ΘΕΜΑ Α

Α1) β Α2) δ Α3) γ Α4) δ

Α5) α) Λ β) Λ γ) Σ δ) Σ ε) Σ

ΘΕΜΑ Β

Β1 Σωστή απάντηση: (γ)

$\cdot \Delta\vec{p} = \vec{p}' - \vec{p} \overset{\uparrow(+)}{\Rightarrow} \Delta p = m\cdot\frac{U}{3} - (-m\cdot U) \Rightarrow \Delta p = \frac{4}{3}mU$

$\cdot \Sigma\vec{F} = \frac{\Delta\vec{p}}{\Delta t} \overset{\uparrow(+)}{\Rightarrow} \Sigma F = \frac{4mU}{3\Delta t}$

$\cdot \Sigma F = N - w \Rightarrow \boxed{N = mg + \frac{4mU}{3\Delta t}}$

Β2 i) Σωστή απάντηση: (β)

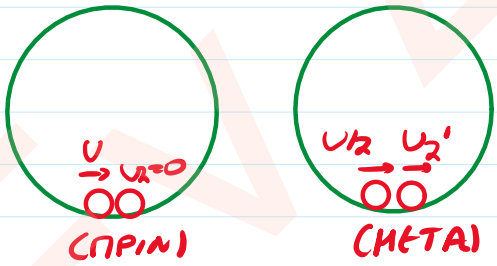
$K_1 = \frac{1}{2}m_1 U^2$

$K_1' = \frac{1}{2}m_1\left(\frac{U}{2}\right)^2 \Rightarrow K_1' = \frac{1}{2}m_1\frac{U^2}{4} \Rightarrow K_1' = \frac{K_1}{4}$

$\cdot \pi_1 = \frac{\Delta K_1}{K_1}\cdot 100\% = \frac{K_1' - K_1}{K_1}\cdot 100\% = \frac{\frac{K_1}{4} - K_1}{K_1}\cdot 100\%$

$\Rightarrow \pi_1 = \frac{-\frac{3}{4}K_1}{K_1}\cdot 100\% \Rightarrow \boxed{\pi_1 = -75\%}$

ii) Σωστή απάντηση: (α)



Α.Δ.Ο: $\vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2'$

$\overset{(+)}{\Rightarrow} m_1\cdot U + 0 = m_1\frac{U}{2} + m_2\cdot U_2'$

$\Rightarrow 2mU - 2m\frac{U}{2} = mU_2'$

$\Rightarrow U_2' = U$

Την πρώτη φορά τα θα συναντηθούν:

$S_2 = S_1 + 2\pi R \Rightarrow U_2'\cdot t - U_1'\cdot t = 2\pi R$

$\Rightarrow U\cdot t - \frac{U}{2}\cdot t = 2\pi R \Rightarrow \frac{1}{2}U\cdot t = 2\pi R \Rightarrow \boxed{t = \frac{4\pi R}{U}}$

Β3 Σωστή απάντηση: (α)

Θ.Μ.Κ.Ε: $\frac{1}{2}m\cdot U_0^2 - 0 = q\cdot V_1 \Rightarrow V_1 = \frac{mU_0^2}{2q}$ (1)

$$\epsilon = \frac{V_2}{\ell} = \frac{V'}{\ell/2} \Rightarrow V' = \frac{V_2}{2}$$

Θ.Μ.Κ.Ε. (Σε σχ. Ο.Η.Π.)

$$\frac{1}{2}m\cdot(2U_0)^2 - \frac{1}{2}m\cdot U_0^2 = q\cdot\frac{V_2}{2}$$

$$\Rightarrow 4mU_0^2 - mU_0^2 = q\cdot V_2 \Rightarrow V_2 = \frac{3mU_0^2}{q} \quad (2)$$

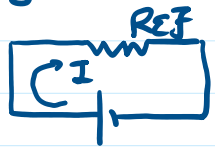
$$\frac{(2)}{(1)} \Rightarrow \frac{V_2}{V_1} = \frac{\frac{3mU_0^2}{q}}{\frac{mU_0^2}{2q}} = 6 \Rightarrow \boxed{V_2 = 6\cdot V_1}$$

ΘΕΜΑ Γ

Γ1 $R_{1,2} = \frac{R_1\cdot R_2}{R_1+R_2} = \frac{6\cdot 3}{6+3} = 2\,\Omega$

$R_{\epsilon\sigma} = R_{1,2} + R_3 = 5\,\Omega \rightarrow R_{o\lambda} = R_{\epsilon\sigma} + r \Rightarrow \boxed{R_{o\lambda} = 6\,\Omega}$

