Μοριοδότηση 2018

Ενδεικτικές απαντήσεις και από γραπτά μαθητών

Θέμα Α

A1 - γ

A2 - δ

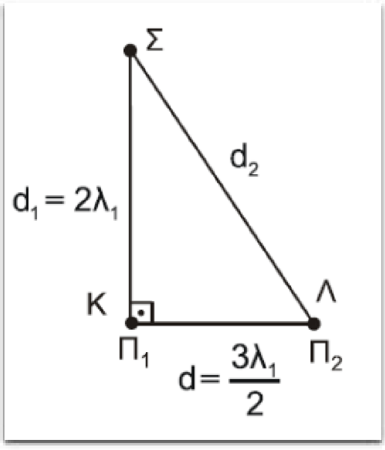
A3 - α

A4 - δ

A5: $\Lambda - \Sigma - \Lambda - \Sigma - \Lambda$

Θέμα Β

B1-(i)



$$d_2 = \sqrt{d_1^2 + d^2} = \sqrt{4 \cdot \lambda_1^2 + \frac{9}{4} \cdot \lambda_1^2} = \frac{5 \cdot \lambda_1}{2}$$

Ίδιο υλικό

$$v_\delta = \lambda_1 \cdot f_1 = \lambda_2 \cdot f_2 \xrightarrow{f_2 = 2 \cdot f_1} \lambda_2 = \frac{\lambda_1}{2}$$

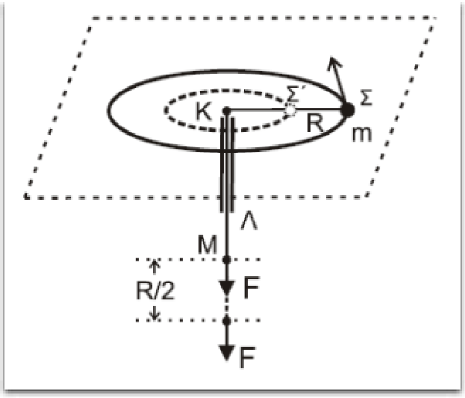
α) <u>τρόπος</u>

$$|A_\Sigma| = |2A \cdot \sigma\upsilon\nu \frac{2\pi(d_1 - d_2)}{2\lambda_2}| = |2A \cdot \sigma\upsilon\nu \frac{\pi(\frac{3\lambda_1}{2} - \frac{5\lambda_1}{2})}{\frac{\lambda_1}{2}}| = |2\mathrm{A}|$$

β) <u>τρόπος</u>

$$\left.\begin{array}{c} d_1 - d_2 = \frac{3\lambda_1}{2} - \frac{5\lambda_1}{2} = -\lambda_1 = -2\lambda_2 \\ d_1 - d_2 = N \cdot \lambda_2 \end{array}\right\} \mathrm{N} = -2 \quad \varepsilon\nu\acute{\iota}\sigma\chi\upsilon\sigma\eta$$

B2 - (iii)



m: $\Sigma\vec{\tau}_{\varepsilon\xi(K)} = \vec{0} \Rightarrow \Delta\vec{L} = \vec{0} \Rightarrow \vec{L_1} = \vec{L_2}$

Η τάση του νήματος διέρχεται από τον άξονα περιστροφής

α) τρόπος

Άρα $m \cdot \upsilon_1 \cdot R = m \cdot \upsilon_2 \cdot \frac{R}{2} \Rightarrow \upsilon_2 = 2\upsilon_1$

$$\mathbf{\Theta MKE}_m(\Sigma \to \Sigma') \quad \mathrm{K}_{\Sigma'} - \mathrm{K}_{\Sigma} = W_F \Rightarrow \frac{1}{2} \cdot m \cdot \upsilon_2^2 - \frac{1}{2} \cdot m \cdot \upsilon_1^2 = W_F$$

$$\left.\begin{matrix} W_F = \frac{3}{2} \cdot m \cdot \upsilon_1^2 \\ \\ \upsilon_1 = \omega \cdot R \end{matrix}\right\} W_F = \frac{3}{2} \cdot m \cdot \omega^2 \cdot R^2$$

