ΑΠΟΛΥΤΗΡΙΕΣ ΕΞΕΤΑΣΕΙΣ ΤΗΣ Γ' ΛΥΚΕΙΟΥ
ΦΥΣΙΚΗ ΘΕΤΙΚΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ

ΟΙ ΑΠΑΝΤΗΣΕΙΣ ΤΩΝ ΘΕΜΑΤΩΝ ΑΠΟ ΚΑΘΗΓΗΤΕΣ

του ΦΡΟΝΤΙΣΤΗΡΙΟΥ

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ΘΕΜΑ Α

Α1. γ

Α2. β

Α3. γ

Α4. β

Α5. $\alpha-\Sigma$, $\beta-\Sigma$, $\gamma-\Lambda$, $\delta-\Lambda$, $\varepsilon-\Sigma$

ΘΕΜΑ Β

Β1. (iii)

$$\upsilon_1=\upsilon_{max}=\omega_1\cdot A_1=\sqrt{\frac{\kappa}{m}}\cdot A_1 \qquad (1)$$

$$\text{ΑΔΟ:}\quad m\cdot\upsilon_1=2m\cdot\upsilon_2\Leftrightarrow\upsilon_2=\frac{\upsilon_1}{2} \qquad (2)$$

$$\upsilon_2=\upsilon'_{max}=\omega_2\cdot A_2=\sqrt{\frac{\not{2}\kappa}{\not{2}m}}\cdot A_2 \qquad (3)$$

$$(2)\underset{(3)}{\overset{(1)}{\Rightarrow}}\sqrt{\frac{\not{\kappa}}{\not{m}}}\cdot A_2=\frac{1}{2}\sqrt{\frac{\not{\kappa}}{\not{m}}}\cdot A_1\Rightarrow\frac{A_1}{A_2}=2\Rightarrow\text{(iii)}$$

B2. (ii)

$$N = \frac{T_\Delta}{T_{TA\Lambda}} \Rightarrow T_{TA\Lambda} = \frac{T_\Delta}{N} = \frac{2}{200} = \frac{1}{100}\sec$$

$$T_{TA\Lambda} = \frac{2\pi}{\omega_{TA\Lambda}} = \frac{2\pi}{\frac{\omega_1 + \omega_2}{2}} = \frac{2}{f_1 + f_2} \Rightarrow \frac{2}{f_1 + f_2} = \frac{1}{100}$$

$$f_1 + f_2 = 200\ \text{Hz} \quad (1)$$

$$T_\Delta = \frac{1}{|f_1 - f_2|} \overset{f_1 > f_2}{\Rightarrow} T_\Delta = \frac{1}{f_1 - f_2} \Rightarrow f_1 - f_2 = \frac{1}{2}\text{Hz} \quad (2)$$

$$\overset{(1)(2)}{\Rightarrow} 2f_1 = 200,5 \Rightarrow f_1 = 100,25\text{Hz} \Rightarrow f_2 = 99,75\text{Hz} \Rightarrow (\text{ii})$$

B3. (iii)

ΕΛ. ΚΡΟΥΣΗ $m_1 m_2$: Επειδή $U_2 = 0$:

$$U_1' = \frac{m_1 - m_2}{m_1 + m_2} U_1 \quad (1)$$

$$U_2' = \frac{2m_1 U_1}{m_1 + m_2} \quad (2)$$

ΚΡΟΥΣΗ m_2 – τοίχου: επειδή η κρούση είναι ελαστική

$$U_2'' = -U_2' \overset{(2)}{\Rightarrow} U_2'' = -\frac{2m_1 U_1}{m_1 + \omega_1} \quad (3)$$

Επειδή τα σώματα βρίσκονται σε σταθερή απόσταση:

$$U_1' = U_2'' \underset{(3)}{\overset{(1)}{\Rightarrow}} \frac{m_1 - m_2}{\cancel{m_1 + \omega_1}} \cancel{U_1} = -\frac{2m_1 \cancel{U_1}}{\cancel{m_1 + \omega_1}}$$

$$m_1 - m_2 = -2m_1 \Rightarrow 3m_1 = m_2 \Rightarrow \frac{m_1}{m_2} = \frac{1}{3} \Rightarrow (\text{iii})$$

ΘΕΜΑ Γ

Γ1. Το κύμα από την Π_2 φτάνει πρώτο: $t_2 = 0,2\text{s}$

$$r_2 = U_\Delta \cdot t_2 = 1\ \text{m}$$

Το κύμα από την Π_1 φτάνει: $t_1 = 1,4s$, οπότε αρχίζει η συμβολή:

$r_1 = U_\Delta \cdot t_1 = 7\ m$

Γ2. $t < 0,2s$: $y = 0$ αφού δεν έχει φτάσει κανένα κύμα.

$0,2s \le t < 1,4s$: $y = A\eta\mu 2\pi\left(\frac{t}{T} - \frac{r_2}{\lambda}\right)$ αφού έχει φτάσει μόνο το Π_2.

