

ΜΑΘΗΜΑ

ΦΥΣΙΚΗ ΠΡΟΣΑΝΑΤΟΛΙΣΜΟΥ

ΛΥΣΕΙΣ

ΤΑΞΗ

Γ' ΛΥΚΕΙΟΥ

ΕΞΕΤΑΣΤΕΑ ΥΛΗ

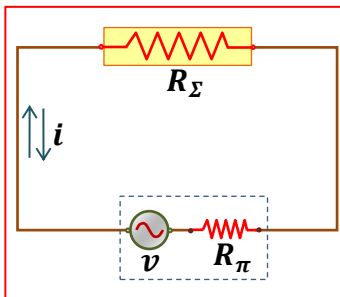
ΚΥΜΑΤΑ, ΚΒΑΝΤΟΜΗΧΑΝΙΚΗ, Η/Μ ΕΠΑΓΩΓΗ

ΘΕΜΑ Α

A.1. α A.2. β A.3. γ A.4. β A.5. α, Λ, β, Λ, γ, Σ, δ, Σ, ε, Λ

ΘΕΜΑ Β

B.1. β



$$\bar{P}_\Sigma = P_K + \frac{300}{100} P_K \Rightarrow \bar{P}_\Sigma = \frac{400}{100} P_K \Rightarrow I_{\varepsilon\nu}^2 R_\Sigma = 4I_K^2 R_\Sigma \Rightarrow I_{\varepsilon\nu} = 2I_K \Rightarrow$$

$$\Rightarrow \frac{V_{\varepsilon\nu}}{2R} = 2 \frac{V'_K}{2R} \Rightarrow \frac{V}{\sqrt{2}} = 2 \frac{V'}{\sqrt{2}} \Rightarrow V = 2V' \Rightarrow N\omega BA = 2N\omega' BA \Rightarrow \omega' = \frac{\omega}{2}$$

$$\text{Άρα } \pi(\%) = \frac{|\omega' - \omega|}{\omega} \cdot 100(\%) = \frac{\left|\frac{\omega}{2} - \omega\right|}{\omega} \cdot 100(\%) \Rightarrow \boxed{\pi(\%) = 50\%}$$

B.2. γ

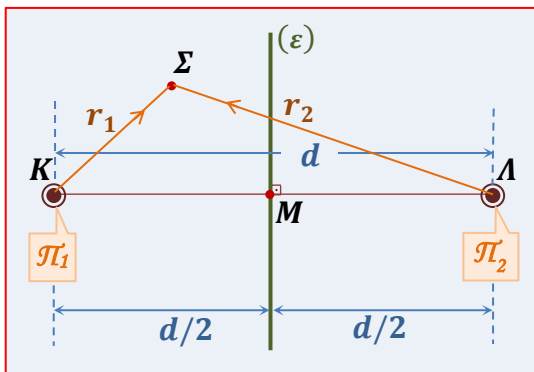
Θ. Μ. Κ. Ε. (για το e^- , μεταξύ καθόδου - ανόδου): $K' - K = eV_{AC} \Rightarrow \begin{cases} K'_1 - K_1 = eV_{AC} \\ K'_2 - K_2 = eV_{AC} \end{cases} \Rightarrow$

$$\Rightarrow \begin{cases} 1,9K_1 - K_1 = eV_{AC} \\ 1,3K_2 - K_2 = eV_{AC} \end{cases} \Rightarrow \begin{cases} 0,9K_1 = eV_{AC} \\ 0,3K_2 = eV_{AC} \end{cases} \Rightarrow 0,9K_1 = 0,3K_2 \Rightarrow K_2 = 3K_1 \quad (1)$$

Φωτοηλεκτρική εξίσωση Einstein: $K = E - \varphi \Rightarrow \begin{cases} K_1 = E_1 - \varphi \\ K_2 = E_2 - \varphi \end{cases} \xrightarrow{(1)} \begin{cases} E_1 = K_1 + \varphi \\ 3K_1 = 1,5E_1 - \varphi \end{cases} \Rightarrow$

$$\Rightarrow 3K_1 = 1,5(K_1 + \varphi) - \varphi \Rightarrow 3K_1 = 1,5K_1 + 1,5\varphi - \varphi \Rightarrow 1,5K_1 = 0,5\varphi \Rightarrow \boxed{\varphi = 3K_1}$$

B.3. β



Αρχικά: $r_1 - r_2 = \kappa\lambda_1 \xrightarrow{(\kappa=-2)} r_1 - r_2 = -2\lambda_1 \quad (1)$

