

ΠΕΜΠΤΗ 1 ΙΟΥΝΙΟΥ 2006
ΦΥΣΙΚΗ
ΘΕΤΙΚΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ

ΑΠΑΝΤΗΣΕΙΣ

Θέμα 1ο

1. $\rightarrow \delta$, 2. $\rightarrow \beta$, 3. $\rightarrow \gamma$, 4. $\rightarrow \alpha$

5.

$$\alpha \rightarrow \Sigma$$

$$\beta \rightarrow \Lambda$$

$$\gamma \rightarrow \Lambda$$

$$\delta \rightarrow \Lambda$$

$$\varepsilon \rightarrow \Sigma$$

Θέμα 2ο

1. (α)

Στην Θ.Ι. (Ο) ο παρατηρητής έχει μέγιστη ταχύτητα $v_{A \max}$ και συνεπώς όταν κινείται προς την πηγή (s) θα αντιλαμβάνεται τη μέγιστη δυνατή συχνότητα f_A σύμφωνα με τη σχέση: $f_A = \frac{v + v_{A \max}}{v} f_s$

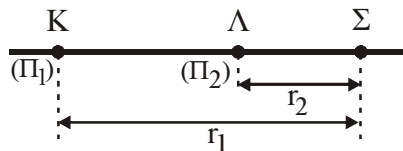
2. Στο χρόνο $t_1 = \frac{5T}{4}$ έχω $v_{E_1} = 0$ και $v_B = v_{B \max}$. Άρα $I = Q_1 \cdot \omega_1 \Rightarrow I = \frac{Q_1}{\sqrt{LC_1}}$.

Για το δεύτερο κύκλωμα ισχύει:

$$Q_2 = \frac{I}{\omega_2} \Rightarrow Q_2 = \frac{Q_1 / \sqrt{LC_1}}{1/2 \sqrt{LC_1}} \Rightarrow Q_2 = 2Q_1$$

Σωστό το (γ)

3.



$$\text{Ισχύει: } |r_1 - r_2| = K\Lambda \Rightarrow |r_1 - r_2| = 6\text{cm} \Rightarrow |r_1 - r_2| = \frac{3}{2} \cdot 4 \Rightarrow$$

$$\Rightarrow |r_1 - r_2| = 3 \cdot \frac{4}{2} = 3 \cdot \frac{\lambda}{2}.$$

Περιττό πολ/σιο του $\frac{\lambda}{2}$. Άρα έχουμε απόσβεση. Σωστό το (β)

4. Για το σημείο B ισχύει:

$$u_B = u_{cm} + u_{\gamma\rho} = u_{cm} + \omega \cdot \frac{R}{2} \left\{ \begin{array}{l} \omega = \frac{u_{cm}}{R} \end{array} \right\} \Rightarrow u_B = u_{cm} + \frac{u_{cm}}{R} \cdot \frac{R}{2} \Rightarrow$$

$$\Rightarrow v_B = v_{cm} + \frac{v_{cm}}{2} \Rightarrow \frac{R}{2} \Rightarrow v_B = \frac{3}{2} v_{cm}$$

Σωστό το (α)

ΘΕΜΑ 3ο

Δεδομένα:

$m_1 = 1 \text{ kg}$
 $m_2 = 3 \text{ kg}$
 $k = 100 \text{ N/m}$
 $\Delta \ell = 0.2 \text{ m}$
 Ελαστική
 $\pi = 3,14$

Ζητούμενα:

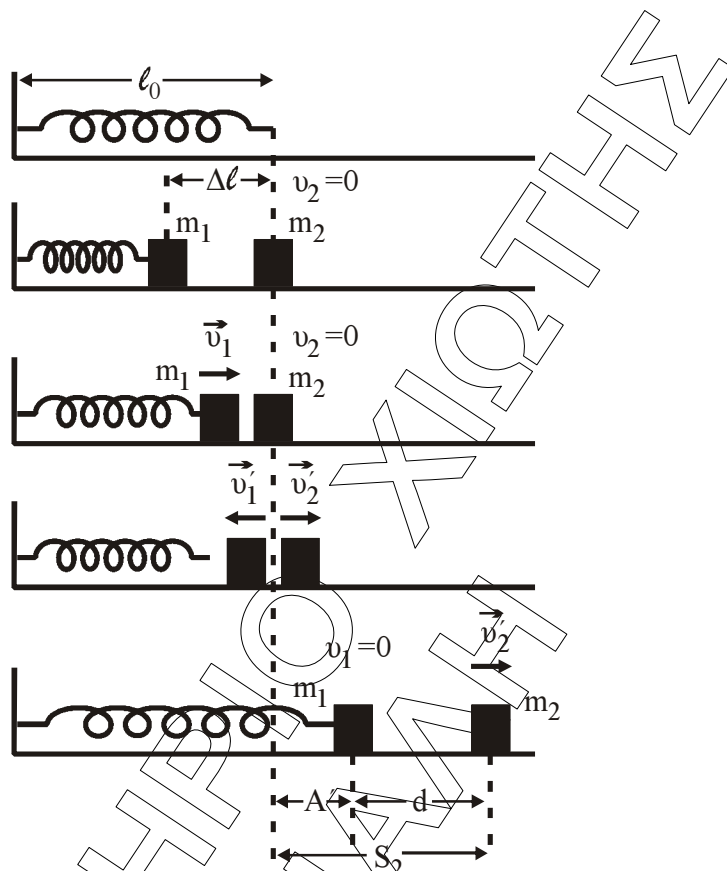
α) $u_1 =$

β) $u_1 =$

$u_2 =$

γ) $x_1 = f(t)$

δ) $d =$ όταν Σ_1 ακινητοποιείται για δεύτερη φορά.



α)

$$U_1 = U_{\max} = A \cdot \omega = \Delta \ell \cdot \omega$$

$$D = m_1 \omega^2 \Rightarrow \omega^2 = \frac{D}{m_1} \Rightarrow \omega^2 = \frac{100}{1} \Rightarrow \omega = 10 \text{ rad/sec} \left. \vphantom{\omega^2 = \frac{D}{m_1}} \right\} \Rightarrow u_1 = 0,2 \cdot 10 \Rightarrow u_1 = 2 \text{ m/sec}$$

β)

$$u'_1 = \frac{m_1 - m_2}{m_1 + m_2} u_1 \Rightarrow u'_1 = \frac{1 - 3}{1 + 3} \cdot 2 \Rightarrow u'_1 = \frac{-2}{4} \cdot 2 \Rightarrow u'_1 = -1 \text{ m/sec}$$

$$u'_2 = \frac{2m_1}{m_1 + m_2} u_1 \Rightarrow u'_2 = \frac{2 \cdot 1}{1 + 3} \cdot 2 \Rightarrow u'_2 = 1 \text{ m/sec}$$

γ) $X_1 = A' \eta \mu(\omega t + \varphi_0)$ (1)

Για $t = 0$, $X_1 = 0$, $u < 0 \Rightarrow \dots \Rightarrow \varphi_0 = \pi \text{ rad.}$

$$U_{\max}' = u'_1 = A' \cdot \omega \Rightarrow 1 = A' \cdot 10 \Rightarrow A' = 0,1 \text{ m}$$
 (2)

$$(1) \Rightarrow X_1 = 0,1 \cdot \eta \mu(10t + \pi) \quad [\text{SI}]$$

δ)

$$\left. \begin{aligned} &\text{γίνεται } U = 0 \text{ για δεύτερη φορά μετά από } t = \frac{3T}{4} \\ &\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} \Rightarrow T = \frac{2\pi}{10} \Rightarrow T = 0,2\pi \text{ sec} \end{aligned} \right\} \Rightarrow t = \frac{3 \cdot 0,2\pi}{4} \Rightarrow t = \frac{0,6\pi}{4} \text{ sec.}$$