$y = 5\cdot 10^{-3}\eta\mu 2\pi\left(\frac{t}{T} - \frac{r_2}{\lambda}\right)$ (1)

$3T = t_1 - t_2 \Rightarrow T = \frac{t_1 - t_2}{3} = \frac{1,4 - 0,2}{3} = \frac{1,2}{3} = 0,4s$

$\lambda = UT = 2\ m$

$(1) \Rightarrow y = 5\cdot 10^{-3}\eta\mu 2\pi(2,5t - 0,5) \Rightarrow$

$y = 5\cdot 10^{-3}\eta\mu(5\pi t - \pi)$

$t \ge 1,45$: $y_{O\Lambda} = 2A\sigma\upsilon\cancel{2}\pi\frac{r_1 - r_2}{\cancel{2}\lambda}\eta\mu 2\pi\left(\frac{t}{T} - \frac{r_1 + r_2}{2\lambda}\right)$

$y_{O\Lambda} = 10\cdot 10^{-3}\sigma\upsilon 3\pi\eta\mu 2\pi(2,5t - 2)$

$y_{O\Lambda} = 10\cdot 10^{-3}\sigma\upsilon 3\pi\eta\mu(5\pi t - 4\pi)$

$y_{O\Lambda} = 10\cdot 10^{-3}\eta\mu(5\pi t - 3\pi)$

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

Γ3. $y_1 > A \Rightarrow A_{O\Lambda} = 2A = 10\cdot 10^{-3}\ m$

ΑΔΕΤ: $\frac{1}{2}mU^2 + \frac{1}{2}Dy_1^2 = \frac{1}{2}DA_{O\Lambda}^2 \Rightarrow$

$\Rightarrow |U| = \omega\sqrt{A_{O\Lambda}^2 - y_1^2} = \frac{2\pi}{T}\sqrt{A_{O\Lambda}^2 - y_1^2}$

$$\Rightarrow |U| = \frac{2\pi}{0,4}\sqrt{10^2 - 10^{-6} - 25\cdot 3\cdot 10^{-6}} = \frac{2\pi}{0,4}\cdot 5\cdot 10^{-3}$$

$$\Rightarrow \boxed{|U| = 25\pi\cdot 10^{-3}\ \text{m/s}}$$

Γ4. $f' = \frac{10}{9}f \Rightarrow \omega' = \frac{10}{9}\omega$ και $\lambda' = \frac{9}{10}\lambda = 1,8\ \text{m}$

$$A' = \left|2A\sigma\upsilon\nu 2\pi\frac{r_1 - r_2}{2\lambda'}\right| = \left|2A\cdot\sigma\upsilon\nu 2\pi\frac{6}{2\cdot 1,8\cdot 0,3}\right| =$$

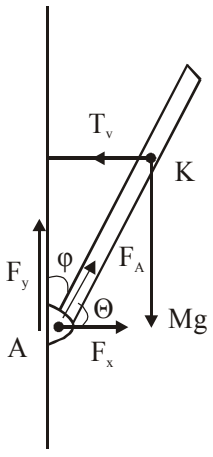
$$A' = \left|2A\sigma\upsilon\nu\frac{10\pi}{3}\right| = 10\cdot 10^{-3}\cdot\frac{1}{2} \Rightarrow A' = 5\cdot 10^{-3}\,\text{m}$$

$$\frac{K_1}{K_2} = \frac{E_{O\Lambda 1}}{E_{O\Lambda 2}} = \frac{\frac{1}{2}D_1A_1^2}{\frac{1}{2}D_2A_2^2} = \frac{\frac{1}{2}m\cdot\omega_1^2\cdot A_1^2}{\frac{1}{2}m\cdot\omega_2^2\cdot A_2^2} =$$

$$\frac{K_1}{K_2} = \frac{\omega_1^2\cdot A_1^2}{\frac{100}{81}\omega_1^2\frac{A_1^2}{4}} = \frac{4\cdot 81}{100} \Rightarrow \frac{K_1}{K_2} = \frac{324}{100} = \boxed{\frac{81}{25}}$$

ΘΕΜΑ Δ

Δ1.



$$\Sigma\tau_\kappa = 0 \Leftrightarrow Mg\frac{1}{2}\eta\mu\varphi = T_\upsilon\frac{1}{2}\sigma\upsilon\nu\varphi$$

$$\Rightarrow T_\upsilon = \frac{Mg\eta\mu\varphi}{\sigma\upsilon\nu\varphi} = 42\text{N}$$

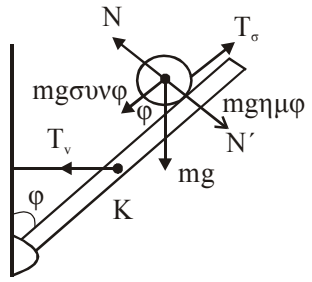
$$\Sigma F_x = 0 \Leftrightarrow F_x - T_\upsilon = 0 \Rightarrow F_x = 42\text{N}$$

$$\Sigma F_y = 0 \Leftrightarrow F_y - Mg = 0 \Rightarrow F_y = 56\text{N}$$

$$F_A = \sqrt{F_x^2 + F_y^2} \Rightarrow \boxed{F_A = 70\text{N}}$$

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

Δ2.



