

ΦΥΣΙΚΗ ΠΑΝΕΛΛΑΔΙΚΕΣ 2022

ΘΕΜΑ Α

A1. γ, A2. δ, A3. γ, A4. β, A5: α. λ, β. ζ, γ. λ, δ. ζ, ε. ζ

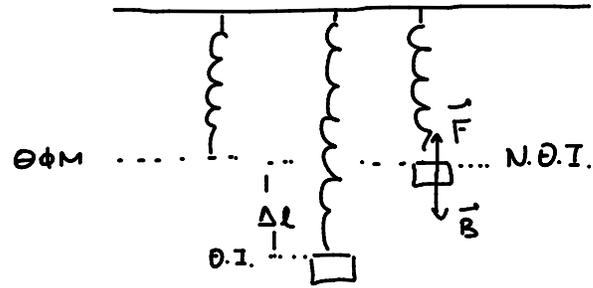
ΘΕΜΑ Β

B1. i.

Πείραμα 1: Η ΘΦΜ είναι ακραία δέση

$$A_1 = \Delta l \rightarrow A_1 = \frac{u_3 g}{k}$$

Πείραμα 2



Η αριστερή Θ.Ι. είναι ακραία δέση:

$$A_2 = \Delta l \rightarrow A_2 = \frac{u_3 g}{k}$$

B2. ii.

Από Torricelli:

$$v_1 = \sqrt{2g(H - \frac{5H}{6})} \rightarrow v_1 = \sqrt{2g \frac{H}{6}} \rightarrow v_1 = \sqrt{\frac{gH}{3}}$$

$$V = \pi \cdot \Delta t_1 \rightarrow V = A \cdot v_1 \cdot \Delta t_1 \rightarrow \Delta t_1 = \frac{V}{A \cdot v_1}$$

Από Torricelli:

$$v_1 = \sqrt{2g\left(H - \frac{H}{3}\right)} \rightarrow v_2 = 2\sqrt{\frac{2H}{3}} \rightarrow v_2 = 2v_1$$

$$V = \pi_1 \cdot \Delta t_1 + \pi_2 \cdot \Delta t_2 \rightarrow \Delta t_2 = \frac{V}{\pi_1 + \pi_2} \rightarrow$$

$$\rightarrow \Delta t_2 = \frac{V}{A \cdot (v_1 + v_2)}$$

$$\frac{\Delta t_2}{\Delta t_1} = \frac{\frac{V}{A(v_1 + v_2)}}{\frac{V}{A \cdot v_1}} = \frac{v_1}{v_1 + v_2} = \frac{v_1}{3v_1} = \frac{1}{3}$$

B3. iii.

$$P_{1,z\epsilon\lambda} = \frac{P_1}{5} \rightarrow m_1 \cdot V_1 = \frac{m_1 \cdot v_1}{5} \rightarrow V_1 = \frac{v_1}{5}$$

$$K_{\text{εκ}\lambda,1} = \frac{1}{2} m_1 v_1^2$$

$$K_{z\epsilon\lambda,1} = \frac{1}{2} m_1 V_1^2 \rightarrow K_{z\epsilon\lambda,1} = \frac{1}{2} m_1 \cdot \frac{v_1^2}{25}$$

$$\Delta K_1 = K_{z\epsilon\lambda,1} - K_{\text{εκ}\lambda,1} \rightarrow \Delta K_1 = -\frac{24}{50} m_1 v_1^2$$

