Λύσεις κριτηρίου 11

ΘΕΜΑ Α

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

ΘΕΜΑ Β

Β1. (i)

$$\text{ΑΔΕΤ}: \ E = K + U \Rightarrow \frac{1}{2}m\upsilon^2 = \frac{1}{2}DA^2 - \frac{1}{2}Dx^2 \Rightarrow$$

$$\frac{1}{2}m\upsilon^2 = \frac{1}{2}m\omega^2A^2 - \frac{1}{2}m\omega^2x^2 \Rightarrow |\upsilon| = \omega A\frac{\sqrt{2}}{2}$$

$$\left|\frac{dK}{dt}\right| = \left|\frac{W_{F_{\varepsilon\pi}}}{\Delta t}\right| = |F_{\varepsilon\pi}\upsilon| = kx|\upsilon| \Rightarrow \left|\frac{dK}{dt}\right| = kA\frac{\sqrt{2}}{2}\omega A\frac{\sqrt{2}}{2} = \frac{1}{2}kA^2\frac{2\pi}{T} \Rightarrow \left|\frac{dK}{dt}\right| = \frac{2\pi E}{T}$$

Β2. (ii)

$$t_1 = t_2 \Rightarrow \frac{T_1}{4} = \frac{T_2}{4} \Rightarrow 2\pi\sqrt{\frac{m_1}{k_1}} = 2\pi\sqrt{\frac{m_2}{k_2}} \Rightarrow m_1 = 3m_2$$

$$\upsilon_{2,max} = \omega_2A_2 = \omega_1 3A_1 = 3\upsilon_{1,max} \Rightarrow \upsilon_2 = -3\upsilon_1 \quad (1)$$

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

Παίρνοντας υπόψη την (1) προκύπτει $\upsilon_2' = -\upsilon_2$

Άρα, μετά από κάθε κρούση τα σώματα επιστέφουν με αντίθετες ταχύτητες. Το χρονικό διάστημα μεταξύ δύο διαδοχικών κρούσεων αντιστοιχεί σε μισή περίοδο.

$$S_{ολ} = S_1 + S_2 = 5A_1 + 5A_2 = 20A_1$$

Β3. (iii)

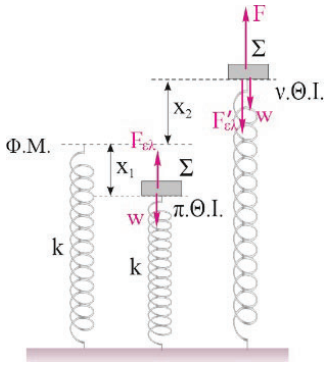
$$Q_1 = E_0 - E_1 \Rightarrow \frac{8E_0}{9} = E_0 - E_1 \Rightarrow E_1 = \frac{E_0}{9} \Rightarrow \frac{1}{2}DA_1^2 = \frac{1}{9}\frac{1}{2}DA_0^2 \Rightarrow A_1 = \frac{1}{3}A_0$$

$$A_1 = A_0e^{-\Lambda t_1} \Rightarrow e^{-\Lambda t_1} = \frac{1}{3}$$

$$A_2 = A_0e^{-\Lambda t_2} = A_0e^{-\Lambda 2t_1} = A_0\left(e^{-\Lambda t_1}\right)^2 = A_0\left(\frac{1}{3}\right)^2 \Rightarrow A_2 = \frac{A_0}{9}$$

ΘΕΜΑ Γ

Γ1. $\Pi.\Theta.\text{I.}\ \Sigma F = 0 \Rightarrow F_{\varepsilon\lambda} = w \Rightarrow x_1 = \dfrac{mg}{k} = 0,2m$



$\text{N.}\Theta.\text{I.}\ \Sigma F = 0 \Rightarrow F = F_{\varepsilon\lambda}' + w \Rightarrow x_2 = \dfrac{F - mg}{k} = 0,2m$

$\Theta\text{MKE}: K_{\tau\varepsilon\lambda} - K_{\alpha\rho\chi} = W_F + W_w + W_{F_{\varepsilon\lambda}} \Rightarrow$

$\dfrac{1}{2}m\upsilon_{1,max}{}^2 = F(x_1 + x_2) - mg(x_1 + x_2) + \dfrac{1}{2}kx_1{}^2 - \dfrac{1}{2}kx_2{}^2$

