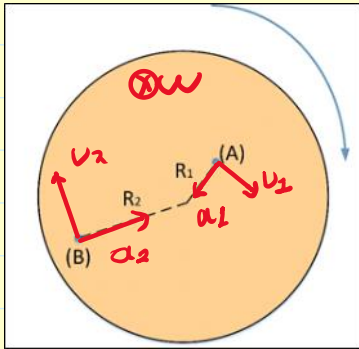


ΘΕΜΑ Α

A1) β A2) δ A3) γ A4) α
 A5) α) δ β) ε γ) η δ) λ ε) λ

ΘΕΜΑ Β

B1) i)



ii) Ξωσιν απάντηση: **β**

$$\frac{Q_1}{Q_2} = \frac{\omega^2 \cdot R_1}{\omega^2 \cdot R_2} \Rightarrow \frac{1}{4} = \frac{R_1}{R_2} \Rightarrow R_2 = 4R_1$$

$$\frac{U_1}{U_2} = \frac{\omega \cdot R_1}{\omega \cdot R_2} \Rightarrow \frac{U_1}{U_2} = \frac{R_1}{4R_1} \Rightarrow U_2 = 4U_1$$

$$\frac{S_1}{S_2} = \frac{U_1 \cdot \Delta t}{U_2 \cdot \Delta t} \Rightarrow \frac{S_1}{S_2} = \frac{U_1}{4U_1} \Rightarrow \frac{S_1}{S_2} = \frac{1}{4}$$

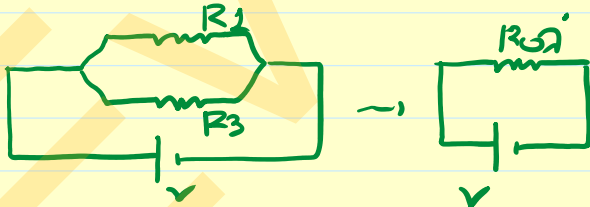
B2) Ξωσιν απάντηση: **γ**



$$R_{02} = R_1 + R_2 = 4R$$

$$Q_1 = \frac{V_1^2 \cdot \Delta t}{R_{02}} = \frac{(4V_2)^2 \cdot \Delta t}{4R}$$

$$\Rightarrow Q_1 = 4 \frac{V_2^2 \cdot \Delta t}{R} \quad (1)$$



$$Q_2 = \frac{V_2^2 \cdot \Delta t}{R_{02}'}$$

$$(1) = (2) \Rightarrow 4 \frac{V_2^2 \cdot \Delta t}{R} = \frac{V_2^2 \cdot \Delta t}{R_{02}'} \Rightarrow R_{02}' = \frac{R}{4} \Rightarrow \frac{R_1 \cdot R_3}{R_1 + R_3} = \frac{R}{4}$$

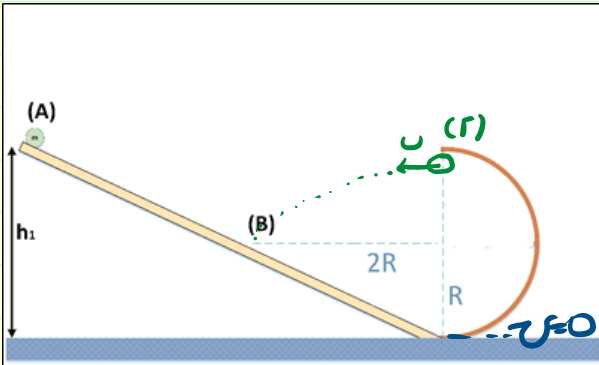
$$\Rightarrow 4 \cdot R \cdot R_3 = R(R + R_3) \Rightarrow 4R \cdot R_3 = R^2 + R \cdot R_3 \Rightarrow 3R \cdot R_3 = R^2$$

$$\Rightarrow R_3 = \frac{R}{3}$$

B3) Ξωσιν απάντηση: **α**

Οριζόντια βολή: $\Delta t_B = \sqrt{\frac{2R}{g}}$

και $\Delta x = U \cdot \Delta t_B \Rightarrow 2R = U \cdot \sqrt{\frac{2R}{g}} \Rightarrow 4R^2 = U^2 \cdot \frac{2R}{g} \Rightarrow U = \sqrt{2gR}$



