

**ΠΑΝΕΛΛΑΔΙΚΕΣ ΕΞΕΤΑΣΕΙΣ
Γ' ΤΑΞΗΣ ΗΜΕΡΗΣΙΟΥ ΓΕΝΙΚΟΥ ΛΥΚΕΙΟΥ ΚΑΙ ΕΠΑΛ (ΟΜΑΔΑ Β')
ΤΡΙΤΗ 10 ΙΟΥΝΙΟΥ 2014
ΕΞΕΤΑΖΟΜΕΝΟ ΜΑΘΗΜΑ: ΦΥΣΙΚΗ
ΘΕΤΙΚΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ (ΚΑΙ ΤΩΝ ΔΥΟ ΚΥΚΛΩΝ)**

ΘΕΜΑ Α

A1: γ

A2: β

A3: γ

A4: β

A5:

α. Σ

β. Σ

γ. Λ

δ. Λ

ε. Σ

B1: Σωστό το iii)

Εφόσον το αφήνουμε ελεύθερο σε απόσταση d από Θ.Ι είναι $A_1 = d$ πλαστική κρούση:

$$\left. \begin{aligned} \text{Εφαρμόζω Α.Δ.Ο: } m_1 u_1 + 0 &= (m_1 + m_2) u_\sigma \Rightarrow u_1 = 2u_\sigma \quad (m_1 = m_2) \\ u_1 = u_{\max(i)} = \omega_1 A_1 &\Rightarrow u_1 = \sqrt{\frac{\kappa}{m_1}} A_1 \\ u_\sigma = u_{\max(\sigma)} = \omega_\sigma A_2 &\Rightarrow u_\sigma = \sqrt{\frac{2\kappa}{2m_1}} A_2 \Rightarrow u_\sigma = \sqrt{\frac{\kappa}{m_1}} A_2 \end{aligned} \right\} \Rightarrow \sqrt{\frac{\kappa}{m_1}} A_1 = 2 \sqrt{\frac{\kappa}{m_1}} A_2 \Rightarrow \frac{A_1}{A_2} = 2$$

B2: Σωστό το ii)

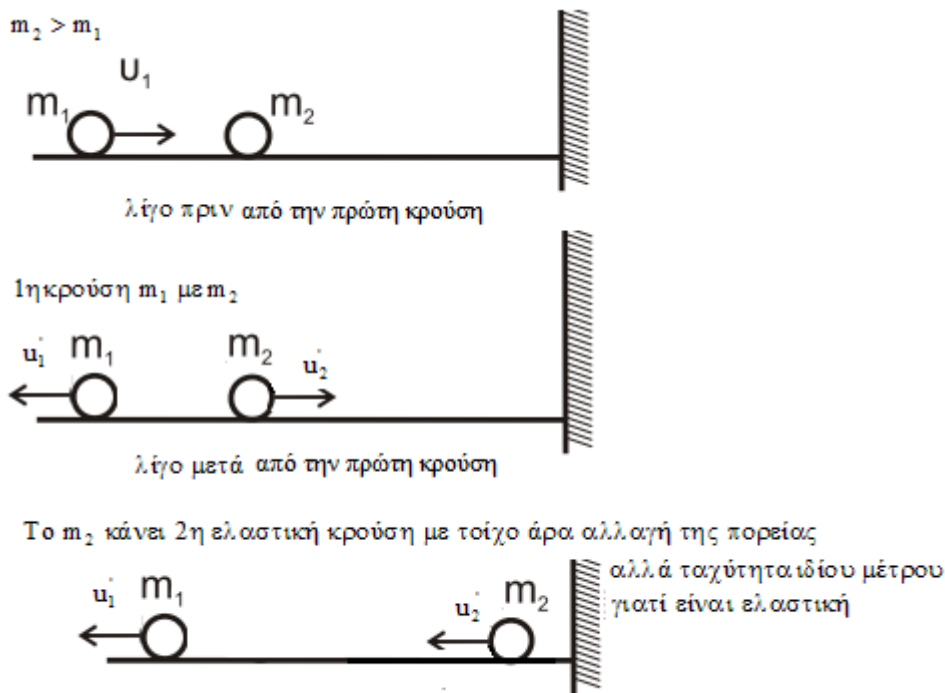
$$T_\Delta = \frac{1}{|f_1 - f_2|} \xrightarrow{f_1 > f_2} T_\Delta = \frac{1}{f_1 - f_2} \Rightarrow f_1 - f_2 = \frac{1}{T_\Delta} = \frac{1}{2} = 0,5 \text{ Hz}$$

