ΦΥΣΙΚΗ ΚΑΤΕΥΘΥΝΣΗΣ 2014
ΑΠΑΝΤΗΣΕΙΣ ΘΕΜΑΤΩΝ

ΘΕΜΑ Α

Α.1 γ
Α.2 β
Α.3 γ
Α.4 β
Α.5 Σ, Σ, Λ, Λ, Σ

ΘΕΜΑ Β

Β.1 (iii)

$$v_1 = v_{\max(1)} = \omega_1 . A_1 = \sqrt{\frac{k}{m}} . d \quad (1)$$

$$A.\Delta.O\text{:}\ m_1 . v_1 = (m_1 + m_2) . v_\kappa \Longrightarrow m . v_1 = 2m . v_\kappa \Longrightarrow v_1 = 2v_\kappa \quad (2)$$

$$v_\kappa = v_{max(2)} = \omega_2 . A_2 = \sqrt{\frac{2k}{2m}} . A_2 \quad (3)$$

Από συνδυασμό των σχέσεων (1), (2), (3) προκύπτει ότι: $\boldsymbol{\frac{A_1}{A_2} = 2}$

Β.2 (ii)

$$f_\delta = \frac{1}{T_\delta} \Longrightarrow f_\delta = 0{,}5\ Hz$$

$$f_\delta = f_1 - f_2 \Longrightarrow f_1 - f_2 = 0{,}5\ Hz \quad (1)$$

$$f = \frac{N}{T_\delta} \Longrightarrow f = 100\ Hz$$

$$f = \frac{f_1 + f_2}{2} \Longrightarrow f_1 + f_2 = 200\ Hz \quad (2)$$

Από συνδυασμό των σχέσεων (1), (2) προκύπτει ότι:

$$\boldsymbol{f_1 = 100{,}25\ Hz\ , f_2 = 99{,}75\ Hz}$$

Β.3 (iii)

$$\upsilon_1^{'} = \frac{m_1 - m_2}{m_1 + m_2}.\upsilon_1 \quad (1)$$

$$\upsilon_2^{'} = \frac{2m_1}{m_1 + m_2}.\upsilon_1 \quad (2)$$

$$\upsilon_2^{''} = -\upsilon_2^{'} \quad (3)$$

$$d = \sigma\tau\alpha\theta. \Longrightarrow \upsilon_1^{'} = \upsilon_2^{''} \Longrightarrow \frac{m_1 - m_2}{m_1 + m_2}.\upsilon_1 = -\frac{2m_1}{m_1 + m_2}.\upsilon_1 \Longrightarrow \boldsymbol{\frac{m_1}{m_2} = \frac{1}{3}}$$

ΘΕΜΑ Γ

Γ.1

$$t_2 = \frac{r_2}{\upsilon_\delta} \Longrightarrow \boldsymbol{r_2 = 1m} \quad , \qquad t_1 = \frac{r_1}{\upsilon_\delta} \Longrightarrow \boldsymbol{r_1 = 7m}$$

Γ.2

$$3T = 1{,}4 - 0{,}2 = 1{,}2s \Longrightarrow \boldsymbol{T = 0{,}4s}$$

$$f = \frac{1}{T} \Longrightarrow \boldsymbol{f = 2{,}5\ Hz}$$

$$\upsilon_\delta = \lambda.f \Longrightarrow \boldsymbol{\lambda = 2m}$$

$$0 \le t < 0{,}2s: \quad \boldsymbol{y = 0}$$

$$0{,}2s \le t < 1{,}4s: \quad y = A.\eta\mu 2\pi\left(\frac{t}{T} - \frac{r_2}{\lambda}\right) \Longrightarrow \boldsymbol{y = 5.10^{-3}\eta\mu(5\pi t - \pi)} \quad (\boldsymbol{S.I})$$

$$t \ge 1{,}4s: \quad y = 2A.\sigma\upsilon\nu 2\pi\left(\frac{r_1 - r_2}{2\lambda}\right).\eta\mu 2\pi\left(\frac{t}{T} - \frac{r_1 + r_2}{2\lambda}\right) \Longrightarrow$$

