ΦΥΣΙΚΗ Β ΛΥΚΕΙΟΥ

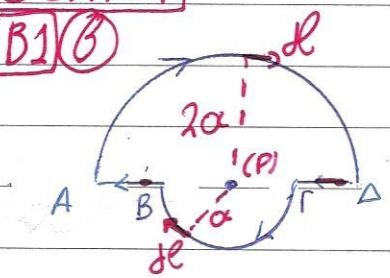
ΛΥΣΕΙΣ 14-05-2023

ΘΕΜΑ Α

Α1 β **Α2** δ **Α3** δ **Α4** δ **Α5** α) Λ β) Σ γ) Λ δ) Λ ε) Σ

ΘΕΜΑ Β

Β1 (β)



ΑΒ: $dB = \frac{\mu_0}{4\pi}\cdot\frac{I\,dl}{r^2}\,\eta\mu 180^\circ = 0$

ΓΔ: $dB = \frac{\mu_0}{4\pi}\cdot\frac{I\,dl}{r^2}\,\eta\mu 0^\circ = 0$

- Τόξο ΑΔ: $dB = \frac{\mu_0 I\,dl}{4\pi\,(2\alpha)^2}\cdot\eta\mu 90^\circ$ ($\eta\mu 90^\circ = 1$)

$$B_{A\Delta} = \Sigma dB = \frac{\mu_0}{4\pi}\cdot\frac{I}{4\alpha^2}\cdot\underbrace{\Sigma dl}_{2\alpha\cdot\pi} \Rightarrow B_{A\Delta} = \frac{\mu_0}{4\pi}\cdot\frac{I}{4\alpha^2}\,2\alpha\cdot\pi$$

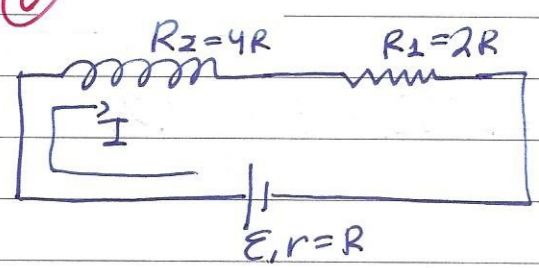
$$\Rightarrow B_{A\Delta} = \frac{\mu_0}{8}\cdot\frac{I}{\alpha}\ \otimes$$

- Τόξο ΓΒ: $dB = \frac{\mu_0}{4\pi}\cdot\frac{I\cdot dl}{\alpha^2}\,\eta\mu 90^\circ$ ($\eta\mu 90^\circ = 1$)

$$B_{\Gamma B} = \frac{\mu_0}{4\pi}\cdot\frac{I}{\alpha^2}\cdot\underbrace{\Sigma dl}_{\alpha\pi} = \frac{\mu_0}{4\pi}\cdot\frac{I}{\alpha^2}\,\alpha\cdot\pi \Rightarrow B_{\Gamma B} = \frac{\mu_0}{4}\cdot\frac{I}{\alpha}\ \otimes$$

$\rightsquigarrow B_{ολ(Ρ)} = B_{A\Delta} + B_{\Gamma B} = \frac{\mu_0 I}{8\alpha} + \frac{\mu_0 I}{4\alpha} \Rightarrow \boxed{B_{ολ(Ρ)} = \frac{3\mu_0 I}{8\alpha}}$

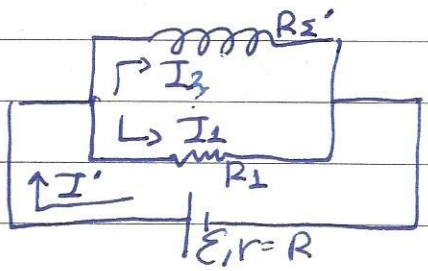
Β2 (β)



$R_{ολ} = R_2 + R_1 + r = 7R$

$I = \frac{\varepsilon}{R_{ολ}} = \frac{\varepsilon}{7R} \rightarrow B = \mu_0\cdot n\cdot I$

$\Rightarrow B = \mu_0\cdot n\cdot\frac{\varepsilon}{7R}$ (1)



Το μισό σωληνοειδές: $R_2' = \frac{R_2}{2} = 2R$

$n = \frac{N}{\ell} = \frac{N/2}{\ell/2}$: σταθερό

$$R_{\Sigma,1} = \frac{R_\Sigma' \cdot R_1}{R_\Sigma' + R_1} = \frac{2R \cdot 2R}{4R} = R \rightarrow R_{o1} = R_{\Sigma,1} + r = 2R$$

