ΜΑΓΝΗΤΙΚΟ ΠΕΔΙΟ

5B105

$B = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I}{\alpha}$

$B' = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I'}{\alpha}$

$\frac{B}{B'} = \frac{\frac{\mu_0}{4\pi} \cdot \frac{2\pi I}{\alpha}}{\frac{\mu_0}{4\pi} \cdot \frac{2\pi I'}{\alpha}} \Rightarrow \frac{B}{B'} = \frac{I}{I'} \Rightarrow \frac{B}{B'} = \frac{\frac{\varepsilon}{R}}{\frac{3E}{R}} = \frac{1}{3} \Rightarrow$

$B' = 3B$

Σωστό το (γ)

5B106

$B_A > B_\Gamma \Rightarrow \frac{\mu_0}{4\pi} \cdot \frac{2I_A}{r_A} . \frac{\mu_0}{4\pi} \cdot \frac{2I_\Gamma}{r_\Gamma} \Rightarrow I_A > I_\Gamma$

Σωστό το (α)

5B108

$\Sigma B = 0 \Rightarrow$

$B_1 - B_2 = 0 \Rightarrow \frac{\mu_0}{4\pi} \cdot \frac{2I_1}{d_1} - \frac{\mu_0}{4\pi} \cdot \frac{2I_2}{d_2} = 0 \Rightarrow$

$\frac{\mu_0}{4\pi} \cdot \frac{2I_1}{d_1} = \frac{\mu_0}{4\pi} \cdot \frac{2I_2}{d_2} \Rightarrow \frac{I_1}{d_1} = \frac{5I_1}{d_2} \Rightarrow$

$d_2 = 5d_1$

όμως $d_2 - d_1 = d \Rightarrow 5d_1 - d_1 = d \Rightarrow$

$4d_1 = d \Rightarrow d_1 = \frac{d}{4}$

Σωστό το (α)

5B109

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2(2I)}{d}$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2I}{d}$

Αφού $|\vec{B_1}| > |\vec{B_2}|$

$B = B_1 - B_2 \Rightarrow B = \frac{\mu_0}{4\pi} \cdot \frac{2I}{d}$ δηλ $B = B_2$

$B_{ολ(\Gamma)} = B_1' + B_2$

$B_{ολ(\Gamma)} = \frac{\mu_0}{4\pi} \cdot \frac{2(2I)}{3d} + B$

$B_{ολ(\Gamma)} = \frac{2}{3}\frac{\mu_0}{4\pi} \cdot \frac{2I}{d} + B$

$B_{ολ(\Gamma)} = \frac{2}{3}B + B$

$B_{ολ(\Gamma)} = \frac{5}{3}B$

Σωστό το (γ)

5B110

$\overrightarrow{\Sigma B} = 0$

$\overrightarrow{B_K} + \overrightarrow{B_M} + \overrightarrow{B_N} + \overrightarrow{B_\Lambda} = 0 \xRightarrow{\uparrow(+)}$

θεωρώ θετική φορά από τη σελίδα προς τον αναγνώστη

$B_M - B_K - B_N + B_\Lambda = 0 \Rightarrow B_M + B_\Lambda = B_K + B_N \Rightarrow$

$\frac{\mu_0}{4\pi} \cdot \frac{2I_M}{\alpha\sqrt{2}} + \frac{\mu_0}{4\pi} \cdot \frac{2I_\Lambda}{\alpha\sqrt{2}} = \frac{\mu_0}{4\pi} \cdot \frac{2I_K}{\alpha\sqrt{2}} + \frac{\mu_0}{4\pi} \cdot \frac{2I_N}{\alpha\sqrt{2}}$

$\frac{\mu_0}{4\pi} \cdot \frac{2}{\alpha\sqrt{2}}(I_M + I_\Lambda) = \frac{\mu_0}{4\pi} \cdot \frac{2}{\alpha\sqrt{2}}(I_K + I_N) \Rightarrow$

$I_M + I_\Lambda = I_K + I_N \Rightarrow$

$-2I + I_\Lambda = -2I - 2{,}5I \Rightarrow I_\Lambda = -2{,}5I$

Σωστό το (β)

5B116

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2I_1}{0{,}6r}$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2I_2}{0{,}8r} \xRightarrow{I_2 = \frac{2I_1}{3}}$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2\frac{2I_1}{3}}{0{,}8r} \Rightarrow B_2 = \frac{\mu_0}{4\pi}\frac{2\,2I_1}{2{,}4r} \Rightarrow$

$B_2 = \frac{2}{4} \cdot \frac{\mu_0}{4\pi} \cdot \frac{2I_1}{0{,}6r} \Rightarrow B_2 = \frac{1}{2}B_1$

$r^2 = x^2 + (0{,}6r)^2 \Rightarrow$

$r^2 = x^2 + 0{,}36r^2 \Rightarrow r^2 - 0{,}36r^2 = x^2 \Rightarrow$

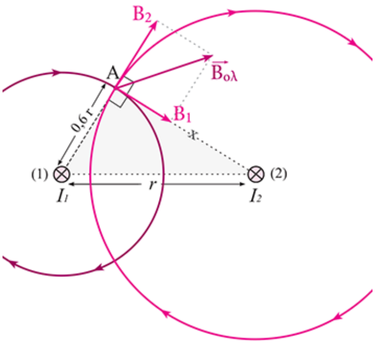
$0{,}64r^2 = x^2 \Rightarrow x = 0{,}8r$

${B_{ολ}}^2 = {B_1}^2 + {B_2}^2 \Rightarrow {B_{ολ}}^2 = {B_1}^2 + (\frac{1}{2}B_1)^2 \Rightarrow$

${B_{ολ}}^2 = {B_1}^2 + \frac{1}{4}{B_1}^2 \Rightarrow {B_{ολ}}^2 = \frac{5}{4}{B_1}^2 \Rightarrow$

$B_{ολ} = \frac{B_1\sqrt{5}}{2}$

Σωστό το (α)