$$\left. \begin{aligned} T_{\text{ταλ}} = \frac{2\pi}{\omega} = \frac{2\pi}{\omega_1 + \omega_2} = \frac{2\pi \cdot 2}{2\pi(f_1 + f_2)} &\Rightarrow T_{\text{ταλ}} = \frac{2}{f_1 + f_2} \Rightarrow f_1 + f_2 = \frac{2}{T_{\text{ταλ}}} \\ T_\Delta = 200 T_{\text{ταλ}} &\Rightarrow T_{\text{ταλ}} = \frac{1}{100} \text{ s} \end{aligned} \right\} \Rightarrow$$

$$\left. \begin{aligned} f_1 + f_2 = 200 \\ f_1 - f_2 = 0,5 \end{aligned} \right\} \Rightarrow 2f_1 = 200,5 \Rightarrow f_1 = 100,25 \text{ Hz}$$

Οπότε $f_2 = 99,75 \text{ Hz}$

B3.
ΣΩΣΤΗ (iii)



1^η Κρούση

$$\text{ΑΔΟ} + \text{ΑΔΚΕ: } -u_1' = \frac{(m_1 - m_2)}{m_1 + m_2} u_1 \Rightarrow u_1' = -\frac{(m_1 - m_2)}{m_1 + m_2} u_1$$

$$u_2' = \frac{2m_1 u_1}{m_1 + m_2}$$

Αφού η απόσταση δεν αλλάζει μετά από 2^η κρούση

$$\text{πρέπει } u_1' = u_2' \Rightarrow -\frac{(m_1 - m_2)}{m_1 + m_2} u_1 = \frac{2m_1 u_1}{m_1 + m_2} \Rightarrow m_1 + m_2 = 2m_1 \Rightarrow m_2 = 3m_1 \Rightarrow \frac{m_1}{m_2} = \frac{1}{3}$$

ΘΕΜΑ Γ

Γ1.

Το κύμα από Π₂ φτάνει τη στιγμή $t_2 = 0,2 \text{ sec}$

$$t_2 = \frac{r_2}{u} \Rightarrow r_2 = ut_2 = 1 \text{ m.}$$

Το κύμα από Π₁ φτάνει τη στιγμή $t_1 = 1,4 \text{ sec}$

$$t_1 = \frac{r_1}{u} \Rightarrow r_1 = ut_1 = 7 \text{ m.}$$

Γ2.

Σε χρονικό διάστημα $\Delta t_\beta = t_1 - t_2 = 1,2 \text{ sec}$ το (Σ) εκτελεί $N = \frac{\Delta t_\beta}{T} = 3$ ταλαντώσεις, άρα

$$T = \frac{\Delta t_\beta}{N} = 0,4 \text{ s} \Rightarrow f = \frac{1}{T} = 2,5 \text{ Hz}, \quad \omega = 2\pi f = 5\pi \text{ rad/s.}$$

Άρα $\lambda = \frac{u}{f} = 2 \text{ m}$

$\Delta t_\alpha : 0 \leq t < 0,2 \text{ s}$ $y_\Phi = 0$ (δεν έχει φτάσει κανένα κύμα).

$\Delta t_\beta : 0,2 \text{ s} \leq t < 1,4 \text{ s}$ $y_\Phi = A \eta\mu\left(\frac{2\pi t}{T} - \frac{2\pi r_2}{\lambda}\right) \Rightarrow y_p = 5 \cdot 10^{-3} \cdot \eta\mu(5\pi t - \pi), \text{ SI}$

Όπου εκτελεί $N=3$ ταλαντώσεις.

