Απαντήσεις στη Φυσική Προσανατολισμού Γ' Λυκείου – 10/6/2022

Θέμα Α

Α1. γ Α2. δ Α3. γ Α4. β

Α5. α) Λ β) Σ γ) Λ δ) Σ ε) Σ

Θέμα Β

Β1. α) i

β) Πείραμα 1 $\Sigma \vec{F} = \vec{0} \Rightarrow \ldots \Rightarrow k\Delta l = mg \Rightarrow \Delta l = \frac{mg}{k} = A_1$

Πείραμα 2 νέα ΘΙ χαμηλά

$$\Sigma \vec{F} = \vec{0} \Rightarrow \vec{F} + \vec{F}_{\varepsilon\lambda} + \vec{w} = \vec{0} \Rightarrow \vec{F} + \vec{w} = -\vec{F}_{\varepsilon\lambda} \Rightarrow$$

$$\Rightarrow \vec{0} = -\vec{F}_{\varepsilon\lambda} \Rightarrow \vec{F}_{\varepsilon\lambda} = \vec{0} \Rightarrow \text{ΘΦΜ}$$

οπότε $A_2 = \Delta l = \frac{mg}{k} = A_1$

Β2. α) ii

β) Εξίσωση Bernoulli ανάμεσα σε σημείο της ελ. επιφάνειας Γ και σημείο έξω από την τρύπα 1 Δ

$$P_\Gamma + \left(\frac{dK}{dV}\right)_\Gamma + \left(\frac{dU_{\beta\alpha\rho}}{dV}\right)_\Gamma = P_\Delta + \left(\frac{dK}{dV}\right)_\Delta + \left(\frac{dU_{\beta\alpha\rho}}{dV}\right)_\Delta \Rightarrow$$

$$\Rightarrow \cancel{P_{\alpha\tau\mu}} + \cancel{\tfrac{1}{2}\rho \upsilon_\Gamma^2}^{\,0} + \rho g H = \cancel{P_{\alpha\tau\mu}} + \tfrac{1}{2}\rho \upsilon_1^2 + \rho g \frac{5H}{6} \Rightarrow$$

$$\Rightarrow \tfrac{1}{2}\cancel{\rho} \upsilon_1^2 = \cancel{\rho} g H - \cancel{\rho} g \frac{5H}{6} \Rightarrow \upsilon_1^2 = 2gH - \frac{5gH}{3} \Rightarrow$$

$\Rightarrow |\vec{v}_1| = \sqrt{\frac{gH}{3}}$

όμοια για οπή 2

$\ldots \Rightarrow \cancel{P_{atm}} + \cancel{\frac{1}{2}\rho v^2}^{\,0} + \rho g H = \cancel{P_{atm}} + \frac{1}{2}\rho v_2^2 + \rho g \frac{H}{3}$

$\Rightarrow \frac{1}{2}\rho v_2^2 = \rho g H - \rho g \frac{H}{3} \Rightarrow \frac{1}{2}\cancel{\rho} v_2^2 = \frac{2}{3}\cancel{\rho} g H$

$\Rightarrow |\vec{v}_2| = \sqrt{\frac{4gH}{3}}$

για οπή 1 μόνο $\rightarrow \Pi_1 = \frac{dV}{dt} = \sigma\tau\alpha\vartheta = \frac{\Delta V}{\Delta t} \Rightarrow$

$\Rightarrow \Pi_1 = \frac{V}{\Delta t_1} \Rightarrow \Delta t_1 = \frac{V}{\Pi_1} = \frac{V}{A \cdot v_1} = \frac{V}{A \cdot \sqrt{\frac{gH}{3}}}$

και για 2 οπές $\rightarrow m_{\varepsilon\xi} = m_1 + m_2 \Rightarrow \frac{dm}{dt} = \frac{dm_1}{dt} + \frac{dm_2}{dt}$

$\Rightarrow \cancel{\rho}\frac{dV}{dt} = \cancel{\rho}\frac{dV_1}{dt} + \cancel{\rho}\frac{dV_2}{dt} \Rightarrow \Pi = \Pi_1 + \Pi_2 \Rightarrow$