$\Sigma F_x = 0 \Rightarrow$ ευθ. ομαλή $\Rightarrow u_2' \rightarrow$ σταθερή

$$u_2' = \frac{S}{t} \Rightarrow S = u_2' \cdot t \Rightarrow S = 1 \cdot \frac{0,6\pi}{4} \Rightarrow S = 0,15\pi \text{ m}$$

$$\text{οπότε: } d = S - A' \Rightarrow d = 0,15\pi - 0,1 \Rightarrow d = 0,471 \cdot 0,1 \Rightarrow d = 0,371 \text{ m}$$

Απόδειξη για $\phi_0 = \pi$

$$(1) \xRightarrow[t=0]{x_1=0} 0 = A' \eta \mu(\omega \cdot 0 + \phi_0) \Rightarrow \eta \mu \phi_0 = 0 \Rightarrow \eta \mu \phi_0 = \eta \mu 0 \Rightarrow$$

$$\phi_0 = 2\kappa\pi + 0 \quad \text{ή} \quad \phi_0 = 2\kappa\pi + \pi - 0 \Rightarrow \kappa = 0 \Rightarrow \phi_0 = 0 \quad \text{ή} \quad \phi_0 = \pi$$

$$U = U_{\max} \sin(\omega t + \phi_0) \xRightarrow[t=0]{} U = U_{\max} \sin \phi_0 \Rightarrow$$

$$\Rightarrow \begin{cases} \phi_0 = 0 & U = U_{\max} \cdot \sin 0 = U_{\max} > 0 \\ \phi_0 = \pi & U = U_{\max} \cdot \sin \pi = -U_{\max} < 0 \end{cases} \text{ Δεκτή, αφού δίνεται θετική φορά προς τα δεξιά}$$

ΘΕΜΑ 4ο

Δεδομένα:

$$M = 3 \text{ kg}$$

$$F = 9 \text{ N}$$

$$R_1 = 0,1 \text{ m}$$

$$R_1 = 0,2 \text{ m}$$

ενωμένες

$$B\Gamma = \frac{\ell}{4}$$

$$I_A = 0,09 \text{ kg} \cdot \text{m}^2$$

$$m = 1 \text{ kg}$$

$$g = 10 \text{ m/sec}^2$$

Ζητούμενα:

α) $N =$;

β) $T =$;

γ)

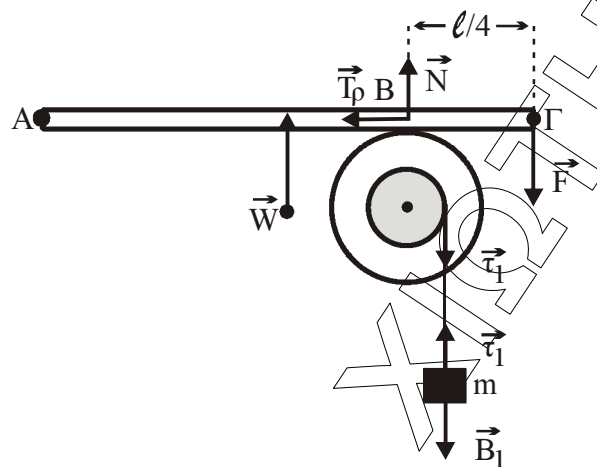
$$\ell = 0,5 \text{ m}$$

$$U_{\text{cm}} =$$

δ)

$$\frac{d\omega}{dt} =$$

$$\ell = 0,5 \text{ m}$$



α) $\Sigma \tau = 0$ ως προς το Α:

$$\Sigma \tau = 0 \Rightarrow \tau_N - \tau_W - \tau_F = 0 \Rightarrow$$

$$N \cdot \frac{3\ell}{4} - W \cdot \frac{\ell}{2} - F \cdot \ell = 0 \Rightarrow N \cdot \frac{3}{4} - W \cdot \frac{1}{2} - F = 0 \Rightarrow$$

$$N \cdot \frac{3}{4} - 3 \cdot 10 \cdot \frac{1}{2} - 9 = 0 \Rightarrow N \cdot \frac{3}{4} - 15 - 9 = 0 \Rightarrow$$

$$N = \frac{4}{3} \cdot 24 \Rightarrow N = 32 \text{ N}$$

β)