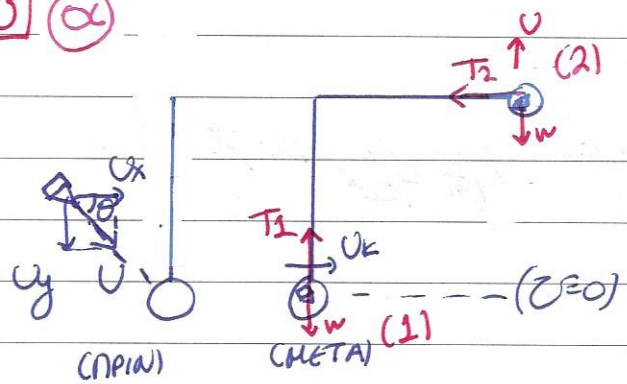
$$I' = \frac{\mathcal{E}}{R_{o1}} = \frac{\mathcal{E}}{2R}$$

$$V_1 = V_\Sigma' \Rightarrow I_1 \cdot R_1 = I_2 \cdot R_\Sigma' \Rightarrow I_1 = I_2 = \frac{I'}{2} \Rightarrow I_1 = I_2 = \frac{\mathcal{E}}{4R}$$

$$B' = \mu_o \cdot n \cdot I_2 \Rightarrow B' = \mu_o \cdot n \cdot \frac{\mathcal{E}}{4R} \quad (2)$$

$$\frac{(2)}{(1)} \Rightarrow \frac{B'}{B} = \frac{\mu_o n \frac{\mathcal{E}}{4R}}{\mu_o n \frac{\mathcal{E}}{7R}} \Rightarrow \frac{B'}{B} = \frac{7}{4} \Rightarrow \boxed{B' = \frac{7}{4} B}$$

B3 (α)



$$U_x = U \cdot \sin\theta = \frac{U}{2} = 4\sqrt{3gl}$$

A.Δ.Ο. (x'x)

$$m \cdot U_x = (4+m) \cdot U_k \Rightarrow m \cdot 4\sqrt{3gl} = 4m\, U_k$$

$$\Rightarrow U_k = \sqrt{3gl}$$

Θεσ(1): $\Sigma F_R = 4m \cdot \frac{U_k^2}{l} \Rightarrow T_1 - 4mg = 4m \frac{(\sqrt{3gl})^2}{l}$

$$\Rightarrow T_1 = 4mg + 12mg \Rightarrow T_1 = 16mg \quad (1)$$

Α.Δ.Μ.Ε (1→2): $K_1 + U_1^{\nearrow 0} = K_2 + U_2 \Rightarrow \frac{1}{2} \cdot 4m\, U_k^2 = \frac{1}{2} 4m U^2 + 4mgl$

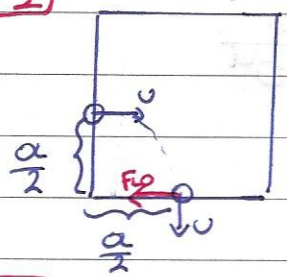
$$\Rightarrow (\sqrt{3gl})^2 = U^2 + 2gl \Rightarrow U = \sqrt{gl}$$

$$\Sigma F_R = 4m \frac{U^2}{l} \Rightarrow T_2 = 4m \frac{(\sqrt{gl})^2}{l} \Rightarrow T_2 = 4mg \quad (2)$$

$$\frac{(1)}{(2)} \Rightarrow \frac{T_1}{T_2} = \frac{16mg}{4mg} \Rightarrow \boxed{\frac{T_1}{T_2} = \frac{4}{1}}$$

ΘΕΜΑ Γ

Γ1



$$R=\frac{m\cdot\upsilon}{B\cdot|q|}=\frac{6,4\cdot10^{-27}\cdot10^{4}}{10^{-2}\cdot3,2\cdot10^{-19}}\Rightarrow R=\frac{2\cdot10^{-23}}{10^{-21}}$$

$$\Rightarrow \boxed{R=2\cdot10^{-2}\,m}$$

Γ2 $\frac{d\rho}{dt}=\Sigma F=F_{L0}=B\cdot\upsilon\cdot|q|=10^{-2}\cdot10^{4}\cdot3,2\cdot10^{-19}$

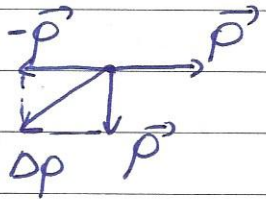
$$\Rightarrow \boxed{\frac{d\rho}{dt}=3,2\cdot10^{-17}\,N}$$

$\boxed{W_{F_{L0}}=0}$ $(\vec{F}_{L0}\perp\vec{\upsilon})$

Γ3 $T=\frac{2\pi m}{B\cdot|q|}=\frac{2\pi\cdot6,4\cdot10^{-27}}{10^{-2}\cdot3,2\cdot10^{-19}}\Rightarrow T=4\pi\cdot10^{-6}\,s$

