Θέμα Α (1)

A1) γ

A2) δ

A3) γ

A4) β

A5)

α) Σ

β) Λ

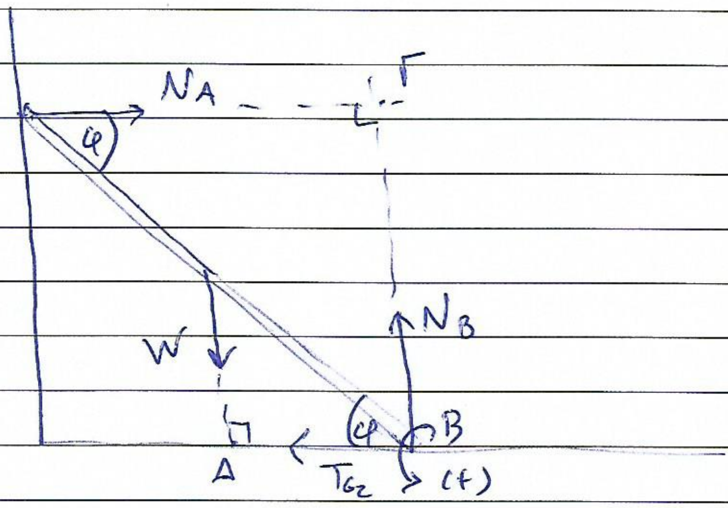
γ) Σ

δ) Σ

ε) Λ

Θέμα Β

B1)



$$\Sigma\tau_{(B)} = 0 \Rightarrow w(B\Delta) - N_A(B\Gamma) = 0 \Rightarrow w\frac{L}{2}\sigma\upsilon\nu\varphi = N_A L\,\eta\mu\varphi$$

$$\Rightarrow N_A = \frac{w}{2\,\varepsilon\varphi\varphi}$$

~~$\Sigma F_x = 0 \Rightarrow T_{\sigma\tau} = N_A$~~

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$\Sigma F_x = 0 \Rightarrow T_{\sigma 2} = N_A \Rightarrow T_{\sigma 2} = \frac{W}{2\varepsilon\varphi\varphi}$

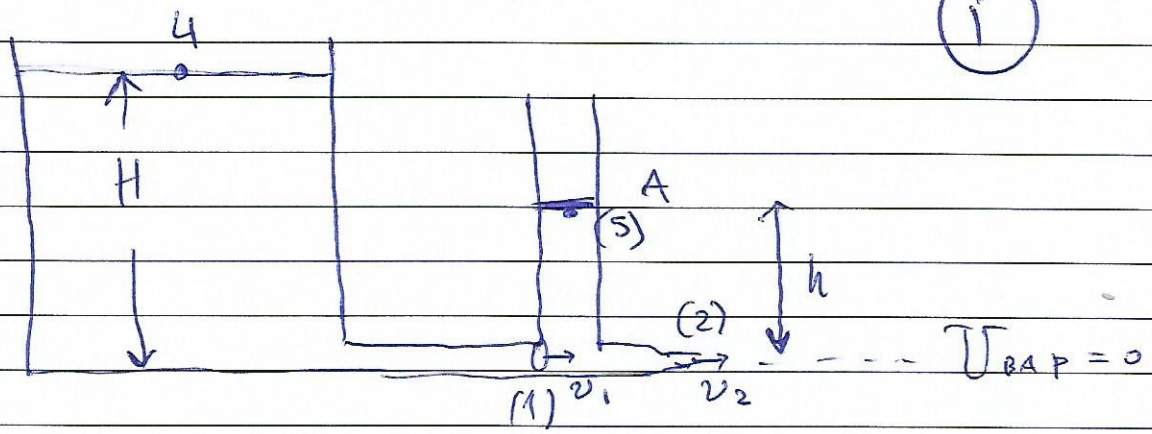
$\Sigma F_y = 0 \Rightarrow N_B = W$

Πρέπει $T_{\sigma 2} \leq \mu \cdot N_B \Rightarrow \frac{W}{2\varepsilon\varphi\varphi} \leq \mu \cdot W \Rightarrow$