$$\boldsymbol{y = -10.10^{-3}\eta\mu(5\pi t - 4\pi)} \quad (\boldsymbol{S.I})$$

Γ.3

$$\omega = 2\pi f \Longrightarrow \boldsymbol{\omega = 5\pi\ rad/s}$$

$$K + U = E \Longrightarrow \frac{1}{2}m\upsilon^2 + \frac{1}{2}m\omega^2 y^2 = \frac{1}{2}m\omega^2 A^2 \Longrightarrow \boldsymbol{|\upsilon| = 25\pi.10^{-3}\ m/s}$$

Γ.4

$$\frac{K_1}{K_2}=\frac{E_1}{E_2}=\frac{\frac{1}{2}m\omega_1^2A_1^2}{\frac{1}{2}m\omega_2^2A_2^2}=\left(\frac{\omega_1}{\omega_2}\right)^2.\left(\frac{A_1}{A_2}\right)^2=\left(\frac{f_1}{f_2}\right)^2.\left(\frac{A_1}{A_2}\right)^2 \quad (1)$$

$$\upsilon_\delta=\lambda.f=\lambda'.f' \Longrightarrow \lambda'=1{,}8m$$

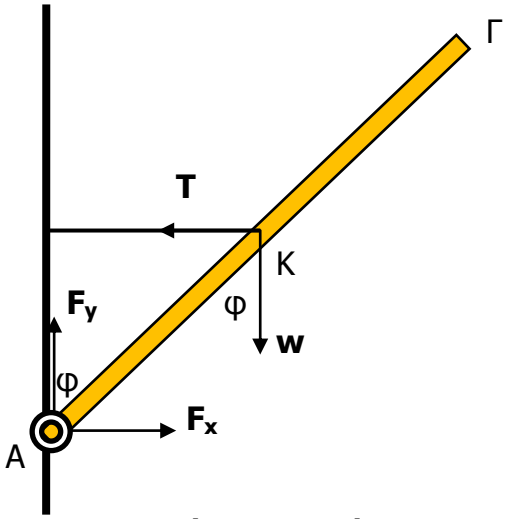
$$A_2=2A.\left|\sigma\upsilon\nu 2\pi\left(\frac{r_1-r_2}{2\lambda'}\right)\right| \Longrightarrow A_2=0{,}5.10^{-2}\,m \quad (2)$$

Από συνδυασμό των (1), (2) προκύπτει ότι:

$$\boldsymbol{\frac{K_1}{K_2}=\frac{81}{25}}$$

ΘΕΜΑ Δ

Δ.1



$$\Sigma\tau_{(A)}=0 \Longrightarrow -Mg.\frac{l}{2}.\eta\mu\varphi+T.\frac{l}{2}.\sigma\upsilon\nu\varphi=0 \Longrightarrow \boldsymbol{T=42\ N}$$

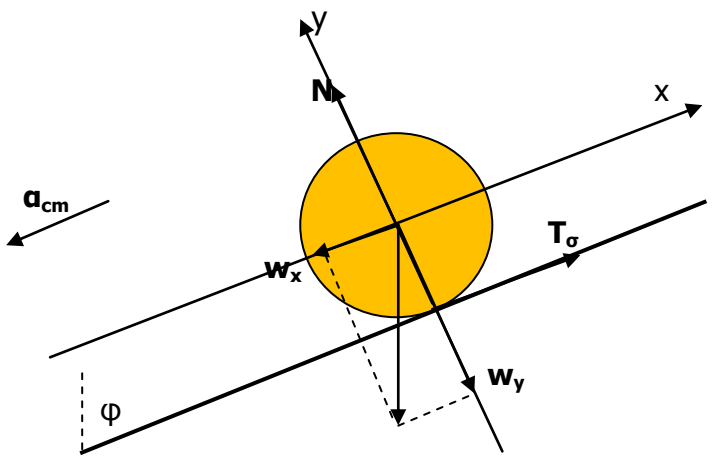
$$\Sigma F_x=0 \Longrightarrow F_x-T=0 \Longrightarrow \boldsymbol{F_x=42\ N}$$

