ΘΕΜΑ Α

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ΘΕΜΑ Β

Β3 | (ii) 15 Κ. 5.41 έχουμε

Β1 | (i) $\omega_1 = 399\pi$ rad/s $\Rightarrow f_1 = \frac{399}{2}$ Hz

$\omega_2 = 401\pi$ rad/s $\Rightarrow f_2 = \frac{401}{2}$ Hz

Περίοδος διακροτήματος $T_\delta = \frac{1}{|f_1 - f_2|} = 1$ s

Χρονικό διάστημα μεταξύ τριών μεγιστοποιήσεων πλάτους:

$\Delta t = 2T_\delta = 2$ sec

Συχνότητα περιοδικής κίνησης $f = \frac{f_1 + f_2}{2} = 200$ Hz

$f = \frac{N}{\Delta t} \Rightarrow N = f \cdot \Delta t \Rightarrow N = 400$ παλμώσεις

Β2 | (iii) $A_1 v_1 = A_2 v_2 \Rightarrow v_2 = 2v_1$

$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho 4v_1^2 \Rightarrow P_1 - P_2 = \frac{1}{2}\rho \cdot 3v_1^2 \Rightarrow$

$\Rightarrow \rho g \cdot h = \frac{3}{2}\rho v_1^2 \Rightarrow h = \frac{3v_1^2}{2g}$

Αντίστοιχα : $h' = \frac{3v_1'^2}{2g} \xrightarrow{v_1' = 2v_1} h' = \frac{3 \cdot 4v_1^2}{2g}$

$\Rightarrow h' = 4 \frac{3v_1^2}{2g} \Rightarrow h' = 4h$

ΘΕΜΑ Γ $v = \frac{\Delta x}{\Delta t} = \frac{x_p - 0}{t_p - 0} \Rightarrow v = \frac{1}{2} = 0,5 \text{ m/s}$

Η μέση της γραφικής παράστασης :

$\omega = \frac{\Delta\varphi}{\Delta t} \Rightarrow \omega = \frac{20\pi}{2} = 10\pi \text{ rad/s} \longrightarrow f = 5 \text{Hz}$

$\lambda = \frac{v}{f} \Rightarrow \lambda = 0,1 \text{ m}$

Γ1. $E_{ολ} = K_{max} = \frac{1}{2} \Delta m v_{max}^2 = \frac{1}{2} \Delta m \omega^2 A^2 \Rightarrow A = 4 \times 10^{-2} \text{ m}$

Γ2. $y = A \eta\mu 2\pi \left(ft - \frac{x}{\lambda} \right) \Rightarrow y = 4 \times 10^{-2} \eta\mu 2\pi (5t - 10x)$ S.I

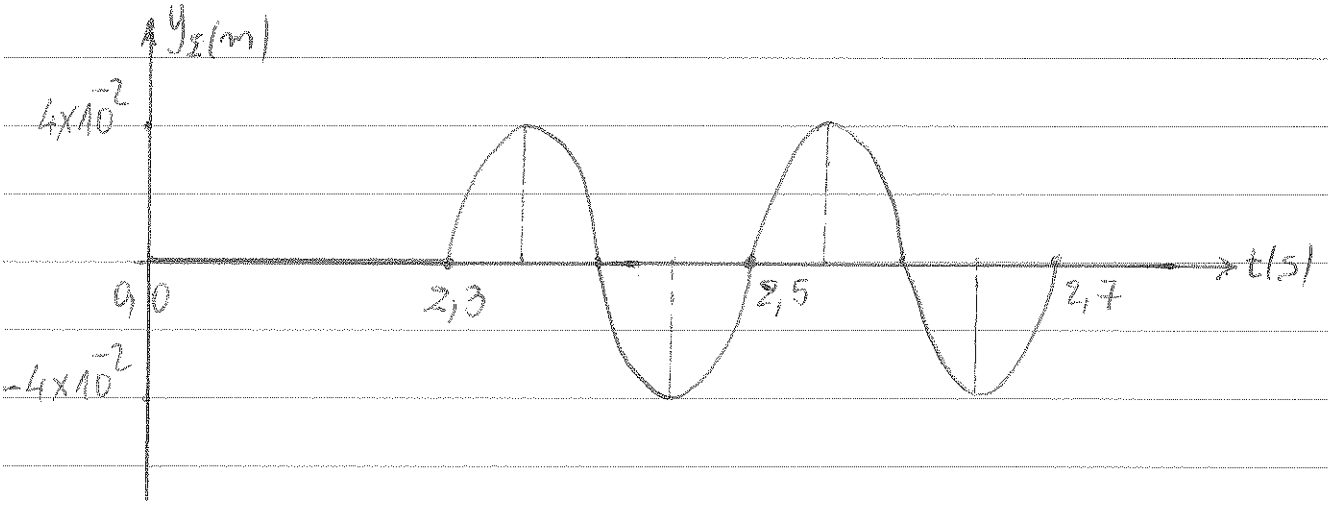
Γ3. $\Delta x = x_\Sigma - x_P = 0,15 \text{ m} \quad \Delta\varphi = \frac{2\pi}{\lambda} \cdot \Delta x \Rightarrow \Delta\varphi = 3\pi \text{ rad}$

Άρα το Σ ταλαντώνεται σε αντίθεση φάσης με το Ρ

$v_\Sigma = -v_P = -\omega A \Rightarrow v_\Sigma = -0,4\pi \text{ m/s}$

Γ4. $y_\Sigma = A \eta\mu 2\pi \left(ft - \frac{x_\Sigma}{\lambda} \right) \Rightarrow y_\Sigma = 4 \times 10^{-2} \eta\mu 2\pi (5t - 11,5)$ (S.I)

