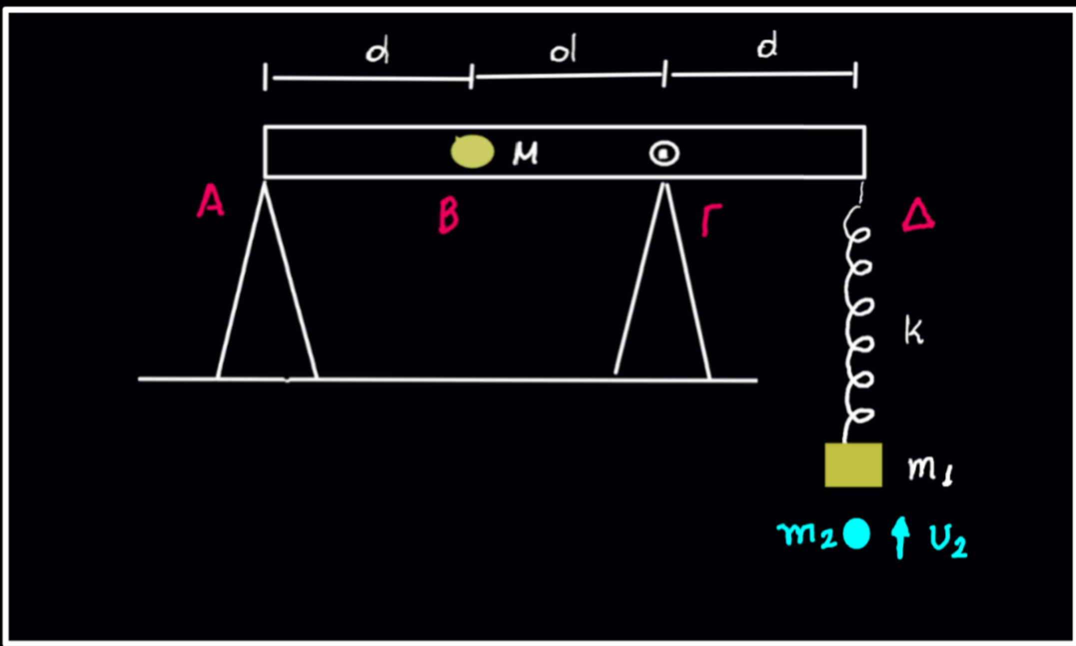
Φυσική Γ Λυκείου
Διαγώνισμα Προσομοίωσης

Ποθητάκης Γιώργος
Φυσικός



ΘΕΜΑ Α

A1) Γ A2) Γ A3) Δ A4) Δ

A5) Σ / Λ / Σ / Λ / Σ

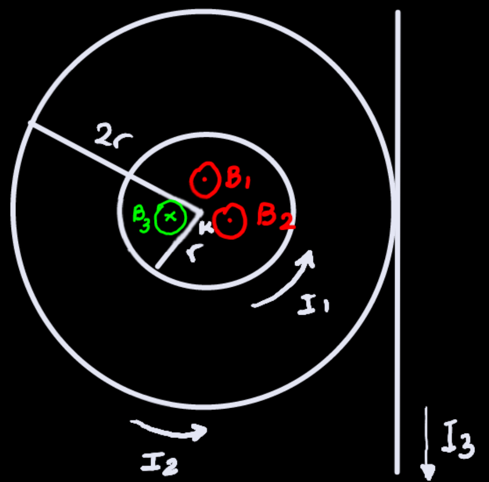
ΘΕΜΑ Β

B1) Σωστό το (β).

$B_{ολ}(K)=0 \Rightarrow \vec{B_1}+\vec{B_2}+\vec{B_3}=0 \Rightarrow B_1+B_2-B_3=0 \Rightarrow$

$\Rightarrow B_1+B_2=B_3 \Rightarrow k_\mu \cdot \frac{2\pi I_1}{r} + k_\mu \frac{2\pi I_2}{2r} = k_\mu \cdot \frac{2I_3}{2r} \Rightarrow$

$\Rightarrow 2\pi I_1 + \pi I_2 = I_3 \Rightarrow \boxed{2I_1+I_2=\frac{I_3}{\pi}}$



B2) Σωστό το (α). $\frac{K_1-K_1'}{K_1}\cdot 100\% = 75\% \Rightarrow$

$\frac{K_1-K_1'}{K_1}=\frac{3}{4} \Rightarrow K_1'=\frac{K_1}{4} \Rightarrow v_1'=\pm\frac{v_1}{2} \xrightarrow{m<M} v_1'=-\frac{v_1}{2} \Rightarrow \frac{m-M}{m+M}v_1=-\frac{v_1}{2}\Rightarrow \frac{M}{m}=3 \Rightarrow \boxed{\lambda=3}$

B3) Σωστό το (γ).

