ΦΥΣΙΚΗ ΚΑΤΕΥΘΥΝΣΗΣ
ΘΕΤΙΚΗΣ - ΤΕΧΝΟΛΟΓΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ
ΑΠΑΝΤΗΣΕΙΣ

ΘΕΜΑ Α

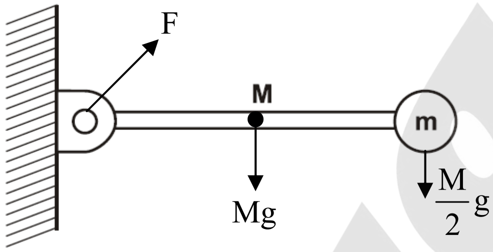
Α1. α. **Α2.** β **Α3.** α **Α4.** δ

Α5. **α.** Λ
β. Σ
γ. Σ
δ. Λ
ε. Σ

ΘΕΜΑ Β

Β1.

Σωστό το iii.



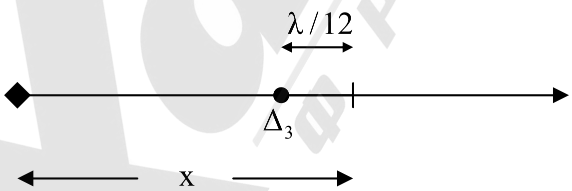
Για ράβδος – σώμα : $I_{ΟΛ} = I_ρ + \frac{M}{2}L^2 = \frac{1}{3}ML^2 + \frac{1}{2}ML^2 = \frac{5}{6}ML^2$

$$\Sigma\vec{\tau} = I_{ΟΛ}\cdot\vec{\alpha_\gamma} \Rightarrow Mg\frac{L}{2} + \frac{M}{2}gL = \frac{5}{6}ML^2\cdot\alpha_\gamma \Rightarrow \alpha_\gamma = \frac{6g}{5L}$$

Για ράβδο : $\left(\frac{\Delta\vec{L}}{\Delta t}\right)_\rho = \Sigma\vec{\tau_\rho} = I_\rho\cdot\alpha_\gamma = \frac{1}{3}ML^2\cdot\frac{6g}{5L} = \frac{2}{5}MgL$

Β2.

Σωστό το iii.



$$x = x_{\Delta_3} + \frac{\lambda}{12} = (2\kappa+1)\frac{\lambda}{4} + \frac{\lambda}{12} \xrightarrow[\kappa=2]{3ος\ δεσμός} x = \frac{5\lambda}{4} + \frac{\lambda}{12} = \frac{16\lambda}{12} = \frac{4\lambda}{3}$$

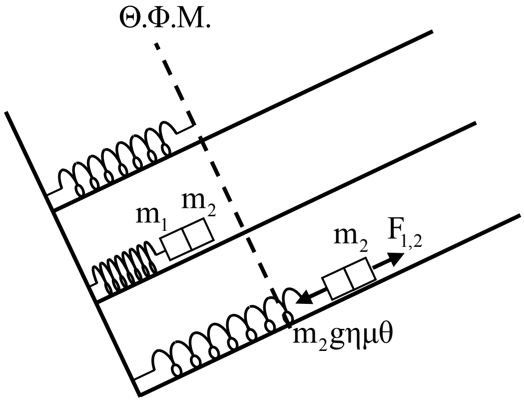
$$A' = 2A\left|συν2\pi\frac{x}{\lambda}\right| = 2A\left|συν2\pi\frac{4\lambda/3}{\lambda}\right| = 2A\left|συν\frac{8\pi}{3}\right| = 2A\left|συν\left(2\pi+\frac{2\pi}{3}\right)\right| =$$

$$= 2A\left|συν\frac{2\pi}{3}\right| = 2A\frac{1}{2} = A$$

Άρα $\boxed{A' = A}$

Β3.

Σωστό το i.