$$\Sigma \frac{1}{2} m_1 v_1^2 \sim (1) \text{ ή } \frac{24}{50} m_1 v_1^2$$

100 x<sub>i</sub>

$$x = 96\%$$

Άρα η κρούση είναι ελαστική

η (2) ήρθε το 96% της  $K_{\text{εκ}\lambda,1}$

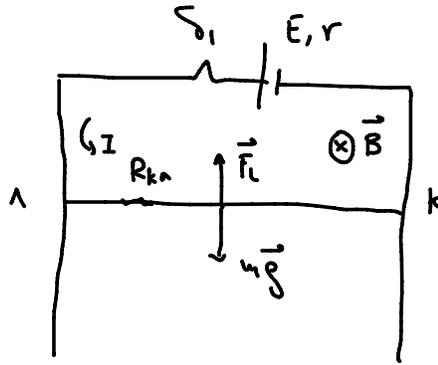
ΘΕΜΑ Γ

Γ1.  $I = \frac{E}{R_{k\alpha} + r} = 3A$

$\Sigma \vec{F} = 0 \rightarrow F_L - mg = 0$

$\rightarrow BIL = mg \rightarrow B = 1T$

και φορτι που φαινετα 60 C x hpa



Γ2. Στις ωχεια δέου

$\Sigma \vec{F} = m \cdot a \rightarrow$

$mg - F_L = ma \rightarrow$

$mg - \frac{B^2 \cdot v \cdot l^2}{R_0 \lambda} = m \cdot a \quad (1)$

Απο τω (1) φαει οτι η v αυξανετα η α μεινετα.

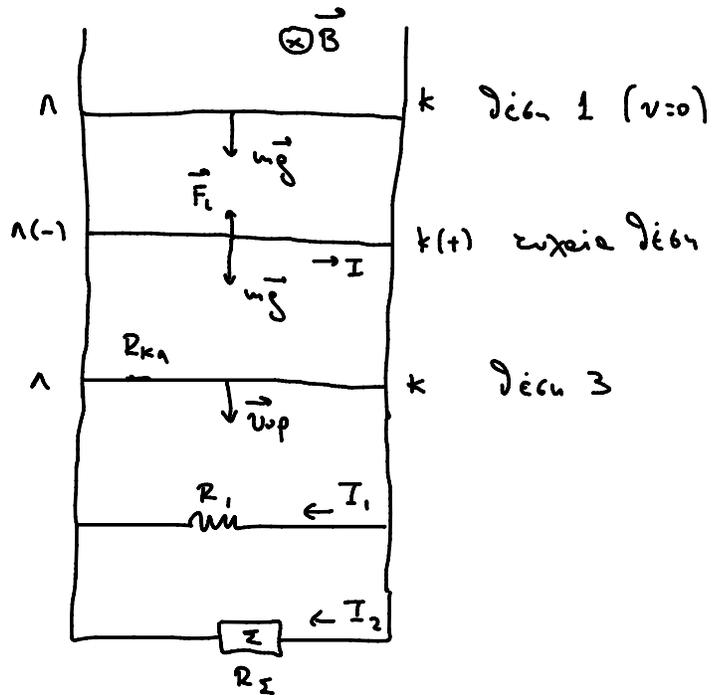
Αρα επιταχυνόμενα με μειούμενο ρυθμο, μέχρι να γίνει  $a=0$ , οποτε ο κλ αποκει  $v_{op}$ .

(1)  $\xrightarrow{a=0} v_{op} = \frac{mg R_0 \lambda}{B^2 \cdot l^2} \quad (2)$

$P_{\Sigma} = V_{\Sigma} \cdot I_{\Sigma} \rightarrow I_{\Sigma} = 1A$

$R_{\Sigma} = \frac{V_{\Sigma}}{I_{\Sigma}} \rightarrow R_{\Sigma} = 6 \Omega$

$R_{\Sigma \gamma} = \frac{r_1 \cdot R_{\Sigma}}{r_1 + R_{\Sigma}} \rightarrow R_{\Sigma \gamma} = 2 \Omega$



$$R_{02} = R_{E2} + R_{K1} \rightarrow R_{02} = 4 \Omega$$

$$(2) \rightarrow v_{op} = 12 \text{ m/s}$$

$$\Gamma 3. (1) \xrightarrow{v=6 \text{ m/s}} a = 5 \text{ m/s}^2$$

$$\frac{d\vec{p}}{dt} = \vec{\Sigma F} \rightarrow \frac{d\vec{p}}{dt} = m \cdot \vec{a} \rightarrow \frac{dp}{dt} = 1,5 \text{ kg m/s}^2 \text{ και φορά προς τα κάτω}$$

$\Gamma 4.$  Όταν ο κλ ανασταθίσει με  $v_{op}$

$$\vec{\Sigma F} = 0 \rightarrow F_L = mg \rightarrow BIl = mg \rightarrow I = 3 \text{ A}$$