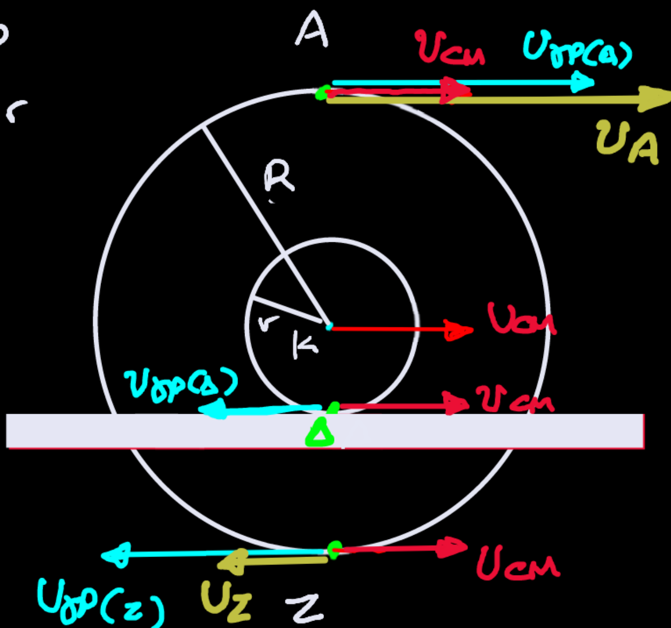
Λόγω Κ.Χ.Ο: Σημείο Δ ακίνητο

$\Rightarrow v_\Delta=0 \Rightarrow v_{cm}-v_{γρ}(\Delta)=0 \Rightarrow v_{cm}=\omega r$

• Σημείο Α: $v_A = v_{cm}+v_{γρ}(A) = \omega\cdot R+\omega r=\omega(R+r) = \omega(2{,}5r+r)=3{,}5\cdot\omega\cdot r$

• Σημείο Z: $v_Z = v_{cm}-v_{γρ}(Z)=\omega r-\omega R = \omega(r-R)=\omega(r-2{,}5r) = -1{,}5\omega r$

• $|v_A-v_Z| = |3{,}5\omega\cdot r-(-1{,}5\omega r)| = |5\cdot\omega r| = 5\cdot v_{cm}$



B4)

• $E_{επ}=N\cdot\frac{\Delta\Phi}{\Delta t}=\frac{\Delta\Phi}{\Delta t}=\frac{B\cdot\Delta S}{\Delta t}=\frac{B\cdot\Delta x\cdot\ell}{\Delta t}=B\cdot v\cdot\ell$

• $I_{επ}=\frac{E_{επ}}{R_{ολ}}=\frac{Bv\ell}{3R+R}=\frac{Bv\ell}{4R}$

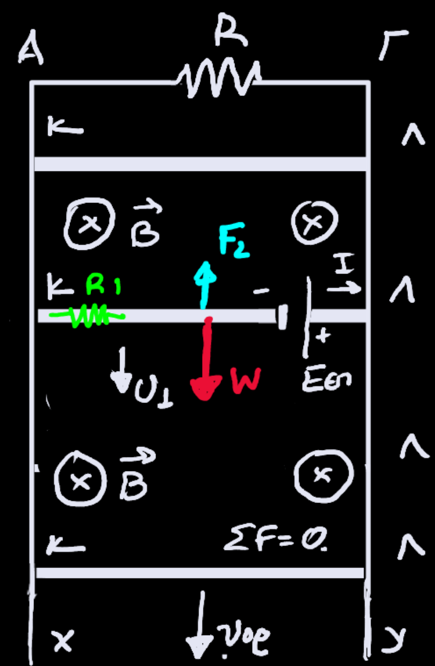
• $F_L=B\cdot I\cdot\ell=\frac{B^2v\ell^2}{4R}$

• Θα είναι $v=v_{ορ}$ όταν $\Sigma F=0 \Rightarrow W=F_L \Rightarrow$

$\Rightarrow mg=\frac{B^2 v_{ορ}\ell^2}{4R} \Rightarrow \boxed{v_{ορ}=\frac{4mgR}{B^2\ell^2}}$