5B117

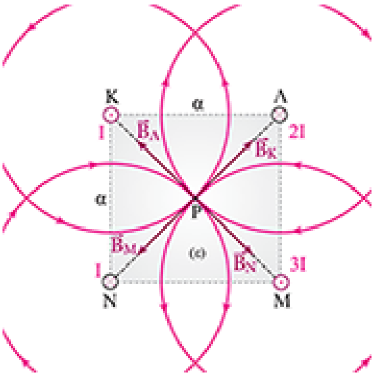
$$B_N=\frac{\mu_0}{4\pi}\cdot\frac{2I}{\frac{\delta}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{4\,I}{\alpha\sqrt{2}}=$$

$$B_\Lambda=\frac{\mu_0}{4\pi}\cdot\frac{2\cdot 2I_1}{\frac{\delta}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{8I}{\alpha\sqrt{2}}=$$

$$B_M=\frac{\mu_0}{4\pi}\cdot\frac{2\cdot 3I}{\frac{\delta}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{12I}{\alpha\sqrt{2}}=$$

$$B_K=\frac{\mu_0}{4\pi}\cdot\frac{2I}{\frac{\delta}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{4I}{\alpha\sqrt{2}}$$

$$\delta^2=\alpha^2+\alpha^2\Rightarrow\delta^2=2\alpha^2\Rightarrow\delta=\alpha\sqrt{2}$$



Αφού $|\vec{B}_\Lambda|>|\vec{B}_N|$

$$B_{\Lambda,N}=\frac{\mu_0}{4\pi}\cdot\frac{8\,I}{\alpha\sqrt{2}}-\frac{\mu_0}{4\pi}\cdot\frac{4\,I}{\alpha\sqrt{2}}=B$$

$$B_{\Lambda,N}=\frac{\mu_0}{4\pi}\cdot\frac{4I}{\alpha\sqrt{2}}$$

Αφού $|\vec{B}_M|>|\vec{B}_K|$

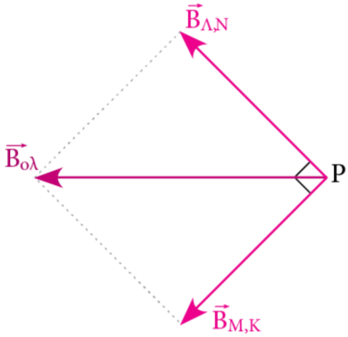
$$B_{M,K}=\frac{\mu_0}{4\pi}\cdot\frac{12I}{\alpha\sqrt{2}}-\frac{\mu_0}{4\pi}\cdot\frac{4I}{\alpha\sqrt{2}}\Rightarrow$$

$$B_{M,K}=\frac{\mu_0}{4\pi}\cdot\frac{8I}{\alpha\sqrt{2}}\Rightarrow B_{M,K}=2B$$

$$B_{o\lambda}{}^2=B_{\Lambda,N}{}^2+B_{M,K}{}^2\Rightarrow B_{o\lambda}{}^2=B^2+(2B)^2\Rightarrow$$

$$B_{o\lambda}{}^2=5B^2\Rightarrow B_{o\lambda}=B\sqrt{5}$$

Σωστό το (α)



5B118

$$\left.\begin{aligned}B_1&=\frac{\mu_0}{4\pi}\cdot\frac{2I_1}{\frac{r}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{2I}{\frac{r}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{4I}{r}\\ B_2&=\frac{\mu_0}{4\pi}\cdot\frac{2I_2}{\frac{r}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{6I}{\frac{r}{2}}=\frac{\mu_0}{4\pi}\cdot\frac{12I}{r}\end{aligned}\right\}\Rightarrow\frac{B_2}{B_1}=3\Rightarrow$$

$$B_2=3B_1=3B$$

$$B_{1,2}=B_1+B_2=4B_1=4B$$

$$B_3=\frac{\mu_0}{4\pi}\cdot\frac{2\pi I_3}{r}$$

$$B_{o\lambda}{}^2=B_{1,2}{}^2+B_3{}^2\Rightarrow$$

$$20B^2=(B_1+B_2)^2+B_3{}^2\Rightarrow$$

$$20B^2=16B^2+B_3{}^2\Rightarrow$$

$$B_3{}^2=4B^2\Rightarrow B_3=2B\Rightarrow$$

$$\frac{\mu_0}{4\pi}\cdot\frac{2\pi I_3}{r}=2\frac{\mu_0}{4\pi}\cdot\frac{2I}{\frac{r}{2}}\Rightarrow\pi I_3=4I\Rightarrow I_3=\frac{4I}{\pi}$$

Σωστό το (α)

5B125

$$\overrightarrow{\Delta B}=\overrightarrow{B_{\tau\varepsilon\lambda}}-\overrightarrow{B_{\alpha\rho\chi}}\Rightarrow$$

$$\overrightarrow{\Delta B}=\overrightarrow{B_{\tau\varepsilon\lambda}}+\left(-\overrightarrow{B_{\alpha\rho\chi}}\right)\Rightarrow$$

Για το μέτρο του $\overrightarrow{\Delta B}$ είναι:

$$\Delta B^2=B_\tau{}^2+B_\alpha{}^2+2B_\tau B_\alpha\sigma\upsilon\nu 120^\circ$$

$$\Delta B^2=B^2+B^2+2B^2\left(-\frac{1}{2}\right)$$

$\Delta B^2 = B^2 + B^2 - B^2$

$\Delta B^2 = B^2$

$\Delta B = B$

Σωστό το (β)

5B126

$B_{(O)1} = \mu_0 \cdot I_1 \cdot n_1 \Rightarrow B_O = \mu_0 \cdot I \cdot n_1 \quad (1)$

$B_{(O)2} = \mu_0 \cdot I_2 \cdot n_2 \Rightarrow B_O = \mu_0 \cdot 3I \cdot n_2 \quad (2)$

Από (1) και (2): $\mu_0 \cdot I \cdot n_1 = \mu_0 \cdot 3I \cdot n_2 \Rightarrow$

$n_1 = 3n_2$

$\frac{N_1}{\ell_1} = 3\frac{N_2}{\ell_2} \Rightarrow \frac{N_1}{2\ell_2} = 3\frac{N_2}{\ell_2} \Rightarrow N_1 = 6N_2$

Σωστό το (γ)

5B127

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I}{R_1} \quad (1)$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I}{R_2} N_2 \quad (2)$ όπου $N_2 = 2$ σπείρες

Αλλά $\ell_1 = 2\pi R_1$

Αλλά $\ell_2 = 2 \cdot 2\pi R_2$

Επειδή όμως $\ell_1 = \ell_2 \Rightarrow 2\pi R_1 = 2 \cdot 2\pi R_2 \Rightarrow$