$\Rightarrow \varepsilon\varphi\varphi \geq \frac{1}{2\mu}$ άρα $(\varepsilon\varphi\varphi)_{min} = \frac{1}{2\mu}$

B2)

i



$h = H/4 \qquad A_2 = \frac{A_1}{2}$

Bernoulli $4 \to 2$: $P_{atm} + \rho g H + \frac{1}{2}\rho \upsilon_4^2 = P_{atm} + \frac{1}{2}\rho \upsilon_2^2 + 0$ (με $\upsilon_4 = 0$)

$\Rightarrow \upsilon_2 = \sqrt{2gH}$

Εξίσωση συνέχειας $1 \to 2$

$A_1 \cdot \upsilon_1 = A_2 \cdot \upsilon_2 \Rightarrow \upsilon_1 = \frac{\sqrt{2gH}}{2}$

Bernoulli $1 \to 2$

$$P_1 + \frac{1}{2}\rho v_1^2 = P_{ατμ} + \frac{1}{2}\rho v_2^2 \Rightarrow$$

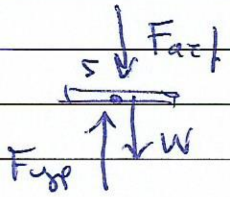
$$\Rightarrow P_1 - P_{ατμ} = \frac{1}{2}\rho\left(v_2^2 - v_1^2\right)$$

$$P_1 - P_{ατμ} = \frac{1}{2}\rho\left(4v_1^2 - v_1^2\right)$$

$$P_1 - P_{ατμ} = \frac{3}{2}\rho v_1^2 \Rightarrow P_1 - P_{ατμ} = \frac{3}{2}\rho \cdot \frac{2gH}{4}$$

$$P_1 - P_{ατμ} = \frac{3}{4}\rho g H \quad (1)$$

Ισορροπία εμβόλου



$$F_{υγρ} = F_{ατμ} + W \Rightarrow P_s = P_{ατμ} + \frac{W}{A} \quad (2)$$

$$P_1 - P_s = \rho g h \Rightarrow P_1 = P_{ατμ} + \frac{W}{A} + \rho g \frac{H}{4} \quad (3)$$

$$1, 3 \to \quad \frac{W}{A} + \rho g \frac{H}{4} = \frac{3}{4}\rho g H$$

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

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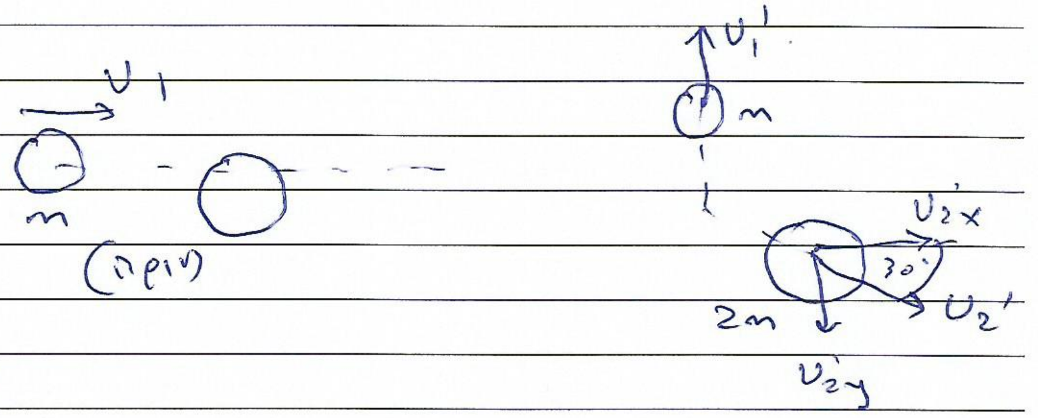
B3)



