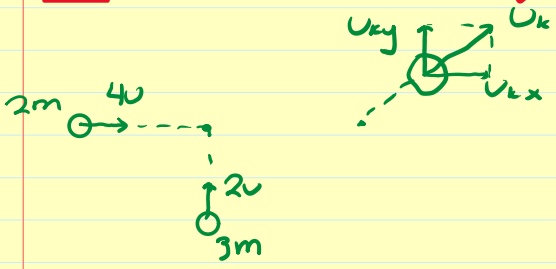
ΘΕΜΑ Α

Α1) α Α2) γ Α3) β Α4) δ

Α5) α) Λ β) Λ γ) Λ δ) Σ ε) Λ

ΘΕΜΑ Β

Β1 Σωστή απάντηση: (γ)



$\frac{A.\Delta.O.(x'x)}{\Sigma F_x=0}: \vec{p}_{1x}+\vec{p}_{2x}=\vec{p}_{kx} \Rightarrow 2m\cdot 4\upsilon = 5m\cdot \upsilon_{kx} \Rightarrow \upsilon_{kx}=\frac{8}{5}\upsilon$

$\frac{A.\Delta.O.(y'y)}{\Sigma F_y=0}: \vec{p}_{1y}+\vec{p}_{2y}=\vec{p}_{ky} \Rightarrow 3m\cdot 2\upsilon = 5m\cdot \upsilon_{ky} \Rightarrow \upsilon_{ky}=\frac{6}{5}\upsilon$

$\upsilon_k=\sqrt{\upsilon_{kx}^2+\upsilon_{ky}^2}=\sqrt{(\frac{8}{5}\upsilon)^2+(\frac{6}{5}\upsilon)^2}=\sqrt{\frac{64}{25}\upsilon^2+\frac{36}{25}\upsilon^2}=\sqrt{\frac{100}{25}\upsilon^2} \Rightarrow \upsilon_k=2\upsilon$

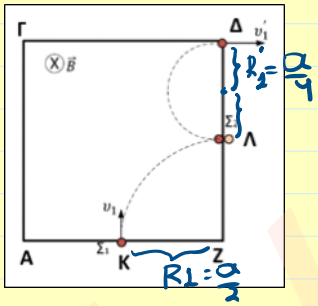
$K_1=\frac{1}{2}m_1\cdot\upsilon_1^2=\frac{1}{2}\cdot 2m(4\upsilon)^2=16m\upsilon^2$

$K_1'=\frac{1}{2}m_1\cdot\upsilon_k^2=\frac{1}{2}2m\cdot(2\upsilon)^2=4m\cdot\upsilon^2$

$\Rightarrow \Delta K_1=-12m\upsilon^2$

$\pi_1=\frac{\Delta K_1}{K_1}\cdot 100\%=\frac{-12m\upsilon^2}{16m\upsilon^2}\cdot 100\% \Rightarrow \boxed{\pi_1=-75\%}$ (γ)

Β2 **Α** Σωστή απάντηση: (β)



ΠΡΙΝ την κρούση:

$R_1=\frac{\alpha}{2} \Rightarrow \frac{m_1\cdot\upsilon_1}{B\cdot|q|}=\frac{\alpha}{2} \Rightarrow \upsilon_1=\frac{\alpha B|q|}{2m_1}$ (1)

ΜΕΤΑ την κρούση:

$R_1'=\frac{\alpha}{4} \Rightarrow \frac{m_1\cdot\upsilon_1'}{B\cdot|q|}=\frac{\alpha}{4} \Rightarrow \upsilon_1'=\frac{\alpha\cdot B\cdot|q|}{4m_1}$ (2)

$\frac{(2)}{(1)} \Rightarrow \frac{\upsilon_1'}{\upsilon_1}=\frac{2}{4}=\frac{1}{2} \Rightarrow \boxed{\upsilon_1'=\frac{\upsilon_1}{2}}$ (β)

