Θέμα Α

A_1. β A_2. δ A_3. β A_4. α A_5. Λ, Σ, Σ, Λ, Λ

Θέμα Β

B_1.

$$\varphi = 2\pi\left(\frac{t_1}{T} - \frac{x}{\lambda}\right)$$

για $\varphi = 4\pi\ rad$, $x = 0$ } $4\pi = 2\pi \cdot \left(\frac{2}{T} - \frac{0}{\lambda}\right) \Rightarrow 2 = \frac{2}{T} \Rightarrow \underline{T = 1\ sec}$

Για $t_2 = 2{,}5\ s$ έχουμε $t_2 = 2{,}5 \cdot T = 5 \cdot \frac{T}{2}$ άρα 5 φωτεινά εκκρεμή θέση. (i)

B_2. $K = h \cdot f_2 - \varphi$

και

ΘΜΚΕ: $K_f - K = -W_{αντ.πεδ}$

$K = q \cdot V_0$

} $h \cdot f_2 - \varphi = e \cdot V_0 \Rightarrow V_0 = \frac{h \cdot f_2 - \varphi}{e} = \frac{h \cdot 3f_1 - \varphi}{e}$

αρχικά: $h \cdot f_1 = \varphi$ • έτσι: $V_0 = \frac{3hf_1 - hf_1}{e} \Rightarrow \boxed{V_0 = \frac{2hf_1}{e}}$ (ii)

3. α) Για να μην εκτρέπονται:

$\Sigma F = 0$

$F_{ηλ} = F_{μαγν}$

$E \cdot q = B_1 \cdot v \cdot q$

$\boxed{v = \frac{E}{B_1}}$ (ii)

β) $d = 2R_2 - 2R_1$

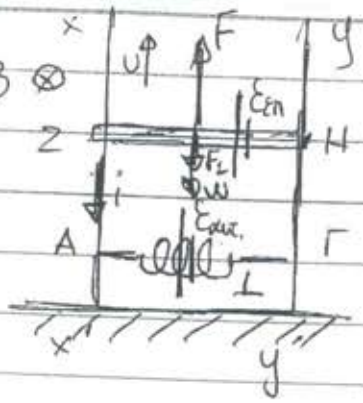
$d = \frac{2m_2 \cdot v}{B_2 \cdot e} - \frac{2m_1 \cdot v}{B_2 \cdot e}$

$d = \frac{2\Delta m \cdot v}{B_2 \cdot e} - \frac{2\Delta m \cdot E}{B_2 \cdot e \cdot B_1}$

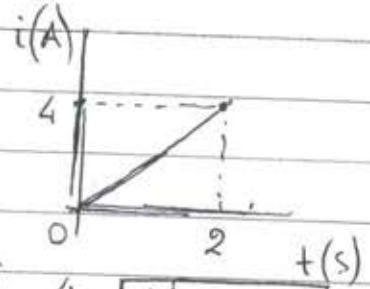
$\boxed{\Delta m = \frac{d \cdot B_2 \cdot B_1 \cdot e}{2 \cdot E}}$ (i)

Θέμα Γ

$L=0,5H$
$l=1m$
$m=0,5kg$
$R=1\Omega$
$B=1T$
$i=2t$



Γ1. για $t=0 \rightarrow i=0$
για $t=2s \rightarrow i=4A$



$$\frac{\Delta i}{\Delta t}=\frac{4}{2} \Rightarrow \boxed{\frac{\Delta i}{\Delta t}=2\,A/s}$$

Γ2. Επειδή το i αυξάνεται εμφανίζεται $E_{αυτ}$ που προσπαθεί να το μειώσει, άρα έχει την πολικότητα του σχήματος.

$$|E_{αυτ}|=L\cdot\frac{\Delta i}{\Delta t}=0,5\cdot 2 \Rightarrow \boxed{E_{αυτ}=1\,V}$$

Το Q εκφράζεται κάτω εμβαδόν στο διάγραμμα $i-t$
Άρα $Q_{ολ}=E_{μεσ}=\frac{b\cdot\upsilon}{2}=\frac{2\cdot 4}{2} \Rightarrow \boxed{Q_{ολ}=4C}$

Γ3. $i=\frac{\mathcal{E}-E_{αυτ}}{R_{ολ}}$
$\mathcal{E}-E_{αυτ}=i\cdot R_{ολ}$
$\mathcal{E}=E_{αυτ}+i\cdot R_{ολ}$
$\mathcal{E}=1+2t\,(S.I.)$

