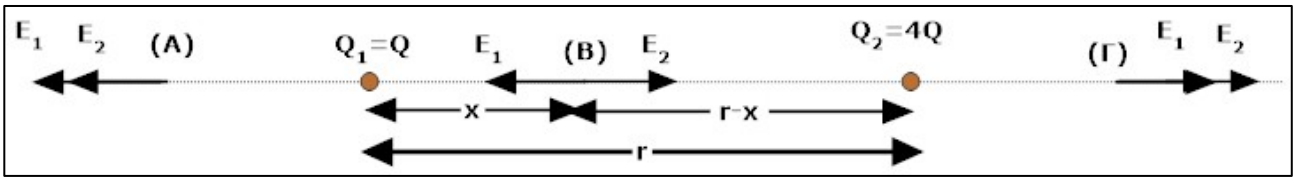
Θέμα Α

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

Θέμα Β

Β1. Σωστή απάντηση είναι η (β).



Στις θέσεις Α και Γ απορρίπτεται,αφού $\vec{E}_1 \nearrow\nearrow \vec{E}_2$
Στη θέση Β, αναμεσα στα δύο φορτία, έχουμε:

$$\Sigma E = 0 \Rightarrow E_1 = E_2 \Rightarrow \cancel{K_c}\frac{|Q_1|}{x^2} = \cancel{K_c}\frac{|Q_2|}{(d-x)^2} \Rightarrow \frac{Q}{x^2} = \frac{4Q}{(d-x)^2} \Rightarrow \frac{(d-x)^2}{x^2} = 4 \Rightarrow$$

$$\frac{(r-x)^2}{x^2} = 4 \Rightarrow \frac{(r-x)}{x} = 2 \Rightarrow r - x = 2x \Rightarrow 3x = r \Rightarrow \boxed{x = r/3}$$

ή $\frac{(r-x)^2}{x^2} = 4 \Rightarrow \frac{(r-x)}{x} = -2 \Rightarrow r - x = -2x \Rightarrow -x = r \Rightarrow x = -r$ Απορρίπτεται

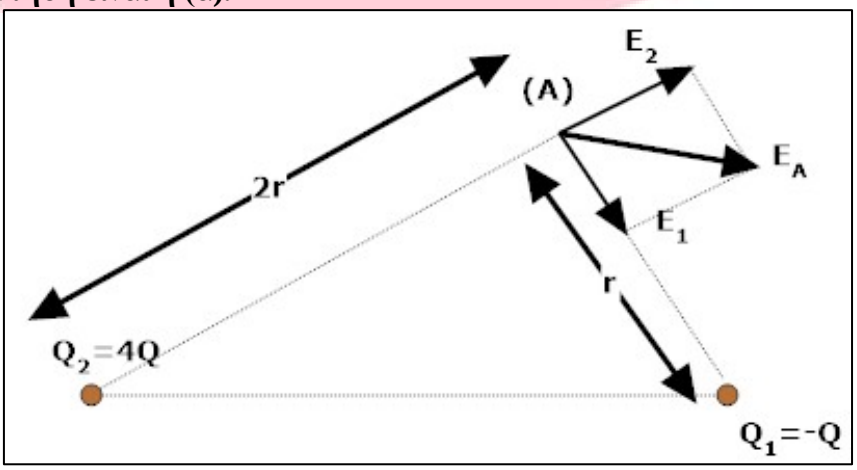
Β2. Σωστή απάντηση είναι η (γ).

Η μόνη δύναμη που δρα ως κεντρομόλος, είναι η τάση του νήματος:

$$T_{\theta\rho} = \Sigma F_R = m\frac{\upsilon^2}{\ell} \Rightarrow 2\cancel{m}g = \cancel{m}\frac{\upsilon^2}{\ell} \Rightarrow \upsilon = \sqrt{2g\ell}$$

$$\upsilon = 2\pi\ell f \Rightarrow \sqrt{2g\ell} = 2\pi\ell f \Rightarrow f = \frac{\sqrt{2g\ell}}{2\pi\ell} \Rightarrow \boxed{f = \frac{1}{2\pi}\sqrt{\frac{2g}{\ell}}}$$

Β3. Σωστή απάντηση είναι η (α).



