ΘΕΜΑ Α

Α1. γ

Α2. δ

Α3. γ

Α4. β

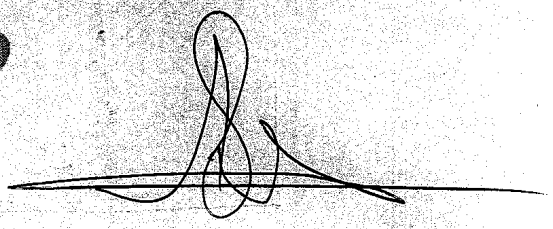
Α5. α. Σ

β. Λ

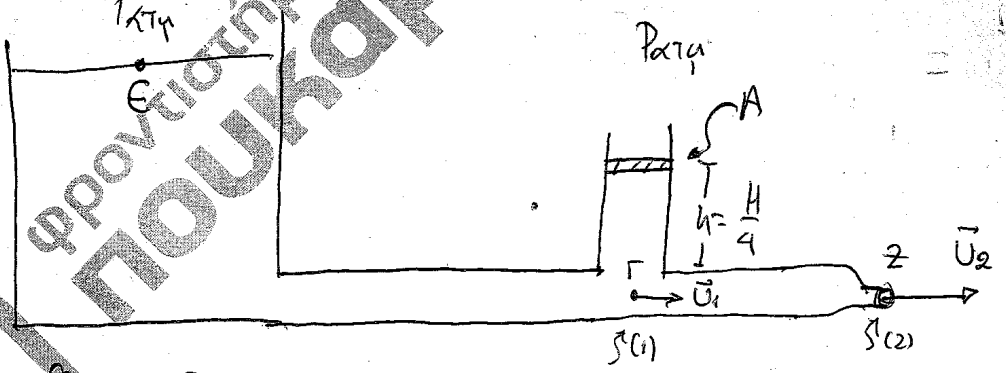
γ. Σ

δ. Σ

ε. Λ



Β2) Σωστό το i



Bernoulli Ε → 2:

$P_{atm} + \frac{1}{2}\rho v_E^2 + \rho g H = P_{atm} + \frac{1}{2}\rho \cdot U_2^2 \Rightarrow U_2 = \sqrt{2gH}$ (1)

Αρχή της συνέχειας

$\Pi_1 = \Pi_2 \Rightarrow A_1 \cdot U_1 = A_2 U_2 \overset{A_2 = \frac{A_1}{2}}{\underset{(1)}{\Rightarrow}} U_1 = \frac{\sqrt{2gH}}{2}$ (2)

Bernoulli: Γ → 2

$P_\Gamma + \frac{1}{2}\rho U_1^2 = P_{atm} + \frac{1}{2}\rho U_2^2 \Rightarrow P_\Gamma = P_{atm} + \frac{1}{2}\rho(U_2^2 - U_1^2)$

$\overset{(1),(2)}{\Rightarrow} P_\Gamma = P_{atm} + \frac{1}{2}\rho\left(2gH - \frac{2gH}{4}\right) \Rightarrow P_\Gamma = P_{atm} + \frac{1}{2}\rho\frac{3}{4}2gH$

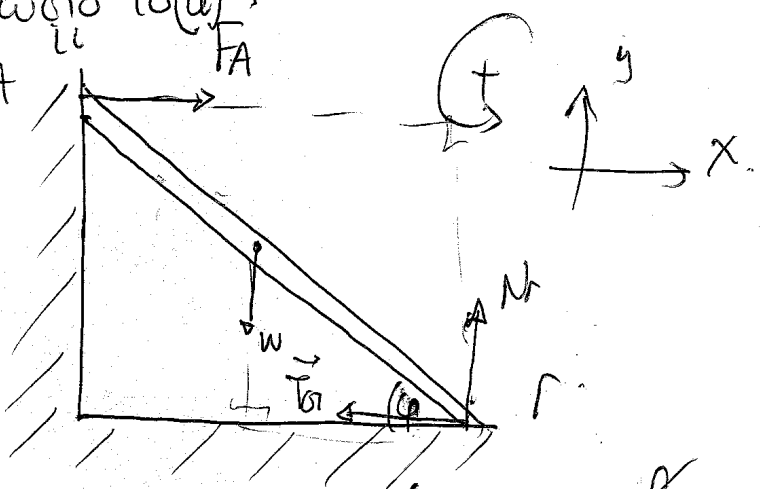
$\Rightarrow P_\Gamma = P_{atm} + \frac{3}{4}\rho g H$ (3).