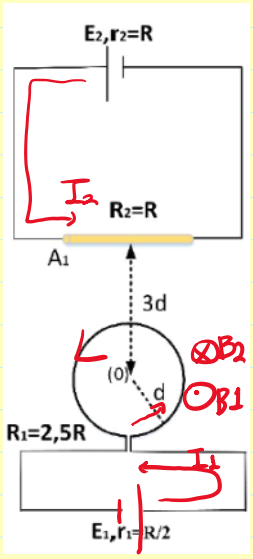
Β3 Σωστή απάντηση: (γ)

Μετά την κρούση το Σ_1 αντιστρέφει τη φορά κίνησης:

$\upsilon_1'=\frac{m_1-m_2}{m_1+m_2}\cdot\upsilon_1 \Rightarrow -\frac{\upsilon_1}{2}=\frac{m_1-m_2}{m_1+m_2}\cdot\upsilon_1 \Rightarrow -m_1-m_2=2m_1-2m_2$

$\Rightarrow m_2=3m_1 \rightarrow \boxed{\frac{m_1}{m_2}=\frac{1}{3}}$ (γ)

Β3



Α Για να είναι $B_{ολ}=0$, θα πρέπει: $B_1 \uparrow\downarrow \vec{B_2}$. Επειδή $B_2 \otimes$, θα πρέπει $B_1 \odot$, άρα η φορά των ρεμάτων φαίνεται στο σχήμα.

Β Σωστή απάντηση: (α)

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2I_2}{3d}$

Στον κυκλικό αγωγό:

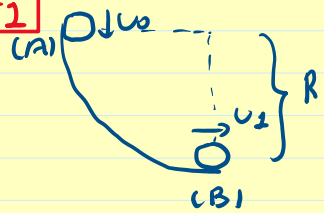
$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_1}{d}$

$\rightsquigarrow B_{ολ}=0 \Rightarrow B_1 = B_2 \Rightarrow \frac{\mu_0}{4\pi} \cdot \frac{2\pi \cdot I_1}{d} = \frac{\mu_0}{4\pi} \cdot \frac{2I_2}{3d}$

$\Rightarrow \frac{\mathcal{E}_1}{2,5R+0,5} \cdot \pi = \frac{1}{3} \cdot \frac{\mathcal{E}_2}{R+R} \Rightarrow \frac{\mathcal{E}_1}{3R} \cdot \pi = \frac{1}{3} \cdot \frac{\mathcal{E}_2}{2R} \Rightarrow \boxed{\frac{\mathcal{E}_1}{\mathcal{E}_2} = \frac{1}{2\pi}}$ (α)

ΘΕΜΑ Γ

Γ1



Α.Δ.Μ.Ε. (Α→Β): $K_A + U_A = K_B + U_B$ (U_B = 0)

$\Rightarrow \frac{1}{2}m_1 \upsilon_0^2 + m_1 g R = \frac{1}{2}m_1 \upsilon_1^2$

$\Rightarrow \frac{6^2}{2} + 10R = \frac{10^2}{2} \Rightarrow 10R = 32 \Rightarrow \boxed{R = 3,2m}$

Γ2 $\cdot \upsilon_1' = \frac{m_1-m_2}{m_1+m_2}\upsilon_1 + \frac{2m_2}{m_1+m_2}\upsilon_2 = \frac{1-3}{1+3}(+10) + \frac{2 \cdot 3}{1+3}(-2)$

$\Rightarrow \upsilon_1' = -5 - 3 \Rightarrow \boxed{\upsilon_1' = -8 m/s}$

$\cdot \upsilon_2' = \frac{2m_1}{m_1+m_2}\upsilon_1 + \frac{m_2-m_1}{m_1+m_2}\upsilon_2 = \frac{2}{4}\cdot(+10) + \frac{3-1}{4}\cdot(-2)$

