Λύσεις διαγωνίσματος Γ' λυκείου 30 Μαΐου 2021

ΘΕΜΑ Α

Α1-α Α2-β Α3-γ Α4-α Α5 ΣΛΣΣΣ

ΘΕΜΑ Β

Β1-γ $y = \frac{1}{2}gt^2 \xrightarrow{y=\frac{3h}{4}} \frac{3h}{4} = \frac{1}{2}g t_{\epsilon\delta}^2 \Rightarrow t_{\epsilon\delta} = \sqrt{\frac{3}{2}\frac{h}{g}}$

$x = u \cdot t_{\epsilon\delta} \Rightarrow \frac{3}{2}h = u\sqrt{\frac{3h}{2g}} \Rightarrow \frac{9}{4}h^2 = u^2\frac{3h}{2g} \Rightarrow u^2 = \frac{3}{2}gh$

Bernoulli: $P + \rho g\frac{h}{4} = P_{atm} + \frac{1}{2}\rho u^2 \Rightarrow P + \rho g\frac{h}{4} = P_{atm} + \frac{1}{2}\rho\frac{3}{2}gh$

$\Rightarrow P = P_{atm} + \frac{3}{4}\rho gh - \frac{1}{4}\rho gh \Rightarrow \boxed{P = P_{atm} + \frac{1}{2}\rho gh}$

Β2-α $\Pi_1, \Pi_3: f_{\delta 13} = f_3 - f_1 \rightarrow f_{\delta 13} = \frac{N_{13}}{\Delta t_1} \Rightarrow f_3 - f_1 = 4\,Hz$ ①

$\Pi_2, \Pi_3: f_{\delta 23} = f_3 - f_2 \longrightarrow f_{\delta 23} = \frac{N_{23}}{\Delta t_2} \Rightarrow f_3 - f_2 = 3\,Hz$ ②

① − ② $\Rightarrow f_3 - f_1 - f_3 + f_2 = 4Hz - 3Hz \Rightarrow f_2 - f_1 = 1Hz = f_{\delta 12}$

$\Pi_1, \Pi_2: f_{\delta 12} = \frac{N_{12}}{\Delta t_1} \Rightarrow N_{12} = f_{\delta 12}\cdot\Delta t_1 \Rightarrow \boxed{N_{12} = 5}$

Β3-α $\bar{P}_1 = \bar{P}_2 \Rightarrow I_{\epsilon v_1}^2 \cdot R_1 = I_{\epsilon v_2}^2 R_2$

$\Rightarrow \left(\frac{V_{\epsilon v_1}}{R_{o\lambda 1}}\right)^2 R = \left(\frac{V_{\epsilon v_2}}{R_{o\lambda 2}}\right)^2 \cdot 4R \Rightarrow \frac{V_{\epsilon v_1}}{R_{o\lambda 1}} = 2\frac{V_{\epsilon v_2}}{R_{o\lambda 2}}$

$\Rightarrow \frac{N\omega_1 BA}{\sqrt{2}\cdot 2R} = 2\frac{N\omega_2 BA}{\sqrt{2}\cdot 6R} \Rightarrow \frac{\omega_1}{2} = \frac{2\omega_2}{6} \Rightarrow \boxed{\omega_2 = 1,5\omega_1}$

ΘΕΜΑ Γ

$m = 0,8kg$ $l = 1m$ $R_1 = 0,3\Omega$ $R_2 = 0,2\Omega$ $B_1 = 1\,T$ $h_1 = 1m$ $B_2 = 2T$ $h_2 = 0,8m$

$u = 3m/s$ $h_3 = 0,15m$ $k = 60\,N/m$.