$\Delta t_\gamma : t \geq 1,4 \text{ s}$ $y_\Phi = A \sigma\upsilon\nu \frac{2\pi(r_1 - r_2)}{2\lambda} \cdot \eta\mu\left(\frac{2\pi t}{T} - \frac{2\pi(r_1 + r_2)}{2\lambda}\right) \Rightarrow$

$$y_\Phi = 10^{-2} \cdot \sigma\upsilon\nu \frac{2\pi \cdot 6}{2 \cdot 2} \eta\mu\left(5\pi t - \frac{2\pi \cdot 8}{2 \cdot 2}\right) \Rightarrow$$

$$y_\Phi = -10^{-2} \cdot \eta\mu(5\pi t - 4\pi) \quad \text{ή} \quad y_\Phi = 10^{-2} \cdot \eta\mu(5\pi t - 3\pi) \text{ SI (μόριο ενίσχυσης).}$$

Γ3.

Η στιγμή t_1 είναι μετά τη συμβολή αφού $y_1 > A = 5 \cdot 10^{-3} \text{ m}$ οπότε το πλάτος είναι

$$|A'| = 2A = 10^{-2} \text{ m}, \quad y_1 = \frac{|A'| \sqrt{3}}{2}$$

Από ΑΔΕΤ: $K + U = E \Rightarrow \frac{1}{2} m u_1^2 + \frac{1}{2} m \omega^2 y_1^2 = \frac{1}{2} m \omega^2 |A'|^2 \Rightarrow$

$$u_1^2 + \omega^2 |A'|^2 \frac{3}{4} = \omega^2 |A'|^2 \Rightarrow u_1^2 = \frac{\omega^2 |A'|^2}{4} \Rightarrow u_1 = \pm \frac{\omega |A'|}{2}$$

Άρα το μέτρο της ταχύτητας είναι $u_1 = 2,5\pi \cdot 10^{-2} \text{ m/s}$

Γ4.

$$K_1 = \frac{1}{2} m u_{\max}^2 = \frac{1}{2} m \omega_1^2 |A'_{\Phi_1}|^2$$

$$f_2 = \frac{10}{9} f_1 \Rightarrow \omega_2 = \frac{10}{9} \omega_1 \Rightarrow \frac{\omega_1}{\omega_2} = \frac{9}{10}$$

Άρα $\left. \begin{array}{l} \lambda_2 = \frac{u}{f_2} \\ \lambda_1 = \frac{u}{f_1} \end{array} \right\} \Rightarrow \lambda_2 = \frac{9}{10} \lambda_1$

Συνεπώς το νέο πλάτος μετά τη συμβολή θα είναι:

$$|A'_{\Phi_2}| = \left| 2A \sigma\upsilon\nu \frac{2\pi(r_1 - r_2)}{2\lambda_2} \right| = \left| 2A \sigma\upsilon\nu \frac{2\pi \cdot 6}{2 \cdot 1,8} \right| = \left| 2A \sigma\upsilon\nu \frac{10\pi}{3} \right| \Rightarrow$$

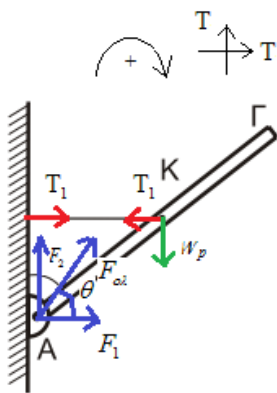
$$|A'_{\phi_2}| = \left| 2A \left(-\frac{1}{2} \right) \right| = A = 5 \cdot 10^{-3} \text{ m}$$

$$K_2 = \frac{1}{2} m \omega_2^2 |A'_{\phi_2}|^2$$

$$\text{Συνεπώς } \frac{K_1}{K_2} = \frac{\frac{1}{2} m \omega_1^2 (2A)^2}{\frac{1}{2} m \omega_2^2 A^2} = 4 \left(\frac{\omega_1}{\omega_2} \right)^2 = 3,24 = \frac{81}{25}$$

ΘΕΜΑ Δ

Δ1.



