Παρατηρήσεις

ΘΕΜΑΤΑ ΦΥΣΙΚΗΣ 2022

ΘΕΜΑ Α

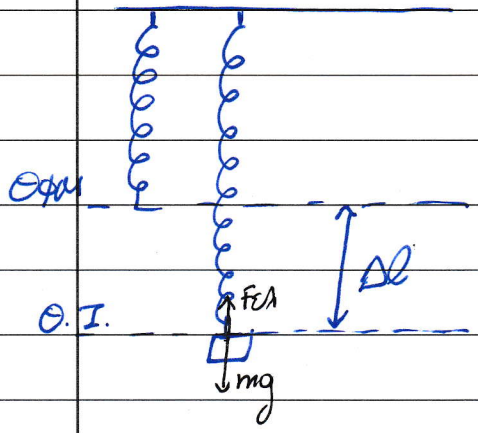
Α1) γ Α2) δ Α3) γ Α4) β

Α5) α) Λ β) Σ γ) Λ δ) Σ ε) Σ

ΘΕΜΑ Β

Β1) Σωστή απάντηση: i

Πείραμα 1



Θ.Ι.: $\Sigma F = 0$

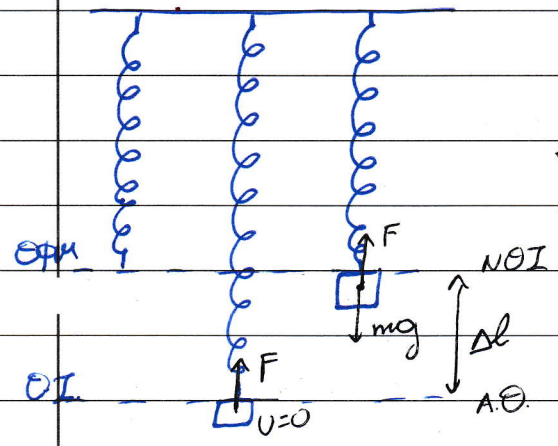
$\Rightarrow K \cdot \Delta l = m \cdot g$

$\Rightarrow \Delta l = \frac{m \cdot g}{K}$

Αφού $U = 0$ στη ΘΦΜ:

$A_1 = \Delta l = \frac{m \cdot g}{K}$ (1)

Πείραμα 2



Ν.Θ.Ι.:

$\Sigma F = 0 \Rightarrow F = mg$

$(F_{ελ} = 0)$

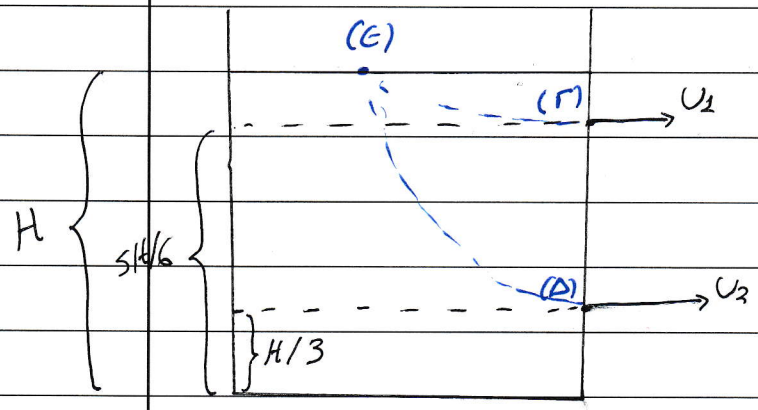
Άρα στη ΘΦΜ

$A_2 = \Delta l = \frac{mg}{K}$ (2)

(1), (2) $\Rightarrow$ $\boxed{A_1 = A_2}$

Παρατηρήσεις

B2 Σωστή απάντηση: ii



Ε.Ι. Bernoulli (Ε→Γ): $U_1 = \sqrt{2g(H - \frac{5H}{6})}$

$\Rightarrow U_1 = \sqrt{\frac{gH}{3}}$

Ε.Ι. Bernoulli (Ε→Δ): $U_2 = \sqrt{2g(H - \frac{H}{3})}$

$\Rightarrow U_2 = \sqrt{\frac{4gH}{3}} = 2 \cdot \sqrt{\frac{gH}{3}}$

- $\Pi_\Gamma = \frac{V}{\Delta t_1} \Rightarrow \Delta t_1 = \frac{V}{A \cdot U_1}$ (1)