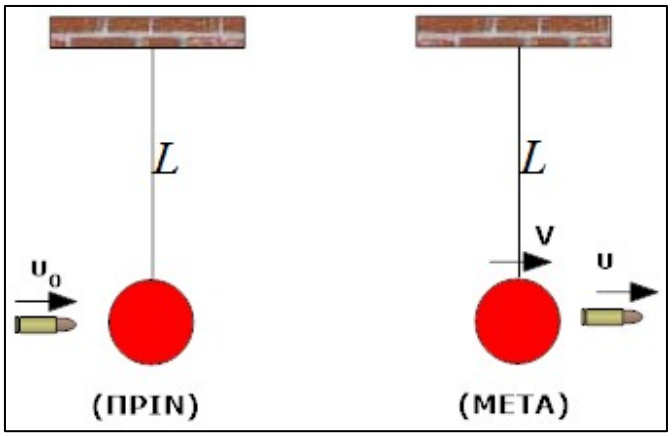
$$E_1 = k\frac{|Q_1|}{r^2} = k\frac{|Q|}{r^2} \quad και \quad E_2 = k\frac{|Q_2|}{(2r)^2} \Rightarrow E_2 = k\frac{|4Q|}{4r^2} \Rightarrow E_2 = k\frac{|Q|}{r^2}$$

Τα διανύσματα είναι κάθετα μεταξύ τους, άρα:

$$E = \sqrt{E_1^2 + E_2^2} \Rightarrow E = \sqrt{(k\frac{Q}{r^2})^2 + (k\frac{Q}{r^2})^2} \Rightarrow \boxed{E = \sqrt{2}k\frac{Q}{r^2}}$$

Θέμα Γ

Γ1. $\text{ΑΔΟ}: \vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2' \overset{(+)}{\Longrightarrow} m\upsilon_o = MV + m\upsilon \Rightarrow 40 = 2V + 20 \Rightarrow \boxed{V = 10\, m/s}$



Γ2. $K_{ολ(πριν)} = \frac{1}{2}m\upsilon_0^2 = \frac{1}{2}0,4 \cdot 100^2 \Rightarrow K_{ολ(πριν)} = 2000J$

$K_{ολ(μετά)} = \frac{1}{2}m\upsilon^2 + \frac{1}{2}MV^2 = \frac{1}{2}0,4 \cdot 50^2 + \frac{1}{2}2 \cdot 10^2 \Rightarrow K_{ολ(μετά)} = 600J$

$\Delta K = K_{ολ(μετά)} - K_{ολ(πριν)} \Rightarrow \boxed{\Delta K = -1400J}$

Γ3. $\Delta\vec{p} = \vec{p}_m' - \vec{p}_m \overset{(+)}{\Rightarrow} \Delta p = m\upsilon - m\upsilon_0 \Rightarrow \Delta p = -20\, kg\, m/s$

$\Sigma\vec{F} = \frac{\Delta\vec{p}}{\Delta t} \overset{(+)}{\Rightarrow} \Sigma F = \frac{-20}{0,1} \Rightarrow \boxed{\Sigma F = -200N}$

