Θεμα Α:

Α1: γ , Α2: δ , Α3: α , Α4: δ

Α5: Λ − Σ − Λ − Σ − Λ

Θεμα Β:

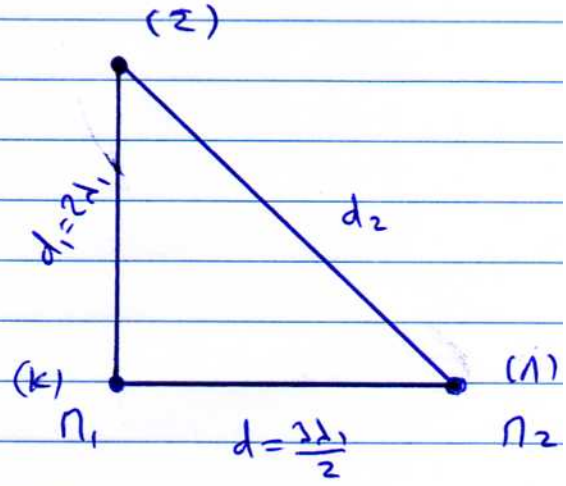
Β.1

α) Σωστη η (i)

β) $d_2 = \sqrt{d^2 + d_1^2} \Rightarrow$

$\Rightarrow d_2 = \sqrt{\frac{9\lambda_1^2}{4} + 4\lambda_1^2} = \sqrt{\frac{25\lambda_1^2}{4}} \Rightarrow$

$\Rightarrow d_2 = \frac{5\lambda_1}{2}$



$v_1 = v_2 \Rightarrow d_1 f_1 = d_2 f_2 \Rightarrow \lambda_1 f_1 = d_2 2 f_1 \Rightarrow$

$\Rightarrow \lambda_1 = 2\lambda_2 \Rightarrow \lambda_2 = \frac{\lambda_1}{2}$.

(Σ): $d_2 - d_1 = \frac{5\lambda_1}{2} - 2\lambda_1 = \frac{5\lambda_1}{2} - \frac{4\lambda_1}{2} \Rightarrow d_2 - d_1 = \frac{\lambda_1}{2} = \frac{2\lambda_2}{2} \Rightarrow$

$\Rightarrow d_2 - d_1 = \lambda_2 = 1 \cdot \lambda_2$, αρα $k = 1$, ενίσχυση

B2| (E.277)

a) Σωστη η (iii)

β) Α.Δ.Στρ.: $L_A = L_y \Rightarrow I\omega = I_1\omega_1 \Rightarrow$

$\Rightarrow \cancel{mR^2}\omega = m\frac{R^2}{4}\omega_1 \Rightarrow \omega = \frac{\omega_1}{4} \Rightarrow \omega_1 = 4\omega$

ΘΜΚΕ: $W_F = \Delta K = \frac{1}{2}I_1\omega_1^2 - \frac{1}{2}I\omega^2 = \frac{1}{2}m\frac{R^2}{4}\cdot\cancel{16}\omega^2 - \frac{1}{2}mR^2\omega^2 \Rightarrow$

$\Rightarrow W_F = 4\cdot\frac{1}{2}mR^2\omega^2 - \frac{1}{2}mR^2\omega^2 \Rightarrow W_F = 3\frac{1}{2}mR^2\omega^2 \Rightarrow$

$\Rightarrow W_F = \frac{3}{2}mR^2\omega^2$

B3|

α) Σωστη η (i)

β) Γ-Δ: $P_\Gamma + \cancel{\rho g h_\Gamma} + \frac{1}{2}\rho v_\Gamma^2 = P_\Delta + \cancel{\rho g h_\Delta} + \frac{1}{2}\rho v_\Delta^2 + \rho g h \Rightarrow$

$\Rightarrow P_\Gamma - P_\Delta = \frac{1}{2}\rho v_\Delta^2 - \frac{1}{2}\rho v_\Gamma^2 + \rho g h \quad (1)$

$\Pi_\Gamma = \Pi_\Delta \Rightarrow A_\Gamma v_\Gamma = A_\Delta v_\Delta \Rightarrow 2\cancel{A_\Delta} v_\Gamma = \cancel{A_\Delta} v_\Delta \Rightarrow v_\Delta = 2v_\Gamma \quad (2)$

Δ-Κ: $h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2h}{g}}$

$S = 4h = v_\Delta t \Rightarrow 4h = v_\Delta\sqrt{\frac{2h}{g}} \Rightarrow \cancel{16}^{8}h^2 = v_\Delta^2\cdot\frac{\cancel{2}h}{g} \Rightarrow h = \frac{v_\Delta^2}{8g} \quad (3)$