- $V = V_1 + V_2$

$\Rightarrow \frac{V_1}{\Delta t_2} + \frac{V_2}{\Delta t_2} = \frac{V}{\Delta t_2} \Rightarrow \Pi_\Gamma + \Pi_\Delta = \frac{V}{\Delta t_2} \Rightarrow \Delta t_2 = \frac{V}{A \cdot U_1 + A \cdot U_2}$ (2)

$\frac{(2)}{(1)} \Rightarrow \frac{\Delta t_2}{\Delta t_1} = \frac{A \cdot U_1}{A(U_1 + U_2)} = \frac{\sqrt{\frac{gH}{3}}}{\sqrt{\frac{gH}{3}}(1+2)}$

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

Παρατηρήσεις

B3) Σωστή απάντηση: iii

$$P_1' = \frac{P_1}{5} \Rightarrow v_1' = \frac{v_1}{5}$$

$$K_1 = \frac{1}{2} m_1 v_1^2 \qquad K_1' = \frac{1}{2} m_1 v_1'^2 = \frac{1}{25} \frac{1}{2} m_1 v_1^2$$

$$K_1' = \frac{1}{25} K_1$$

ΔΚΕ $\quad \Delta K_1 = -\Delta K_2$

$$K_1' - K_1 = -(K_2' - K_2)$$

$$K_2' = K_1 - K_1'$$

$$K_2' = \frac{24}{25} K_1$$

$$\Pi = \frac{K_2'}{K_1} 100\% = \frac{24}{25} 100\% \Rightarrow \Pi = 96\% \ (iii)$$

ή

$$p_1' = \frac{p_1}{5} \Rightarrow m_1 \cdot v_1' = m_1 \cdot \frac{v_1}{5} \Rightarrow \frac{m_1 - m_2}{m_1 + m_2} \cdot v_1 = \frac{v_1}{5}$$

$$\Rightarrow m_1 + m_2 = 5m_1 - 5m_2 \Rightarrow 4m_1 = 6m_2$$

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

$$\rightsquigarrow v_2' = \frac{2m_1}{m_1 + m_2} v_1 = \frac{2 \cdot \frac{3}{2} m_2}{\frac{3}{2} m_2 + m_2} \cdot v_1 = \frac{3m_2}{\frac{5}{2} m_2} \cdot v_1$$

$$\Rightarrow v_2' = \frac{6}{5} v_1$$

$$\cdot \Pi = \frac{K_2'}{K_1} \cdot 100\% = \frac{\frac{1}{2} m_2 \cdot v_2'^2}{\frac{1}{2} m_1 \cdot v_1^2} \cdot 100\% = \frac{m_2 \cdot \frac{36}{25} v_1^2}{\frac{3}{2} m_2 \cdot v_1^2} \cdot 100\%$$