Όμως στο σημείο Γ

$P_\Gamma = P_{atm} + \frac{W}{A} + \rho g\frac{H}{4} \overset{(3)}{\Rightarrow} P_{atm} + \frac{3}{4}\rho g H = P_{atm} + \frac{W}{A} + \rho g\frac{H}{4}$

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

Β1). Σωστο το (α)



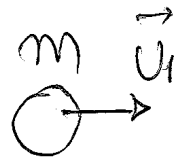
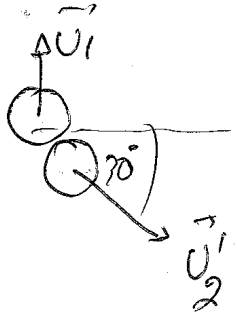
- $\Sigma\vec{\tau}(\Gamma) = 0 \Rightarrow F_A \cdot \ell \cdot \eta\mu\varphi - W \cdot \frac{\ell}{2} \cdot \sigma\upsilon\nu\varphi = 0 \Rightarrow$

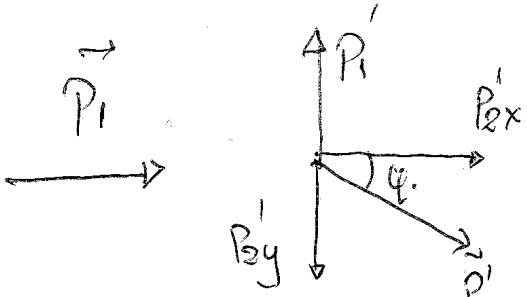
$$\varepsilon\varphi\varphi = \frac{W}{2F_A} \quad (1)$$

- $\Sigma F_x = 0 \Rightarrow F_A = T_{\sigma\tau} \overset{\text{οριακή τριβή}}{\Rightarrow} F_A = \mu_1 N \quad (2)$ να ισορροπήσει

- $\Sigma F_y = 0 \rightarrow W = N \quad (3)$

$(1) \overset{(2)}{\underset{(3)}{\Rightarrow}} \varepsilon\varphi\varphi = \frac{N}{2\mu_1 N} \Rightarrow \varepsilon\varphi\varphi = \frac{1}{2\mu_1}$

Β3).   Σωστό το (iii)



• Δ.Κ.Ε: $K_{πριν}^{(1)} = K_{μετα} \Rightarrow \frac{1}{2}mU_1^2 = \frac{1}{2}mU_1'^2 + \frac{1}{2}2mU_2'^2$

$\Rightarrow U_1^2 = U_1'^2 + 2U_2'^2$ (1)

• ΑΔΟ xx': $\vec{P}_{x(πριν)} = \vec{P}_{x(μετά)} \Rightarrow P_1 = P_{2x}' \Rightarrow$

$\Rightarrow mU_1 = 2mU_2' \cdot συν 30° \Rightarrow U_1 = 2U_2' \frac{\sqrt{3}}{2}$

$\Rightarrow U_1 = U_2' \sqrt{3}$ (2)

• ΑΔΟ yy': $\vec{P}_{y(πριν)} = \vec{P}_{y(μετα)} \Rightarrow P_1' = P_{2y}' \Rightarrow mU_1' = 2mU_2' \cdot ημφ$

$\Rightarrow U_1' = U_2'$ (3)

Άρα (1) $\overset{(2)}{\underset{(3)}{\Rightarrow}}$ $U_1^2 = U_1'^2 + 2 \cdot U_1'^2 \Rightarrow U_1^2 = 3U_1'^2 \Rightarrow U_1 = \sqrt{3}\, U_1'$ (4)

