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## ΘΕΜΑ Α

**Α1.** α

**Α2.** β

**Α3.** δ

**Α4.** α

**Α5.** **α)** Λάθος

**β)** Σωστό

**γ)** Σωστό

**δ)** Λάθος

**ε)** Λάθος

## ΘΕΜΑ Β

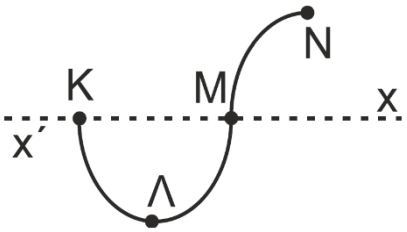
**Β1.** Σωστή απάντηση η (iii)

$$\text{ΑΔΟ: } m\cdot u_o = 4m\cdot u_\kappa \Rightarrow \boxed{u_\kappa = \frac{u_o}{4}} \quad (1)$$

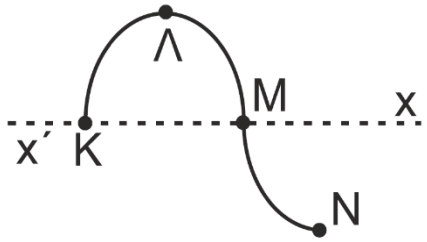
$$\frac{K_{\text{ολ,μετά}}}{K_{1,\text{πριν}}} = \frac{\frac{1}{2}4m\cdot u_\kappa^2}{\frac{1}{2}m\cdot u_o^2} \overset{(1)}{\Rightarrow} \frac{K_{\text{ολ,μετά}}}{K_{1,\text{πριν}}} = \frac{4\cdot\frac{u_o^2}{16}}{u_0^2} \Rightarrow \boxed{\frac{K_{\text{ολ,μετά}}}{K_{1,\text{πριν}}} = \frac{1}{4}}$$

**Β2.** Σωστή απάντηση η (iii)

Για να είναι το Μ στη Θ.Ι. και $u_M < 0$ θα πρέπει να έχει στιγμιότυπο το



Οπότε μετά από $\frac{3T}{2} = T + \frac{T}{2}$ Θα είναι:




**Β3.** Σωστή απάντηση η (ii)

$$\lambda' = \lambda + \frac{h}{m_e \cdot c}\left(1 - \overset{1/2}{\sigma\upsilon\nu\varphi}\right) \Rightarrow \boxed{\lambda' = \lambda + \frac{h}{2 \cdot m_e \cdot c}} \quad (1)$$

$$K'_\varphi = K_e$$

$$K_\varphi = K'_\varphi + K_e \Rightarrow K_\varphi = 2K'_\varphi \Rightarrow \frac{hc}{\lambda} = 2\frac{hc}{\lambda'} \Rightarrow \boxed{\lambda' = 2\lambda} \quad (2)$$

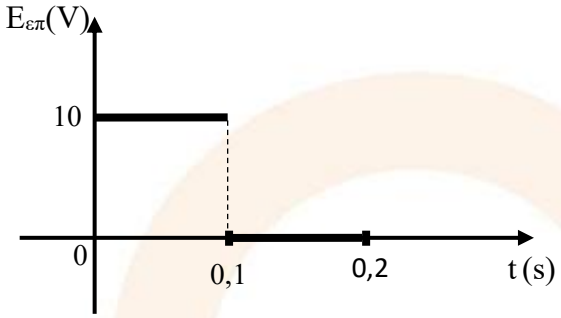
$$(1) \overset{(2)}{\Rightarrow} 2\lambda - \lambda = \frac{h}{2m_e \cdot c} \Rightarrow \boxed{\lambda = \frac{h}{2m_e \cdot c}} \quad (3)$$

$$K_\varphi = E_o = h \cdot f = h \cdot \frac{c}{\lambda} \overset{(3)}{\Rightarrow} E_o = \frac{\frac{hc}{1}}{\frac{h}{2m_e c}} \Rightarrow E_o = \frac{2m_e c \cancel{h} c}{\cancel{h}} \Rightarrow \boxed{E_o = 2m_e c^2}$$