$$\Rightarrow \Pi = \frac{72}{75} \cdot 100\% \Rightarrow \boxed{\Pi = 96\%}$$

Παρατηρήσεις

ΘΕΜΑ Γ

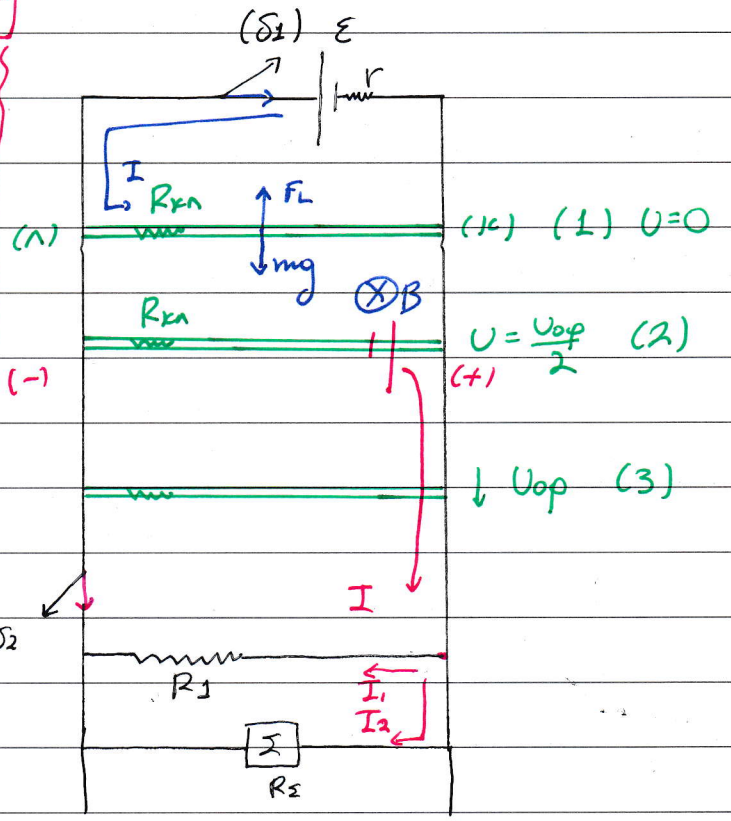
$\mathcal{E} = 9V$

$r = 1\,\Omega$

$\ell = 1m$

$m = 0,3kg$

$R_{KA} = 2\,\Omega$



Δ1: κλειστός, Δ2: ανοιχτός

Γ1) $\Sigma F = 0 \Rightarrow F_L = mg \Rightarrow B \cdot I \cdot \ell = mg$ (1)

$I = \frac{\mathcal{E}}{R_{KA} + r} \Rightarrow I = \frac{9}{3} = 3A$

(1) $\Rightarrow B \cdot 3 \cdot 1 = 3 \Rightarrow \boxed{B = 1T}$, ⊗

Γ2) $V_K = 6V$, $P_K = 6W$, $U_{op} = ;$, $R_1 = 3\,\Omega$

Δ1: ανοιχτός, Δ2: κλειστός

$R_\Sigma = \frac{P_K^2}{V_K^2} = 6\,\Omega$

$R_{1,\Sigma} = \frac{R_1 \cdot R_\Sigma}{R_1 + R_\Sigma} = \frac{3 \cdot 6}{3+6} = 2\,\Omega$

Παρατηρήσεις

Λόγω του w, εκτελεί επιταχυνόμενη κίνηση.

$U\uparrow \rightsquigarrow \mathcal{E}_{επ} = B \cdot U \cdot l \uparrow \rightsquigarrow I = \frac{\mathcal{E}_{επ}}{R_{ολ}} \uparrow \rightsquigarrow F_L = B \cdot I \cdot l \uparrow$

$\rightsquigarrow \Sigma F = w - F_L \downarrow$, μέχρι $\Sigma F = 0$

$\Sigma F = 0 \Rightarrow F_L = w \Rightarrow B \cdot I \cdot l = mg$

$\Rightarrow B \cdot \frac{\mathcal{E}_{επ}}{R_{ολ}} \cdot l = mg \Rightarrow B \cdot \frac{B \cdot U_{op} \cdot l}{R_{1,2} + R_{κιν}} \cdot l = mg$

$\Rightarrow U_{op} = \frac{mg\,(R_{1,2} + R_{κιν})}{B^2 \cdot l^2} \Rightarrow U_{op} = \frac{3\,(2+2)}{1^2 \cdot 1^2}$

$\Rightarrow \boxed{U_{op} = 12\,m/s}$

Γ3) $U = \frac{U_{op}}{2} = 6\,m/s$, $\frac{dp}{dt} = ;$

$\mathcal{E}_{επ} = B \cdot \frac{U_{op}}{2} \cdot l = 6V$

$I = \frac{\mathcal{E}_{επ}}{R_{ολ}} = \frac{6}{4} = 1,5A$

$F_L = B \cdot I \cdot l = 1,5\,N$

$\Sigma F = w - F_L = 3 - 1,5 \Rightarrow \boxed{\frac{dp}{dt} = \Sigma F = 1,5N}$

Γ4) Κανονική λειτουργία

$I_k = \frac{P_k}{V_k} = 1A$, $\mathcal{E}_{επ} = B \cdot U_{op} \cdot l = 12V \rightarrow I = \frac{\mathcal{E}_{επ}}{R_{ολ}} = 3A$

