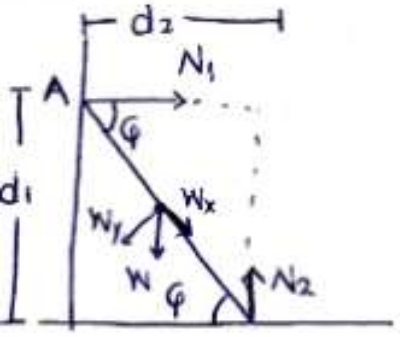
ΘΕΜΑΤΑ ΦΥΣΙΚΗΣ

ΘΕΜΑ Α

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

ΘΕΜΑ Β

Β1. Σωστή η πρόταση (ii)



$d_1 = \ell \cdot \eta\mu\varphi$

$d_2 = \ell \cdot \sigma\upsilon\nu\varphi$

Ισορροπία: $\Sigma F_y = 0 \Rightarrow N_2 = W$

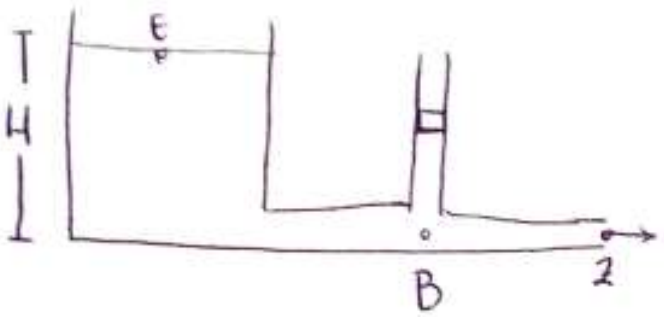
$T = \mu \cdot N_2 \Rightarrow T_{\alpha} = \mu \cdot N_2 = \mu \cdot W$

$\Sigma \tau = 0 \Rightarrow W_y \cdot \frac{L}{2} + T_{\alpha} d_1 = N_2 \cdot d_2 \Rightarrow W \sigma\upsilon\nu\varphi \frac{L}{2} + \mu \cdot W \cdot L \cdot \eta\mu\varphi = W L \sigma\upsilon\nu\varphi$

$\frac{\sigma\upsilon\nu\varphi}{2} + \mu \cdot \eta\mu\varphi = \sigma\upsilon\nu\varphi \Rightarrow \mu\eta\mu\varphi = \frac{1}{2}\sigma\upsilon\nu\varphi \Rightarrow \boxed{\varepsilon\varphi\varphi = \frac{1}{2\mu}}$

B_2. Σωστή απάντηση (i)

$\Pi_1 = \Pi_2 \Rightarrow A_1 U_1 = \frac{A_2}{2} U_2 \Rightarrow U_1 = \frac{U_2}{2}$



Bernoulli: $E \to Z$ $\quad P_{atm} + \rho g H + \frac{1}{2}\rho U_E^2 = P_{atm} + \frac{1}{2}\rho U_2^2$ (0)

$U_2^2 = 2gH \Rightarrow U_2 = \sqrt{2gH}$

$U_2 = \sqrt{2gH} \qquad U_1 = \frac{\sqrt{2gH}}{2}$

$P_B = P_{atm} + \frac{W}{A} + \rho g h$

Bernoulli: $B \to Z$ $\quad P_B + \frac{1}{2}\rho U_B^2 = P_{atm} + \frac{1}{2}\rho U_2^2 \Rightarrow$

$P_{atm} + \frac{W}{A} + \rho g h + \frac{1}{2}\rho \frac{2gH}{4} = P_{atm} + \frac{1}{2}\rho 2gH$

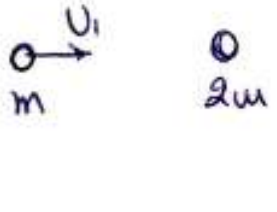
$\frac{W}{A} + \rho g \frac{H}{4} + \rho g \frac{H}{4} = \rho g H \Rightarrow \frac{W}{A} = \frac{\rho g H}{2} \Rightarrow$

$W = \frac{\rho g H A}{2}$.

