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ΑΠΑΝΤΗΣΕΙΣ ΣΤΗ ΦΥΣΙΚΗ ΚΑΤΕΥΘΥΝΣΗΣ

ΘΕΜΑ Α

Α1. δ
Α2. α
Α3. β
Α4. γ
Α5. **α.** Σωστό, **β.** Λάθος, **γ.** Λάθος, **δ.** Σωστό, **ε.** Σωστό.

ΘΕΜΑ Β

Β1. γ

Αιτιολόγηση :

$$|A| = 2A\cdot συν\left(π\cdot\frac{x_1 - x_2}{λ}\right) = 2A\cdot συν\frac{π}{4} = \sqrt{2}A$$

Β2. γ

Αιτιολόγηση :

Δ1 κλειστός, Δ2 ανοιχτός

$$t_0 = 0 : Q_{1_{max}} = Q,\ i = 0$$

$$t_1 = \frac{7T_1}{4} : i = -I\cdot ημω_1 t_1 = -I\cdot ημ\left(\frac{2π}{T_1}\cdot\frac{7T_1}{4}\right) = -I\cdot ημ\frac{7π}{2} = I$$

Δ1 ανοιχτός, Δ2 κλειστός

$$t_0 = 0 : q = Q,\ i = I$$

Α.Δ.Ε.

$$\frac{1}{2}Li^2 + \frac{1}{2}\cdot\frac{q^2}{C_2} = \frac{1}{2}\cdot\frac{Q_{2_{max}}{}^2}{C_2} \Rightarrow \frac{\cancel{1}}{\cancel{2}}LI^2 + \frac{\cancel{1}}{\cancel{2}}\cdot\frac{Q^2}{C_2} = \frac{\cancel{1}}{\cancel{2}}\cdot\frac{Q_{2_{max}}{}^2}{C_2} \overset{I = ω_1 Q}{\Rightarrow}$$

$$Lω_1^2 Q^2 + \frac{Q^2}{C_2} = \frac{Q_{2_{max}}{}^2}{C_2} \overset{ω_1 = \frac{1}{\sqrt{LC_1}}}{\Rightarrow} \cancel{L}\frac{1}{\cancel{L}C_1}Q^2 + \frac{Q^2}{C_2} = \frac{Q_{2_{max}}{}^2}{C_2} \overset{C_2 = 2C_1}{\Rightarrow}$$

$$\frac{Q^2}{C_1} + \frac{Q^2}{2C_1} = \frac{Q_{2_{max}}{}^2}{2C_1} \Rightarrow Q_{2_{max}}{}^2 = 3Q^2 \Rightarrow Q_{2_{max}} = \sqrt{3}Q$$

B3. β

Αιτιολόγηση :

$$y_1 = A \cdot ημ\left(ωt + \frac{π}{3}\right), \quad y_2 = \sqrt{3}A \cdot ημ\left(ωt - \frac{π}{6}\right)$$

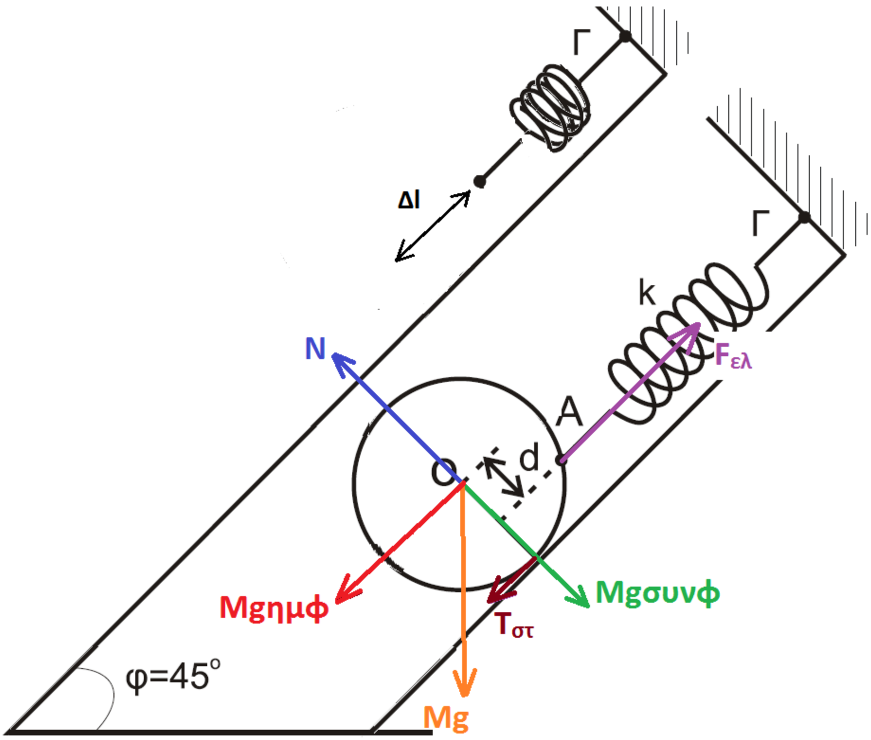
$$A' = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cdot συν(φ_{02} - φ_{01})}$$