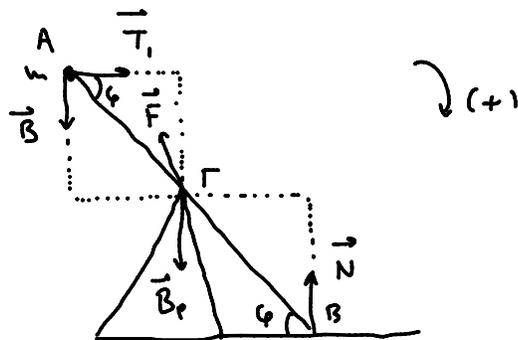
$$V_{K1} = E_{cn} - I \cdot R_{K1} \rightarrow V_{K1} = B \cdot v_{op} \cdot l - I \cdot R_{K1} \rightarrow V_{K1} = 6 \text{ V}$$

Επειδή  $V_{K1} = V_{\Sigma}$  η συσκευή λειτουργεί κενό υικά

### ΘΕΜΑ Δ

$\Delta 1.$  Για το σώμα  
στηρείο πλαίσιο - σφαιρίδιο

$$\vec{\Sigma \tau} = 0 \rightarrow$$



$$T_1 \cdot \frac{l}{2} \cdot \sin \phi - B \cdot \frac{l}{2} \cdot \cos \phi - N \cdot \frac{l}{2} \cdot \cos \phi = 0 \rightarrow T_1 \cdot \sin \phi - mg \cdot \cos \phi = N \cdot \cos \phi \rightarrow N = 4 \text{ N}$$

$\Delta 2.$  Για το σώμα στηρείο πλαίσιο - σφαιρίδιο:

$$I_{02}(r) = I_{cm}(r) + m \cdot \left(\frac{l}{2}\right)^2 = \frac{1}{12} M_p \cdot l^2 + m \left(\frac{l}{2}\right)^2 = 2 \text{ kg} \cdot \text{m}^2$$

$$\text{Την } t=0: \sum \vec{\tau}^{(r)} = I_0 \lambda(r) \cdot \vec{e}_y \rightarrow B \cdot \frac{l}{2} \cdot 600 \varphi = I_0 \lambda(r) \cdot e_y \rightarrow$$

$$\rightarrow a_y = \frac{mg \frac{l}{2} 600 \varphi}{I_0 \lambda(r)} \rightarrow a_y = 3 \text{ rad/s}^2$$

$$\frac{dL_{p(r)}}{dt} = \sum \vec{\tau}_{p(r)} \rightarrow \frac{dL_{p(r)}}{dt} = I_{p(r)} \cdot \vec{a}_y \rightarrow \frac{dL_{p(r)}}{dt} = \frac{1}{12} M_p \cdot l^2 \cdot a_y \rightarrow$$

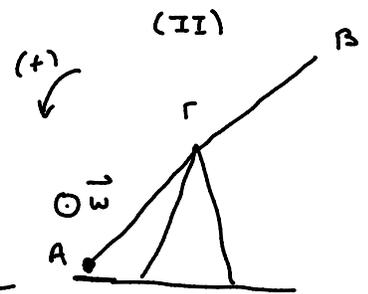
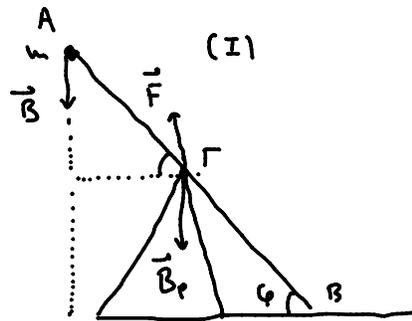
$$\rightarrow \frac{dL_{p(r)}}{dt} = 3 \text{ kg} \cdot \frac{\text{m}^2}{\text{s}^2} \text{ και κεραιδωμέν προς τον αναγνώστη}$$

Δ3. Από ΘΜΚΕ

για το σώμα στρέφει

από (I) σε (II)