• ΑΔΟ μεταξύ Σ1 και Σ3: $\vec{P}_{πριν} = \vec{P}_{μετα} \Rightarrow$

$\Rightarrow mU_1' = 2mV_{cm} \Rightarrow V_{cm} = \frac{U_1'}{2} \overset{(4)}{\Rightarrow} V_{cm} = \frac{U_1}{2\sqrt{3}}$ (5)

Άρα $\frac{K_{CM}}{K_1} = \frac{\frac{1}{2}2mV_{cm}^2}{\frac{1}{2}mU_1^2} = \frac{2\frac{U_1^2}{12}}{U_1^2} = \frac{1}{6}$

ΘΕΜΑ Γ

Γ1) . $\bar{P}_1 = \frac{V_{ev}^2}{R_1} \Rightarrow V_{ev} = \sqrt{\bar{P}_1 \cdot R_1} = \sqrt{12 \cdot 6} = \boxed{6\sqrt{2}\ V}$

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

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

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

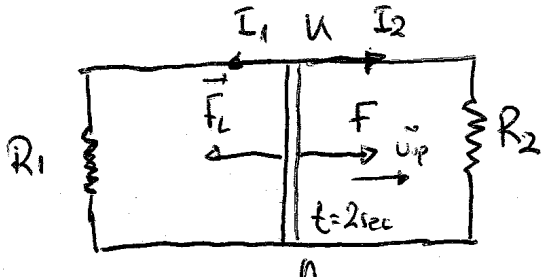
Η $P_1 = \frac{U_1^2}{R_1} \Rightarrow P_1 = \frac{V'^2}{R} \cdot \eta\mu^2(\omega' t) = \underline{96\eta\mu^2(100\pi t)\ (SI)}$

Για $t = 5 \cdot 10^{-3}\ s$

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

$\Rightarrow \boxed{P_1 = 96\ W}$

Γ3)



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

. $R_{o\lambda} = R_{1,2} + R_{\alpha\nu} = 4\Omega$

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

άρα $U = a \cdot \Delta t_1 = 1(2-0) = 2\ m/s.$

Στη συνέχεια

$$\Sigma F = 0 \Rightarrow F = F_L \Rightarrow F = \frac{B^2 l^2 v_\rho}{R_{o\lambda}}$$

$$\Rightarrow B = \sqrt{\frac{F \cdot R_{o\lambda}}{l^2 v_\rho}} \Rightarrow \boxed{B = 1\,T}$$

Γ4) $0 \to 2\,sec$

$I = 0$, $Q = 0$

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

Όμως $I = \frac{BUl}{R_{o\lambda}} = 0{,}5A$

και $V_1 = V_2 \Rightarrow I_1 \cdot R_1 = I_2 R_2 \Rightarrow 6I_1 = 3I_2$

$\Rightarrow I_2 = 2I_1$

και $I = I_1 + I_2 \Rightarrow I = \frac{3I_2}{2} \Rightarrow I_2 = \frac{1}{3}A$ (2)

Επίσης $\Delta x_2 = U \cdot \Delta t_2 \Rightarrow \Delta x_2 = 6m$ (2)

