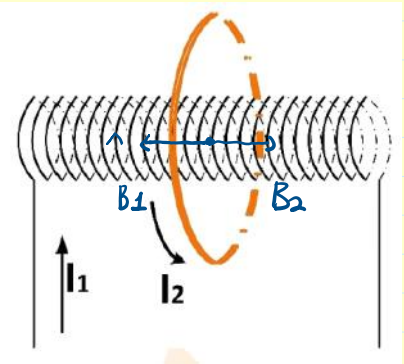
Θέμα Α

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

Θέμα Β

Β1 Σωστή απάντηση: (α)

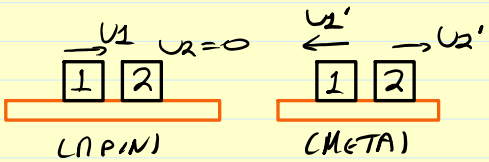


$B_{ολ} = 0 \Rightarrow B_1 = B_2 \Rightarrow \mu_0 \cdot n \cdot I_1 = \frac{\mu_0}{4\pi} \frac{2\pi I_2}{r} \cdot N_2$

$\Rightarrow \frac{N_1}{\ell} \cdot I_1 = \frac{1}{2} \cdot \frac{I_2}{\ell/5} \cdot \frac{N_1}{10} \Rightarrow I_1 = \frac{5}{20} \cdot I_2$

$\Rightarrow \boxed{I_2 = 4 I_1}$

Β2 **Α** Σωστή απάντηση: (β)

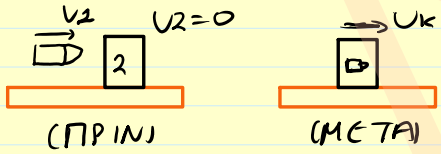


$U_1' = \frac{m_1 - m_2}{m_1 + m_2} \cdot U_1 \Rightarrow -\frac{U_1}{2} = \frac{m_1 - m_2}{m_1 + m_2} \cdot U_1$

$\Rightarrow 2m_1 - 2m_2 = -m_1 - m_2$

$\Rightarrow \boxed{3m_1 = m_2}$

$U_2' = \frac{2m_1}{m_1 + m_2} \cdot U_1 = \frac{2m_1}{4m_1} \cdot U_1 \Rightarrow U_2' = \frac{U_1}{2}$



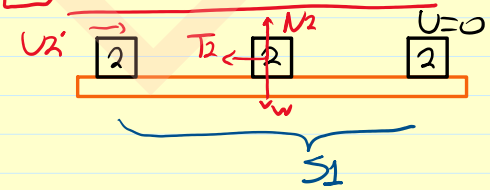
Α.Δ.Ο. ($\xrightarrow{(+)}$)

$m_1 \cdot U_1 = (m_1 + m_2) \cdot U_κ \Rightarrow m_1 U_1 = 4 m_1 U_κ$

$\Rightarrow U_κ = \frac{U_1}{4}$

Άρα: $\boxed{\frac{U_2'}{U_κ} = \frac{U_1/2}{U_1/4} = 2}$

Β Σωστή απάντηση: (β)



Θ.Μ.Κ.Ε.

$0 - \frac{1}{2} m_2 U_2'^2 = W_{T_2} \Rightarrow W_{T_2} = -\frac{1}{2} 3m_1 \cdot \frac{U_1^2}{4}$

$\Rightarrow W_{T_2} = -\frac{3}{8} m_1 \cdot U_1^2$

$\rightsquigarrow Q_1 = |W_{T_2}| = \frac{3}{8} m_1 \cdot U_1^2$

Πλαστική κρούση

→ $K_{\text{αλ στριν1}} = \frac{1}{2} m_1 \cdot U_1^2$

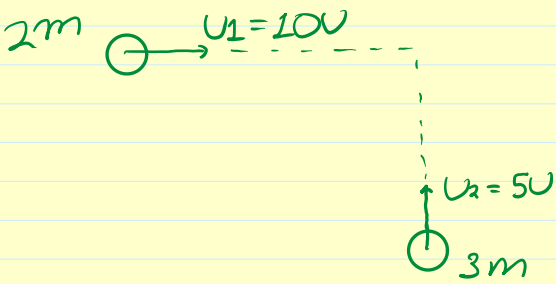
→ $K_{\text{αλ μετα}} = \frac{1}{2}(m_1+m_2)\cdot U_k^2 = \frac{m_1 \cdot U_1^2}{8}$

