ΛΥΣΕΙΣ Β 13/10/2024

ΘΕΜΑ Α

Α1) γ Α2) α Α3) β Α4) β

Α5) α) Λ β) Λ γ) Σ δ) Λ ε) Σ

ΘΕΜΑ Β

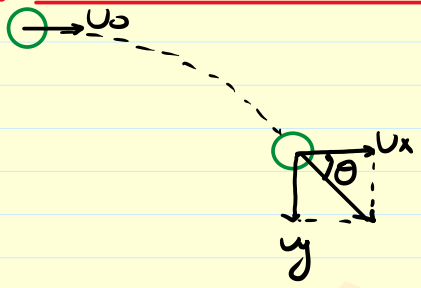
Β1) i) Σωστή απάντηση: β

- $K' = 4K \Rightarrow \frac{1}{2}m \cdot U'^2 = 4 \cdot \frac{1}{2}m \cdot U_0^2 \Rightarrow U' = \sqrt{4U_0^2} \Rightarrow U' = 2 \cdot U_0$
- $U'^2 = U_x^2 + U_y^2 \Rightarrow (2U_0)^2 = U_0^2 + U_y^2 \Rightarrow 4U_0^2 - U_0^2 = U_y^2$

$\Rightarrow U_y = U_0 \cdot \sqrt{3}$

Όμως: $U_y = g \cdot t \Rightarrow U_0 \cdot \sqrt{3} = g \cdot t \Rightarrow \boxed{t = \frac{\sqrt{3} \cdot U_0}{g}}$

ii) Σωστή απάντηση: β



$\varepsilon\varphi\theta = \frac{U_y}{U_x} = \frac{U_0 \cdot \sqrt{3}}{U_0} \Rightarrow \boxed{\varepsilon\varphi\theta = \sqrt{3}}$

Β2) i) Σωστή απάντηση: γ

$E_1 = K_c \cdot \frac{|Q_1|}{(3r)^2} = K_c \cdot \frac{9Q}{9r^2} \Rightarrow E_1 = K_c \cdot \frac{Q}{r^2}$

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

$\Rightarrow E_{ολ} = E_1 + E_2$

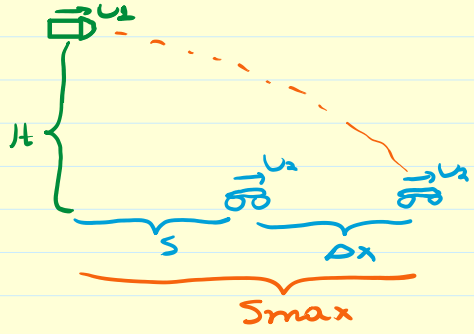
$\Rightarrow E_{ολ} = K_c \cdot \frac{Q}{r^2} + K_c \cdot \frac{Q}{r^2} \Rightarrow \boxed{E_{ολ} = 2K_c \cdot \frac{Q}{r^2}}$

ii) Σωστή απάντηση: α

Στο σημείο Β: $q<0$, άρα $\vec{F}_{ολ} \uparrow\downarrow \vec{E}_{ολ}$

$E_{ολ} = \frac{F_{ολ}}{|q|} \Rightarrow F_{ολ} = E_{ολ} \cdot |q| \Rightarrow \boxed{F_{ολ} = 2K_c \cdot \frac{Q^2}{r^2}}$

Β3) Σωστή απάντηση: γ



$S_{max} = u_1 \cdot t_{\varepsilon\varphi} = u_1 \cdot \sqrt{\frac{2H}{g}}$

$\Delta x = u_2 \cdot t_{\varepsilon\varphi} = u_2 \cdot \sqrt{\frac{2H}{g}}$

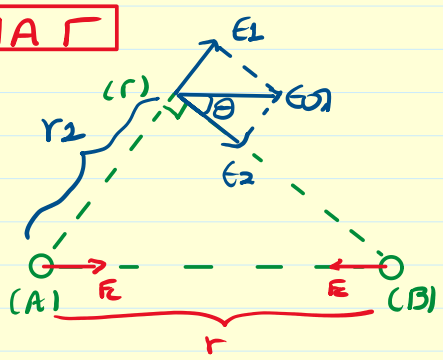
Από το σχήμα:

$\cdot S_{max} = S + \Delta x$

$\Rightarrow u_1 \cdot \sqrt{\frac{2H}{g}} = 20u_2 \cdot \sqrt{\frac{2H}{g}} + u_2 \cdot \sqrt{\frac{2H}{g}} \Rightarrow \boxed{u_1 = 21 \cdot u_2}$

