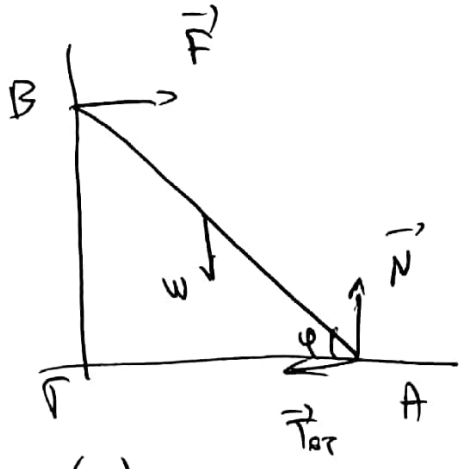
ΘΕΜΑ Α

Α1 γ Α2 δ Α3 γ Α4 β Α5 Σ, Λ, Σ Σ Λ

ΘΕΜΑ Β



Β1) $\Sigma\tau_{(A)} = 0 \Rightarrow w\frac{(A\Gamma)}{2} = F(B\Gamma) \Rightarrow$

$\frac{w}{2}\ell\sigma\upsilon\varphi = F\ell\eta\mu\varphi \Rightarrow w = 2F\varepsilon\varphi\varphi$

$F = T_{ΟΓ}$ $\quad N = w$

$T_{ΟΓ} \le \mu N \Rightarrow \frac{w}{2\varepsilon\varphi\varphi} \le \mu w \Rightarrow \mu \ge \frac{1}{2\varepsilon\varphi\varphi}$ → (ii)

Β2) $P_1 = \frac{w}{A} + \rho g\frac{H}{4} + P_{atm}$

$A_1 U_1 = A_2 U_2 \Rightarrow U_2 = 2U_1$

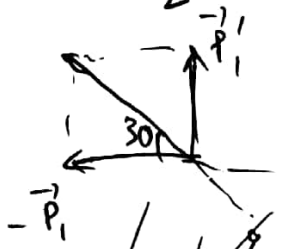
$U_2 = \sqrt{2gH}$

$P_1 + \frac{1}{2}\rho U_1^2 = P_{atm} + \frac{1}{2}\rho U_2^2 \Rightarrow P_{atm} + \frac{w}{A} + \rho g\frac{H}{4} + \frac{1}{2}\rho\frac{2gH}{4} =$

$P_{atm} + \frac{1}{2}\rho 2gH \Rightarrow \frac{w}{A} + \rho g\frac{H}{4} + \rho\frac{gH}{4} = \rho gH \Rightarrow$

$\frac{w}{A} = \frac{\rho gH}{2} \Rightarrow w = \frac{\rho gHA}{2}$ (i)

Β3)



$\sigma\upsilon\nu 30 = \frac{P_1'}{P_1} \Rightarrow \frac{\sqrt{3}}{2} = \frac{m_1 U_1'}{m_1 U_1} \Rightarrow U_1' = \frac{U_1\sqrt{3}}{2}$

$m_1 U_1' = 2m_1 V \Rightarrow V = \frac{U_1'}{2} = \frac{U_1\sqrt{3}}{6}$

$\frac{K_6}{K_1} = \frac{\frac{1}{2}2m\frac{U_1^2 3}{36}}{\frac{1}{2}mU_1^2} = \frac{1}{6}$

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ΘΕΜΑ Γ

$\ell = 1\ m \quad m = 0{,}5\ kg \quad R_{\kappa\lambda} = 2\ \Omega$

$v = V\eta\mu 5\pi t$ S.I. $\quad R_1 = 6\ \Omega,\ R_2 = 3\ \Omega$

Γ1) $\bar{P} = I_{\varepsilon\varphi}^2 R_1 \Rightarrow I_{\varepsilon\varphi} = \sqrt{2}\ A \qquad V_{\varepsilon\varphi} = I_{\varepsilon\varphi} R_1 = 6\sqrt{2}\ V$

$V = V_{\varepsilon\varphi} \cdot \sqrt{2} = 12\ V.$

Γ2) $f' \rightarrow 2f \rightarrow \omega' \rightarrow 2\omega \qquad V' = 2V = 24\ V$

$V'_{\varepsilon\varphi} = 12\sqrt{2}\ A,\ I'_{\varepsilon\varphi} = 2\sqrt{2}\ A$

$P_1 = i^2 R_1 = \frac{v^2}{R_1} = \frac{24 \cdot 24\eta\mu^2 1000\pi t}{6} = 96\eta\mu^2 1000\pi t$ S.I.