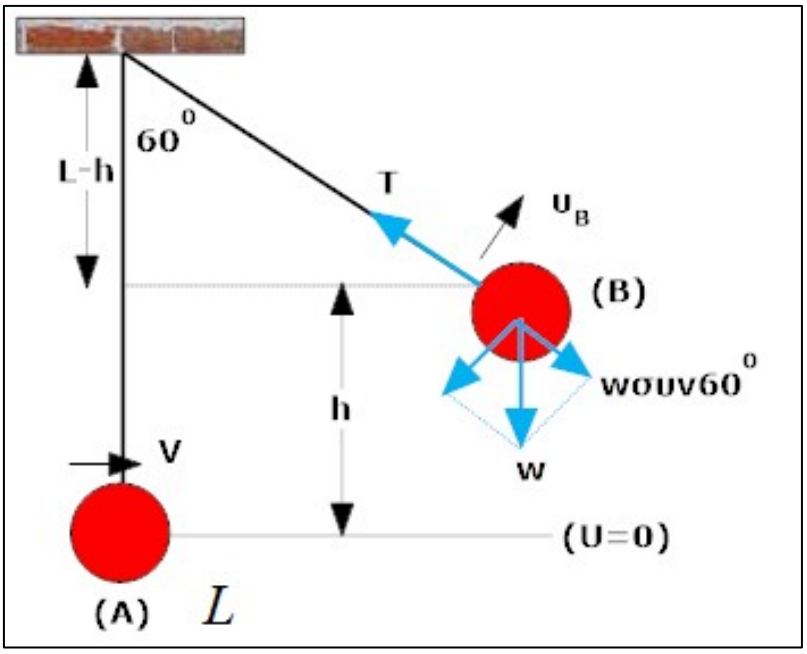
Γ4. $συν60^0 = \frac{\ell - h}{\ell} \Rightarrow h = \frac{\ell}{2}$

ΑΔΜΕ(Α-Β):

$K_A + U_A = K_B + U_B \Rightarrow \frac{1}{2}MV^2 + 0 = \frac{1}{2}MV'^2 + Mg\frac{L}{2} \Rightarrow 100 = V'^2 + 50 \Rightarrow V' = \sqrt{50}m/s$

Η κεντρομόλος δύναμη στο σημείο αυτό, είναι:

$\Sigma F_R = M\frac{V'^2}{L} \Rightarrow T - Mg συν60^0 = M\frac{V'^2}{L} \Rightarrow \boxed{T = 30N}$



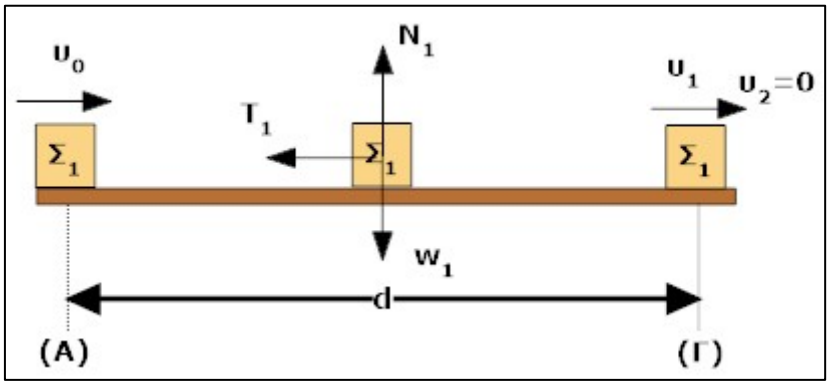
Θέμα Δ

Δ1. $\Sigma F_y = 0 \Rightarrow N_1 = w_1 \Rightarrow N_1 = 20N$

$T_1 = \mu \cdot N_1 \Rightarrow T_1 = 10N$

ΘΜΚΕ(Α εώς Γ)

