ΘΕΜΑ Α

A1. α

A2. β

A3. α

A4. δ

A5. α → ΛΑΘΟΣ
β → ΣΩΣΤΟ
γ → ΣΩΣΤΟ
δ → ΛΑΘΟΣ
ε → ΣΩΣΤΟ

ΘΕΜΑ Β

B1. Σωστή επιλογή (iii)

Είναι $\frac{\Delta L_p}{\Delta t} = I_p \alpha_{γων}$ (1)

$$\Sigma\tau = I_\alpha \cdot \alpha_{γων} \Rightarrow mgL + Mg\frac{L}{2} = \left(\frac{1}{3}ML^2 + mL^2\right)\alpha_{γων}$$

$$\Rightarrow MgL = \left(\frac{1}{3}ML^2 + \frac{ML^2}{2}\right)\alpha_{γων} \Rightarrow$$

$$\Rightarrow \alpha_{γων} = \frac{6g}{5L}$$

Από (1) $\Rightarrow \frac{\Delta L_p}{\Delta t} = \frac{1}{3}ML^2 \cdot \frac{6g}{5L} \Rightarrow \frac{\Delta L_p}{\Delta t} = \frac{2MgL}{5}$

B2. Σωστή επιλογή (iii)

Δεσμοί: $x_{\Delta_3} = (2k+1)\frac{\lambda}{4} \xrightarrow{k=2} x_{\Delta_3} = \frac{5\lambda}{4}$

Άρα $x_M = x_{\Delta_3} + \frac{\lambda}{12} = \frac{4\lambda}{3}$

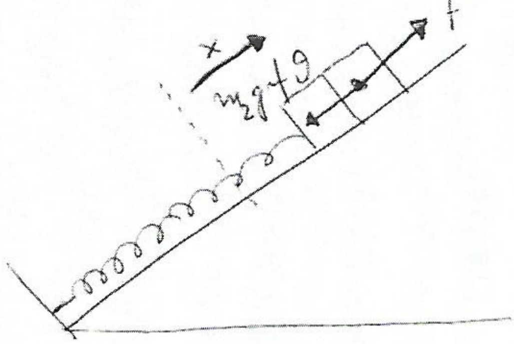
$A' = \left|2A\,\text{συν}\frac{2\pi x_M}{\lambda}\right| = \left|2A\,\text{συν}\frac{8\pi}{3}\right| = \left|2A\,\text{συν}\frac{2\pi}{3}\right| = A$

B3.

Σωστή επιλογή (i)

$$\left.\begin{aligned} D = k &= (m_1+m_2)\omega^2 \\ D_2 &= m_2\omega^2 \end{aligned}\right\} \Rightarrow D_2 = D\cdot\frac{m_2}{m_1+m_2} = \frac{k\cdot m_2}{m_1+m_2}$$

Μελέτη της Α.Α.Τ του Σ2.



$\Sigma F_2 = -D_2\cdot x \Rightarrow$

$F - m_2 g\eta\mu\theta = -D_2\cdot x \Rightarrow$

$\Rightarrow F = -\frac{k m_2}{m_1+m_2}x + m_2 g\eta\mu\theta$

Απαιτούμε $F > 0 \Rightarrow -\frac{k\cdot m_2}{m_1+m_2}x + m_2 g\eta\mu\theta > 0 \Rightarrow$

$\Rightarrow (m_1+m_2)g\,\eta\mu\theta > kx \xrightarrow{x=A}$

$\Rightarrow k\cdot A < (m_1+m_2)\cdot g\,\eta\mu\theta$

ΘΕΜΑ Γ

Γ1. $U_E = E - U_B \Rightarrow U_E = E - \frac{1}{2}Li^2$

$U_E = 8\cdot10^{-2} - 8\cdot10^{-2}\, i^2$ $\Big\} \Rightarrow$

$E = 8\cdot 10^{-2}\,J$ και $\frac{1}{2} L = 8\cdot10^{-2} \Rightarrow L = 16\cdot10^{-2}\,H$

$E = \frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} C\cdot V_0^2 \Rightarrow C = \frac{2E}{V_0^2} \Rightarrow C = 10^{-4}\,F$

$T = 2\pi\sqrt{LC} = 2\pi\sqrt{16\cdot10^{-6}} = 8\pi\cdot10^{-3}\,s$, $\omega = \frac{2\pi}{T} = 250\, r/s$

Γ2. $U_E = \frac{1}{2} \frac{q^2}{C}$ (1) και $q = Q\,συν\,\omega t = C\cdot V_0\, συν\, \frac{2\pi}{T}\cdot\frac{T}{12}$

$q = C\cdot V_0\cdot \frac{\sqrt{3}}{2}$ (2)   Από (1),(2) $\Rightarrow U_E = \frac{1}{2}\frac{Q^2}{C}\cdot\frac{3}{4} = 6\cdot10^{-2}\,J$

Γ3. $E = U_E + U_B \Rightarrow E = U_E + \frac{U_E}{3} \Rightarrow E = \frac{4}{3} U_E \Rightarrow U_E = \frac{3}{4} E$

$\frac{1}{2} q^2/C = \frac{3}{4}\cdot\frac{1}{2}\frac{Q^2}{C} \Rightarrow |q| = \frac{\sqrt{3}}{2} C V_0 = 2\sqrt{3}\cdot10^{-3}\,C$