$m_1 = m$

$m_2 = 2m$ Α.Δ.Ο στον x'x

$m_3 = m$

$$m \cdot \upsilon_1 = 2m \cdot \upsilon'_{2x} \Rightarrow m \cdot \upsilon_1 = 2m \cdot \upsilon'_2 \cdot συν30^\circ$$

$$\Rightarrow \boxed{\upsilon_1 = \sqrt{3} \cdot \upsilon'_2}$$

Α.Δ.Ο στον y'y: $0 = m \cdot \upsilon'_1 - 2m \cdot \upsilon'_{2y} \Rightarrow$

$$\Rightarrow \upsilon'_1 = 2 \cdot \upsilon'_2 \cdot ημ30^\circ \Rightarrow \upsilon'_1 = \upsilon'_2$$

άρα $\upsilon_1 = \sqrt{3} \cdot \upsilon'_1 \Rightarrow \upsilon'_1 = \frac{\sqrt{3}}{3} \upsilon_1$

Α.Δ.Ο στην πλαστική: $m_1 \cdot \upsilon'_1 = (m_1 + m_3) \cdot \upsilon_Σ$

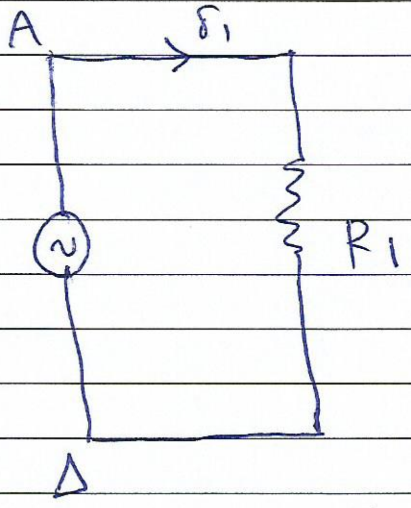
$$\Rightarrow \upsilon_Σ = \frac{\upsilon'_1}{2} = \frac{\sqrt{3}}{6} \upsilon_1$$

$$\frac{K_{τελ}}{K_1} = \frac{\frac{1}{2} 2m \cdot \frac{3}{36} \upsilon_1^2}{\frac{1}{2} m \upsilon_1^2} = \frac{1}{6}$$ (iii)

Θέμα Γ

$\upsilon = V \cdot \eta\mu(50\pi t)$ S.I

$R_1 = 6\,\Omega \quad R_2 = 3\,\Omega \quad \bar{P} = 12W$



$\bar{P} = V_{\varepsilon\nu} \cdot I_{\varepsilon\nu}$ ή $\bar{P} = I_{\varepsilon\nu}^2 \cdot R_1$

$I_{\varepsilon\nu} = \sqrt{\frac{\bar{P}}{R_1}} \Rightarrow \boxed{I_{\varepsilon\nu} = \sqrt{2}\,A}$

$V_{\varepsilon\nu} = I_{\varepsilon\nu} \cdot R_1 \Rightarrow V_{\varepsilon\nu} = 6\sqrt{2}\,V$

$V_{\varepsilon\nu} = \frac{V}{\sqrt{2}} \Rightarrow V = \sqrt{2} \cdot V_{\varepsilon\nu} \Rightarrow \boxed{V = 12\,Volt}$

Γ2 Για $\omega' = 2\omega$

$V' = NBA\omega' = 2V = 24\,Volt$

και $\upsilon = 24 \cdot \eta\mu(100\pi t)$ (S.I)

$P = \upsilon \cdot i = \frac{\upsilon^2}{R_1} \Rightarrow P = \frac{24^2 \cdot \eta\mu^2(100\pi t)}{6}$

$\Rightarrow P = 96 \cdot \eta\mu^2(100\pi t)$ (S.I)

Για $t = 5 \cdot 10^{-3}s$: $P = 96 \cdot \eta\mu^2\left(\frac{\pi}{2}\right) \Rightarrow \boxed{P = 96\,W}$

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Γ3)

