ΦΥΣΙΚΗ ΠΡΟΣΑΝΑΤΟΛΙΣΜΟΥ
ΘΕΤΙΚΩΝ ΣΠΟΥΔΩΝ
ΑΠΑΝΤΗΣΕΙΣ

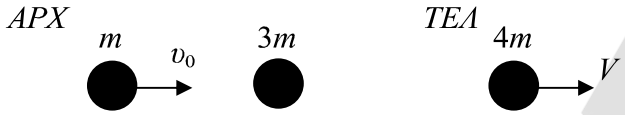
ΘΕΜΑ Α

Α1. α **Α2.** β **Α3.** δ **Α4.** α

Α5. **α.** Λ **β.** Σ **γ.** Σ **δ.** Λ **ε.** Λ

ΘΕΜΑ Β

Β1. Σωστό το iii

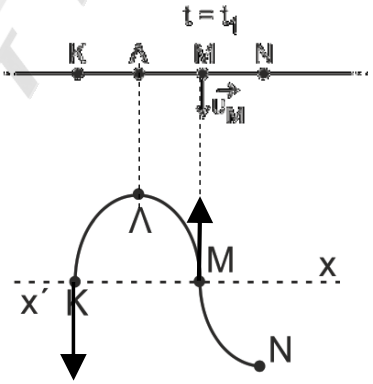


Α.Δ.Ο. (Μονωμένο σύστημα)

$$m\upsilon_0 + 0 = 4mV \Rightarrow V = \frac{\upsilon_0}{4}$$

$$\frac{K'}{K_1} = \frac{\frac{(m+M)V^2}{2}}{\frac{m\upsilon_0{}^2}{2}} = \frac{4 \cdot \frac{\upsilon_0{}^2}{16}}{\upsilon_0{}^2} = \frac{1}{4}$$

Β2. Σωστό το iii

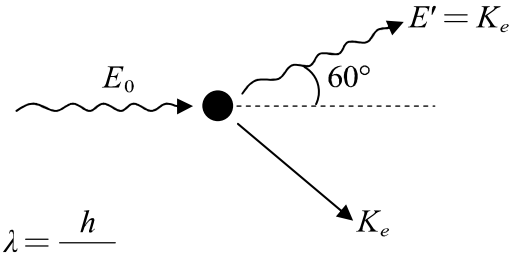


$\varphi_M < \varphi_\Lambda$ (Διάδοση προς τα θετικά. Το Μ σε $\Delta t = \frac{3T}{2}$ βρίσκεται στη Θέση Ισορροπίας με $\upsilon_M > 0$ για να βρεθεί στη θέση του Λ που έχει μεγαλύτερη φάση)

Β3. Σωστό το ii

$$E_0 = E' + K_e \Rightarrow E_0 = 2E' = 2\frac{hc}{\lambda'}$$

$$\lambda' = \lambda + \frac{h}{m_e c}(1 - \sigma\upsilon\nu 60°) \Rightarrow \lambda' = \lambda + \frac{h}{2m_e c}$$



$$\left.\begin{array}{l} E_0 = \frac{hc}{\lambda} \\ E_0 = 2\frac{hc}{\lambda + \frac{h}{2m_e c}} \end{array}\right\} \frac{\cancel{hc}}{\lambda} = 2\frac{\cancel{hc}}{\lambda + \frac{h}{2m_e c}} \Rightarrow \lambda = \frac{\lambda + \frac{h}{2m_e c}}{2} \Rightarrow \lambda = \frac{h}{m_e c}$$

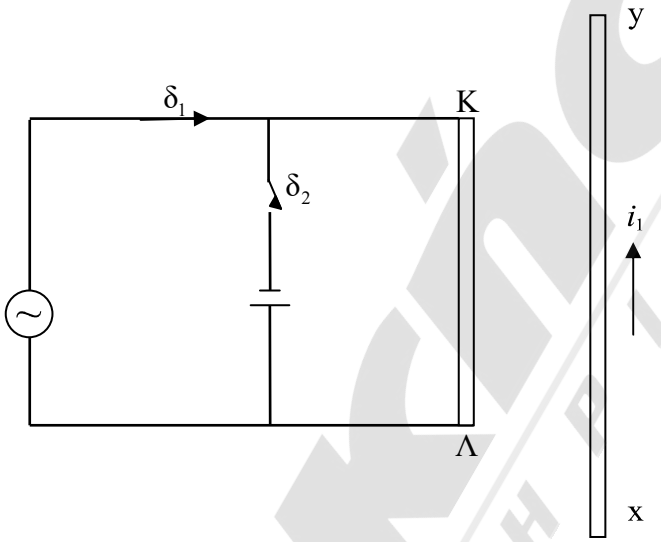
$$E_0 = \frac{hc}{\lambda} = \frac{hc}{\frac{h}{2m_e c}} = 2m_e c^2$$

ΘΕΜΑ Γ

$A=2\cdot10^{-2}\ m^2$, $N=100$ σπειρ.