$$\Sigma F_x = 0 \Rightarrow F_1 = T_1 = 42 \text{ N}$$

$$\Sigma F_y = 0 \Rightarrow F_2 = w = Mg = 56 \text{ N}$$

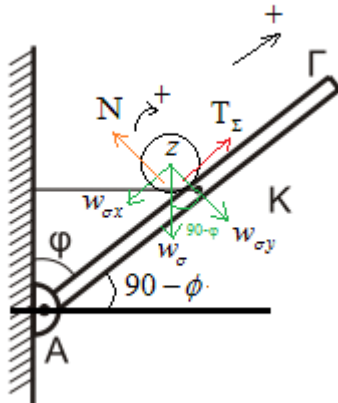
$$\Sigma \tau_A = 0 \Rightarrow Mg \frac{L}{2} \eta \mu \varphi - T_1 \frac{L}{2} \sigma \nu \nu \varphi = 0 \Rightarrow Mg \frac{L}{2} \eta \mu \varphi = T_1 \frac{L}{2} \sigma \nu \nu \varphi \Rightarrow$$

$$56 \cdot \frac{6}{10} = T_1 \cdot \frac{8}{10} \Rightarrow T_1 = 42 \text{ N}$$

$$\text{Άρα } F_{ολ} = \sqrt{F_1^2 + F_2^2} = \sqrt{42^2 + 56^2} = \sqrt{1764 + 3136} = 70 \text{ N}$$

$$\epsilon \varphi \theta = \frac{F_2}{F_1} = \frac{56}{42} = \frac{8}{6} = 1,33, \text{ άρα } F_{ολ} \text{ είναι πάνω στη ράβδο τελικά}$$

Δ2.



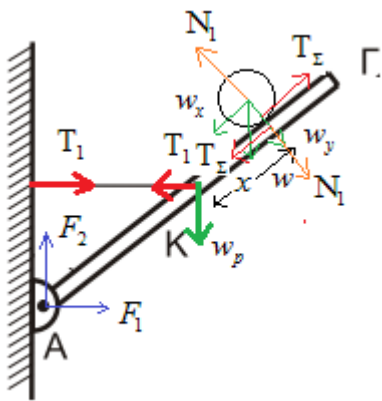
$$\Sigma F_x = m\alpha_{cm} \Rightarrow T_z - mg \sin\phi = m\alpha_{cm} \quad (1)$$

$$\Sigma \tau_z = I_z \alpha_\gamma \Rightarrow -T_z r = \frac{2}{5} m r^2 \alpha_\gamma \Rightarrow -T_z = \frac{2}{5} m \alpha_{cm} \quad (2)$$

$$\text{Από (1), (2)} \quad -mg \sin\phi = \frac{7}{5} m \alpha_{cm} \Rightarrow \alpha_{cm} = -\frac{7}{5} g \sin\phi \Rightarrow \alpha_{cm} = -\frac{40}{7} \text{ m/s}^2$$

$$\alpha_{cm} = \alpha_\gamma r \Rightarrow -\frac{40}{7} = \alpha_\gamma \frac{1}{70} \Rightarrow \alpha_\gamma = -400 \text{ rad/s}^2$$

Δ3.



$$\text{Σφαίρα: } \Sigma F_y = 0 \Rightarrow N_1 = w_y \Rightarrow N_1 = mg \eta \mu \phi = 0,4 \cdot 10 \cdot 0,6 = 2,4 \text{ N}$$

