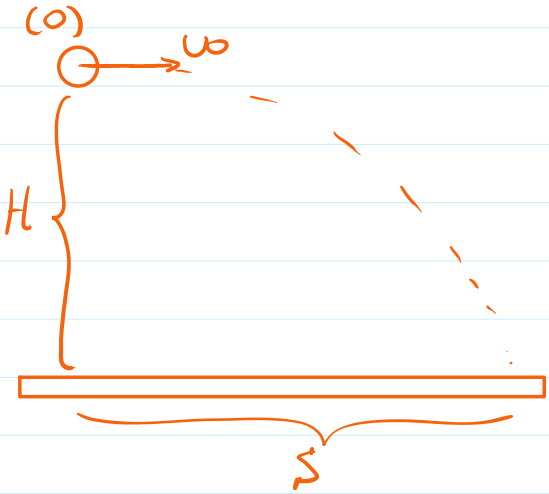
ΘΕΜΑ Α

Α1) γ Α2) δ Α3) β Α4) γ

Α5) α) Λ β) Λ γ) Λ δ) Σ ε) Σ

ΘΕΜΑ Β

Β1 Σωστή απάντηση (γ)



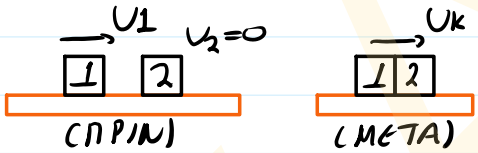
Στην αρχική θέση (Ο): $K = 4U \Rightarrow \frac{1}{2} m \cdot U_0^2 = 4 mgH$

$\Rightarrow U_0 = \sqrt{8gH}$

$t_{\varepsilon\delta} = \sqrt{\frac{2H}{g}}$

Άρα: $S = U_0 \cdot t_{\varepsilon\delta} = \sqrt{8gH}\sqrt{\frac{2H}{g}} = \sqrt{\frac{16gH^2}{g}} \Rightarrow \boxed{S = 4H}$

Β2 i) Σωστή απάντηση (α)



$\pi = \frac{Q_{κρ}}{K_{αρχ}} \cdot 100\% = \frac{K_1 - \frac{K_1}{2}}{K_1} \cdot 100\%$

$\Rightarrow \boxed{\pi = 50\%}$

ii) Σωστή απάντηση (γ)

Α.Δ.Ο.: $\vec{p}_1 + \vec{p}_2 = \vec{p}_{κοινή} \xrightarrow{(+)} m_1 U_1 = (m_1 + m_2) U_κ$

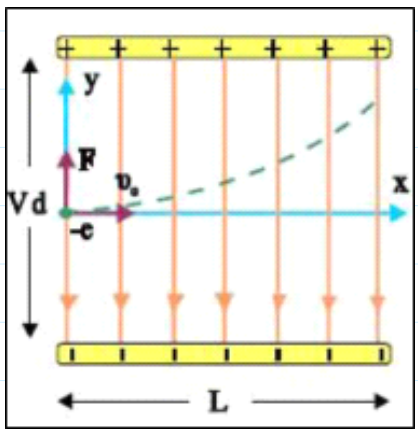
$\Rightarrow U_κ = \frac{m_1 U_1}{m_1 + m_2}$ (1)

$K = \frac{K_1}{2} \Rightarrow \frac{1}{2}(m_1 + m_2) U_κ^2 = \frac{1}{2} \cdot \frac{1}{2} m_1 U_1^2$

$(1) \Rightarrow (m_1 + m_2) \frac{m_1^2 U_1^2}{(m_1 + m_2)^2} = \frac{1}{2} m_1 U_1^2 \Rightarrow 2m_1 = m_1 + m_2$

$\Rightarrow m_1 = m_2 \rightarrow \boxed{\frac{m_1}{m_2} = 1}$

Β3 Ζωντανά (γ)



Αρχικά: $E = \frac{V}{d} \rightarrow F_{ηλ} = E \cdot |q|$

$F_{ηλ} = m \cdot a \Rightarrow a = \frac{E \cdot |q|}{m}$

$y = \frac{1}{2} a \cdot t^2 \Rightarrow y = \frac{1}{2} a \left(\frac{L}{v_0}\right)^2 \quad (1)$