Διαγραφή τεταρτοκυκλίου: $\boxed{\Delta t=\frac{T}{4}=\pi\cdot10^{-6}\,s}$

$\rightsquigarrow \Delta\vec{p}=\vec{p}'-\vec{p}\Rightarrow\Delta\vec{p}=\vec{p}'+(-\vec{p})$

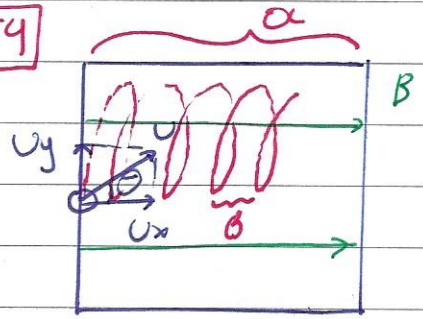


$$p=p'=m\cdot\upsilon=6,4\cdot10^{-27}\cdot10^{4}=6,4\cdot10^{-23}\,kg\frac{m}{s}$$

$$\Delta p=\sqrt{p^2+p'^2}=\sqrt{2p^2}=p\cdot\sqrt{2}$$

$$\Rightarrow \boxed{\Delta p=6,4\cdot\sqrt{2}\cdot10^{-23}\,kg\frac{m}{s}}$$

Γ4



$\upsilon_x=\upsilon\cdot\sigma\upsilon\theta=0,8\cdot10^{4}\,m/s$

$\upsilon_y=\upsilon\cdot\eta\mu\theta=0,6\cdot10^{4}\,m/s$

$T=\frac{2\pi m}{B\cdot|q|}=4\pi\cdot10^{-6}\,s$ (Ερ Γ3)

$$\beta=\upsilon_x\cdot T=0,8\cdot10^{4}\cdot4\pi\cdot10^{-6}\Rightarrow\boxed{\beta=3,2\pi\cdot10^{-2}\,m}$$

$$R=\frac{m\cdot\upsilon_y}{B\cdot|q|}=\frac{6,4\cdot10^{-27}\cdot10^{4}\cdot0,6}{10^{-2}\cdot3,2\cdot10^{-19}}\Rightarrow\boxed{R=1,2\cdot10^{-2}\,m}$$

Γ5 Από εφ. Γ1 → $R = \frac{\alpha}{2} \Rightarrow \alpha = 2R = 4 \cdot 10^{-2} m$

↳ Κ.Κ. $U_x = \frac{\Delta x}{\Delta t} \Rightarrow \Delta t = \frac{\Delta x}{U_x} = \frac{\alpha}{U_x} = \frac{4 \cdot 10^{-2}}{0,8 \cdot 10^4}$

$\Rightarrow \boxed{\Delta t = 5 \cdot 10^{-6} s}$

$N = \frac{\Delta x}{6} \Rightarrow N = \frac{\alpha}{6} = \frac{4 \cdot 10^{-2}}{3,2\pi 10^{-2}} \Rightarrow \boxed{N = \frac{1,25}{\pi} \text{ θηλιές}}$

ΘΕΜΑ Δ

Δ1 $U_2' = \frac{2m_1}{m_1+m_2} \cdot U_1 = \frac{2 \cdot 3}{3+9} \cdot 4 \Rightarrow \boxed{U_2' = 2\,m/s}$

Δ2 $U_1' = \frac{m_1-m_2}{m_1+m_2} \cdot U_1 \Rightarrow U_1' = \frac{3-9}{3+9} \cdot 4 \Rightarrow \boxed{U_1' = -2\,m/s}$

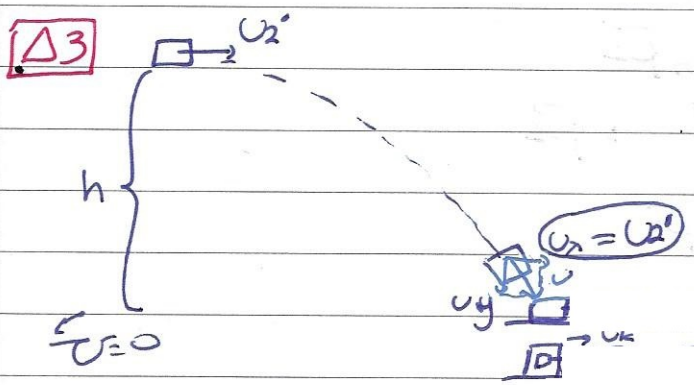
$K_1 = \frac{1}{2} m_1 \cdot U_1^2 = \frac{1}{2} \cdot 3 \cdot 4^2 = 24\,J$

$K_1' = \frac{1}{2} \cdot m_1 \cdot U_1'^2 = \frac{1}{2} \cdot 3 \cdot 2^2 = 6\,J$

$\Rightarrow \pi = \frac{\Delta K_1}{K_1} \cdot 100\% = \frac{6-24}{24} \cdot 100\%$

$\Rightarrow \boxed{\pi = -75\%}$

Δ3



Α.Δ.Ο. (x'x)

$m_2 \cdot U_x = (m_2+m_3) \cdot U_k$

$\Rightarrow 9 \cdot 2 = 18 \cdot U_k$

$\Rightarrow \boxed{U_k = 1\,m/s}$

Α.Δ.Μ.Ε.

