ΠΑΝΕΛΛΗΝΙΕΣ 2013

ΦΥΣΙΚΗ ΚΑΤΕΥΘΥΝΣΗΣ

ΕΝΔΕΙΚΤΙΚΕΣ ΑΠΑΝΤΗΣΕΙΣ

ΘΕΜΑ Α

Α. 1 – γ

Α.2 – γ

Α.3 – δ

Α.4 – γ

Α. 5 α – Σ

β - Λ

γ – Σ

δ – Λ

ε – Σ

ΘΕΜΑ Β

Β.1

$$\Delta \mathrm{E} = \mathrm{E}_1 - \mathrm{E}_0 = \frac{1}{2} LI^2 - \frac{1}{2} CV^2 = 2 \cdot 10^{-3} - 4 \cdot 10^{-3} = -2 \cdot 10^{-3} J$$

Άρα μείωση $|\Delta \mathrm{E}| = 2 \cdot 10^{-3} J$

Β.2

d=2λ$_1$ →4 υπερβολές απόσβεσης

$$\left.\begin{array}{l} f_2 = 3 f_1 \\ \upsilon_\delta = \lambda_1 f_1 \\ \upsilon_\delta = \lambda_2 f_2 \end{array}\right\} \Rightarrow \lambda_2 = \frac{\lambda_1}{3} \; \acute{\eta} \; \lambda_1 = 3\lambda_2$$

Άρα d=6λ$_2$

$$-d \le r_1 - r_2 \le d$$

$$-d \le (2\kappa + 1)\frac{\lambda_2}{2} \le d$$

$$-\frac{2d}{\lambda_2} \le (2\kappa+1) \le \frac{2d}{\lambda_2}$$

$$-12 \le (2\kappa+1) \le 12$$

$(2\kappa+1) = \pm 11, \pm 9, \pm 7, \pm 5, \pm 3, \pm 1$ 12 υπερβολές απόσβεσης

Β.3

ΑΔΣ $L_{ολ(πριν)} = L_{ολ(μετά)}$

$$\mathrm{I}_1\omega_1 = (\mathrm{I}_1 + \mathrm{I}_2)\omega$$

$$\mathrm{I}_1\omega_1 = \frac{5I_1}{4}\omega \Rightarrow \omega = \frac{4}{5}\omega_1$$

$$\Delta L_1 = L_{1(μετά)} - L_{1(πριν)} = \mathrm{I}_1\frac{4}{5}\omega_1 - \mathrm{I}_1\omega_1 = -\frac{1}{5}\mathrm{I}_1\omega_1 = -\frac{L}{5}$$

Άρα $|\Delta L_1| = \frac{L}{5}$

ΘΕΜΑ Γ

Γ.1

$$\upsilon'_1 = \frac{(m_1 - m_2)\upsilon_1}{m_1 + m_2}$$

$$\upsilon'_1 = \frac{-m_1\upsilon_1}{3m_1} = -\frac{\upsilon_1}{3}$$

$$|\upsilon_1| = 3\sqrt{10}m/s = 9{,}6m/s$$

Για το $Σ_1$ $\Sigma F_y = 0 \Rightarrow N_1 = w_1 = m_1 g$

$T=\mu N_1=\mu m_1 g$

ΘΜΚΕ για το $Σ_1$

$$\frac{1}{2}m_1\upsilon_1^2 - \frac{1}{2}m_1\upsilon_0^2 = -\mu \cdot \mathrm{N}_1 \cdot d$$

$$\frac{1}{2}m_1\upsilon_1^2 - \frac{1}{2}m_1\upsilon_0^2 = -\mu \cdot m_1 \cdot g \cdot d$$

$$\upsilon_0^2 = \upsilon_1^2 + 2\mu g d$$

$\upsilon_0 = 10m/s$

Γ.2

$$\upsilon_2^{'} = \frac{2m_1\upsilon_1}{m_1+m_2} = \frac{2m_1 \cdot 3\sqrt{10}}{3m} = 2\sqrt{10}m/s$$

ΕΛΑΣΤΙΚΗ ΚΡΟΥΣΗ: $|\Delta K_1| = |\Delta K_2|$

$$\frac{|\Delta K_2|}{K_{o\lambda(\pi\rho\iota\nu)}} = \frac{\frac{1}{2}m_2\upsilon_2^{'2}}{\frac{1}{2}m_1\upsilon_1^2} = 2\cdot(\frac{2\sqrt{10}}{3\sqrt{10}})^2 = \frac{8}{9} = \frac{800}{9}\%$$