$K\Lambda\rightarrow \ell=1m$

$R=10\ \Omega$, $E=20\ V$, $r=0$

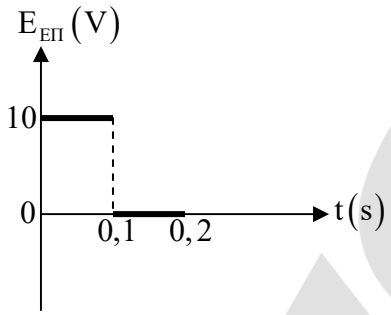


Γ1.

$$E_{E\Pi}=\left|\frac{\Delta\varphi}{\Delta t}\right|N\begin{cases}\xrightarrow{0\rightarrow0,1} E_{E\Pi}=\left|\frac{\Delta B}{\Delta t}\right|A\cdot N=\\ \xrightarrow{0,1\rightarrow0,2} E_{E\Pi}=\left|\frac{\Delta B}{\Delta t}\right|A\cdot N=\end{cases}$$

$$\begin{cases}=5\cdot2\cdot10^{-2}\cdot10^{2}=10\ V\\ =0\end{cases}$$

Άρα



Γ2.

$B=0,5\ T$

$$\omega=50\pi\ r/s\Rightarrow\omega=\frac{2\pi}{T}\Rightarrow T=\frac{2\pi}{\omega}=\frac{2\cancel{\pi}}{50\cancel{\pi}}=\frac{1}{25}\ s$$

$$V_0=B\omega NA=0,5\cdot50\pi\cdot100\cdot2\cdot10^{-2}\Rightarrow V_0=50\pi\ V$$

$$V_{EN}=\frac{V_0}{\sqrt{2}}\Rightarrow V_{EN}=\frac{50\pi}{\sqrt{2}}\ V$$

$$I_{EN}=\frac{V_{EN}}{R}=\frac{50\pi}{\sqrt{2}\cdot10}\Rightarrow I_{EN}=\frac{5\pi}{\sqrt{2}}\ A$$

$$Q=I_{EN}{}^2RT=\frac{\cancel{25}\pi^2}{2}\cdot10\cdot\frac{1}{25}\Rightarrow Q=50\ J$$

Γ3.

Αν $\omega'=2\omega\Rightarrow\omega'=100\pi$, $T'=\frac{2\pi}{100\pi}=\frac{1}{50}\ s$

$$V_0'=B\omega'NA=0,5\cdot100\pi\cdot2\cdot10^{-2}\cdot100\Rightarrow V_0'=100\pi\ V,\ V'_{EN}=\frac{100\pi}{\sqrt{2}}\ V$$

$$I'_{EN}=\frac{V'_{EN}}{R}=\frac{100\pi}{\sqrt{2}\cdot10}\Rightarrow I'_{EN}=\frac{10\pi}{\sqrt{2}}\ A$$

$$Q'=(I'_{EN})^2RT'=\frac{\cancel{100}\pi^2}{\cancel{2}}\cdot10\cdot\frac{1}{\cancel{50}}\Rightarrow Q'=100\ J$$

$$\pi=\frac{Q'-Q}{Q}\cdot100\%=\left(\frac{Q'}{Q}-1\right)\cdot100\%=\left(\frac{100}{50}-1\right)100\%=100\%$$

Γ4.

$$d = 2 \cdot 10^{-2}\ m,\ i_1 = 5\ A$$

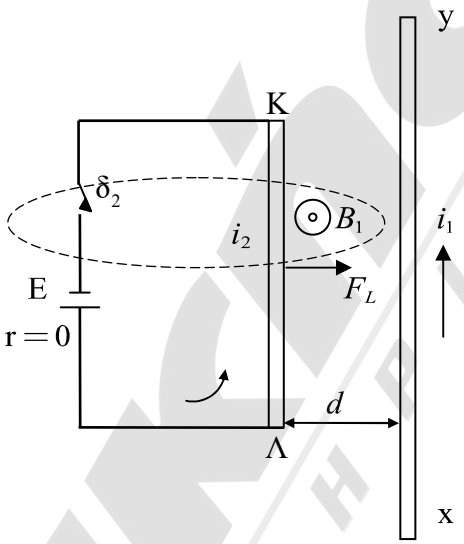
$$i_2 = \frac{E}{R} = \frac{20}{10} \Rightarrow \boxed{i_2 = 2\ A}$$

$$F_L = B_1 \cdot i_2 \cdot \ell \quad (1)$$

$$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2i_1}{d} = \frac{\mu_0}{4\pi} \cdot \frac{\cancel{2} \cdot 5}{\cancel{2} \cdot 10^{-2}} \Rightarrow B_1 = \frac{\mu_0}{4\pi} \cdot 500\ T$$