β) τρόπος

$$I_1 \cdot \omega = \mathrm{I}_2 \cdot \omega' \Rightarrow m \cdot R^2 \cdot \omega = m \cdot \frac{R^2}{4} \cdot \omega' \Rightarrow \omega' = 4\omega$$

$$\mathbf{\Theta MKE}_m(\Sigma \to \Sigma') \quad \mathrm{K}_{\Sigma'} - \mathrm{K}_{\Sigma} = W_F \Rightarrow \frac{1}{2} \cdot \mathrm{I}_2 \cdot \omega'^2 - \frac{1}{2} \cdot \mathrm{I}_1 \cdot \omega^2 = W_F \Rightarrow W_F = \frac{1}{2} m \frac{R^2}{4} 16\omega^2 - \frac{1}{2} m \cdot R^2 \omega^2 \Rightarrow W_F = \frac{3}{2} \cdot m \cdot \omega^2 \cdot R^2$$

Β3 - (ι)

Εξίσωση Bernoulli για μια ρευματική γραμμή $(\Gamma \to \Delta)$

$$P_\Gamma + \frac{1}{2}\rho \cdot \upsilon_\Gamma^2 = P_\Delta + \frac{1}{2}\rho \cdot \upsilon_\Delta^2 + \rho \cdot g \cdot h$$

Εξίσωση συνέχειας $(\Gamma \to \Delta)$

$$\Pi_\Gamma = \Pi_\Delta \Rightarrow \mathrm{A}_\Gamma \cdot \upsilon_\Gamma = \mathrm{A}_\Delta \cdot \upsilon_\Delta \overset{A_\Gamma = 2A_\Delta}{\Longrightarrow} \upsilon_\Delta = 2\upsilon_\Gamma$$

Οριζόντια βολή $(\Delta \to \mathrm{K})$

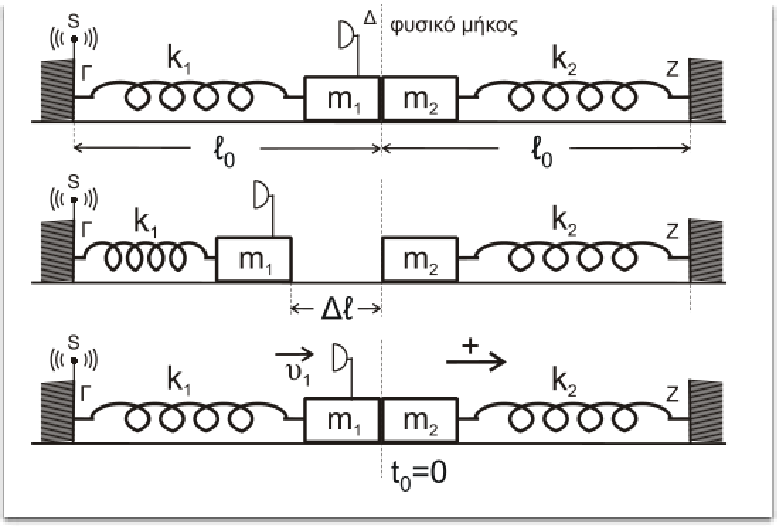
$$\left.\begin{matrix} h = \frac{1}{2} g \cdot t^2 \\ \\ 4h = \upsilon_\Delta \cdot t \end{matrix}\right\} 4h = \upsilon_\Delta \cdot \sqrt{\frac{2h}{g}} \Rightarrow \upsilon_\Delta^2 = 8g \cdot h \overset{\upsilon_\Delta = 2\upsilon_\Gamma}{\Longrightarrow} 4\upsilon_\Gamma^2 = 8g \cdot h \Rightarrow \upsilon_\Gamma^2 = 2g \cdot h \Rightarrow g \cdot h = \frac{\upsilon_\Gamma^2}{2}$$

Άρα η εξίσωση Bernoulli γράφεται

$$P_\Gamma - P_\Delta = \frac{1}{2}\rho \cdot \upsilon_\Delta^2 + \rho \cdot g \cdot h - \frac{1}{2}\rho \cdot \upsilon_\Gamma^2 = \frac{1}{2}\rho \cdot 4\upsilon_\Gamma^2 + \rho \cdot \frac{\upsilon_\Gamma^2}{2} - \frac{1}{2}\rho \cdot \upsilon_\Gamma^2 = 2\rho \cdot \upsilon_\Gamma^2$$

