ΑΠΑΝΤΗΣΕΙΣ ΦΥΣΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ 23/5/16

Θέμα Α

Α1- β **Α**2 – γ **Α3**- β **Α4**- δ

Α5 **α** – Σ **β**- Λ **γ** –Σ , **δ** –Λ **ε** – Λ

Θέμα Β

Β1. iii) Απευθείας ήχος $f_1 = \frac{Unx}{Unx+\frac{Unx}{10}} f_s \Rightarrow f_1 = \frac{Unx}{\frac{11}{10}Unx} f_s \Rightarrow f_1 = \frac{10}{11} f_s$

$ήχος\ απο\ ανάκλαση\ : f_2 = \frac{Unx}{Unx-\frac{Unx}{10}} f_s = \frac{Unx}{\frac{9Uηx}{10}} f_s \Rightarrow f_2 = \frac{10}{9} f_s$

Συνεπώς $\frac{f_1}{f_2} = \frac{\frac{10}{11}f_s}{\frac{10}{9}f_s} = \frac{9.10}{11.10} \Rightarrow \frac{f_1}{f_2} = \frac{9}{11}$

Β2. i) $Umax_M = \omega|A'_M| = 2\omega A\ |συν\ \frac{2\pi}{\lambda}.x_M\Big| = 2\omega A.|συν\ \frac{2\pi}{\lambda}.\frac{9\lambda}{8}\Big|$

$= 2\omega A|συν\ \frac{9\pi}{4}\Big|$

$= 2\omega A|συν\ (2\pi + \frac{\pi}{4})\Big| = 2\omega\ A\ \frac{\sqrt{2}}{2} = \frac{2\pi}{T} A\sqrt{2} \Rightarrow Umax_M = \frac{2\sqrt{2}\pi A}{T}$

Β3. ii) Εξίσωση συνέχειας : $A_A\ U_A = A_B\ .\ U_B \xRightarrow{A_A=2A_B} 2U_A = U_B$

Εξίσωση Bernoulli : $P_A + \frac{1}{2}\rho v_A^2 + \rho g y = P_B + \frac{1}{2}\rho v_A^2 + \rho g y \Rightarrow P_A - P_B =$
$\frac{1}{2}\rho .4v_A^2 - \frac{1}{2}\rho. v_A^2 \Rightarrow P_A - P_B = 3\ \frac{1}{2}\ \rho. v_A^2 \Rightarrow P_A - P_B = 3\ Λ$

Θέμα Γ

Γ1) ΑΔΜΕ (Α,Γ) $\vec{N} \perp \vec{dx}$: $W_N = 0$ J

$Eμηχ_A = Eμηχ_Γ \Rightarrow K_A + U_{βαρ_A} = K_Γ + U_{βαρ_Γ} \Rightarrow m_1 g R = \frac{1}{2} m_1 v_Γ^2 \Rightarrow$

$|\vec{v_Γ}| = \sqrt{2gR} \Rightarrow |\vec{U}| = 10$ m/s

Γ2) Από τη θέση Γ εώς οριακά πρίν την κεντρική ελαστική κρούση για το m_1

$WΤολ_1 = -\ Τολ_1\ .\ S = -\ \mu N_1\ .\ S_1 = -\mu m_1 g S_1 =$

ΘΜΚΕ $\Delta K = \Sigma W \Rightarrow \frac{1}{2} m_1 v_1^2 - \frac{1}{2} m_1 u_1^2 = Wτολ_1 \Rightarrow \frac{1}{2} m_1 v_1^2 - \frac{1}{2} m_1 u_Γ^2 = \mu -$
$-m_1 g S_1 \Rightarrow m_1 v_1^2 = \frac{1}{2} m_1 u_Γ^2 = 2\mu m_1 g S_1 \Rightarrow |\vec{v_1}| = \sqrt{v_Γ^2 - 2\mu g S_1}$

$\Rightarrow |\vec{v_1}| = \sqrt{64}\ \frac{m}{S} = 8\frac{m}{S}$

Για την κεντρική ελαστική κρούση ισχύουν $v_1' = \frac{m_1 - m_2}{m_1 + m_2} u_1 + \frac{2m_2}{m_1+m_2} u_2$

$\Rightarrow v_1' = \frac{-2\,m_1}{4\,m_1} u_1 + \frac{6m_1}{4m_1} u_2 \Rightarrow v_1' = -\frac{v_1}{2} + \frac{3}{2}u_2 \xRightarrow[\substack{v_1 = 8\frac{m}{s} \\ v_2 = -4\frac{m}{s}}]{} v_1' = -4 + \frac{3}{2}\ (-4)$