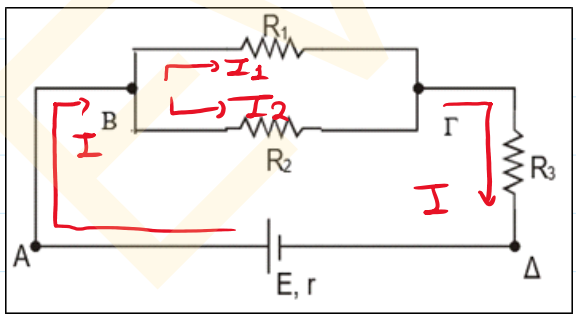
Τελικά: $E' = \frac{V/2}{d} = \frac{E}{2} \rightarrow F_{ηλ}' = \frac{E}{2} \cdot |q|$

$F_{ηλ}' = m \cdot a' \Rightarrow \frac{E}{2}|q| = m \cdot a' \Rightarrow a' = \frac{E \cdot |q|}{2m} = \frac{a}{2}$

$y' = \frac{1}{2} \cdot a' \cdot t^2 \Rightarrow y' = \frac{1}{2} \frac{a}{2} \left(\frac{L}{v_0}\right)^2 \quad (2)$

$\frac{(2)}{(1)} \Rightarrow \frac{y'}{y} = \frac{\frac{1}{2}\frac{a}{2}\left(\frac{L}{v_0}\right)^2}{\frac{1}{2} a \left(\frac{L}{v_0}\right)^2} \Rightarrow \frac{y'}{y} = \frac{1}{2} \Rightarrow \boxed{y' = \frac{y}{2}}$

ΘΕΜΑ Γ



Γ1 $R_{εξ} = ;$

$R_{1,2} = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{24 \cdot 8}{32} = 6\,\Omega \Rightarrow R_{1,2} = 6\,\Omega$

$R_{εξ} = R_{1,2} + R_3 \Rightarrow \boxed{R_{εξ} = 9\,\Omega}$

Γ2 $V_2 = ;$

$V_1 = I_1 \cdot R_1 = 2 \cdot 24 = 48\,V \rightarrow \boxed{V_2 = V_1 = 48\,V}$

Γ3 $P_{πηγης} = ;$

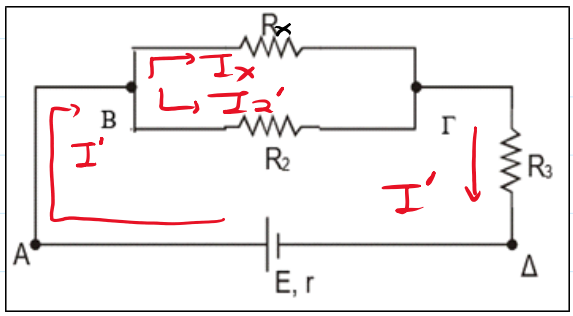
$$I_2 = \frac{V_2}{R_2} = \frac{48}{8} = 6A \rightarrow I = I_1 + I_2 = 8A$$

$$P_{πηγης} = I^2 \cdot R_{ολ} = 8^2 (9+1) \Rightarrow \boxed{P_{πηγης} = 640W}$$

Γ4 $\mathcal{E} = ;$

$$I = \frac{\mathcal{E}}{R_{ολ}} \Rightarrow \mathcal{E} = I \cdot R_{ολ} \Rightarrow \mathcal{E} = 8 \cdot 10 \Rightarrow \boxed{\mathcal{E} = 80V}$$

Γ5 $R_x = ;$, $π = ;$



Αρχικά: $V_π = \mathcal{E} - I \cdot r = 80 - 8 \cdot 1$

$\Rightarrow V_π = 72V$

Τελικά: $V_π' = V_π - 2 = 70V$

$V_π' = \mathcal{E} - I' \cdot r \Rightarrow 70 = 80 - I' \cdot 1$

$\Rightarrow I' = 10A$

$$I' = \frac{\mathcal{E}}{R_{ολ}'} \Rightarrow R_{ολ}' = \frac{\mathcal{E}}{I'} = \frac{80}{10} \Rightarrow R_{ολ}' = 8\,Ω$$