Θέμα Γ

Γ1



$$k_1 = k_2 = k$$

$$m_1 = m_2 = m$$

$$\Delta l = 0.4m = A_1$$

$$K_1 - m, \quad \text{AAT}: D_1 = k_1 = m_1 \cdot \omega_1^2 \Rightarrow \omega_1 = \sqrt{\frac{k}{m}} = 5\frac{rad}{sec}$$

$$\upsilon_{max1} = \omega_1 \cdot A_1 = \sqrt{\frac{k}{m}} \cdot \Delta l = 2\frac{m}{sec}$$

$$f_1 = \frac{\upsilon_{\eta\chi} - \upsilon_{max1}}{\upsilon_{\eta\chi}} \cdot f_s$$

$$\text{ΑΔΟ} \quad m_1, m_2 \quad (\Theta.\text{I.}) \quad m_1 \cdot \upsilon_{max1} = (m_1 + m_2) \cdot V \Rightarrow V = 1\frac{m}{sec}$$

$$f_2 = \frac{\upsilon_{\eta\chi} - V}{\upsilon_{\eta\chi}} \cdot f_s$$

$$\frac{f_1}{f_2} = \frac{\upsilon_{\eta\chi} - \upsilon_{max1}}{\upsilon_{\eta\chi} - V} = \frac{338}{339}$$

Γ2

$$(m_1 + m_2):$$

Στη θέση Θ.Φ.Μ. $\Sigma F = 0$ άρα αυτή είναι και Θ.Ι.

$$\text{T.}\,\Theta.: \Sigma F = -F_{\text{ΕΛ}1} - F_{\text{ΕΛ}2} = -k_1 \cdot x - k_2 \cdot x = -(2k)x$$

Για να εκτελεί ένα σώμα ΑΑΤ πρέπει να ισχύει

$$\Sigma F = -D \cdot x, \quad \text{άρα} \quad D = 2k = (m_1 + m_2)\omega^2 \Rightarrow \omega = \sqrt{\frac{2k}{2m}} = \sqrt{\frac{k}{m}} = 5\frac{rad}{sec}, \quad T = \frac{2\pi}{\omega} = \frac{2\pi}{5} sec$$

$$\Theta.\text{I.}: V = \upsilon_{max} \overset{\upsilon_{max} = \omega \cdot A}{\Longrightarrow} 1 = 5 \cdot A \Rightarrow A = 0.2m$$

Γ3

$$\left.\begin{array}{r} h = f_{\text{ΔΕΚΤΗ}} = f_s \\ f_{\text{ΔΕΚΤΗ}} = \frac{\upsilon_{\eta\chi} \pm \upsilon_{\Sigma\Upsilon\Sigma}}{\upsilon_{\eta\chi}} \cdot f_s \end{array}\right\} \upsilon_{\Sigma\Upsilon\Sigma} = 0$$

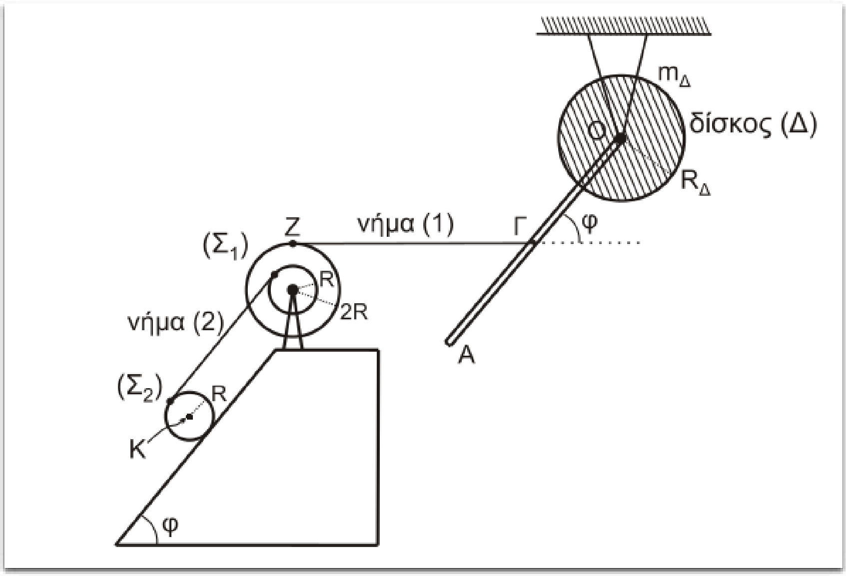
Για πρώτη φορά, δηλαδή ακραία θέση, οπότε

$$\Delta t = \frac{T}{4} = \frac{\pi}{10} sec$$

Γ4

$$|\frac{dp}{dt}|_{m_1+m_2(max)} = \Sigma F_{max} = D\cdot A \overset{D=100}{\Longrightarrow} \Sigma F_{max} = 20N, \quad ή \quad \frac{kg\cdot m}{sec^2}$$