$\Rightarrow \Pi = A v_1 + A v_2 \Rightarrow \frac{V}{\Delta t_2} = A(v_1 + v_2) \Rightarrow \Delta t_2 = \frac{V}{A(v_1+v_2)}$

Συνεπώς

$$\frac{\Delta t_1}{\Delta t_2} = \frac{\frac{\cancel{V}}{\cancel{A} v_1}}{\frac{\cancel{V}}{\cancel{A}(v_1+v_2)}} = \frac{v_1 + v_2}{v_1} = \frac{\sqrt{\frac{gH}{3}} + 2\sqrt{\frac{gH}{3}}}{\sqrt{\frac{gH}{3}}} =$$

$$= \frac{3\sqrt{\frac{gH}{3}}}{\sqrt{\frac{gH}{3}}} = 3 \Rightarrow \boxed{\frac{\Delta t_2}{\Delta t_1} = \frac{1}{3}}$$

B3. α) iii)

β) ΑΔΟ $\Sigma \vec{F}_{εξ} = \vec{0} \Rightarrow \vec{p}_{πριν} = \vec{p}_{μετά} \Rightarrow p_{πριν} = p_{μετά} \Rightarrow$

$\Rightarrow p_1 + 0 = \frac{p_1}{5} + p_2' \Rightarrow p_2' = \frac{4p_1}{5}$

και $p_1' = \frac{p_1}{5} \Rightarrow \cancel{m_1} v_1' = \frac{\cancel{m_1} v_1}{5} \Rightarrow v_1' = \frac{v_1}{5} \xRightarrow{κ.ε.κ.}$

$\Rightarrow \frac{m_1 - m_2}{m_1 + m_2} \cancel{v_1} = \frac{\cancel{v_1}}{5} \Rightarrow 5m_1 - 5m_2 = m_1 + m_2 \Rightarrow$

$\Rightarrow 4m_1 = 6m_2 \Rightarrow m_2 = \frac{2}{3} m_1$

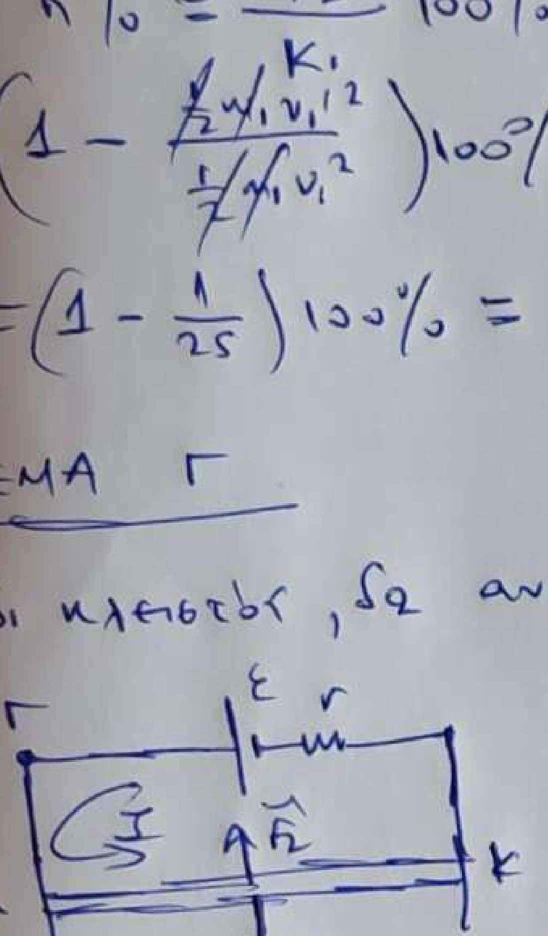
άρα $\eta\% = \frac{K_2'}{K_1} 100\% = \frac{K_1 - K_1'}{K_1} 100\% = \left(1 - \frac{K_1'}{K_1}\right) 100\% =$