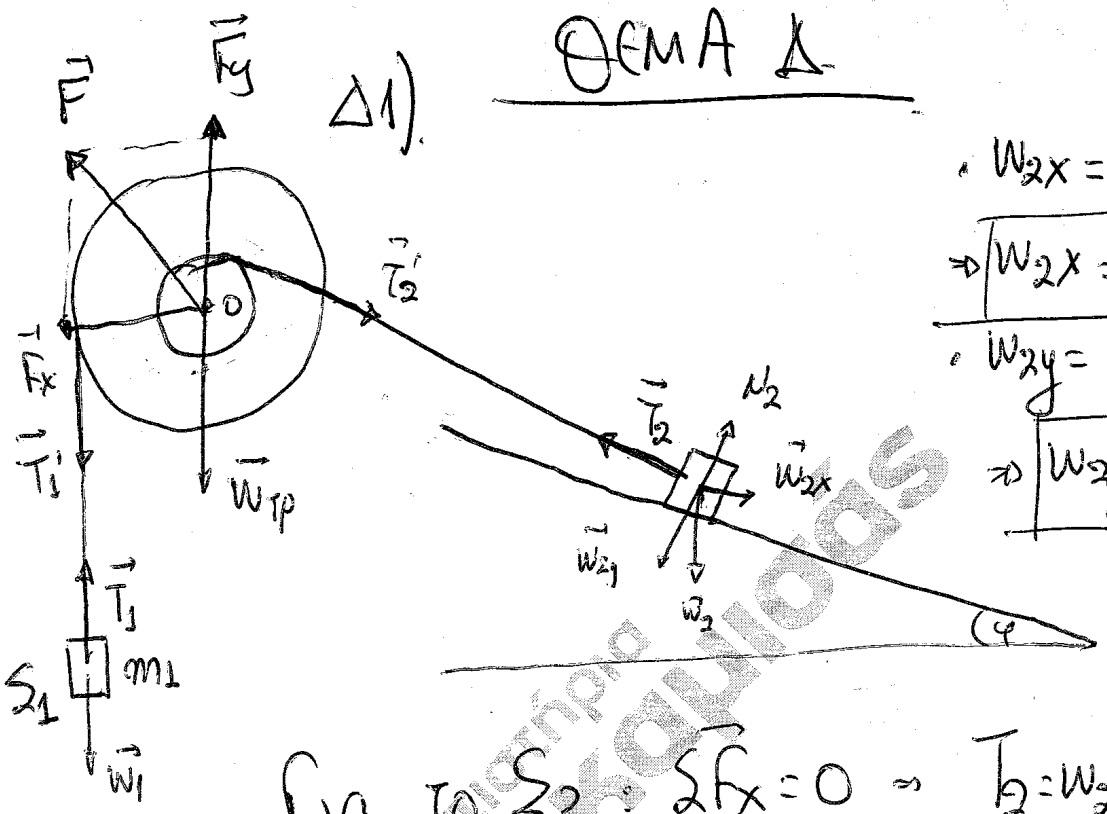
και $\Delta x_1 = \frac{1}{2} a \cdot \Delta t_1^2 = 2m$ (3).

Συνεπώς (1), (2) $\Delta x = \Delta x_1 + \Delta x_2 = 8m$ (4)

(1) (2) (4) $\Rightarrow \Pi\% = 25\%$

ΘΕΜΑ Δ

Δ1)



• $w_{2x} = m_2 g \eta\mu\varphi$

$\Rightarrow \boxed{w_{2x} = 30N}$

• $w_{2y} = m_2 g \sigma\upsilon\nu\varphi \Rightarrow$

$\Rightarrow \boxed{w_{2y} = 40N}$

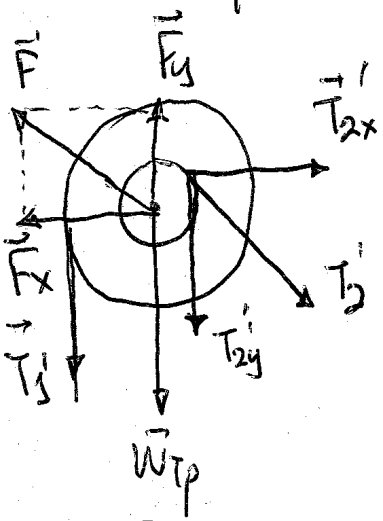
Για το Σ_2: $\Sigma F_x = 0 \Rightarrow T_2 = w_{2x} \Rightarrow \boxed{T_2 = 30N}$

Νήμα αβαρές $T_2' = T_2 = 30N$

Για την τροχαλία: $\Sigma \vec{\tau}(O) = 0 \Rightarrow$

$\Rightarrow T_2' r = T_1' \cdot 2r \Rightarrow \boxed{T_1' = 15N}$

Νήμα αβαρές $T_1' = T_1 = 15N$.