$$= \sqrt{A^2 + \left(\sqrt{3}A\right)^2 + 2A \cdot \sqrt{3}A \cdot συν\left(-\frac{π}{6} - \frac{π}{3}\right)}$$

$$= \sqrt{A^2 + 3A^2 + \cancel{2\sqrt{3}A^2 \cdot συν\left(-\frac{π}{2}\right)}} = \sqrt{4A^2} = 2A$$

$$\left.\begin{aligned} E_1 &= \frac{1}{2}DA^2 \\ E_2 &= \frac{1}{2}D\left(\sqrt{3}A\right)^2 = 3\,\frac{1}{2}DA^2 \\ E_{ολ} &= \frac{1}{2}DA'^2 = \frac{1}{2}D\,(2A)^2 = 4\,\frac{1}{2}DA^2 \end{aligned}\right\} \Rightarrow \quad E_{ολ} = E_1 + E_2$$

ΘΕΜΑ Γ



Γ1. Ο δίσκος ισορροπεί

$$\sum F_x = 0 \Rightarrow M g ημφ + T_{στ} = F_{ελ} \quad (1)$$

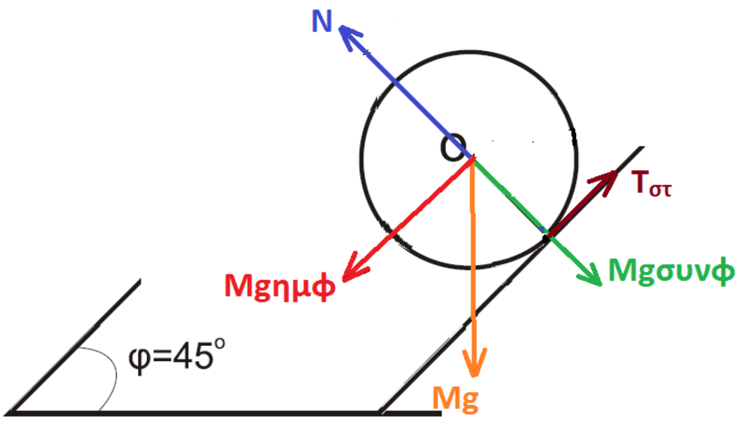
$$\sum τ_{(O)} = 0 \Rightarrow F_{ελ} \cdot \frac{\cancel{R}}{2} - T_{στ} \cdot \cancel{R} = 0 \Rightarrow T_{στ} = \frac{F_{ελ}}{2} \quad (2)$$

$$(1), (2) \overset{F_{ελ} = k \cdot Δl}{\Rightarrow} M g ημφ + \frac{k \cdot Δl}{2} = k \cdot Δl \Rightarrow M g ημφ = \frac{k \cdot Δl}{2} \Rightarrow$$

$$Δl = \frac{2 M g ημφ}{k} = \frac{2 \cdot 2\cancel{\sqrt{2}} \cdot 1\cancel{0} \cdot \frac{\cancel{\sqrt{2}}}{\cancel{2}}}{10\cancel{0}} = \mathbf{0,4\ m}$$

Γ2. $(2) \Rightarrow T_{στ} = \frac{k \cdot Δl}{2} = \frac{100 \cdot 0,4}{2} = \mathbf{20\ N}$

Γ3. Το ελατήριο κόβεται



Κύλιση χωρίς ολίσθηση, άρα $α_{cm} = α_{γων} \cdot R \quad (1)$

$$\sum F_x = M \cdot α_{cm} \Rightarrow M g ημφ - T_{στ} = M \cdot α_{cm} \quad (2)$$

$$\sum τ_{(O)} = I \cdot α_{γων} \overset{(1)}{\Rightarrow} T_{στ} \cdot \cancel{R} = \frac{1}{2} M R^{\cancel{2}} \cdot \frac{α_{cm}}{\cancel{R}} \Rightarrow T_{στ} = \frac{1}{2} M α_{cm} \quad (3)$$

$$(2) \overset{(3)}{\Rightarrow} \cancel{M} g ημφ - \frac{1}{2} \cancel{M} α_{cm} = \cancel{M} α_{cm} \Rightarrow g ημφ = \frac{3}{2} α_{cm} \Rightarrow$$

$$α_{cm} = \frac{2 g ημφ}{3} = \frac{2 \cdot 10 \cdot \frac{\sqrt{2}}{2}}{3} = \mathbf{\frac{10\sqrt{2}}{3}\ m/s^2}$$

Γ4. Λόγω μεταφορικής κίνησης

$$S = \frac{1}{2}\alpha_{cm}t^2 \Rightarrow t = \sqrt{\frac{2S}{\alpha_{cm}}} = \sqrt{\frac{2 \cdot 0,3\sqrt{2}}{\frac{10\sqrt{2}}{3}}} = \sqrt{\frac{18}{100}} = \frac{3\sqrt{2}}{10}\ \text{s}$$