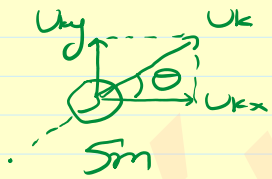
$\Rightarrow Q_{\text{κρ.}} = \frac{m_1 \cdot U_1^2}{2} - \frac{m_1 \cdot U_1^2}{8}$

$\Rightarrow Q_{\text{κρ}} = \frac{3}{8} m_1 \cdot U_1^2$

$\frac{Q_1}{Q_2} = \frac{\frac{3}{8} m_1 \cdot U_1^2}{\frac{3}{8} m_1 \cdot U_1^2} \Rightarrow \boxed{\frac{Q_1}{Q_2} = 1}$

Β3 Σωστή απάντηση: (γ)





Α.Δ.Ο (x'x) (+→)

$2m \cdot 10U = 5m \cdot U_{kx} \Rightarrow U_{kx} = 4U$

Α.Δ.Ο (y'y) (↑+)

$3m \cdot 5U = 5m \cdot U_{ky} \Rightarrow U_{ky} = 3U$

$\Rightarrow U_k = \sqrt{U_{kx}^2 + U_{ky}^2}$

$\Rightarrow U_k = \sqrt{9U^2 + 16U^2} = \sqrt{25U^2}$

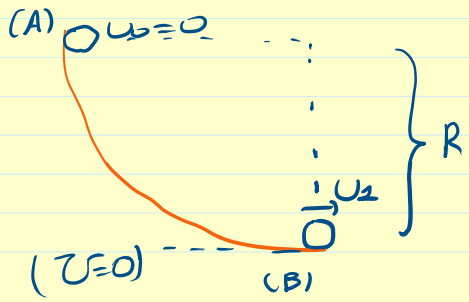
$\Rightarrow U_k = 5 \cdot U$

$\pi_1 = \frac{K_1' - K_1}{K_1} \cdot 100\% = \left(\frac{K_1'}{K_1} - 1\right) \cdot 100\% = \left(\frac{\frac{1}{2} m_1 \cdot U_k^2}{\frac{1}{2} m_1 \cdot U_1^2} - 1\right) \cdot 100\%$

$\Rightarrow \pi_1 = \left(\frac{25U^2}{100U^2} - 1\right) \cdot 100\% \Rightarrow \boxed{\pi = -75\%}$

ΘΕΜΑ Γ

Γ1 R =;

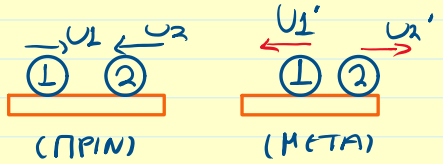


Α.Δ.Μ.Ε (Α → Β)

$K_A^{0} + U_A = K_B + U_B^{0} \Rightarrow mgR = \frac{1}{2} m U_1^2$

$\Rightarrow R = \frac{U_1^2}{2g} = \frac{16}{20} \Rightarrow \boxed{R = 0{,}8\,m}$

Γ2 $U_1' =; \ , \ U_2' =;$



$$U_1' = \frac{m_1-m_2}{m_1+m_2}\cdot U_1 + \frac{2m_2}{m_1+m_2}\cdot U_2$$

$$\Rightarrow U_1' = \frac{3-1}{3+1}\cdot(+4) + \frac{2\cdot 1}{3+1}(-8)$$

$$\Rightarrow U_1' = 2 - 4 \Rightarrow \boxed{U_1' = -2\,m/s}$$

$$U_2' = \frac{2m_1}{m_1+m_2}\cdot U_1 + \frac{m_2-m_1}{m_1+m_2}\cdot U_2 \Rightarrow U_2' = \frac{2\cdot 3}{3+1}\cdot(+4) + \frac{1-3}{3+1}(-8)$$

