Λύσεις διαγωνίσματος Φυσικής Γ 23/10/2021

ΘΕΜΑ Α

$A_1 - \gamma$ $A_2 - \alpha$ $A_3 - \delta$ $A_4 - \alpha$ A_5 ΣΣΛΣΛ

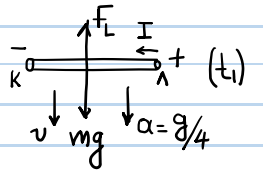
ΘΕΜΑ Β

Β1 – α | Ισχύει $Q_{συν} = Q_{εναλ} \Rightarrow \frac{V_\Sigma^2}{R}\Delta t = \frac{V_{εν}^2}{6R}\Delta t \Rightarrow V_{εν}^2 = 6V_\Sigma^2$

$\Rightarrow \frac{V^2}{2} = 6V_\Sigma^2 \Rightarrow V^2 = 12V_\Sigma^2 \Rightarrow \boxed{V = 2\sqrt{3}V_\Sigma}$

Β2 Ι-β | ΙΙ-α

Ι) $\Delta q = \frac{\Delta\Phi}{R_{ολ}} = \frac{B\cdot\Delta S}{R_1+R_2} = \frac{B\ell\cdot h}{R+R} \Rightarrow \boxed{\Delta q = \frac{B\ell\cdot h}{2R}}$

ΙΙ) 

(t_1) $\Sigma F = ma \Rightarrow mg - F_L = \frac{1}{4}mg \Rightarrow F_L = \frac{3}{4}mg$

$dW_{F_L} = -F_L\cdot dx = -BI\ell\cdot dx = -BI\ell\upsilon\cdot dt = -B\upsilon\ell\cdot I\cdot dt = -dW_{ηλεπ} = -dQ_{R_{ολ}} \Rightarrow$

$dW_{F_L} = -dQ_{R_{ολ}} \rightarrow \frac{dW_{F_L}}{dt} = -\frac{dQ_{R_{ολ}}}{dt} \Rightarrow$

$\frac{dQ_{R_{ολ}}}{dt} = -\frac{dW_{F_L}}{dt} = -\frac{-F_L dx}{dt} = +F_L\cdot\upsilon \Rightarrow$

$\frac{dQ_{R_{ολ}}}{dt} = F_L\cdot\upsilon = \frac{3}{4}mg\cdot\upsilon \Rightarrow \boxed{\frac{dQ_{R_{ολ}}}{dt} = \frac{3}{4}mg\upsilon}$

Β3 – γ $\Theta I_{1,2}$: Για m_2: $\Sigma F_2 = 0 \Rightarrow T = m_2 g = mg$

Για m_1: $\Sigma F_1 = 0 \Rightarrow F_{ελ} = m_1 g + T = mg + mg$

$\Rightarrow k\Delta\ell = 2mg \Rightarrow \Delta\ell = \frac{2mg}{k}$

ΘI_1: $\Sigma F_1' = 0 \Rightarrow F_{ελ_1} = m_1 g \Rightarrow k\Delta\ell_1 = mg \Rightarrow \Delta\ell_1 = \frac{mg}{k}$

$A_1 = \Delta\ell - \Delta\ell_1 \Rightarrow A_1 = \frac{2mg}{k} - \frac{mg}{k} \Rightarrow \boxed{A_1 = A = \frac{mg}{k}}$ (1)

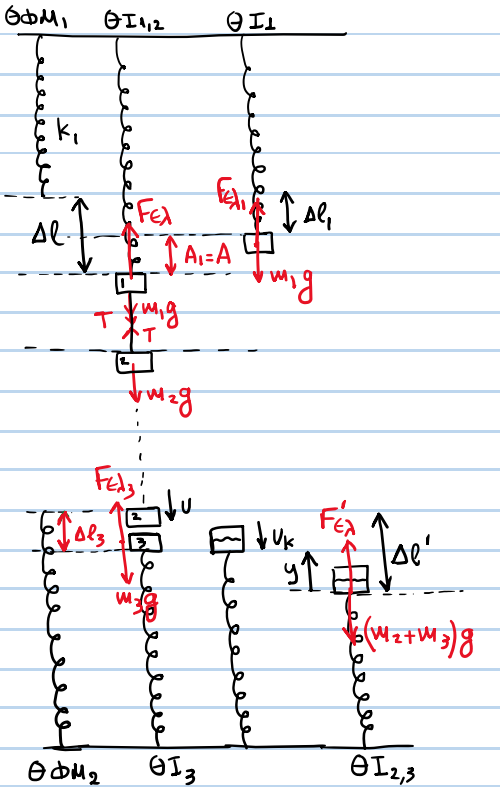
ΘI_3: $\Sigma F_3 = 0 \Rightarrow F_{ελ_3} = m_3 g \Rightarrow k\Delta\ell_3 = mg \Rightarrow \Delta\ell_3 = \frac{mg}{k}$