$R_1 = 2R_2 \quad (3)$

Από (1) και (2): $\frac{B_1}{B_2} = \frac{R_2}{R_1 \cdot N_2} \overset{(3)}{\Longrightarrow}$

$\frac{B_1}{B_2} = \frac{R_2}{2R_1 \cdot 2} \Rightarrow$

$\frac{B_1}{B_2} = \frac{1}{4}$

Σωστό το (α)

5B128

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi(2I)}{r}$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I}{2r}$

Όμως $B_{ολ(K)} = B_2 + B_2$

$B_{ολ(K)} = \frac{\mu_0}{4\pi} \cdot \frac{4\pi I}{r} + \frac{\mu_0}{4\pi} \cdot \frac{\pi I}{r} \Rightarrow$

$B_{ολ(K)} = \frac{5\mu_0 \pi I}{4\pi r} \Rightarrow B_{ολ(K)} = \mu_0 \frac{5I}{4r}$

Σωστό το (γ)

5B129

$\left.\begin{array}{l} \ell = 2\pi R_1 \\ \ell = 2 \cdot 2\pi R_2 \end{array}\right\} \Rightarrow$

$2\pi R_1 = 2 \cdot 2\pi R_2 \Rightarrow R_1 = 2R_2$

$\left.\begin{array}{l} B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_1}{R_1} \\ B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_2}{R_2} N_2 \end{array}\right\} \Rightarrow \frac{B_1}{B_2} = \frac{R_2 \cdot I_1}{R_1 \cdot I_2 \cdot N_2} \Rightarrow$

$\frac{B_1}{B_2} = \frac{R_2}{2R_2} \cdot \frac{2I}{I} \cdot \frac{1}{N_2} \Rightarrow \frac{B_1}{B_2} = \frac{1}{2} \cdot 2 \cdot \frac{1}{2} \Rightarrow \frac{B_1}{B_2} = \frac{1}{2}$

5B130

Στο σχ. α $\quad B_1 = B_A + B_\Gamma \Rightarrow$

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_A}{r} + \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_\Gamma}{r} \Rightarrow$

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi}{r}\left(I_A + \frac{I_\Gamma}{2}\right) \quad (1)$

$B_2 = B_\Gamma - B_A \Rightarrow$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_\Gamma}{2r} - \frac{\mu_0}{4\pi} \cdot \frac{2\pi I_A}{r} \Rightarrow$

$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{2\pi}{r}\left(\frac{I_\Gamma}{2} - I_A\right) \quad (2)$

Αφού όμως $B_1 = 5B_2$

$\frac{\mu_0}{4\pi} \cdot \frac{2\pi}{r}\left(I_A + \frac{I_\Gamma}{2}\right) = 5\,\frac{\mu_0}{4\pi} \cdot \frac{2\pi}{r}\left(\frac{I_\Gamma}{2} - I_A\right) \Rightarrow$

$I_A + \frac{I_\Gamma}{2} = 5\left(\frac{I_\Gamma}{2} - I_A\right) \Rightarrow$

$I_A + \frac{I_\Gamma}{2} = 5\frac{I_\Gamma}{2} - 5I_A \Rightarrow$

$I_A + 5I_A = 5\frac{I_\Gamma}{2} - \frac{I_\Gamma}{2} \Rightarrow 6I_A = \frac{4I_\Gamma}{2} \Rightarrow 6I_A = \frac{4I_\Gamma}{2} \Rightarrow$

$6I_A = 2I_\Gamma \Rightarrow \frac{I_A}{I_\Gamma} = \frac{2}{6} \Rightarrow \frac{I_A}{I_\Gamma} = \frac{1}{3}$

5B132

$B_1 = \mu_0\, I\, n \Rightarrow B = \mu_0\, I\, n$

$I = \frac{\varepsilon}{R_{ολ}}$

$I = \frac{\varepsilon}{R_\Sigma}$

$B_1 = \mu_0 \frac{\varepsilon}{R_\Sigma}\frac{N}{\ell}$

$B' = \mu_0\, I\, n$

$B' = \mu_0 \frac{2\varepsilon}{2R_\Sigma}\frac{2N}{2\ell}$

$B' = \mu_0 \frac{\varepsilon}{R_\Sigma}\frac{N}{\ell}$

Άρα $B' = B$

Σωστό το (α)

5B133

$$\left.\begin{matrix} N_1 = 2N_2 \\ N_2 = 2N_3 \end{matrix}\right\} \Rightarrow N_1 = 5N_3$$

$$B_\Gamma = B_1 + B_2 = \frac{\mu_0 I}{2}\frac{N_2}{\ell} + \frac{\mu_0 I}{2}\frac{N_2}{2\ell} = \frac{\mu_0 I}{2\ell}(N_1 + N_2)$$

$$B_\Gamma = \frac{\mu_0 I}{2\ell}15N_3 \quad (1)$$

$$B_\Delta = B_2 + B_3 \frac{\mu_0 I N_2}{2\ell} + \frac{\mu_0 I N_3}{2\ell} = \frac{\mu_0 I}{2\ell}(N_2 + N_3) \Rightarrow$$

$$B_\Delta = \frac{\mu_0 I}{2\ell}6N_3 \quad (2)$$

$$\xrightarrow{(1),(2)} \frac{B_\Delta}{B_\Gamma} = \frac{6N_3}{15N_3} = \frac{6}{15} = \frac{2}{5}$$

Σωστό το (β)

5B136

$$\overrightarrow{B_1} + \overrightarrow{B_2} = 0 \Rightarrow B_1 - B_2 = 0 \Leftrightarrow B_1 = B_2 \Leftrightarrow$$

$$\frac{\mu_0 2 I_1 \pi N_1}{4\pi\alpha} = \mu_0 I_2 n \Leftrightarrow \frac{I_1 N_1}{2a} = \frac{I_2 N_2}{\ell} \Leftrightarrow$$

$$\frac{\varepsilon_1 N_1}{2aR_1} = \frac{\varepsilon_2 N_2}{R_2 \ell} \Leftrightarrow \frac{\varepsilon_1}{\varepsilon_2} = \frac{2aR_1 N_2}{\ell R_2 N_1}$$

Σωστό το (α)