$\Rightarrow \upsilon_2' = 5 - 1 \Rightarrow \boxed{\upsilon_2' = 4 m/s}$

Γ3 $K_2 = \frac{1}{2}m_2 \upsilon_2^2 = \frac{1}{2} \cdot 3 \cdot 2^2 = 6J$

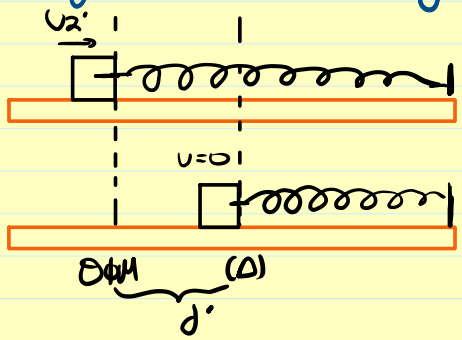
$K_2' = \frac{1}{2}m_2 \upsilon_2'^2 = \frac{1}{2} \cdot 3 \cdot 4^2 = 24J$

$\Rightarrow \Delta K_2 = 24 - 6 = 18J$

$K_1 = \frac{1}{2}m_1 \upsilon_1^2 = \frac{1}{2} \cdot 1 \cdot 10^2 = 50J$

Άρα: $\pi = \frac{\Delta K_2}{K_1} \cdot 100\% = \frac{18}{50} \cdot 100\% \Rightarrow \boxed{\pi = 36\%}$

Γ4 $\Sigma F_{2y}=0 \Rightarrow N_2=m_2 g=30N \rightarrow T_2=\mu\cdot N_2=\frac{4}{15}\cdot 30=8\,N$



$\Theta.\Mu.\kappa.\Epsilon.(\Theta\Phi\Mu\rightarrow\Delta)$

$0 \quad -\frac{1}{2}m_2 U'^2=-T_2\cdot d'+0-\frac{1}{2}k d'^2$

$\Rightarrow 0-3\cdot 4^2=-16d'-160d'^2$

$\Rightarrow -48=-16d'-160d'^2$

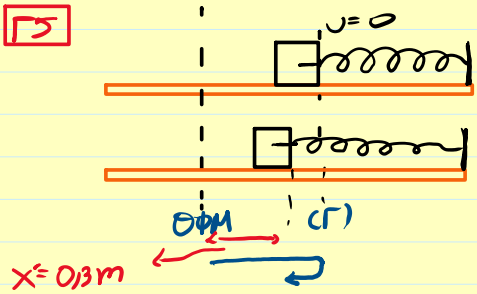
$\Rightarrow 160d'^2+16d'-48=0 \Rightarrow 10d'^2+d'-3=0$

$\Delta=1^2-4\cdot 10\cdot(-3)=121$

$d'=\frac{-1\pm\sqrt{121}}{2\cdot 10}=\frac{-1\pm 11}{20}=$ (−) $d'=-\frac{12}{20}\,m$ · Απορ.

(+) $\boxed{d'=\frac{10}{20}=0{,}5m}$

Γ5

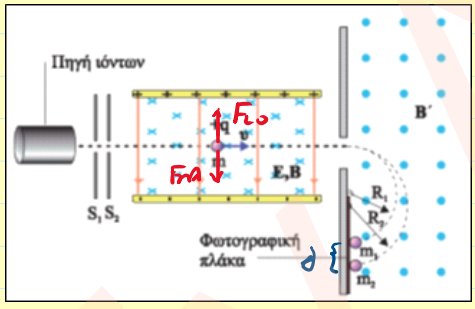


$F_{ΕΛ}=k\cdot x'=160\cdot 0{,}3=48N$

$\left|\frac{dp_2}{dt}\right|=|\Sigma F|=|F_{ΕΛ}-T_2| \Rightarrow \boxed{\left|\frac{dp_2}{dt}\right|=40N}$

ΘΕΜΑ Δ

Δ1



Τα ιόντα που δεν εκτρέπονται, είναι εκείνα όπου $\Sigma F=0$.