$R_{εξ}' = R_{ολ}' - r \Rightarrow R_{εξ}' = 7\,Ω$

$R_{εξ}' = R_{x,2} + R_3 \Rightarrow 7 = R_{x,2} + 3 \Rightarrow R_{x,2} = 4\,Ω$

$$R_{x,2} = \frac{R_x \cdot R_2}{R_x + R_2} \Rightarrow 4 = \frac{R_x \cdot 8}{R_x + 8} \Rightarrow 4R_x + 32 = 8R_x \Rightarrow \boxed{R_x = 8\,Ω}$$

(ή) $V_{x,2} = V_π' - V_3 \Rightarrow V_{x,2} = 70 - 10 \cdot 3 = 40V = V_x = V_2$

$$I_2' = \frac{V_2}{R_2} = \frac{40}{8} = 5A \rightarrow I_1' = I' - I_2' = 5A$$

$$R_x = \frac{V_x}{I_x} = \frac{40}{5} \Rightarrow \boxed{R_x = 8\,Ω}$$

Αρχικά: $P_3 = I^2 \cdot R_3 = 8^2 \cdot 3 \Rightarrow P_3 = 192\,W$

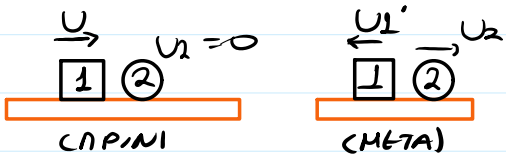
Τελικοί: $P_3' = I'^2 \cdot R_3 = 10^2 \cdot 3 \Rightarrow P_3' = 300W$

$$\pi = \frac{P_3' - P_3}{P_3} \cdot 100\% = \frac{I'^2 R_3 - I^2 R_3}{I^2 R_3} \cdot 100\% = \frac{10^2 - 8^2}{8^2} \cdot 100\%$$

$$\Rightarrow \pi = \frac{36}{64} \cdot 100\% \Rightarrow \boxed{\pi = 56{,}25\%}$$

ΘΕΜΑ Δ

Δ1 $U_2' = ;$



Α.Δ.Ο.

$$\vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2' \overset{(+)}{\Rightarrow} m_1 \cdot U = -m_1 \cdot U_1' + m_2 \cdot U_2'$$

$$\Rightarrow 2 \cdot 10 = -2 \cdot 5 + 6 \cdot U_2' \Rightarrow 6 \cdot U_2' = 30 \Rightarrow \boxed{U_2' = 5 m/s}$$

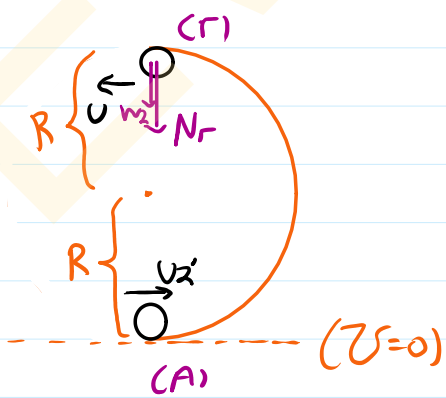
Δ2 $\pi = ;$

$$K_1 = \frac{1}{2} m_1 U_1^2 = \frac{1}{2} \cdot 2 \cdot 10^2 = 100J$$

$$K_2' = \frac{1}{2} m_2 U_2'^2 = \frac{1}{2} \cdot 6 \cdot 5^2 = 75J$$

$$\pi = \frac{K_2'}{K_1} \cdot 100\% = \frac{75}{100} \cdot 100\% \Rightarrow \boxed{\pi = 75\%}$$