5B137

$$\left.\begin{matrix} B_1 = \frac{\mu_0}{4\pi}\cdot\frac{2\,I_1}{r} \\ B_2 = \frac{\mu_0}{4\pi}\cdot\frac{2I_2}{r} \end{matrix}\right\} \Rightarrow \frac{B_1}{B_2} = \frac{I_1}{I_2} \Rightarrow$$

$$\frac{B_1}{B_2} = \frac{1{,}5I_2}{I_2} \Rightarrow \frac{B_1}{B_2} = 1{,}5 \Rightarrow B_1 = 1{,}5B_2$$

$$B_{o\lambda}{}^2 = B_1{}^2 + B_2{}^2 - 2B_1B_2\sigma\upsilon\nu\varphi \Rightarrow$$

$$(2B_2)^2 = (1{,}5B_2)^2 + B_2{}^2 - 2\cdot 1{,}5B_2B_2\sigma\upsilon\nu\varphi \Rightarrow$$

$$4B_2{}^2 = \frac{9B_2{}^2}{4} + B_2{}^2 - 3B_2{}^2\sigma\upsilon\nu\varphi \Rightarrow$$

$$3\sigma\upsilon\nu\varphi = \frac{9}{4} + 1 - 4 \Rightarrow$$

$$3\sigma\upsilon\nu\varphi = \frac{9}{4} - 3 \Rightarrow 3\sigma\upsilon\nu\varphi = \frac{9}{4} - \frac{12}{4} \Rightarrow$$

$$3\sigma\upsilon\nu\varphi = -\frac{3}{4} \Rightarrow \sigma\upsilon\nu\varphi = -\frac{1}{4}$$

Σωστό το (γ)

5B138

$$F_K = F_{L(2)}$$

$$m\frac{\upsilon^2}{R} = B\upsilon q \cdot \eta\mu\varphi \Leftrightarrow$$

$$\frac{m\upsilon}{qB} = R$$

Σωστό το (β)

5B139

$$\frac{T_1}{T_2} = \frac{\frac{2\pi m}{qB}}{\frac{2\pi m}{qB}} = 1 \Rightarrow T_1 = T_2$$

5B141

$$\frac{\frac{R_{He}}{R_{Be}}}{R_4} = \frac{\frac{\frac{m_{He}\upsilon_{He}}{2q\cdot B}}{\frac{m_{Be}\upsilon_{He}}{2q\cdot B}}}{\frac{m_4\upsilon_4}{q\cdot B}} = \frac{\frac{\frac{4m_H}{2}}{\frac{qm_H}{2}}}{6m_H} = \frac{\frac{4}{9}}{12}$$

Σωστό το (β)

5B142

$$t_x = \frac{1}{1}T \Rightarrow t_x = \frac{1}{1}\cdot\frac{2\pi m}{B\cdot 9} \Rightarrow t_x = \frac{\pi m}{B\cdot 9}$$

χρονικό διάστημα παραμονής

$$\Delta\vec{P} = \vec{P}_{\tau\varepsilon\lambda} - \vec{P}_{\alpha\rho\chi}$$
$$\Delta\vec{P} = m\vec{\upsilon}_{\tau\varepsilon\lambda} - m\vec{\upsilon}_{\alpha\rho\chi}$$

$$\Delta P = m(-\upsilon) - m(+\upsilon) \Rightarrow \Delta P = -m\upsilon - m\upsilon \Rightarrow$$

$$\Delta P = -2m\upsilon \Rightarrow |\Delta P| = 2m\upsilon$$

Σωστό το (γ)

5B143

$$\Sigma\varepsilon\ 1T \rightarrow 2\pi$$

$$\Delta t \rightarrow \frac{\pi}{3}$$

$$\varphi = 60^\circ$$

$$2\pi\cdot\Delta t = \frac{\pi}{3}\cdot T \Rightarrow \Delta t = \frac{1}{6}T \Rightarrow \Delta t = \frac{1}{6}\cdot\frac{2\pi m}{9B} \Rightarrow$$

$$\Delta t = \frac{1}{3}\cdot\frac{\pi m}{9B}$$

Σωστό το (γ)

5B144

$$\Sigma W = \Delta K$$

$$WF_{\eta\lambda} = K_\tau - K_\alpha \Rightarrow qV = \frac{1}{2}m\upsilon^2 \Rightarrow \upsilon^2 = \frac{2\cdot qV}{m} \Rightarrow$$

$$\upsilon = \sqrt{\frac{2\cdot qV}{m}}$$

Γενικά $R = \frac{\upsilon m}{qV} \Rightarrow R = \frac{m}{qV}\sqrt{\frac{2 \cdot qV}{m}} \Rightarrow$

$R = \sqrt{\frac{2 \cdot qm^2 V}{q^2 Bm}} \Rightarrow R = \sqrt{\frac{2 \cdot mV}{qB}} \Rightarrow R = \sqrt{\frac{m}{q}} \cdot \sqrt{\frac{2V}{B}}$

$R_\delta = \sqrt{\frac{m_\delta}{q_\delta}} \cdot \sqrt{\frac{2V}{B}} \Rightarrow R_\delta = \sqrt{\frac{2m\rho}{q\rho}} \cdot \sqrt{\frac{2V}{B}} \quad (1)$

$R_\alpha = \sqrt{\frac{m_\alpha}{q_\alpha}} \cdot \sqrt{\frac{2V}{B}} \Rightarrow R_\alpha = \sqrt{\frac{4m\rho}{2q\rho}} \cdot \sqrt{\frac{2V}{B}} \Rightarrow$

$R_\alpha = \sqrt{\frac{2m\rho}{q\rho}} \cdot \sqrt{\frac{2V}{B}} \quad (2)$

$R_\rho = \sqrt{\frac{m\rho}{q\rho}} \cdot \sqrt{\frac{2V}{B}} \quad (3)$

Από $(1), (2) \Rightarrow R_\delta = R_\alpha$

Από $(1) : (3) \Rightarrow \frac{R_\delta}{R_\rho} = \sqrt{2}$

Σωστό το (γ)

5B145

$2T_1 = 6T_2 \Leftrightarrow T_1 = 3T_2 \Leftrightarrow$

$\frac{2\pi \cdot m_1}{B \cdot |q_1|} = \frac{3 \cdot 2\pi \cdot m_2}{B \cdot |q_2|} \Leftrightarrow m_1 = 3m_2$