ΘΕΜΑ Γ

Γ1)



$\cdot E_1 = K_c \cdot \frac{|Q_1|}{r_1^2} = 9 \cdot 10^9 \cdot \frac{9 \cdot 10^{-6}}{(3 \cdot 10^{-2})^2}$

$\Rightarrow E_1 = \frac{9 \cdot 9 \cdot 10^3}{9 \cdot 10^{-4}} \Rightarrow \boxed{E_1 = 9 \cdot 10^7 \, N/C}$

Γ2) $F_{\Pi\lambda} = K_c \cdot \frac{|Q_1 \cdot Q_2|}{r^2} = 9 \cdot 10^9 \cdot \frac{9 \cdot 10^{-6} \cdot 16 \cdot 10^{-6}}{(5 \cdot 10^{-2})^2} = \frac{9 \cdot 9 \cdot 16 \cdot 10^{-3}}{25 \cdot 10^{-4}}$

$\Rightarrow \boxed{F_{\Pi\lambda} = 518{,}4 \, N}$

Γ3) $r^2 = r_1^2 + r_2^2 \Rightarrow 5^2 = 3^2 + r_2^2 \Rightarrow r_2^2 = 25 - 9 = 16$

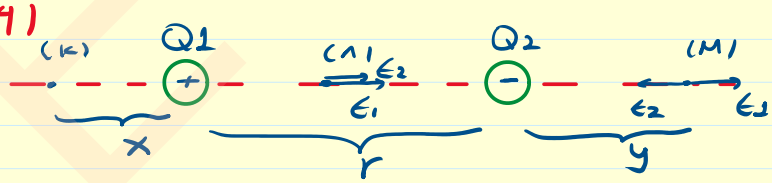
$\Rightarrow r_2 = 4 \, cm$

$E_2 = K_c \cdot \frac{|Q_2|}{r_2^2} = 9 \cdot 10^9 \cdot \frac{16 \cdot 10^{-6}}{(4 \cdot 10^{-2})^2} = \frac{9 \cdot 16 \cdot 10^3}{16 \cdot 10^{-4}} = 9 \cdot 10^7 \, N/C$

$E_{o\lambda} = \sqrt{E_1^2 + E_2^2} = \sqrt{(9 \cdot 10^7)^2 + (9 \cdot 10^7)^2} = \sqrt{2(9 \cdot 10^7)^2} \Rightarrow \boxed{E_{o\lambda} = 9\sqrt{2} \cdot 10^7 \, N/C}$

Κατεύθυνση: $\varepsilon\varphi\theta = \frac{E_2}{E_1} = 1 \rightarrow \boxed{\theta = 45^\circ}$

Γ4)



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

Σημείο Μ: $E_1 = K_c \cdot \frac{|Q_1|}{(r+y)^2}$, $E_2 = K_c \cdot \frac{|Q_2|}{y^2}$ $\Big\} \xrightarrow{|Q_1| < |Q_2|} (r+y)^2 > y^2$

$E_1 < E_2 \rightarrow E_{o\lambda} \neq 0$

Σημείο Κ.

$E_{o2}=0 \Rightarrow E_1=E_2 \Rightarrow K\frac{|Q_1|}{x^2}=K\frac{|Q_2|}{(r+x)^2}$

$\Rightarrow \frac{9\cdot10^{-6}}{x^2}=\frac{16\cdot10^{-6}}{(r+x)^2} \Rightarrow 9(r+x)^2=16x^2$

$\Rightarrow 3(r+x)=\pm 4x$

$\xrightarrow{(+)} 3r+3x=4x \Rightarrow x=3r \Rightarrow \boxed{x=15\cdot10^{-2}\,m}$

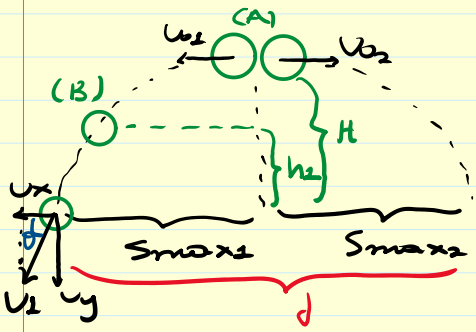
$\xrightarrow{(-)} 3r+3x=-4x \Rightarrow -7x=3r \Rightarrow x=-\frac{3r}{7}<0$: Απορ.