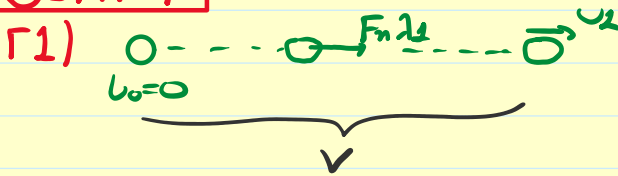
A. Δ. Μ. Ε. (A → Γ)

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

$$\Rightarrow mgh_1 = \frac{1}{2}m(\sqrt{2gR})^2 + mg \cdot 2R$$

$$\Rightarrow g \cdot h_1 = g \cdot R + 2gR \Rightarrow h_1 = 3R$$

ΘΕΜΑ Γ



Θ. Μ. Κ. Ε.

$$\frac{1}{2}m \cdot v_1^2 - 0 = q \cdot V$$

$$\Rightarrow \frac{1}{2} \cdot 10^{-10} \cdot (3 \cdot 10^3)^2 = 10^{-6} \cdot V$$

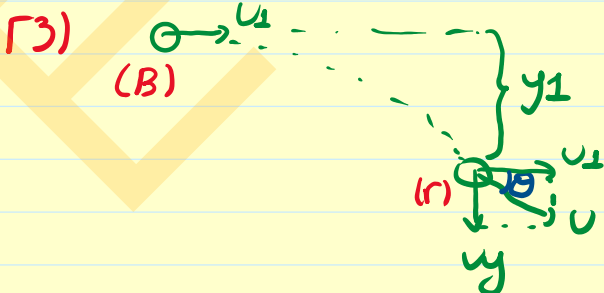
$$\Rightarrow \frac{1}{2} \cdot 10^{-10} \cdot 9 \cdot 10^6 = 10^{-6} \cdot V \Rightarrow V = 450V$$

Γ2) $F_{n2} = E_i |q| = 10^4 \cdot 10^{-6} = 10^{-2} N$
 $a_1 = \frac{F_{n2}}{m} = \frac{10^{-2}}{10^{-10}} \Rightarrow a_1 = 10^8 m/s^2$

$$v_1 = a_1 \cdot \Delta t_1 \Rightarrow \Delta t_1 = \frac{v_1}{a_1} = \frac{3 \cdot 10^3}{10^8} \Rightarrow \Delta t_1 = 3 \cdot 10^{-5} s$$

$$\Delta x_1 = \frac{1}{2} a_1 \Delta t_1^2 = \frac{1}{2} \cdot 10^8 \cdot (3 \cdot 10^{-5})^2 = \frac{1}{2} \cdot 10^8 \cdot 9 \cdot 10^{-10}$$

$$\Rightarrow \Delta x_1 = 4,5 \cdot 10^{-2} m$$



$$F_{n2} = (2 \cdot |q|) = 2 \cdot 10^4 \cdot 10^{-6} = 2 \cdot 10^{-2} N$$

$$a_2 = \frac{F_{n2}}{m} = \frac{2 \cdot 10^{-2}}{10^{-10}} \Rightarrow a_2 = 2 \cdot 10^8 m/s^2$$

$$\Delta t_2 = \frac{L}{v_1} = \frac{6 \cdot 10^{-2}}{3 \cdot 10^3} \Rightarrow \Delta t_2 = 2 \cdot 10^{-5} s$$

$$U_x = v_1 = 3 \cdot 10^3 m/s$$

$$U_y = a_2 \cdot \Delta t_2 = 2 \cdot 10^8 \cdot 2 \cdot 10^{-5} = 4 \cdot 10^3 m/s$$

$$U = \sqrt{U_x^2 + U_y^2} = \sqrt{9 \cdot 10^6 + 16 \cdot 10^6} = \sqrt{25 \cdot 10^6} \Rightarrow U = 5 \cdot 10^3 m/s$$

$$\Gamma 4) \text{Θ.Μ.Κ.Ε. (B} \rightarrow \Gamma) : \frac{1}{2} m \cdot U^2 - \frac{1}{2} m \cdot U_1^2 = q \cdot V$$

$$\Rightarrow \frac{1}{2} \cdot 10^{-10} \cdot (5 \cdot 10^3)^2 - \frac{1}{2} \cdot 10^{-10} \cdot (3 \cdot 10^3)^2 = 10^{-6} \cdot V$$

