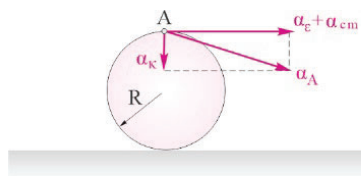
Λύσεις κριτηρίου 13

ΘΕΜΑ Α

Α1. (β) **Α2.** (δ) **Α3.** (β) **Α4.** (α) **Α5.** α. Λ β. Σ γ. Σ δ. Λ ε. Λ

ΘΕΜΑ Β

Β1. (i)



$$\alpha_\varepsilon = \frac{\Delta\upsilon_{\gamma\rho}}{\Delta t} = \frac{\Delta(\omega R)}{\Delta t} = R\frac{\Delta\omega}{\Delta t} = R\alpha_{\gamma\omega\nu} = \alpha_{cm}$$

$$\alpha_A = \sqrt{(\alpha_\varepsilon + \alpha_{cm})^2 + \alpha_\kappa^{\ 2}} \Rightarrow$$

$$2\sqrt{2}\alpha_{cm} = \sqrt{(2\alpha_{cm})^2 + \alpha_\kappa^{\ 2}} \Rightarrow \alpha_\kappa = 2\alpha_{cm} \quad (1)$$

$$\alpha_\kappa = \frac{\upsilon_{\gamma\rho}^{\ 2}}{R} = \omega^2 R,$$

Από την (1) και τη σχέση $\omega = \alpha_{\gamma\omega\nu} t$

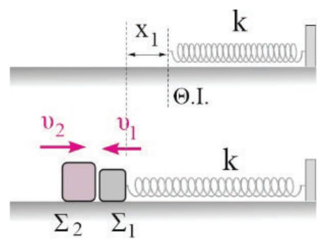
$$\omega^2 R = 2\alpha_{cm} \Rightarrow \omega = \sqrt{\frac{2\alpha_{cm}}{R}} = \sqrt{2\alpha_{\gamma\omega\nu}} \Rightarrow \alpha_{\gamma\omega\nu} t = \sqrt{2\alpha_{\gamma\omega\nu}} \Rightarrow t = \sqrt{\frac{2}{\alpha_{\gamma\omega\nu}}}$$

Β2. (ii)

$$\text{ΑΔΕΤ}: \ E = K + U \Rightarrow \frac{1}{2}kA_1^{\ 2} = \frac{1}{2}m\upsilon_1^{\ 2} + \frac{1}{2}kx_1^{\ 2}$$

Ομοίως για τη νέα ταλάντωση

$$\frac{1}{2}kA_2^{\ 2} = \frac{1}{2}m\upsilon_1'^{2} + \frac{1}{2}kx_1^{\ 2}$$



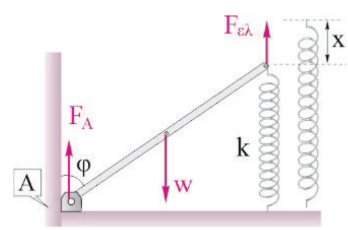
Επειδή $A_1 = A_2$, άρα και $\upsilon_1 = -\upsilon_1'$

$$\upsilon_1' = -\upsilon_1 \Rightarrow \frac{m_1 - m_2}{m_1 + m_2}\upsilon_1 + \frac{2m_2}{m_1 + m_2}\upsilon_2 = -\upsilon_1 \Rightarrow$$

$$-\frac{\upsilon_1}{2} + \frac{3\upsilon_2}{2} = -\upsilon_1 \Rightarrow \upsilon_2 = -\frac{\upsilon_1}{3}$$

$$\upsilon_2' = \frac{2m_1}{m_1 + m_2}\upsilon_1 + \frac{m_2 - m_1}{m_1 + m_2}\upsilon_2 \Rightarrow \upsilon_2' = \frac{\upsilon_1}{3}$$

Β3. (iii)



$$\Sigma\tau_{(A)} = 0 \Rightarrow w\frac{L}{2}\eta\mu\varphi = F_{\varepsilon\lambda}L\eta\mu\varphi \Rightarrow F_{\varepsilon\lambda} = \frac{w}{2} \Rightarrow$$

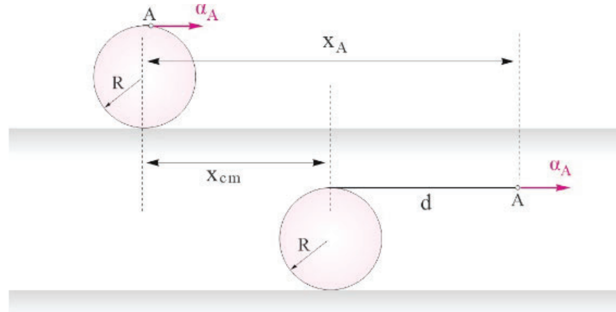
$$kx = \frac{mg}{2} \Rightarrow x = \frac{mg}{2k} = \frac{L}{2}$$

$$\sigma\upsilon\nu\varphi = \frac{L - x}{L} = \frac{1}{2}$$

ΘΕΜΑ Γ

Γ1. $\upsilon_A = \upsilon_{cm} + \upsilon_{\gamma\rho} = 2\upsilon_{cm} \Rightarrow \frac{\Delta\upsilon_A}{\Delta t} = \frac{\Delta(2\upsilon_{cm})}{\Delta t} \Rightarrow \alpha_A = 2\alpha_{cm} \Rightarrow \alpha_{cm} = 1m/s^2$