$\Rightarrow v_1' = -10\ \frac{m}{s}$ *οριακά μετά προς τα αριστερά με* $|\vec{v_1}|$ *=10 m/s*

και $v_2' = \frac{2m_1}{m_1+m_2} u_1 + \frac{m_1 - m_2}{m_1+m_2} u_2 \xRightarrow{m2=3m_1} v_2' = \frac{2\,m_1}{4\,m_1}. u_1 + \frac{2\,m_1}{4\,m_1}. u_2$

$\Rightarrow v_2' = \frac{1}{2}u_1 + \frac{1}{2}u_2 \Rightarrow v_2' = (4-2)\frac{m}{s} \Rightarrow v_2'\ 2\frac{m}{s} (προς\ τα\ δεξιά\ )$

$με\ |\vec{v_2}| = 2\ m/s$

Γ3) $\Delta\vec{P_2} = \vec{P_2'} - \vec{P_2} \Rightarrow \Delta P_2 = P_2' - (P_2) = m_2 v_2' - m_2 v_2 \Rightarrow$

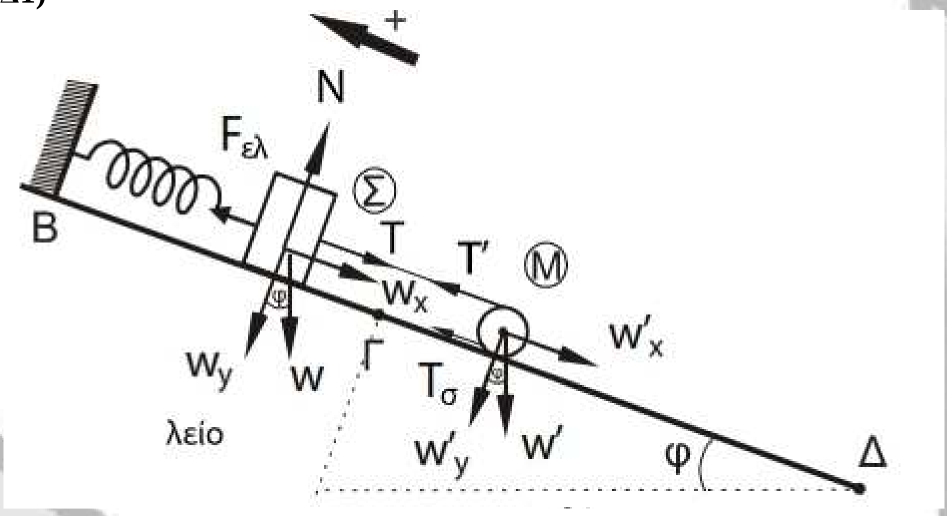
$\Delta P_2 = m_2(v_2' - v_2) = 3[2 - (-4)]kg\ .\ m/s = 18kg\ .\ m/s \Rightarrow |\Delta\vec{P_2}| = 18\ kg\ .\ m/s$

Γ4) $\pi\% = \frac{k_1' - k_1}{k_1} 100\% = \left(\frac{k_1'}{k_1} - 1\right) 100\% = \left(\frac{\frac{1}{2}m_1 v_1'^2}{\frac{1}{2}m_1 v_1^2} - 1\right) 100\%$

$= (\frac{100}{64} - 1)100\% = \frac{36}{64}.100\% = 56,25\%$

Θέμα Δ

Δ1)



Το σύστημα ισορροπεί :

m : $\Sigma\widehat{F} = \widehat{0} \implies F_{ελ_1} = T' + mgημφ \implies kΔl_1 = T' + mgημφ$ (1)

M: $\Sigma\widehat{τ}_{(0)} \implies 0 \implies T.R - T_{στ}.R - 0 \implies T = T_{στ}$ (2)

$\Sigma\overrightarrow{F_x} = \vec{0} \implies T + T_{στ}.R = Mgημφ \overset{(2)}{\implies} 2T = Mgημφ \implies T = \frac{1}{2}\,Mgημφ \implies T = 5N$

Από (1)&(2) $\xrightarrow{|\vec{T'}|=|\vec{T}|} kΔl_1 = \frac{Mgημφ}{2} + Mgημφ \implies 100\,kΔl_1 = 5 + 5 \overset{(SI)}{\implies} Δl_1 = 0{,}1m$

Δ2) Η Θέση ισορροπίας του m (ταλάντωση)

$\Sigma\overrightarrow{F_x} = \vec{0} \implies kΔl_2 = mgημφ \implies Δl_2 = \frac{mgημφ}{K} = 0{,}05m$

