15-10-2023

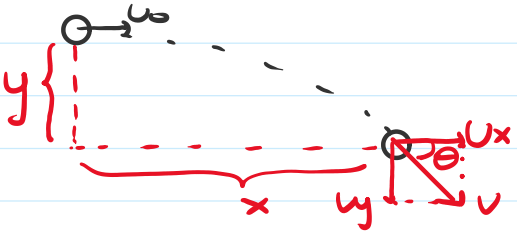
ΘΕΜΑ Α

Α1) α Α2) γ Α3) δ Α4) δ

Α5) α) Λ β) Σ γ) Σ δ) Λ ε) Λ

ΘΕΜΑ Β

Β1 i) Σωστή απάντηση: **β**



$x = 4y \Rightarrow \upsilon_0 \cdot t = 4 \cdot \frac{1}{2} \cdot g \cdot t^2$

$\Rightarrow t = \frac{\upsilon_0}{2g}$

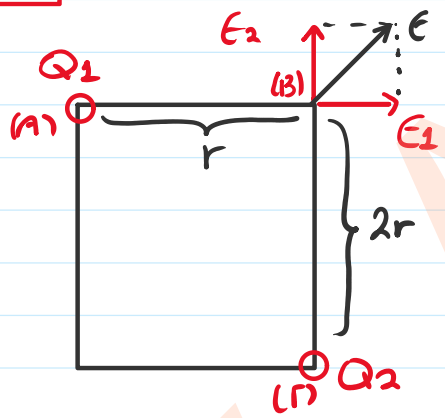
ii) Σωστή απάντηση: **γ**

$\upsilon_x = \upsilon_0$

$\upsilon_y = g \cdot t = g \cdot \frac{\upsilon_0}{2g} \Rightarrow \upsilon_y = \frac{\upsilon_0}{2}$

$\Rightarrow \varepsilon\varphi\theta = \frac{\upsilon_y}{\upsilon_x} = \frac{\frac{\upsilon_0}{2}}{\frac{\upsilon_0}{1}} \Rightarrow \boxed{\varepsilon\varphi\theta = \frac{1}{2}}$

Β2 Σωστή απάντηση: **β**



$E_1 = K_c \cdot \frac{Q_1}{r^2} = K_c \cdot \frac{Q}{r^2}$

$E_2 = K_c \cdot \frac{Q_2}{(2r)^2} = K_c \cdot \frac{4Q}{4r^2} = K_c \cdot \frac{Q}{r^2} = E_1$

$\cdot E = \sqrt{E_1^2 + E_2^2} = \sqrt{2 \cdot E_1^2} = E_1 \cdot \sqrt{2}$

$\Rightarrow \boxed{E = \sqrt{2} \cdot K_c \cdot \frac{Q}{r^2}}$

Β3 i) $\upsilon_0 = \frac{x}{t} \Rightarrow t = \frac{x}{\upsilon_0}$

$y = \frac{1}{2} g t^2 \Rightarrow y = \frac{1}{2} \cdot g \left(\frac{x}{\upsilon_0}\right)^2 \Rightarrow \boxed{y = \frac{g}{2\upsilon_0^2} \cdot x^2}$

ii) Σωστή απάντηση: **α**

$y_1 = \frac{g}{2\upsilon_0^2} \cdot x_1^2 \Rightarrow x_{max_1}^2 = \frac{4h \cdot 2\upsilon_0^2}{g} \Rightarrow x_{max_1} = 2\upsilon_0 \sqrt{\frac{2h}{g}}$

$y_2 = \frac{g}{32\upsilon_0^2} \cdot x_2^2 \Rightarrow x_{max_2}^2 = \frac{h \cdot 32 \cdot \upsilon_0^2}{g} \Rightarrow x_{max_2} = 4\upsilon_0 \sqrt{\frac{2h}{g}}$

· $d = x_{max2} - x_{max1} = 4U_0\sqrt{\frac{2h}{g}} - 2U_0\sqrt{\frac{2h}{g}}$

$\Rightarrow \boxed{d = 2U_0\sqrt{\frac{2h}{g}}}$

ΘΕΜΑ Γ

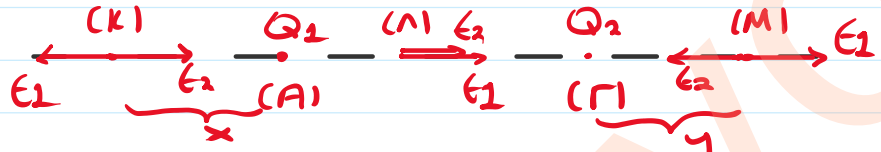
Γ1 $U_{συστ.} = K_c\frac{Q_1 \cdot Q_2}{A\Gamma} = 9\cdot10^9\frac{10^{-6}\cdot(-4\cdot10^{-6})}{2} \Rightarrow \boxed{U_{συστ} = -18\cdot10^{-3}\,J}$

Γ2 $V_{Q_1} = K_c\frac{Q_1}{AM} = 9\cdot10^9\cdot\frac{10^{-6}}{1} \Rightarrow V_{Q_1} = 9\cdot10^3\,V$