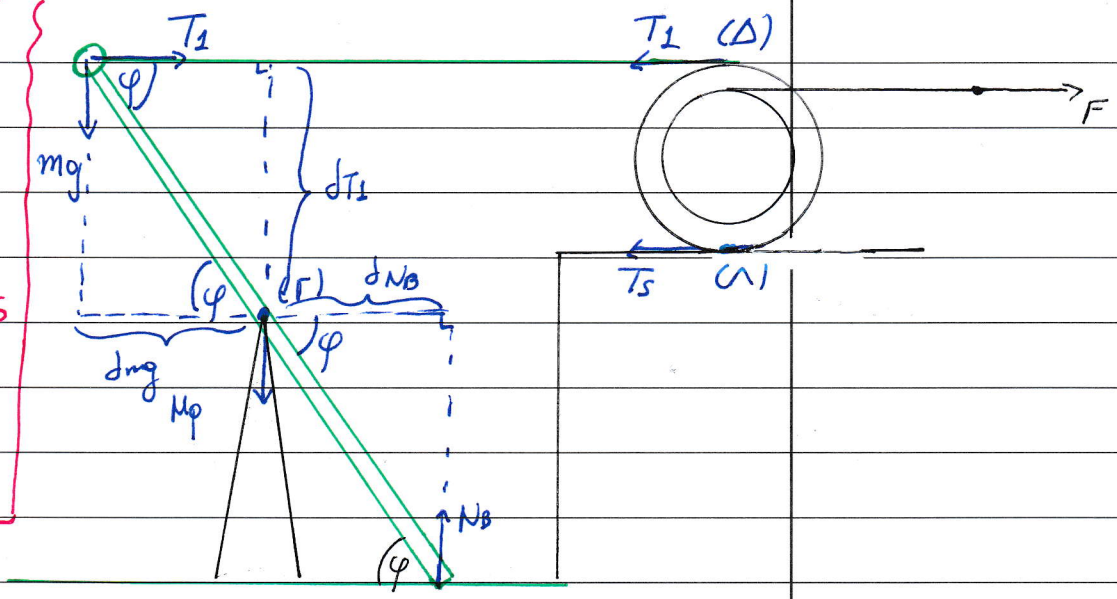
$V_1 = V_2 \Rightarrow I_1 \cdot R_1 = I_2 \cdot R_2 \Rightarrow I_1 \cdot 3 = I_2 \cdot 6$

$\Rightarrow I_1 = 2I_2 \rightarrow I_1 + I_2 = I \Rightarrow 3I_2 = 3 \Rightarrow I_2 = 1A$

Άρα: $I_k = I_2 \rightarrow$ λειτουργεί κανονικά

ΘΕΜΑ Δ

$M_ρ = 3kg$
$\ell = 2m$
$m = 1kg$
$ημφ = 0,8$
$συνφ = 0,6$
$M_1 = 7kg$
$R = 0,4m$
$r = 0,3m$



Δ1) $F = 10,5N$, $N_B = ;$

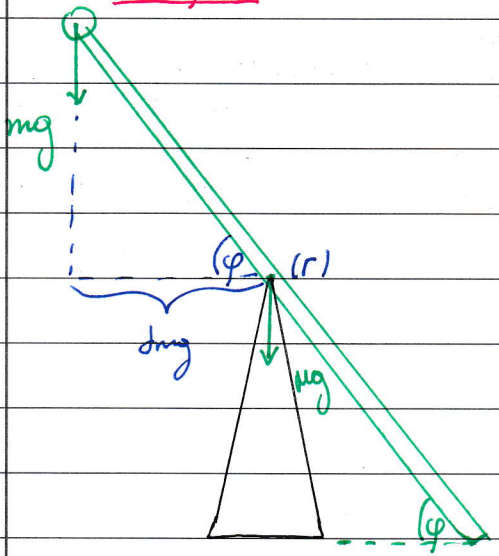
Ισορροπία ράβδου:

$$\Sigma\tau_{(\Gamma)} = 0 \Rightarrow -T_1 \cdot \frac{\ell}{2} ημφ = N_B \cdot \frac{\ell}{2} συνφ + mg \frac{\ell}{2} συνφ$$

$$\Rightarrow 10,5 \cdot 0,8 = N_B \cdot 0,6 + 10 \cdot 0,6$$

$$\Rightarrow N_B = \frac{8,4 - 6}{0,6} = \frac{2,4}{0,6} \Rightarrow \boxed{N_B = 4N}$$