Τελικά: $r_1 - r_2 = (2\kappa + 1) \frac{\lambda_2}{2} \xrightarrow{(\kappa=-3)} r_1 - r_2 = -5 \frac{\lambda_2}{2} \quad (2)$

Από τις σχέσεις (1), (2) $\rightarrow 2\lambda_1 = 5 \frac{\lambda_2}{2} \Rightarrow \lambda_2 = \frac{4}{5} \lambda_1 \quad (3)$

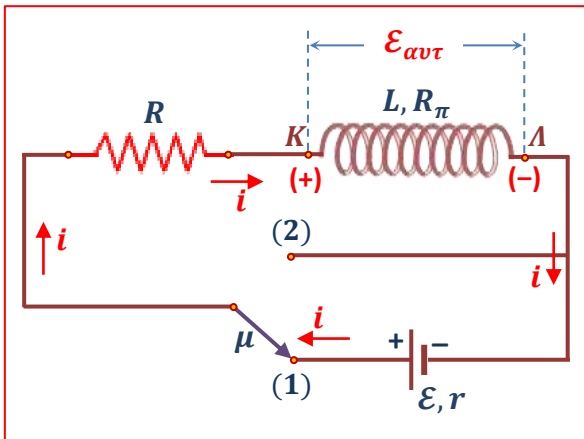
Ισχύει ότι: $|d_1 - d_2| < d \Rightarrow -d < d_1 - d_2 < d \Rightarrow$

$\xrightarrow{(\text{επίσχυση})} -d < \kappa\lambda < d \Rightarrow \begin{cases} -4\lambda_1 < \kappa\lambda_1 < 4\lambda_1 \\ -4\lambda_1 < \kappa\lambda_2 < 4\lambda_1 \end{cases} \Rightarrow$

$$\begin{aligned} &\Rightarrow \left\{ \begin{array}{l} -4\lambda_1 < \kappa\lambda_1 < 4\lambda_1 \\ -4\lambda_1 < \kappa\frac{4}{5}\lambda_1 < 4\lambda_1 \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} -4 < \kappa < 4 \\ -5 < \kappa < 5 \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} \kappa = -3, -2, -1, 0, 1, 2, 3 \\ \kappa = -4, -3, -2, -1, 0, 1, 2, 3, 4 \end{array} \right\} \Rightarrow \\ &\Rightarrow \left\{ \begin{array}{l} n_1 = 7 \text{ υπερβολές ενίσχυσης} \\ n_2 = 9 \text{ υπερβολές ενίσχυσης} \end{array} \right\} \xrightarrow{(-)} \boxed{\Delta n = n_2 - n_1 = 2} \end{aligned}$$

ΘΕΜΑ Γ

Γ.1.



$$P_R = i_1^2 \cdot R \Rightarrow i_1 = \sqrt{\frac{P_R}{R}} \Rightarrow i_1 = 1 \text{ A}$$

$$R_{o\lambda} = R + R_{\pi} + r \Rightarrow R_{o\lambda} = 50 \Omega$$

$$\begin{aligned} i_1 &= \frac{\varepsilon - |\varepsilon_{\text{αντ}_1}|}{R_{o\lambda}} \Rightarrow \varepsilon - |\varepsilon_{\text{αντ}_1}| = i_1 \cdot R_{o\lambda} \Rightarrow \\ &\Rightarrow \varepsilon = (50 + 50) \text{ V} \Rightarrow \boxed{\varepsilon = 100 \text{ V}} \end{aligned}$$

Γ.2.

i) Από τον 2^ο κανόνα Kirchhoff, έχουμε:

$$V_{K\Lambda_1} = |\varepsilon_{\text{αντ}_1}| + i_1 \cdot R_{\pi} \Rightarrow V_{K\Lambda_1} = (50 + 20) \text{ V} \Rightarrow \boxed{V_{K\Lambda_1} = 70 \text{ V}}$$

(ή αλλιώς $V_{K\Lambda_1} = -i_1 \cdot (R + r) + \varepsilon \Rightarrow V_{K\Lambda_1} = (-30 + 100) \text{ V} = 70 \text{ V}$)

ii) $P_{\pi_1} = V_{K\Lambda_1} \cdot i_1 \Rightarrow \boxed{P_{\pi_1} = 70 \text{ W}}$