Δ3 $N_r = ;$



Α.Δ.Μ.Ε. (Α→Γ)

$$K_A + U_A = K_\Gamma + U_\Gamma$$

$$\Rightarrow \frac{1}{2} m_2 U_2'^2 = \frac{1}{2} m_2 U^2 + m_2 g \cdot 2R$$

$$\Rightarrow U_2'^2 = U^2 + 4 \cdot g \cdot R$$

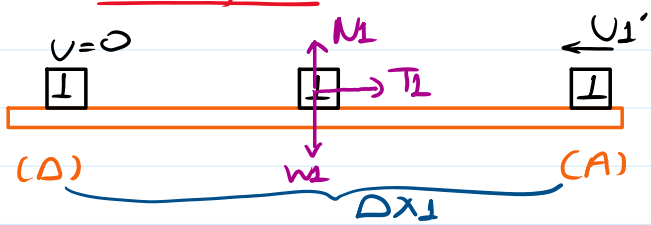
$$\Rightarrow 5^2 = U^2 + 4 \cdot 10 \cdot 0{,}4$$

$$\Rightarrow U^2 = 25 - 16 \Rightarrow U = 3 m/s$$

$$\Sigma F_{R_r} = m_2 \cdot \frac{U^2}{R} = 6 \cdot \frac{3^2}{0,4} = 15 \cdot 9 = 135\,N$$

$$\Sigma F_{R_r} = N_r + W_2 \Rightarrow 135 = N_r + 60 \Rightarrow \boxed{N_r = 75\,N}$$

Δ4 $\Delta t_{stop} = ;$



$$\Sigma F_y = 0 \Rightarrow N_1 = m_1 g = 20N$$

$$T_1 = \mu \cdot N_1 = 4\,N$$

$$\Sigma F_x = m_1 \cdot a \Rightarrow T_1 = m_1 \cdot a \Rightarrow 4 = 2 \cdot a \Rightarrow a = 2\,m/s^2$$

$$U = U_1' - |a| \cdot \Delta t_{stop} \Rightarrow 0 = 5 - 2 \cdot \Delta t_{stop} \Rightarrow \boxed{\Delta t_{stop} = 2,5\,s}$$

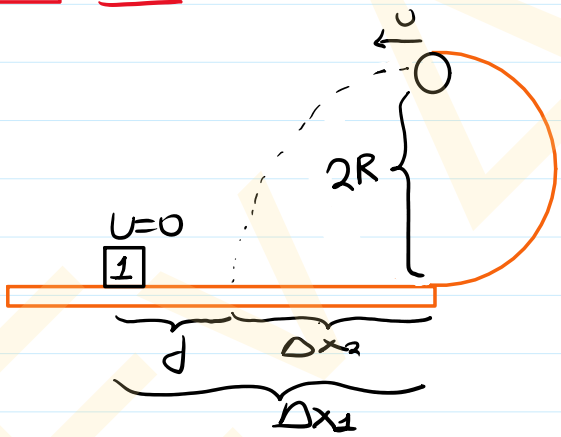
Δ5 $\dfrac{\Delta p_1/\Delta t}{\Delta p_2/\Delta t} = ;$

$$\frac{\Delta p_1}{\Delta t} = \Sigma F_1 = T_1 = 4\,N$$

$$\frac{\Delta p_2}{\Delta t} = \Sigma F_2 = W_2 = 60\,N$$

$$\Rightarrow \boxed{\frac{\Delta p_2/\Delta t}{\Delta p_2/\Delta t} = \frac{4}{60} = \frac{1}{15}}$$

Δ6 $d = ;$



$$\Sigma 1: \Delta x_1 = U_1' \cdot \Delta t_{stop} - \frac{1}{2}|a| \cdot \Delta t_{stop}^2$$

$$\Rightarrow \Delta x_1 = 5 \cdot 2,5 - \frac{1}{2} \cdot 2 \cdot 2,5^2$$

$$\Rightarrow \Delta x_1 = 12,5 - 6,25$$

$$\Rightarrow \Delta x_1 = 6,25\,m$$

$$\Sigma 2: \Delta x_2 = U \cdot t_{\varepsilon\varsigma} = U \cdot \sqrt{\frac{2 \cdot 2R}{g}} = 3 \cdot \sqrt{\frac{4 \cdot 0,4}{10}} = 3 \cdot 0,4$$

$$\Rightarrow \Delta x_2 = 1,2\,m$$

$$d = \Delta x_1 - \Delta x_2 = 6,25 - 1,2 \Rightarrow \boxed{d = 5,05\,m}$$