Δ2) $\left(\frac{dL}{dt}\right)_ρ = ;$



$$\text{Θ.Ν.Σ: } \Sigma\tau_{(\Gamma)} = I_{ολ(Γ)} \cdot αγων$$

$$\Rightarrow mg \cdot \frac{\ell}{2} \cdot συνφ = \left[I_{cm(ρ)} + m \cdot \left(\frac{\ell}{2}\right)^2\right] αγων$$

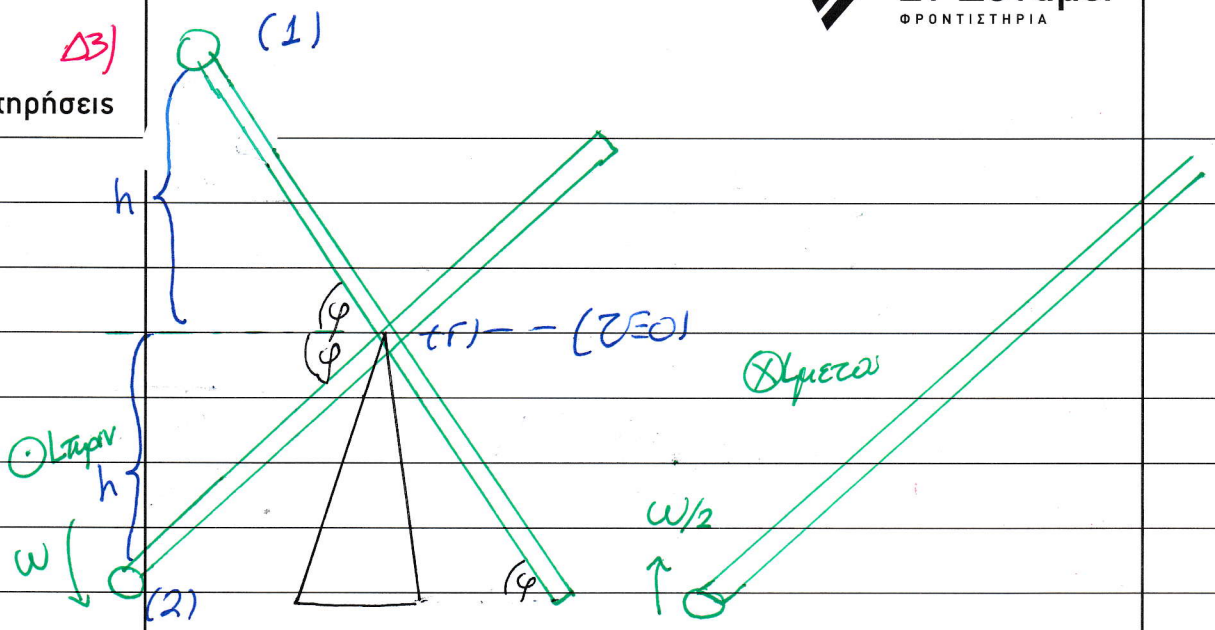
$$\Rightarrow 10 \cdot 0,6 = \left(\frac{1}{12} 3 \cdot 4 + 1 \frac{4}{4}\right) \cdot αγων$$

$$\Rightarrow 6 = 2 αγων \Rightarrow αγων = 3 rad/s^2$$

$$\left(\frac{dL}{dt}\right)_ρ = I_ρ \cdot αγων = \frac{1}{12} M_ρ \cdot \ell^2 \cdot αγων \Rightarrow \boxed{\left(\frac{dL}{dt}\right)_ρ = 3 kgm^2/s^2}$$

Δ3)

Παρατηρήσεις



$\eta\mu\varphi = \frac{h}{\ell/2} \Rightarrow h = \frac{\ell}{2}\eta\mu\varphi$

Α.Δ.Μ.Ε. (1 → 2)