$\frac{1}{2} \cdot m_2 \cdot U_2'^2 + m_2 \cdot g \cdot h = \frac{1}{2} m_2 \cdot U^2 \Rightarrow 4 + 20 \cdot 0{,}2 = U^2 \Rightarrow U = \sqrt{8}\ m/s$

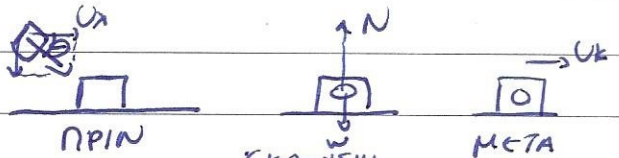
$K_2 = \frac{1}{2} m_2 \cdot U^2 = 36\,J$

$K_{\text{ολ μετά}} = \frac{1}{2}(m_2+m_3) \cdot U_k^2 = 9\,J$

$\Rightarrow E_{\text{απ.}} = 36 - 9 = 27\,J$

$\pi = \frac{E_{\text{απ.}}}{K_2} \cdot 100\% = \frac{27}{36} \cdot 100\% \Rightarrow \boxed{\pi = 75\%}$

Δ4



$t = \sqrt{\frac{2h}{g}} = \sqrt{0{,}04} = 0{,}2\,s$

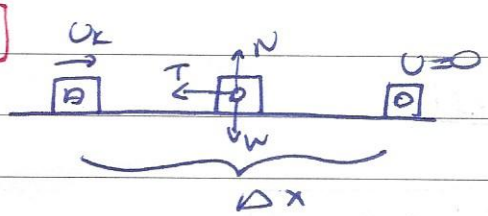
$U_y = g \cdot t = 2\,m/s$

$\text{εφ}\,\theta = \frac{U_y}{U_x} = 1 \rightarrow \varphi = 45^\circ$

$\Sigma \vec{F}_y = \frac{\Delta \vec{p}_y}{\Delta t} \overset{(+)}{\Rightarrow} N - w = \frac{0 - (-m_2 \cdot U_y)}{\Delta t} \Rightarrow N = 180 + \frac{9 \cdot 2}{0{,}1\theta}$

$\Rightarrow \boxed{N = 280\,N}$

Δ5



$$\Sigma F_y = 0 \Rightarrow N = (m_2+m_3)g = 180N$$
$$T = \mu \cdot N = \frac{1}{20} \cdot 180 = 9N$$

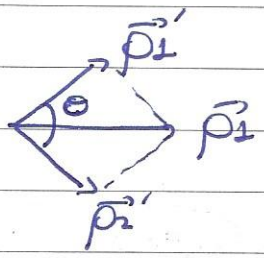
Θ.Μ.Κ.Ε.

$$0 - \frac{1}{2}(m_2+m_3)\cdot v_1^2 = -T\cdot\Delta x \Rightarrow -\frac{1}{2}\cdot 18\cdot 1 = -9\cdot\Delta x$$

$$\Rightarrow \boxed{\Delta x = 1m}$$

Δ6 Α.Δ.Ο.

$$\vec{p_1} = \vec{p_1'} + \vec{p_2'}$$



$$K = \frac{1}{2}m\cdot v^2 = \frac{1}{2}m\cdot\frac{m\cdot v^2}{m} = \frac{p^2}{2m}$$

$$\rightarrow p_1^2 = p_1'^2 + p_2'^2 + 2p_1'\cdot p_2'\cdot\sigma\upsilon\theta \quad (1)$$

→ Δ.Κ.Ε.

$$K_1 = K_1' + K_2' \Rightarrow \frac{p_1^2}{2m_1} = \frac{p_1'^2}{2m_1} + \frac{p_2'^2}{2m_2} \quad (2)$$

$$(1) \overset{(2)}{\Rightarrow} p_1'^2 + p_2'^2 = p_1'^2 + p_2'^2 + 2p_1'\cdot p_2'\cdot\sigma\upsilon\theta$$

$$\Rightarrow 2p_1'\cdot p_2'\cdot\sigma\upsilon\theta = 0 \xrightarrow{2p_1'\cdot p_2' \neq 0} \sigma\upsilon\theta = 0 \rightarrow \boxed{\theta = 90^\circ}$$