ΘΕΜΑ Α

Α1 γ. Α2 δ Α3. γ Α4 β Α5 Λ Σ Λ Σ Σ

ΘΕΜΑ Β

Β1 Σωστη (i).

$$A_1 = \Delta l_0 = \frac{mg}{k}$$

Αρχικη θεση: $\Sigma F_{(0)} \Rightarrow F + F_{\epsilon(0)} - W = 0$

$F_{\epsilon(0)} = 0$. Αρα θ.Ι και θ.φ.μ Αρχικη $\Delta l_0 = \frac{mg}{k} = A_2$

Β2 Σωστη (ii)

$$\Pi_A = \frac{V}{\Delta t_1} \Rightarrow \Delta t_1 = \frac{V}{\Pi_A} = \frac{V}{A \cdot v_1} = \frac{V}{A\sqrt{2g\frac{H}{6}}} = \frac{V}{A\sqrt{\frac{gH}{3}}} \quad (1)$$

$$V = V_1 + V_2 = \Pi_A \cdot \Delta t_2 + \Pi_B \cdot \Delta t_2 = \left(A \cdot \sqrt{2g\frac{H}{6}} + A\sqrt{2g\frac{2H}{3}}\right)\Delta t_2$$

$$\Delta t_2 = \frac{V}{A\left(\sqrt{\frac{gH}{3}} + 2\sqrt{\frac{gH}{3}}\right)} = \frac{V}{A\sqrt{\frac{gH}{3}}} \quad (2)$$

$$\frac{\Delta t_2}{\Delta t_1} = \frac{\frac{V}{3A\sqrt{gH/3}}}{\frac{V}{V\sqrt{gH/3}}} = \frac{1}{3}$$

Β3. Σωστή η (iii).

$\vec{P}_{αρχ} = \vec{P}_{τελ} \Rightarrow P_1 = P_1' + P_2' \Rightarrow P_1 = \frac{P_1}{5} + P_2' \Rightarrow$

$P_2' = \frac{4P_1}{5}$

$v_2' = \frac{2m_1v_1}{m_1+m_2} \Rightarrow \frac{P_2'}{m_2} = \frac{2P_1}{m_1+m_2} \Rightarrow \frac{4P_1}{5m_2} = \frac{2P_1}{m_1+m_2} \Rightarrow 2m_1 + 2m_2 = 5m_2$

$2m_1 = 3m_2 \Rightarrow m_1 = 1,5m_2$

ή $P_1' = \frac{P_1}{5} \Rightarrow v_1' = \frac{v_1}{5} \Rightarrow \frac{m_1-m_2}{m_1+m_2} \cdot v_1 = \frac{v_1}{5} \Rightarrow m_1 = 1,5m_2$

$\frac{ΔK_2}{K_1} \cdot 100\% = \frac{\frac{1}{2}m_2v_2'^2 \cdot 100\%}{\frac{1}{2}m_1v_1^2} = \frac{\frac{P_2'^2}{m_2}}{\frac{P_1^2}{m_1}} \cdot 100\% = \frac{m_1}{m_2} \cdot \left(\frac{P_2'}{P_1}\right)^2 \cdot 100\%$

$= 1,5 \cdot \frac{16}{25} \cdot 100\% = 96\%$

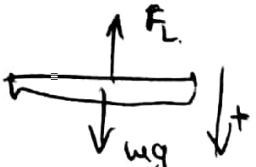
ΘΕΜΑ Γ

Γ1. $\vec{B}$ ⊗ $\Sigma\vec{F} = \vec{0} \Rightarrow F_L = mg \Rightarrow B\frac{E}{r+R_{ση}}l = mg$

$\Rightarrow B\frac{9}{3} \cdot l = 3 \Rightarrow B = 1\,T$

Γ2. $I_K = \frac{P_K}{V_K} = 1\,A$ $R_Σ = \frac{V_K}{I_K} = 6\,Ω$.

Καθως ο αγωγος κατερχεται εχουμε



$\Sigma F = ma \Rightarrow F_L - mg = ma \Rightarrow a = g - \frac{B^2l^2}{mR_{ολ}}v$ (1)

Καθως $v\uparrow$ $a\downarrow$ οποτε επιταχυνομενη με επαυ. επιταχυνση.

v_{op} οταν $a = 0 \xrightarrow{(1)} v_{op} = \frac{mgR_{ολ}}{B^2l^2}$ (2)

$R_{1,\Sigma} = \frac{R_1 R_\Sigma}{R_1 + R_\Sigma} = 2\,\Omega$ $\quad R_{o\lambda} = R_{1,\Sigma} + R_{\kappa\lambda} = 4\,\Omega$.

