ΦΥΣΙΚΗ ΚΑΤΕΥΘΥΝΣΗΣ

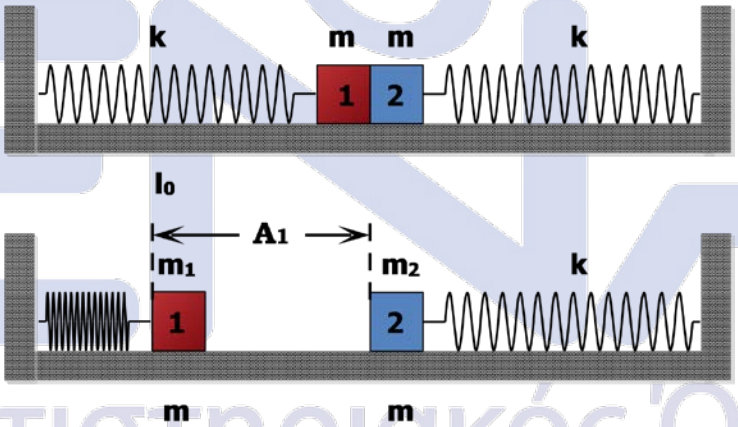
ΘΕΜΑ Α

Α1→γ
Α2→β
Α3→γ
Α4→β

Α5. α→Σωστό
β→Σωστό
γ→Λάθος
δ→Λάθος
ε→Σωστό

ΘΕΜΑ Β

Β1. Σωστό είναι το (iii).



ΑΔΟ

$$\vec{P}_{\alpha\rho\chi} = \vec{P}_{\tau\varepsilon\lambda} \Leftrightarrow mu_1 = 2mV \Leftrightarrow \omega_1 A_1 = 2\omega_2 A_2 \Leftrightarrow \frac{A_1}{A_2} = \frac{2\omega_2}{\omega_1} = \frac{2\sqrt{\frac{2m}{2k}}}{\sqrt{\frac{m}{k}}} = 2$$

Β2. Σωστό είναι το (ii).

$$T_\sigma = \frac{1}{|f_1 - f_2|} \Leftrightarrow |f_1 - f_2| = 0{,}5 \Leftrightarrow \boxed{f_1 - f_2 = \pm 0{,}5}\ (1)$$

Όμως

$$f = \frac{N}{t} \Leftrightarrow f = \frac{200}{2} = 100\ Hz$$

Επομένως

$$\frac{f_1 + f_2}{2} = 100 \Leftrightarrow \boxed{f_1 + f_2 = 200\ Hz}\ (\mathbf{2})$$

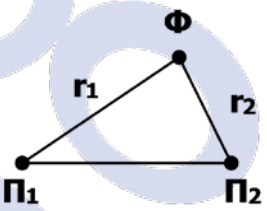
Από (1) και (2) έχουμε

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

Β3. Σωστό είναι το (iii).

$$u_1' = -u_2 \Leftrightarrow \frac{m_1 - m_2}{m_1 + m_2} \cdot u_1 = -\frac{2m_1}{m_1 + m_2} \cdot u_1 \Leftrightarrow 3m_1 = m_2 \Leftrightarrow \frac{m_1}{m_2} = \frac{1}{3}$$

ΘΕΜΑ Γ



Γ1.

$$u = \frac{\lambda}{T} \Leftrightarrow \lambda = 2\ m$$
$$3T = 1{,}2 \Leftrightarrow T = 0{,}4\ s$$
$$\omega = \frac{2\pi}{0{,}4} = 5\pi\ (r/s)$$
$$r_2 = u \cdot t_2 = 5 \cdot 0{,}2 = 1\ m$$
$$r_1 = u \cdot t_1 = 5 \cdot 1{,}4 = 7\ m$$

Γ2.

$$y(t) = \begin{cases} 0, & t < 0{,}2 \\ 5 \cdot 10^{-3} \cdot \eta\mu\left(2\pi\left(\frac{t}{0{,}4} - \frac{1}{2}\right)\right), & 0{,}2 \le t < 1{,}4 \\ -10^{-2}\eta\mu\big(2\pi(2{,}5 \cdot t - 2)\big), & t \ge 1{,}4 \end{cases}$$

Γ3. Εφαρμόζοντας ΑΔΕΤ προκύπτει ότι το μέτρο της ταχύτητας είναι

$$u = \left|\pm\omega\sqrt{A^2 - y^2}\right| \Leftrightarrow u = 5\pi\sqrt{10^{-4} - 25 \cdot 3 \cdot 10^{-6}} = 5\pi\sqrt{10^{-4} - 0{,}75 \cdot 10^{-4}} =$$

$$= 5\pi \cdot 10^{-2}\sqrt{\frac{1}{4}} = \pm\frac{5\pi \cdot 10^{-2}}{2} = 2{,}5\pi \cdot 10^{-2}\ m/s$$

Γ4.

