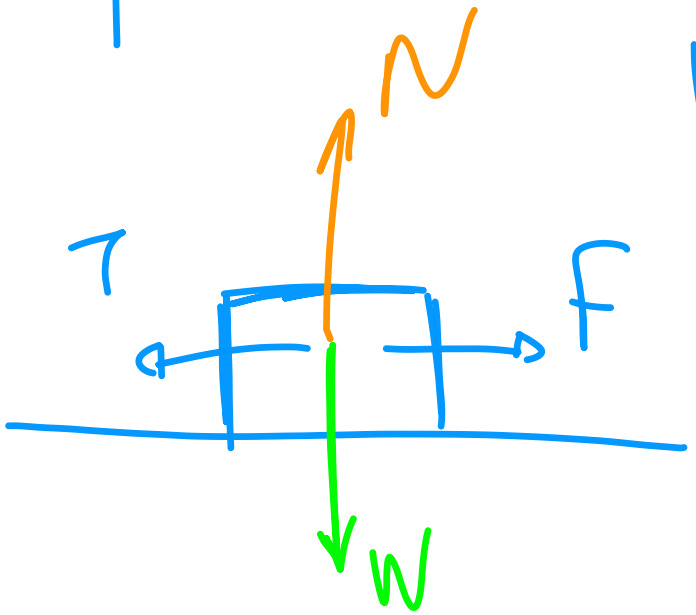
↳ συντελεστής στατικής τριβής

Τριβή Ολίσθησης

Το σώμα κινείται

$T = \mu_{ολ} \cdot N$

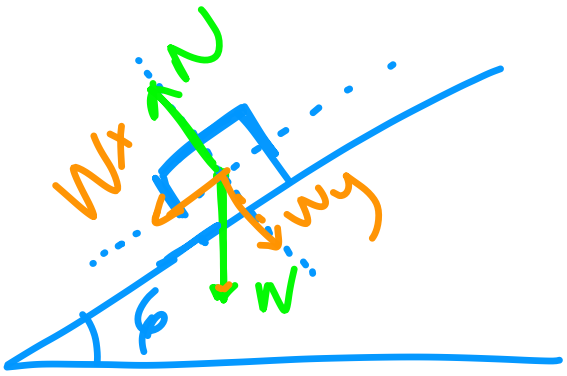




$W = N$

$T = \mu N$

$T = \mu m g$



$$Wx = mg \sin\varphi$$

$$Wy = mg \cos\varphi$$

$$T = \mu \cdot N$$

$$T = \mu \cdot Wy$$

$$T = \mu mg \cos\beta$$

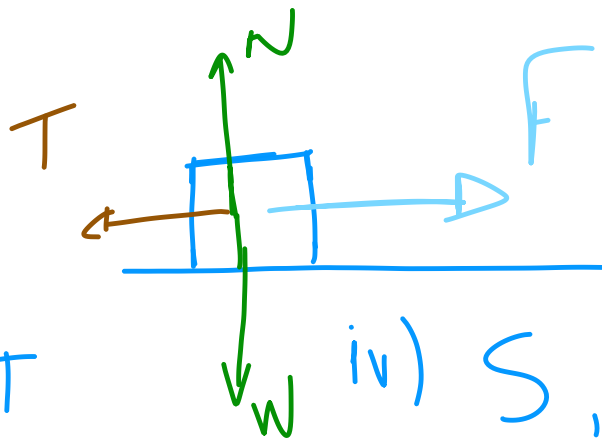
ΑΣΚΗΣΗ
(ΤΡΙΒΗ ΣΕ ΟΡΙΖΟΝΤΙΟ ΕΠΙΠΕΔΟ)

