2014

33 ΒΑΘΜΟΛΟΓΙΚΟ - ΧΑΛΑΝΔΡΙ

ΕΝΔΕΙΚΤΙΚΕΣ ΑΠΑΝΤΗΣΕΙΣ ΦΥΣΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ

ΘΕΜΑ Α. , Α1 γ Α2 β Α3 γ ή β Α4 β Α5. Σ Σ Λ Λ Σ (4×5+5×1=) (25)

ΘΕΜΑ Β.

B_1 iii (2)

Α.Δ.Ο $m_1 v_{1max} = (m_1+m_2) v_{2max} \Rightarrow v_{1max} = 2v_{2max}$ (2)

$v_{max} = \omega A$ (1)

$\omega = \sqrt{k/m}$ $\omega_1 = \omega_2$ (1+1)

$\omega_1 A_1 = 2\omega_2 A_2 \Rightarrow A_1/A_2 = 2$ (1)

} 6 } 8

B_2 ii (2)

$f_\delta = f_1 - f_2 \Rightarrow \frac{1}{T_\delta} = f_1 - f_2 \Rightarrow f_1 - f_2 = 0{,}5\,Hz$ ① (2)

Σε 2 s 200 ταλ/σεις, άρα $\bar{f} = 100\,Hz$ (1)

$\bar{f} = \frac{f_1+f_2}{2} \Rightarrow$ $f_1 + f_2 = 200\,Hz$ ② (2)

Από ① ∧ ② : $2f_1 = 200{,}5\,Hz \Rightarrow f_1 = 100{,}25\,Hz$ (1)

} 6 } 8 (25)

B_3 iii (2)

Απόσταση σταθερή: $\vec{v}_1' = \vec{v}_2''$ (2)

Η m_2 μετά την κρούση έχει $\vec{v}_2'' = -\vec{v}_2'$, άρα $\vec{v}_1' = -\vec{v}_2'$ (1)

Κρούση κεντρική ελαστική: $v_1' = \frac{m_1-m_2}{m_1+m_2} v_1$, $v_2' = \frac{2m_1 v_1}{m_1+m_2}$ (2)

$\frac{m_1-m_2}{m_1+m_2} v_1 = -\frac{2m_1 v_1}{m_1+m_2} \Rightarrow \frac{m_1}{m_2} = \frac{1}{3}$ (2)

} 7 } 9

ΘΕΜΑ Γ

Γ1. Αναγνώριση χρόνων $t_2=0{,}2s$, $t_1=1{,}4s$ (1+1) (2)

$r_2 = \upsilon t_2 = 5\frac{m}{s}\cdot 0{,}2s \Rightarrow \quad r_2 = 1m$ (2)

$r_1 = \upsilon\cdot t_1 = 5\frac{m}{s}\cdot 1{,}4s \Rightarrow \quad r_1 = 7m$ (2) } 6

Γ2. Από σχήμα $3T = 1{,}4s - 0{,}2s \Rightarrow \quad T = 0{,}4$ (1) (1)

$\upsilon = \lambda f \Rightarrow \lambda = \upsilon T = 5\frac{m}{s}\cdot 0{,}4s \Rightarrow \quad \lambda = 2m$ (1) (1)

$y_\Sigma = 0 \quad 0 \leq t < 0{,}2s$ (1)

$y_\Sigma = 5\cdot 10^{-3}\cdot \eta\mu 2\pi\left(2{,}5t - \frac{1}{2}\right)$ (SI), $0{,}2s \leq t < 1{,}4s$ (1)

$y_\Sigma = 2A\cdot \sigma\upsilon\nu\frac{2\pi(r_1-r_2)}{2\lambda}\cdot \eta\mu 2\pi\left(\frac{t}{T} - \frac{r_1+r_2}{2\lambda}\right) = -10\cdot 10^{-3}\cdot \eta\mu 2\pi(2{,}5t-2)$ (SI) $1{,}4s \leq t \leq 2{,}2s$ (2) } 6