Θεμα Δ



Ράβδος (ρ)

$$M = 8kg$$

$$l = 3m$$

Δίσκος (Δ)

$$m_\Delta = 4kg$$

$$R_\Delta = \frac{\sqrt{2}}{2}m$$

Τροχαλία (τροχ)

$$R = 0.2m$$

$$I_{\tau\rho o\chi} = 1.95kg\cdot m^2$$

Κύλινδρος

$$m = 30kg$$

$$R = 0.2m$$

$$\eta\mu\varphi = 0.8$$

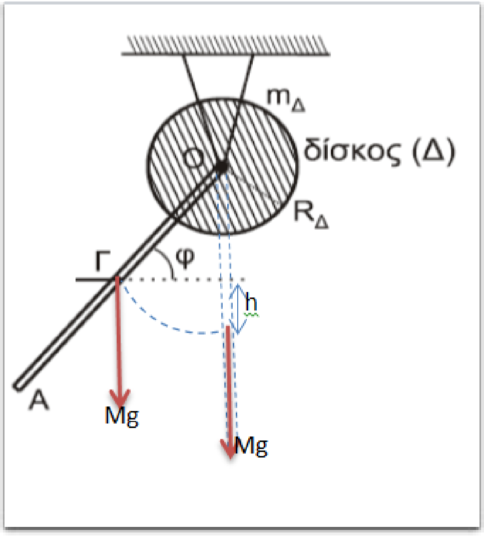
$$\sigma\upsilon\nu\varphi = 0.6$$

$$g = 10\frac{m}{sec^2}$$

Δ1

$$I_{\rho-\Delta} = (\frac{1}{12}\cdot M\cdot l^2 + M\frac{l^2}{4}) + \frac{1}{12}\cdot m_\Delta\cdot R_\Delta^2 = 25kg\cdot m^2$$

Δ2



$$|\frac{dL}{dt}|_{\rho-\Delta} = \Sigma\tau_{(0)} = W_\rho \cdot \frac{l}{2} \cdot \sigma\upsilon\nu\varphi = 72\frac{kg \cdot m^2}{sec^2} \quad ή \quad N \cdot m$$

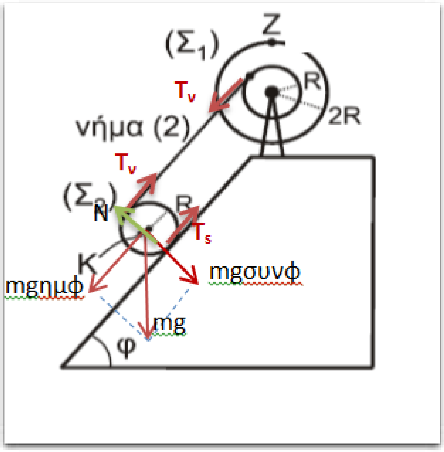
Δ3

α) τρόπος

$$\mathrm{A\Delta ME}_{\rho-\Delta}(\mathrm{I} \to II) : K_I + U_1 = K_{II} + U_{II} \Rightarrow 0 + (-M \cdot g \cdot \frac{l}{2} \cdot \eta\mu\varphi + U_{\beta\alpha\rho(\Delta)(\mathrm{I}))}) = \mathrm{K_{II}} + (-\mathrm{M} \cdot g \cdot \frac{l}{2} + U_{\beta\alpha\rho(\Delta)(II))})$$

$$K_{II} = M \cdot g \cdot \frac{l}{2} \cdot (1 - \eta\mu\varphi) \Rightarrow K_{II} = 24J$$