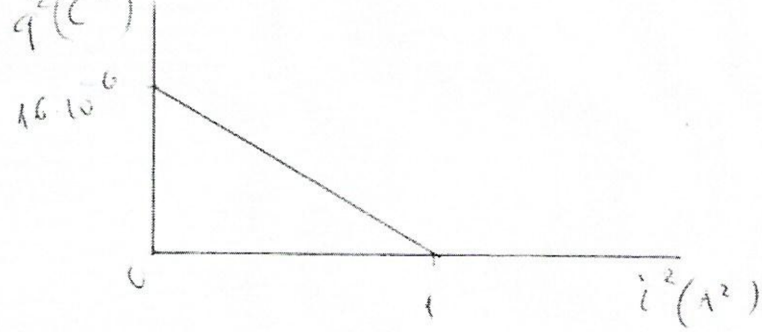
$\left|\frac{di}{dt}\right| = \left|\frac{E_{αυτ}}{L}\right| = \left|\frac{q}{LC}\right| = \frac{2\sqrt{3}\cdot10^{-3}}{16\cdot10^{-6}} = \frac{\sqrt{3}}{8}\cdot10^{3}\, A/s$

Γ4. $E = U_E + U_B \Rightarrow \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}\frac{q^2}{C} + \frac{1}{2} Li^2 \Rightarrow$

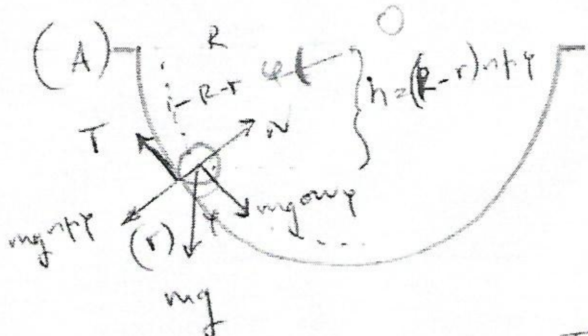
$q^2 = Q^2 - LC\cdot i^2 \Rightarrow q^2 = (40\cdot10^{-4})^2 - 16\cdot10^{-6}\, i^2$

$q^2 = 16\cdot10^{-6} - 16\cdot10^{-6}\, i^2$ $0 \le i^2 \le 1$

και $I = \omega Q = 1A \Rightarrow I^2 = 1A^2$



ΘΕΜΑ Α



$U_{βαρ}=0$

$r=\frac{R}{5}$

Α1. $\Sigma F = m a_{cm} \Rightarrow mg\,συνφ - T = m a_{cm}$

$\Sigma \tau = I a_{γων} \Rightarrow T r = \frac{2}{5} m r^2 a_{γων}$ $\Bigg\} \Rightarrow$ $mg\,συνφ - T = m a_{cm}$, $\frac{5}{2} T = m a_{cm}$

$\frac{7}{2} T = mg\,συνφ \Rightarrow T = \frac{2}{7} \cdot 14\,συνφ \Rightarrow T = 4\,συνφ$

Α2. $N - mg\,ημφ = \frac{m v_{cm}^2}{R-r}$ (1)

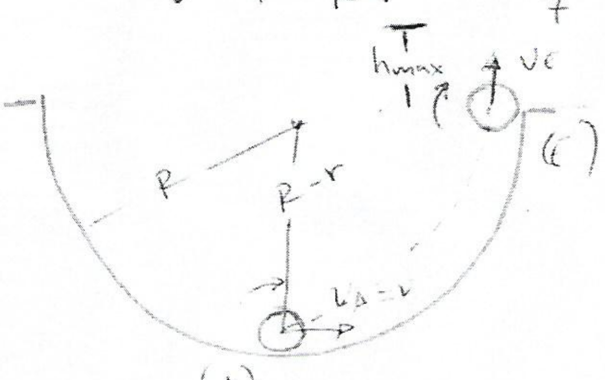
ΑΔΜΕ (Α),(Γ) $K_A + U_A = K_Γ + U_Γ \Rightarrow$

$0 = \frac{1}{2} I \omega^2 + \frac{1}{2} m v_{cm}^2 - mg(R-r)ημφ \Rightarrow$

$mg(R-r)ημφ = \frac{7}{10} m v_{cm}^2 \Rightarrow v_{cm}^2 = \frac{10g(R-r)ημφ}{7}$ (2)

(1),(2) $\Rightarrow N - mg\,ημφ = \frac{m}{R-r} \cdot \frac{10g(R-r)ημφ}{7} \Rightarrow N = 17N$

Α3.



$U_{βαρ}=0$

ΑΔΜΕ (Α),(Γ) $K_A + U_A = K_Γ + U_Γ \Rightarrow$

$\frac{1}{2} m v_A^2 + \frac{1}{2} I \omega_A^2 - mg(R-r) = \frac{1}{2} m v_Γ^2 + \frac{1}{2} I \omega_Γ^2$

$v_A^2 + \frac{2}{5} v_A^2 - 2g(R-r) = v_Γ^2 + \frac{2}{5} v_Γ^2 \Rightarrow$

$\frac{7}{5} v_A^2 - 2g(R-r) = \frac{7}{5} v_Γ^2 \Rightarrow v_Γ = 4\,m/s$

Άρα $\omega_Γ = \frac{v_Γ}{r} = 20\,r/s$ και $h_{max} = \frac{v_Γ^2}{2g} = \frac{16}{20} = 0,8\,m$

ΔΗ)

$$\frac{dK}{dt} = -\Sigma F \cdot v_t$$

$$\frac{dK}{dt} = -mg v_t = -1{,}4 \cdot 10 \cdot 4 = -56 J/s.$$

και $\frac{dL}{dt} = \Sigma\tau = 0$ διότι έχει χαθεί η επαφή.