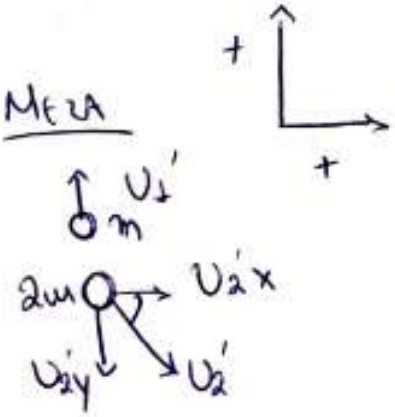
B_3 Σωστή απάντηση (iii)

ΓΙΑ ΕΛΑΣΤΙΚΗ

ΠΡΙΝ



ΜΕΤΑ



$U_{2x}' = U_2' \sigma\upsilon\nu 30 = \frac{\sqrt{3}}{2} U_2'$

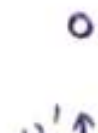
$U_{2y}' = U_2' \eta\mu 30 = \frac{1}{2} U_2'$

ΑΔΟ xx': $\cancel{m}U_1 = \cancel{2m}\frac{\sqrt{3}}{\cancel{2}}U_2' \Rightarrow U_1 = \sqrt{3}U_2' \Rightarrow \boxed{U_2' = \frac{\sqrt{3}}{3}U_1}$

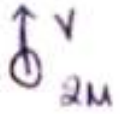
ΑΔΟ yy': $0 = \cancel{m}U_1' - \cancel{2m}\frac{U_2'}{\cancel{2}} \Rightarrow U_1' = U_2' \Rightarrow \boxed{U_1' = \frac{\sqrt{3}}{3}U_1}$

ΓΙΑ ΠΛΑΣΤΙΚΗ

ΠΡΙΝ



ΜΕΣΑ



ΑΔΟ $m U_1' = 2mV \Rightarrow V = \frac{U_1'}{2} \Rightarrow$

$$\boxed{V = \frac{U_1\sqrt{3}}{6}}$$

$$\frac{K_2}{K_1} = \frac{\frac{1}{\cancel{2}}\cancel{2}mV^2}{\frac{1}{\cancel{2}}m U_1^2} = \frac{2\left(\frac{U_1\sqrt{3}}{6}\right)^2}{U_1^2} = \frac{\frac{6}{36}\cancel{U_1^2}}{\cancel{U_1^2}} = \frac{1}{6}$$

ΘΕΜΑ Γ

Γ1) $\overline{P_1} = \frac{V_{ev}^2}{R_1} \Rightarrow V_{ev} = \sqrt{\overline{P_1}\cdot R_1} = \sqrt{12\cdot 6} = \boxed{6\sqrt{2}\ V}$

$V_{ev} = \frac{V}{\sqrt{2}} \Rightarrow V = V_{ev}\cdot\sqrt{2} = 6\sqrt{2}\sqrt{2} = \boxed{12V}$

$I_{ev} = \frac{V_{ev}}{R_1} = \frac{6\sqrt{2}}{6} = \boxed{\sqrt{2}\ A}$

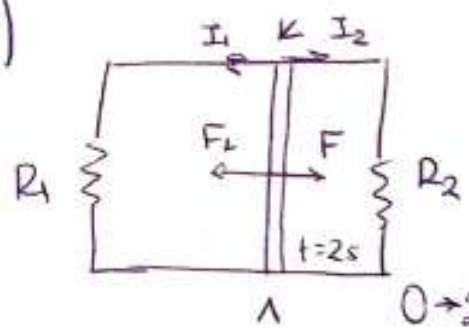
Γ2) $V' = N\omega' BA \overset{\omega'=2\omega}{\Rightarrow} V' = N\cdot 2\omega\cdot B\cdot A \Rightarrow \boxed{V' = 2V}$

$P_1 = \frac{U_1^2}{R} = \frac{V'^2}{R}\eta\mu^2(\omega' t) = 96\,\eta\mu^2(100\pi t)\ (SI)$

Για $t = 5 \cdot 10^{-3}$ s

$P_1 = 96\,\mu\mu^2 (10^2 \pi \cdot 5 \cdot 10^{-3}) = 96\,\mu\mu^2 \frac{\pi}{2} = \boxed{96\ W}$

