Φυσική Θετικής και Τεχνολογικής Κατεύθυνσης

22-5-2013

Θέμα Α

Α1. γ

Α2. γ

Α3. δ

Α4. γ

Α5. α) Σ

β) Λ

γ) Σ

δ) Λ

ε) Σ

Θέμα Β

Β1. Σωστό το (ii)

$$E_o = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = 4\cdot 10^{-3}\,J$$

Τη μεταγενέστερη χρονική στιγμή: $E_1 = \frac{1}{2}LI^2 = 2\cdot 10^{-3}\,J$

άρα: $\Delta E = E_o - E_1 = 2\cdot 10^{-3}\,J$

Β2.

Η ταχύτητα παραμένει σταθερή άρα

$$\upsilon = \lambda_1 f_1 = \lambda_2 f_2 \Rightarrow \lambda_2 = \frac{\lambda_1 f_1}{f_2} \Rightarrow \lambda_2 = \frac{\lambda_1 f_1}{3f_1} \Rightarrow \lambda_2 = \frac{\lambda_1}{3}\,.$$

Επομένως

$$d = 2\lambda_1 = 2\left(3\lambda_2\right) \Rightarrow d = 6\lambda_2\,.$$

Κατά συνέπεια για το νέο μήκος κύματος θα ισχύει $|r_1 - r_2| < \phi$ οπότε

$$-6\lambda_2 < r_1 - r_2 \langle 6\lambda_2 \Rightarrow -6\lambda_2 < (2N+1)\frac{\lambda_2}{2} < 6\lambda_2 \Rightarrow -12\lambda_2 < (2N+1)\lambda_2 < 12\lambda_2 \Rightarrow$$

$$-13 < 2N < 11 \Rightarrow -6{,}5 < N < 5{,}5 \Rightarrow N = 12$$

Σωστή απάντηση η iii).

Β3. Σωστό είναι το (ii)

Από Αρχή Διατήρησης Στροφορμής

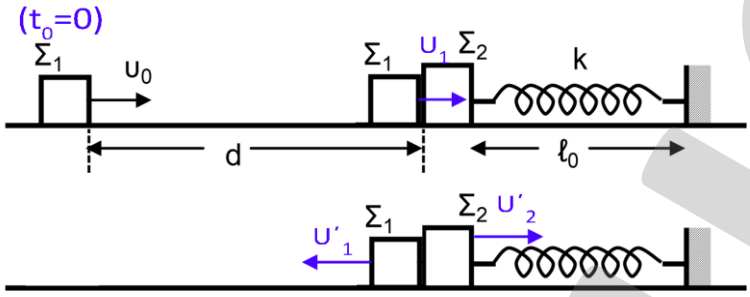
$$\vec{L}_{\pi\rho\acute{\iota}\nu} = \vec{L}_{\mu\epsilon\tau\acute{\alpha}}$$

$$L_1 + 0 = L_1^{'} + L_2^{'}$$

$$I_1\omega_1 = I_1\omega + \frac{I_1}{4}\omega \Leftrightarrow \omega = \frac{5}{4}\omega_1$$

$$|\Delta L| = |L_1' - L_1| = L_1 - L_1' = I_1\omega_1 - I_1\omega = \frac{1}{5}I_1\omega_1 = \frac{1}{5}L_1$$

Θέμα Γ



Γ1.

$$u_1' = \frac{m_1 - m_2}{m_1 + m_2}u_1 \Rightarrow -\sqrt{10} = \frac{m_1 - 2m_1}{m_1 + 2m_1}u_1$$

$$\Rightarrow -\sqrt{10} = \frac{-m_1}{3m_1}u_1$$

$$\Rightarrow u_1 = 3\sqrt{10}\,m/s$$

Εφαρμόζοντας **Θ.Μ.Κ.Ε.**

$$K_1 - K_0 = W_T \Rightarrow \frac{1}{2}m_1u_1^2 - \frac{1}{2}m_1u_0^2 = W_T \overset{T=\mu mg}{\Rightarrow} m_1u_1^2 - m_1u_0^2 = -2\mu m_1 g d$$