$E_{επ}=B\upsilon l$
$1+2t=1\cdot\upsilon\cdot 1$
$\boxed{\upsilon=1+2t}\,(SI)$

Γ4. $a=\frac{\Delta\upsilon}{\Delta t}=\frac{1+2t_2-(1+2t_1)}{\Delta t}=\frac{2\Delta t}{\Delta t} \Rightarrow a=2\,m/s^2$

$\Sigma F=m\cdot a$
$F-F_L-w=m\cdot a$
$F=BIl+mg+ma$
$F=1\cdot 4\cdot 1+0,5\cdot 10+0,5\cdot 2$
$F=4+5+1$
$\boxed{F=10N}$

$i=2\cdot t_1$
$i=2\cdot 2$
$i=4A$

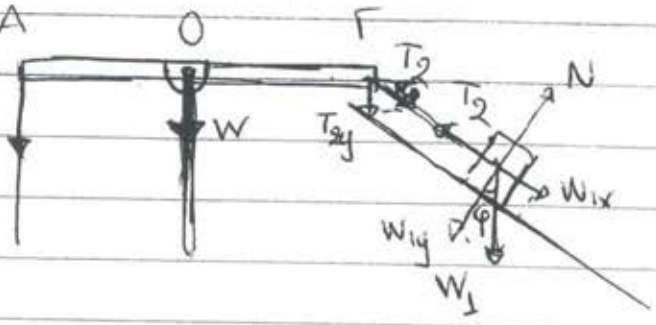
$\frac{\Delta W_F}{\Delta t}=P_1=F\cdot\upsilon$
$\upsilon=1+2\cdot t_1$
$\upsilon=1+2\cdot 2$
$\upsilon=5\,m/s$
$\frac{\Delta W_F}{\Delta t}=10\cdot 5$
$\boxed{\frac{\Delta W_F}{\Delta t}=50\,J/s}$

$\frac{\Delta U_B}{\Delta t}=E_{αυτ}\cdot i$
$\frac{\Delta U_R}{\Delta t}=1\cdot 4$
$\boxed{\frac{\Delta U_B}{\Delta t}=4\,J/s}$

Θέμα Δ

$\alpha = 0{,}8\,m$
$R = 2\,\Omega$
$\mathcal{E} = 30\,V,\ r \to 0$
$m_1 = 3\,kg$
$\varphi = 37^\circ$
$m_2 = 1\,kg$
$k = 100\,N/m$

Δ1.



Στο m_1: $\Sigma F_x = 0$

$T_2 = W_{1x}$

$T_2 = m_1 \cdot g \cdot \eta\mu\varphi$

$T_2 = 3 \cdot 10 \cdot \frac{3}{5}$

$T_2 = 18\,N$

στη ράβδο: $\Sigma \vec{\tau}_O = 0$

$\vec{\tau}_{T_1} + \vec{\tau}_{T_2} = \vec{0}$

$T_1 \cdot \frac{\ell}{2} - T_{2y} \cdot \frac{\ell}{2} = 0$

$T_1 \cdot \frac{\ell}{2} = T_2 \cdot \eta\mu\varphi \cdot \frac{\ell}{2}$

$T_1 = 18 \frac{3}{5}$

$\boxed{T_1 = 10{,}8\,N}$

Δ2.

Στο ΝΜ: $F_L = BIl$ με $I = \frac{\mathcal{E}}{R_{ολ}}$

$F_L = B \cdot 15 \cdot 0{,}8$ $\quad I = \frac{30}{2}$

$F_L = 12 \cdot B$ $\quad I = 15\,A$

για ισορροπία των γγ' πρέπει: $F_L = T$

$12 \cdot B = 10{,}8$

$\boxed{B = 0{,}9\,T}$

Δ3. Για το Σ_2:

$A = d = \frac{9\pi}{100}\,m$

$D = m_2 \omega^2$

$100 = 1 \cdot \omega^2$

$\omega = 10\,r/s$

$\omega = \frac{2\pi}{T}$

$10 = \frac{2\pi}{T}$

$T = 0{,}2\pi\,sec$

στη ΘΙ: $\quad U_2 = U_{max} = \omega \cdot A$

$U_2 = 10 \cdot \frac{9\pi}{100}$

$U_2 = \frac{9\pi}{10}\,m/s$

Θέλει $t = \frac{T}{4}$

$t = \frac{0{,}2\pi}{4}$

$t = \frac{\pi}{20}\,sec$

για το Σ_1: $\Sigma F_x = m_1 a$

$w_{1x} = m_1 a$

$m_1 g \eta\mu\varphi = m_1 a$

$10 \cdot \frac{3}{5} = a$

$a = 6\,m/s$

$U_1 = a \cdot t$

$U_1 = 6 \cdot \frac{\pi}{20}$

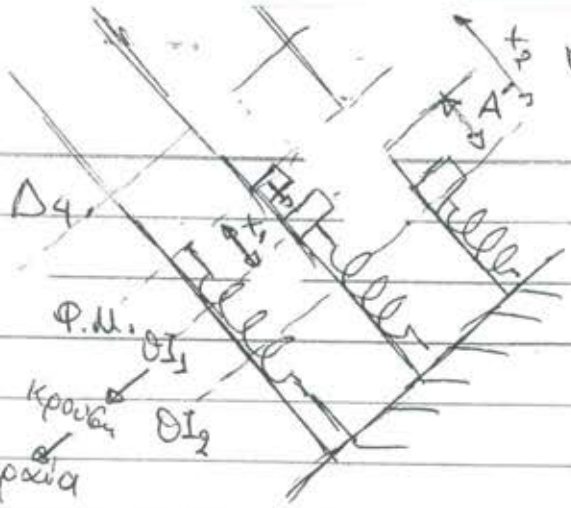
$U_1 = \frac{3\pi}{10}\,m/s$

$\Sigma F_{εξ} = 0$: Α.Δ.Ο.

$P_{αρχ} = P_{τελ}$

$m_2 U_2 - m_1 U_1 = m_2 \cdot U_2$

$1 \cdot \frac{9\pi}{10} - 3 \cdot \frac{3\pi}{10} = 4 \cdot U_2 \Rightarrow \boxed{U_2 = 0}$



$x = A' \cdot \eta\mu(\omega' t + \varphi_0)$

με $D = m_2 \cdot \omega'^2$ και $\varphi_0 = \frac{\pi}{2}$ rad

$100 = 4\omega'^2$ γιατί τη $t=0$: $x = +A'$

$\omega'^2 = 25$

$\omega' = 5$ r/s

$\Theta I_1 : \Sigma F_x = 0$ $\quad \Theta I_2 : \Sigma F_x = 0$ $\quad$ οπότε $A' = x_2 - x_1$

$F_{\epsilon\lambda 1} = W_{2x}$ $\quad F'_{\epsilon\lambda 1} = W_{2x}$ $\quad A' = 0{,}24 - 0{,}06$

$k \cdot x_1 = m_2 g \eta\mu\varphi$ $\quad k \cdot x_2 = m_2 g \eta\mu\varphi$ $\quad A' = 0{,}18\,m$

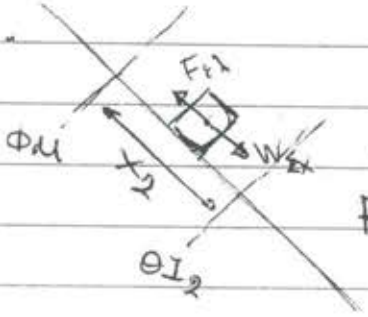
$100 \cdot x_1 = 1 \cdot 10 \cdot \frac{3}{5}$ $\quad 100\, x_2 = 4 \cdot 10 \cdot \frac{3}{5}$

$x_1 = \frac{3}{50}$ $\quad x_2 = \frac{12}{50}$ Τελικά:

$x_1 = 0{,}06\,m$ $\quad x_2 = 0{,}24\,m$

$$x = 0{,}18 \cdot \eta\mu\left(5t + \frac{\pi}{2}\right) \text{ (SI)}$$

Δ5.



$\Sigma F = F_{\epsilon\lambda} - W_{2x}$

$-D \cdot x = F_{\epsilon\lambda} - m_2 g \eta\mu\varphi$

$F_{\epsilon\lambda} = -D x + m_2 g \eta\mu\varphi$

$F_{\epsilon\lambda} = -100 \cdot x + 4 \cdot 10 \cdot \frac{3}{5}$

$F_{\epsilon\lambda} = -100x + 24$ (SI)

για $x = -A' = -0{,}18 \rightarrow F_{\epsilon\lambda} = 42$ N

για $x = A' = 0{,}18 \rightarrow F_{\epsilon\lambda} = 6$ N

για $x = 0 \rightarrow F_{\epsilon\lambda} = 24$ N