Γ.3

$$0 \le t \le t_1 : \alpha_1 = \frac{\Sigma F}{m_1} = \frac{\mu m_1 g}{m_1} = \mu g = 5m/s^2$$

$$\upsilon_1 = \upsilon_0 - \alpha_1 \cdot t_1 \Rightarrow t_1 = \frac{\upsilon_0 - \upsilon_1}{\alpha_1} = \frac{10-9,6}{5}$$

$$t_1 = \frac{0,4}{5} = 0,08s$$

$t_1 \le t \le t_2$ Ίδια επιβράδυνση α_1=5m/s^2

$$\upsilon_2 = \upsilon_1^{'} - \alpha_1 \cdot \Delta t_2 \Rightarrow \Delta t_2 = \frac{\upsilon_1^{'}}{\alpha_1} = \frac{\sqrt{10}}{5} = \frac{3,2}{5} = 0,64s$$

$$t_2 = t_1 + \Delta t_2 = 0,08 + 0,64 = 0,72s$$

Γ.4

ΘΜΚΕ για το Σ_2

$$K_{\tau\varepsilon\lambda} - K_{\alpha\rho\chi} = W_{\text{ΤΡΙΒΗΣ}} + W_{F\varepsilon\lambda}$$

$$-\frac{1}{2}m_2\upsilon_2^{'2} = -\mu \cdot m_2 g \cdot \Delta l - \frac{1}{2}K\Delta l^2$$

$$\frac{1}{2}\cdot 1 \cdot 40 = 5 \cdot \Delta l + \frac{1}{2}\cdot 105 \cdot \Delta l^2$$

$$40 = 10\Delta l + 105 \cdot \Delta l^2$$

$$21\Delta l^2 + 2\Delta l - 8 = 0$$

$$\Delta l = -\frac{28}{42}\alpha\pi o\rho, \quad \Delta l = \frac{24}{42} = \frac{4}{7}m$$

ΘΕΜΑ Δ

Δ.1

$$\Sigma F_X = M \cdot a_{cm} \Rightarrow w_x - T_s = M \cdot a_{cm}(1)$$

$$\Sigma\tau = \mathrm{I} \cdot \alpha_{\gamma\omega\nu} \Rightarrow \mathrm{T}_s \cdot R = \frac{1}{2}MR^2 \cdot a_{\gamma\omega}$$

$$\mathrm{T}_s = \frac{1}{2}M \cdot a_{CM}(2)$$

$$(1)+(2) \Rightarrow w_x = \frac{3}{2}Ma_{CM} \Rightarrow Mg \cdot \eta\mu\phi = \frac{3}{2}\mathrm{M}\alpha_{CM} \Rightarrow a_{CM} = \frac{2}{3}g \cdot \eta\mu\phi$$

Δ.2

m=μάζα αφαιρούμενου κυλίνδρου

$$\frac{m}{\mathrm{M}} = \frac{d \cdot \pi r^2 \cdot h}{d \cdot \pi R^2 \cdot h} = (\frac{r}{R})^2 \Rightarrow m = (\frac{r}{R})^2 M$$

$$I_{κοιλ} = \frac{1}{2}MR^2 - \frac{1}{2}mr^2 = \frac{1}{2}MR^2 - \frac{1}{2}M(\frac{r}{R})^2 r^2$$

$$I_{κοιλ} = \frac{1}{2}\mathrm{M}R^2(1 - \frac{r^4}{R^4})$$

Δ.3

$$\Sigma F_x = M \cdot a_{cm} \Rightarrow w_x - T_s = M \cdot a_{cm}$$

$$\Sigma\tau = \mathrm{I}_{κοιλ} \cdot \alpha_{\gamma\omega\nu} \Rightarrow \mathrm{T}s \cdot R = \frac{1}{2}MR^2(1 - \frac{r^4}{R^4})a_\gamma$$

$$\mathrm{M}g \cdot \eta\mu\phi = \mathrm{M}\alpha_{CM} + \frac{1}{2}M \cdot a_{CM}(1 - \frac{r^4}{R^4})$$

$$g \cdot \eta\mu\phi = \alpha_{CM}(\frac{3}{2} - \frac{r^4}{2R^4})$$

$$a_{CM} = \frac{g \cdot \eta\mu\phi}{\frac{3}{2} - \frac{r^4}{2R^4}} = \frac{2R^4 \cdot g\eta\mu\phi}{3R^4 - r^4}$$

Δ.4

Αφού $r = \frac{R}{2}, I_{κοιλ} = \frac{15}{32}\mathrm{M}R^2$

$$\frac{K_{μετ}}{\mathrm{K}_{περ}} = \frac{\frac{1}{2}\mathrm{M}\upsilon_{CM}^2}{\frac{1}{2} \cdot \frac{15}{32} MR^2\omega^2} = \frac{32}{15}$$