Γ1 α) $\Delta q = \frac{\Delta\Phi}{R_{o\lambda}} = \frac{B_1 l\cdot h_1}{R_1+R_2} = \frac{1\cdot 1\cdot 1}{0,5}\,C \Rightarrow \boxed{\Delta q = 2C}$

β) ΑΔΕ $K_{\alpha\epsilon\chi}^{\nearrow 0} + W_{mg} = K_{\tau\epsilon\lambda} + Q_{R_{o\lambda}}$

$mgh = \frac{1}{2}mu^2 + Q_{R_{o\lambda}} \Rightarrow 8 = 3,6 + Q_{R_{o\lambda}}$

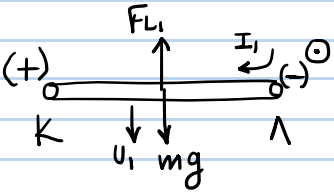
$\Rightarrow \boxed{Q_{R_{o\lambda}} = 4,4\,J}$

Η μείωση της δυναμικής ενέργειας μέσω του έργου βάρους μετατρέπεται σε κινητική ενέργεια και σε θερμότητα στις αντιστάσεις

Γ2) $I_1 = 4A \rightarrow I_1 = \frac{\mathcal{E}_{επ1}}{R_{ολ}} \Rightarrow I = \frac{B_1 v_1 \ell}{R_{ολ}} \Rightarrow v_1 = \frac{I R_{ολ}}{B_1 \cdot \ell} \Rightarrow v_1 = 2\,m/s.$

α) $\frac{dQ_{R_2}}{dt} = P_{R_2} = I_1^2 R_2 = 4^2 \cdot 0,2\ W \Rightarrow \boxed{\frac{dQ_{R_2}}{dt} = P_{R_2} = 3,2\,J/s}$

β)

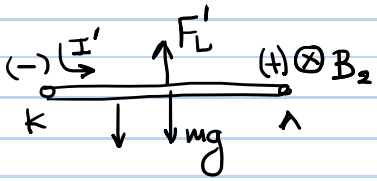


$F_{L_1} = B_1 I_1 \ell = 4N$

$$\frac{dE_{MHX}}{dt} = \frac{dK}{dt} + \frac{dU}{dt} = \Sigma F \cdot v_1 - mg v_1 = (mg - F_{L_1}) v_1 - mg v_1$$

$$\Rightarrow \frac{dE_{MHX}}{dt} = -F_{L_1} \cdot v_1 = -4 \cdot 2\ J/s \Rightarrow \boxed{\frac{dE_{MHX}}{dt} = -8\ J/s}$$

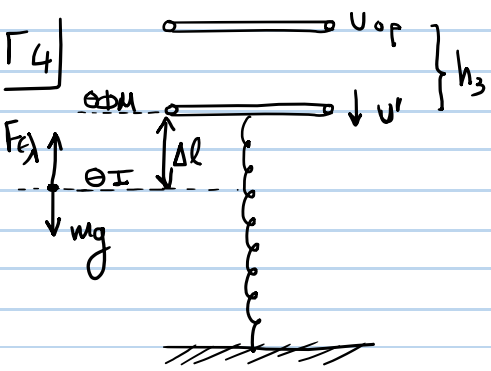
Γ3) $v_{op} \rightarrow \Sigma F' = 0 \Rightarrow F_L' = mg$



$$\Rightarrow B_2 I' \ell = mg \Rightarrow B_2 \frac{\mathcal{E}'_{επ}}{R_{ολ}} \ell = mg$$

$$\Rightarrow B_2 \frac{B_2 v_{op} \cdot \ell}{R_{ολ}} \ell = mg \Rightarrow v_{op} = \frac{mg \cdot R_{ολ}}{B_2^2 \cdot \ell^2} \Rightarrow \boxed{v_{op} = 1\,m/s}$$

Γ4)



ΘΜΚΕ: $\frac{1}{2}mv'^2 - \frac{1}{2}mv_{op}^2 = mgh_3$

$$v' = \sqrt{v_{op}^2 + 2gh_3}$$

$$v' = \sqrt{1+3} \Rightarrow v' = 2\,m/s.$$

ΘΙ $\Sigma F = 0 \Rightarrow F_{ελ} = mg \Rightarrow k\Delta\ell = mg$

$$\Rightarrow \Delta\ell = \frac{mg}{k} = \frac{8}{60} \Rightarrow \Delta\ell = \frac{2}{15}\,sec.$$