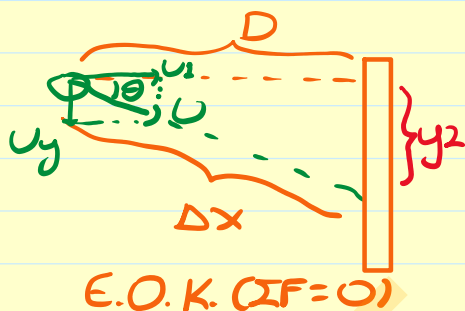
$$\Rightarrow 12,5 \cdot 10^{-4} - 4,5 \cdot 10^{-4} = 10^{-6} V$$

$$\Rightarrow \boxed{V = 800V}$$

$$\Gamma 5) \text{Σω Ο.Η.Π. (21) : } y_1 = \frac{1}{2} a_2 \cdot D t^2 = \frac{1}{2} \cdot 2 \cdot 10^3 \cdot (2 \cdot 10^{-5})^2$$

$$\Rightarrow y_1 = 4 \cdot 10^{-2} \text{ m}$$

$$\text{Καταθλιση: } \epsilon_{\varphi} \cdot \theta = \frac{y_1}{U_x} = \frac{4 \cdot 10^{-2}}{3 \cdot 10^3} \Rightarrow \boxed{\epsilon_{\varphi} \cdot \theta = \frac{4}{3}}$$



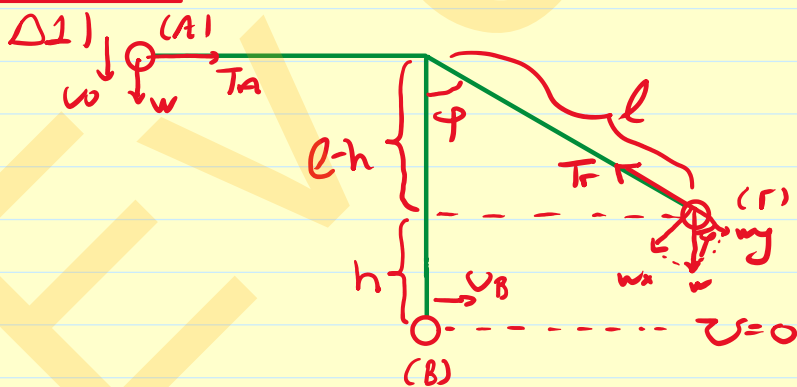
$$\cdot \epsilon_{\varphi} \cdot \theta = \frac{y_2}{D} \Rightarrow y_2 = 3 \cdot 10^3 \cdot \frac{4}{3} = 4 \cdot 10^2 \text{ m}$$

Η κατακόρυφη απόκλιση είναι:

$$y = y_1 + y_2 = 4 \cdot 10^{-2} + 4 \cdot 10^{-2}$$

$$\Rightarrow \boxed{y = 8 \cdot 10^{-2} \text{ m}}$$

ΘΕΜΑ Δ



$$\Sigma F_{RA} = m \frac{U_0^2}{\rho} = 2 \cdot \frac{(\sqrt{26})^2}{0,5}$$

$$\Rightarrow \boxed{\Sigma F_{RA} = 104N = T_A}$$

Δ2) Α.Δ.Μ.Ε. (A → B)

$$K_A + \zeta_A = K_B + \zeta_B \Rightarrow \frac{1}{2} m \omega^2 + m g \cdot l = \frac{1}{2} m U_B^2$$

$$\Rightarrow (\sqrt{26})^2 + 20 \cdot 0,5 = U_B^2 \Rightarrow U_B = \sqrt{36} \Rightarrow \boxed{U_B = 6 \text{ m/s}}$$

$$\Delta 3) \cdot \sigma_{\text{cup}} = \frac{\ell - h}{\ell} \Rightarrow \frac{1}{2} = \frac{\ell - h}{\ell} \Rightarrow h = \frac{\ell}{2}$$

$$\cdot \text{A. D. M. E. (B} \rightarrow \Gamma): K_B + \cancel{U_B^0} = K_{\Gamma} + U_{\Gamma}$$

$$\Rightarrow \frac{1}{2} \cancel{m} \cdot U_B^2 = \frac{1}{2} \cancel{m} \cdot U_{\Gamma}^2 + \cancel{m} g \cdot \frac{\ell}{2}$$

$$\Rightarrow 36 = U_{\Gamma}^2 + 5 \Rightarrow U_{\Gamma} = \sqrt{31} \text{ m/s}$$

$$\cdot \cancel{2} F_{\Gamma r} = \cancel{m} \cdot \frac{U_{\Gamma}^2}{\ell} = 2 \cdot \frac{(\sqrt{31})^2}{0.15} = 124 \text{ N}$$

$$\cdot W_y = w \cdot \sigma_{\text{cup}} = 10 \text{ N}$$

$$\cdot \cancel{2} F_{\Gamma r} = T_r - W_y \Rightarrow \boxed{T_r = 134 \text{ N}}$$

