ΛΥΣΕΙΣ ΦΚΑΤ Γ' ΛΥΚΕΙΟΥ
3/1/2016.

ΘΕΜΑ Α

$A_1-\alpha$ $A_2-\gamma$ $A_3-\gamma$ $A_4-\beta$ $A_5-\gamma$ $A_6-\delta$ $A_7-\beta$

$A_8.$ $\alpha-\Sigma$ $\beta-\Sigma$ $\gamma-\Lambda$ $\delta-\Lambda$

ΘΕΜΑ Β

Β1 Ενίσχυση: $|r_1-r_2|=N\lambda \Rightarrow |r_1-r_2|=N\cdot\frac{v}{f} \Rightarrow f=\frac{N\cdot v}{|r_1-r_2|} \xrightarrow{N=1} \boxed{f_{1min}=\frac{v}{|r_1-r_2|}}$.

Απόσβεση: $|r_1-r_2|=(2N+1)\frac{\lambda}{2} \Rightarrow |r_1-r_2|=(2N+1)\frac{v}{2f} \Rightarrow f=\frac{(2N+1)\cdot v}{2|r_1-r_2|} \Rightarrow$

$N=0 \Rightarrow \boxed{f_{2min}=\frac{v}{2|r_1-r_2|}}$.

$\frac{f_{1min}}{f_{2min}}=\frac{\frac{v}{|r_1-r_2|}}{\frac{v}{2|r_1-r_2|}} \Rightarrow \boxed{\frac{f_{1min}}{f_{2min}}=2}$ Σωστή η **β.**

Β2 **Α** $\Delta\phi_B=2\pi\frac{\Delta t}{T} \Rightarrow \Delta\phi_B=2\pi\frac{\frac{5T}{8}}{T} \Rightarrow \boxed{\Delta\phi_B=\frac{5\pi}{4}\ rad}$

$\Delta\phi_B=\phi_B(t_2)-\phi_B(t_1) \Rightarrow \frac{5\pi}{4}=\frac{13\pi}{4}-\phi_B(t_1) \Rightarrow \boxed{\phi_B(t_1)=2\pi\ rad}$

Επειδή $\phi_A(t_1)>\phi_B(t_1)$ Το κύμα διαδίδεται από το Α προς Β.

Σωστή η **α**

Β $\Delta\phi_{AB}=\phi_A(t_1)-\phi_B(t_1)=\frac{10\pi}{4}-\frac{8\pi}{4}=\frac{\pi}{2}\ rad.$ $v=\frac{\lambda}{T} \Rightarrow \boxed{\lambda=0,8m}$

$\Delta\phi_{AB}=2\pi\cdot\frac{\Delta x}{\lambda} \Rightarrow \frac{\pi}{2}=2\pi\cdot\frac{\Delta x}{0,8} \Rightarrow \boxed{\Delta x=0,2m}$

Σωστή η **γ**

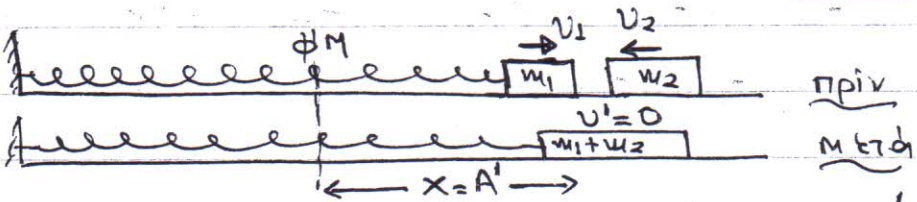
Β3 $E=E_1+E_2 \Rightarrow \frac{1}{2}DA^2=\frac{1}{2}DA_1^2+\frac{1}{2}D\cdot A_2^2 \Rightarrow A^2=A_1^2+A_2^2 \Rightarrow$

$A_1^2+A_2^2+2A_1A_2\sigma\upsilon\nu\phi=A_1^2+A_2^2 \Rightarrow \sigma\upsilon\nu\phi=0 \Rightarrow \boxed{\phi=\frac{\pi}{2}\ rad}$

Σωστή η **γ**.

