ΘΕΜΑ Α

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

ΘΕΜΑ Β

Β1 Σωστή απάντηση: (α)

Κύκλωμα 1: $R_{ολ} = R + r = 2R \rightarrow I = \frac{\mathcal{E}}{R_{ολ}} = \frac{\mathcal{E}}{2R}$

$$V_1 = \mathcal{E} - I \cdot r = \mathcal{E} - \frac{\mathcal{E}}{2R} \cdot R = \mathcal{E} - \frac{\mathcal{E}}{2} \Rightarrow V_1 = \frac{\mathcal{E}}{2}$$

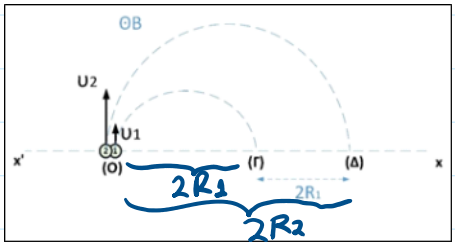
Κύκλωμα 2: $R_{εξ} = \frac{3R \cdot 6R}{3R + 6R} = \frac{18R^2}{9R} = 2R \rightarrow R_{ολ} = R_{εξ} + r = 3R$

$$I = \frac{\mathcal{E}}{R_{ολ}} = \frac{\mathcal{E}}{3R}$$

$$V_2 = \mathcal{E} - I \cdot r = \mathcal{E} - \frac{\mathcal{E}}{3R} \cdot R = \mathcal{E} - \frac{\mathcal{E}}{3} \Rightarrow V_2 = \frac{2\mathcal{E}}{3}$$

$$\frac{V_1}{V_2} = \frac{\frac{\mathcal{E}}{2}}{\frac{2\mathcal{E}}{3}} \Rightarrow \boxed{\frac{V_1}{V_2} = \frac{3}{4}}$$

Β2 Σωστή απάντηση: (β)

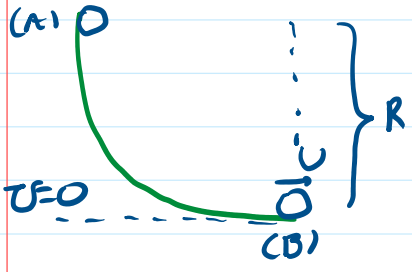


• $\Gamma\Delta = 2R_2 - 2R_1 \Rightarrow 2R_1 = 2R_2 - 2R_1$
$\Rightarrow 2R_2 = 4R_1 \Rightarrow R_2 = 2R_1$

$$\sim \frac{m \cdot U_2}{B \cdot |q_2|} = 2\frac{m \cdot U_1}{B \cdot |q_1|} \Rightarrow \frac{4 \cdot U_1}{|q_2|} = \frac{2U_1}{|q_1|}$$
$$\Rightarrow |q_2| = 2|q_1|$$

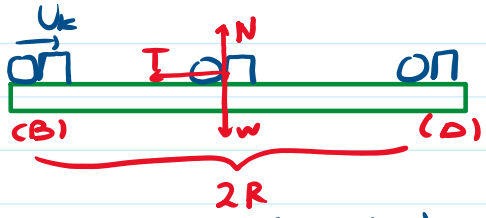
$$\frac{\Delta t_1}{\Delta t_2} = \frac{T_{1/2}}{T_{2/2}} = \frac{\frac{2\pi m}{B \cdot |q_1|}}{\frac{2\pi m}{B \cdot |q_2|}} = \frac{|q_2|}{|q_1|} = \frac{2|q_1|}{|q_1|} \Rightarrow \boxed{\frac{\Delta t_1}{\Delta t_2} = 2}$$

Β3 Σωστή απάντηση: (γ)



ΑΔΜΕ (Α→Β): $K_A^{\nearrow 0} + U_A = K_B + U_B^{\nearrow 0}$
$\Rightarrow mgR = \frac{1}{2}mU^2 \Rightarrow U = \sqrt{2gR}$ (1)

ΑΔΟ: $mU = (M+m)U_{κ} \Rightarrow U_{κ} = \frac{mU}{M+m}$ (2)



$(\Sigma F_y = 0 \Rightarrow N = (M+m)g$
$T = \mu \cdot (M+m)g)$

Θ.Μ.Κ.Ε (Β→Δ)

$K_{τελ} - K_{αρχ} = W_{\vec{w}} + W_{\vec{N}} + W_T$

$\Rightarrow -\frac{1}{2}(M+m)\cdot U_k^2 = -\mu\cdot(M+m)\cdot g\cdot 2R$

$\Rightarrow U_k^2 = 2\mu\cdot g\cdot 2R$

(2)
$\Rightarrow \frac{m^2\cdot U^2}{(M+m)^2} = 2\cdot\frac{1}{8}\cdot 2\cdot g\cdot R$