$A\Delta O$: $\vec{P}_{πριν} = \vec{P}_{μετα} \Rightarrow P_2 = P_k \Rightarrow m_2\upsilon = (m_2+m_3)\upsilon_k$

$\Rightarrow m\upsilon = 2m\upsilon_k \Rightarrow \upsilon = 2\upsilon_k \Rightarrow \boxed{\upsilon_k = \frac{\upsilon}{2}}$ (2)

$\Theta I_{2,3}$: $\Sigma F_{2,3} = 0 \Rightarrow F_{ελ}' = (m_2+m_3)g$

$\Rightarrow k\Delta\ell' = 2mg \Rightarrow \Delta\ell' = \frac{2mg}{k}$



ΑΔΕΤ για m_2+m_3 αμέσως μετά την κρούση:

$E = K+U \Rightarrow \frac{1}{2}kA_2^2 = \frac{1}{2}(m_2+m_3)U_K^2 + \frac{1}{2}ky^2$ όπου $|y| = \Delta\ell' - \Delta\ell_3 = \frac{2mg}{k} - \frac{mg}{k}$

$\Rightarrow \frac{1}{2}k(2A)^2 = \frac{1}{2}2mU_K^2 + \frac{1}{2}kA^2$ $\Rightarrow \boxed{|y| = \frac{mg}{k} = A}$ από σχέση ①

$\Rightarrow 4kA^2 = 2mU_K^2 + kA^2 \Rightarrow 2mU_K^2 = 3kA^2$

② $\Rightarrow 2m\frac{U^2}{4} = 3kA^2 \Rightarrow \boxed{\frac{1}{2}mU^2 = 3kA^2}$ ③

ΘΜΚΕ για m_2 στην καθοδο: $K_{2τελ} - K_{2αρχ}^{0} = W_{m_2 g} \Rightarrow \frac{1}{2}m_2U^2 - 0 = m_2gh$

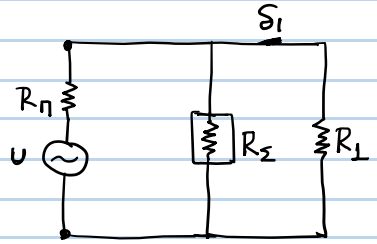
$\Rightarrow \frac{1}{2}mU^2 = mgh$ ③ $\Rightarrow 3kA^2 = mgh \Rightarrow 3A^2 = \frac{mg}{k}h$ ① $\Rightarrow 3A^2 = A\cdot h \Rightarrow \boxed{h = 3A}$

ΘΕΜΑ Γ

Γ1) Για συσκευή $P_K = 50W$, $V_K = 10V$ $\rightarrow$ $P_K = \frac{V_K^2}{R_2} \Rightarrow R_2 = \frac{V_K^2}{P_K} = \frac{100}{50} \Rightarrow R_2 = 2\,\Omega$

και $I_K = \frac{V_K}{R_2} = \frac{10}{2} \Rightarrow I_K = 5A$

Πλάτος εναλλασσόμενης τάσης $V = NwB_1A = 40\cdot 50\cdot\sqrt{2}\cdot 10^{-2}V \Rightarrow V = 20\sqrt{2}$ Volt



$R_1 // R_\Sigma : R_{1\Sigma} = \frac{R_1R_\Sigma}{R_1+R_\Sigma} = 1\,\Omega$ $R_{o\lambda} = R_\Pi + R_{1\Sigma} = 4\,\Omega$