(2) $\Rightarrow v_{o\rho} = \frac{0{,}3 \cdot 10 \cdot 4}{1 \cdot 1} \Rightarrow v_{o\rho} = 12\ m/s$

Γ3. από την (1) $\Rightarrow a_1 = 10 - \frac{1 \cdot 6 \cdot 1}{0{,}3 \cdot 4} \Rightarrow$

$a_1 = 5\ m/s^2$

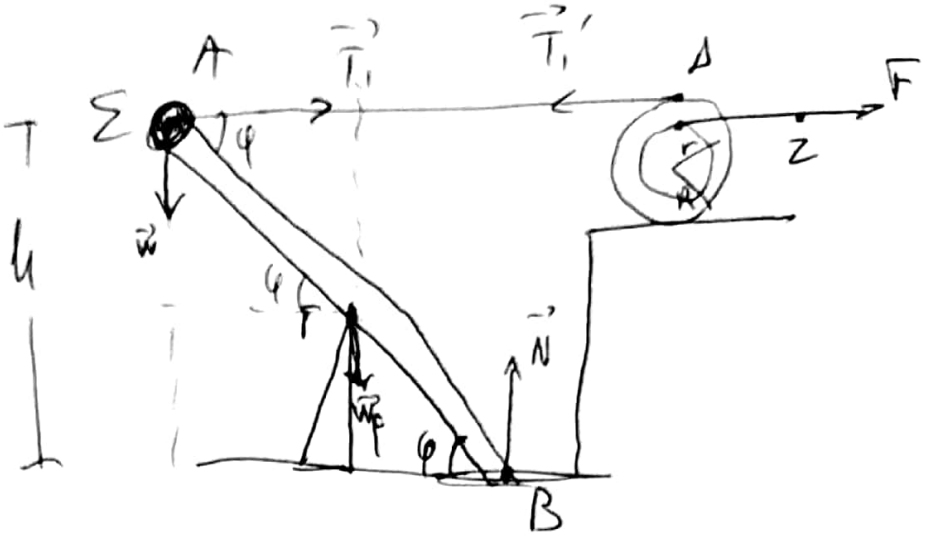
$\frac{dp}{dt} = \Sigma F = m a_1 = 1{,}5\ kg\ m/s^2.$

Γ4. $E_{\varepsilon\pi} = B v_{o\rho} \ell = 12\ V$ $\quad I = \frac{E_{\varepsilon\pi}}{R_{o\lambda}} = 3A.$

$V_{\kappa\lambda} = I R_{1,\Sigma} = 6\ V = V_\kappa$ άρα δείχουρχει κανονικά.

ΘΕΜΑ Δ

$M_\rho = 3\,kg$
$\ell = 2\,m$
$m = 1\,kg$
$\eta\mu\varphi = 0,8$
$M_T = 7\,kg$
$R = 0,4\,m$
$r = 0,3\,m$



Δ1. $\Sigma\tau_{(\Gamma)} = 0 \Rightarrow T_1 \frac{\ell}{2}\eta\mu\varphi = mg\frac{\ell}{2}\sigma\upsilon\nu\varphi + N\cdot\frac{\ell}{2}\sigma\upsilon\nu\varphi \Rightarrow$

$10,5\cdot 0,8 = 10\cdot 0,6 + 0,6\,N \Rightarrow N = \frac{10,5\cdot 8}{6} - 10 = 4\,N.$

Δ2. $\frac{dL}{dt}(\Gamma) = \Sigma\tau_{(\Gamma)} = \tau_w = mg\frac{\ell}{2}\sigma\upsilon\nu\varphi = 6\ kg\,m^2/s^2$

με. $\frac{d\vec{L}}{dt}\odot$ $\frac{dL}{dt}(\rho) = I_\rho\cdot\alpha_\gamma = I_\rho\frac{d\omega}{dt} = \frac{1}{2}\cdot\frac{dL}{dt} = 3\,kg\,m^2/s^2$