$$\Sigma F_y=0 \Longrightarrow F_y-w=0 \Longrightarrow \boldsymbol{F_y=56\ N}$$

$$F=\sqrt{F_x^2+F_y^2} \Longrightarrow \boldsymbol{F=70\ N}$$

$$\varepsilon\varphi\theta = \frac{F_y}{F_x} \Longrightarrow \boldsymbol{\varepsilon\varphi\theta = \frac{4}{3}}$$

Δ.2



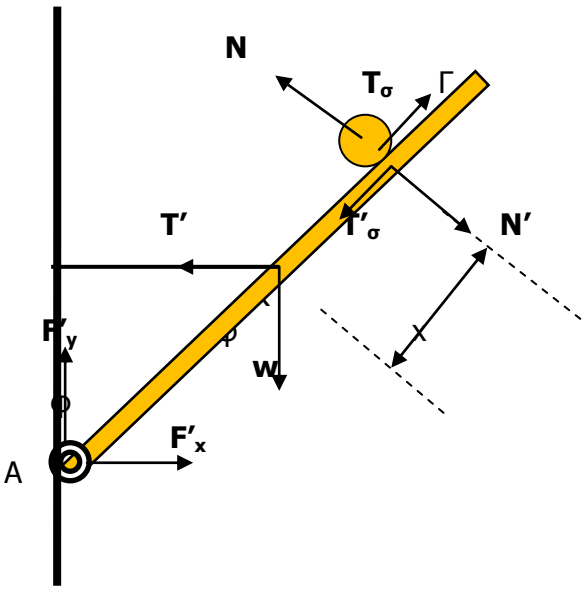
$$\Sigma\tau_{(cm)} = I_{cm}.\alpha_\gamma \Longrightarrow T_\sigma.r = \frac{2}{5}.m.r^2.\alpha_\gamma \Longrightarrow T_\sigma = \frac{2}{5}.m.r.\alpha_\gamma \quad (1)$$

$$\Sigma F_x = m.a_{cm} \Longrightarrow m.g.\sigma\upsilon\nu\varphi - T_\sigma = m.a_{cm} \quad (2)$$

$$a_{cm} = \alpha_\gamma.r \quad (3)$$

Από συνδυασμό των (1), (2), (3) προκύπτει ότι: $\boldsymbol{\alpha_\gamma = 400\ rad/s^2}$

Δ.3



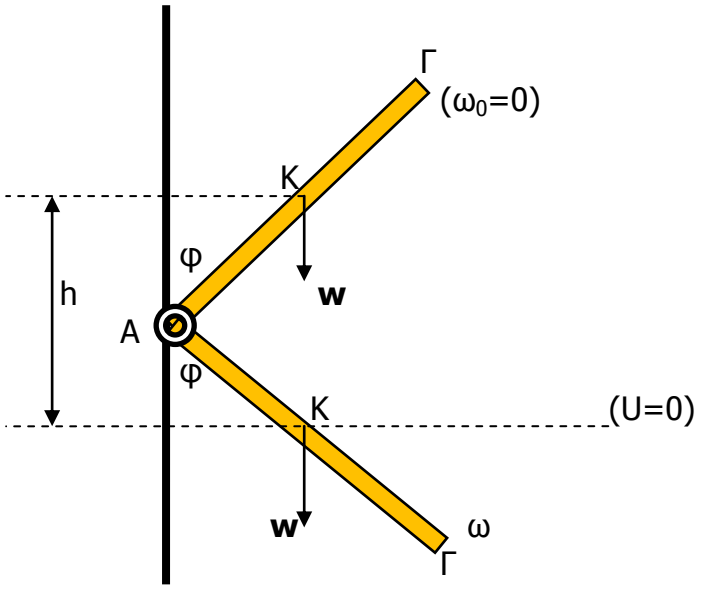
$$\Sigma\tau_{(A)} = 0 \Longrightarrow -N^{'}.\left(\frac{l}{2}+x\right) - Mg.\frac{l}{2}.\eta\mu\varphi + T^{'}.\frac{l}{2}.\sigma\upsilon\nu\varphi = 0 \Longrightarrow 0{,}8.T^{'} = N^{'}.(1+x) \quad (1)$$