$= \left(1 - \frac{\cancel{\frac{1}{2}} \cancel{m_1} v_1'^2}{\cancel{\frac{1}{2}} \cancel{m_1} v_1^2}\right) 100\% = \left(1 - \frac{\frac{v_1^2}{25}}{v_1^2}\right) 100\% =$

$= \left(1 - \frac{1}{25}\right) 100\% = \frac{24}{25} 100\% = 96\%.$

ΘΕΜΑ Γ

Γ1. $Δ_1$ κλειστός, $Δ_2$ ανοιχτός, ο αγωγός ισορροπεί



$\Sigma \vec{F} = \vec{0} \Rightarrow \vec{F}_L + \vec{w} = \vec{0} \Rightarrow$

$\Rightarrow \vec{F}_L = -\vec{w} \Rightarrow$

$\Rightarrow |\vec{F}_L| = mg = 3N$

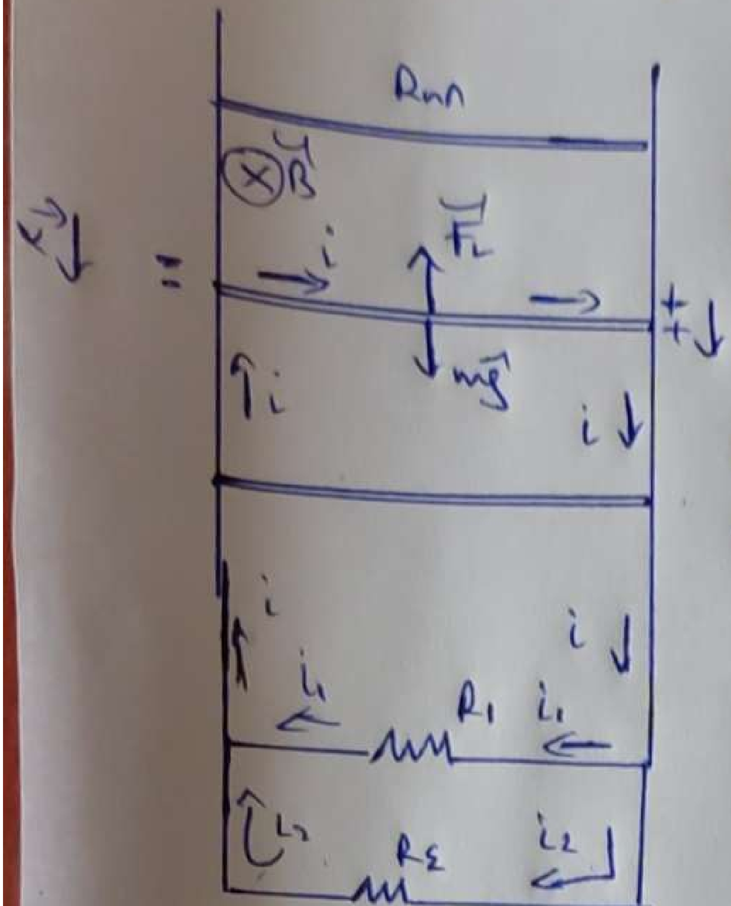
κανόνας 3 δαχτύλων ⊗ $\vec{B}$

οπότε $BIl = mg \Rightarrow B \frac{E}{R_{ολ}} l = mg \Rightarrow B = \frac{mg R_{ολ}}{El}$

$\Rightarrow B = \frac{3(1+2)}{9 \cdot 1} T = \frac{3 \cdot 3}{9} T \Rightarrow \boxed{B = 1T}$

Γ2.

δ_1 ανοιχτός, δ_2 κλειστός



για R_Σ

$P_K = V_K I_K \Rightarrow I_K = \frac{P_K}{V_K} = \frac{6}{6}A = 1A$

$R_\Sigma = \frac{V_K}{I_K} = 6\Omega$

για αγωγό ΚΛ

$\mathcal{E}_{\epsilon\pi} = -N\frac{d\Phi}{dt} \Rightarrow |\mathcal{E}_{\epsilon\pi}| = \cancel{N}^1 \left|\frac{d\Phi}{dt}\right|$