$\frac{\upsilon_1}{\upsilon_2} = \frac{\frac{|q| \cdot B \cdot R_1}{m_1}}{\frac{|q| \cdot B \cdot R_2}{m_2}} = \frac{R_1 m_2}{R_2 m_1} = \frac{R_1 m_2}{2R_1 3m_2} = \frac{1}{6} \Rightarrow$

$\upsilon_2 = 6\upsilon_1$

Σωστό το (β)

5B147

Από (α)

$F_C = k\frac{Q \cdot q}{r^2} \Rightarrow \frac{m\upsilon_1{}^2}{r} = k\frac{Q \cdot q}{r^2} \quad (1)$

Από (β)

$F_{L2} = B\upsilon_2 q \Rightarrow \frac{m\upsilon_2{}^2}{r} = B\upsilon_2 q \Rightarrow \upsilon_2 = \frac{Bqr}{m} \Rightarrow$

$Bq = \frac{m\upsilon_2}{r} \quad (2)$

Από (γ)

$F_C + F_{L2} = k\frac{Q \cdot q}{r^2} + B\upsilon_3 q \Rightarrow$

$\frac{m\upsilon_3{}^2}{r} = k\frac{Q \cdot q}{r^2} + B\upsilon_3 q \xRightarrow{(1),\ (2)}$

$\frac{m\upsilon_3{}^2}{r} = \frac{m\upsilon_1{}^2}{r} + \frac{m\upsilon_2}{r} \cdot \upsilon_3$

$\upsilon_3{}^2 - \upsilon_2\upsilon_3 - \upsilon_1{}^2 = 0 \Rightarrow$

$\upsilon_3{}^2 - 18\upsilon_3 - 144 = 0$

$\Delta = (-18)^2 - 4 \cdot 1 \cdot (-144) \Rightarrow$

$\Delta = 324 + 576 \Rightarrow \Delta = 900 > 0$

$\upsilon_3 = \frac{18 \pm \sqrt{900}}{2} = \frac{18 \pm 30}{2}$

$\upsilon_3 = 24\frac{m}{s}$ δεκτό ή

$\upsilon_3 = -6\frac{m}{s}$

5B148

$\vec{F} = 0 \Rightarrow$

$F_{\eta\lambda} = F_{L2} \Rightarrow E \cdot q = B \cdot U \cdot q \Leftrightarrow$

$\frac{E}{B} = U$

Το σωματίδιο για να κάνει ευθύγραμμη ομαλή κίνηση πρέπει να έχει ταχύτητα $\frac{E}{B}$ που ισχύει

Σωστό το (β)

5B149

Στο B: $\frac{I}{2} = \frac{2\pi \cdot m}{2q \cdot B} = \frac{\pi \cdot m}{q \cdot B} = \frac{2\pi m}{2qB}$

Στο 2B: $\frac{I'}{2} = \frac{2\pi \cdot m}{2 \cdot 2q \cdot B} = \frac{\pi \cdot m}{2q \cdot B} = \frac{\pi \cdot m}{2q \cdot B}$

$T = \frac{T'}{2} + \frac{T}{2} = \frac{3\pi m}{q \cdot B}$

Σωστό το (γ)

5B150

$T_\alpha = \frac{9\pi m_\alpha}{Bq_\alpha} \Rightarrow T_\alpha = \frac{2\pi \cdot 4m_\rho}{B \cdot 2q_\rho} \Rightarrow T_\alpha = \frac{2\pi \cdot 2m_\rho}{B \cdot q_\rho} \quad (1)$

$T_\rho = \frac{2\pi \cdot m_\rho}{B \cdot q_\rho} \quad (2)$

Από $(1) : (2) \Rightarrow \frac{T_\alpha}{T_\rho} = \frac{\frac{2\pi \cdot 2m_\rho}{B \cdot q_\rho}}{\frac{2\pi \cdot m_\rho}{B \cdot q_\rho}} \Rightarrow \frac{T_\alpha}{T_\rho} = 2 \Rightarrow$

$T_\alpha = 2T_\rho$

$$\left.\begin{aligned} R_\alpha &= \frac{m_\alpha \upsilon_\alpha}{q_\alpha B} = \frac{4m\rho \cdot 2\upsilon\rho}{2q_\rho B} \\ R_\rho &= \frac{m_\rho \upsilon_\rho}{q_\rho B} \end{aligned}\right\} \Rightarrow \frac{R_\alpha}{R_\rho} = 4 \Rightarrow R_\alpha = 4R_\rho$$

5B151

$m_p = 1836m_e$

$$\upsilon_p = \upsilon_e$$

$$\left.\begin{aligned} f_p = \frac{N_p}{\Delta t} \Rightarrow \Delta t = \frac{N_p}{f_p} \\ f_e = \frac{N_e}{\Delta t} \Rightarrow \Delta t = \frac{N_e}{f_e} \end{aligned}\right\} \Rightarrow \frac{N_p}{f_p} = \frac{N_e}{f_e} \Rightarrow$$

$$\frac{1}{f_p} = \frac{N_e}{f_e} \Rightarrow N_e = \frac{f_e}{f_p} \Rightarrow N_e = \frac{\frac{1}{T_e}}{\frac{1}{T_p}} \Rightarrow N_e = \frac{T_p}{T_e} \Rightarrow$$

$$N_e = \frac{\frac{2\pi m_p}{Bq_p}}{\frac{2\pi m_e}{Bq_e}} \Rightarrow N_e = \frac{m_p}{m_e} \Rightarrow N_e = \frac{1836 m_e}{m_e} \Rightarrow$$

$$N_e = 1836$$

Σωστό το (γ)

5B152

$$D = X_\alpha - X_p$$

$$D = 2R_\alpha - 2R_p$$

$$D = 2(R_\alpha - R_p)$$

$$D = 2\left(\frac{m_\alpha \upsilon_\alpha}{Bq_\alpha} - \frac{m_p \upsilon_p}{Bq_p}\right)$$

$$D = 2\left(\frac{4m_p \upsilon}{B2q_p} - \frac{m_p \upsilon}{Bq_p}\right)$$

$$D = 2\left(\frac{2m_p \upsilon}{Bq_p} - \frac{m_p \upsilon}{Bq_p}\right)$$

$$D = 2\frac{m_p \upsilon}{Bq_p}$$

Σωστό το (β)