Για το σύστημα $K = D_{ολ} = \left(m_1 + m_2\right)\omega^2 \Rightarrow \omega = \sqrt{\dfrac{K}{m_1 + m_2}}$

Για το m_2 : $D_2 = m_2\omega^2$

Η πιθανή αποκόλληση θα συμβεί πάνω από τη θέση ισορροπίας, στην ακραία θέση ταλάντωσης του συστήματος

$$\Sigma F_2 = m_2 g\eta\mu\theta - F_{1,2} \overset{\Sigma F_2 = D_2 x}{\Rightarrow} D_2 x = m_2 g\eta\mu\theta - F_{1,2} \Rightarrow F_{1,2} = m_2 g\eta\mu\theta - D_2 x \Rightarrow$$

$$\xrightarrow[F_{1,2}=\min]{\text{όταν } x=A} F_{1,2_{(\min)}} = m_2 g\eta\mu\theta - \frac{m_2 k}{m_1 + m_2} A \xrightarrow{F_{1,2(\min)}} m_2 g\eta\mu\theta - \frac{m_2 k}{m_1 + m_2} A > 0 \Rightarrow$$

$$kA < \left(m_1 + m_2\right) g\eta\mu\theta$$

ΘΕΜΑ Γ

Γ1.

$$U_E = 8 \cdot 10^2\left(1 - i^2\right) \xrightarrow{i=0} U_{E\max} = 8 \cdot 10^2 \text{ J}$$

$$U_{E\max} = \frac{1}{2} C \cdot V^2 \Leftrightarrow C = \frac{2U_{E\max}}{V^2} = \frac{2 \cdot 8 \cdot 10^{-2}}{40^2} = 10^{-4} \text{ F}$$

$$\left.\begin{aligned} U_E &= 8 \cdot 10^{-2} - 8 \cdot 10^{-2} i^2 \\ U_E &= U_{E\max} - \frac{1}{2} L i^2 \end{aligned}\right\} \Rightarrow \frac{1}{2} L \cancel{i^2} = 8 \cdot 10^{-2} \cancel{i^2} \Rightarrow L = 16 \cdot 10^{-2} \text{H}$$

$$T = 2\pi\sqrt{LC} = 2\pi\sqrt{10^{-4} \cdot 16 \cdot 10^{-2}} = 2\pi \cdot 4 \cdot 10^{-3} \Rightarrow \boxed{T = 8\pi \cdot 10^{-3} \text{ s}}$$

Γ2.

$$U_E = U_{E\max}\sigma\upsilon\nu^2\omega t = 8 \cdot 10^{-2} \cdot \sigma\upsilon\nu^2 \frac{2\pi}{\cancel{T}} \cdot \frac{\cancel{T}}{12} = 8 \cdot 10^{-2} \sigma\upsilon\nu^2 \frac{\pi}{6} = 6 \cdot 10^{-2} \text{ J}$$

Γ3.

$$E_{ΟΛ} = U_E + U_B \Rightarrow U_{E_{\max}} = U_E + \frac{U_E}{3} \Rightarrow U_{E_{\max}} = \frac{4}{3} U_E \Rightarrow U_{E_{\max}} = \frac{4}{3}\frac{1}{2}\frac{q^2}{C} \Rightarrow q = \pm\sqrt{\frac{3U_{E_{\max}} \cdot C}{2}} \Rightarrow$$

$$\Rightarrow q = \pm\sqrt{\frac{3\cdot 8\cdot 10^{-2}\cdot 10^{-4}}{2}} \Rightarrow q = \pm 2\sqrt{3}\cdot 10^{-3}\ \text{C}$$

$$\frac{\Delta i}{\Delta t} = \left|-\frac{Vi}{i}\right| = \frac{V_C}{L} = \frac{q}{LC} = \frac{2\sqrt{3}\cdot 10^{-3}}{16\cdot 10^{-2}\cdot 10^{-4}} = \frac{\sqrt{3}}{8}\cdot 10^3\ \frac{\text{A}}{\text{s}} = 125\sqrt{3}\ \frac{\text{A}}{\text{s}}$$

Γ4.