$m = 10\,kg$

$g = 10\,m/s^2$

$\mu = 0,1$

$F = 25\,N$



$N = w$

$N = mg$

i) T

ii) a

iii) U, $t = 10\,s$

iv) S, $t = 10\,s$

v) Αν η χρονική στιγμή $t = 10\,s$ η δυναμοστατικής σε πόσο χρόνο θα σταματήσει το κινητό και πόσο διάστημα θα έχει διανύσει

i) $T = \mu N \Rightarrow$

$T = \mu m g$

$T = 0,1 \cdot 10 \cdot 10 \Rightarrow \boxed{T = 10\,N}$

ii) $\sum F = ma$

$F - T = ma \Rightarrow 25 - 10 = 10a$

$15 = 10a \Rightarrow a = 1,5\,\frac{m}{s^2}$

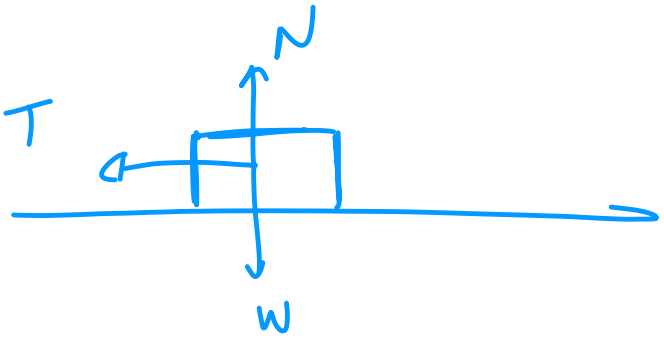
iii) $U = at \Rightarrow U = 1,5 \cdot 10 \Rightarrow U = 15\,m/s$

iv) $S = \frac{1}{2} a t^2 \Rightarrow$

$S = \frac{1}{2} \cdot 1{,}5 \cdot 10^2 \Rightarrow$

$S = 75\,m$

v)



$\Sigma F = m a' \Rightarrow$

$T = m a' \Rightarrow a' = \frac{T}{m} \Rightarrow$

$a' = \frac{10}{10} = 1\ m/s^2$

Επιβράδυνση

$t_{0)} = \frac{U}{a} \Rightarrow$

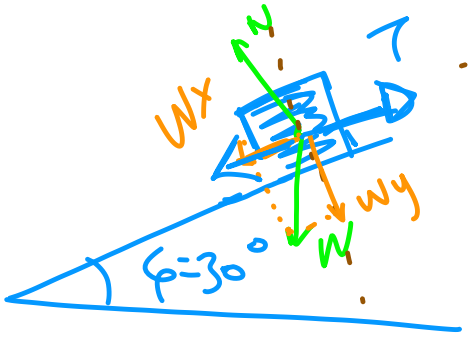
$t_{0)} = \frac{15}{1} \Rightarrow t_{0)} = 15\,s$

$S_{0)} = \frac{U_0^2}{2a}$

$S_{0)} = \frac{15^2}{2 \cdot 1} \Rightarrow$

$S_{0)} = 112{,}5\,m$

ΑΣΚΗΣΗ



$W_x = W \eta\mu\varphi$

$W_y = W \sigma\upsilon\nu\varphi$

$\boxed{W_y = N}$

$m = 1\,kg$

$g = 10\,m/s^2$

$\mu = 0{,}1$

α) T

β) υ $(t = 5\,s)$

γ) S $(t = 5\,s)$

α) $T = \mu N \Rightarrow$

$T = \mu W_y \Rightarrow$

$T = \mu m g \sigma\upsilon\nu\varphi$

$T = 0{,}1 \cdot 1 \cdot 10 \frac{\sqrt{3}}{2} \Rightarrow$

$T = \frac{\sqrt{3}}{2} N$

β) $\Sigma F = ma$

$W_x - T = ma \Rightarrow$

$mg\eta\mu\varphi - \mu mg\sigma\upsilon\nu\varphi = ma$

$a = g\eta\mu\varphi - \mu g \sigma\upsilon\nu\varphi$

$a = g(\eta\mu\varphi - \mu\sigma\upsilon\nu\varphi)$

$a = 10 \cdot \left(\frac{1}{2} - 0{,}1\frac{\sqrt{3}}{2}\right) \Rightarrow a = 5 - \frac{\sqrt{3}}{2}\ m/s^2$

$$v = at \Rightarrow$$

$$v = \left(5 - \frac{\sqrt{3}}{2}\right) \cdot 5 \Rightarrow$$

$$v = 25 - \frac{5\sqrt{3}}{2} \ m/s$$

$$S = \frac{1}{2} a t^2 \Rightarrow$$

$$S = \frac{1}{2}\left(5 - \frac{\sqrt{3}}{2}\right) \cdot 5^2 \Rightarrow S = 62,5 - \frac{25\sqrt{3}}{4} \ m$$