$$\Rightarrow U_2' = 6 + 4 \Rightarrow \boxed{U_2' = 10\,m/s}$$

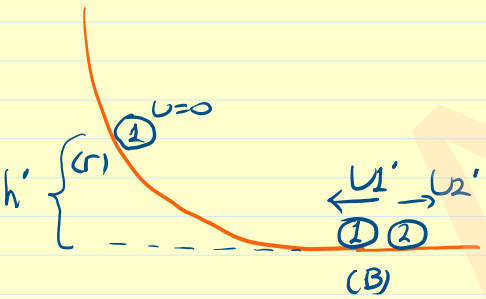
Γ3 $W_{\Sigma F_2} =;$

Θ.Μ.Κ.Ε. (Για το Σ2)

$$K_2' - K_2 = W_{\Sigma F_2} \Rightarrow W_{\Sigma F_2} = \frac{1}{2}m_2 U_2'^2 - \frac{1}{2}m_2 U_2^2 = \frac{1}{2}\cdot 1\cdot 100 - \frac{1}{2}\cdot 1\cdot 64$$

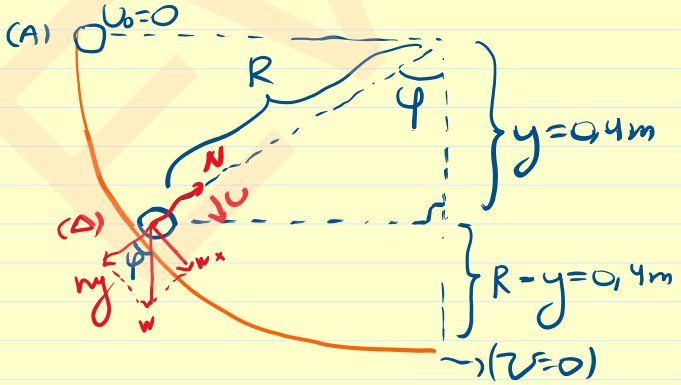
$$\Rightarrow \boxed{W_{\Sigma F_2} = 18\,J}$$

Γ4



Επειδή το τετράγωνο είναι λείο, το Σ1 θα σφηνώσει σε μια θέση Γ και θα επιστρέψει με ταχύτητα μέτρο U_1' στη θέση Β.
Το οριζόντιο επίπεδο είναι επίσης λείο, άρα $U_2' > U_1'$ → θα αγκαλιάζονται.

Γ5 $\frac{dU_{βαρ}}{dt} =;$



Α.Δ.Μ.Ε. (Α → Δ)

$$0 + m_1 g R = \frac{1}{2}m_1 U^2 + m_1 g(R-y)$$

$$\Rightarrow 8 = \frac{U^2}{2} + 10\cdot 0{,}4$$

$$\Rightarrow 4 = \frac{U^2}{2} \Rightarrow U = \sqrt{8} = 2\sqrt{2}\,m/s$$

$$\alpha_{ημ\varphi} = \frac{y}{R} = \frac{1}{2} \rightsquigarrow \varphi = 60^\circ$$

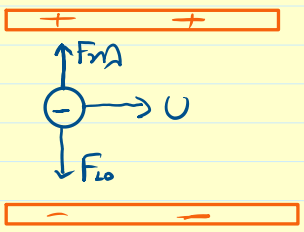
$$w_x = w\cdot ημ\varphi = m_1 g\cdot\frac{\sqrt{3}}{2} \Rightarrow w_x = 15\sqrt{3}\,N$$

$$\frac{dK}{dt} = \Sigma F\cdot U = w_x\cdot U = 15\sqrt{3}\cdot 2\cdot\sqrt{2} \Rightarrow \frac{dK}{dt} = 30\sqrt{6}\,J/s$$

Άρα: $\boxed{\frac{dU_{βαρ}}{dt} = -\frac{dK}{dt} = -30\sqrt{6}\,J/s}$

ΘΕΜΑ Δ

Δ1 $B_1 = ;$



$$\Sigma F = 0 \Rightarrow F_{\lambda 1} = F_{l0} \Rightarrow \epsilon \cdot |q| = B_1 \cdot \upsilon \cdot |q|$$

$$\Rightarrow B_1 = \frac{\epsilon}{\upsilon} = \frac{4 \cdot 10^3}{2 \cdot 10^4} \Rightarrow \boxed{B_1 = 0{,}2\,T}$$