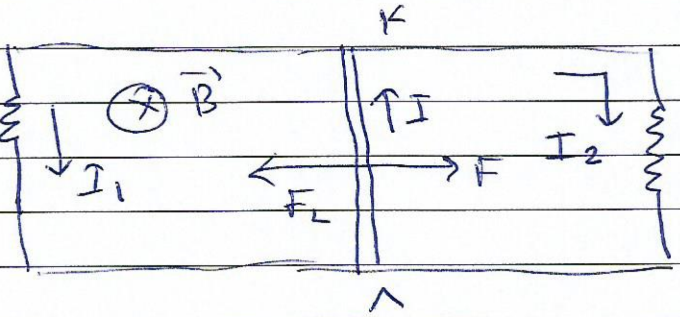
Από $0 - t_1 = 2s$ η ράβδος εκτελεί ευθύγραμμη ομαλά επιταχυνόμενη κίνηση.

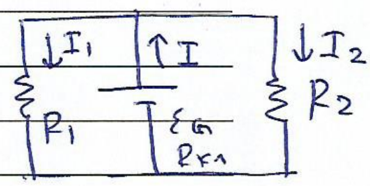
με $a = \frac{\Sigma F}{m} = \frac{F}{m} = 1\ m/s^2$

Άρα για $t_1 = 2$ sec: $v_1 = a \cdot t_1 \Rightarrow \boxed{v_1 = 2\ m/s}$

και $x_1 = \frac{1}{2} a t_1^2 \Rightarrow x_1 = \frac{1}{2} \cdot 1 \cdot 2^2 \Rightarrow \boxed{x_1 = 2\ m}$

Μετά την t_1 είναι $v_1 =$ σταθ.





$\Sigma F = 0 \Rightarrow F = F_L \Rightarrow F = B \cdot I \cdot \ell \Rightarrow$

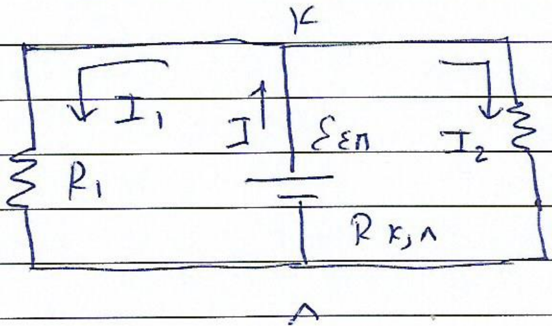
$\Rightarrow F = \frac{B^2 v_1 \ell^2}{R_{o\lambda}} \Rightarrow B = \sqrt{\frac{F \cdot R_{o\lambda}}{v_1 \cdot \ell^2}}$

$R_{o\lambda} = R_{1,2} + R_{\kappa\lambda} = \frac{R_1 \cdot R_2}{R_1 + R_2} + R_{\kappa\lambda} = 4\,\Omega$

άρα $\boxed{B = 1T}$

Γ4) Έχουμε ρεύμα στο κύκλωμα

από $t_1 = 2\ sec$ έως $t_2 = 5\ sec$



$$I = \frac{E_{επ}}{R_{ολ}} = \frac{B υ_1 l}{R_{ολ}} = 0,5A$$

$$V_{KΛ} = I \cdot R_{1,2} = 1V \quad \left(ή \ V_{KΛ} = E_{επ} - I \cdot R_{KΛ}\right)$$