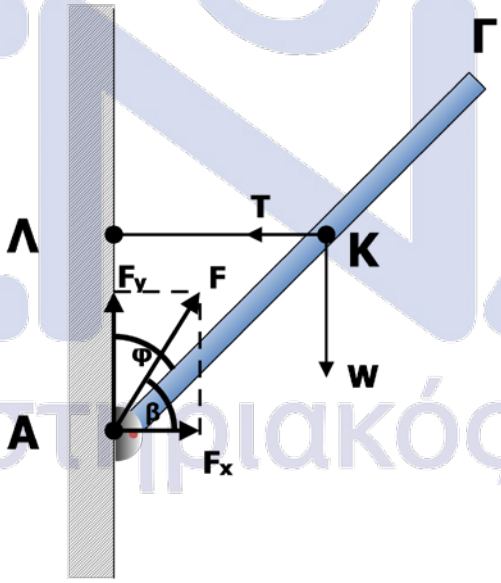
$$f_2 = \frac{10}{9}f_1 \Leftrightarrow \frac{u}{\lambda_2} = \frac{10}{9}\cdot\frac{u}{\lambda_1} \Leftrightarrow \lambda_2 = \frac{9}{10}\lambda_1 = \frac{9}{5}\ m$$

$$A' = \left|2A\sigma\upsilon\nu\left(2\pi\frac{r_1 - r_2}{2\lambda_2}\right)\right| = 2A\left|\sigma\upsilon\nu\left(2\pi\frac{1-7}{2\cdot\frac{9}{5}}\right)\right| = A$$

$$\left.\begin{aligned} D_2 &= m\cdot\omega_2^2 = m\left(\frac{10}{9}\omega_1\right)^2 = \frac{100}{81}D_1 \\ K_1 &= \frac{1}{2}D_1A_1^2 = \frac{1}{2}D_1(2A)^2 \\ K_2 &= \frac{1}{2}D_2A_2^2 = \frac{1}{2}D_2A^2 = \frac{1}{2}\cdot\frac{100}{81}D_1A^2 \end{aligned}\right\} \Leftrightarrow \frac{K_1}{K_2} = \frac{81}{25} = 3{,}24$$

ΘΕΜΑ Δ

Δ1.



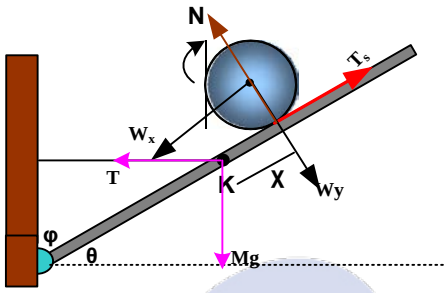
$$\Sigma\tau_A = 0 \Rightarrow T(A\Lambda) - W\cdot(K\Lambda) = 0 \Rightarrow T\sigma\upsilon\nu\varphi\cdot\frac{l}{2} - M\cdot g\cdot\eta\mu\varphi\cdot\frac{l}{2} = 0 \Rightarrow T = 42\ N$$

$$\Sigma F = 0 \Rightarrow \begin{cases}\Sigma F_x = 0\\ \Sigma F_y = 0\end{cases} \Rightarrow \begin{cases} F_x - T = 0\\ F_y - Mg = 0\end{cases} \Rightarrow \begin{cases}F_x = 42\ N\\ F_y = 56\ N\end{cases}$$

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

$$\varepsilon\varphi\beta = \frac{F_y}{F_x} \Rightarrow \varepsilon\varphi\beta = \frac{4}{3}$$

Δ2)



σφαίρα : ΣΥΝΘΕΤΗ

Μεταφορική: $\boxed{\Sigma\vec{F}_x = m\cdot\vec{a}_{cm}} \Rightarrow T_s - W_x = ma_{cm} \Rightarrow \boxed{T_S - mg\eta\mu\theta = ma_{cm}}$ (1)

Στροφική : $\boxed{\Sigma\vec{\tau}_{cm} = I_{cm}\cdot\vec{\alpha}_{\gamma\omega v}} \Rightarrow -T_s R = \frac{2}{5}mR^2 a_{\gamma\omega v} \Rightarrow \boxed{-T_s = \frac{2}{5}ma_{cm}}$ (2)

και προσθέτουμε κατά μέλη (1) + (2) :

$$-mg\eta\mu\theta = ma_{cm} + \frac{2}{5}ma_{cm} \Rightarrow -mg\eta\mu\theta = \frac{7}{5}ma_{cm} \Rightarrow a_{cm} = -\frac{5}{7}g\eta\mu\theta \Rightarrow a_{cm} = -\frac{5}{7}\cdot 10\cdot\frac{8}{10} \Rightarrow a_{cm} = -\frac{40}{7}m/s^2$$

$$a_{cm} = a_{\gamma\omega v}R \Rightarrow a_{\gamma\omega v} = \frac{a_{cm}}{R} \Rightarrow a_{\gamma\omega v} = \frac{-\frac{40}{7}}{\frac{1}{70}} rad/s^2 \Rightarrow a_{\gamma\omega v} = -400 rad/s^2$$