$t \geq \frac{x_\Sigma}{v} = 2,3 \text{ sec}$



ΘΕΜΑ Δ

Δ1. Ισορροπία Σ_1 : $T_1' = m_1 g = 10N \Rightarrow T_1' = T_1$

-11- Σ_2 : $T_2' = m_2 g = 15N \Rightarrow T_2' = T_2$

Ισορροπία στερεού Σ : $\Sigma\tau_{(K)} = 0 \Rightarrow T_1 R + T \cdot R - T_2 \cdot 2R = 0$

$\Rightarrow T = 2T_2 - T_1 \Rightarrow T = 20N$

Ισορροπία Σ_3 $\Sigma F_x = 0 \Rightarrow F_{\epsilon\lambda} = T_x + W_{3x} \Rightarrow$

$\Rightarrow k \cdot \Delta l_0 = T \cdot \sigma\upsilon\nu\varphi + m_3 g \, \eta\mu\varphi$

$\Rightarrow \Delta l_0 = 0,12 m$

Δ2. ΘΙ ΑΑΤ $\Sigma F = 0 \Rightarrow F_{\epsilon\lambda}' = W_{3x} \Rightarrow k \cdot \Delta l_1 = m_3 g \, \eta\mu\varphi$

$\Rightarrow \Delta l_1 = 0,08 m$

πλάτος : $A = \Delta l_1 - \Delta l_0 \Rightarrow A = 0,04 m$

$t = 0$: $x = -A \Rightarrow \varphi_0 = \frac{3\pi}{2}$

$K = m_3 \omega^2 \Rightarrow \omega = 10 rad/s$ $\quad x = 0,04 \, \eta\mu\left(10t + \frac{3\pi}{2}\right) (SI)$

$t_1 = \frac{T}{15}s \rightarrow x = 0{,}04\ m_4\left(\frac{2\pi}{3} + \frac{3\pi}{2}\right) = 0{,}04\ m_4\ \frac{13\pi}{6} = 0{,}04\ m_4\left(2\pi + \frac{\pi}{6}\right)$

$\Rightarrow x = 0{,}02\ m$

$\left|\frac{dP}{dt}\right| = |\Sigma F| = kx \Rightarrow \left|\frac{dP}{dt}\right| = 6\ kg\ m/s^2$

Δ3. $\Sigma F_2 = m_2 g - T_2 = m_2 a_2 \Rightarrow m_2 g - T_2 = m_2\, a_{ang} \cdot 2R$ (1)

$\Sigma F_1 = T_1 - m_1 g = m_1 a_1 \Rightarrow T_1 - m_1 g = m_1\, a_{ang} R$ (2)

$\Sigma \tau_{(K)} = I_\Sigma \cdot a_{ang} \Rightarrow T_2 \cdot 2R - T_1 R = \Sigma_\Sigma \cdot a_{ang} \Rightarrow 2T_2 - T_1 = \frac{I}{R} \cdot a_{ang}$ (3)

$(1)\times 2 + (2) + (3) \Rightarrow 2m_2 g - m_1 g = \left(4m_2 R + m_1 R + \frac{I}{R}\right) a_{ang}$

$\Rightarrow \boxed{a_{ang} = 20\ rad/s^2}$

Δ4. $\Delta y_1 = \frac{1}{2} a_1 \cdot \Delta t^2 = \frac{1}{2}\, a_{ang} R \cdot \Delta t^2$

$\Delta y_2 = \frac{1}{2} a_2 \cdot \Delta t^2 = \frac{1}{2}\, a_{ang} \cdot 2R \cdot \Delta t^2$

$\Delta y_1 + \Delta y_2 = h \Rightarrow \frac{3}{2}\, a_{ang} R \cdot \Delta t^2 = h \Rightarrow \Delta t = 0{,}4\,s$

$w = a_{ang} \cdot \Delta t \Rightarrow w = 8\ rad/s$

$L_{\Sigma_{(K)}} = I_K \cdot w \Rightarrow L_{\Sigma(K)} = 0{,}24\ kg\ m^2/s$

Δ5. $\Delta\varphi = \frac{1}{2}\alpha_{\gamma\omega}\cdot\Delta t^2$

$\omega = \alpha_{\gamma\omega}\cdot\Delta t \Rightarrow \Delta t = \frac{\omega}{\alpha_{\gamma\omega}}$

$\Rightarrow \Delta\varphi = \frac{1}{2}\alpha_{\gamma\omega}\frac{\omega^2}{\alpha_{\gamma\omega}^2}$

$\Rightarrow \Delta\varphi = \frac{\omega^2}{2\alpha_{\gamma\omega}} \Rightarrow \omega = \sqrt{2\alpha_{\gamma\omega}\cdot\Delta\varphi}$

$\Rightarrow \omega = \sqrt{2\cdot\alpha_{\gamma\omega}\cdot N\cdot 2\pi} \Rightarrow \omega = 40\ rad/s$

$\left|\frac{dK}{dt}\right| = \Sigma\tau\cdot\omega = I_\kappa\cdot\alpha_{\gamma\omega}\cdot\omega \Rightarrow \left|\frac{dK}{dt}\right| = 24\ \frac{J}{s}$

ΟΜΟΓΕΝΕΙΣ

Β3. Κρούση Β-Γ : $v_1' = \frac{m-2m}{m+2m}v_1 = -\frac{1}{3}v_1$

Κρούση Β-Α : $v_1'' = \frac{m-2m}{m+2m}v_1 = -\frac{1}{3}v_1' \Rightarrow$

$v_1'' = -\frac{1}{3}\left(-\frac{1}{3}v_1\right) \Rightarrow v_1'' = \frac{1}{9}v_1$

$\frac{K_1''}{K_1} = \left(\frac{v_1''}{v_1}\right)^2 = \frac{1}{81}$