ΑΔΕΤ στη ΘΦΜ: $E = K + U \Rightarrow \frac{1}{2}kA^2 = \frac{1}{2}mv'^2 + \frac{1}{2}k\Delta\ell^2$

$D = k$

$$\Rightarrow A^2 = \frac{m}{k}v'^2 + \Delta\ell^2 = \frac{0,8 \cdot 4}{60} + \left(\frac{2}{15}\right)^2 = \frac{0,8}{15} + \frac{4}{225}$$

$$\Rightarrow A^2 = \frac{0,8 \cdot 15}{15^2} + \frac{4}{225} = \frac{16}{225} \Rightarrow A = \frac{4}{15}\,m$$

Στην κάτω ακραία $v = 0 \rightarrow \left|\frac{dP}{dt}\right| = |\Sigma F| = |-kA| = \left|-60\,\frac{4}{15}\right|$

$$\boxed{\left|\frac{dP}{dt}\right| = 16\,N}$$

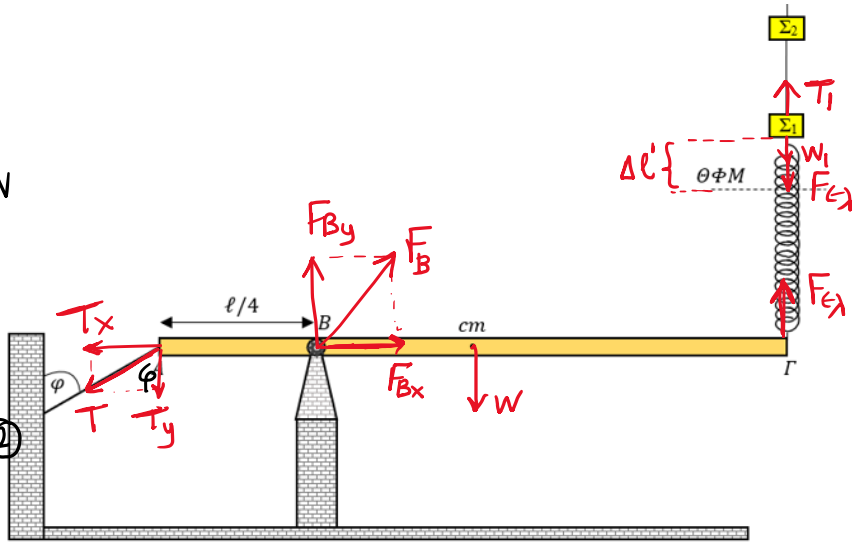
ΘΕΜΑ Δ

$W = 50N \quad W_{τρoχ} = 10\sqrt{5}N$

$\varphi = 60^o \quad k = 100 N/m$

$r = 0,1m \quad R = 0,2m$

$m_1 = m_2 = 1kg \quad F_{ελ} = 10N$



Δ1) Ισορροπία δοκού

$\Sigma F_x = 0 \Rightarrow F_{Bx} = T_x$ (1)

$\Sigma F_y = 0 \Rightarrow F_{ελ} + F_{By} = T_y + W$ (2)

$\Sigma \tau_B = 0 \Rightarrow \tau_{Ty} + \tau_{Fελ} - \tau_W = 0$

$\Rightarrow T_y \frac{\ell}{4} = W\frac{\ell}{4} - F_{ελ}\frac{3\ell}{4} \Rightarrow T_y = W - 3F_{ελ} = 50 - 30 \Rightarrow T_y = 20N$

$\Rightarrow T \cdot \sigma\upsilon\nu\varphi = 20N \Rightarrow T\frac{1}{2} = 20N \Rightarrow \boxed{T = 40N}$

(1) $\Rightarrow F_{Bx} = T\eta\mu\varphi = 40\frac{\sqrt{3}}{2} \Rightarrow F_{Bx} = 20\sqrt{3}N$