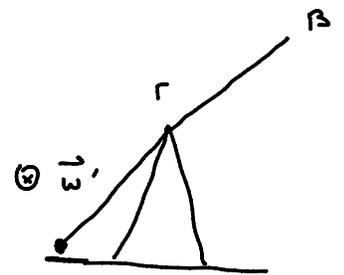
$$K_{zε2} - K_{zεx} = W_B \rightarrow$$



$$\frac{1}{2} I_0 \lambda(r) \omega^2 - 0 = mg \cdot l \cdot \sin \varphi \rightarrow \omega = 4 \text{ rad/s}$$

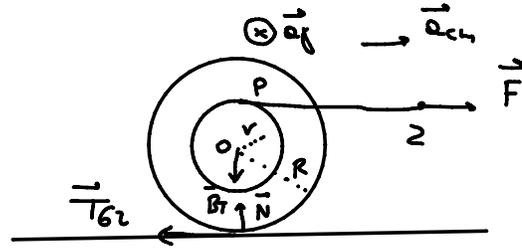
$$\vec{\Delta L} = \vec{L}_{zελ} - \vec{L}_{zεx} \rightarrow |\Delta \vec{L}| = | -I_0 \lambda(r) \cdot \omega' - I_0 \lambda(r) \cdot \omega |$$

$$\rightarrow |\Delta \vec{L}| = I_0 \lambda(r) \cdot \frac{\omega}{2} + I_0 \lambda(r) \cdot \omega \rightarrow |\Delta \vec{L}| = 12 \text{ kg} \cdot \frac{\text{m}^2}{\text{s}}$$



Το διάνυσμα  $\Delta \vec{L}$  έχει κεραιδωμέν προς τον αναγνώστη

Δ4.



$$M_P = 3 \text{ kg}$$

$$l = 2 \text{ m}$$

$$m = 1 \text{ kg}$$

$$M_T = 7 \text{ kg}$$

$$R = 0,4 \text{ m}$$

$$r = 0,3 \text{ m}$$

$$\sum \vec{F}_x = M_T \cdot \vec{a}_{cm} \rightarrow F - T_{GZ} = M_T \cdot a_{cm} \quad (1)$$

$$\sum \vec{\tau} = I_{cm}(T) \cdot \vec{\alpha} \rightarrow F \cdot r + T_{GZ} \cdot R = \frac{1}{2} M_T \cdot R^2 \cdot \alpha$$

$$\frac{k \cdot 7 \cdot 16 \text{ m}}{a_{cm} = \alpha \cdot R}$$

$$F \cdot r + T_{GZ} \cdot R = \frac{1}{2} M_T \cdot a_{cm} \cdot R \quad (2)$$

$$\text{Ans (1) \& (2): } a_{cm} = 2 \text{ m/s}^2$$

$$\Delta S. \quad \Delta x_0 = \frac{1}{2} a_{cm} \cdot \Delta t^2 \xrightarrow{\Delta t = 2 \text{ s}} \Delta x_0 = 4 \text{ m}$$

$$W_F = W_{\vec{F}(M(T)} + W_{\tau_F(s)} = F \cdot \Delta x_0 + F \cdot r \cdot \Delta \vartheta \xrightarrow{\substack{k \cdot 7 \cdot 16 \text{ m} \\ \Delta x_0 = \Delta \vartheta \cdot R}}$$

$$W_F = F \cdot \Delta x_0 + F \cdot r \cdot \frac{\Delta x_0}{R} \rightarrow W_F = F \cdot \Delta x_0 \cdot \left(1 + \frac{r}{R}\right) \rightarrow W_F = 84 \text{ J}$$

∴

$$W_{\vec{F}} = F \cdot \Delta x_p = F \cdot (\Delta x_0 + \Delta \vartheta \cdot r) \rightarrow \dots \rightarrow W_F = 84 \text{ J}$$

∴

$$v_{cm} = a_{cm} \cdot \Delta t \xrightarrow{\Delta t = 2 \text{ s}} v_{cm} = 4 \text{ m/s}$$

$$v_{cm} = \omega \cdot R \rightarrow \omega = 10 \text{ rad/s}$$

Θυκε για  $\Delta t = 2s$  για κίνηση

$$K_{\text{trans}} + K_{\text{rot}} = W_F \rightarrow \frac{1}{2} M_T \cdot v_{\text{cm}}^2 + \frac{1}{2} I_{\text{cm}(T)} \cdot \omega^2 = W_F \rightarrow W_F = 84J$$