**ΘΕΜΑ Γ**

**Γ1.** $0 \to 0{,}1\,\text{sec}: \quad E_{\varepsilon\pi} = N\frac{\Delta\Phi}{\Delta t} = N\frac{\Delta B \cdot A}{\Delta t} = 100 \cdot 5 \cdot 2 \cdot 10^{-2} = 10\,\text{V}$

$0{,}1 \to 0{,}2\,\text{sec}: \quad E_{\varepsilon\pi} = 0$




**Γ2.** $V = N\omega BA = 100 \cdot 50\pi \cdot 0,5 \cdot 2 \cdot 10^{-2} = 50\pi \text{ V}$

$$V_{\varepsilon\nu} = \frac{V}{\sqrt{2}} = \frac{50\pi\sqrt{2}}{2} = 25\pi\sqrt{2} \text{ V}$$

$$I_{\varepsilon\nu} = \frac{V_{\varepsilon\nu}}{R} = \frac{25\pi\sqrt{2}}{10} = 2,5\pi\sqrt{2} \text{ A}$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{50\pi} = \frac{1}{25} \text{s}$$

$$Q = I_{\varepsilon\nu}^2 \cdot R \cdot T = \frac{25^2 \cdot \pi^2 \cdot 2}{100} \cdot 10 \cdot \frac{1}{25} = 50 \text{ J}$$

**Γ3.** $\omega' = 100\pi \text{ rad/s}, \quad T' = \frac{2\pi}{\omega'} = \frac{2\pi}{100\pi} = \frac{1}{50} \text{s}$

$$I'_{\varepsilon\nu} = 5\pi\sqrt{2} \text{ A}$$

$$Q' = I'^2_{\varepsilon\nu} \cdot R \cdot \Delta t' = 25 \cdot \pi^2 \cdot 2 \cdot 10 \cdot \frac{1}{50} = 100 \text{ J}$$

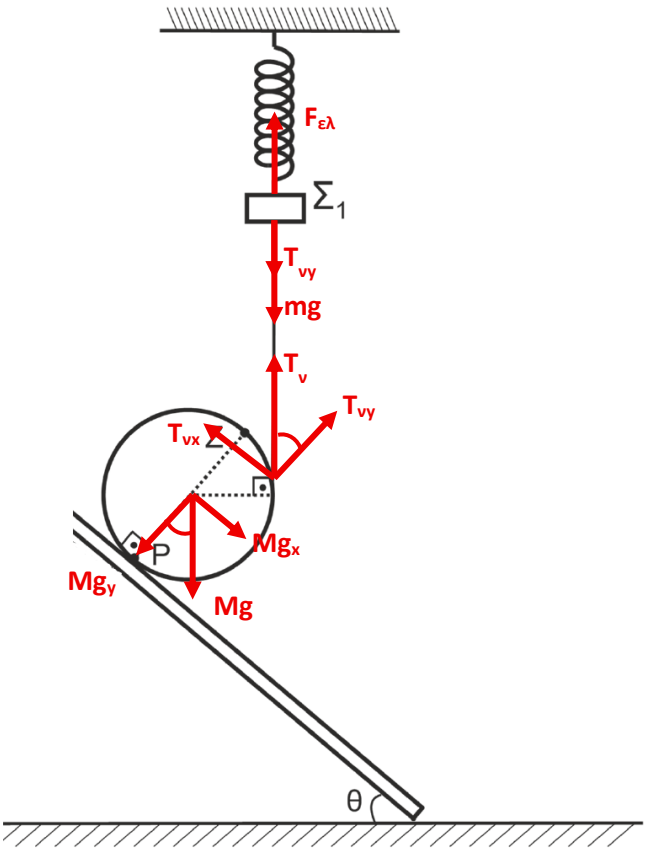
$$\Pi\% = \left[\frac{Q' - Q}{Q}\right] \cdot 100\% = \left[\frac{Q'}{Q} - 1\right] \cdot 100\% = 100\%$$