• Όταν $v_1=\frac{v_{ορ}}{5} \Rightarrow v_1=\frac{4mgR}{5B^2\ell^2}$ τότε

$t_0=0$
$v_0=0$



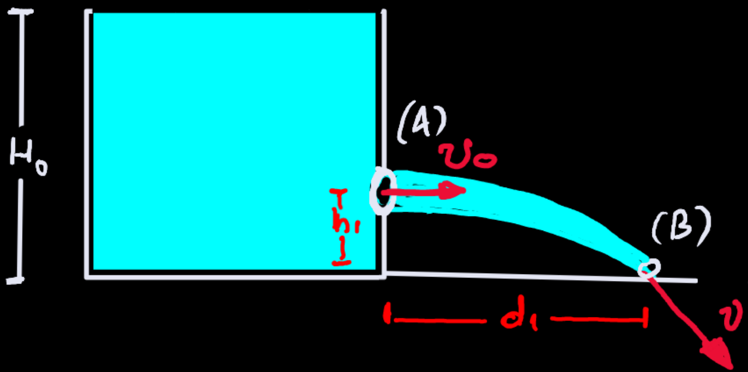
$I_{επ} = \frac{BU_1\ell}{4R} = \frac{B\ell}{4R}\cdot\frac{4mg}{5B^2\ell^2} = \frac{mg}{5B\ell}$

και $\frac{\Delta Q}{\Delta t}\Big|_{R_1} = P_{R_1} = I_{επ}^2\cdot R_1 = \left(\frac{mg}{5B\ell}\right)^2\cdot 3R = \frac{m^2g^2\,3R}{25B^2\ell^2} = \frac{3m^2g^2}{25B^2\ell^2}$

Σωστό το γ.

ΘΕΜΑ Γ

Γ1) $d_1 = ;$



• Torricelli: $υ_0 = \sqrt{2g(H_0-h_1)} \Rightarrow$

$\Rightarrow υ_0 = \sqrt{2\cdot10(4-0,8)} \Rightarrow \boxed{υ_0 = 8\,m/s}$

• ΒΕΛΗΝΕΚΕΣ: $d_1 = υ_0\cdot t_{πτ} \Rightarrow d_1 = υ_0\cdot\sqrt{\frac{2h_1}{g}} \Rightarrow d_1 = 8\sqrt{\frac{2\cdot0,8}{10}} \Rightarrow \boxed{d_1 = 3,2m}$

Γ2)

$Π = A_0\cdot υ_0 \Rightarrow Π = 5\sqrt5\cdot10^{-4}\cdot8 \Rightarrow Π = 4\sqrt5\cdot10^{-3}\,m^3/s.$

$Π = \frac{ΔV}{Δt} \xrightarrow[(ρ=\frac{Δm}{ΔV})]{} Π = \frac{Δm/ρ}{Δt} \Rightarrow Δm = Π\cdotρ\cdotΔt \Rightarrow Δm = Π\cdotρ\cdot\sqrt{\frac{2h_1}{g}} \Rightarrow$

$\Rightarrow Δm = 4\sqrt5\cdot10^{-3}\cdot10^3\cdot0,4 \Rightarrow \boxed{Δm = 1,6\cdot\sqrt5\ kg.}$

Γ3)

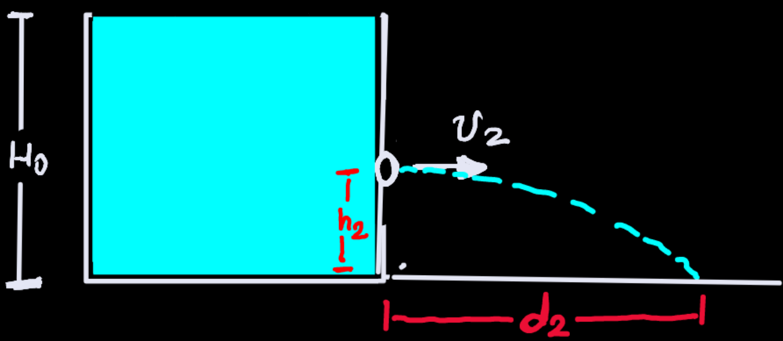
Bernoulli (A→B): $P_A + \frac12ρυ_0^2 + ρgh_1 = P_B + \frac12ρυ^2$, $(P_A = P_B = P_{atm})$