• Για το Σ_1: $\Sigma \vec{F} = 0 \Rightarrow T_1 = w_1 \Rightarrow$

$\Rightarrow m_1 g = 15 \Rightarrow \boxed{m_1 = 1,5\ kg}$

• $T_{2x}' = T_2 \sigma\upsilon\nu\varphi \Rightarrow T_{2x}' = 30 \cdot 0,8$

$\Rightarrow \boxed{T_{2x}' = 24N}$

• $T_{2y}' = T_2 \cdot \eta\mu\varphi \Rightarrow \boxed{T_{2y}' = 18N}$

• $W_{τρ} = M \cdot g \Rightarrow \boxed{W_{τρ} = 15N}$

Για την τροχαλία

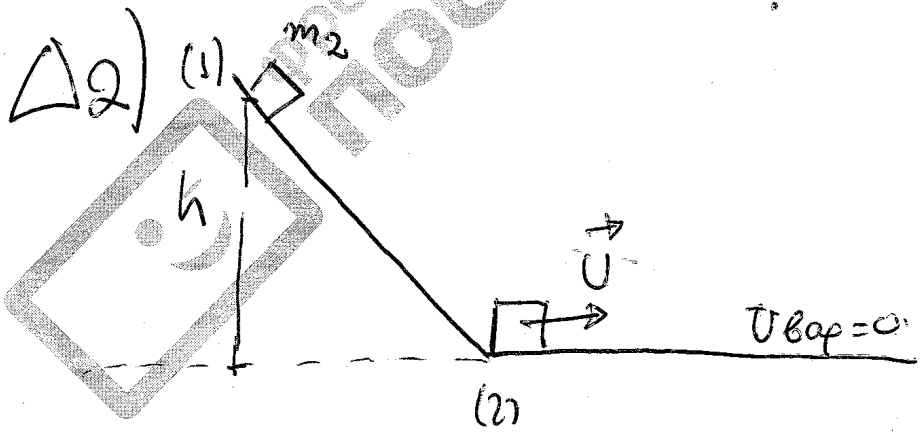
• $\Sigma \vec{F}_x = 0 \Rightarrow F_x = T_{2x}' \Rightarrow \boxed{F_x = 24N}$

• $\Sigma F_x = 0 \Rightarrow F_y = W_{τρ} + T_{2y}' + T_1' \Rightarrow \boxed{F_y = 48N}$

Συνεπώς $F = \sqrt{F_x^2 + F_y^2} \Rightarrow F = \sqrt{24^2 + 48^2} = \sqrt{20 \cdot 12^2}$

$\Rightarrow F = 12\sqrt{20} \Rightarrow \boxed{F = 24\sqrt{5}\,N}$

Δ2)



Α.Δ.Ε $K_1 + U_1 = K_2 + U_2 \Rightarrow 0 + m_2 g h = \frac{1}{2} m_2 U^2 + 0$

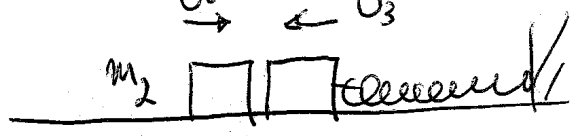
$\Rightarrow U = \sqrt{2gh} \Rightarrow \boxed{U = 6\,m/s}$

• $l = U \Delta t \Rightarrow \Delta t = \frac{l}{U} \Rightarrow \boxed{\Delta t = \frac{\pi}{10}\,sec}$

Όμως $\Delta t = \frac{T}{4} \Rightarrow T = \frac{4\pi}{10}\,s \Rightarrow \boxed{T = 0{,}4\pi\,sec}$

Ν $T = 2\pi\sqrt{\frac{m_3}{K}} \Rightarrow 0{,}4\pi = 2\pi\sqrt{\frac{5}{K}} \Rightarrow K = 125\,N/m$

Δ3/ Στο σημείο Δ (+)