$$\Sigma \tau = 0 \Rightarrow \tau_{T\rho} - \tau_{T_1} = 0 \Rightarrow \tau_{T\rho} = \tau_{T_1} \Rightarrow$$

$$\Rightarrow T_\rho \cdot R_2 = T_1 \cdot R_1$$

$$\Sigma F_y = 0 \Rightarrow B_1 - T_1 = 0 \Rightarrow T_1 = B_1 \Rightarrow T_\rho \cdot R_2 = B_1 \cdot R_1 \Rightarrow$$

$$\Rightarrow T_\rho \cdot 0,2 = 1 \cdot 10 \cdot 0,1 \Rightarrow T_\rho = 5 \text{ N}$$

γ)

ΘΝΜΚ για m:

$$\Sigma F_y = m \cdot \alpha_{cm} \Rightarrow B_1 - T_1 = m \cdot \alpha_{cm} \Rightarrow 1 - 10 - T_1 = 1 \cdot \alpha_{cm} \Rightarrow 10 - T_1 = \alpha_{cm} \quad (1)$$

ΘΝΜΚ για τροχ.:

$$\Sigma \tau = I_{o\lambda} \cdot \alpha_{\gamma\omega\nu} \Rightarrow I_{T_1} - I_{o\lambda} \cdot \alpha_{\gamma\omega\nu} \Rightarrow T_1 \cdot R_1 = I_{o\lambda} \frac{\alpha_{cm}}{R_1} \Rightarrow$$

$$T_1 = I_{o\lambda} \frac{\alpha_{cm}}{R_1^2} \Rightarrow T_1 = 0,09 \frac{\alpha_{cm}}{0,01} \Rightarrow T_1 = 9\alpha_{cm} \quad (2)$$

$$(1) \Rightarrow 10 - 9\alpha_{cm} = \alpha_{cm} \Rightarrow 1 \text{ m/sec}^2$$

$$\left. \begin{aligned} U_{cm} &= \alpha_{cm} \cdot t \Rightarrow t = \frac{U_{cm}}{\alpha_{cm}} \\ x &= \frac{1}{2} \alpha_{cm} t^2 \end{aligned} \right\} \Rightarrow x = \frac{1}{2} \alpha_{cm} \left(\frac{U_{cm}}{\alpha_{cm}} \right)^2 \Rightarrow x = \frac{1}{2} \alpha_{cm} \cdot \frac{U_{cm}^2}{\alpha_{cm}^2} \Rightarrow x = \frac{1}{2} \frac{U_{cm}^2}{\alpha_{cm}} \Rightarrow$$

$$U_{cm}^2 = 2\alpha_{cm} \cdot x \Rightarrow U_{cm}^2 = 2\alpha_{cm} \cdot \ell \Rightarrow U_{cm}^2 = 2 \cdot 1 \cdot 0,5 \Rightarrow U_{cm}^2 = 1 \Rightarrow U_{cm} = 1 \text{ m/sec}$$

δ)

$$\frac{dW}{dt} = P = \Sigma T \cdot \omega = T_1 \cdot R_1 \cdot \omega \quad (3)$$

$$(2) \Rightarrow T_1 = 9 \cdot 1 \Rightarrow T_1 = 9 \text{ N}$$

$$t = \frac{U_{cm}}{\alpha_{cm}} = \frac{1}{1} = 1 \text{ sec} \quad , \quad \alpha_{cm} = \alpha_{\gamma\omega\nu} \cdot R_1 \Rightarrow \alpha_{\gamma\omega\nu} = \frac{\alpha_{cm}}{R_1} \Rightarrow \alpha_{\gamma\omega\nu} = \frac{1}{0,1} \Rightarrow \alpha_{\gamma\omega\nu} = 10 \text{ rad/sec}^2$$

$$\omega = \alpha_{\gamma\omega\nu} \cdot t \Rightarrow \omega = 10 \cdot 1 = 10 \text{ rad/sec}$$

$$(3) \Rightarrow \frac{dW}{dt} = 9 \cdot 0,1 \cdot 10 = 9 \text{ W}$$