(25)

Γ3 Α.Δ.Ε. για την ταλάντωση: $\frac{1}{2}Dy_1^2 + \frac{1}{2}m\upsilon_1^2 = \frac{1}{2}DA^2 \Rightarrow$ 3

$\upsilon_1 = \pm\omega\sqrt{A^2 - y_1^2} = \pm\frac{2\pi}{0{,}4}\sqrt{(10\cdot 10^{-3})^2 - (5\sqrt{3}\cdot 10^{-3})^2}\ \frac{m}{s} \Rightarrow$ 2

$\upsilon_1 = 25\pi\cdot 10^{-3}\ \frac{m}{s}$ ή $\upsilon_1 = \frac{\pi}{40}$ m/s 1 } 6

Γ4 $\frac{K_{1max}}{K_{2max}} = \frac{E_1}{E_2} = \frac{\frac{1}{2}D_1A_1^2}{\frac{1}{2}D_2A_2^2} = \frac{m\omega_1^2A_1^2}{m\omega_2^2A_2^2} \Rightarrow \frac{K_{1max}}{K_{2max}} = \frac{f_1^2A_1^2}{f_2^2A_2^2}$ (2)

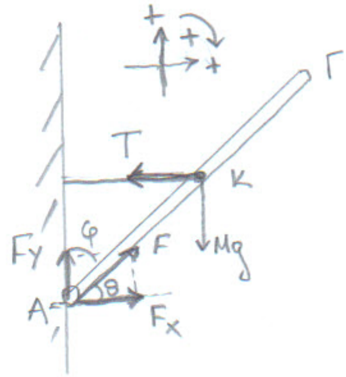
$\upsilon = \lambda_1 f_1 = \lambda_2 f_2 \Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{f_2}{f_1} = \frac{10}{9} \Rightarrow \lambda_2 = \frac{9}{10}\lambda_1$ (1)

$A_2 = 2A\cdot\left|\sigma\upsilon\nu\frac{2\pi(r_1-r_2)}{2\lambda_2}\right| = 2A\cdot\left|\sigma\upsilon\nu\frac{60\pi}{18}\right| = 2A\ \sigma\upsilon\nu\frac{\pi}{3} \Rightarrow A_2 = A = A_1/2$ (2)

$\frac{K_{1max}}{K_{2max}} = \frac{f_1^2\cdot A_1^2}{\left(\frac{10}{9}f_1\right)^2\left(\frac{A_1}{2}\right)^2} = 4\cdot\frac{81}{100} \Rightarrow \frac{K_{1max}}{K_{2max}} = \frac{81}{25} = 3{,}24$ (2) } 7

ΘΕΜΑ Δ.

Δ1



$\Sigma F_y = 0 \Rightarrow F_y - Mg = 0 \Rightarrow F_y = 56N$, + Σχήμα (1)

$\Sigma F_x = 0 \Rightarrow F_x - T = 0 \Rightarrow F_x = T$ ①

$\Sigma \tau(A) = 0 \Rightarrow Mg\frac{\ell}{2}\eta\mu\varphi - T\frac{\ell}{2}\sigma\upsilon\nu\varphi = 0 \Rightarrow T = Mg\frac{\eta\mu\varphi}{\sigma\upsilon\nu\varphi} \Rightarrow T = 42N$

Από ① $\Rightarrow F_x = 42N$ (1)

$F = \sqrt{F_x^2 + F_y^2} = \sqrt{42^2 + 56^2}\ N \Rightarrow F = 70N$ (1)

$\epsilon\varphi\theta = \frac{F_y}{F_x} = \frac{56}{42} \Rightarrow \epsilon\varphi\theta = \frac{4}{3}$ (1)