Γ2



$$I = \frac{\epsilon}{R_{o\lambda}} = \frac{24}{6} \Rightarrow I = 4A$$

$$V_\pi = \epsilon - I\cdot r \Rightarrow V_\pi = 24 - 4\cdot 1 \Rightarrow \boxed{V_\pi = 20V}$$

Γ3 $V_1 = V_2 \Rightarrow I_1\cdot R_1 = I_2\cdot R_2 \Rightarrow I_1\cdot 6 = I_2\cdot 3 \Rightarrow I_2 = 2I_1$ (1)

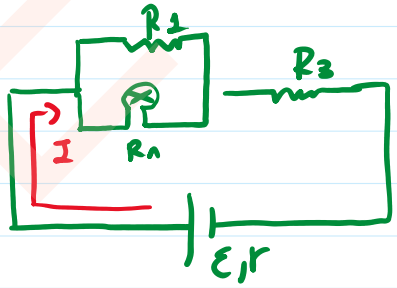
$I_1 + I_2 = I \overset{(1)}{\Rightarrow} I_1 + 2I_1 = 4 \Rightarrow I_1 = \frac{4}{3}A$

$$Q_1 = I_1^2\cdot R_1\cdot\Delta t = \left(\frac{4}{3}\right)^2\cdot 6\cdot 60 = \frac{16}{\cancel{9}_3}\cdot\overset{2}{\cancel{6}}\cdot 60 \Rightarrow \boxed{Q_1 = 640J}$$

$(1) \Rightarrow I_2 = 2\cdot I_1 = \frac{8}{3}A \rightarrow P_2 = I_2^2\cdot R_2 = \frac{64}{9}\cdot 3 \Rightarrow \boxed{P_2 = \frac{64}{3}W}$

Γ4 $I_k = \frac{P_k}{V_k} = \frac{24}{12} \Rightarrow \boxed{I_k = 2A}$ και $R_\Lambda = \frac{V_k}{I_k} = \frac{12}{2} \Rightarrow \boxed{R_\Lambda = 6\,\Omega}$

Γ5



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

$$R_{\epsilon\sigma} = R_{1,\Lambda} + R_3 = 6\,\Omega$$

$$R_{o\lambda} = R_{\epsilon\sigma} + r = 7\,\Omega$$

$$I = \frac{\epsilon}{R_{o\lambda}} = \frac{24}{7}A$$

$\cdot V_1 = V_\Lambda \Rightarrow I_1\cdot R_1 = I_\Lambda\cdot R_\Lambda \Rightarrow I_1\cdot 6 = I_\Lambda\cdot 6$

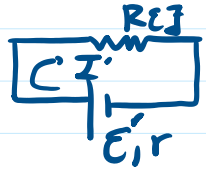
$\Rightarrow I_1 = I_\Lambda = \frac{I}{2} = \frac{12}{7}\,A$

Αφού: $I_\Lambda = \frac{12}{7}\,A < I_K = 2A$, υπολειτουργεί

Γ6 Λειτουργεί κανονικά: $I_\Lambda = I_K = 2A$

$V_1 = V_\Lambda \Rightarrow I_1 \cdot R_1 = I_\Lambda R_\Lambda \Rightarrow I_1 = I_\Lambda = 2A$

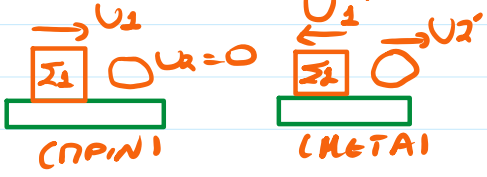
$I' = I_1 + I_\Lambda = 4A$



$\mathcal{E}' = I \cdot R_{23} = 4 \cdot 7 \Rightarrow \boxed{\mathcal{E}' = 28V}$

ΘΕΜΑ Δ

Δ1



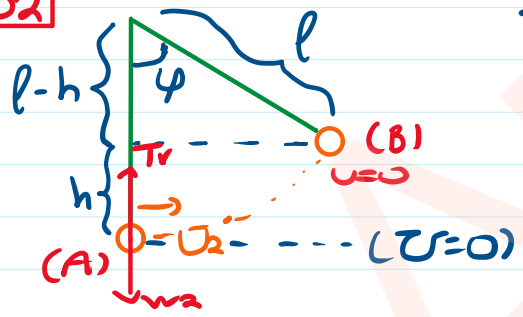
Α.Δ.Ο.: $\vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2'$