(2) $\Rightarrow 10 + F_{By} = 20 + 50 \Rightarrow F_{By} = 60N$

$\vec{F_B} = \vec{F_{Bx}} + \vec{F_{By}} \longrightarrow F_B = \sqrt{F_{Bx}^2 + F_{By}^2} = \sqrt{1200 + 3600} = \sqrt{4800}\,N$

$\Rightarrow \boxed{F_B = 40\sqrt{3}N}$

Δ2) Ισορροπία Σ_1 : $\Sigma F_1 = 0 \Rightarrow T_1 = w_1 + F_{ελ}$

$\Rightarrow T_1 = m_1 g + F_{ελ} \Rightarrow T_1 = 20N$

Ισορροπία Σ_2 : $\Sigma F_2 = 0 \Rightarrow T_2 = T_1 + W_2$

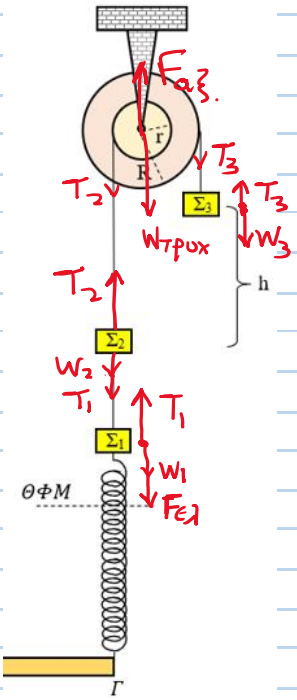
$\Rightarrow T_2 = T_1 + m_2 g \Rightarrow T_2 = 30N.$

Διπλή τροχαλία : $\Sigma \tau = 0 \Rightarrow \tau_{T_2} = \tau_{T_3}$

$\Rightarrow T_2 \cdot r = T_3 R \Rightarrow T_3 = \frac{r}{R} T_2 \Rightarrow T_3 = 15N$

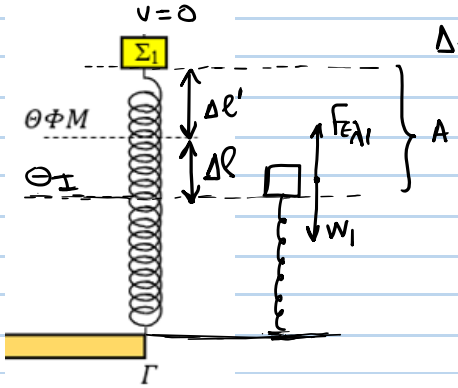
Ισορροπία Σ_3 : $\Sigma F_3 = 0 \Rightarrow T_3 = W_3 = m_3 g$

$\Rightarrow 15 = 10 m_3 \Rightarrow \boxed{m_3 = 1,5kg}$



Δ3) ΘΙ(αατ) $\Sigma F_1 = 0 \Rightarrow F_{ελ1} = W_1 \Rightarrow k\Delta\ell = m_1 g$

$\Delta\ell = \frac{m_1 g}{k} = 0,1\,m$



πλάτος αατ

$A = \Delta\ell' + \Delta\ell$

$A = 0,2\,m$

όπου $F_{ελ} = 10N$

$k\Delta\ell' = 10N$

$100\,\Delta\ell' = 10$

$\Delta\ell' = 0,1m$

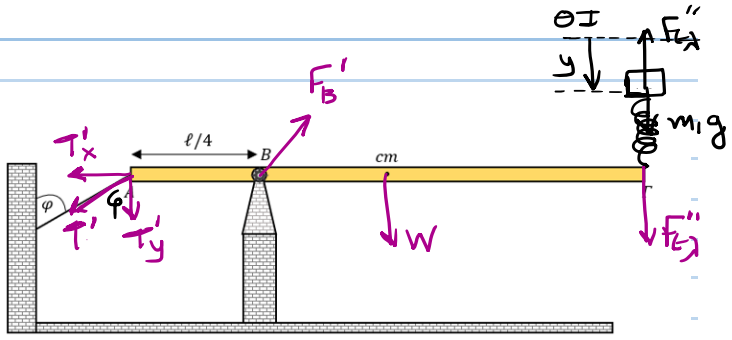
$\Sigma \tau_B' = 0 \Rightarrow \tau_{T_y'} - \tau_W - \tau_{F_{\epsilon\lambda}''} = 0$