με φορά $\otimes$

Δ2 $R_2 = ;$, $m_2 = ;$

$$R_1 = \frac{m_1 \cdot \upsilon_0}{B_2 \cdot |q|} = \frac{56 \cdot 10^{-27} \cdot 2 \cdot 10^4}{10^{-1} \cdot 1{,}6 \cdot 10^{-19}} \Rightarrow R_1 = 70 \cdot \frac{10^{-23}}{10^{-20}} \Rightarrow R_1 = 70 \cdot 10^{-3}\,m$$

$$d = 2R_2 - 2R_1 \Rightarrow R_2 = \frac{d}{2} + R_1 = \frac{8 \cdot 10^{-3}}{2} + 70 \cdot 10^{-3} \Rightarrow \boxed{R_2 = 74 \cdot 10^{-3}\,m}$$

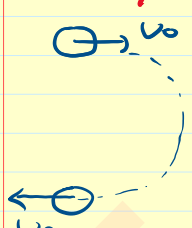
$$R_2 = \frac{m_2 \cdot \upsilon_0}{B_2 \cdot |q|} \Rightarrow m_2 = \frac{R_2 \cdot B_2 \cdot |q|}{\upsilon_0} = \frac{74 \cdot 10^{-3} \cdot 10^{-1} \cdot 1{,}6 \cdot 10^{-19}}{2 \cdot 10^4}$$

$$\Rightarrow \boxed{m_2 = 59{,}2 \cdot 10^{-27}\,kg}$$

$$\rightsquigarrow \Delta m = m_2 - m_1 = 59{,}2 \cdot 10^{-27} - 56 \cdot 10^{-27} = 3{,}2 \cdot 10^{-27}\,kg$$

$$\rightarrow N = \frac{\Delta m}{m_N} = \frac{3{,}2 \cdot 10^{-27}}{1{,}6 \cdot 10^{-27}} \Rightarrow \boxed{N = 2 \text{ νετρόνια}}$$

Δ3 $\Delta p_1 = ;$

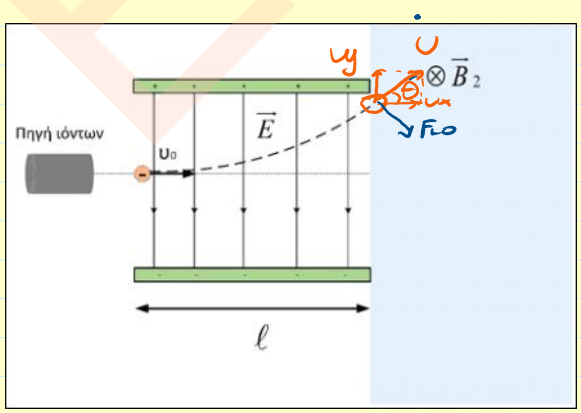


$$\Delta \vec{p}_1 = \vec{p}_1' - \vec{p}_1 \overset{(+)}{\Rightarrow} \Delta p_1 = m_1 \upsilon_0 - (-m_1 \upsilon_0)$$

$$\Rightarrow \Delta p_1 = 2 m_1 \upsilon_0 = 2 \cdot 56 \cdot 10^{-27} \cdot 2 \cdot 10^4$$

$$\Rightarrow \boxed{\Delta p_1 = 224 \cdot 10^{-23}\,kg\,\frac{m}{s}}$$

Δ4 $\upsilon = ;$



$$\cdot \upsilon_0 = \frac{\ell}{\Delta t} \Rightarrow \Delta t = \frac{\ell}{\upsilon_0} = \frac{5 \cdot 10^{-1}}{2 \cdot 10^4}$$

$$\Rightarrow \Delta t = 2{,}5 \cdot 10^{-5}\,s$$

$$\cdot a = \frac{\epsilon \cdot |q|}{m_1} = \frac{200 \cdot 1{,}6 \cdot 10^{-19}}{56 \cdot 10^{-27}} = 8 \cdot 10^8\,m/s^2$$

$$\cdot \upsilon_y = a \cdot \Delta t = 8 \cdot 10^8 \cdot 2{,}5 \cdot 10^{-5} = 20 \cdot 10^3$$