$= B\cdot\left|\frac{dA}{dt}\right| = B\ell\frac{dy}{dt} = B\upsilon\ell$

$R_1 || R_\Sigma \Rightarrow R_{1,\Sigma} = \frac{R_1 R_\Sigma}{R_1+R_\Sigma} \Rightarrow$

$\Rightarrow R_{1\Sigma} = \frac{3\cdot 6}{3+6}\Omega = \frac{18}{9}\Omega = 2\Omega$

Συνεπώς $i = \frac{\mathcal{E}}{R_{o\lambda}} = \frac{B\upsilon\ell}{R_{1\Sigma}+R_{κλ}}$

$F_L = Bi\ell\,\cancel{\eta\mu\frac{\pi}{2}}^1 = B\frac{B\upsilon\ell}{R_{o\lambda}}\ell = \frac{B^2\upsilon\ell^2}{R_{o\lambda}}$

και $\Sigma\vec{F} = m\vec{\alpha}_1 \Rightarrow mg - \frac{B^2\upsilon\ell^2}{R_{o\lambda}} = m\alpha$ ①

Ε. Μετ/νη επιταχ. κίνηση με $\alpha\downarrow$ ($\upsilon\uparrow$)

Για $\alpha = 0\frac{m}{s^2} \rightarrow \upsilon = \upsilon_{op}$ οπότε

① $\Rightarrow mg = \frac{B^2\upsilon_{op}\ell^2}{R_{o\lambda}} \Rightarrow \upsilon_{op} = \frac{mgR_{o\lambda}}{B^2\ell^2} = \frac{3\cdot 4}{1\cdot 1}\frac{m}{s}$

$\Rightarrow \upsilon_{op} = 12\frac{m}{s}$

(Γ3) $\frac{d\vec{p}}{dt} = \Sigma\vec{F} = m\cdot\vec{\alpha}$

από ① $\Rightarrow m\alpha = mg - \frac{B^2 \frac{v_{ορ}}{2} l^2}{R_{ολ}} =$

$= \left(3 - \frac{1\cdot 6\cdot 1}{4}\right)N = (3-1,5)N = 1,5N$

Συνεπώς $\frac{d\vec{p}}{dt} \begin{cases} μ & 1,5N \\ δ & y'y \\ φ & κάτω \end{cases}$

(Γ4) Για $v = v_{ορ} = 12\frac{m}{s}$

$i_{ολ} = \frac{B v_{ορ} l}{R_{ολ}} = \frac{12}{4}A = 3A$ και $E_{επ} = B v_{ορ} l = 12V$

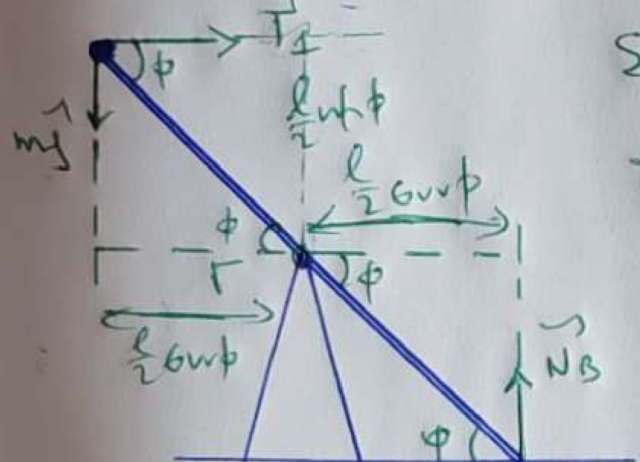
όμως $V_Λ = V_{R_Σ} \Rightarrow E_{επ} - i_{ολ}\cdot R_{ΛΛ} = i_2 \cdot R_Σ \Rightarrow$

$\Rightarrow 12 - 3\cdot 2 = i_2 \cdot 6 \Rightarrow i_2 = 1A = I_κ$

άρα λειτουργεί κανονικά

ΘΕΜΑ Δ

Δ1 Σύστημα ράβδος - σώμα σε ισορροπία



$\Sigma\vec{\tau}_{(Γ)} = \vec{0} \overset{*}{\Rightarrow} \Sigma\tau_{(Γ)} = 0\,Nm$