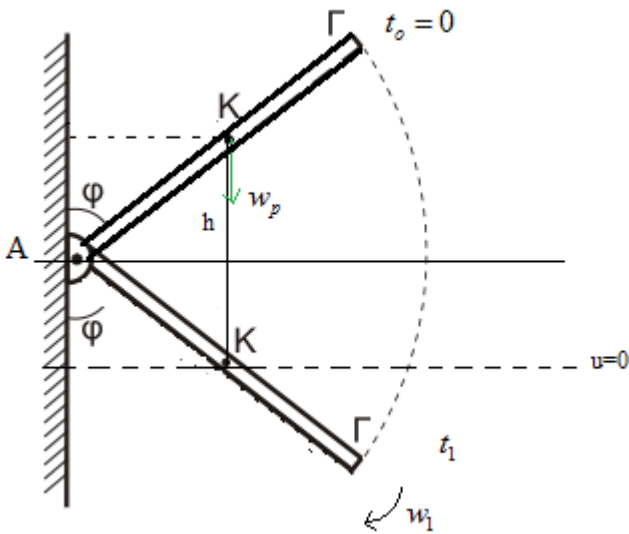
Ράβδος

$$\Sigma \tau_A = 0 \Rightarrow Mg \frac{L}{2} \eta \mu \phi - T_1 \frac{L}{2} \sigma \nu \nu \phi + N_1 \left(\frac{1}{2} + x \right) = 0 \Rightarrow 5,6 \cdot 10 \cdot 1 \cdot \frac{6}{10} - T_1 \cdot 1 \cdot \frac{8}{10} + \frac{24}{10} (1+x) = 0 \Rightarrow$$

$$\Rightarrow 33,6 - 0,8T_1 + 2,4(1+x) = 0 \Rightarrow 33,6 + 2,4 + 2,4x = 0,8T_1 \Rightarrow 36 + 2,4x = 0,8T_1 \Rightarrow T_1 = 45 + 3x$$

$$0 \leq x \leq 1 \text{ m}$$

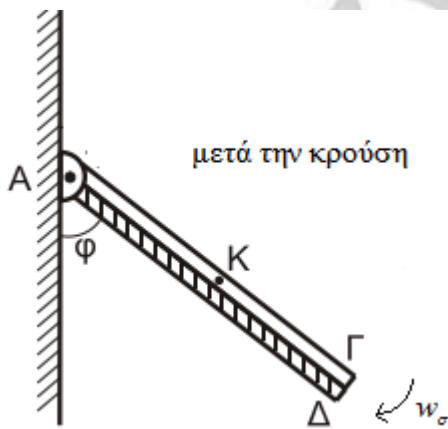
Δ4.



$$\frac{\Delta K \text{ στροφοική}}{\Delta t} = P_{\Sigma T} = \Sigma \tau_A \cdot \omega = Mg \frac{L}{2} \eta \mu \phi \cdot \omega$$

$$\Theta.Ε.Ε \quad K_{(2)} - K_{(1)} = W_{w'} \Rightarrow \frac{1}{2} I_{(A)} \omega^2 = Mgl \sigma \nu \phi \Rightarrow \frac{\omega^2}{3} = 8 \Rightarrow \omega^2 = 24 \Rightarrow \omega = \sqrt{24} \text{ rad/sec}$$

$$\frac{\Delta K_{\sigma \tau \rho}}{\Delta t} = 33,6 \sqrt{24} \text{ Watt} = 67,2 \sqrt{6} \text{ Watt}$$



Δ5.

$$\left. \begin{array}{l} K = \frac{1}{2} I \omega^2 \\ L = I \omega \end{array} \right\} \Rightarrow K = \frac{1}{2} \frac{L^2}{I}$$

$$\text{Α.Δ.Στρ. } \vec{L}_{\sigma \sigma \sigma} = \vec{L}_1$$

$$|\Delta K \%| = \left(\frac{K_1 - K_{\sigma \sigma \sigma}}{K_1} \right) \cdot 100 \Rightarrow |\Delta K \%| = \left(1 - \frac{K_{\sigma \sigma \sigma}}{K_1} \right) \cdot 100 \Rightarrow$$

$$|\Delta K\%| = \left(1 - \frac{\frac{1}{2} \frac{L_{\sigma\sigma.}^2}{I_{\sigma\sigma.}}}{\frac{1}{2} \frac{L_1^2}{I_1}} \right) \cdot 100 = \left(1 - \frac{I_1}{I_{\sigma\sigma.}} \right) \cdot 100$$

$$I_1 = \frac{1}{3} M l^2$$

$$I_{\sigma\sigma.} = \frac{1}{3} (M + 3M) l^2 = 4I_1$$

$$\Rightarrow |\Delta K\%| = \left(1 - \frac{1}{4} \right) \cdot 100 = 75\%$$

Επιμέλεια: Αγγελής Γ. , Δοξόπουλος Κ.