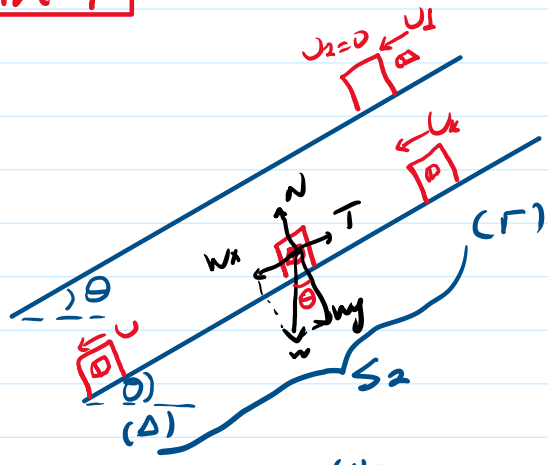
(1)
$\Rightarrow m^2\cdot 2gR = (M+m)^2\cdot\frac{1}{4}\cdot 2gR$

$\Rightarrow (M+m)^2 = 4m^2 \Rightarrow M+m = 2m$

$\Rightarrow \boxed{M = m}$

ΘΕΜΑ Γ

Γ1



Α.Δ.Ο.

$\vec{p}_1 + \vec{p}_2 = \vec{p}_{κοιν}$

$\overset{(+)}{\Rightarrow} m_1\cdot U_1 = (m_1+m_2)\cdot U_k$

$\Rightarrow 0{,}2\cdot 60 = 2\cdot U_k$

$\Rightarrow \boxed{U_k = \frac{12}{2} = 6\ m/s}$

Γ2

$\Sigma\vec{F}_1 = \frac{\Delta\vec{p}_1}{\Delta t} \overset{(+)}{\Rightarrow} \Sigma F_1 = \frac{m_1\cdot U_k - m_1\cdot U_1}{\Delta t} = \frac{1{,}2-12}{0{,}01} = \frac{-10{,}8}{0{,}01}$

$\Rightarrow \boxed{\Sigma F_1 = -1080N}$

Γ3

$W_x = W\cdot ημθ = 20\cdot\frac{1}{2} = 10\ N$

$W_y = W\cdot συνθ = 20\cdot\frac{\sqrt{3}}{2} = 10\sqrt{3}N$

$\Sigma F_y = 0 \Rightarrow N = w_y = 10\sqrt{3}N \rightarrow T = \mu N = \frac{\sqrt{3}}{2}\cdot 10\sqrt{3} = 15N$

Θ.Μ.Κ.Ε. (Γ→Δ1)

$\frac{1}{2}m_{Ω2}\cdot U^2 - \frac{1}{2}m_{Ω2}\cdot U_k^2 = W_x\cdot 5 - T\cdot 5$

$\Rightarrow \frac{1}{2}\cdot 2\cdot 4^2 - \frac{1}{2}\cdot 2\cdot 6^2 = 10\cdot 5 - 15\cdot 5$

$\Rightarrow 16-36 = -5\cdot 5$

$\Rightarrow -20 = -5S \Rightarrow \boxed{S = 4m}$

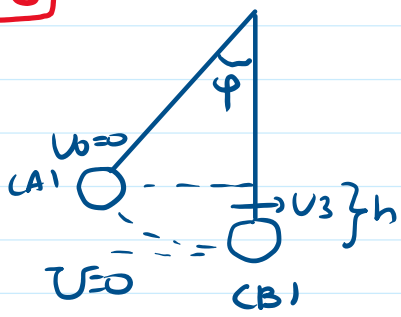
Γ4 $\Sigma F_x = w_x - T = 10 - 15 = -5N$

$\frac{dK}{dt} = \Sigma F_x \cdot U = -5 \cdot 4 \Rightarrow \boxed{\frac{dK}{dt} = -20 J/s}$

Γ5 $\underline{A.\Delta.O.}: m_3 U_3 - (m_1 + m_2) U_k = 0$

$\Rightarrow 4 \cdot U_3 = 2 \cdot 4 \Rightarrow \boxed{U_3 = 2 m/s}$

Γ6



$\underline{A\Delta ME (A \to B)}$

$m_3 g h = \frac{1}{2} m_3 U_3^2$

$\Rightarrow h = \frac{2^2}{20} = 0,2m$

$\sigma\upsilon\nu\varphi = \frac{\ell - h}{\ell} = \frac{0,2}{0,4} = \frac{1}{2}$

$\rightsquigarrow \boxed{\varphi = 60^\circ = \frac{\pi}{3} rad}$

ΘΕΜΑ Δ

Δ1 $R_1 = \frac{m \cdot U}{B_1 \cdot |q|} = \frac{5 \cdot 10^{-10} \cdot 2 \cdot 10^3}{1 \cdot 4 \cdot 10^{-6}} \Rightarrow R_1 = 2,5 \cdot 10^{-1} \Rightarrow \boxed{R_1 = 0,25m}$