$\Sigma F=0 \Rightarrow F_{Lo}=F_{ΗΛ} \Rightarrow B\cdot U|q|=E\cdot|q|$

$\Rightarrow E=B\cdot U=0{,}5\cdot 6\cdot 10^4 \Rightarrow \boxed{E=3\cdot 10^4\,N/C}$

Δ2 Τα ισότοπα έχουν το ίδιο φορτίο (ίδιος αριθμός πρωτονίων) και διαφορετικό αριθμό νετρονίων, άρα διαφορετική μάζα. → διαφορετική αδράνεια

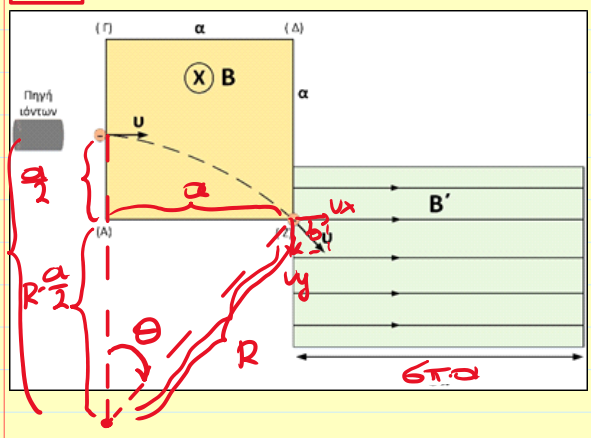
Δ3 $d=2R_2-2R_1 \Rightarrow d=2\cdot\left(\frac{m_2 U}{B'|q|}-\frac{m_1 U}{B'|q|}\right) \Rightarrow d=\frac{2U}{B'|q|}\underbrace{(m_2-m_1)}_{\Delta m}$

$\Rightarrow \Delta m=\frac{d\cdot B'|q|}{2U}=\frac{7{,}5\cdot 10^{-3}\cdot 0{,}5\cdot 1{,}6\cdot 10^{-19}}{2\cdot 6\cdot 10^4}$

$\Rightarrow \Delta m=0{,}5\cdot 10^{-26} \Rightarrow \boxed{\Delta m=5\cdot 10^{-27}kg}$

$\frac{\Delta m}{m_N}=\frac{5\cdot 10^{-27}}{\frac{5}{3}\cdot 10^{-27}} \Rightarrow \frac{\Delta m}{m_N}=3 \rightsquigarrow \boxed{3\ \text{νετρόνια}}$

Δ4



$$R^2=(R-\frac{a}{2})^2+a^2$$

$$\Rightarrow R^2=R^2-2R\cdot\frac{a}{2}+\frac{a^2}{4}+a^2$$

$$\Rightarrow R=\frac{5a^2}{4}\Rightarrow R=\frac{5a}{4}\Rightarrow a=\frac{4}{5}R\ (1)$$

Όμως: $R=\frac{m\cdot U}{B\cdot|q|}=\frac{3,2\cdot10^{-27}\cdot5\cdot10^{4}}{0,5\cdot1,6\cdot10^{-19}}$

$$\Rightarrow \boxed{R=20\cdot10^{-4}\,m}$$

$$(1)\Rightarrow a=\frac{4}{5}\cdot R=\frac{4}{5}\cdot20\cdot10^{-4}\Rightarrow \boxed{a=16\cdot10^{-4}\,m}$$

Δ5 $\eta\mu\theta=\frac{a}{R}=\frac{a}{\frac{5a}{4}}=0,8\rightsquigarrow\sigma\upsilon\theta=0,6$

$$T=\frac{2\pi m}{B\cdot|q|}=\frac{2\pi\cdot3,2\cdot10^{-27}}{0,5\cdot1,6\cdot10^{-19}}\Rightarrow T=8\pi\cdot10^{-8}\,s$$

- $\beta=U_x\cdot T=U\cdot\sigma\upsilon\theta\cdot T=5\cdot10^{4}\cdot0,6\cdot8\pi\cdot10^{-8}$

$$\Rightarrow \beta=24\pi\cdot10^{-4}\,m$$

Άρα: $N_x=\frac{\Delta x}{\beta}=\frac{6\pi\cdot a}{\beta}=\frac{6\pi\cdot16\cdot10^{-4}}{24\pi\cdot10^{-4}}\Rightarrow \boxed{N_x=4\ \text{βήματα}}$