$mg \cdot h + 0 = 0 + \frac{1}{2} I_{ολ(Γ)} \cdot \omega^2 - mgh$

$\Rightarrow 2mgh = \frac{1}{2}\left(\frac{1}{12} M_ρ \cdot \ell^2 + m\frac{\ell^2}{4}\right)\cdot\omega^2$

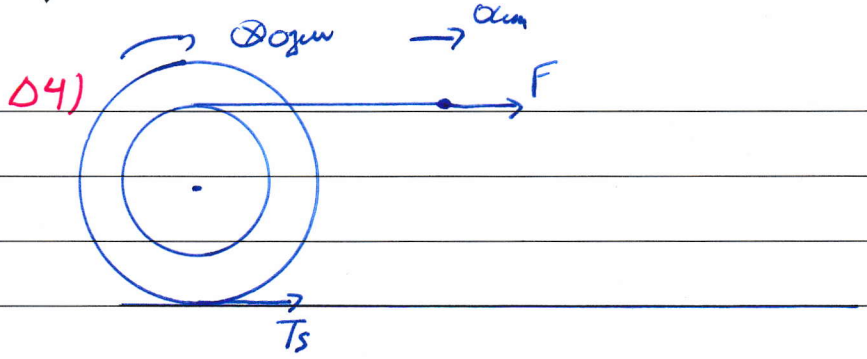
$\Rightarrow 20 \cdot \frac{\ell}{2} \cdot 0{,}8 = \frac{1}{2} \cdot 2 \cdot \omega^2$

$\Rightarrow \omega^2 = 16 \Rightarrow \omega = 4\,rad/s$

$\rightsquigarrow \Delta\vec{L} = \vec{L}_{τελ} - \vec{L}_{αρχ} \overset{⊗(+)}{\Rightarrow} \Delta L = I_{ολ(Γ)}\cdot\omega - \left(-I_{ολ(Γ)}\cdot\omega\right)$

$\Rightarrow \Delta L = \frac{3}{2} I_{ολ(Γ)}\cdot\omega = \frac{3}{2}\cdot 2 \cdot 4 \Rightarrow \boxed{\Delta L = 12\,kg\frac{m^2}{s}}\ ⊗$

Δ4)



Θ.Ν.Μ.: $\Sigma \vec{F}_x = m \cdot \vec{a}_{cm} \overset{(+)}{\Rightarrow} F + T_s = M_\tau \cdot a_{cm}$ (1)

Θ.Ν.Σ.: $\Sigma \vec{\tau}_{cm} = I_{cm} \cdot \vec{a}_{\gamma\omega} \Rightarrow \frac{F \cdot r}{R} - T_s \cdot R = \frac{1}{2} M_\tau \cdot R^2 \cdot a_{\gamma\omega}$ ($a_{\gamma\omega} = a_{cm}$)

$\Rightarrow \frac{F \cdot r}{R} - T_s = \frac{1}{2} M_\tau \cdot a_{cm}$ (2)

(1)+(2) $\Rightarrow F + F \cdot \frac{r}{R} = \frac{3}{2} M_\tau \cdot a_{cm}$

$\Rightarrow 12 + 12 \cdot \frac{0,3}{0,4} = \frac{3}{2} \cdot 7 \cdot a_{cm}$

$\Rightarrow 21 = \frac{21}{2} \cdot a_{cm} \Rightarrow \boxed{a_{cm} = 2 m/s^2}$

Δ5) $W_F = ;$

$a_{cm} = a_{\gamma\omega} \cdot R \Rightarrow a_{\gamma\omega} = \frac{2}{0,4} = 5 rad/s^2$

$\theta = \frac{1}{2} a_{\gamma\omega} \cdot t^2 = \frac{1}{2} \cdot 5 \cdot 2^2 \Rightarrow \theta = 10 rad$

$W_F = F \cdot x_{cm} + F \cdot r \cdot \theta = F \cdot R \cdot \theta + F \cdot r \cdot \theta$

$\Rightarrow W_F = F \cdot \theta \cdot (R + r)$

$\Rightarrow W_F = 12 \cdot 10 \cdot (0,4 + 0,3)$

$\Rightarrow \boxed{W_F = 84 J}$