Γ3)



$R_{1,2} = \frac{R_1 R_2}{R_1 + R_2} = \frac{6 \cdot 3}{9} = 2\,\Omega$

$R_{ολ} = R_{1,2} + R_{λπ} = 4\,\Omega$

$0 \to 2$s $\quad \alpha = \frac{\Sigma F}{m} = \frac{F}{m} = \frac{0,5}{0,5} = 1\ m/s^2$

Ομαλά $U = \alpha \cdot \Delta t_1 = 1 \cdot 2 = 2\ m/s$

Μετά τα 2s $\quad \Sigma F = 0 \Rightarrow F_L = F \Rightarrow F = \frac{B^2 \ell^2 \cdot U_{op}}{R_{ολ}} \Leftrightarrow$

$B^2 = \frac{F R_{ολ}}{\ell^2 U_{op}} \Rightarrow \boxed{B = \sqrt{\frac{F R_{ολ}}{\ell^2 U_{op}}} = 1\ T}$

Γ4) Από $0 \to 2$s

$I = 0A$ ΚΑΙ $Q = 0J$.

$\Pi\% = \frac{Q_2}{W_F} \cdot 100\% = \frac{I_2^2 R_2 \Delta t}{F \Delta x}$ (1)

$\boxed{I = \frac{B u \ell}{R_{ολ}} = 0,5A}$

$V_1 = V_2 \Leftrightarrow I_1 R_1 = I_2 R_2 \Rightarrow 6 I_1 = 3 I_2 \Rightarrow \boxed{I_2 = 2 I_1}$

Επίσης $I = I_1 + I_2 = 3 I_1 \Rightarrow I = \frac{3 I_2}{2} \Leftrightarrow \boxed{I_2 = \frac{2}{3} I = \frac{1}{3} A}$

Άρα $\Delta x_2 = U \cdot \Delta t_2 = \boxed{6\ m}$

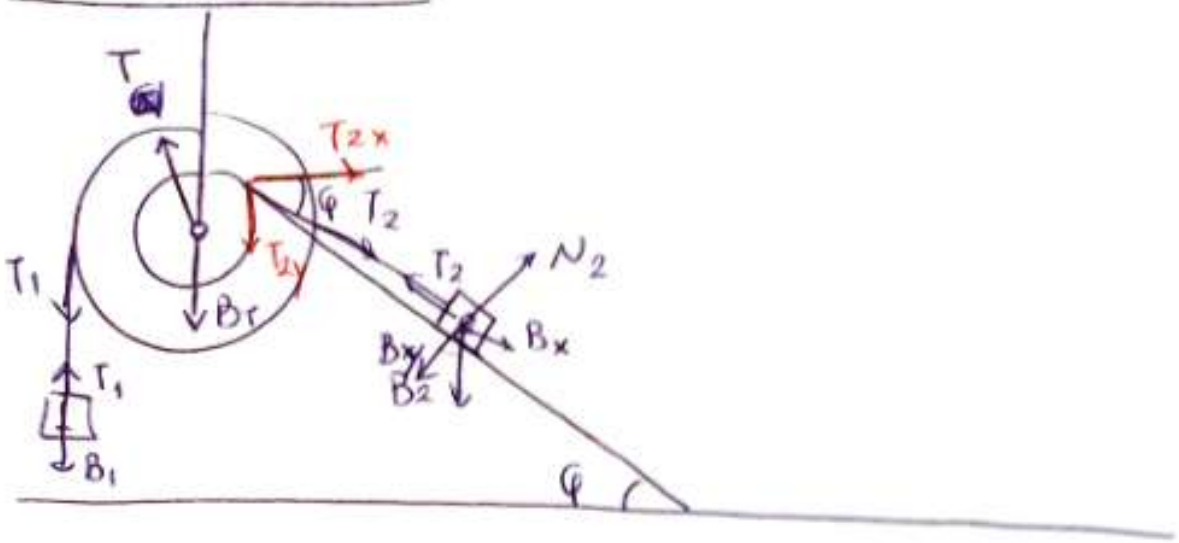
Και $\Delta x_1 = \frac{1}{2} \alpha \Delta t_1^2 = 2m$