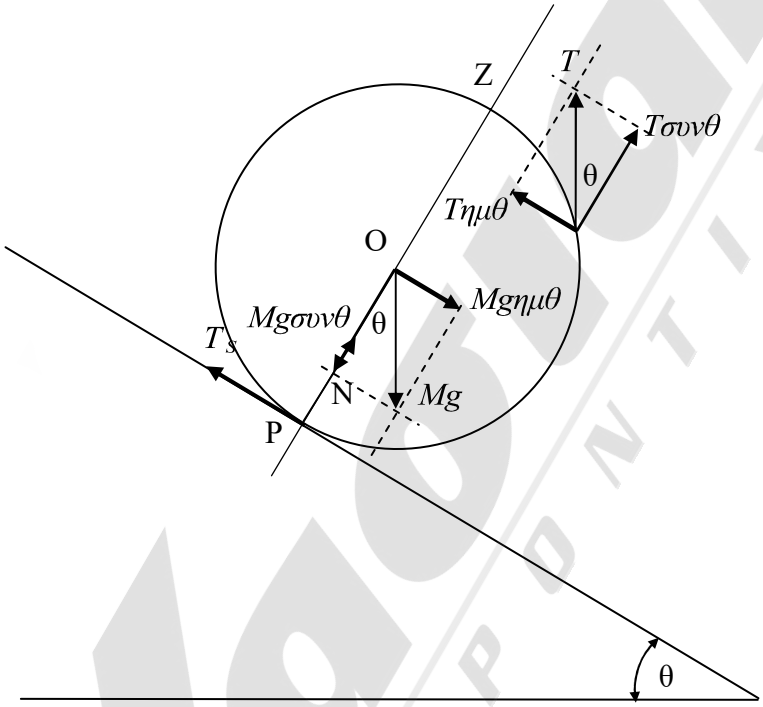
$$(1) \Rightarrow F_L = \frac{\mu_0}{4\pi} \cdot 500 \cdot 2 \cdot 1 \Rightarrow F_L = \frac{\mu_0}{\pi} \cdot 250\ N$$

ΕΙΤΕ $F_L = \frac{\mu_0}{4\pi} \cdot \frac{2I_1 I_2}{d} \ell \Rightarrow F_L = \frac{250\mu_0}{\pi} N$



ΘΕΜΑ Δ

Δ1.

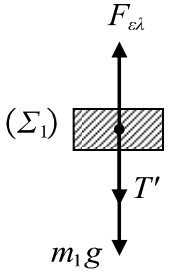


$$\Sigma \overrightarrow{\tau_{(O)}} = 0 \Rightarrow -T_S \cdot R + T \cdot R = 0 \Rightarrow T = T_S$$

$$\Sigma \overrightarrow{F_x} = 0 \Rightarrow T_S - Mg\eta\mu\theta + T\eta\mu\theta = 0 \Rightarrow T - 40 \cdot 0,6 + T \cdot 0,6 = 0 \Rightarrow$$

$$1,6T = 24 \Rightarrow T = \frac{24}{1,6} = 15\ N$$

$$F_{\varepsilon\lambda} = T' + m_1 g \Rightarrow k\Delta\ell = T + m_1 g \Rightarrow 60\Delta\ell = 1,5 + 15 \Rightarrow \Delta\ell = \frac{16,5}{60} = 0,5\ m$$



Δ2.

α) Όταν Ζ μηδενισθεί για 2η φορά θα έχει διαγράψει τόξο ίσο με την περίμετρο 1,5 κύκλου

άρα $\Delta S = 1,5 \cdot 2\pi R = 3\pi R = 3\pi \frac{9}{8\pi} \Rightarrow \Delta S = \frac{27}{8}\ m$