$$N^{'} = N \quad (2) \ \Delta\rho\acute{\alpha}\sigma\eta - \alpha\nu\tau\acute{\iota}\delta\rho\alpha\sigma\eta$$

$$\Sigma F_y = 0 \Longrightarrow N - m.g.\eta\mu\varphi = 0 \Longrightarrow N = 2{,}4\ N \quad (3)$$

Από συνδυασμό των (1), (2), (3) προκύπτει ότι: $\boldsymbol{T^{'} = 45 + 3x\ (S.I)} \quad \boldsymbol{0 \le x < 1m}$

Δ.4



$$\frac{dK}{dt} = P_{\Sigma\tau} = \Sigma\tau.\omega = \tau_w.\omega \ \ (1)$$

$$\tau_w = Mg.\frac{l}{2}.\eta\mu\varphi \ \Longrightarrow \boldsymbol{\tau_w = 33{,}6\ N.m} \ \ (2)$$

$$A.\Delta.M.E\text{:}\ K_{(\alpha\rho\chi)} + U_{(\alpha\rho\chi)} = K_{(\tau\varepsilon\lambda)} + U_{(\tau\varepsilon\lambda)} \Longrightarrow Mgh = \frac{1}{2}.\frac{1}{3}.M.l^2.\omega^2 \Longrightarrow$$

$$\Longrightarrow g.2.\frac{l}{2}.\sigma\upsilon\nu\varphi = \frac{1}{6}.l^2.\omega^2 \Longrightarrow \boldsymbol{\omega = \sqrt{24}\frac{rad}{s}} \ \ (3)$$

Από συνδυασμό των (1), (2), (3) προκύπτει ότι:

$$\frac{dK}{dt} = \boldsymbol{67{,}2\sqrt{6}\ J/s}$$

Δ.4

$$\pi\% = \frac{K_{o\lambda(\alpha\rho\chi)} - K_{o\lambda(\tau\varepsilon\lambda)}}{K_{o\lambda(\alpha\rho\chi)}}.100\% \quad (1)$$

$$K_{o\lambda(\alpha\rho\chi)} = \frac{1}{2}.I.\omega^2 \quad (2)$$

$$K_{o\lambda(\tau\varepsilon\lambda)} = \frac{1}{2}.I_{o\lambda}.{\omega_\kappa}^2 \quad (3)$$

$$I_{o\lambda} = I + I' = \frac{1}{3}.M.l^2 + \frac{1}{3}.3M.l^2 = \frac{4}{3}.M.l^2 \Longrightarrow \boldsymbol{I_{0\lambda} = 4I} \quad (4)$$

$$A.\Delta.\Sigma\text{:}\ \ L_{o\lambda(\alpha\rho\chi)} = L_{o\lambda(\tau\varepsilon\lambda)} \Longrightarrow I.\omega = I_{o\lambda}.\omega_\kappa \Longrightarrow I.\omega = 4I.\omega_\kappa \Longrightarrow \boldsymbol{\omega_\kappa = \frac{\omega}{4}} \quad (5)$$

Από συνδυασμό των (3), (4), (5) προκύπτει ότι:

$$K_{o\lambda(\tau\varepsilon\lambda)} = \frac{1}{2}.4I.\frac{\omega^2}{16} \Longrightarrow \boldsymbol{K_{o\lambda(\tau\varepsilon\lambda)} = \frac{1}{4}K_{o\lambda(\alpha\rho\chi)}} \quad (6)$$

Από συνδυασμό των (1), (6) προκύπτει ότι: $\boldsymbol{\pi\% = 75\%}$