$\Rightarrow υ = \sqrt{υ_0^2+2gh_1} \Rightarrow υ = 4\sqrt5\,m/s$

Εξίσωση συνέχειας: $Π_A = Π_B \Rightarrow A_0\cdotυ_0 = A\cdotυ \Rightarrow$

$\Rightarrow 5\cdot\sqrt5\cdot10^{-4}\cdot8 = A\cdot4\sqrt5 \Rightarrow \boxed{A = 10^{-3}\,m^2}$

Γ4) $h_2 = ;$



• $d_2 = \frac54 d_1 \Rightarrow d_2 = \frac54\cdot3,2 = 4m.$

• $d_2 = υ_2\cdotΔt \Rightarrow 4 = \sqrt{2g(H_0-h_2)}\sqrt{\frac{2h_2}{g}} \Rightarrow$

$\Rightarrow 16 = 4h_2(H_0-h_2) \Rightarrow 4 = h_2(4-h_2) \Rightarrow$

$\Rightarrow h_2^2 - 4h_2 + 4 = 0 \Rightarrow (h_2-2)^2 = 0 \Rightarrow \boxed{h_2 = 2m}$

• Υπολογισμός d_{max}. (Έστω d το βεληνεκές της βολής).

$$d = v\cdot\Delta t \Rightarrow d = \sqrt{2g(H_0-h_2)}\sqrt{\frac{2h_2}{g}} \Rightarrow \dots \Rightarrow 4h_2^2 - 4H_0h_2 + d^2 = 0$$

$\Delta = (-4H_0)^2 - 16d^2 = 16H_0^2 - 16d^2$, $\Delta \geq 0 \Rightarrow H_0^2 \geq d^2 \Rightarrow d^2 \leq H_0^2$

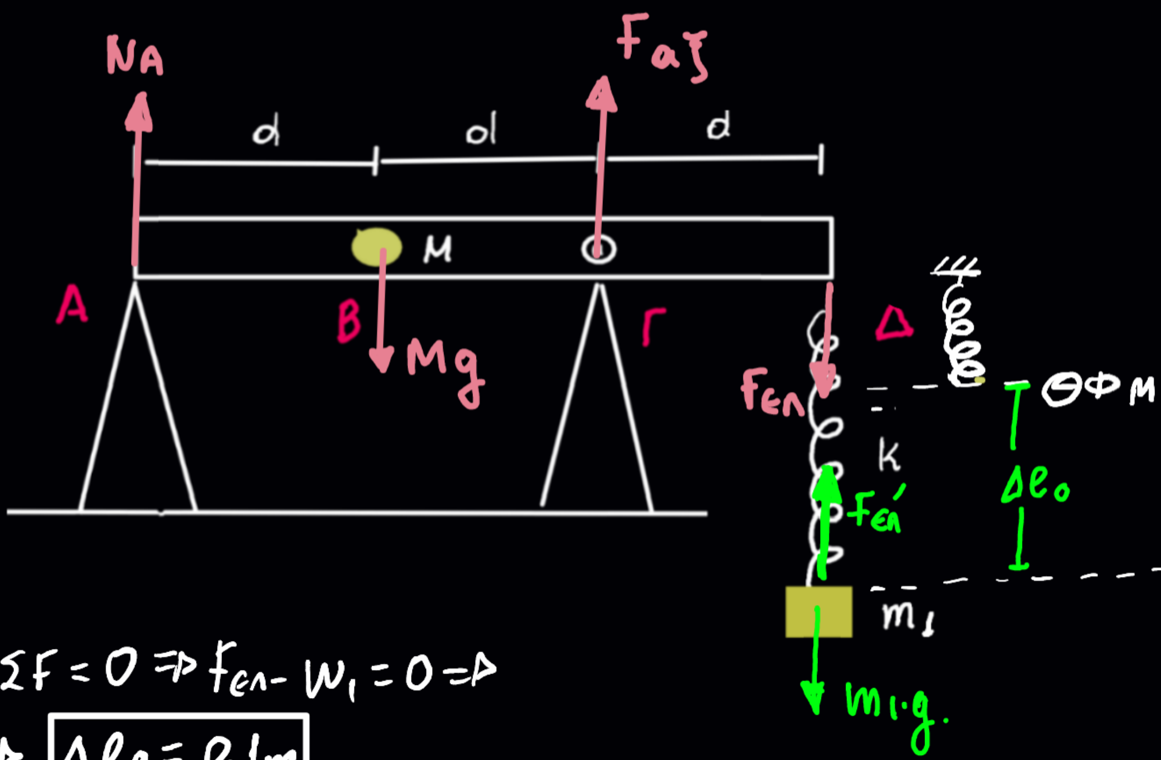
$\Rightarrow d \leq H_0 \Rightarrow d_{max} = H_0$ όταν $\Delta = 0$ κ' τότε $h_2 = -\frac{\beta}{2\alpha} = \frac{H_0}{2}$

δηλαδή $d_{max} = H_0 = 4m = d_2$ και η οπή πρέπει να ανοιχτεί στο μέσο του πλευρικού τοιχώματος.