Δ3)

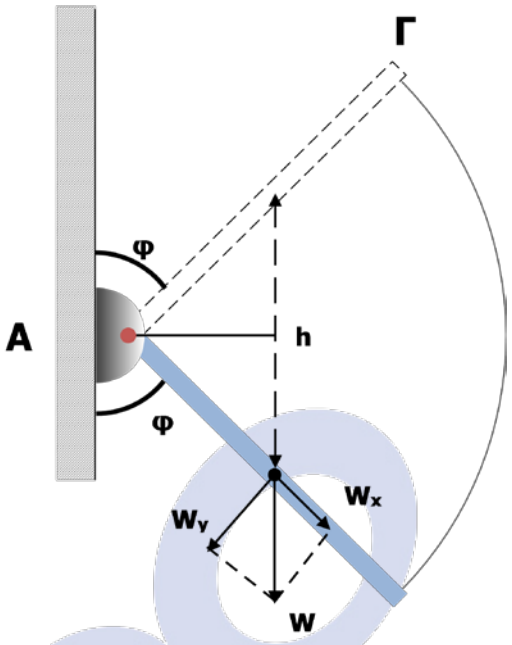
Καθώς η σφαίρα ανεβαίνει , η ράβδος ισορροπεί στροφικά

$$\Sigma\vec{\tau}_{(A)} = 0 \Rightarrow -T\cdot\frac{L}{2}\eta\mu\theta + W\cdot\frac{L}{2}\sigma\upsilon\nu\theta + w_y\cdot(\frac{L}{2}+x) = 0 \Rightarrow$$

$$-T\cdot\frac{L}{2}\eta\mu\theta + Mg\cdot\frac{L}{2}\sigma\upsilon\nu\theta + mg\sigma\upsilon\nu\theta\cdot(\frac{L}{2}+x) = 0 \Rightarrow -T\cdot\frac{8}{10} + 56\cdot\frac{6}{10} + 4\cdot\frac{6}{10}\cdot(1+x) = 0 \Rightarrow$$

$$T = 45 + 3\chi \quad , με\ \chi \in [0,1]m$$

Δ4)



Ο ρυθμός μεταβολής κινητικής ενέργειας της ράβδου είναι

$$\frac{dK}{dt}=\Sigma\tau\cdot\omega\Rightarrow\frac{dK}{dt}=Mg\frac{L}{2}\eta\mu\varphi\cdot\omega\ (1)$$

Όπου ω από ΘΜΚΕ

$$K_{\tau\varepsilon\lambda}-K_{\alpha\rho\chi}=w_{\beta\alpha\rho}\Rightarrow\frac{1}{2}I_A\omega^2=Mgh\Rightarrow\frac{1}{2}\cdot\frac{1}{3}ML^2\omega^2=MgL\eta\mu\theta\Rightarrow$$

$$\frac{1}{6}L\omega^2=10\cdot\frac{8}{10}\Rightarrow\omega=\sqrt{24}rad/s\Rightarrow\omega=2\sqrt{6}rad/s$$

$$\alpha\rho\alpha\qquad\frac{dK}{dt}=56\cdot\frac{6}{10}\cdot2\sqrt{6}J/s\Rightarrow\frac{dK}{dt}=67,2\sqrt{6}J/s$$

Δ5)

Από αρχή διατήρησης της στρόφορμης

Η νέα ράβδος αφού έχει μάζα 3Μ, η ροπή αδράνειας της θα είναι $I_2=3I$

$$\vec{L}_{\pi\rho\iota\nu}=\vec{L}_{\mu\varepsilon\tau\alpha}\Rightarrow I\omega=(I+I')\omega_k\Rightarrow I\omega=4I\omega_k\Rightarrow\omega_k=\frac{\omega}{4}$$

$$\text{Άρα}:\ Q\%=\frac{Q}{K_{\alpha\rho\chi}}100\%\Rightarrow Q\%=(1-\frac{K_{\tau\varepsilon\lambda}}{K_{\alpha\rho\chi}})100\%\Rightarrow Q\%=\left(1-\frac{\frac{1}{2}(4I)\omega_k^2}{\frac{1}{2}I\omega^2}\right)100\%\Rightarrow$$

$$Q\%=\left(1-\frac{4I\frac{\omega^2}{16}}{I\omega^2}\right)100\%=\left(1-\frac{1}{4}\right)100\%\Rightarrow Q\%=75\%$$