$V_{Q_2} = K_c\frac{Q_2}{\Gamma M} = 9\cdot10^9\cdot\frac{(-4\cdot10^{-6})}{1} \Rightarrow V_{Q_2} = -36\cdot10^3\,V$

$V_M = V_{Q_1} + V_{Q_2} \Rightarrow \boxed{V_M = -27\cdot10^3\,V}$

Γ3



Διερεύνηση:

→ Σημείο Λ: $\vec{E_1} \uparrow\uparrow \vec{E_2}$, άρα $E_{ολ} \neq 0$

→ Σημείο Μ: $E_1 = K_c\frac{|Q_1|}{(A\Gamma+y)^2}$, $E_2 = K_c\frac{|Q_2|}{y^2}$ $\Big\}$ $\xrightarrow{|Q_1|<|Q_2|,\ (A\Gamma+y)^2>y^2}$ $E_1 < E_2 \Rightarrow E_{ολ} \neq 0$

→ Σημείο Κ:

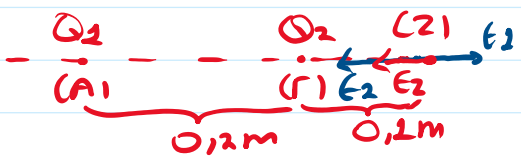
$E_1 = E_2 \Rightarrow K_c\frac{|Q_1|}{x^2} = K_c\frac{|Q_2|}{(A\Gamma+x)^2} \Rightarrow \frac{10^{-6}}{x^2} = \frac{4\cdot10^{-6}}{(A\Gamma+x)^2}$

$\Rightarrow (A\Gamma+x)^2 = 4x^2 \Rightarrow A\Gamma + x = \pm 2x$

$\xrightarrow{(+1)} A\Gamma + x = 2x \Rightarrow \boxed{x = A\Gamma = 2m}$

$\xrightarrow{(-1)} A\Gamma + x = -2x \Rightarrow -3x = A\Gamma \Rightarrow x = -\frac{A\Gamma}{3}$: Απορ.

Γ4



Σημείο Ζ:

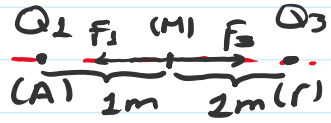
$E_1 = K_c\frac{|Q_1|}{(AZ)^2} = 9\cdot10^9\cdot\frac{10^{-6}}{9} = 10^3\,N/C$

$E_2 = K_c\frac{|Q_2|}{(\Gamma Z)^2} = 9\cdot10^9\cdot\frac{4\cdot10^{-6}}{1} = 36\cdot10^3\,N/C$

$$E_2 = K_c \cdot \frac{|Q_2|}{(\Gamma Z)^2} = 9\cdot 10^9 \cdot \frac{4\cdot 10^{-6}}{1} = 36\cdot 10^3 N/C$$

$$\boxed{E_z = E_2 - E_1 = 35\cdot 10^3 N/C}$$

Γ5



$$F_{n1} = m\cdot a = 10^{-5}\cdot 9\cdot 10^5 = 9\cdot 10^{-} N = \Sigma F$$

$$F_1 = K_c \cdot \frac{|Q_1 \cdot q|}{AM^2} = 9\cdot 10^9 \cdot \frac{10^{-6}\cdot 20\cdot 10^{-6}}{1} = 18\cdot 10^{-2} N$$

$\Sigma F < F_1$, οι $\vec{F_3}$ και $\vec{F_1}$ $\rightarrow Q_3 > 0$

$$\Sigma F = F_1 - F_3 \Rightarrow 9\cdot 10^{-2} = 18\cdot 10^{-2} - F_3 \Rightarrow F_3 = 9\cdot 10^{-2} N$$

$$\cdot\ F_3 = K_c \cdot \frac{|Q_3 \cdot q|}{\Gamma M^2} \Rightarrow 9\cdot 10^{-2} = 9\cdot 10^9 \cdot \frac{Q_3\ 20\cdot 10^{-6}}{1}$$

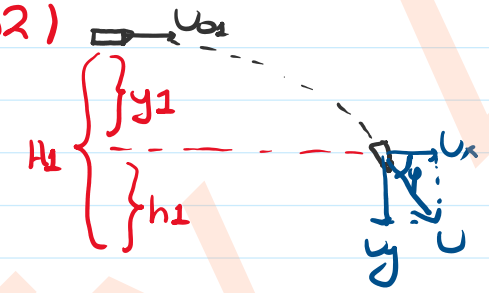
$$\Rightarrow Q_3 = \frac{9\cdot 10^{-2}}{18\cdot 10^4} \Rightarrow \boxed{Q_3 = 5\cdot 10^{-7} C}$$