$$I_2 = \frac{V_{KΛ}}{R_2} = \frac{1}{3}A$$

$$Q_2 = I_2^2 \cdot R_2 \cdot Δt = \frac{1}{9} \cdot 3 \cdot 3 = 1J$$

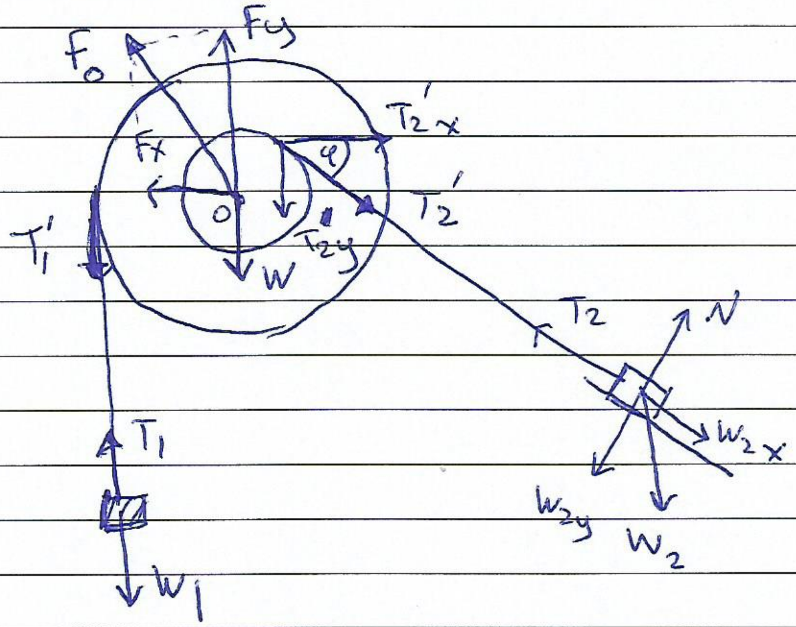
$$x_{ολ} = x_1 + x_2 = x_1 + υ_1 \cdot Δt = 2 + 6 = 8m$$

$$W_F = F \cdot x_{ολ} = 4J$$

άρα $Π\% = \frac{Q}{W_F} = 25\%$

Θέμα Δ

Δ1)



Για το Σ_2: $\Sigma F_{2x} = 0 \Rightarrow T_2 = m_2 g\, \eta\mu\varphi \Rightarrow T_2 = 30\,N$

Για τροχαλία: $\Sigma \tau_{(o)} = 0 \Rightarrow T_2' \cdot r - T_1' \cdot 2r = 0 \Rightarrow T_1' = 15\,N$

Για σώμα Σ_1: $\Sigma F_1 = 0 \Rightarrow W_1 = T_1 \Rightarrow \boxed{m_1 = 1,5\,Kg}$

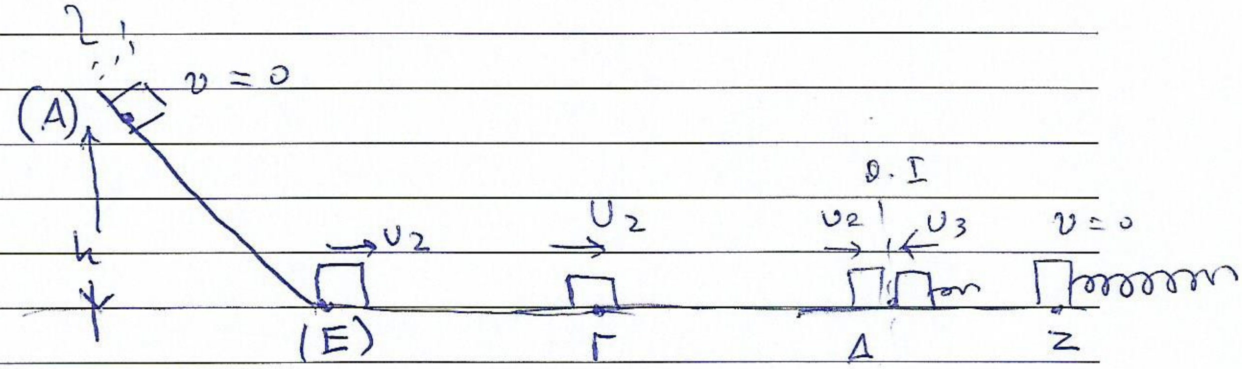
Για τροχαλία: $\Sigma F_x = 0 \Rightarrow F_x = T_2{}'_x \Rightarrow F_x = T_2' \cdot \sigma\upsilon\nu\varphi$