• $E_T = U_T + K \Rightarrow \frac{1}{2} K \cdot d^2 = \frac{1}{2} m_3 U_3^2 \Rightarrow U_3 = d\sqrt{\frac{K}{m_3}}$

$\Rightarrow \boxed{U_3 = 1\,m/s}$

Όμως $U_3' = \frac{2m_2}{m_2+m_3} U_0 + \frac{m_3 - m_2}{m_2+m_3} U_3$

$\Rightarrow U_3' = 6\,m/s$ (ανταλλαγή ταχυτήτων)

Σημείο Δ → ΘΙ

$|U_3| = \omega \cdot A' \Rightarrow \boxed{A' = 1,2\,m}$

με $\omega = \frac{2\pi}{T} \Rightarrow \omega = \frac{2\pi}{\frac{4\pi}{10}} \Rightarrow \boxed{\omega = 5\,rad/s}$

Για $t=0$, $x=0$ & $U<0$

$0 = 1,2\,\eta\mu\varphi_0 \Rightarrow \varphi_0 = \begin{cases} 0 \\ \pi \end{cases}$ Δεκτή μια $\varphi_0 = \pi\,rad$

Συνεπώς $x = A\,\eta\mu(\omega t + \varphi_0) \Rightarrow$

$\Rightarrow x = 1,2\,\eta\mu(5t+\pi)$ (S.I)

Δ4) $E_T' = U_T' + K' \Rightarrow E' = 9U' \Rightarrow$

$\frac{1}{2} K A'^2 = 9 \cdot \frac{1}{2} K x^2 \Rightarrow x = \pm \frac{A'}{3}$ $^{x<0}\Rightarrow$ $x = -\frac{1,2}{3} \Rightarrow$

$\Rightarrow \boxed{x = -0,4\,m}$

Συνεπώς $\frac{\Delta P}{\Delta t} = \Sigma F = -D \cdot x \Rightarrow \boxed{\frac{\Delta P}{\Delta t} = 50\ kg \cdot \frac{m}{s^2}}$

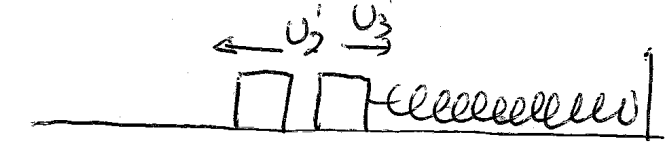
Κ.Σ $E' = K' + U' \Rightarrow E' = K + \frac{K}{8} \Rightarrow$

$\Rightarrow E' = \frac{9K}{8} \Rightarrow \frac{1}{2} m \upsilon_{max}^2 = \frac{9}{8} \frac{1}{2} m \upsilon^2$

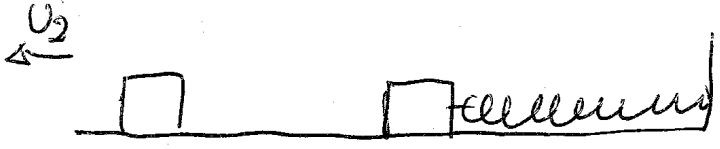
$\Rightarrow \upsilon^2 = \frac{8}{9} \upsilon_{max}^2 \Rightarrow \upsilon = -4\sqrt{2}\ m/s$

Άρα $\left|\frac{\Delta K}{\Delta t}\right| = |\Sigma F \cdot \upsilon| = k|x||\upsilon| = 200\sqrt{2}\ \frac{J}{s}$

Δ.Σ



$\cdot\ \upsilon_2' = \frac{m_2 - m_3}{m_2 + m_2} \upsilon_3 + \frac{2m_3}{m_2 + m_3} \upsilon$



$\Rightarrow \upsilon_2' = 1\ m/s$

$\cdot\ \Delta t' = \frac{T}{2} \Rightarrow \boxed{\Delta t' = \frac{\pi}{5}\ s}$

Συνεπώς $S = \upsilon_2' \cdot \Delta t' \Rightarrow \boxed{S = \frac{\pi}{5}\ m}$