ΘΕΜΑ Δ

Δ1) $t_{\varepsilon\delta} = \sqrt{\frac{2\cdot H_1}{g}} = \sqrt{\frac{2\cdot 320}{10}} = \sqrt{64} \Rightarrow t_{\varepsilon\delta} = 8s$

$$S_{max1} = U_{o1} t_{\varepsilon\delta} \Rightarrow \boxed{S_{max1} = 240m}$$

Δ2)



$$y_1 = H_1 - h_1 = 320 - 240 = 80m$$

$$t_1 = \sqrt{\frac{2\cdot y_1}{g}} = \sqrt{\frac{2\cdot 80}{10}} \Rightarrow t_1 = 4s$$

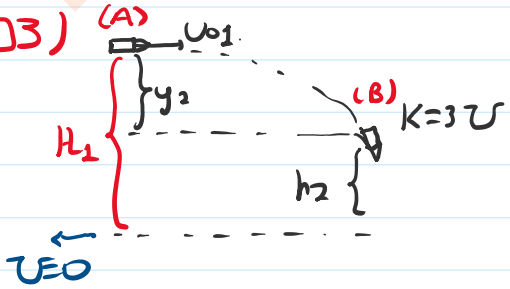
$$U_x = U_{o1} = 30 m/s$$

$$U_y = g\cdot t_1 = 40 m/s$$

$$U = \sqrt{U_x^2 + U_y^2} = \sqrt{30^2 + 40^2} \Rightarrow \boxed{U = 50 m/s}$$

$$\boxed{\varepsilon\varphi\cdot\varphi = \frac{U_y}{U_x} = \frac{4}{3}}$$

Δ3)



Α.Δ.Μ.Ε. (Α→Β)

$$K_A + U_A = K_B + U_B$$

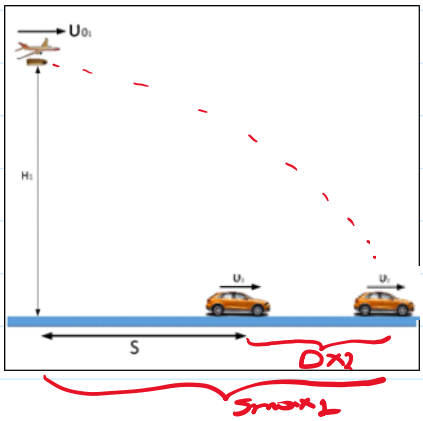
$$\Rightarrow \frac{1}{2} m\cdot U_{o1}^2 + mgH_1 = \frac{1}{4} U_B + U_B$$

$$\Rightarrow \frac{1}{2} m\cdot U_{o1}^2 + mgH_1 = \frac{5}{4} mg\cdot h_2$$

$$\Rightarrow 450 + 3200 = \frac{50}{4} \cdot h_2$$

$$\Rightarrow h_2 = \frac{4 \cdot 3650}{50} \Rightarrow \boxed{h_2 = 292\,m}$$

Δ4)

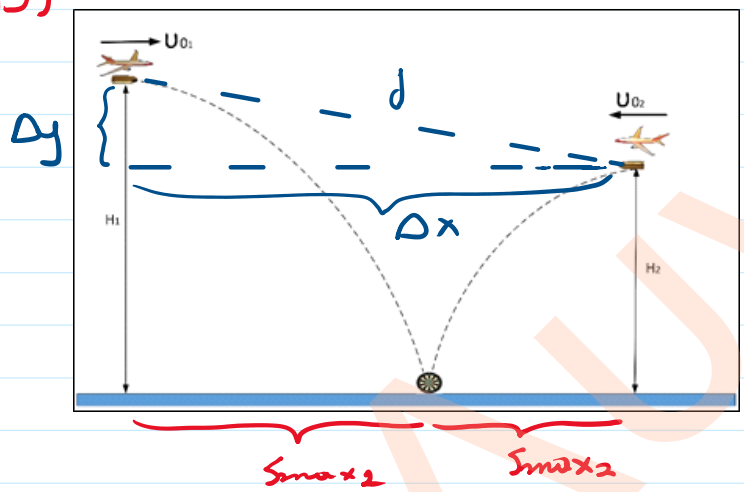


$\bullet\ S_{max_1} - S = \Delta x_2 \Rightarrow \Delta x_2 = 240 - 160$

$\Rightarrow \Delta x_2 = 80\,m$

$$U_2 = \frac{\Delta x_2}{\Delta t} = \frac{80}{8} \Rightarrow \boxed{U_2 = 10\,m/s}$$

Δ5)



$\bullet\ \Delta y = H_1 - H_2 = 320 - 180$

$\Rightarrow \Delta y = 140\,m$

$$\bullet\ t_{cs_2} = \sqrt{\frac{2 \cdot h_2}{g}} = \sqrt{\frac{2 \cdot 180}{10}}$$

$\Rightarrow t_{cs_2} = 6\,s$

$S_{max_2} = U_{02} \cdot t_{cs_2} = 30 \cdot 6 = 180\,m$

$\Delta x = S_{max_1} + S_{max_2} = 240 + 180 \Rightarrow \Delta x = 420\,m$

$$d = \sqrt{\Delta x^2 + \Delta y^2} = \sqrt{(3 \cdot 140)^2 + 140^2} = \sqrt{10 \cdot 140^2}$$

$$\Rightarrow \boxed{d = 140\sqrt{10}\ m}$$