Β4 Α.Δ.Ε $K+U_{ταλ}=E_{ταλ} \Rightarrow K=E_{ταλ}-U_{ταλ} \Rightarrow \frac{1}{2}mv_1^2=\frac{1}{2}DA^2-\frac{1}{2}Dx^2 \Rightarrow$

$mv_1^2=mw^2A^2-mw^2\frac{A^2}{4} \Rightarrow v_1^2=\frac{1}{4}w^2A^2 \Rightarrow \boxed{v_1=\frac{wA}{2}}$



Α.Δ.Ο $P_{ολ}(πριν)=P_{ολ}(μετά) \Rightarrow m_1v_1-m_2v_2=(m_1+m_2)v' \Rightarrow$

$m\cdot\frac{wA}{2}-m\frac{wA}{2}=(m_1+m_2)v' \Rightarrow \boxed{v'=0}$ Ακρ θέση

άρα $A'=x \Rightarrow \boxed{A'=\frac{A\sqrt{3}}{2}}$ Σωστή η α

ΘΕΜΑ Γ

α • $2T=0,4 \Rightarrow \boxed{T=0,2\,s}$ $\quad w=\frac{2\pi}{T} \Rightarrow \boxed{w=10\pi\,r/s}$

• $2\lambda=4 \Rightarrow \boxed{\lambda=2m}$ ή $u=\frac{x_1}{t_1} \Rightarrow \boxed{u=10\,m/s}$

• $u=\frac{\lambda}{T} \Rightarrow \boxed{u=10\,m/s}$

Εξίσωση κύματος: $y=A\eta\mu 2\pi\left(\frac{t}{T}-\frac{x}{\lambda}\right) \Rightarrow \boxed{y=0,1\eta\mu 2\pi\left(\frac{t}{0,2}-\frac{x}{2}\right)}\,(SI)$

Β $U_{max}=wA \Rightarrow U_{max}=10\pi\cdot 0,1 \Rightarrow \boxed{U_{max}=\pi\,m/s}$

$a_{max}=w^2A=(10\pi)^2\cdot 0,1=100\pi^2\cdot 0,1 \Rightarrow \boxed{a_{max}=100\,m/s^2}$

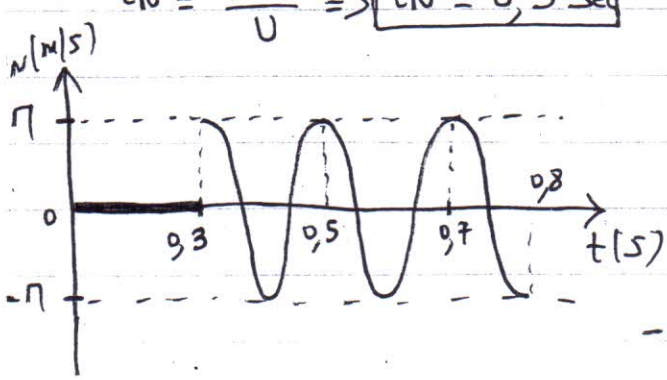
Ταχύτητα σημείου Ν

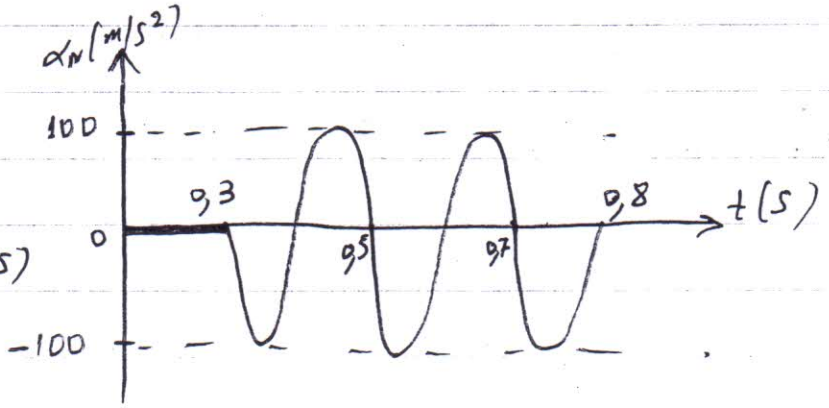
$U_N=U_{max}\,\sigma\upsilon 2\pi\left(\frac{t}{T}-\frac{x_N}{\lambda}\right) \Rightarrow \boxed{U_N=\pi\cdot\sigma\upsilon 2\pi\left(\frac{t}{0,2}-\frac{3}{2}\right)}\,(SI)$

Επιτάχυνση σημείου Ν

$a_N=-a_{max}\eta\mu 2\pi\left(\frac{t}{T}-\frac{x_N}{\lambda}\right) \Rightarrow \boxed{a_N=-100\eta\mu 2\pi\left(\frac{t}{0,2}-\frac{3}{2}\right)}\,(SI)$

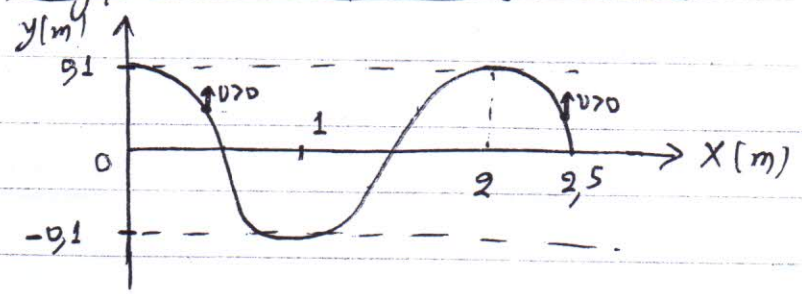
$t_N=\frac{x_N}{U} \Rightarrow \boxed{t_N=0,3\,sec}$