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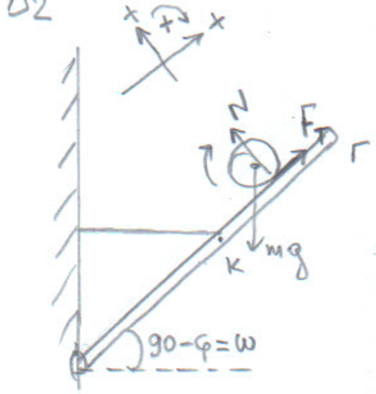
Δ2



$\Sigma F_x = m\alpha_{cm} \Rightarrow F_T - mg\cdot\sigma\upsilon\nu\varphi = m\alpha_{cm}$ (1)

$\Sigma\tau = I\cdot\alpha_{\gamma\omega\nu} \Rightarrow -T\cdot r = I\cdot\alpha_{\gamma\omega\nu}$ (1)

$\alpha_{cm} = \alpha_{\gamma\omega\nu}\cdot r$ + Σχήμα (1)

Ο συνδυασμός τους δίνει

$\alpha_{cm} = -\frac{g\,\sigma\upsilon\nu\varphi}{1+\frac{2}{5}} = -\frac{10\cdot 0{,}8}{1+2/5}\ m/s^2 \Rightarrow \alpha_{cm} = -\frac{40}{7}\frac{m}{s^2}$

$\alpha_{\gamma\omega\nu} = \frac{\alpha_{cm}}{r} = \frac{-40/7}{1/70}\frac{r}{s^2} \Rightarrow \alpha_{\gamma\omega\nu} = -400\ r/s^2$ (2)

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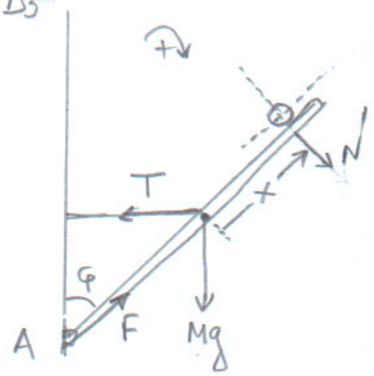
Δ3



Η N' προέρχεται από τη σφαίρα, $N' = mg\eta\mu\varphi$

$\Sigma\tau(A) = 0 \Rightarrow Mg\frac{\ell}{2}\eta\mu\varphi - T\frac{\ell}{2}\sigma\upsilon\nu\varphi + N'(\frac{\ell}{2}+x) = 0 \Rightarrow$ (3)

$T = \frac{Mg\frac{\ell}{2}\eta\mu\varphi + mg\eta\mu\varphi(\frac{\ell}{2}+x)}{\frac{\ell}{2}\cdot\sigma\upsilon\nu\varphi} = \frac{Mg\eta\mu\varphi + mg\eta\mu\varphi(1+x)}{\sigma\upsilon\nu\varphi}$

$\Rightarrow T = \frac{56\cdot 0{,}6 + 4\cdot 0{,}6(1+x)}{0{,}8} \Rightarrow T = 45 + 3x$ (SI) (2)

με $0 \leq x \leq 1m$

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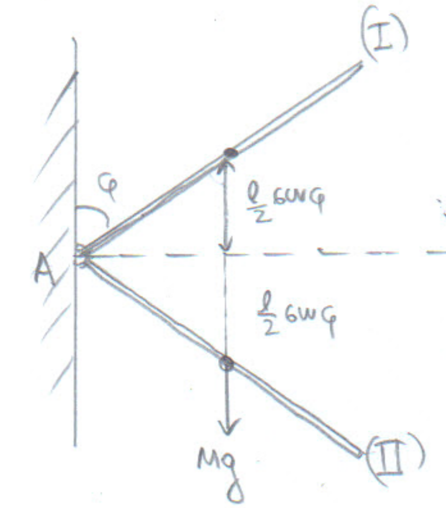
Δ4



$$\frac{dK}{dt} = \Sigma\tau \cdot \omega \quad (1)$$ (1)