$\Rightarrow \upsilon_{1,max} = \sqrt{8}m/s$

Γ2. $W_F = E \Rightarrow F(x_1 + x_2) = \dfrac{1}{2}kA^2 \Rightarrow A = 0,4\sqrt{2}m$

Γ3. $\upsilon_{2,max} = \omega A = \sqrt{\dfrac{k}{m}}A \Rightarrow \upsilon_{2,max} = 4m/s \ ,\ \dfrac{\upsilon_{1,max}}{\upsilon_{2,max}} = \dfrac{\sqrt{8}}{4} = \dfrac{\sqrt{2}}{2}$

Γ4. $K = 3U \Rightarrow E - U = 3U \Rightarrow 4\dfrac{1}{2}Dx^2 = \dfrac{1}{2}DA^2 \Rightarrow x = \pm\dfrac{A}{2}$

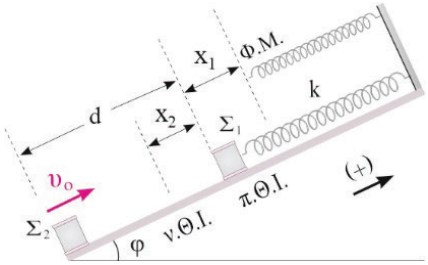
$\left|\dfrac{dP}{dt}\right| = |F_{\varepsilon\pi}| = k|x| = k\dfrac{A}{2} \Rightarrow \left|\dfrac{dP}{dt}\right| = 20\sqrt{2}N$

Γ5. $\alpha_{1,max} = \dfrac{F + F_{\varepsilon\lambda} - w}{m} = \dfrac{F + kx_1 - mg}{m} = 20m/s^2$

$\alpha_{2,max} = \omega^2 A = \dfrac{k}{m}A \Rightarrow \alpha_{2,max} = 20\sqrt{2}m/s^2 \rangle \alpha_{1,max}$

ΘΕΜΑ Δ

Δ1. $\upsilon_{1,max} = \omega_1 A = \sqrt{\dfrac{k}{m_1}}A \Rightarrow \upsilon_{1,max} = 3m/s$



Α.Δ.Ο. $P_{\alpha\rho\chi}=P_{\tau\varepsilon\lambda}=0$ ή

$m_1\upsilon_{1,max} - m_2\upsilon_2 = 0 \Rightarrow \upsilon_2 = 1m/s$

$\Sigma F_x = m\alpha \Rightarrow -mg\eta\mu\varphi = m\alpha \Rightarrow \alpha = -5m/s^2$

$\upsilon_2 = \upsilon_0 + \alpha t \Rightarrow t = 0,2s$

Δ2. Παλιά θέση ισορροπίας: $\Sigma F_x = 0 \Rightarrow F_{\varepsilon\lambda} = w_x = m_1 g\eta\mu\varphi \Rightarrow x_1 = \dfrac{m_1 g\eta\mu\varphi}{k} = 0,05m$

Νέα Θ. Ι.: $\Sigma F_x = 0 \Rightarrow F_{\varepsilon\lambda}' = k\left(x_1 + x_2\right) = w_{o\lambda,x} = \left(m_1 + m_2\right)g\eta\mu\varphi \Rightarrow x_2 = \dfrac{m_2 g\eta\mu\varphi}{k} = 0,15m$

$A' = x_2 = 0,15m$, $\omega' = \sqrt{\dfrac{k}{m_1 + m_2}} = 5rad/s$

Για t=0 είναι x=A', $x = A'\eta\mu\left(\omega' t + \varphi_0\right) = A' \Rightarrow \eta\mu\varphi_0 = 1 \Rightarrow \varphi_0 = \dfrac{\pi}{2}$

$x = A'\eta\mu\left(\omega' t + \varphi_0\right) = 0,15\eta\mu\left(5t + \dfrac{\pi}{2}\right)$ (S.I.)

Δ3. $x = 0,15\eta\mu\left(5\dfrac{\pi}{3} + \dfrac{\pi}{2}\right) = 0,075m$, $\alpha = -\omega'^2 x = -1,875m/s^2$

Δ4. $d = \upsilon_0 t + \dfrac{1}{2}\alpha t^2 \Rightarrow d = 0,3m$

$U_{max} = \left(m_1 + m_2\right)gd\eta\mu\varphi \Rightarrow U_{max} = 6J$