$\Rightarrow F_x = 24\,N$

$\Sigma F_y = 0 \Rightarrow F_y - T_1' - W - T_{2y} = 0 \Rightarrow F_y = 48\,N$

$F_o = \sqrt{F_x^2 + F_y^2} = \sqrt{24^2 + 48^2} = 24\sqrt{5}\,N$

Δ2|



Θ.Μ.Κ.Ε για Σ_2 ($A \to E$): $\frac{1}{2} m_2 \upsilon_2^2 - 0 = m_2 g h \Rightarrow$

$\Rightarrow |\upsilon_2| = 6\ m/s$

$\Delta t_2 = \Delta t_3 \Rightarrow \frac{(\Gamma\Delta)}{|\upsilon_2|} = \frac{T}{4} \Rightarrow T = \frac{4 \cdot \ell}{|\upsilon_2|}$

$\Rightarrow T = 0{,}4\pi\ sec$ και $\omega = \frac{2\pi}{T} = 5\ rad/s$

$D = m_3 \cdot \omega^2 \Rightarrow K = 5 \cdot 5^2 \Rightarrow$ $\boxed{K = 125\ N/m}$

Δ3| $|\upsilon_3| = \omega \cdot A = \omega \cdot d \Rightarrow \upsilon_3 = +1\ m/s$ ($\overset{(+)}{\leftarrow}$)

και $\upsilon_2 = -6\ m/s$

$m_2 = m_3$ άρα έχουμε ανταλλαγή ταχυτήτων

Δηλαδή

$\upsilon_2' = +1\ m/s$ και $\upsilon_3' = -6\ m/s$

$|\upsilon_3'| = \upsilon_{max} \Rightarrow |\upsilon_3'| = \omega \cdot A' \Rightarrow A' = 1{,}2\ m$

Για $t_0 = 0$: $x = 0$ και $\upsilon_3' < 0$ ... άρα $\varphi_0 = \pi\ rad$

$x = 1,2 \cdot ημ(5t + π)$ (S.I)

Δ4) $K = 8U_T \Rightarrow E - U_T = 8U_T \Rightarrow E = 9U_T$

$\Rightarrow |x| = \frac{A'}{3} \Rightarrow |x| = 0,4\ m$

Για $1^η$ φορά $x = -0,4\ m$

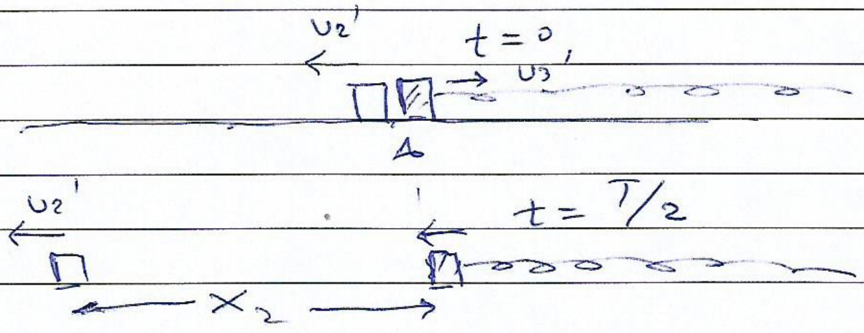
$$\frac{dP}{dt} = ΣF = -D \cdot x = -k \cdot x = -125 \cdot (-0,4) = +50\ N \quad \left(= kg\frac{m}{s^2}\right)$$

Α.Δ.Ε ταλ: $E_T = U_T + K \Rightarrow |υ| = ω\sqrt{A'^2 - x^2} \Rightarrow$

$$\Rightarrow |υ| = 5 \cdot \sqrt{1,2^2 - 0,4^2} = 5 \cdot 0,4 \cdot \sqrt{3^2 - 1^2} \Rightarrow |υ| = 4\sqrt{2}\ m/s$$

και $\left|\frac{dK}{dt}\right| = |-D \cdot x \cdot υ| = k \cdot |x| \cdot |υ| = 200\sqrt{2}\ J/s$

Δ5)



$$x_2 = |υ_2'| \cdot Δt = |υ_2'| \frac{T}{2} = |υ_3| \cdot \frac{T}{2} = 1 \cdot \frac{π}{5} = \frac{π}{5}\ m$$

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