ΘΕΜΑ Δ

Δ1 $F_{αξ} = ;$ $U_{ελατ} = ?$

$M = 13\,kg$
$m_1 = 1\,kg$
$g = 10\,m/s^2$
$d = 1\,m$
$k = 100\,N/m$



ΙΣΟΡΡΟΠΙΑ

• Σώμα m_1: ΘΙ: $\Sigma F = 0 \Rightarrow F_{ελ} - W_1 = 0 \Rightarrow$
$\Rightarrow k \cdot \Delta\ell_0 = m_1 g \Rightarrow \boxed{\Delta\ell_0 = 0{,}1\,m}$

• $U_{ελατ} = \frac{1}{2} k \cdot \Delta\ell_0^2 \Rightarrow U_{ελατ} = \frac{1}{2} \cdot 100 \cdot 0{,}1^2 \Rightarrow \boxed{U_{ελατ} = 0{,}5\,J}$

• $F_{ελ} = k \cdot \Delta\ell_0 = 100 \cdot 0{,}1 = 10\,N$, $F_{ελ} = F_{ελ}' \Rightarrow \boxed{F_{ελ}' = 10\,N}$

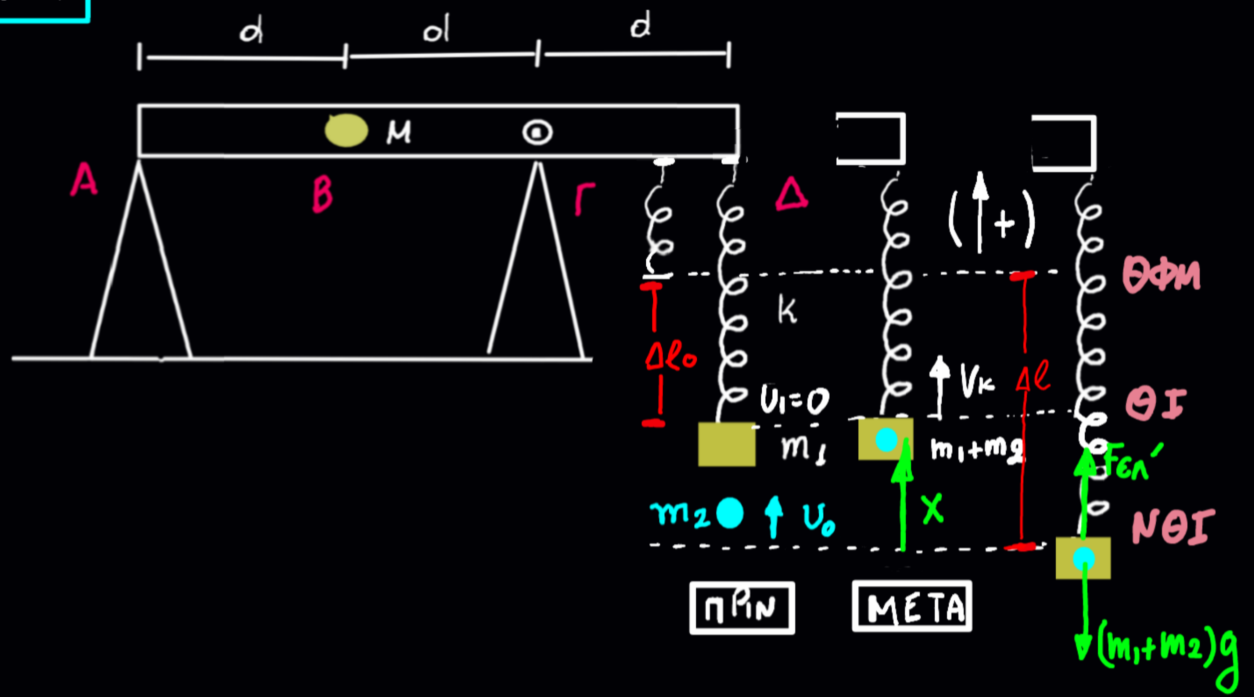
• Ράβδος_μαζα M: $\Sigma F = 0$ και $\Sigma\tau = 0$