$\overset{(+)}{\Rightarrow} m_1 U_1 = -m_1 U_1' + m_2 U_2'$

$\Rightarrow 10 + 5 = 3 U_2'$

$\Rightarrow \boxed{U_2' = 5\,m/s}$

Δ2



$\Sigma F_R = m_2 \frac{U_2'^2}{\ell} = 3 \cdot \frac{25}{2,5} = 30N$

$\Sigma F_R = T_\nu - w_2 \Rightarrow \boxed{T_\nu = 60N}$

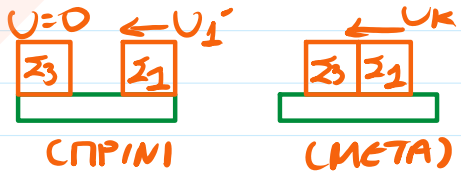
Δ3 Α.Δ.Μ.Ε. (Α → Β)

$K_A + U_A = K_B + U_B \Rightarrow \frac{1}{2} m_2 U_2'^2 = m_2 g h$

$\Rightarrow h = \frac{U_2'^2}{2g} = \frac{25}{20} \Rightarrow h = 1,25m$

$\sigma\upsilon\nu\varphi = \frac{\ell - h}{\ell} = \frac{2,5 - 1,25}{2,5} = \frac{1,25}{2,5} \Rightarrow \boxed{\sigma\upsilon\nu\varphi = \frac{1}{2}}$

Δ4



Α.Δ.Ο.: $\vec{p}_2 + \vec{p}_3 = \vec{p}_{\text{ΚΟΙΝΗ}}$

$\overset{(+)}{\Rightarrow} m_1 U_1' = (m_1 + m_3) U_K$

$\Rightarrow 1 \cdot 5 = 5 \cdot U_K \Rightarrow U_K = 1\,m/s$

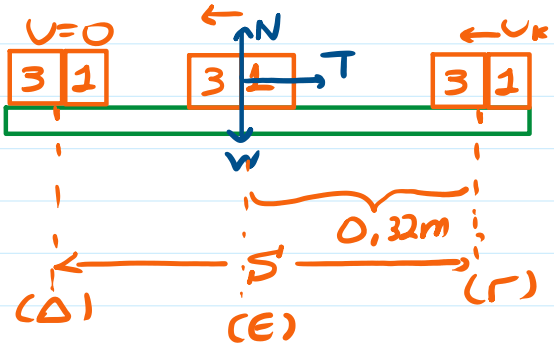
$K_{\text{ΠΡΙΝ}} = \frac{1}{2} m_1 U_1'^2 = \frac{1}{2} \cdot 1 \cdot 5^2 = 12,5\,J$

$K_{μετά} = \frac{1}{2}(m_1+m_3)\cdot U_K^2 = \frac{1}{2}\cdot 5\cdot 1^2 = 2{,}5\,J$

$E_{απωλειων} = K_{πριν} - K_{μετα} = 10\,J$

$π = \frac{E_{απωλειων}}{K_{πριν}}\cdot 100\% = \frac{10}{12{,}5}\cdot 100\% \Rightarrow \boxed{π = 80\%}$

Δ5



Θ.Μ.Κ.Ε. (Γ→Δ)

$0 - \frac{1}{2}(m_2+m_3)U_K^2 = W_T$

$\Rightarrow W_T = -2{,}5\,J$

$\rightsquigarrow Q_{τρ.} = |W_T| = 2{,}5\,J$

$Q_{ολ} = E_{απ.} + Q_{τρ} \Rightarrow \boxed{Q_{ολ} = 12{,}5\,J}$

Δ6 $\Sigma F_y = 0 \Rightarrow N = (m_2+m_3)g = 50\,N$

$T = \mu\cdot N = 5\,N$

Θ.Μ.Κ.Ε. (Γ→Ε): $\frac{1}{2}(m_2+m_3)\cdot U^2 - \frac{1}{2}(m_2+m_3)\cdot U_K^2 = -T\cdot(ΓΕ)$

$\Rightarrow \frac{1}{2}\cdot 5\cdot U^2 - \frac{1}{2}\cdot 5\cdot 1^2 = -5\cdot 0{,}32$

$\Rightarrow U^2 = 1 - 0{,}64 \Rightarrow U^2 = 0{,}36 \Rightarrow U = 0{,}6\,m/s$

$\frac{dK}{dt} = -T\cdot U = -5\cdot 0{,}6 \Rightarrow \boxed{\frac{dK}{dt} = -3\,J/s}$