**Γ4.** $I = \frac{E}{R_{o\lambda}} = \frac{20}{10} = 2 \text{ A}$

$$F_L = B \cdot I \cdot L = \frac{\mu_o}{4\pi} \cdot \frac{2I_1}{d} \cdot I \cdot \ell \Rightarrow F_L = 10^{-7} \cdot \frac{2 \cdot 5}{2 \cdot 10^{-2}} \cdot 2 \cdot 1 \Rightarrow F_L = 10^{-4} \text{ N}$$

**ΘΕΜΑ Δ**

**Δ1.**




$$\Sigma\tau_{(cm)} = 0 \Rightarrow T\nu \cdot R = T_{\sigma\tau} \cdot R \Rightarrow T\nu = T_{\sigma\tau}$$

$$\Sigma F_x = 0 \Rightarrow T_{vx} + T_{\sigma\tau} = w_x \Rightarrow T_v \cdot \eta\mu\theta + T_{\sigma\tau} = M \cdot g \cdot \sigma\upsilon\nu\theta \Rightarrow 1,6 \cdot T_v = 24 \Rightarrow T_v = 15\ N$$

$$\Sigma\text{ώμα: } \Sigma F_y = 0 \Rightarrow k \cdot \Delta l_o = m_1 g + T_v \Rightarrow \Delta l_o = \frac{m_1 g + T_v}{k} \Rightarrow \Delta l_o = 0,5\ m$$

**Δ2. α)** $\Delta\theta = 3\pi\ rad$

$$\Delta x_{cm} = \Delta\theta \cdot R \Rightarrow \Delta x_{cm} = 3\pi \cdot \frac{9}{8\pi} \Rightarrow \Delta x_{cm} = \frac{27}{8}\ m$$

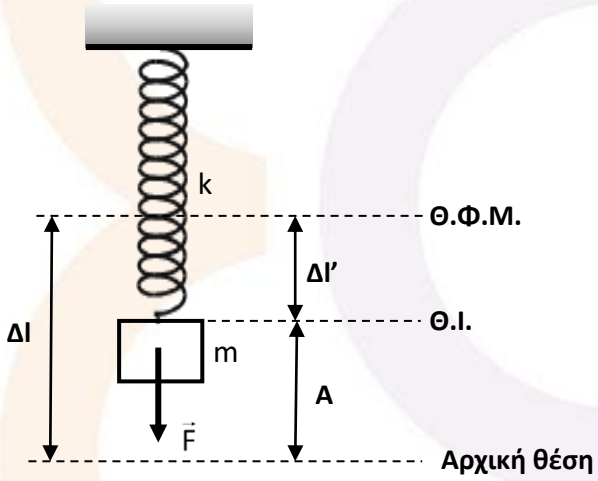
**β)** $\Delta\theta = \frac{1}{2}\cdot\alpha_{\gamma\omega\nu}\cdot t^2 \Rightarrow 3\pi = \frac{1}{2}\cdot\alpha_{\gamma\omega\nu}\cdot 1,5^2 \Rightarrow \alpha_{\gamma\omega\nu} = \frac{8\pi}{3}\ rad/s^2$

$\alpha_{cm} = \alpha_{\gamma\omega\nu}\cdot R \Rightarrow \alpha_{cm} = 3\ m/s^2$

$u_{cm} = \alpha_{cm}\cdot t \Rightarrow u_{cm} = 4,5\ m/s$

$u = \sqrt{u_{cm}^2 + u_{\gamma\rho}^2} = \sqrt{2u_{cm}^2} \Rightarrow u = 4,5\sqrt{2}\ m/s$

**Δ3.**




Για το ελατήριο $\omega = \sqrt{\frac{k}{m_1}} \Rightarrow \omega = \sqrt{40} = 2\pi\ \ r/s$

και $T = \frac{2\pi}{\omega} \Rightarrow T = 1\ sec.$

$N = \frac{\Delta t}{T} = \frac{1,5}{1} \Rightarrow N = 1,5$ ταλαντ.