(1),(2),(3) $\Rightarrow P_\Gamma - P_\Delta = \frac{1}{2}\rho 4v_\Gamma^2 - \frac{1}{2}\rho v_\Gamma^2 + \rho\cancel{g}\frac{4v_\Gamma^2}{2\cancel{8}\cancel{g}} \Rightarrow$

$\Rightarrow P_\Gamma - P_\Delta = \frac{4}{2}\rho v_\Gamma^2 - \frac{1}{2}\cancel{\rho v_\Gamma^2} + \frac{1}{2}\cancel{\rho v_\Gamma^2} \Rightarrow P_\Gamma - P_\Delta = 2\rho v_\Gamma^2 \quad (4)$

Θέμα Γ:

Γ1) ΑΔΕ Γ₁-Δ₁: $\frac{1}{2}k_1\Delta\ell^2 = \frac{1}{2}m_1v_1^2 \Rightarrow 50\cdot\frac{16}{200} = 2v_1^2 \Rightarrow$

$\Rightarrow 8 = 2v_1^2 \Rightarrow v_1^2 = 4 \Rightarrow v_1 = 2\ m/s$ (1)

$f_1 = \frac{v - v_1}{v} f_s \Rightarrow f_1 = \frac{340-2}{340} f_s \Rightarrow f_1 = \frac{338}{340} f_s$ (2)

ΑΔΟ Δ₁-Δ₂: $m_1v_1 + 0 = (m_1+m_2)V \Rightarrow 2\cdot 2 = 4V \Rightarrow V = 1\ m/s$ (3)

$f_2 = \frac{v - V}{v} f_s = \frac{340-1}{340} f_s \Rightarrow f_2 = \frac{339}{340} f_s$ (4)

$\frac{(2)}{(4)} \Rightarrow \frac{f_1}{f_2} = \frac{\frac{338}{340}f_s}{\frac{339}{340}f_s} = \frac{338}{339} \Rightarrow \frac{f_1}{f_2} = 0,99$ (5)

Γ2) Θ.Ε.: $\Sigma F = -F_1 - f_2 = -k_1x - k_2x = -(k_1+k_2)x \Rightarrow$

$\Rightarrow \Sigma F = -2k\cdot x$, $D = 2k = 100\ N/m$ (6)

(Δ₂): Θ.Ι.Τ.: $V = V_{max} = \omega A$ (7)

$D = (m_1+m_2)\omega^2 \Rightarrow 100 = 4\omega^2 \Rightarrow \omega^2 = 25 \Rightarrow \omega = 5\ r/s$ (8)

$(7),(8) \overset{(3)}{\Rightarrow} 1 = 5A \Rightarrow A = \frac{1}{5} = 0,2\ m$ (9)

Γ3) $f_3 = \frac{v-0}{v} f_s$, προσοχή $V_1 = 0$ ώρα Θ.Μ.Α.

οπότε $t = \frac{T}{4} = \frac{1}{4}\cdot\frac{2\pi}{\omega} = \frac{2\pi}{4\cdot 5} = \frac{\pi}{10} \Rightarrow t = 0,1\pi\ sec$ (10)

Γ4) $\frac{\Delta p}{\Delta t} = \Sigma F_{max} = D\cdot A \overset{(6)}{\underset{(9)}{\Rightarrow}} \left(\frac{\Delta p}{\Delta t}\right)_{max} = 100\cdot 0,2 = 20\ N.$ (11)

Θέμα Δ:

Δ1) $I_{(O),ραβ.} = \frac{1}{12}Ml^2 + M\left(\frac{l}{2}\right)^2 = \frac{1}{12}Ml^2 + \frac{1}{4}Ml^2 = \frac{1}{12}Ml^2 + \frac{3}{12}Ml^2 \Rightarrow$

$\Rightarrow I_{(O),ραβ} = \frac{4}{12}Ml^2 = \frac{1}{3}Ml^2 = \frac{1}{3}\cdot 8\cdot 3 \Rightarrow I_{(O),ραβ.} = 24\ kgr\,m^2$ (1)

$I_{ολ(O)} = I_{(O),ραβ} + I_{(O),δισκ.} = 24 + \frac{1}{2}m_Δ R_Δ^2 = 24 + \frac{1}{2}4\cdot\frac{R}{4} \Rightarrow$

$\Rightarrow I_{ολ(O)} = 24 + 1 = 25\ kgr\,m^2$ (2)