$t = 5 \cdot 10^{-3}\ s \qquad P_1 = 96\eta\mu^2 \frac{\pi}{2} = 96\ W$

Γ3) $\Sigma F = ma \Rightarrow F = ma \Rightarrow a = 1\ m/s^2$

$v = v_{op} = at = 2\ m/s$

$R_{1,2} = \frac{R_1 R_2}{R_1 + R_2} = 2\ \Omega$

$R_{o\lambda} = 4\ \Omega$

$v_{op} = \frac{F R_{o\lambda}}{B^2 \ell^2} \Rightarrow 2 = \frac{0{,}5 \cdot 4}{B^2 1} \Rightarrow$

$B = 1\ T.$

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~~$\Delta K = W_F + W_{F_L} = W_{F_L} = -F \cdot \Delta x_2 = -3\ J$~~

$I = \frac{B v_{op} l}{R_{eq}} = \frac{1}{2}\ A$

$V_n = I R_{eq} = 1\ V \qquad Q_2 = \frac{V_n}{R_2} \cdot \Delta t = \frac{1}{3} \cdot 3 = 1\ J$

$\Delta x_1 = \frac{1}{2} a t_1^2 = 2\ m \qquad \Delta x_2 = v_{op} \Delta t = 6\ m$

$W_F = F(\Delta x_1 + \Delta x_2) = 4\ J$

$\frac{Q_2}{W_F} = \frac{1}{4} \rightarrow 25\%$

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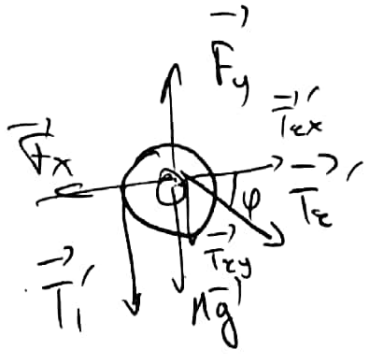
ΘΕΜΑ Δ.

$M = 1,5\,kg$
$m_2 = 5\,kg$
$m_3 = 5\,kg$
$d = 0,2\,m$



$T_2 = m_2 g \cdot \frac{4}{5} = 30\,N$

Δ1) $\Sigma\tau_{(O)} = 0 \Rightarrow T_1' \cdot 2r = T_2' \cdot r \Rightarrow 2m_1 g = m_2 g \cdot \frac{4}{5} \Rightarrow$

$m_1 = \frac{3}{2}\,kg$.

$F_x = T_{2x}' = T_2' \cos\varphi = 24\,N$.

$F_y = T_1' + Mg + T_2 \cdot \frac{4}{5} = 15 + 15 + 18 = 48\,N$

$F = \sqrt{24^2 + 48^2} = 24\sqrt{5}\,N$.

Δ2) $\frac{1}{2} m_2 v_2^2 = m_2 g h \Rightarrow v_2 = 6\,m/s$

$\Delta t_2 = \frac{T}{4} \Rightarrow \frac{\ell}{v_2} = \frac{T}{4} \Rightarrow \frac{3\pi}{30} = \frac{T}{4} \Rightarrow T = \frac{2\pi}{5}\,s \quad \omega = 5\,rad/s$

$k = m_3 \omega^2 = 125\,N/m$.

Δ3) $v_3 = \omega \cdot d = 1\,m/s$

$v_3' = \frac{2m_2 v_2}{m_3 + m_2} + \frac{(m_3 - m_2) v_3}{m_3 + m_2} \Rightarrow v_3' = -6\,m/s$.

$|v_3'| = v_{max} = \omega A' \Rightarrow A' = 1,2\,m$

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

Δ4) $K = 8U \Rightarrow E = 9U \Rightarrow A^2 = 9x^2 \Rightarrow x = \pm 0,4\,m$

Για πρώτη φορά $(v < 0)$ $x = -0,4\,m$.

$\frac{dp}{dt} = \Sigma F = -kx = 50\,N$.

$K = E - U = \frac{1}{2} k (A^2 - x^2) = \frac{125}{2}(1,44 - 0,16) = \frac{125}{2} \cdot 1,28 \Rightarrow$

$\frac{1}{2} m v_{cm}^2 = \frac{125}{2} \cdot 1,28 \Rightarrow |v| = 5 \cdot 0,8\sqrt{2} = 4\sqrt{2}\,m/s \overset{v<0}{\Rightarrow} v = -4\sqrt{2}\,m/s$

$\frac{dK}{dt} = \frac{dp}{dt} \cdot v = -200\sqrt{2}\,J/s$.

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