$I = \frac{V}{R_{o\lambda}} = \frac{20\sqrt{2}}{4} \Rightarrow I = 5\sqrt{2}\,A$

$i = I\eta\mu(wt) \Rightarrow \boxed{i = 5\sqrt{2}\cdot\eta\mu(50t)\ SI}$

Γ2] $V_\Sigma = V_{εν_{R_1}} \Rightarrow I_{εν_\Sigma}R_\Sigma = I_{εν_1}R_1 \Rightarrow I_{εν_\Sigma} = I_{εν_1}$ και $I_{εν} = I_{εν_\Sigma} + I_{εν_1} = 2I_{εν_\Sigma}$

αρα $I_{εν_\Sigma} = \frac{I_{εν}}{2} = \frac{I}{2\sqrt{2}} = \frac{5\sqrt{2}}{2\sqrt{2}} \Rightarrow \boxed{I_{εν_\Sigma} = 2,5A < I_K = 5A}$ υπολειτουργεί

Γ3] δ_1 - ανοιχτός $R'_{o\lambda} = R_\Pi + R_\Sigma = 5\,\Omega$ $I'_{εν} = \frac{V_{εν}}{R'_{o\lambda}} = \frac{V}{R'_{o\lambda}\sqrt{2}} = \frac{20\sqrt{2}}{5\sqrt{2}} \Rightarrow I'_{εν} = 4A$

$I'_{εν} = 4A < I_K = 5A$ συνεχίζει να υπολειτουργεί.

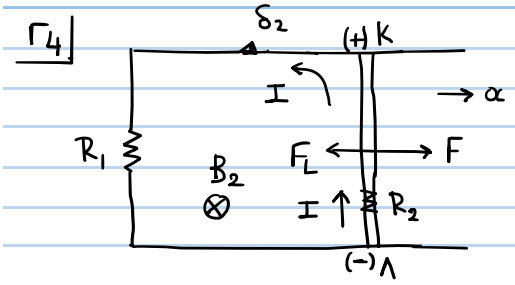
Για να λειτουργεί κανονικά πρέπει $I''_{εν} = I_K = 5A \Rightarrow \frac{I''}{\sqrt{2}} = 5A \Rightarrow I'' = 5\sqrt{2}\,A$

και $V'' = I''\cdot R'_{o\lambda} = 5\sqrt{2}\cdot 5 \Rightarrow V'' = 25\sqrt{2}$ Volt

$\frac{V''}{V} = \frac{Nw'B_1A}{NwBA} \Rightarrow \frac{25\sqrt{2}}{20\sqrt{2}} = \frac{w'}{w} \Rightarrow w' = \frac{5}{4}w$

Αρα $\Delta w = w' - w = \frac{5}{4}w - w \Rightarrow \boxed{\Delta w = \frac{w}{4} = 12,5\ rad/s}$

Γ4



κινηση αγωγου σε ΟΜΠ ⇒ εμφανιση $\mathcal{E}_{επ}$

$$\mathcal{E}_{επ} = \frac{d\Phi}{dt} = \frac{B_2 \cdot dS}{dt} = \frac{B_2\, dx \cdot \ell}{dt} = B_2 u \ell \qquad u = at$$

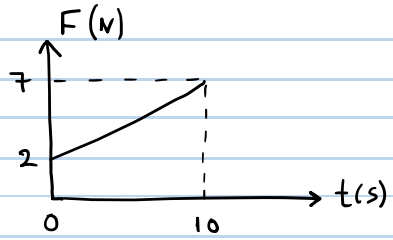
$$I = \frac{\mathcal{E}_{επ}}{R''_{ολ}} = \frac{B_2 u \ell}{R_1 + R_2} = \frac{B_2 a \ell}{R_1 + R_2} \cdot t \Rightarrow \boxed{I = 0{,}5t \ SI}$$

$$F_L = B_2 I \ell \Rightarrow \boxed{F_L = 0{,}5t \ SI}$$

$$\Sigma F = ma \Rightarrow F - F_L = ma \Rightarrow F = ma + F_L$$

$$\Rightarrow \boxed{F = 2 + 0{,}5t \ SI}$$

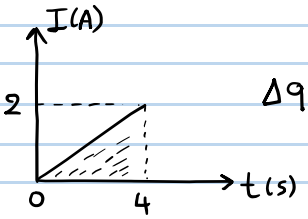
$0 \le t \le 10 sec$



Γ5 $I = 2A \Rightarrow 0{,}5t = 2 \Rightarrow t = 4 sec \longrightarrow u = at = 2 \cdot 4 \frac{m}{s} \Rightarrow u = 8 m/s.$

$$\frac{dK}{dt} = \Sigma F \cdot u = ma u = 1 \cdot 2 \cdot 8 \ J/s \Rightarrow \boxed{\frac{dK}{dt} = 16 \ J/s}$$