5B153

Από ΘΜΚΕ: (Γ) → (Α) για το σωματίδιο $\Sigma W = \Delta K$

$$W_{F\eta\lambda(\Gamma\to A)} = K_\tau - K_a$$

$$q \cdot V = \frac{1}{2} m\upsilon^2$$

$$2q \cdot V = m\upsilon^2 \Rightarrow \upsilon = \sqrt{\frac{2q \cdot V}{m}}$$

Για την κίνηση στο ΟΜΠ $(\vec{B_1})$

$$R_1 = \frac{m\upsilon}{qB_1} \Rightarrow R_1 = \frac{m}{qB_1}\sqrt{\frac{2q \cdot V}{m}} \quad (1)$$

Για την κίνηση στο ΟΜΠ $(\vec{B_2})$

$$R_2 = \frac{m\upsilon}{qB_2} \Rightarrow R_2 = \frac{m}{qB_2}\sqrt{\frac{2q \cdot V}{m}} \quad (2)$$

Τελικά έχουμε: όπου $d = 2R_1 + 2R_2 \xRightarrow{(1),\ (2)}$

$$d = 2\frac{m}{qB_1}\sqrt{\frac{2q \cdot V}{m}} + 2\frac{m}{qB_2}\sqrt{\frac{2q \cdot V}{m}} \Rightarrow$$

$$d = 2\frac{m}{q}\sqrt{\frac{2q \cdot V}{m}}\left(\frac{1}{B_1} + \frac{1}{B_2}\right) \Rightarrow$$

$$d = \sqrt{\frac{m^2 8q \cdot V}{q^2 m}}\left(\frac{1}{B_1} + \frac{1}{B_2}\right) \Rightarrow$$

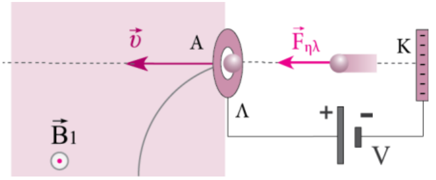
$$d = \sqrt{\frac{8m \cdot V}{q}} \cdot \frac{B_1 + B_2}{B_1 \cdot B_2} \Rightarrow$$

$$d^2 = \frac{8m \cdot V}{q} \cdot \frac{(B_1 + B_2)^2}{{B_1}^2 \cdot {B_2}^2} \Rightarrow$$

$$\frac{q}{m} = \frac{8V}{d^2} \cdot \frac{(B_1 + B_2)^2}{{B_1}^2 \cdot {B_2}^2}$$

Σωστό το (β)

5B153



$$R_1 = \frac{m\upsilon}{qB_1}$$

$$R_2 = \frac{m\upsilon}{qB_2}$$

$$d = 2R_1 + 2R_2 \Rightarrow d = 2(R_1 + R_2)$$

$$d = 2\frac{m\upsilon}{q}\left(\frac{1}{B_1} + \frac{1}{B_2}\right) \Rightarrow d = 2\frac{m\upsilon}{q}\left(\frac{B_1 + B_2}{B_1 \cdot B_2}\right) \Rightarrow$$

$$d^2 = 4\frac{m^2\upsilon^2}{q^2}\frac{(B_1 + B_2)^2}{{B_1}^2 \cdot {B_2}^2}$$

$$d^2 = 4\frac{m^2}{q^2}\frac{2qV}{m}\frac{(B_1 + B_2)^2}{{B_1}^2 \cdot {B_2}^2}$$

ΘΜΚΕ (Κ) → (Λ)

$$\Sigma W = \Delta K$$

$$WF_{\eta\lambda} = K_\tau - K_\alpha$$

$$qV = \frac{1}{2}m\upsilon^2 - 0 \Rightarrow 2qV = m\upsilon^2 \Rightarrow \upsilon^2 = \frac{2qV}{m}$$

$$\frac{q}{m} = 4\frac{1}{d^2}2V\frac{(B_1 + B_2)^2}{{B_1}^2 \cdot {B_2}^2} \Rightarrow$$

$$\frac{q}{m} = \frac{8V}{d^2}\frac{(B_1 + B_2)^2}{{B_1}^2 \cdot {B_2}^2}$$

Σωστό το (β)

5B154

$$R_2 = \frac{R_1}{2} \Rightarrow R_1 = 2R_2$$

Αρχικά το σωματίδιο έχει K_1 και η μεταβολή στην κινητική του ενέργεια ΔΚ δηλαδή

Αρχικά K_1 απώλεια ΔΚ

Αν 100 −"− π ;

$$\pi = \frac{\Delta K}{K_1} \cdot 100 = \frac{K_2 - K_1}{K_1} \cdot 100 \Rightarrow$$

$$\pi = \frac{\frac{1}{2}m\upsilon_2^2 - \frac{1}{2}m\upsilon_1^2}{\frac{1}{2}m\upsilon_1^2} \cdot 100 \Rightarrow$$

$$\pi = \left[\left(\frac{\upsilon_2}{\upsilon_1}\right)^2 - 1\right] \cdot 100$$

όμως ισχύει $R = \frac{m\upsilon}{qB} \Rightarrow \upsilon = \frac{RqB}{m}$

οπότε τελικά: $\pi = \left[\left(\frac{\frac{R_2 qB}{m}}{\frac{R_1 qB}{m}}\right)^2 - 1\right] \cdot 100 \Rightarrow$

$$\pi = \left[\left(\frac{R_2}{R_1}\right)^2 - 1\right] \cdot 100 \Rightarrow \pi = \left[\left(\frac{R_2}{2R_2}\right)^2 - 1\right] \cdot 100 \Rightarrow$$

$$\pi = \left[\frac{1}{4} - 1\right] \cdot 100 \Rightarrow \pi = -75\%$$

Σωστό το (γ)

5B155

$$\text{ΑΓ} = \text{ΜΝ} \Rightarrow R_1 = R_2$$

$$\frac{R_1}{R_2} = \frac{\frac{m_1 \upsilon_1}{qB}}{\frac{m_2 \upsilon_2}{qB}} \Rightarrow m_2 \upsilon_2 = m_1 2\upsilon_2 \Rightarrow m_2 = 2m_1$$

Σωστό το (γ)