Δ4



νήμα(2) αβαρές, μη εκτατό $(\mathrm{T_2} = \mathrm{T_2'})$

ΚΧΟ:

$$\upsilon_{\mathrm{B}} = 2 \cdot \upsilon_{cm} = 2 \cdot \omega \cdot R \Rightarrow \alpha_{\mathrm{B}} = 2 \cdot \alpha_{cm} = 2 \cdot \alpha_{\gamma\omega\nu} \cdot R$$

$$\upsilon_{\mathrm{B}} = \upsilon_H = \omega_{\tau\rho o\chi} \cdot R \Rightarrow \alpha_{\mathrm{B}} = \alpha_{\mathrm{H}} = \alpha_{\gamma\omega\nu_{\tau\rho o\chi}} \cdot R$$

$$m : \quad MET \quad \Sigma F_x = m \cdot \alpha_x \Rightarrow W_x - T_{\sigma\tau} - \mathrm{T_2} = m \cdot \alpha_{cm} \quad (1)$$

$$\mathrm{\Sigma TPO\Phi.} \quad \Sigma\tau = \mathrm{I} \cdot \alpha_{\gamma\omega\nu} \Rightarrow T_{\sigma\tau} \cdot R - T_2 \cdot R = \frac{1}{2} \cdot m \cdot R^2 \cdot \alpha_{\gamma\omega\nu} \overset{\alpha_{cm} = \alpha_{\gamma\omega\nu} \cdot R}{\Longrightarrow} T_{\sigma\tau} - \mathrm{T_2} = \frac{1}{2} \cdot m \cdot \alpha_{cm} \quad (2)$$

$$(1)\Lambda(2) \Rightarrow W_x - 2T_2 = \frac{3}{2} \cdot m \cdot \alpha_{cm} \quad (3)$$

$$\tau\rho o\chi : \quad \Sigma\tau = \mathrm{I} \cdot \alpha_{\gamma\omega\nu} \Rightarrow T_2' \cdot R = 1.95 \cdot \alpha_{\gamma\omega\nu(\tau\rho o\chi)} \underset{(3)}{\overset{\alpha_{\gamma\omega\nu(\tau\rho o\chi)} = \frac{2\alpha_{cm}}{R}}{\Longrightarrow}}$$

$$W_x - 2 \cdot \frac{1.95 \cdot \frac{2\alpha_{cm}}{R}}{R} = \frac{3}{2} \cdot m \cdot \alpha_{cm}$$

$$300 \cdot 0.8 - \frac{4 \cdot 1.95 \cdot \alpha_{cm}}{4 \cdot 10^{-2}} = 45 \cdot \alpha_{cm} \Rightarrow \alpha_{cm} = 1\frac{m}{sec^2}$$

$$\alpha_{cm} = \alpha_{\gamma\omega\nu} \cdot R \Rightarrow \alpha_{\gamma\omega\nu} = 5\frac{rad}{sec^2}$$

κύλινδρος:

α) τρόπος

$$s = \frac{1}{2} \cdot \alpha_{cm} \cdot t^2 \Rightarrow t = 2sec$$

$$\upsilon_{cm} = \alpha_{cm} \cdot t \Rightarrow \upsilon_{cm} = 2\frac{m}{sec}$$

β) τρόπος

$$\Theta\mathrm{MKE}_{\mathrm{O}\to S} : K_{\tau\varepsilon\lambda} - \mathrm{K}_{\alpha\rho\chi} = \Sigma W \Rightarrow (\frac{1}{2} \cdot m \cdot \upsilon_{cm}^2 + \frac{1}{2} \cdot m \cdot R^2 \cdot \omega^2) - 0 = (\Sigma F_x) \cdot S + (\Sigma\tau) \cdot \Delta\theta$$

$$\Sigma F_x = m \cdot \alpha_{cm}$$

$$\Sigma\tau = \mathrm{I} \cdot \alpha_{\gamma\omega\nu}$$

$$\frac{3}{4} \cdot m \cdot \upsilon_{cm}^2 = m \cdot \alpha_{cm} \cdot s + \frac{1}{2} \cdot m \cdot R^2 \cdot \alpha_{\gamma\omega\nu} \cdot \Delta\theta \xrightarrow[\Delta\theta \cdot R = S]{\alpha_{\gamma\omega\nu} \cdot R = \alpha_{cm}}$$

$$\frac{3}{4} \cdot m \cdot \upsilon_{cm}^2 = m \cdot \alpha_{cm} \cdot s + \frac{1}{2} \cdot m \cdot \alpha_{cm} \cdot s \Rightarrow \frac{3}{4} \cdot m \cdot \upsilon_{cm}^2 = \frac{3}{2} \cdot \alpha_{cm} \cdot S \Rightarrow \upsilon_{cm} = 2\frac{m}{sec}$$

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