$$\Rightarrow u_1^2 - u_0^2 = -10 \Rightarrow \left(3\sqrt{10}\right)^2 - u_0^2 = -10$$

$$\Rightarrow u_0^2 = 90 + 10 = 100 \Rightarrow u_0 = 10\,m/s$$

Γ2. $$u_2' = \frac{2m_1}{m_1 + m_2}u_1 \Rightarrow u_2' = \frac{2m_1}{3m_1}3\sqrt{10} = 2\sqrt{10}$$

$$\frac{\frac{1}{2}m_1u_1^2 - \frac{1}{2}m_1u_1'^2}{\frac{1}{2}m_1u_1^2} = \frac{9\cdot 10 - 10}{9\cdot 10} = \frac{80}{90} = \frac{8}{9}$$ **Δηλαδή 88,8%**

Γ3. $$\sum F_x = m_1\alpha \Rightarrow -T = m_1\alpha \Rightarrow -\mu m_1 g = m_1\alpha \Rightarrow \alpha = -\mu g \Rightarrow \alpha = -5\,m/s^2$$

$$u_1 = u_0 - |\alpha|t_1 \Rightarrow t_1 = \frac{u_0 - u_1}{|\alpha|} \Rightarrow t_1 = \frac{10 - 3\sqrt{10}}{5} = \frac{0,4}{5} = 0,08\,s$$

$$0 = u_1' - |\alpha|t_2 \Rightarrow t_2 = \frac{u_1'}{|\alpha|} \Rightarrow t_2 = \frac{\sqrt{10}}{5} = \frac{3,2}{5} = 0,64\,s$$

$$t_{ολ} = t_1 + t_2 = 0,08 + 0,64 = 0,72\,s$$

Γ4. Εφαρμόζοντας **Θ.Μ.Κ.Ε.**

$$K_{τελ} - K_{αρχ} = W_{ολ} \Rightarrow 0 - \frac{1}{2}m_2u_2'^2 = W_T + W_{F_{ελ}}$$

$$W_{F_{ελ}} = -\Delta U = -\left(U_{τελ} - U_{αρχ}\right) = U_{αρχ} - U_{τελ} = 0 - \frac{1}{2}k\Delta\ell^2$$

$$W_T = -T\Delta\ell \overset{T=\mu N_2}{=} -\mu m_2 g\Delta\ell$$

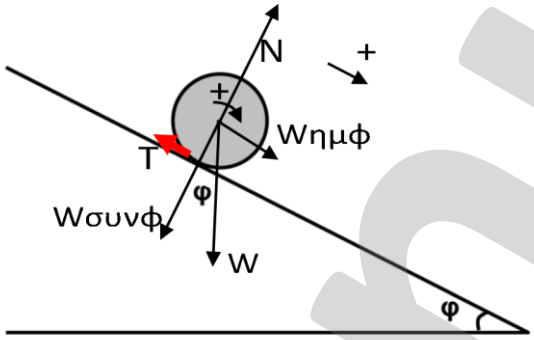
$$-\frac{1}{2}m_2u_2'^2=-\mu m_2g\Delta\ell-\frac{1}{2}k\Delta\ell^2\Rightarrow-\frac{1}{2}\cdot1\cdot40=-0,5\cdot1\cdot10\cdot\Delta\ell-\frac{1}{2}105\Delta\ell^2$$

$$\Rightarrow 105\Delta\ell^2+10\Delta\ell-40=0$$

$$\Delta=10^2-4\cdot105\cdot(-40)=16900$$

$$\Delta\ell=\frac{-10\pm\sqrt{16900}}{2\cdot105}=\begin{cases}\frac{120}{210}=\frac{12}{21}=0,57\text{m (δεκτή)}\\ \frac{-140}{210}=\frac{-14}{21}=-0,67\text{m (απορ.)}\end{cases}$$

Θέμα Δ



Δ1.