5B156

$$\frac{\upsilon_1}{\upsilon_2} = \frac{\frac{q_1 \cdot B \cdot R_1}{m_1}}{\frac{q_2 \cdot B \cdot R_2}{m_2}} = \frac{q_1 \cdot B \cdot R_1 \cdot m_2}{q_2 \cdot B \cdot R_2 \cdot m_1} = \frac{q_1 \cdot \frac{a}{4} \cdot 4m_1}{2q_1 \cdot a \cdot m_1} = \frac{1}{2}$$

Σωστό το (α)

5B157

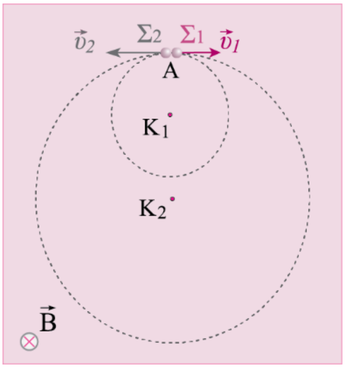
$$\frac{q_1}{m_1} = q\frac{q_2}{m_2} \Rightarrow \frac{q_1}{m_1} = \frac{1}{q} \cdot \frac{q_2}{m_2}$$

$$\left.\begin{array}{l} f_1 = \frac{N_1}{\Delta t} \\ f_2 = \frac{N_2}{\Delta t} \end{array}\right\} \Rightarrow \frac{f_1}{f_2} = \frac{\frac{N_1}{\Delta t}}{\frac{N_2}{\Delta t}} \Rightarrow \frac{f_1}{f_2} = \frac{N_1}{N_2} \Rightarrow \frac{N_1}{N_2} = \frac{\frac{1}{T_1}}{\frac{1}{T_2}} \Rightarrow$$

$$\frac{N_1}{N_2} = \frac{T_2}{T_1} \Rightarrow \frac{N_1}{N_2} = \frac{\frac{2\pi}{B}\frac{m_2}{q_2}}{\frac{2\pi}{B}\frac{m_1}{q_1}} \Rightarrow \frac{N_1}{N_2} = \frac{\frac{m_2}{q_2}}{\frac{1}{q} \cdot \frac{m_2}{q_2}} \Rightarrow$$

$$\frac{N_1}{N_2} = q \Rightarrow \frac{N_1}{N_2} = \frac{q}{1}$$

Άρα $N_1 = q, N_2 = 1$



5B158

Στο ΚΔΓ $\sigma\upsilon\nu 60° = \frac{x}{R} \Rightarrow x = R\sigma\upsilon\nu 60° \Rightarrow$

$x = R\frac{1}{2} \Rightarrow x = \frac{R}{2}$ οπότε $R \leq x + d \Rightarrow$

$$R \leq \frac{R}{2} + d \Rightarrow R - \frac{R}{2} \leq d \Rightarrow \frac{R}{2} \leq d \Rightarrow R \leq 2d \Rightarrow$$

$$\frac{m\upsilon}{qB} \leq 2d \Rightarrow m\upsilon \leq 2dqB \Rightarrow \upsilon \leq \frac{2dqB}{m}$$

$$\upsilon_{0(min)} = \frac{2dqB}{m}$$

Σωστό το (γ)

5B159

Α] $WF_{\eta\lambda} = \Delta K$

$$q_\alpha V = \frac{1}{2}m_\alpha \upsilon_\alpha^2 \Rightarrow \upsilon_\alpha^2 = \frac{2q_\alpha V}{m_\alpha} \Rightarrow$$

$$\upsilon_\alpha^2 = \frac{4q_p V}{4m_p} \Rightarrow \upsilon_\alpha^2 = \frac{q_p V}{m_p} \quad (1)$$

$WF_{\eta\lambda} = \Delta K$

$$q_p V = \frac{1}{2}m_p \upsilon_p^2 \Rightarrow \upsilon_p^2 = \frac{2q_p V}{m_p} \quad (2)$$

$$\xRightarrow{(1),(2)} \frac{\upsilon_p^2}{\upsilon_\alpha^2} = \frac{2}{1} \Rightarrow \frac{\upsilon_p}{\upsilon_\alpha} = \sqrt{2}$$

$$\frac{R_a}{R_p}=\frac{\frac{m_\alpha \upsilon_\alpha}{q_\alpha B}}{\frac{m_p \upsilon_p}{q_p B}}=\frac{m_\alpha \upsilon_\alpha q_p}{m_p \upsilon_p q_\alpha}=\frac{4m_p q_p}{m_p 2q_p \sqrt{2}}=\frac{2}{\sqrt{2}}=\sqrt{2}$$

Σωστό το (β)

B] $\frac{T_\alpha}{T_p}=\frac{\frac{2\pi m_\alpha}{Bq_\alpha}}{\frac{2\pi m_p}{Bq_p}}=\frac{m_\alpha q_p}{m_p q_\alpha}\Rightarrow$

$$\frac{T_\alpha}{T_p}=\frac{4m_p q_p}{m_p 2q_p}=2$$

Σωστό το (α)

5B160

$$\left.\begin{matrix} N_\alpha B_\alpha=\ell \\ N_p B_p=\ell \end{matrix}\right\}\Rightarrow N_\alpha B_\alpha=N_p B_p$$

$$\frac{N_p}{N_\alpha}=\frac{B_\alpha}{B_p}\Rightarrow\frac{N_p}{N_\alpha}=\frac{{\upsilon_{11}}^{\alpha}\cdot T_\alpha}{{\upsilon_{11}}^{p}\cdot T_p}=\frac{\upsilon\sigma\upsilon\nu\varphi_\alpha\cdot\frac{2\pi m_\alpha}{Bq_\alpha}}{\upsilon\sigma\upsilon\nu\varphi_p\cdot\frac{2\pi m_p}{Bq_p}}\Rightarrow$$

$$\frac{N_p}{N_\alpha}=\frac{\sigma\upsilon\nu\varphi_\alpha}{\sigma\upsilon\nu\varphi_p}\cdot\frac{m_\alpha\cdot q_p}{m_p\cdot q_\alpha}=\frac{\sigma\upsilon\nu\varphi_\alpha}{\sigma\upsilon\nu\varphi_p}\cdot\frac{4m_p\cdot q_p}{m_p\cdot 2q_p}\Rightarrow$$

$$\frac{N_p}{N_\alpha}=\frac{2\sigma\upsilon\nu\varphi_\alpha}{\sigma\upsilon\nu\varphi_p}$$

Σωστό το (α)