ΘΝΣ: $\Sigma\tau = I_{cm}\cdot\alpha_\gamma \Leftrightarrow$ (2)

$\Rightarrow -T_\sigma \cdot \cancel{r} = \frac{2}{5}m\cancel{r^2}\alpha_\gamma \Rightarrow$

$\Rightarrow -T_\sigma = \frac{2}{5}mr\cdot\alpha_\gamma$ (1)

ΘΝΜ: $\Sigma F_x = m\cdot\alpha_{cm} \Leftrightarrow$

$\Rightarrow T_\sigma - mg\sigma\upsilon\nu\varphi = mr\cdot\alpha_\gamma$ (2)

$\overset{(1)+(2)}{\Rightarrow} -\cancel{m}g\sigma\upsilon\nu\varphi = \frac{7}{5}\cancel{m}r\cdot\alpha_\gamma \Leftrightarrow \alpha_\gamma = \frac{-5g\sigma\upsilon\nu\varphi}{7r} \Rightarrow$

$\Rightarrow \boxed{\alpha_\gamma = -400\ r/s^2}$

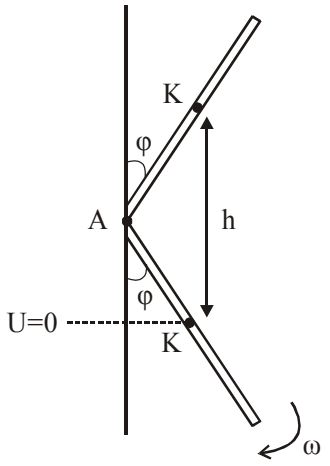
Δ3. $0 \le x \le \frac{1}{2}$, $\left.\begin{array}{l} \text{σφαίρα}: \Sigma F_y = 0 \Leftrightarrow N = mg\eta\mu\varphi \\ N' = N\ (\Delta\text{ΡΑΣΗ} - \text{ΑΝΤΙΔΡΑΣΗ}) \end{array}\right\} \Rightarrow$

$\Rightarrow N' = mg\eta\mu\varphi \Rightarrow N' = 2,4\ N$

$\Sigma\tau_A = 0 \Leftrightarrow N'\left(\frac{1}{2}+x\right) + Mg\frac{1}{2}\eta\mu\varphi - T_v\frac{1}{2}\sigma\upsilon\nu\varphi = 0$

$\Rightarrow \boxed{T_v = 45 + 3x}$, $0 \le x \le 1\ m$

Δ4.



$$\text{ΑΔΜΕ: } Mgh + 0 = 0 + \frac{1}{2} I_p \cdot \omega^2 \Leftrightarrow$$

$$\Leftrightarrow \cancel{M} g \cancel{\ell} \sigma\upsilon\nu\varphi = \frac{1}{2} \cdot \frac{1}{3} \cancel{M} \cancel{\ell^2} \cdot \omega^2 \Leftrightarrow$$

$$\Leftrightarrow \omega = \sqrt{\frac{6g\sigma\upsilon\nu\varphi}{\ell}} = 2\sqrt{6} \ \frac{r}{s}$$

$$\frac{dK}{dt} = \frac{dW_\tau}{dt} = \Sigma\tau \cdot \omega = Mg\frac{\ell}{2}\eta\mu\varphi\omega$$

$$\Rightarrow \boxed{\frac{dK}{dt} = 67,2\sqrt{6}\frac{J}{s}}$$

Δ5. $\text{ΑΔΣ: } L_{\alpha\rho\chi} = L_{\tau\varepsilon\lambda} \Leftrightarrow I_p \cdot \omega = \left(I_p + I'_p\right)\omega' \Leftrightarrow$

$$\Leftrightarrow \frac{1}{3} M\ell^2\omega = \left(\frac{1}{3} M\ell^2 + \frac{1}{3} 3M\ell^2\right)\omega' \Leftrightarrow \frac{1}{3} \cancel{M\ell^2}\,\omega = \frac{4}{3} \cancel{M\ell^2}\,\omega'$$

$$\Rightarrow \omega' = \frac{\omega}{4}$$

$$\Pi\% = \frac{\Delta K}{K_{\alpha\rho\chi}} 100\% = \frac{\frac{1}{2}\left(I_p + I'_p\right)\omega'^2 - \frac{1}{2} I_p \omega^2}{\frac{1}{2} I_p \omega^2} 100\% = \boxed{-75\%}$$