Δ2) $\frac{ΔL}{Δt} = Σ\tau = M_g\frac{l}{2}συνφ = 8\cdot 10\cdot\frac{3}{5}\cdot 0,6 \Rightarrow \frac{ΔL}{Δt} = 72\ N\cdot m$ (3)

Δ3) ΔΕ: (Γ) − (Γ1): $U_{(Γ1)} = 0$ $\quad K_{μετ.} = \frac{1}{2}I_{ολ}\cdot ω^2 = K_{μετ.} \Rightarrow$

$\Rightarrow K_{μετ.} = M_g\left(\frac{l}{2} - \frac{l}{2}ημφ\right) \Rightarrow$

$\Rightarrow K_{μετ.} = 8\cdot 10\left(\frac{3}{2} - \frac{3}{2}\cdot 0,8\right) = 80\cdot\frac{3}{5}\cdot 0,2 \Rightarrow K_{μετ.} = 24\ J$ (4)

Δ4) κυλίνδρου: $ΣF = m\,a_{cm} \Rightarrow m_g ημφ - T - T_ρ = m\,a_{cm} \Rightarrow$

$\Rightarrow 30\cdot 10\cdot 0,8 - T - T_ρ = 30\,a_{cm} \Rightarrow 240 - T - T_ρ = 30\,a_{cm}$ (5)

$Σ\tau = I_κ α_γκ \Rightarrow T_ρ\cdot R - T\cdot R = \frac{1}{2}mR^2 α_γκ \Rightarrow T_ρ - T = \frac{1}{2}mR\,α_γκ$ (6)

τροχαλία: $Σ\tau = I_τ\cdot α_γτ \Rightarrow T\cdot R = 1,95\cdot α_γτ \Rightarrow T\cdot 0,2 = 1,95\,α_γτ$ (7)

(6) $\Rightarrow (a_{cm} = α_γκ\cdot R) \Rightarrow T_ρ - T = \frac{1}{2}m\,a_{cm} = \frac{1}{2}30\,a_{cm} \Rightarrow T_ρ - T = 15\,a_{cm}$ (8)

Κυλίνδρου ανώτερο σημείο:

$$U_K = \omega_{τρ.} \cdot R = 2 \upsilon_{cm,κυλ.} \Rightarrow \omega_{τρ.} \cdot \frac{R}{2} = \upsilon_{1,κυλ} \qquad (9)$$

$$2 \upsilon_{cm,κυλ} = \omega_{τρ} \cdot R \Rightarrow \upsilon_{cm,κ.} = \frac{\omega_{τρ} \cdot R}{2} \Rightarrow a_{cm} = a_{γτρ} \cdot \frac{R}{2} \qquad (10)$$

$$(7),(10) \Rightarrow 0,2T = 1,95 \frac{2 a_{cm}}{R} \Rightarrow T = \frac{2 \cdot 1,95 \cdot a_{cm}}{0,2 \cdot 0,2} = \frac{2 \cdot 195 a_{cm}}{2 \cdot 2} \Rightarrow$$

$$\Rightarrow T = \frac{195}{2} a_{cm} \qquad (11)$$

$$(6),(11) \Rightarrow (a_{cm} = a_{γ,κ} \cdot R) \Rightarrow T_p - \frac{195}{2} a_{cm} = \frac{1}{2} m a_{cm} \Rightarrow$$

$$\Rightarrow T_p = \frac{1}{2} 30 a_{cm} + \frac{195}{2} a_{cm} \Rightarrow T_p = \frac{225}{2} a_{cm} \qquad (12)$$

$$(5),(11),(12) \Rightarrow 240 - \frac{195}{2} a_{cm} - \frac{225}{2} a_{cm} = 30 a_{cm} \Rightarrow$$

$$\Rightarrow 240 = \frac{60}{2} a_{cm} + \frac{195}{2} a_{cm} + \frac{225}{2} a_{cm} \Rightarrow 240 = \frac{480}{2} a_{cm} \Rightarrow$$

$$\Rightarrow a_{cm} = 1 \ m/s^2 \qquad (13)$$

$$S = \frac{1}{2} a_{cm} t^2 \Rightarrow 2 = \frac{1}{2} \cdot 1 \cdot t^2 \Rightarrow t^2 = 4 \Rightarrow t = 2 \ sec \qquad (14)$$

$$U_{cm} = a_{cm} \cdot t = 1 \cdot 2 \Rightarrow \upsilon_{cm} = 2 \ m/s \qquad (15)$$