γ) $\frac{t}{T} = \frac{0,25}{0,2} \Rightarrow \frac{t}{T} = \frac{2,5}{2} \Rightarrow t = 1,25T \Rightarrow \boxed{t = T + \frac{T}{4}}$

Σχηματικό κύμανσης $y = f(x)$



δ] Από το παραπάνω σχήμα την $t = 0,25$ sec έχουμε (2 σημεία) με απομάκρυνση $y = \frac{A}{2}$ και με θετική ταχύτητα.

ε] $\Delta m = 10^{-2} gr = 10^{-2} \cdot 10^{-3} = 10^{-5}$ kg.

$D = m\omega^2 = 10^{-5} \cdot (10\pi)^2 = 10^{-2} N/m$

$y_\Gamma = 0,1 \eta\mu 2\pi \left(\frac{0,25}{0,2} - \frac{1}{2} \right) \Rightarrow y_\Gamma = 0,1 \eta\mu 2\pi \frac{1,5}{2} = 0,1 \eta\mu \frac{3\pi}{2} = -0,1$ m.

$\frac{\Delta P}{\Delta t} = \Sigma F = -D \cdot y_\Gamma = -10^{-2} \cdot (-0,1) = 10^{-3} N \Rightarrow \boxed{\frac{\Delta P}{\Delta t} = 10^{-3} N}$

στ] $y_0 = y_1 + y_2 \Rightarrow 0,1 \eta\mu\omega t = y_1 + 0,1 \eta\mu(\omega t + \pi) \Rightarrow 0,1 \eta\mu\omega t = y_1 - 0,1 \eta\mu\omega t$

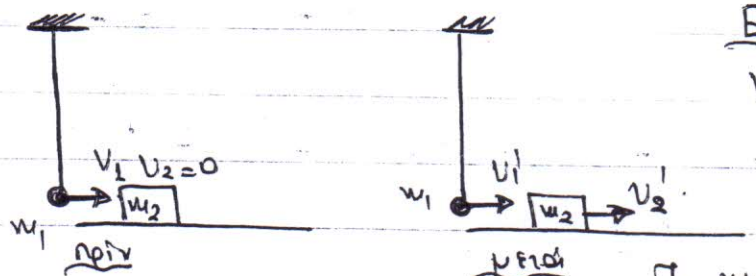
$\Rightarrow y_1 = 0,2 \eta\mu\omega t \Rightarrow \boxed{y_1 = 0,2 \eta\mu 10\pi t}$ (SI)

ή $A_1 > A_2$

$A = A_1 - A_2 \Rightarrow 0,1 = A_1 - 0,1 \Rightarrow \boxed{A_1 = 0,2m} \rightsquigarrow y_1 = 0,2 \eta\mu 10\pi t$ (SI)

ΘΕΜΑ Δ

α]



Ελαστική κρούση

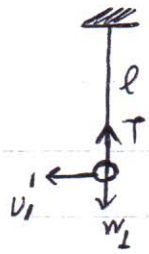
$v_1' = \frac{m_1 - m_2}{m_1 + m_2} v_1 \Rightarrow v_1' = \frac{1-3}{3+1} \cdot 8$

$\boxed{v_1' = -4 m/s}$

Το m_1 μετά την κρούση κινείται προς την αντίθετη φορά.

$v_2' = \frac{2m_1}{m_1 + m_2} v_1 \Rightarrow v_2' = \frac{2 \cdot 1}{4} \cdot 8 \Rightarrow \boxed{v_2' = 4 m/s}$

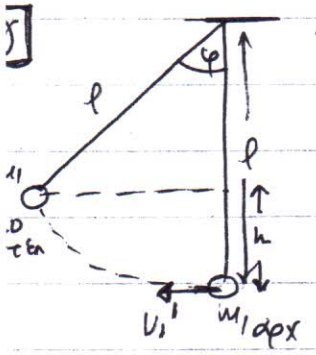
Β]



$\Sigma F = F_K \Rightarrow T - w_1 = \frac{m_1 U_1'^2}{\ell} \Rightarrow T = m_1 g + \frac{m_1 U_1'^2}{\ell} \Rightarrow T = 10 + \frac{1 \cdot 16}{1,6} \Rightarrow$

$\boxed{T = 20N}$

Γ]