$$\Rightarrow \upsilon_y = 2 \cdot 10^4\,m/s$$

$$\upsilon = \sqrt{\upsilon_x^2 + \upsilon_y^2} = \sqrt{2\cdot\upsilon_x^2} = \upsilon_x\cdot\sqrt{2} \Rightarrow \boxed{\upsilon = 2\sqrt{2}\cdot 10^4\ m/s}$$

$$\varepsilon\varphi\theta = \frac{\upsilon_y}{\upsilon_x} = 1 \rightarrow \boxed{\theta = 45^\circ}$$

Δ5 $R =;$

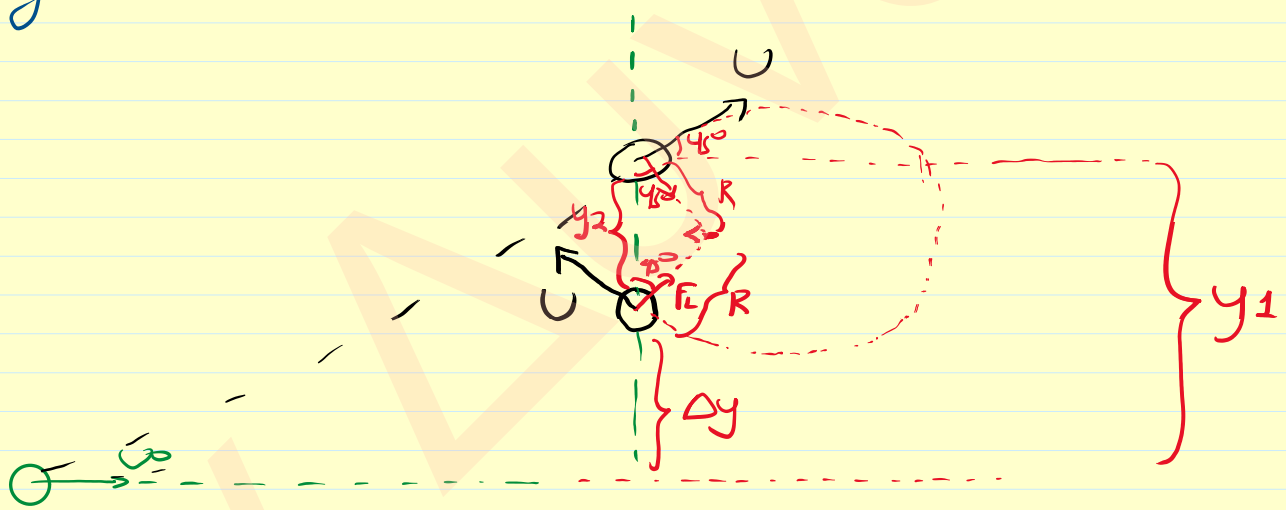
$$R = \frac{m\cdot\upsilon}{B_2\cdot|q|} = \frac{35\cdot 10^{-27}\cdot 2\sqrt{2}\cdot 10^4}{10^{-1}\cdot 1{,}6\cdot 10^{-19}} = \frac{70\cdot\sqrt{2}\cdot 10^{-23}}{10^{-20}} \Rightarrow \boxed{R = 7\sqrt{2}\cdot 10^{-2}\,m}$$

Δ6 $\Delta y =;$

$$\rightsquigarrow y_1 = \frac{1}{2}\cdot a\cdot\Delta t^2 = \frac{1}{2}\,8\cdot 10^8\cdot(2{,}5\cdot 10^{-5})^2 = 4\cdot 10^8\cdot 6{,}25\cdot 10^{-10}$$

$$\Rightarrow y_1 = 25\cdot 10^{-2} = 0{,}25\,m$$

$$\rightsquigarrow y_2 = \sqrt{R^2+R^2} = R\cdot\sqrt{2} = 7\sqrt{2}\cdot 10^{-2}\cdot\sqrt{2} = 14\cdot 10^{-2} = 0{,}14\,m$$



$$\Delta y = y_1 - y_2 = 0{,}25 - 0{,}14 \Rightarrow \boxed{\Delta y = 0{,}11\,m}$$