Οπα $\Delta x = \Delta x_1 + \Delta x_2 = 8m$

Συνεπως (1) $\Longrightarrow \Pi\% = \frac{\left(\frac{1}{3}\right)^2 \cancel{3} \cancel{3}}{0,5 \quad 8} \cdot 100\% = \frac{1}{4} 100\%$

$\boxed{\Pi\% = 25\%}$

ΘΕΜΑ Δ



Δ1. $\Sigma F_{y_2} = 0 \Rightarrow B_{y_2} = N_2$

$\Sigma F_{x_2} = 0 \Rightarrow B_{x_2} = T_2 \Rightarrow m_2 g \eta\mu\varphi = T_2 \Leftrightarrow$

$\Sigma F_{y_1} = 0 \Rightarrow B_1 = T_1 \Rightarrow T_1 = m_1 \cdot g$

$\Sigma \tau_o = 0 \Rightarrow T_1 \cdot 2r = T_2 \cdot r \Leftrightarrow m_1 \cdot g \cdot 2r = m_2 g \eta\mu\varphi \cdot r \Leftrightarrow$

$m_1 = \frac{m_2 \eta\mu\varphi}{2} = \frac{5 \cdot 0,6}{2} = \boxed{1,5\,kg}$

$T = \sqrt{T_x^2 + T_y^2} = \sqrt{24^2 + 48^2} = \sqrt{4^2 \cdot 6^2 + 6^2 \cdot 8^2} = 6\sqrt{4^2 + 8^2} =$

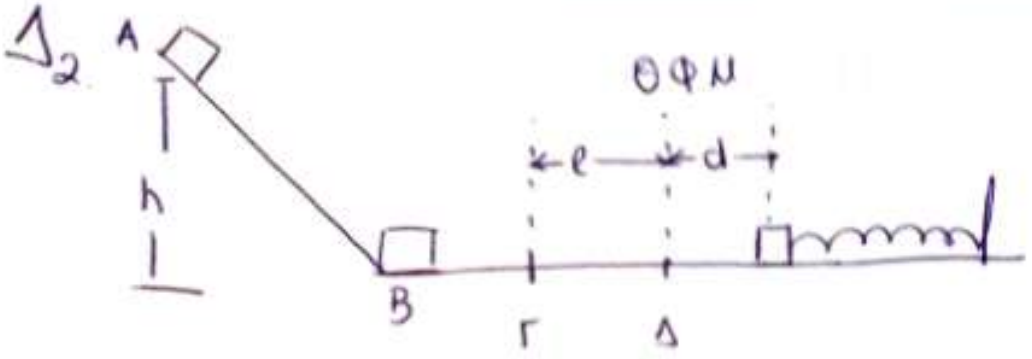
$= 6\sqrt{16 + 64} = 6\sqrt{80} = 6 \cdot 4\sqrt{5} = \boxed{24\sqrt{5}\,N.}$

Για την τροχαλία:

$\Sigma F_x = 0 \Rightarrow T_x = T_{2x} = T_2 \cdot \sigma\upsilon\nu\varphi = m_2 \cdot g \cdot \eta\mu\varphi\,\sigma\upsilon\nu\varphi = 5 \cdot 10 \cdot 0,6 \cdot 0,8 =$

$\boxed{T_x = 24N}$

$\Sigma F_y = 0 \Rightarrow T_y = T_1 + B_\tau + T_{2y} = 15 + 15 + 18 = 48\,N.$



$A\Delta E_{(2)A\to B} \rightarrow \cancel{K_A}^{0} + U_A = K_B + \cancel{U_B}^{0} \Rightarrow$

$m_2 g h = \frac{1}{2} m_2 v_2^2 \Rightarrow$

$v_2 = \sqrt{2gh} = \sqrt{2 \cdot 10 \cdot 1{,}8} = 6\ m/s$

Αρα το 2 εχει $v_2 = 6\ m/s$ και κανει ΕΟΚ

$v_2 = \frac{\ell}{\Delta t} \Leftrightarrow \Delta t = \frac{\ell}{v_2} = \frac{\frac{3\pi}{5}}{6} = \frac{3\pi}{30} = \frac{\pi}{10}\ s$