$\Rightarrow \tau_{w(Γ)} + \cancel{\tau_{w_ρ(Γ)}}^{0} + \cancel{\tau_{F(Γ)}}^{0} +$

$+ \tau_{T_1(Γ)} + \tau_{N_B(Γ)} = 0 \Rightarrow$

$\Rightarrow -T_1 \frac{l}{2}ημφ + mg\frac{l}{2}συνφ +$

$+ N_B\cdot\frac{l}{2}συνφ = 0 \Rightarrow$

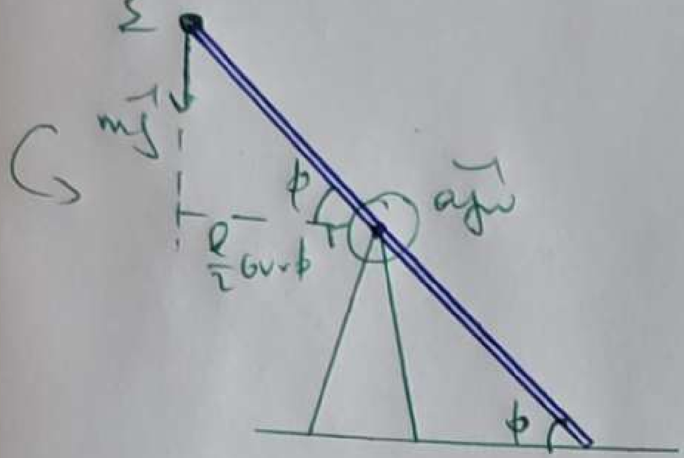
$\Rightarrow N_B \frac{\cancel{\ell}}{\cancel{2}} συνφ = T_1 \frac{\cancel{\ell}}{\cancel{2}} ημφ - mg \frac{\cancel{\ell}}{\cancel{2}} συνφ \Rightarrow$

$\Rightarrow N_B = T_1 εφφ - mg \Rightarrow N_B = 10,5 \frac{0,8}{0,6} - 10 \overset{(SI)}{=}$

$= \overset{3,5}{\cancel{10,5}} \frac{4}{\cancel{3}} - 10 \overset{(SI)}{\Rightarrow} N_B = (14-10)N \Rightarrow N_B = 4N$

Δ2. Κόβεται νήμα 1, χάνεται επαφή με δάπεδο

$t \to 0^+$



$I_{ολ(Γ)} = I_{ρ(Γ)} + I_{m(Γ)} = \frac{1}{12} M_ρ \ell^2 + m\left(\frac{\ell}{2}\right)^2 =$

$= \frac{1}{12} M_ρ \ell^2 + \frac{1}{4} m \ell^2 = \frac{1}{12} 3 \cdot 4 + \frac{1}{4} 1 \cdot 4 \overset{(SI)}{=} 2 kg m^2$

$\Sigma \vec{\tau}_{(Γ)} = I_{ολ(Γ)} \cdot \vec{a}_{γω} \Rightarrow + mg \cdot \frac{\ell}{2} συνφ = I_{ολ} |\vec{a}_{γω}| \Rightarrow$

$\Rightarrow |\vec{a}_{γω}| = \frac{mg \ell συνφ}{2 I_{ολ}} = \frac{10 \cdot \cancel{2} \cdot 0,6}{\cancel{2} \cdot 2} \frac{r}{s^2} = 3 \frac{r}{s^2}$

Επομένως

$\left| \frac{d\vec{L}_ρ}{dt} \right| = I_ρ |\vec{a}_{γω}| = 3 Nm$ $\odot \frac{d\vec{L}_ρ}{dt}$ Γ