$$\Sigma\tau = Mg\frac{\ell}{2}\eta\mu\varphi = 56 \cdot \frac{2}{2} \cdot 0{,}6\,Nm \Rightarrow \Sigma\tau = 33{,}6\,Nm$$ (1)

$$E_{\mu\eta\chi(I)} = E_{\mu\eta\chi(II)} \Rightarrow$$

$$Mg\frac{\ell}{2}\sigma\upsilon\nu\varphi + 0 = -Mg\frac{\ell}{2}\sigma\upsilon\nu\varphi + \frac{1}{2}I_A\omega^2 \Rightarrow$$ (2)

$$2Mg\frac{\ell}{2}\sigma\upsilon\nu\varphi = \frac{1}{2}\cdot\frac{1}{3}M\ell^2\omega^2 \Rightarrow \omega = \sqrt{\frac{6 \cdot g\,\sigma\upsilon\nu\varphi}{\ell}} \Rightarrow$$

$$\omega = \sqrt{\frac{6 \cdot 10 \cdot 0{,}8}{2}}\ \frac{r}{s} \Rightarrow \omega = 2\sqrt{6}\ r/s$$ (1)

Αντικατάσταση στην (1)

$$\frac{dK}{dt} = 33{,}6 \cdot 2\sqrt{6}\ \frac{J}{s} = 67{,}2\sqrt{6}\ \frac{J}{s} = \frac{336}{5}\sqrt{6}\ \frac{J}{s}$$ (1)

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[Διατ. ενεργ-υπολ. ω (3)
τύπος $\frac{dK}{dt}$ (1)
εύρεση Στ (1), αποτ. (1)]

(25)

Δ5

$$\vec{L}_{o\lambda}^{\pi\rho\iota\nu} = \vec{L}_{o\lambda}^{\mu\varepsilon\tau\acute{\alpha}} \Rightarrow I_{(A)}\omega = I_{o\lambda(A)} \cdot \omega'$$ (1)

$$I_{o\lambda(A)} = \frac{1}{3}M\ell^2 + \frac{1}{3}3M\ell^2 \Rightarrow I_{o\lambda(A)} = \frac{4}{3}M\ell^2 = 4I_{(A)}$$ (1)

$$\omega' = \frac{\frac{1}{3}M\ell^2\omega}{\frac{4}{3}M\ell^2} \Rightarrow \omega' = \frac{\omega}{4} \Rightarrow \omega' = \frac{\sqrt{6}}{2}\ r/s$$ (1)

$$\frac{|\Delta K|}{K_{\alpha\rho\chi}}100\% = \frac{\left|\frac{1}{2}I_{o\lambda}\omega'^2 - \frac{1}{2}I\omega^2\right|}{\frac{1}{2}I\omega^2}100\% = \left|\left(\frac{I_{o\lambda}}{I}\frac{\omega'^2}{\omega^2} - 1\right)\right|100\% \Rightarrow$$

$$\frac{|\Delta K|}{K_{\alpha\rho\chi}}100\% = \left|4\,\frac{\omega^2/16}{\omega^2} - 1\right|100\% = \left|\frac{1}{4} - 1\right|100\% \Rightarrow \frac{|\Delta K|}{K_{\alpha\rho\chi}}100\% = 75\%$$ (2)

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[τύπος $\frac{|\Delta K|}{K_{\alpha\rho}}$ 100 % (1)
εύρεση $\omega' = \frac{\sqrt{6}}{2}$ r/s 3 (1 Διατ. στρ + 1 εύρ. $I_{o\lambda}$ + 1 πράξεις)
Τελική επεξεργ. αποτέλεσμα (1)]

ΣΥΝΤΟΝΙΣΤΕΣ: ΠΑΛΟΓΟΣ ΑΝΤΩΝΗΣ – ΠΛΑΚΙΑΣ ΒΑΣΙΛΗΣ