(ή αλλιώς $P_{\pi_1} = P_{L_1} + P_{R_{\pi_1}} = |\varepsilon_{\text{αντ}_1}| \cdot i_1 + i_1^2 \cdot R_{\pi} = (50 + 20) \text{ W} = 70 \text{ W}$)

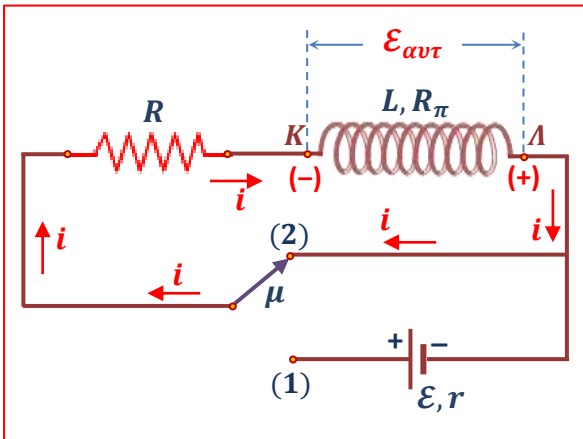
Γ.3.

$$I_o = \frac{\varepsilon}{R_{o\lambda}} \Rightarrow I_o = \frac{100}{50} \text{ A} \Rightarrow I_o = 2 \text{ A}$$

$$\left. \begin{array}{l} L = \mu_o \cdot \frac{N^2}{\ell} \cdot A \\ \Phi_{\text{max}} = B_{\text{max}} \cdot A \Rightarrow \Phi_{\text{max}} = \mu_o \cdot I_o \cdot \frac{N}{\ell} \cdot A \end{array} \right\} \xrightarrow{(\div)} \frac{L}{\Phi_{\text{max}}} = \frac{N}{I_o} \Rightarrow L = 4 \cdot 10^{-2} \cdot \frac{10^2}{2} \text{ H} \Rightarrow$$

$$\Rightarrow \boxed{L = 2 \text{ H}}$$

Γ.4.



$$i) U_{L_o} = \frac{1}{2} L I_o^2 \Rightarrow U_{L_o} = \left(\frac{1}{2} \cdot 2 \cdot 2^2 \right) J \Rightarrow U_{L_o} = 4 J$$

$$U_{L_4} = U_{L_o} - \frac{75}{100} U_{L_o} \Rightarrow U_{L_4} = \frac{25}{100} U_{L_o} \Rightarrow U_{L_4} = 1 J$$

$$U_{L_4} = \frac{1}{2} L i_4^2 \Rightarrow i_4 = \sqrt{\frac{2U_{L_4}}{L}} \Rightarrow i_4 = 1 A$$

$$i_4 = \frac{|\mathcal{E}_{αντ_4}|}{R'_{oλ}} \Rightarrow |\mathcal{E}_{αντ_4}| = i_4 (R + R_π) \Rightarrow |\mathcal{E}_{αντ_4}| = 40 V$$

$$|\mathcal{E}_{αντ_4}| = L \left| \frac{di}{dt} \right| \Rightarrow \left| \frac{di}{dt} \right| = \frac{|\mathcal{E}_{αντ_4}|}{L} \Rightarrow \left| \frac{di}{dt} \right| = 20 A/s \xrightarrow{(\Delta i < 0)} \boxed{\frac{di}{dt} = -20 A/s}$$

$$ii) \underline{A.Δ.E.}: U_{L_o} = U_{L_4} + Q_{R'_{oλ}} \Rightarrow Q_{R'_{oλ}} = (4 - 1) J \Rightarrow \boxed{Q_{R'_{oλ}} = 3 J}$$

Γ.5.

Εάν τοποθετήσουμε το μισό πηνίο στο αρχικό κύκλωμα, τότε:

$$L' = \mu_o \cdot \frac{N'^2}{\ell'} \cdot A \xrightarrow{\left(N' = \frac{N}{2}, \ell' = \frac{\ell}{2} \right)} L' = \frac{L}{2} \Rightarrow L' = 1 H$$

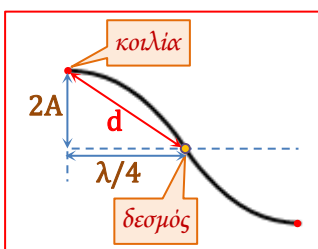
$$R'_π = \frac{R_π}{2} \Rightarrow R'_π = 10 \Omega$$

$$I'_o = \frac{\mathcal{E}}{R + R'_π + r} \Rightarrow I'_o = \frac{100}{40} A \Rightarrow I'_o = 2,5 A$$

$$U'_{L_o} = \frac{1}{2} L' I_o'^2 \Rightarrow U'_{L_o} = \frac{2,5^2}{2} J \Rightarrow \boxed{U'_{L_o} = 3,125 J}$$