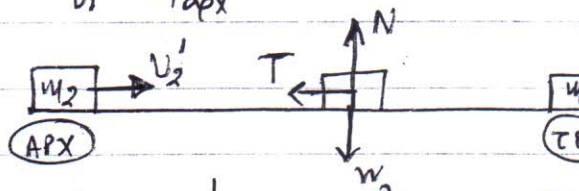


Θ.Μ.Κ.Ε για το w_1

$K_{ΤΕΛ} - K_{ΑΡΧ} = W_{w_1} \Rightarrow 0 - \frac{1}{2} m_1 U_1'^2 = -m_1 g \cdot h \Rightarrow \boxed{h = 0,8m}$

$\sigma\upsilon\phi = \frac{\ell - h}{\ell} \Rightarrow \sigma\upsilon\phi = \frac{0,8}{1,6} \Rightarrow \sigma\upsilon\phi = \frac{1}{2} \Rightarrow \boxed{\phi = 60°}$

Δ]



$\Sigma F_y = 0 \Rightarrow N = w_2 \Rightarrow N = 30N$

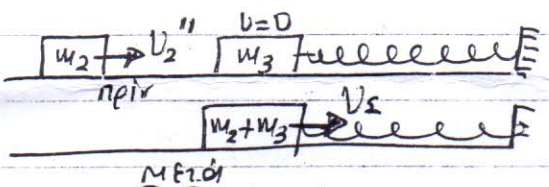
$T = \mu N \Rightarrow T = 0,2 \cdot 30 \Rightarrow T = 6N$

Θ.Μ.Κ.Ε για το w_2

$K_{ΤΕΛ} - K_{ΑΡΧ} = W_T \Rightarrow \frac{1}{2} m_2 U_2''^2 - \frac{1}{2} m_2 U_2'^2 = -T \cdot d \Rightarrow \frac{1}{2} \cdot 3 U_2''^2 - \frac{1}{2} \cdot 3 \cdot 16 = -6 \cdot 1,75$

$\Rightarrow \boxed{U_2'' = 3 m/s}$.

Ε]

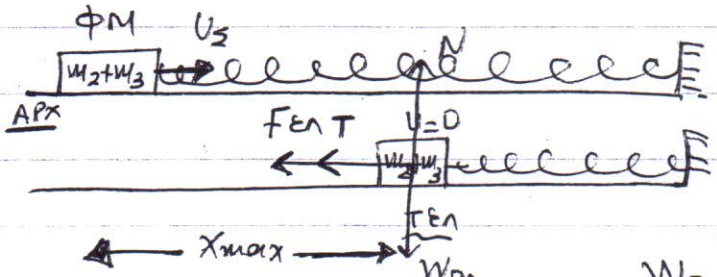


Πλαστική κρούση (Α-Δ.Ο)

$P_{ολ}(πριν) = P_{ολ}(μετά) \Rightarrow m_2 U_2'' = (m_2 + m_3) U_Σ$

$3 \cdot 3 = (3 + 1,5) \cdot U_Σ \Rightarrow \boxed{U_Σ = 2 m/s}$.

Το $(w_2 + w_3)$ μετά την κρούση κινείται με ταχύτητα $U_Σ = 2 m/s$



Έργο τριβής

$W_T = -T \cdot x_{max} = -\mu (w_2 + w_3) g \, x_{max}$

$= -4,5 J$

Έργο δύναμης Ελατηρίου

$W_{F_{ΕΛ}} = U_{ΕΛ}(ΑΡΧ) - U_{ΕΛ}(ΤΕΛ) = -\frac{1}{2} K \cdot x_{max}^2$ ($U_{ΕΛ}(ΤΕΛ) = 0$)

Θ.Μ.Κ.Ε για το $(w_2 + w_3)$

$K_{ΤΕΛ} - K_{ΑΡΧ} = W_T + W_{F_{ΕΛ}} \Rightarrow 0 - \frac{1}{2}(m_2 + m_3) U_Σ^2 = -4,5 - \frac{K}{8} \Rightarrow$

$\Rightarrow -\frac{1}{2} \cdot 4,5 \cdot 4 = -4,5 - \frac{K}{8} \Rightarrow \boxed{K = 36 N/m}$

ΣΤ] $K_{πριν} = \frac{1}{2} m_2 U_2''^2 = \frac{1}{2} 3 \cdot 9 = \frac{27}{2} J$

$K_{μετά} = \frac{1}{2}(m_2 + m_3) U_Σ^2 = \frac{1}{2} \cdot 4,5 \cdot 4 = \frac{18}{2} J$

$Q_{απωλ} = Q = K_{πριν} - K_{μετά} \Rightarrow Q = \frac{27}{2} - \frac{18}{2} \Rightarrow \boxed{Q = 4,5 J}$