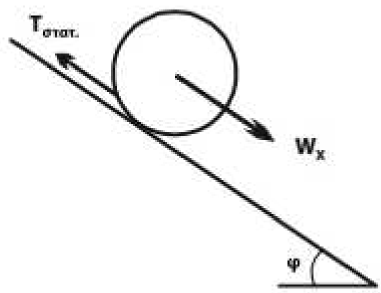
Όταν κόβετε το νήμα ξεκινά με μηδενική ταχύτητα και πλάτος $A = Δl_1 - Δl_2 = 0{,}05m$ με $x(0) = -A \implies Aημφ_0 = -A \implies ημφ_0 = -1 \xrightarrow{φ_0\, ε[0,2π)} φ_0 = \frac{3π}{2}$

Ακόμη $D = m.ω^2 \implies k = mω^2 \implies ω = \sqrt{\frac{k}{m}} = 10\frac{r}{s}$

όποτε $x(t) = Aημ(ωt + φ_0) = 0{,}05\ ημ\,(10\,t + \frac{3π}{2})$ και

$ΣFεπ = -D\,.\,x\,(t) = -5\,.\,ημ\,\left(10\,t + \frac{3π}{2}\right), (S.I.)$

Δ3)



$\Sigma\vec{τ}\,(0) = I_{(0)}\,.\,\vec{α}_{γων} \Rightarrow TστR = \frac{1}{2}\,MR^2|\vec{α}_{γων}| \implies T_{στ} = \frac{1}{2}\,Mα_{cm}$ (3)

$\Sigma\overrightarrow{F_x} = M\,\vec{α}_{cm} \implies Mgημφ - T_{στ} = M.α_{cm} \overset{(3)}{\implies} Mgημφ = \frac{3}{2}\,Mα_{cm}$

$\Longrightarrow \alpha_{cm} = \frac{2}{3}\ g\eta\mu\varphi \ \Longrightarrow \alpha_{cm} = \frac{20}{3}\,\frac{1}{2}\ m/s^2 \ \Longrightarrow \alpha_{cm} = \frac{10}{3}\ \ m/s^2$

Για N = $\frac{12}{\pi}$ περ = $\frac{\Delta\theta}{2\pi} \Longrightarrow \ \Delta\theta = 24\ rad$

S = Δθ . R = 2,4 m

Όμως S = $\frac{1}{2}\, a_{cm}\ .\ t_1^{2}$

$Ucm_1 = a_{cm}\ .\ t_1 \Longrightarrow t_1 \frac{Ucm_1}{a_{cm}}$ (4)

$H\ (4)\gamma\acute{\iota}\nu\varepsilon\tau\alpha\iota\ \ \Longrightarrow s = \frac{1}{2}\ a_{cm}\,.\frac{Ucm^2}{a^2{}_{cm^2}} \ \Longrightarrow Ucm^2 = 2\,.S.\,a_{cm}$

$\Longrightarrow Ucm^2 = 4{,}5\,.\frac{10}{3}\left(\frac{m^2}{s^2}\right) \ \Longrightarrow v_{cm_1} = 4\ m/s$ οπότε

$\left|\vec{L}\right| = I\ |\overrightarrow{\omega_1}| = \frac{1}{2}\ MR^2\ \frac{v_{cm_1}}{R} = \frac{1}{2}\ MR\ v_{cm_1} \Longrightarrow \left|\vec{L}\right| = 0{,}4kgm^2/s$

Δ4) K = Κμετ + Κπερ $\Longrightarrow \frac{dk}{dt} = \frac{d_{K\mu\varepsilon\tau}}{dt} + \frac{d_{K\pi\varepsilon\rho}}{dt} \Longrightarrow \frac{dk}{dt} = \left[\frac{1}{2}\ Mv_{cm}^2\ (t)\right]' +$

$[\frac{1}{2}\ I\omega^2(t)]' = \frac{1}{2}\ M\ .2v_{cm}\ \ .v'_{cm} + \frac{1}{2}I\ 2\omega\ .\ \omega'(t) = M.\,v_{cm}.\,a_{cm} + I\omega\ .\ \alpha_{\gamma\omega\nu} =$

$\Sigma F v_{cm} + \Sigma\tau.\,\omega \Longrightarrow \ \left.\frac{dk}{dt}\right|_{t=3s} = M\ .\,v_{cm}.\,a_{cm} + \frac{1}{2}\ MR^2.\frac{v_{cm}\ (3)}{R}\ \frac{a_{cm}}{R}$

$= \frac{3}{2}\ M.\,a_{cm}\ v_{cm}\ (3) = \frac{3}{2}\ .2.\frac{10}{3}\ .\frac{10}{3}.\,3\ \frac{J}{S}$

$\Longrightarrow \ \left.\frac{dk}{dt}\right|_{t=3s} = 100\ W$