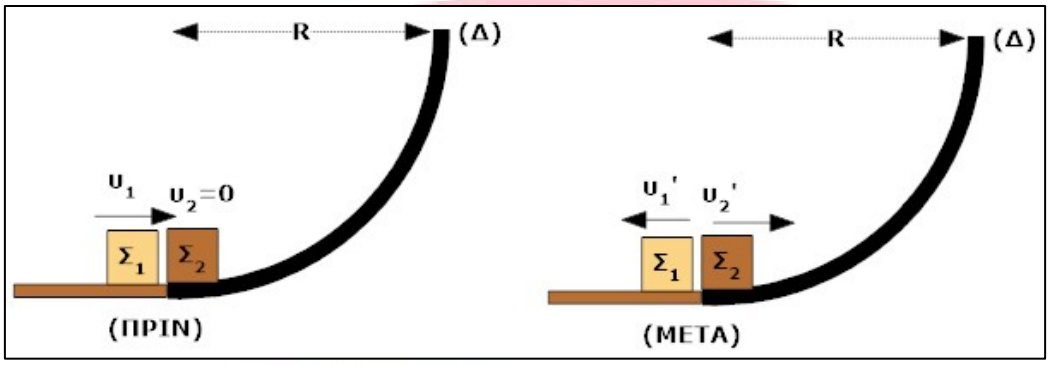
$$K_\Gamma - K_A = \cancel{W_{w_1}} + \cancel{W_{N_1}} + W_{T_1} \Rightarrow \frac{1}{2}m_1\upsilon_1^2 - \frac{1}{2}m_1\upsilon_0^2 = -T_1 \cdot d \Rightarrow \frac{1}{2}2\cdot 5^2 - \frac{1}{2}2\cdot 7^2 = -10\cdot d \Rightarrow \boxed{d = 2,4m}$$



Δ2. $\text{ΑΔΟ}: \vec{p}_1 + \vec{p}_2 = \vec{p}_1' + \vec{p}_2' \overset{(+)\rightarrow}{\Longrightarrow} m_1\upsilon_1 = m_1\upsilon_1' + m_2\upsilon_2' \Rightarrow 10 = 2\upsilon_1' + 16 \Rightarrow \boxed{\upsilon_1' = -3\,m/s}$

$\Delta\vec{p}_1 = \vec{p}_1' - \vec{p}_1 \overset{(+)\rightarrow}{\Rightarrow} \Delta p = -m\upsilon_1' - m\upsilon_1 \Rightarrow \Delta p = -16\,kgm/s$

$|\Delta p| = 16\,kgm/s$, με φορά προς τα αριστερά

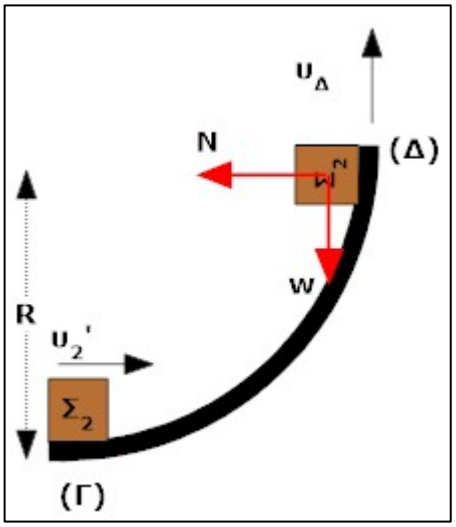


Δ3. ΑΔΜΕ(Γ-Δ):

$$K_\Gamma + U_\Gamma = K_\Delta + U_\Delta \Rightarrow \frac{1}{2}\cancel{m_2}\upsilon_2'^2 + 0 = \frac{1}{2}\cancel{m_2}\upsilon_\Delta^2 + \cancel{m_2}gR \Rightarrow 8 = \frac{\upsilon_\Delta^2}{2} + 5 \Rightarrow \boxed{\upsilon_\Delta = \sqrt{6}m/s}$$

Η κεντρομόλος δύναμη στο σημείο αυτό, είναι:

$$\Sigma F_R = m_2\frac{\upsilon_\Delta^2}{R} \Rightarrow N = 4\frac{6}{0,5} \Rightarrow \boxed{N = 48N}$$



Δ4. $\Sigma\vec{F} = \frac{\Delta\vec{p}}{\Delta t} \overset{(+)\uparrow}{\Rightarrow} \Sigma F = -w_2 \Rightarrow \boxed{\Sigma F = -40N}$