$T_y' \frac{\ell}{4} = W \frac{\ell}{4} + F_{\epsilon\lambda}'' \frac{3\ell}{4}$

$T_y' = W + 3F_{\epsilon\lambda}''$

$T' \sin\varphi = W + 3F_{\epsilon\lambda}''$

$(T' = T_{op} = 220N)$



$220 \frac{1}{2} = 50 + 3F_{\epsilon\lambda}'' \Rightarrow F_{\epsilon\lambda}'' = 20N \Rightarrow k(\Delta\ell + |y|) = 20N$

$100(0,1 + |y|) = 20 \Rightarrow |y| = 0,1m$

ΑΔΕΤ στη σφαίρα που κυλάει το νήμα

$E = K + U \Rightarrow \frac{1}{2} kA^2 = \frac{1}{2} m_1 v^2 + \frac{1}{2} k y^2 \Rightarrow v^2 = \frac{k}{m_1}(A^2 - y^2)$

$\Rightarrow v^2 = \frac{100}{1}\left(\frac{4}{100} - \frac{1}{100}\right) \Rightarrow \boxed{v = \sqrt{3}\, m/s}$

Δ4)

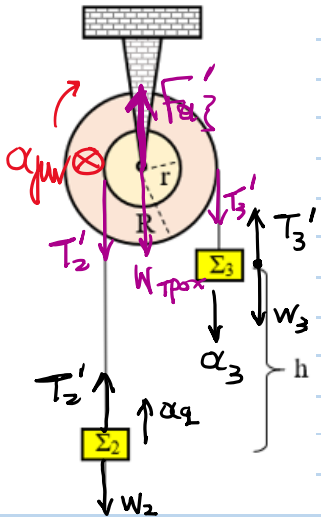
α) $t_1 = 0,4\,sec \rightsquigarrow y_2 + y_3 = h$

$\Rightarrow r\theta + R\theta = h \Rightarrow \frac{R}{2}\theta + R\theta = h \Rightarrow \frac{3R}{2}\theta = h$

$\Rightarrow \theta = \frac{2h}{3R} = \frac{2 \cdot 0,24}{3 \cdot 0,2} \Rightarrow \theta = 0,8\,rad$

$\theta = \frac{1}{2} a_{\gamma\omega} t_1^2 \Rightarrow a_{\gamma\omega} = \frac{2\theta}{t_1^2} = \frac{2 \cdot 0,8}{0,16}$

$\Rightarrow a_{\gamma\omega} = 10\,rad/s^2$



β) $\Sigma F_2' = m_2 a_2 \qquad a_2 = r a_{\gamma\omega} = 1\,m/s^2$

$\Rightarrow T_2' - W_2 = m_2 a_2 \Rightarrow T_2' = m_2 g + m_2 a_2 \Rightarrow T_2' = 11\,N$

$\Sigma F_3' = m_3 a_3 \qquad a_3 = R a_{\gamma\omega} = 2\,m/s^2$

$\Rightarrow W_3 - T_3' = m_3 a_3 \Rightarrow T_3' = m_3 g - m_3 a_3 \Rightarrow T_3' = 12\,N$

Για τροχαλία $\Sigma F_y' = 0 \Rightarrow F_{\alpha\xi}' = T_2' + T_3' + W_{τροχ} \Rightarrow \boxed{F_{\alpha\xi}' = 128N}$

γ) $v_2 = a_2 t_2 = 1 \cdot 0,5 = 0,5\,m/s.$

$\frac{dU_2}{dt} = -\frac{dW_{W_2}}{dt} = -(-W_2 v_2) = +m_2 g v_2 \Rightarrow \boxed{\frac{dU_2}{dt} = +5\,J/s}$