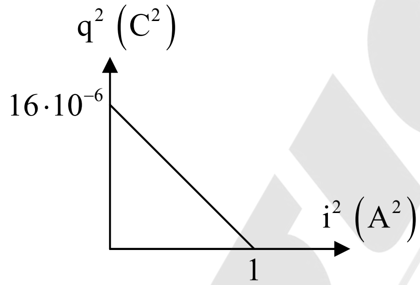
$$U_{B\max} = \frac{1}{2}LI^2 \Rightarrow 8\cdot 10^{-2} = \frac{1}{2}\cdot 16\cdot 10^{-2}\cdot I^2 \Rightarrow \boxed{I = 1\text{A}}$$

$$\omega = \frac{2\pi}{T} \Rightarrow \omega^2 = \frac{1}{16\cdot 10^{-6}}$$

$$\text{ΑΔΕ}_{\text{ταλ.}}:\ U_E + U_B = E_{ΟΛ} \Rightarrow \frac{1}{2}\frac{q^2}{C} + \frac{1}{2}Li^2 = \frac{1}{2}LI^2 \Rightarrow q^2 = \frac{I^2 - i^2}{\omega^2} \Rightarrow q^2 = \frac{I^2}{\omega^2} - \frac{i^2}{\omega^2} \Rightarrow$$

$$q^2 = 16\cdot 10^{-6} - 16\cdot 10^{-6} i^2$$

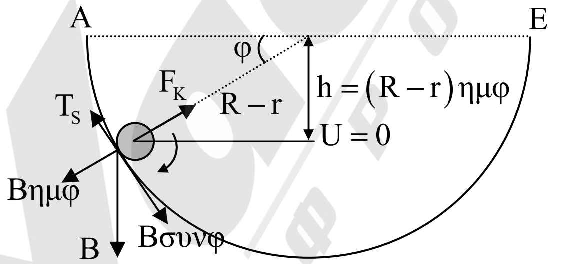
Είναι τη μορφής $y = \beta - \alpha\cdot x$ με $0 < i^2 < I = 1$



ΘΕΜΑ Δ

$m = 1,4\ \text{kgr}$

$r = \frac{R}{8}$



Δ1.

$$\Sigma\vec{\tau} = I\vec{\alpha_\gamma} \Rightarrow T_s\cdot r = I\cdot\alpha_\gamma \Rightarrow T_s\cdot \not{r} = \frac{2}{5}mr^{\not{2}}\cdot\alpha_\gamma\ (1)$$

$$\Sigma\vec{F} = m\vec{\alpha_{cm}} \Rightarrow Β\sigma\upsilon\nu\varphi - T_s = m\alpha_{cm} \xrightarrow[(3)]{(2)} mg\sigma\upsilon\nu\varphi - \frac{2}{5}m\not{r}\frac{\alpha_{cm}}{\not{r}} = m\alpha_{cm} \Rightarrow mg\sigma\upsilon\nu\varphi = \frac{7}{5}m\alpha_{cm} \Rightarrow$$

$$\alpha_{cm} = \frac{5}{7}g\sigma\upsilon\nu\varphi = \frac{50}{7}\sigma\upsilon\nu\varphi$$

$$T_s = \frac{2}{5}m\not{r}\frac{\alpha_{cm}}{\not{r}} = \frac{2}{5}m\frac{50}{7}\sigma\upsilon\nu\varphi \Rightarrow T_s = \frac{20}{7}\cdot 1,4\sigma\upsilon\nu\varphi \Rightarrow \boxed{T_s = 4\sigma\upsilon\nu\varphi}$$

Δ2.

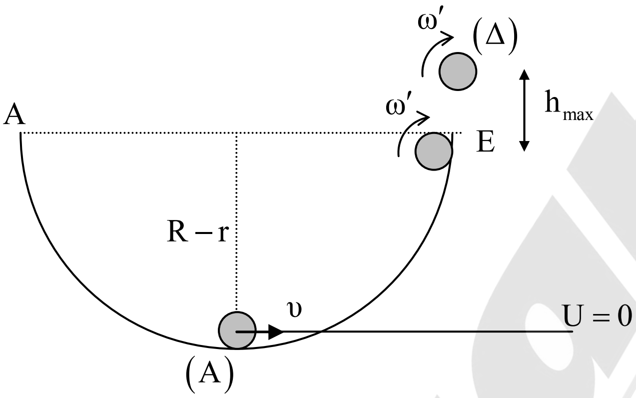
$$\Sigma\vec{F_R} = m\vec{\alpha_K} \Rightarrow F_K - mg\eta\mu\varphi = m\frac{\upsilon_{cm}^2}{R-r} \Rightarrow F_K = mg\eta\mu\varphi + m\frac{\upsilon_{cm}^2}{R-r}\ (2)$$