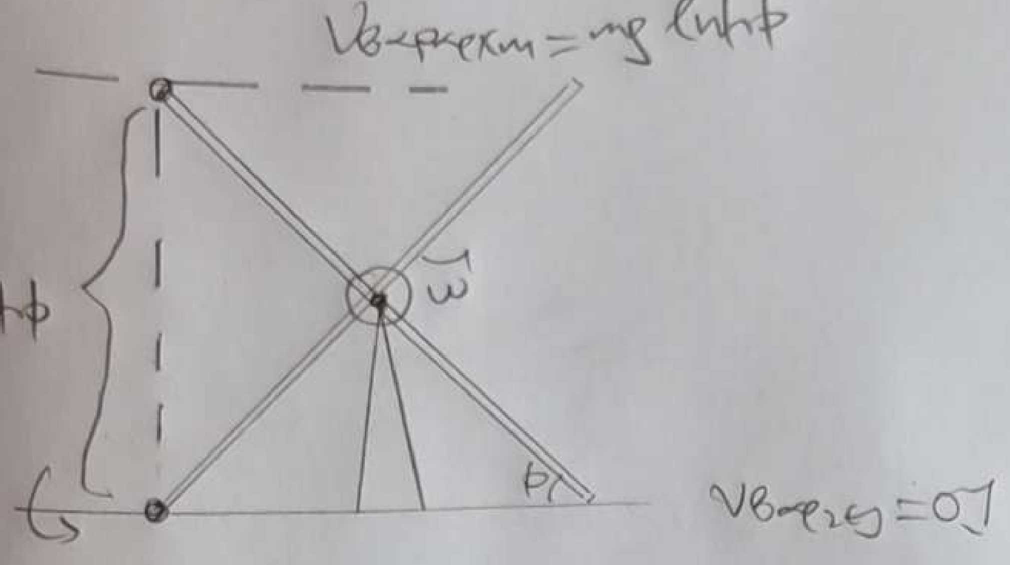
μέτρο 3 Nm

διεύθυνση του άξ. περιστροφής που διέρχεται

από το Γ κάθετα στο επίπεδο της σελίδας

κατεύθυνση με φορά από τη σελίδα προς τα μάτια του αναγνώστη

Δ3.



ΑΔΜΕ για το (Σ.)

$E_{μηχ,αρχ} = E_{μηχ,τελ} \Rightarrow K_{αρχ} + V_{βαρ,αρχ} = K_{τελ} + V_{βαρ,τελ}$

$\Rightarrow 0 + mg\,ℓημφ = \frac{1}{2} I_{ολ}\,ω^2 + 0 \Rightarrow$

$\Rightarrow \frac{1}{2} I_{ολ}\,ω^2 = mg\,ℓημφ \Rightarrow |\vec{ω}| = \sqrt{\frac{2mg\,ℓημφ}{I_{ολ}}}$

$\Rightarrow |\vec{ω}| = \sqrt{\frac{20 \cdot \cancel{2} \cdot 0{,}8}{\cancel{2}}}\ \frac{r}{s} = \sqrt{16}\ \frac{r}{s} = 4\ \frac{r}{s}$

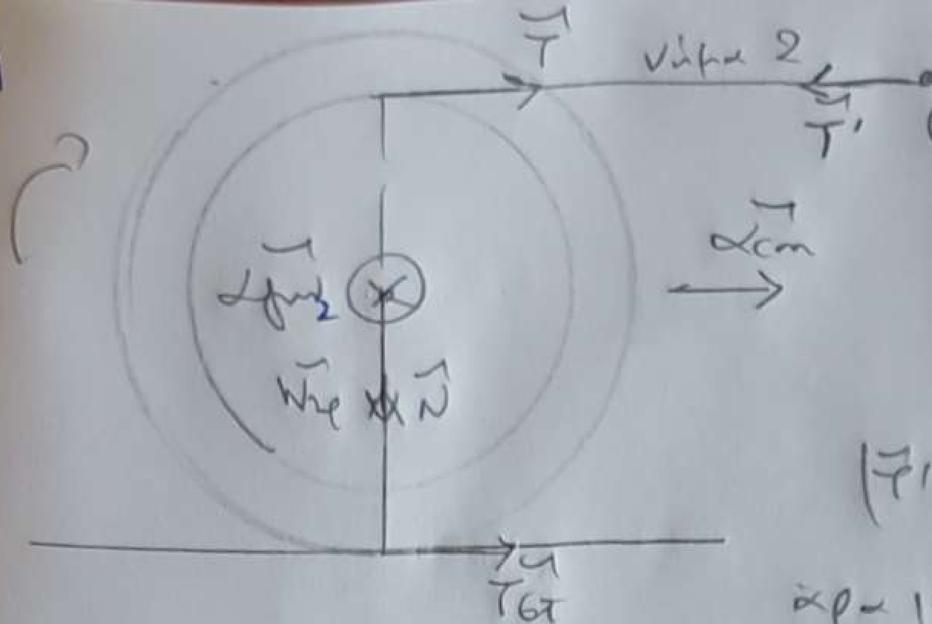
οπότε $\vec{ΔL} = \vec{L}_{τελ} - \vec{L}_{αρχ} \overset{(*)}{\Rightarrow} ΔL = L_{τελ} - L_{αρχ} =$