$x_{cm} = \frac{1}{2}\alpha_{cm}t_1^2 = 8m$



Γ2. $x_A = \frac{1}{2}\alpha_A t_1^2 = 16m$

$d = x_A - x_{cm} = 8m$

Γ3. $\upsilon_{cm} = \alpha_{cm}t_1 = 4m/s$

$\upsilon_{cm} = \omega R \Rightarrow \omega = 20rad/s$

Γ4. $\alpha_{cm} = \alpha_{\gamma\omega\nu}R \Rightarrow \alpha_{\gamma\omega\nu} = 5rad/s^2$

$\theta_3 = \frac{1}{2}\alpha_{\gamma\omega\nu}t_3^2 = 22,5rad$

$\theta_4 = \frac{1}{2}\alpha_{\gamma\omega\nu}t_4^2 = 40rad$, $N = \frac{\Delta\theta}{2\pi} = \frac{\theta_4 - \theta_3}{2\pi} = \frac{35}{4\pi}$ στροφές

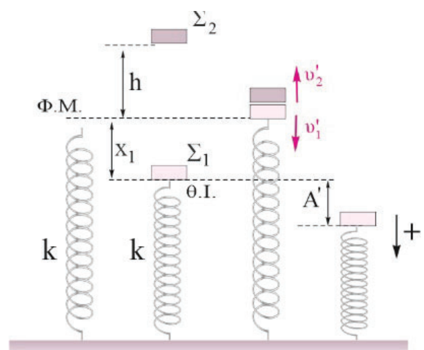
Γ5. $\theta_5 = \omega\Delta t = 20 \cdot 1 = 20rad$, $\theta_{o\lambda} = \theta_4 + \theta_5 = 60rad$

ΘΕΜΑ Δ

Δ1. $\Delta t = \frac{T}{2} \Rightarrow 0,1\pi s = \frac{T}{2} \Rightarrow T = 0,2\pi s$

$T = 2\pi\sqrt{\frac{m_1}{k}} \Rightarrow m_1 = 3kg$

Δ2. Το σώμα Σ_1 φτάνει κάθε μία περίοδο στη θέση φυσικού μήκους του ελατηρίου, άρα αυτή είναι ακραία θέση της ταλάντωσης.



$\theta.\iota.: \Sigma F = 0 \Rightarrow m_1 g = F_{\varepsilon\lambda} = kx_1 \Rightarrow x_1 = \frac{m_1 g}{k} = 0,1m$

$A = x_1 = 0,1m$

Όταν το σώμα Σ_1 διανύσει από την κατώτερη θέση απόσταση s=0,2m, θα βρεθεί στην ανώτερη θέση της ταλάντωσης, στη θέση φυσικού μήκους του ελατηρίου και θα έχει ταχύτητα ίση με μηδέν.

$A\Delta ME: K_2 = U_{\alpha\rho\chi} \Rightarrow \frac{1}{2}m_2\upsilon_2^2 = m_2 gh \Rightarrow \upsilon_2 = 2,5\sqrt{3}m/s$

$K_2' = \frac{1}{2}m_2\upsilon_2'^2 \Rightarrow \upsilon_2' = \frac{\sqrt{3}}{2}m/s$

$A\Delta O: P_{\alpha\rho\chi} = P_{\tau\varepsilon\lambda} \Rightarrow m_2\upsilon_2 = m_1\upsilon_1' - m_2\upsilon_2' \Rightarrow \upsilon_1' = \sqrt{3}\ m/s$

Δ3.

$$\text{ΑΔΕΤ}: \frac{1}{2}kA'^2 = \frac{1}{2}m_1\upsilon_1'^2 + \frac{1}{2}kx_1^2 \Rightarrow A' = 0,2m, \ \omega = \sqrt{\frac{k}{m_1}} \Rightarrow \omega = 10rad/s$$

$$\upsilon_{max} = \omega A' = 2m/s$$

Δ4.

$$x = A'\eta\mu\varphi = 0,2\eta\mu\frac{2\pi}{3} = 0,1\sqrt{3}m \qquad \upsilon = \upsilon_{max}\sigma\upsilon\nu\varphi = 2\sigma\upsilon\nu\frac{2\pi}{3} = -1m/s$$

$$\frac{dK}{dt} = \frac{dW_{F_{\varepsilon\pi}}}{dt} = F_{\varepsilon\pi}\upsilon = -kx\upsilon \Rightarrow \frac{dK}{dt} = 30\sqrt{3}J/s$$

Δ5. $$\frac{F_{\varepsilon\lambda}}{F_{\varepsilon\pi}} = \frac{k(A' - x_1)}{kA'} = \frac{1}{2}$$