Σε αυτό το χρόνο το σώμα 3 ξεκινάει την Α.Α.Τ. Οπα

$\frac{T}{4} = \frac{\pi}{10} \Rightarrow T = \frac{4\pi}{10} = \frac{2\pi}{5}\ s$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{\frac{2\pi}{5}} = 5\ rad/s$

$D = k = m_3 \omega^2 = 5 \cdot 5^2 = 125\ N/m$

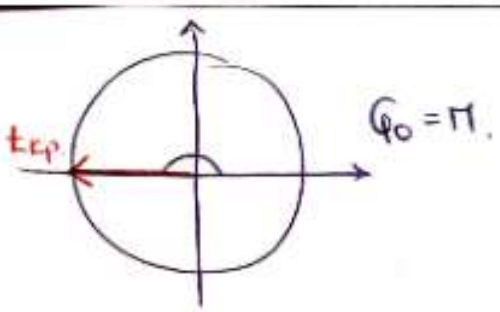
Δ3. Η κρούση γίνεται στη Θ.Ι. άρα $v_3 = v_{max} = \omega \cdot A$

$v_3 = 5 \cdot 0{,}2 = 1\ m/s$ Τα σώματα έχουν ίσες μάζες $m_2 = m_3 = 5kg$

Άρα γίνεται ανταλλαγή ταχυτήτων

$U_3' = -6\ m/s$

$U_2' = 1\ m/s$



$x = A' \eta\mu(\omega t + \varphi_0)$.

$U_3' = \omega \cdot A' \Leftrightarrow 6 = 5 \cdot A' \Leftrightarrow A' = \frac{6}{5} = 1{,}2\,m$

Άρα $x = 1{,}2\,\eta\mu(5t + \pi)$ (SI)

Δ1. $\frac{\Delta p}{\Delta t} = \Sigma F = -D \cdot x$

$K = 8U$

ΑΔΕ: $E = K + U \Rightarrow \frac{1}{2} D \cdot A^2 = 8U + U = 9U \Rightarrow$

$\frac{1}{2} D A^2 = 9 \cdot \frac{1}{2} D x^2 \Rightarrow x = \pm \frac{1}{3} A = \pm \frac{1}{3} \cdot 1{,}2 = \pm 0{,}4\,m$

Άφού είναι 1η φορά άρα $x = -0{,}4\,m$

Άρα $\frac{\Delta p}{\Delta t} = -125 \cdot (-0{,}4) = 50\,N$.

$\left|\frac{\Delta K}{\Delta t}\right| = \left|\frac{\Delta W_{\Sigma F}}{\Delta t}\right| = \frac{|\Sigma F \cdot dx|}{\Delta t} = |\Sigma F \cdot u| = |50 \cdot u|$

ΑΔΕ: $\frac{1}{2} D A^2 = \frac{1}{2} m U^2 + \frac{1}{2} D x^2 \Rightarrow A^2 - x^2 = \frac{m}{D} U^2 \Rightarrow$

$U^2 = \frac{D}{m}(A^2 - x^2) \Rightarrow U = \sqrt{\omega^2 (A^2 - x^2)} = \omega \sqrt{(A^2 - x^2)} = 5\sqrt{A^2 - \frac{1}{9} A^2}$

$$v = 5A\sqrt{\frac{k}{5}} = 6\sqrt{\frac{8}{9}} = 2\sqrt{8} = 4\sqrt{2}\ m/s$$

$$\left|\frac{\Delta K}{\Delta t}\right| = |2F \cdot v| = 200\sqrt{2}\ J/s$$

Στο $\Delta t' = \frac{T}{2} = \frac{\frac{2\pi}{5}}{2} = \frac{\pi}{5}\ s$

Σε αυτό το χρόνο το Σ_2 έχει κάνει ΕΟΚ με $v_2' = 1\ m/s$

$$S_2 = v_2' \Delta t' = \frac{\pi}{5}\ m$$

Άρα τα δύο σώματα απέχουν $d = \frac{\pi}{5}\ m$

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