$I = 0{,}5t$
$0 \le t \le 4 sec$



$$\Delta q = \underset{0 \to 4 sec}{\mathcal{E}_{τραπ}} = \frac{1}{2} \cdot 2 \cdot 4 \ C \Rightarrow \boxed{\Delta q = 4C}$$

ΘΕΜΑ Δ

$m_1 = 1kg \quad k = 100 N/m \quad d = 0{,}3m \ / \ m_2 = 1kg \quad u_2 = 6\sqrt{2} \ m/s \quad y_1 = -0{,}1 m$

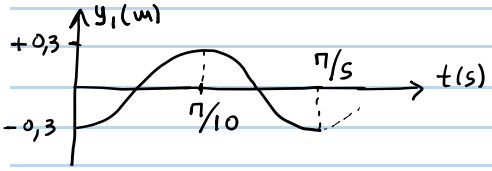
Δ1 $A_1 = d = 0{,}3m \quad D = K = m_1 \omega_1^2 \Rightarrow \omega_1 = \sqrt{k/m_1} = 10 rad/s$

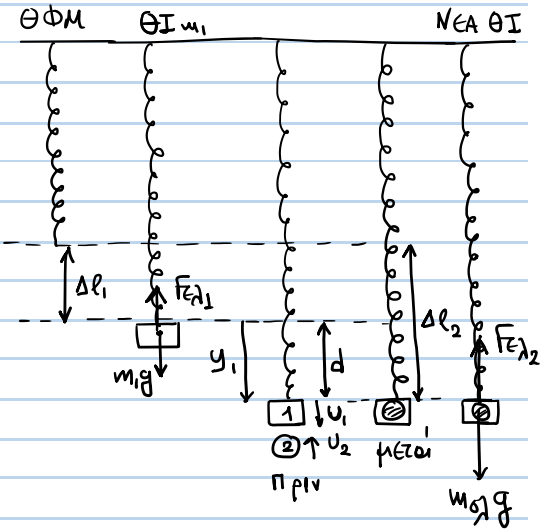
$y_1 = A_1 ημ(\omega_1 t + \varphi_0) \qquad T_1 = 2\pi/\omega_1 \Rightarrow T_1 = \frac{\pi}{5} sec$

$t = 0 \quad y_1 = -A_1 \Rightarrow A_1 ημ(\varphi_0) = -A_1$

$\Rightarrow ημ\varphi_0 = -1 = ημ\frac{3\pi}{2} \rightarrow \varphi_0 = \frac{3\pi}{2}$

Αρα $\boxed{y_1 = 0{,}3 ημ(10t + 3\pi/2) \ SI}$





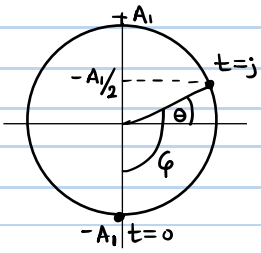
Δ2) $a_1 = a = -15 m/s^2 \quad t=; \ 1η \ φορα \longrightarrow y_1 = +0{,}15m = +A_1/2 \quad u > 0 \ 1η \ t=;$

οπου $a_1 = -a_{1max} ημ(\omega_1 t + \varphi_0)$

$\Rightarrow a_1 = -\omega_1^2 A_1 ημ(\omega_1 t + \varphi_0)$

$\Rightarrow a_1 = -\omega_1^2 y_1 \Rightarrow -15 m/s^2 = -100 y_1$

$\Rightarrow y_1 = +0{,}15 m = +A_1/2$



$$ημθ = \frac{A_1/2}{A_1} = \frac{1}{2} \rightarrow \theta = \pi/6$$

$$\varphi = \pi/2 + \pi/6 = 2\pi/3$$

$$\varphi = \omega_1 t \Rightarrow \frac{2\pi}{3} = 10t \Rightarrow \boxed{t = \frac{\pi}{15} sec}$$