Λόγω στροφικής κίνησης

$$\omega = \alpha_{\gamma\omega\nu} t \overset{(1)}{\Rightarrow} \omega = \frac{\alpha_{cm}}{R} t \Rightarrow \omega = \frac{10\sqrt{2} \cdot \cancel{10}}{\cancel{3}} \cdot \frac{\cancel{3}\sqrt{2}}{\cancel{10}} = 20\ \text{rad/s}$$

$$L = I \cdot \omega = \frac{1}{2}MR^2 \cdot \omega = \frac{1}{\cancel{2}}\cancel{2}\sqrt{2} \cdot 0,01 \cdot 20 = \mathbf{0,2\sqrt{2}\ Kg\ \frac{m^2}{s}}$$

ΘΕΜΑ Δ

Δ1. Πριν : $P_{\pi\rho\iota\nu} = m \cdot u$ (1)

Μετά : $P_{\mu\varepsilon\tau\acute{\alpha}} = \sqrt{P'^2_1 + P'^2_2 + 2P'_1P'_2\sigma\upsilon\nu\varphi}$

$= \sqrt{m^2u_1^2 + m^2u_2^2 + 2m^2u_1u_2\sigma\upsilon\nu\varphi}$ (2)

Από Α.Δ.Ο. και τις (1), (2) $\Rightarrow$

$$m \cdot u = \sqrt{m^2u_1^2 + m^2u_2^2 + 2m^2u_1u_2\sigma\upsilon\nu\varphi} \Rightarrow$$

$$\cancel{m^2}u^2 = \cancel{m^2}u_1^2 + \cancel{m^2}u_2^2 + 2\cancel{m^2}u_1u_2\sigma\upsilon\nu\varphi \Rightarrow$$

$$u^2 = u_1^2 + u_2^2 + 2u_1u_2\sigma\upsilon\nu\varphi \quad (3)$$

Από Α.Δ.Κ.Ε. $\cancel{m}u^2 = \cancel{m}u_1^2 + \cancel{m}u_2^2 \Rightarrow u^2 = u_1^2 + u_2^2$ (4)

Από (3) και (4) έχουμε $2u_1u_2\sigma\upsilon\nu\varphi = 0 \Rightarrow$

$\sigma\upsilon\nu\varphi = 0 \Rightarrow$ $\boldsymbol{\varphi = \frac{\pi}{2}}$ **rad**

$$\textbf{Δ2.}\ u^2 = u_1^2 + u_2^2 \overset{u_2 = \frac{u_1}{\sqrt{3}}}{\Rightarrow} \frac{16}{9} = u_1^2 + \frac{u_1^2}{3} \Rightarrow \frac{16}{9} = \frac{4u_1^2}{3} \Rightarrow$$

$$u_1^2 = \frac{12}{9} \Rightarrow \mathbf{u_1 = \frac{2\sqrt{3}}{3}\ m/s}$$

$$u_2 = \frac{u_1}{\sqrt{3}} \Rightarrow u_2 = \frac{\frac{2\sqrt{3}}{3}}{\sqrt{3}} \Rightarrow \mathbf{u_2 = \frac{2}{3}\ m/s}$$

Δ3. Από Α.Δ.Ο. $\vec{P}_{πριν} = \vec{P}_{μετά} \Rightarrow m_1 \cdot u_1 = (M + m_1)\cdot u_Σ \Rightarrow$

$$u_Σ = \frac{m_1 \cdot u_1}{M + m_1} \Rightarrow u_Σ = \frac{1\cdot \frac{2\sqrt{3}}{3}}{3 + 1} = \frac{\sqrt{3}}{6}\ \text{m/s}$$

$$ΔK = K_{τελ} - K_{αρχ} = \frac{1}{2}(M + m_1)u_Σ^2 - \frac{1}{2}m_1u_1^2$$

$$= \frac{1}{2}(3 + 1)\cdot\left(\frac{\sqrt{3}}{6}\right)^2 - \frac{1}{2}1\cdot\left(\frac{2\sqrt{3}}{3}\right)^2 = \frac{1}{6} - \frac{2}{3} = \mathbf{-\frac{1}{2}\ Joule}$$

Δ4. Θ.Μ.Κ.Ε. $K_{τελ} - K_{αρχ} = W_{τρ} + W_{Fελ} \Rightarrow$

$$-\frac{1}{2}(M + m_1)u_Σ^2 = -μ\cdot N\cdot x_{max} - \frac{1}{2}kx_{max}^2 \overset{N=(M+m_1)g}{\Rightarrow}$$

$$-\frac{1}{2}(M + m_1)u_Σ^2 = -μ\cdot(M + m_1)g\cdot x_{max} - \frac{1}{2}kx_{max}^2 \Rightarrow$$

$$-\frac{1}{2}4\left(\frac{\sqrt{3}}{6}\right)^2 = -\frac{1}{12}\cdot 4\cdot 10\cdot 2\cdot 10^{-2} - \frac{1}{2}k\cdot 4\cdot 10^{-4} \Rightarrow$$

$$-\frac{1}{6} = -\frac{1}{15} - \frac{k}{5000} \Rightarrow \frac{k}{5000} = \frac{1}{10} \Rightarrow \mathbf{k = 500\ N/m}$$