Δ3. $I = I_\rho + I_m = \frac{1}{12}M_\rho\ell^2 + m\frac{\ell}{4} = 1+1 = 2\,kgm^2$

Το σφαιρίδιο κατέρχεται κατά $h = \ell\eta\mu\varphi$

ΘΜΚΕ μεχρι το m να φτασει στο εδαφος

$K_\tau - K_A = W_w \Rightarrow \frac{1}{2}I\omega^2 = mg\ell\eta\mu\varphi \Rightarrow \frac{1}{2}2\omega^2 = 10\cdot 2\cdot 0,8$

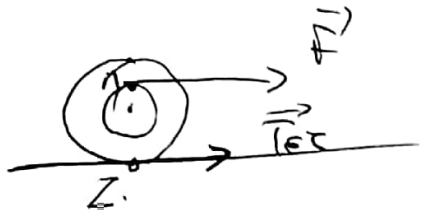
$\omega = 4\ rad/s$ και $\omega' = \frac{\omega}{2} = 2\ rad/s.$

$\vec{L}_{πριν}\ \odot$ $\vec{L}_{μετα}\ \otimes$

$\Delta\vec{L} = \vec{L}_{μετα} - \vec{L}_{πριν} \Rightarrow |\Delta L| = |I\omega' - (-I\omega)| \Rightarrow$

$\Delta L = 3I\frac{\omega}{2} = 12\ kg\,m^2/s.$ $\Delta\vec{L}\ \otimes$

Δ4



Κ.Χ.Ο. Άρα $\vec{U_Z} = \vec{0} \Rightarrow$

$U_{\gamma\rho} = U_{cm} \Rightarrow \omega R = U_{cm} \Rightarrow \frac{d\omega}{dt} \cdot R = \frac{dU_{cm}}{dt} \Rightarrow$

$a_{cm} = a_\gamma R$

$$\left.\begin{array}{l} \Sigma F = M_T \cdot a_{cm} \\ \Sigma \tau_z = I_T \cdot a_\gamma \end{array}\right| \Rightarrow \left.\begin{array}{l} F + T_{\delta\varepsilon} = M_T \cdot a_{cm} \\ F \cdot r - T_{\delta\varepsilon} \cdot R = \frac{1}{2} M_T \cdot R^2 \frac{a_{cm}}{R} \end{array}\right| \Rightarrow$$

$$F + T_{\delta\varepsilon} = M_T a_{cm} \overset{(1)}{\Rightarrow} F\left(\frac{r}{R} + 1\right) = \frac{3}{2} M_T a_{cm} \Rightarrow$$

$$\frac{Fr}{R} - T_{\delta\varepsilon} = \frac{1}{2} M_T a_{cm}$$

$$\Rightarrow 12\left(\frac{3}{4} + 1\right) = \frac{3}{2} 7 a_{cm} \Rightarrow \frac{12 \cdot 7}{4} = \frac{3 \cdot 7}{2} a_{cm} \Rightarrow$$

$$a_{cm} = 2\ m/s^2$$

Σημείωση: (1) $\Rightarrow 12 + T_{\delta\varepsilon} = 14 \Rightarrow T_{\delta\varepsilon} = -2\ N$ άρα αντίθετη φορά από αυτή που σχεδιάστηκε

Δ5.

Την στιγμή $t_1 = 2\ s$ $\quad U_{cm} = a_{cm} \cdot t_1 = 4\ m/s$

$W_{T_{\delta\varepsilon}} = 0.$

$$W_F = \Delta K = K_T - \cancel{K_A}^{\,0} = \frac{1}{2} I\omega^2 + \frac{1}{2} M_T U_{cm}^2 =$$

$$= \frac{3}{4} M_T U_{cm}^2 = \frac{3}{4} \cdot 7 \cdot 16 = 84\ J$$

ή $\quad a_\Pi = a_{cm} + a_\gamma \cdot r = a_{cm} + a_{cm} \cdot \frac{r}{R} = 2 + 2\frac{3}{4} = \frac{7}{2}\ m/s^2$

$$S_\Pi = \frac{1}{2} a_\Pi \cdot t_1^2 = \frac{1}{2} \frac{7}{2} \cdot 4 = 7\ m.$$

$$W_F = F \cdot S_\Pi = 84\ J$$