• $\Sigma F = 0 \Rightarrow F_{αξ} + N_A - Mg - F_{ελ}' = 0 \Rightarrow F_{αξ} + N_A = Mg + F_{ελ}'$
$\Rightarrow F_{αξ} + N_A = 130 + 10 \Rightarrow \boxed{F_{αξ} + N_A = 140}$ (1)

• $\Sigma\tau_{(Γ)} = 0 \Rightarrow \tau_{NA(Γ)} + \tau_{Mg(Γ)} + \tau_{Fελ'(Γ)} + \cancel{\tau_{Fαξ(Γ)}}^{0} = 0 \Rightarrow$
$\Rightarrow -N_A \cdot 2\cancel{d} + Mg \cdot \cancel{d} - F_{ελ}' \cdot d = 0 \Rightarrow 130 - 10 = 2N_A \Rightarrow$
$\Rightarrow 2N_A = 120 \Rightarrow \boxed{N_A = 60\,N}$ (2)

$(1) \overset{(2)}{\Rightarrow} F_{αξ} = 140 - 60 \Rightarrow \boxed{F_{αξ} = 80\,N}$

Δ2



$m_2 = 3Kg$
$\upsilon_2 = 2\sqrt{3}\ m/s$
πλαστική κρούση

$x = x(t) = ;$

• <u>Α.Δ.Ο</u>: $\vec{P}_{\alpha\rho\chi\ o\lambda} = \vec{P}_{\tau\varepsilon\lambda\ o\lambda} \Rightarrow m_2 \upsilon_0 = (m_1 + m_2) V_\kappa \Rightarrow 3 \cdot 2\sqrt{3} = 4 V_\kappa \Rightarrow \boxed{V_\kappa = \frac{3\sqrt{3}}{2}\frac{m}{s}}$

• <u>ΘΙ</u>: $\Sigma F = 0 \Rightarrow F_{\varepsilon\lambda} = m_1 g \Rightarrow k \cdot \Delta\ell_0 = m_1 g \Rightarrow \boxed{\Delta\ell_0 = 0{,}1m}$

• <u>ΝΘΙ</u>: $\Sigma F = 0 \Rightarrow F_{\varepsilon\lambda}' = (m_1 + m_2) g \Rightarrow k \cdot \Delta\ell = (m_1 + m_2) g \Rightarrow \boxed{\Delta\ell = 0{,}4m}$

*Για την ΑΑΤ της $(m_1 + m_2)$ μετά την κρούση :

• <u>Από σχήμα</u>: $x = \Delta\ell - \Delta\ell_0 \Rightarrow \boxed{x = 0{,}3m}$

• <u>ΑΔΕΤ</u> $(t_0 = 0)$: $E = K + U \Rightarrow \frac{1}{2} k A^2 = \frac{1}{2} (m_1 + m_2) V_\kappa^2 + \frac{1}{2} k \cdot x^2 \Rightarrow$

$\Rightarrow 100 A^2 = 4 \left(\frac{3\sqrt{3}}{2}\right)^2 + 100 \cdot 0{,}3^2 \Rightarrow 100 A^2 = 36 \Rightarrow \boxed{A = 0{,}6m}$

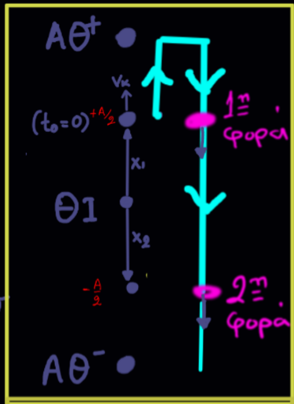
• $\omega = \sqrt{\frac{k}{m_1 + m_2}} \Rightarrow \boxed{\omega = 5\ rad/sec}$

• <u>Για το φ_0</u>: την $t_0 = 0$, $x = +0{,}3m$ και $\upsilon > 0$, $x = A \cdot \eta\mu(\omega t + \varphi_0) \Rightarrow 0{,}3 = 0{,}6\, \eta\mu\varphi_0$

$\Rightarrow \eta\mu\varphi_0 = 1/2 \Rightarrow \eta\mu\varphi_0 = \eta\mu\frac{\pi}{6} \Rightarrow \varphi_0 = 2\kappa\pi + \frac{\pi}{6}$ ή $\varphi_0 = 2\kappa\pi + \frac{5\pi}{6} \xRightarrow[\upsilon > 0]{\kappa = 0} \boxed{\varphi_0 = \frac{\pi}{6} rad}$

Επομένως : $x = A \cdot \eta\mu(\omega t + \varphi_0) \Rightarrow \boxed{x = 0{,}6 \cdot \eta\mu\left(5t + \frac{\pi}{6}\right) \quad (S.I).}$

Δ3 $N_A = ;$ όταν $\frac{K}{U} = 3$ για 2η φορά μετά την $t_0 = 0$.