Αρχικά Δl=0,5 m

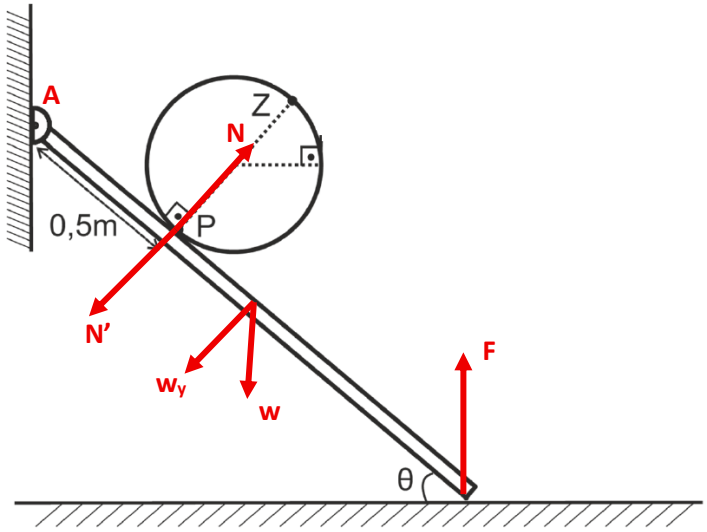
Τελικά $\Sigma F=0 \Rightarrow \Delta l' = \frac{m\cdot g}{k} \Rightarrow \Delta l' = 0,25\ m$

Άρα $A = \Delta l - \Delta l' \Rightarrow A = 0,25\ m$

Το σώμα ξεκινάει από την κάτω ακραία θέση και μετά απο μιάμιση ταλάντωση φτάνει στην άνω ακραία θέση που συμπίπτει με την θέση φυσικού μήκους του ελατηρίου άρα Δl = 0.

Άρα $WF_{\varepsilon\lambda.} = U_{\alpha\rho\chi.(\varepsilon\lambda.)} - U_{\tau\varepsilon\lambda.(\varepsilon\lambda.)} \Rightarrow WF_{\varepsilon\lambda.} = U_{\alpha\rho\chi.(\varepsilon\lambda.)} - 0 = \frac{1}{2}k\Delta l'^2 = 7,5\ J$

**Δ4.**

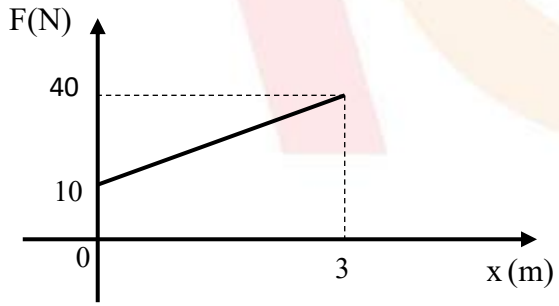



$$\Sigma\tau_{(A)} = 0 \Rightarrow F \cdot L \cdot \sigma\upsilon\nu\theta - w_y \cdot \frac{L}{2} - N'(0,5+x) = 0$$

$$F \cdot L \cdot \sigma\upsilon\nu\theta = m_\delta \cdot g \cdot \sigma\upsilon\nu\theta \cdot \frac{L}{2} + N'(0,5+x)$$

$$F \cdot 4 \cdot 0,8 = 16 + 32 \cdot (0,5+x) \Rightarrow F \cdot 3,2 = 16 + 32x + 16$$

$$\boxed{F = 10 + 10x} \ (\text{S.I.}) \quad 0 \le x \le 3m$$




Για $x = 0 \rightarrow F = 10N$

Για $x = 3m \rightarrow F = 40N$