ΘΕΜΑ Δ

Δ.1.



$$i) t_1 = \frac{T}{2} \Rightarrow T = 0,2 s \text{ και } f = \frac{1}{T} \Rightarrow \boxed{f = 5 Hz}$$

$$\Delta x_{min} = \frac{\lambda}{4} \Rightarrow \lambda = 4 \cdot \Delta x_{min} \Rightarrow \boxed{\lambda = 12 cm}$$

$$ii) d = \sqrt{(2A)^2 + \left(\frac{\lambda}{4}\right)^2} \Rightarrow d^2 = 4A^2 + \frac{\lambda^2}{16} \Rightarrow A^2 = \frac{d^2}{4} - \frac{\lambda^2}{64} \Rightarrow A^2 = \left(\frac{25}{4} - \frac{144}{64}\right) \text{ cm}^2 \Rightarrow$$

$$\Rightarrow A^2 = \left(\frac{25}{4} - \frac{9}{4}\right) \text{ cm}^2 \Rightarrow A^2 = \frac{16}{4} \text{ cm}^2 \Rightarrow A = 2 \text{ cm}$$

$$\text{Άρα } y = 2A \cdot \sigma\upsilon\nu\left(2\pi \frac{x}{\lambda}\right) \cdot \eta\mu\left(2\pi \frac{t}{T}\right) \Rightarrow y = 0,04 \cdot \sigma\upsilon\nu\left(2\pi \frac{x}{0,12}\right) \cdot \eta\mu\left(2\pi \frac{t}{0,2}\right) \Rightarrow$$

$$\Rightarrow \boxed{y = 0,04 \cdot \sigma\upsilon\nu\left(\frac{50\pi x}{3}\right) \cdot \eta\mu(10\pi t)} \quad (S.I.)$$

Δ.2.

$$A'_K = 2A \cdot \sigma\upsilon\nu\left(\frac{50\pi \cdot 0,02}{3}\right) \Rightarrow A'_K = 0,04 \cdot \sigma\upsilon\nu\left(\frac{\pi}{3}\right) \Rightarrow A'_K = 0,02 \text{ m}$$

$$A'_A = 2A \cdot \sigma\upsilon\nu\left(\frac{50\pi \cdot 0,1}{3}\right) \Rightarrow A'_A = 0,04 \cdot \sigma\upsilon\nu\left(\frac{5\pi}{3}\right) \Rightarrow A'_A = 0,02 \text{ m}$$

$$y_K = A'_K \cdot \eta\mu(10\pi t) \Rightarrow 0,01 = 0,02 \cdot \eta\mu(10\pi t) \Rightarrow \eta\mu(10\pi t) = \frac{1}{2} \Rightarrow$$

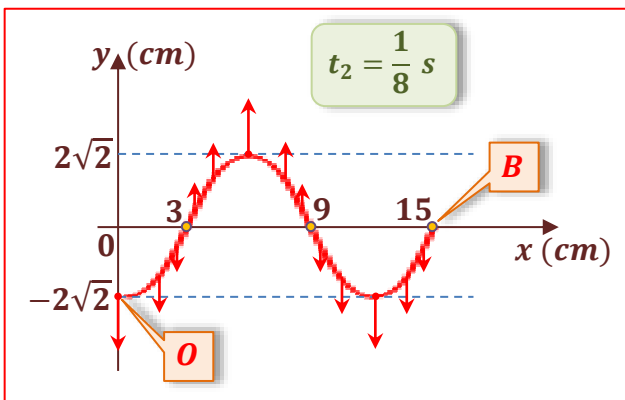
$$\Rightarrow \eta\mu(10\pi t) = \eta\mu\left(\frac{\pi}{6}\right) \xrightarrow{(1\eta \text{ φορά})} 10\pi t = \frac{\pi}{6} \quad (1)$$

$$v_A = \omega A'_A \cdot \sigma\upsilon\nu(10\pi t) \stackrel{(1)}{\Rightarrow} v_A = 10\pi \cdot 0,02 \cdot \sigma\upsilon\nu\left(\frac{\pi}{6}\right) \Rightarrow \boxed{v_A = 0,1\pi\sqrt{3} \text{ m/s}}$$

Δ.3.