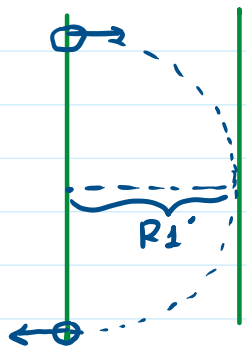
$T_1 = \frac{2\pi m}{B_1 \cdot |q|} = \frac{2\pi \cdot 5 \cdot 10^{-10}}{1 \cdot 4 \cdot 10^{-6}} \Rightarrow T_1 = 2,5\pi \cdot 10^{-4} s$

$\boxed{\Delta t_1 = \frac{T_1}{2} = 1,25\pi \cdot 10^{-4} s}$

Δ2 $\Delta \vec{p} = \vec{p}_\Gamma - \vec{p}_A \overset{(+)}{\Rightarrow} \Delta p = m \cdot U - (-m \cdot U) = 2mU$

$\Rightarrow \Delta p = 2 \cdot 5 \cdot 10^{-10} \cdot 2 \cdot 10^3 \Rightarrow \boxed{\Delta p = 2 \cdot 10^{-6} kg \frac{m}{s}}$

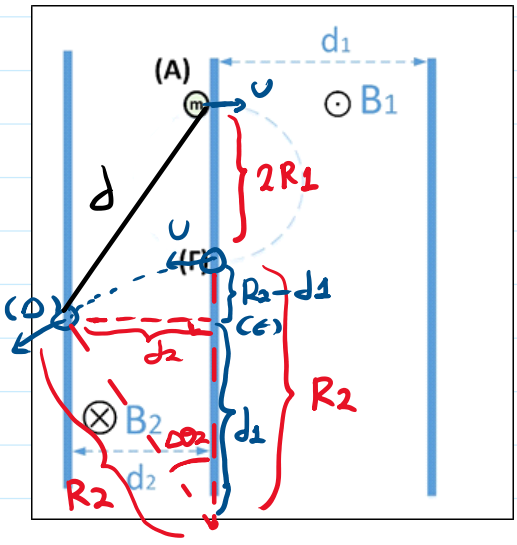
Δ3



$R_1' = d_1 \Rightarrow \frac{m \cdot U}{B_1' \cdot |q|} = d_1 \Rightarrow \frac{5 \cdot 10^{-10} \cdot 2 \cdot 10^3}{B_1' \cdot 4 \cdot 10^{-6}} = 0,5$

$\Rightarrow 2 \cdot 10^{-6} B_1' = 10^{-6} \Rightarrow \boxed{B_1' = 0,5T}$

Δ4



$$R_2 = \frac{m\cdot\upsilon}{B_2|q|} = \frac{5\cdot10^{-10}\cdot2\cdot10^{3}}{0{,}5\cdot4\cdot10^{-6}} \Rightarrow \boxed{R_2 = 0{,}5\,m}$$

$$\eta\mu\Delta\theta_2 = \frac{d_2}{R_2} = \frac{0{,}25\sqrt{3}}{0{,}5} = \frac{\sqrt{3}}{2}$$

$$\rightarrow \Delta\theta_2 = \frac{\pi}{3}\,rad$$

$$\left.\begin{array}{l} T_2 \longrightarrow 2\pi\,rad \\ \Delta t \rightarrow \Delta\theta_2 \end{array}\right\} \Rightarrow \Delta t = T_2\cdot\frac{\Delta\theta_2}{2\pi}\ (1)$$

$$T_2 = \frac{2\pi m}{B_2|q|} = \frac{2\pi\cdot5\cdot10^{-20}}{0{,}5\cdot4\cdot10^{-6}} = 5\pi\cdot10^{-4}\,s$$

$$(1) \Rightarrow \Delta t_2 = 5\pi\cdot10^{-4}\cdot\frac{\pi/3}{2\pi}$$

$$\Rightarrow \boxed{\Delta t_2 = \frac{5\pi}{6}\cdot10^{-4}\,s}$$

Δ5

$$\sigma\upsilon\nu\Delta\theta_2 = \frac{d_1}{R_2} \Rightarrow d_1 = R_2\cdot\sigma\upsilon\nu\Delta\theta_2 = \frac{R_2}{2} = 0{,}25\,m$$

$$A\hat{\Delta}\epsilon:\quad d^2 = \sqrt{d_2^2 + (2R_1 + R_2 - d_1)^2} = \sqrt{(0{,}25\sqrt{3})^2 + (0{,}5+0{,}5-0{,}25)^2}$$

$$\Rightarrow d^2 = \sqrt{3\cdot0{,}25^2 + (3\cdot0{,}25)^2} = \sqrt{12\cdot0{,}25^2} = \sqrt{3\cdot4\cdot0{,}25^2}$$

$$\Rightarrow d = 2\cdot0{,}25\cdot\sqrt{3} \Rightarrow \boxed{d = 0{,}5\sqrt{3}\,m}$$