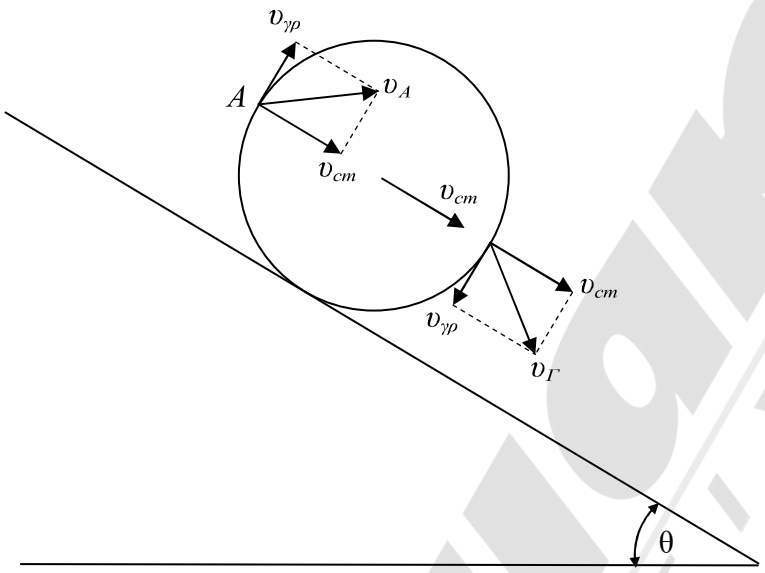
Επειδή είναι κύλιση, όσο περιστρέφεται τόσο θα μετατοπίζεται το κέντρο μάζας άρα

$$\Delta x = \Delta s = \frac{27}{8}\ m \Rightarrow \Delta x = 3,375\ m$$

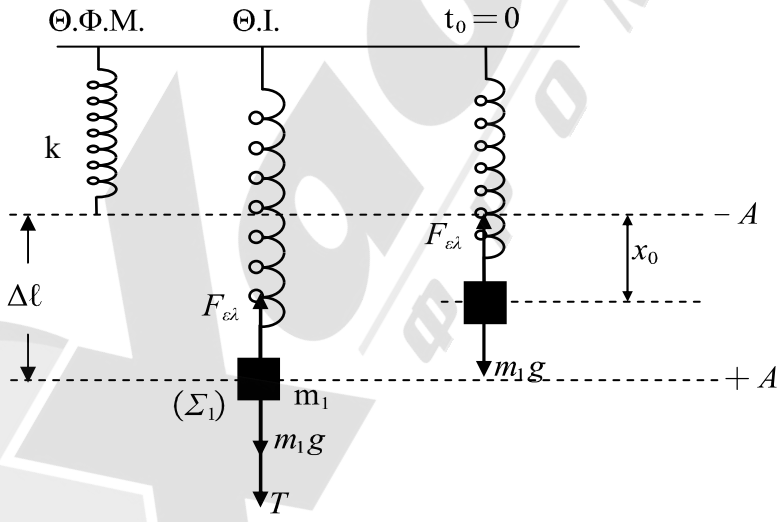
β) $x_{cm} = \frac{1}{2} a_{cm} t_1^{\,2} \Rightarrow a_{cm} = \frac{2x_{cm}}{t_1^{\,2}} \Rightarrow a_{cm} = \frac{2 \cdot \frac{27}{8}}{1,5^2} \Rightarrow a_{cm} = 3\ m/s^2$

$\upsilon_{cm} = a_{cm} \cdot t_1 = 3 \cdot 1,5 \Rightarrow \upsilon_{cm} = 4,5\ m/s$

$\upsilon_\Gamma = \upsilon_A = \sqrt{\upsilon_{cm}^{\,2} + \upsilon_{\gamma\rho}^{\,2}} = \sqrt{2\upsilon_{cm}^{\,2}} = \sqrt{2 \cdot 4,5^2} \Rightarrow \upsilon_A = 4,5\sqrt{2}\ m/s$



Δ3.



Το Σ_1 μετά το κόψιμο του νήματος αφού έχει $\upsilon = 0$ βρίσκεται σε ακραία θέση της ταλάντωσης και θα ταλαντωθεί γύρω από τη ΘI_2 του όπου

$$\Sigma \vec{F} = 0 \Rightarrow F_{\varepsilon\lambda} = m_1 g \Rightarrow k x_0 = m_1 g \Rightarrow x_0 = \frac{m_1 g}{k} = \frac{1,5 \cdot 10}{60} \Rightarrow x_0 = 0,25\ m$$