$$y = 0,04 \cdot \sigma\upsilon\nu\left(\frac{50\pi x}{3}\right) \cdot \eta\mu\left(10\pi \cdot \frac{1}{8}\right) \Rightarrow y = 0,04 \cdot \sigma\upsilon\nu\left(\frac{50\pi x}{3}\right) \cdot \eta\mu\left(\frac{5\pi}{4}\right) \Rightarrow$$

$$\Rightarrow y = 0,04 \cdot \sigma\upsilon\nu\left(\frac{50\pi x}{3}\right) \cdot \left(-\frac{\sqrt{2}}{2}\right) \Rightarrow y = -0,02\sqrt{2} \cdot \sigma\upsilon\nu\left(\frac{50\pi x}{3}\right) \quad (S.I.)$$



Για το σημείο $x = 0$ έχουμε:

$$y_0 = -0,02\sqrt{2} \cdot \sigma\upsilon\nu 0 \Rightarrow y_0 = -0,02\sqrt{2} \text{ m}$$

$$\text{και } v_0 = 10\pi \cdot 0,04 \cdot \sigma\upsilon\nu\left(\frac{5\pi}{4}\right) \Rightarrow$$

$$\Rightarrow v_0 = 0,4\pi \cdot \left(-\frac{\sqrt{2}}{2}\right) \frac{\text{m}}{\text{s}} \Rightarrow v_0 = -0,2\pi\sqrt{2} \text{ m/s}$$

Δ.4.

$$(OB) = 5 \frac{\lambda}{4} \Rightarrow (OB) = 15 \text{ cm}$$

Ελάχιστο πλήθος δεσμών = 1 (το δεξί ακλόνητο άκρο Β της χορδής)

$$(OB) = \frac{\lambda'}{4} \Rightarrow \frac{\lambda'}{4} = 15 \text{ cm} \Rightarrow \lambda' = 60 \text{ cm}$$

$$v'_\delta = v_\delta \Rightarrow \lambda' \cdot f' = \lambda \cdot f \Rightarrow f' = \frac{12 \cdot 5}{60} \text{ Hz} \Rightarrow f' = 1 \text{ Hz}$$

$$\Delta f = f' - f \Rightarrow \Delta f = (1 - 5) \text{ Hz} \Rightarrow \boxed{|\Delta f| = 4 \text{ Hz}}$$

Δ.5.

$$\omega = 2\pi f \Rightarrow \omega = 10\pi \text{ rad/s}, \text{ και } \omega' = 2\pi f' \Rightarrow \omega' = 2\pi \text{ rad/s}$$

$$x_\Delta = (OB) - (\Delta B) \Rightarrow x_\Delta = (15 - 10) \text{ cm} \Rightarrow x_\Delta = 5 \text{ cm}$$

$$|A'_\Delta| = 2A \cdot \sigma\upsilon\nu\left(2\pi \frac{x_\Delta}{\lambda}\right) \Rightarrow |A'_\Delta| = 2A \cdot \sigma\upsilon\nu\left(2\pi \frac{5}{12}\right) \Rightarrow |A'_\Delta| = 2A \cdot \sigma\upsilon\nu\left(\frac{5\pi}{6}\right) \Rightarrow |A'_\Delta| = A\sqrt{3}$$

$$|A''_\Delta| = 2A \cdot \sigma\upsilon\nu\left(2\pi \frac{x_\Delta}{\lambda'}\right) \Rightarrow |A''_\Delta| = 2A \cdot \sigma\upsilon\nu\left(2\pi \frac{5}{60}\right) \Rightarrow |A''_\Delta| = 2A \cdot \sigma\upsilon\nu\left(\frac{\pi}{6}\right) \Rightarrow |A''_\Delta| = A\sqrt{3}$$

$$\text{Άρα } \frac{K_{\max_\Delta}}{K'_{\max_\Delta}} = \frac{\frac{1}{2} m v_{\max_\Delta}^2}{\frac{1}{2} m v'^2_{\max_\Delta}} \Rightarrow \frac{K_{\max_\Delta}}{K'_{\max_\Delta}} = \frac{\omega^2 A'^2_\Delta}{\omega'^2 A''^2_\Delta} \Rightarrow \frac{K_{\max_\Delta}}{K'_{\max_\Delta}} = \frac{100\pi^2 \cdot 3A^2}{4\pi^2 \cdot 3A^2} \Rightarrow \boxed{\frac{K_{\max_\Delta}}{K'_{\max_\Delta}} = 25}$$