$= I_{ολ}\,ω' - I_{ολ}\,ω = I_{ολ}(\underbrace{ω'}_{<0} - \underbrace{ω}_{>0}) = I_{ολ}\left(-\frac{ω}{2} - ω\right) =$

$= -\frac{3}{2} I_{ολ}\,ω = -\frac{3}{2}\, 2 \cdot 4\ kg\,m^2/s = -12\ kg\,m^2/s$

με $\vec{ΔL}$ ⊗ σ

Δ4)



Αφού ισορροπεί σημείο

$\Sigma\vec F = m\cdot\vec\alpha = \vec 0$

$\Rightarrow |\vec F| = |\vec T'|$

$|\vec T'| = |\vec T|$

άρα $|\vec T'| = |\vec T| = |\vec F| = F$

$$\Sigma \vec F_x = M_2\cdot\vec\alpha_{cm} \Rightarrow F + T_{στ} = M_2\cdot\alpha_{cm} \quad (1)$$

$$\Sigma\vec\tau = I_2\vec\alpha_{γων_2} \Rightarrow -T\cdot r + T_{στ}\cdot R = -\frac{1}{2}M_2R^2\cdot\alpha_{γων} \Rightarrow$$

$$\frac{r}{R} = \frac{0,3}{0,4} = \frac{3}{4} \quad r = \frac{3}{4}R \Rightarrow -T\cdot\frac{3\cancel{R}}{4} + T_{στ}\cancel{R} = -\frac{1}{2}M_2\cdot\underbrace{R^{\cancel{2}}\cdot\alpha_{γων}}_{\alpha_{cm}}$$

$$\Rightarrow \frac{3F}{4} - T_{στ} = \frac{1}{2}M_2\cdot\alpha_{cm} \quad (2)$$

Από (1),(2) $\overset{(+)}{\Rightarrow} \frac{3F}{4} + F = \frac{3}{2}M_2\cdot\alpha_{cm} \Rightarrow \frac{7F}{2\cancel{4}} = \frac{3M_2}{\cancel{2}}\alpha_{cm}$

$$\Rightarrow \alpha_{cm} = \frac{7F}{6M_2} \Rightarrow \alpha_{cm} = \frac{\cancel{7}\cdot 12}{6\cdot\cancel{7}}\frac{m}{s^2} \Rightarrow \alpha_{cm} = 2\frac{m}{s^2}.$$

άρα $\vec\alpha_{cm}$
- μ: $2\,m/s^2$
- δ: $x'x$
- φ: δεξιά

Δ5) για $t_1 = 2s \to v_{cm} = \alpha_{cm}t_1 = 4\frac{m}{s}$

οπότε ΑΔΕ $W_F = K_{τελ} = \frac{1}{2}M_{2ε}v_{cm}^2 + \frac{1}{2}I_{2ε}\omega^2 =$

$$= \frac{1}{2}M_2\cdot v_{cm}^2 + \frac{1}{2}\cdot\frac{1}{2}M_2\underbrace{R^2\omega^2}_{v_{cm}^2} = \frac{3}{4}M_2v_{cm}^2 =$$

$$= \frac{3}{\cancel{4}}\cdot 7\cdot\overset{4}{\cancel{16}}\,J = 84\,J$$