$$\text{ΑΔΜΕ}: \ mgh + 0 = \frac{1}{2}m\upsilon_{cm}^2 + \frac{1}{2}I\omega^2 + 0 \Rightarrow \cancel{m}g(R-r)\eta\mu\varphi = \frac{1}{2}\cancel{m}\upsilon_{cm}^2 + \frac{1}{\cancel{2}}\frac{\cancel{2}}{5}\cancel{r^2}\frac{\upsilon_{cm}^2}{\cancel{r^2}} \Rightarrow$$

$$g(R-r)\eta\mu\varphi = \frac{7}{10}\upsilon_{cm}^2 \Rightarrow \upsilon_{cm}^2 = \frac{10}{7}g(R-r)\eta\mu\varphi\ (3)$$

$$(2) \rightarrow F_K = mg\eta\mu\varphi + m\frac{\frac{10}{7}g\cancel{(R-r)}\eta\mu\varphi}{\cancel{R-r}} = \frac{17}{7}mg\eta\mu\varphi = \frac{17}{7}\cdot 1,4\cdot 10\cdot\frac{1}{2} \Rightarrow N = 17\ N$$

Δ3.



$$\text{ΑΔΜΕ (Α,Ε)}: \ \frac{1}{2}m\upsilon^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}m\upsilon'^2 + \frac{1}{2}I\omega'^2 + mg(R-r) \Leftrightarrow$$

$$\Rightarrow \frac{1}{2}m\upsilon^2 + \frac{1}{\cancel{2}}\cdot\frac{\cancel{2}}{5}m\cancel{r^2}\frac{\upsilon^2}{\cancel{r^2}} = \frac{1}{2}m\omega'^2r^2 + \frac{1}{5}m\omega'^2r^2 + \frac{7}{8}mgR \Rightarrow$$

$$\frac{7}{10}m\upsilon^2 = \frac{7}{10}m\omega'^2r^2 + \frac{7}{8}mgR \Rightarrow \frac{7}{10}\cancel{m}\upsilon^2 + \frac{7}{8}\cancel{m}gR = \frac{7}{10}\cancel{m}\omega'^2r^2 \Rightarrow \boxed{\omega' = 20\ rad/s}$$

ΑΔΜΕ (Ε, Δ) :

$$\frac{1}{2}m\upsilon'^2 + \frac{1}{\cancel{2}}\cancel{I\omega'^2} + 0 = 0 + \frac{1}{\cancel{2}}\cancel{I\omega'^2} + mgh_{max} \Rightarrow \frac{1}{2}m\omega'^2r'^2 = mgh_{max} \Rightarrow$$

$$\Rightarrow h_{max} = \frac{\omega'^2r'^2}{2g} = \frac{20^2\cdot 0,2^2}{2\cdot 10} \Rightarrow h_{max} = 0,8\ m$$

Δ4.

Μετά την απώλεια της επαφής $T_S = 0 \Rightarrow \Sigma\tau = 0$ και η σφαίρα εκτελεί ομαλή περιστροφική κίνηση και ομαλά επιβαδυνόμενη μεταφορική κίνηση.

$$\frac{\Delta K}{\Delta t} = P_{\Sigma F} + P_{\Sigma\tau} = \Sigma F\cdot\upsilon' + \Sigma\tau\cdot\omega' = -mg\cdot\upsilon' = -mg\omega'r' = -14\cdot 20\cdot 0,2 = -56\ W$$

$$\frac{\Delta L}{\Delta t} = \Sigma\tau = 0$$