ΘΕΜΑ Δ

Δ1) $t_{\varepsilon\sigma1}=t_{\varepsilon\sigma2}=\sqrt{\frac{2H}{g}}=\sqrt{\frac{2\cdot20}{10}}=\sqrt{4} \Rightarrow \boxed{t_{\varepsilon\sigma1}=t_{\varepsilon\sigma2}=2s}$

Δ2) $S_{max1}=U_{o1}\cdot t_{\varepsilon\sigma1}=10\cdot2 \Rightarrow S_{max1}=20m$

$S_{max2}=U_{o2}\cdot t_{\varepsilon\sigma2}=12\cdot2 \Rightarrow S_{max2}=24m$



$d=S_{max1}+S_{max2}=20+24$

$\Rightarrow \boxed{d=44m}$

Δ3) $\left.\begin{matrix}U_x=U_{o1}=10m/s\\ U_y=g\cdot t_{\varepsilon\sigma1}=20m/s\end{matrix}\right\} \Rightarrow U=\sqrt{U_x^2+U_y^2}=\sqrt{20^2+10^2}$

$\Rightarrow U=\sqrt{500}\,m/s \Rightarrow \boxed{U=10\sqrt{5}\,m/s}$

Κατεύθυνση: $\varepsilon\varphi\theta=\frac{U_y}{U_x}=\frac{20}{10} \Rightarrow \boxed{\varepsilon\varphi\theta=2}$

Δ4) Α.Δ.Μ.Ε. (Α→Β)

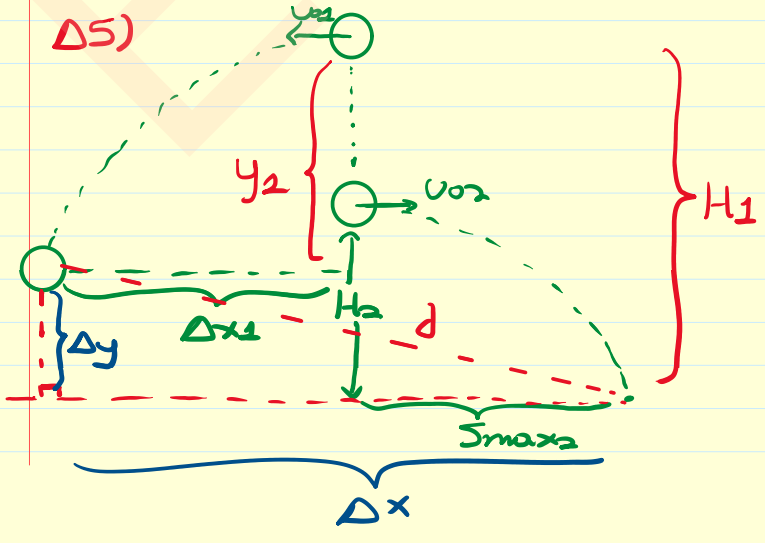
$K_A+U_A=K_B+U_B \xrightarrow{K_B=4U_B} \frac{1}{2}m_1U_{o1}^2+m_1gH=4U_B+U_B$

$\Rightarrow \frac{1}{2}m_1\cdot U_{o1}^2+m_1gH=5m_1\cdot g\cdot h_1 \Rightarrow \frac{10^2}{2}+10\cdot20=50\cdot h_1$

$\Rightarrow 250=50h_1 \Rightarrow h_1=5m$

Άρα: $y_1=H-h_1=20-5 \Rightarrow \boxed{y_1=15m}$

Δ5)



Σ2: $t_{\varepsilon\sigma2}=\sqrt{\frac{2H_2}{g}}=2s$

$S_{max2}=U_{o2}\cdot t_{\varepsilon\sigma2}=24m$

Σ1: $\Delta x_1=U_{o1}\cdot t_{\varepsilon\sigma2}=8\cdot2=16m$

$y_1=\frac{1}{2}\cdot g\cdot t_{\varepsilon\sigma2}^2=\frac{1}{2}10\cdot2^2=20m$

$\Delta x = \Delta x_1 + S_{max_2} = 40m$
$\Delta y = H_1 - y_1 = 50 - 20 = 30m$
$\Rightarrow d = \sqrt{\Delta x^2 + \Delta y^2} = \sqrt{40^2 + 30^2}$

$\Rightarrow \boxed{d = 50m}$

Δ6) $S_{max_1} = S_{max_2} \Rightarrow v_{o_1} \cdot t_{es_1}' = v_{o_2} \cdot t_{es_2} \Rightarrow t_{es_1}' = \frac{24}{8} = 3s$

$H_1' = \frac{1}{2} g\, t_{es_2}^2 = \frac{1}{2} \cdot 10 \cdot 3^2 \Rightarrow \boxed{H_1' = 45m}$