$\Delta 4)$ $\cancel{2}$ οο $\sigma_{\text{μικρο}} \sigma_{\text{μεσο}} : T \geq 0$

$$\cancel{2} F_r = T + w \Rightarrow T = \cancel{m} \cdot \frac{U^2}{\ell} - mg$$

$$\text{Αρα: } T \geq 0 \Rightarrow \cancel{m} \cdot \frac{U^2}{\ell} \geq mg \Rightarrow U \geq \sqrt{gl}$$

$$\text{Ιση οριακή περίπτωση: } U = \sqrt{gl}$$

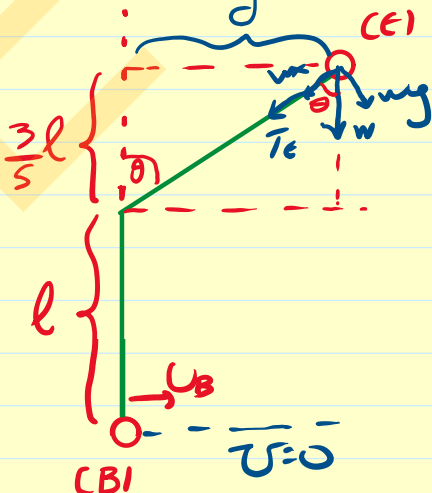
A. D. M. E. : B \rightarrow Δ

$$K_B + U_B = K_{\Delta} + U_{\Delta} \Rightarrow \frac{1}{2} \cancel{m} \cdot U_{\text{min}}^2 = \frac{1}{2} \cancel{m} \cdot (\sqrt{gl})^2 + \cancel{m} g 2\ell$$

$$\Rightarrow U_{\text{min}} = \sqrt{5gl} = 5 \text{ m/s}$$

Ομως: $U_B = 6 \text{ m/s} > U_{\text{min}} \rightarrow$ ευθεία ανακίνηση

$\Delta 5)$



A. D. M. E. (B \rightarrow E)

$$K_B + U_B = K_E + U_E$$

$$\Rightarrow \frac{1}{2} \cancel{m} \cdot U_B^2 = \frac{1}{2} \cancel{m} \cdot U_E^2 + \cancel{m} g \cdot \frac{8\ell}{5}$$

$$\Rightarrow 36 = U_E^2 + \frac{16}{5} g \ell$$

$$\Rightarrow 36 - 16 = U_E^2 \Rightarrow U_E = \sqrt{20} \text{ m/s}$$

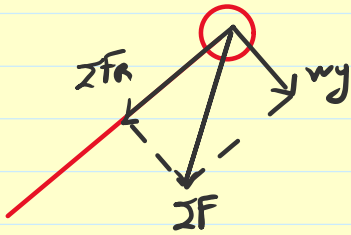
$$\cancel{2} F_r = \frac{\cancel{m} \cdot U_E^2}{\ell} = 2 \cdot \frac{(\sqrt{20})^2}{0.15} = 80 \text{ N}$$

$$\cdot d^2 = l^2 - \left(\frac{3}{5}l\right)^2 \Rightarrow d^2 = 0,5^2 - 0,3^2 = 0,25 - 0,09$$

$$\Rightarrow d = \sqrt{0,16} \Rightarrow d = 0,4 \text{ m}$$

$$\cdot \eta \mu \vartheta = \frac{d}{l} = \frac{0,4}{0,5} = 0,8$$

$$\cdot \eta \mu \vartheta = \frac{w_y}{w} \Rightarrow 0,8 = \frac{w_y}{20} \Rightarrow w_y = 16 \text{ N}$$



$$\Sigma F = \sqrt{\Sigma F_R^2 + w_y^2} = \sqrt{80^2 + 16^2} = \sqrt{6400 + 256}$$

$$\Rightarrow \Sigma F = \sqrt{6656} \text{ N}$$