Σχήμα 1

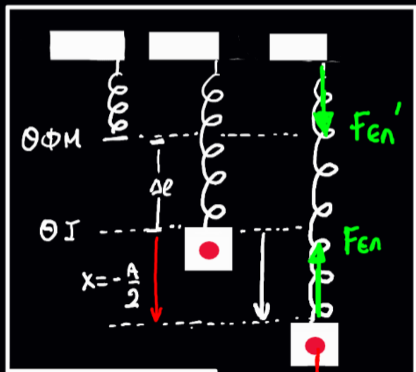
• Για 2η φορά μετά την $t_0 = 0$ είναι $x = -\frac{A}{2}$

Άρα $x = -0{,}3m$.

• $F_{ελ} = K(\Delta\ell + |x|) = K(\Delta\ell + |-\frac{A}{2}|) =$
$= 100(0{,}4 + 0{,}3) = 70N$.

$$\left\{\begin{array}{l} \text{αλλιώς: } \Sigma\vec{F} = -D\vec{x} \Rightarrow F_{ελ} - W = -D \cdot x \Rightarrow \\ F_{ελ} - (m_1+m_2)g = -k\cdot(-\frac{A}{2}) \Rightarrow \\ \Rightarrow F_{ελ} - 40 = -100(-0{,}3) \Rightarrow F_{ελ} = 70N \end{array}\right\}$$

• $F_{ελ} = F_{ελ}' \Rightarrow F_{ελ}' = 70N$



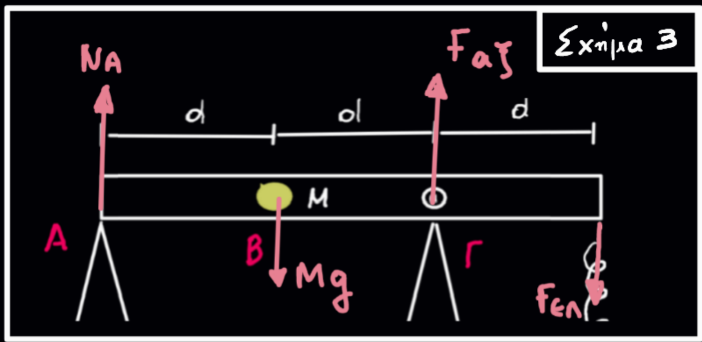
Σχήμα 2

• ΙΣΟΡΡΟΠΙΑ ΡΑΒΔΟΥ.

$\Sigma\tau_{(\Gamma)} = 0 \Rightarrow -N_A \cdot 2d + Mg \cdot d - F_{ελ}' \cdot d = 0$

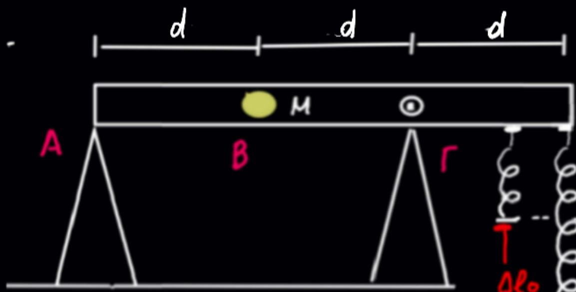
$\Rightarrow N_A = \frac{Mg - F_{ελ}'}{2} \Rightarrow N_A = \frac{130 - 70}{2} \Rightarrow$

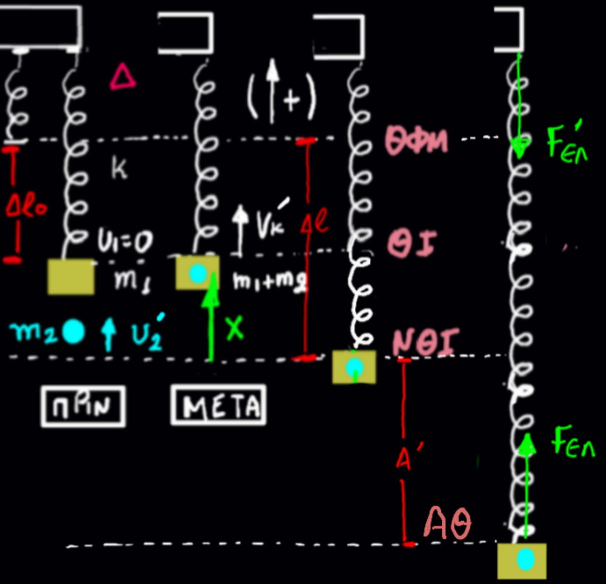
$\Rightarrow \boxed{N_A = 30N}$



Δ4

$K_{2,max} = ?$ ώστε να μη χάνεται η επαφή της ράβδου στο A.