Δ_3) ΑΔΕΤ για m_1 πριν: $E_1 = K_1 + U_1 \Rightarrow \frac{1}{2}kA_1^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}ky_1^2$

$\Rightarrow v_1 = \pm\omega_1\sqrt{A_1^2 - y_1^2} \Rightarrow v_1 = \pm\sqrt{8} = \pm 2\sqrt{2}\ m/s$ κινούμενο προς $-A_1$ $\rightarrow$ $\boxed{v_1 = -2\sqrt{2}\ m/s}$

Δ_4) ΘΙm_1: $\Sigma F_1 = 0 \Rightarrow F_{\epsilon\lambda_1} = m_1 g \Rightarrow k\Delta\ell_1 = m_1 g \Rightarrow \Delta\ell_1 = \frac{m_1 g}{k} \Rightarrow \Delta\ell_1 = 0,1m$

ΝΕΑ ΘΙ: $\Sigma F = 0 \Rightarrow F_{\epsilon\lambda_2} = m_{o\lambda} g \Rightarrow k\Delta\ell_2 = (m_1+m_2)g \Rightarrow \Delta\ell_2 = \frac{(m_1+m_2)g}{k} \Rightarrow \Delta\ell_2 = 0,2m$

Θέση ισορροπίας: $d = \Delta\ell_2 - \Delta\ell_1 = 0,1m$ Διαπιστώνεται ότι είναι η ΝΕΑ ΘΙ

αφού $|y_1| = d = 0,1m$ οπότε η αρχική ταχύτητα είναι η v_{max} της νέας

απλής ταλάντωσης που θα εκτελέσει το συσσωμάτωμα $\rightarrow |v_K| = v_{max}$

Α.Δ.Ο: $\vec{P}_{o\lambda\,πριν} = \vec{P}_{o\lambda\,μετα} \Rightarrow \vec{P}_1 + \vec{P}_2 = \vec{P}_{κοιν} \uparrow \Rightarrow -m_1|v_1| + m_2 v_2 = m_{o\lambda}|v_K|$

$\Rightarrow -2\sqrt{2} + 6\sqrt{2} = 2|v_K| \Rightarrow |v_K| = 2\sqrt{2}\ m/s\ (\uparrow)$

$|v_K| = v_{max} = \omega A \Rightarrow |v_K| = \sqrt{k/m_{o\lambda}} \cdot A \Rightarrow 2\sqrt{2} = \sqrt{50}\,A \Rightarrow 2\sqrt{2} = 5\sqrt{2}\cdot A \Rightarrow \boxed{A = 0,4\,m}$

όπου $D = k = m_{o\lambda}\omega^2 \Rightarrow \omega = \sqrt{k/m_{o\lambda}} = 5\sqrt{2}\ rad/s$

Δ_5) $|\Sigma F| = m_{o\lambda} g = 20N \Rightarrow k|y| = 20N \Rightarrow 100|y| = 20 \Rightarrow |y| = 0,2m$

Το συσσωμάτωμα μετά την κρούση κινείται προς τα πάνω άρα πρώτη

φορά $|\Sigma F| = 20N \rightarrow |y| = 0,2m$ στη θετική του άξονα της αρχή και

κινούμενο προς τα πάνω ($v>0$). Άρα $y>0 \rightarrow y = +0,2m$

ΑΔΕΤ: $E = K + U \Rightarrow \frac{1}{2}kA^2 = \frac{1}{2}m_{o\lambda}v^2 + \frac{1}{2}ky^2 \xrightarrow{v>0} v = +\omega\sqrt{A^2 - y^2}$

$\Rightarrow v = +5\sqrt{2}\sqrt{\frac{16}{100} - \frac{4}{100}} = +5\sqrt{2}\,\frac{2\sqrt{3}}{10} \Rightarrow v = +\sqrt{6}\ m/s.$

$\frac{dK}{dt} = \frac{dW_{\Sigma F}}{dt} = \frac{\Sigma F\,dx}{dt} = \Sigma F \cdot v = -Dyv = -kyv$

$\Rightarrow \frac{dK}{dt} = -kyv = -100(+0,2)(+\sqrt{6})\ J/s \Rightarrow \boxed{\frac{dK}{dt} = -20\sqrt{6}\ J/s}$