$$\sum F=m\alpha_{cm}\Rightarrow W\eta\mu\phi-T=m\alpha_{cm}\Rightarrow mg\eta\mu\phi-T=m\alpha_{cm}\Rightarrow$$

$$-T=m\alpha_{cm}-mg\eta\mu\phi\Rightarrow T=mg\eta\mu\phi-m\alpha_{cm}(1)$$

$$\sum\tau=I\alpha_{\gamma\omega\nu}\Rightarrow TR=\frac{1}{2}MR^2\frac{\alpha_{cm}}{R}$$

$$\Rightarrow T=\frac{1}{2}M\alpha_{cm}(2)$$

Από (1), (2) $\frac{1}{2}M\alpha_{cm}=Mg\eta\mu\phi-M\alpha_{cm}\Rightarrow\frac{3}{2}M\alpha_{cm}=Mg\eta\mu\phi\Rightarrow\alpha_{cm}=\frac{2g}{3}\eta\mu\phi$

Δ2. $I=I_{κοιλ}+I_{εσωτ}$

$$I_{εσωτ}=\frac{1}{2}mr^2=\frac{1}{2}\frac{Mr^2}{R^2}r^2=\frac{1}{2}\frac{Mr^4}{R^2}\text{ διότι}$$

$$\left.\begin{aligned}\rho=\frac{M}{V}\\ \rho=\frac{m}{V_{εσωτ}}\end{aligned}\right\}\Rightarrow\frac{M}{V}=\frac{m}{V_{εσωτ}}\Rightarrow\frac{M}{\pi R^2h}=\frac{m}{\pi r^2h}\Rightarrow mR^2=Mr^2\Rightarrow m=\frac{Mr^2}{R^2}$$

Οπότε $\frac{1}{2}MR^2=I_{κοιλ}+\frac{1}{2}\frac{Mr^4}{R^2}\Rightarrow I_{κοιλ}=\frac{1}{2}MR^2-\frac{1}{2}\frac{Mr^4}{R^2}=\frac{1}{2}MR^2\left(1-\frac{r^4}{R^4}\right)$

Δ3. $\sum F=M\alpha_{cm}\Rightarrow Mg\eta\mu\phi-T=M\alpha_{cm}\Rightarrow-T=M\alpha_{cm}-Mg\eta\mu\phi\Rightarrow T=Mg\eta\mu\phi-M\alpha_{cm}$

$$\sum\tau=I_{κοιλ}\alpha_{\gamma\omega\nu}\Rightarrow TR=I_{κοιλ}\alpha_{\gamma\omega\nu}\Rightarrow T=I_{κοιλ}\frac{\alpha_{cm}}{R^2}$$

$$I_{κοιλ}\frac{\alpha_{cm}}{R^2}=Mg\eta\mu\phi-M\alpha_{cm}\Rightarrow\frac{1}{2}MR^2\left(1-\frac{r^4}{R^4}\right)\frac{\alpha_{cm}}{R^2}=Mg\eta\mu\phi-M\alpha_{cm}\Rightarrow$$

$$\left[\frac{1}{2}\left(1-\frac{r^4}{R^4}\right)+1\right]\alpha_{cm}=g\eta\mu\phi\Rightarrow\alpha_{cm}=\frac{g\eta\mu\phi}{\frac{1}{2}\left(1-\frac{r^4}{R^4}\right)+1}=\frac{g\eta\mu\phi}{\frac{3}{2}-\frac{r^4}{2R^4}}$$

Δ4.

$$\frac{K_{\mu\varepsilon\tau}}{K_{\sigma\tau\rho}}=\frac{\frac{1}{2}Mu_{cm}^2}{\frac{1}{2}I_{\kappa o\iota\lambda}\omega^2}=\frac{Mu_{cm}^2}{I_{\kappa o\iota\lambda}\frac{u_{cm}^2}{R^2}}=\frac{MR^2}{I_{\kappa o\iota\lambda}}=\frac{MR^2}{\frac{1}{2}MR^2\left(1-\frac{r^4}{R^4}\right)}=\frac{2}{1-\left(\frac{r}{R}\right)^4}\overset{r=\frac{R}{2}}{\Rightarrow}$$

$$\frac{K_{\mu\varepsilon\tau}}{K_{\sigma\tau\rho}}=\frac{2}{1-\left(\frac{1}{2}\right)^4}=\frac{2}{1-\frac{1}{16}}=\frac{2}{\frac{15}{16}}=\frac{32}{15}$$