• Έστω U_2' η νέα ταχύτητα της m_2 πριν τη κρούση.

• ΑΔΟ: $\vec{P}_{ΑΡχ} = \vec{P}_{ΤΕΛ} \Rightarrow \boxed{m_2 U_2' = (m_1+m_2)V_K'}$ (Ι)

• ΑΔΕΤ αμέσως μετά τη κρούση:

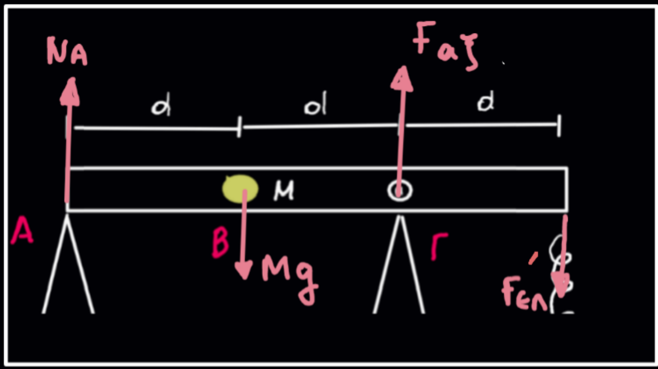
$E' = K' + U \Rightarrow \boxed{\frac{1}{2}kA'^2 = \frac{1}{2}(m_1+m_2)V_K'^2 + \frac{1}{2}k\cdot x^2}$ (ΙΙ)

• Η επαφή στο Α χάνεται μόνο αν η $F_{ελ}$ έχει φορά προς τα κάτω $(-A \leq x \leq +\Delta\ell)$

• Ράβδος ισορροπεί: $\Sigma\tau_{(\Gamma)} = 0 \Rightarrow$

$$\Rightarrow -N_A \cdot 2d - F_{ελ}' \cdot d + Mg \cdot d = 0 \Rightarrow$$

$$\Rightarrow \boxed{N_A = \frac{Mg - F_{ελ}'}{2}}$$



Για να μη χάνεται η επαφή στο Α: $N_A \geq 0 \Rightarrow$

$$\Rightarrow \frac{Mg - F_{ελ}'}{2} \geq 0 \Rightarrow F_{ελ}' \leq Mg \Rightarrow F_{ελ}' \leq 130 \Rightarrow \boxed{F_{ελ} \leq 130N}$$

$$\Sigma\vec{F} = -D\vec{x} \Rightarrow F_{ελ} - W = -k \cdot x \Rightarrow F_{ελ} = (m_1 + m_2)g - k \cdot x \Rightarrow$$

$$\Rightarrow \boxed{F_{ελ} = 40 - 100x}$$ Θα πρέπει $F_{ελ} \leq 130N$

$(-A' \leq x \leq +\Delta\ell)$

• αν $x = +\Delta\ell = +0{,}4m \Rightarrow F_{ελ} = 0$ $(F_{ελ} \leq 130N)$

• αν $x = -A' \Rightarrow$ τότε $F_{ελ} \leq 130 \Rightarrow 40 - 100(-A') \leq 130 \Rightarrow$

$$\Rightarrow 40 + 100A' \leq 130 \Rightarrow A' \leq 0{,}9 \Rightarrow \boxed{A'_{max} = 0{,}9m}$$

$$(\text{II}) \Rightarrow \frac{1}{2}k A'^2_{max} = \frac{1}{2}(m_1 + m_2) V'^2_{K,max} + \frac{1}{2}k \cdot x^2 \Rightarrow \boxed{V'_{K,max} = 0{,}3\sqrt{2}\ m/s}$$

$$(\text{I}) \Rightarrow m_2 \cdot U'_{2,max} = (m_1 + m_2) V'_{K,max} \Rightarrow \boxed{U'_{2,max} = 0{,}4\sqrt{2}\ m/s}$$

Επομένως $\boxed{K_{2,max} = \frac{1}{2} m_2 \cdot U'^2_{2,max} = 0{,}48J}$