Άρα $A = \Delta\ell - x_0 \Rightarrow A = 0,25\ m$

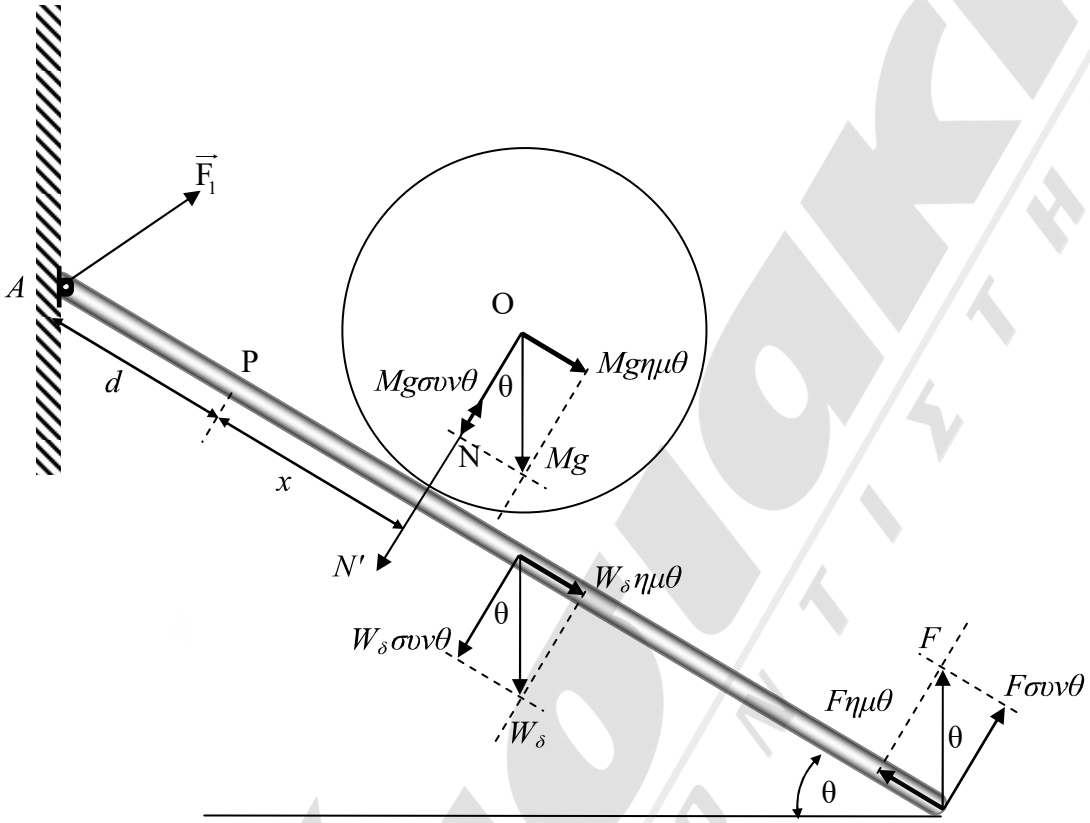
και $\varphi_0 = \frac{\pi}{2}$, $\omega = \sqrt{\frac{k}{m_1}} = \sqrt{\frac{60}{1,5}} = \sqrt{40} = 2\pi\ r/s$

οπότε $y = 0,25\eta\mu\left(2\pi t + \frac{\pi}{2}\right) \xrightarrow{t_1 = 1,5\ s} y = -0,25\sigma\upsilon\nu 3\pi = 0,25 \cdot (-1) = -0,25 = -A$

θα έχει την t_1 παραμόρφωση $\Delta\ell' = \Delta\ell - 2A = 0$ δηλαδή θα βρίσκεται στη ΘΦΜ.

$W_{t_0 \to t_1}^{F_{\epsilon\lambda}} = U_{\epsilon\lambda_{(t_0)}} - U_{\epsilon\lambda_{(t_1)}} = \frac{1}{2}k\Delta\ell^2 - 0 = \frac{1}{2} \cdot 60 \cdot 0,5^2 \Rightarrow W_{t_0 \to t_1}^{F_{\epsilon\lambda}} = 7,5\ J$

Δ4.



Για στεφάνη : $\Sigma\overrightarrow{F_y} = 0 \Rightarrow N = mg\sigma\upsilon\nu\theta = 40 \cdot 0,8 \Rightarrow N = 32\ N$

Για ράβδο που ισορροπεί : $\Sigma\overrightarrow{\tau_{(A)}} = 0 \Rightarrow m_\delta g\sigma\upsilon\nu\theta\frac{\ell}{2} - F\sigma\upsilon\nu\theta \cdot L + N'(d+x) = 0 \Rightarrow$

$10 \cdot 0,8 \cdot 2 - F \cdot 0,8 \cdot 4 + 32(0,5 + x) = 0 \Rightarrow 16 - 3,2F + 16 + 32x = 0 \Rightarrow$

$3,2F = 32 + 32x \Rightarrow F = 10 + 10x \quad (S.I.)$

για $x = 0 \Rightarrow F = 10\ N$, για $x = 3\ m \Rightarrow F = 40\ N$