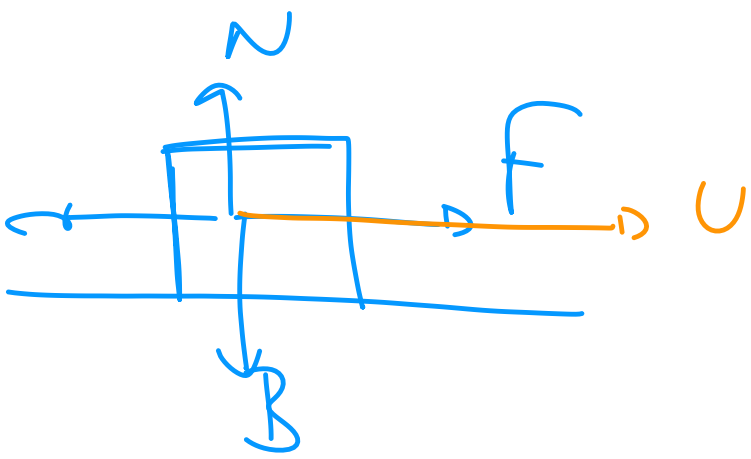
Έργο Δυνάμεις

$$W = F \cdot x$$

$W > 0$ F, x ίδια φορά

$W = 0$ F, x είναι κάθετα

Μονάδα Joule (J)



$W_F > 0$

$W_B = 0$

$W_N = 0$

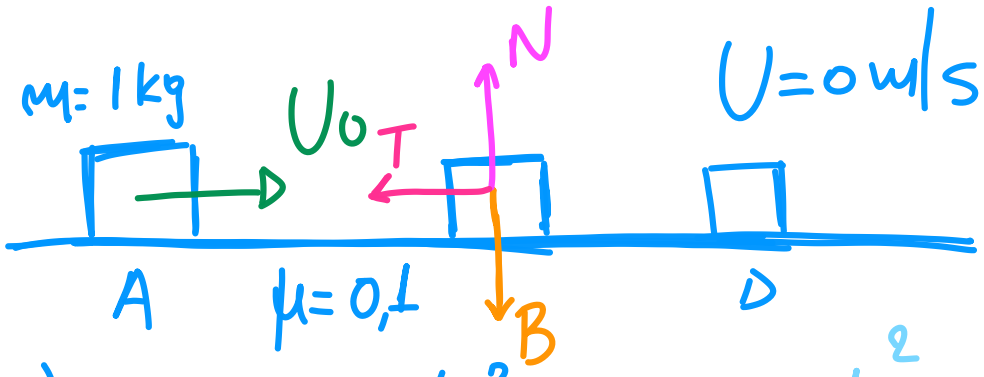
$W_T < 0$

διαιτητρίβη είναι αντίθετη της κίνησης

ΕΦΑΡΜΟΓΗ

$U_0 = 10\,m/s$

$g = 10\,m/s$



i) $S_{ολ}(AΔ)$

ii) $t_{ολ}(AΔ)$

iii) W_T, W_B, W_N

i) $S_{ολ} = \frac{U_0^2}{2a} \rightsquigarrow S_{ολ} = \frac{10^2}{2\cdot 1} = 50\,m$

$T = ma \Rightarrow \mu N = ma \Rightarrow$

$\mu mg = ma \Rightarrow$

$a = \mu g \Rightarrow a = 0,1 \cdot 10$

$a = 1\,m/s^2$

ii) $t_{ολ} = \frac{U_0}{a}$

$t_{ολ} = \frac{10}{1} = 10\,s$

$T = \mu N \Rightarrow$

$T = \mu mg$

iii) $W_T = -T \cdot S \Rightarrow$

$W_T = -\mu mg \cdot S \Rightarrow^{ii)} W_B = 0$

$W_T = -0,1 \cdot 1 \cdot 10 \cdot 50$

$W_T = -50\,J$

$W_N = 0\,J$