5B161

$$\overrightarrow{\Sigma F_{(\Sigma)}}=0\Rightarrow$$

$$\vec{T'}+\overrightarrow{W_{(\Sigma)}}=0\Rightarrow W_{(\Sigma)}=T'\Leftrightarrow T'=mg$$

νήμα αβαρές μη εκτατό, άρα $T=T'=mg$

$$\overrightarrow{\Sigma F_{(\rho)}}=0\Leftrightarrow\vec{F_L}+\vec{W}+\vec{T}=0\Rightarrow$$

$$F_L-W-T=0\Leftrightarrow$$

$$F_L=W+T=0\Leftrightarrow$$

$$B\cdot I_{max}\cdot\ell=Mg+mg\Leftrightarrow$$

$$B\cdot\frac{V_{max}}{R_1+R}\cdot\ell=g(M+m)\Leftrightarrow$$

$$\frac{B\cdot\ell\cdot V_{max}}{(R_1+R)g}=M+m_{max}\Leftrightarrow$$

$$\frac{B\cdot\ell\cdot V_{max}}{(R_1+R)g}-M=m_{max}$$

Σωστό το (α)

5B162

$$\overrightarrow{F_L}=\overrightarrow{F_{L1}}+\overrightarrow{F_{L2}}\Leftrightarrow {F_L}^2={F_{L1}}^2+{F_{L2}}^2\Leftrightarrow$$

$$\sqrt{{F_L}^2}=\sqrt{{B_{1y}}^2\cdot I^2\cdot\ell^2+{B_2}^2\cdot I^2\cdot\ell^2}\Leftrightarrow$$

$$F_L=\sqrt{B^2\cdot I^2\cdot\ell^2+B^2\cdot I^2\cdot\ell^2}\Leftrightarrow$$

$$F_L=\sqrt{2B^2\cdot I^2\cdot\ell^2}\Leftrightarrow F_L=BI\ell\sqrt{2}$$

$$B_{1y}=B_1\sigma\upsilon\nu\varphi=B_1\sigma\upsilon\nu 60^\circ=\frac{B_1}{2}=B$$

Σωστό το (α)

5B163

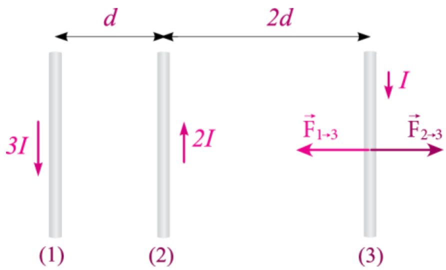
$$F_{1,3}=\frac{\mu_0}{4\pi}\frac{2\,I_1 I_3}{3d}\cdot\ell\Rightarrow\frac{F_{1,3}}{\ell}=\frac{\mu_0}{4\pi}\frac{2\cdot 3I\cdot I}{3d}\Rightarrow$$

$$\frac{F_{1,3}}{\ell}=\frac{\mu_0}{4\pi}\frac{2\,I^2}{d}$$

$$F_{2,3}=\frac{\mu_0}{4\pi}\frac{2\,I_2 I_3}{2d}\cdot\ell\Rightarrow\frac{F_{2,3}}{\ell}=\frac{\mu_0}{4\pi}\frac{2\cdot 2I\cdot I}{2d}\Rightarrow$$

$$\frac{F_{2,3}}{\ell}=\frac{\mu_0}{4\pi}\frac{2\,I^2}{d}$$

$$\frac{\Sigma F}{\ell}=\frac{F_{2,3}}{\ell}-\frac{F_{1,3}}{\ell}=0$$



5B164

$$F_1-F_2=\frac{3\mu_0\cdot I\cdot 2I_\alpha}{3\cdot 2\pi\cdot\frac{\alpha}{2}}-\frac{\mu_0\cdot I\cdot 2I_\alpha}{2\pi\cdot\frac{3\alpha}{2}}=\frac{4\mu_0\cdot I^2}{3\pi}$$

$$\Sigma F=m\cdot\alpha\Rightarrow F_1-F_2=m\cdot\alpha\Leftrightarrow$$

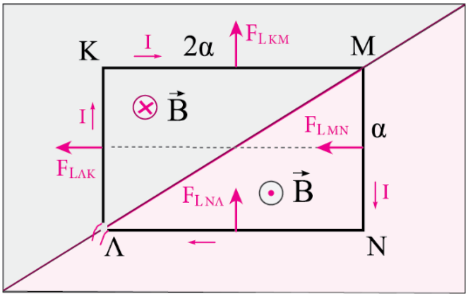
$$\alpha\cdot m=\frac{4\mu_0\cdot I^2}{3\pi}\Leftrightarrow$$

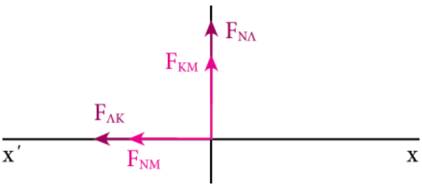
$$\alpha\cdot 4m^*=\frac{4\mu_0\cdot I^2}{3\pi}\Leftrightarrow$$

$$\alpha=\frac{\mu_0\cdot I^2}{3\pi m^*}\Leftrightarrow$$

Σωστό το (α)

5B165





$F_{LMN} = BI\alpha$

$F_{LN\Lambda} = BI2\alpha$

$F_{LK\Lambda} = BI\alpha$

$F_{LKM} = BI2\alpha$

$\Sigma F_{x\prime x} = F_{\Lambda K} + F_{NM}$

$\Sigma F_{x'x} = BI\alpha + BI\alpha$

$\Sigma F_{x'x} = 2BI\alpha$

$\Sigma F_{y\prime y} = F_{N\Lambda} + F_{KM}$

$\Sigma F_{y\prime y} = 2BI\alpha + 2BI\alpha$

$\Sigma F_{y\prime y} = 4BI\alpha$

$\Sigma F_{o\lambda}{}^2 = \Sigma F_{x'x}{}^2 + \Sigma F_{y'y}{}^2$

$\Sigma F_{o\lambda}{}^2 = 4B^2I^2\alpha^2 + 16B^2I^2\alpha^2$

$\Sigma F_{o\lambda}{}^2 = 20B^2I^2\alpha^2$

$\Sigma F_{o\lambda} = 2\sqrt{5}BI\alpha$

$$\varepsilon\varphi\theta = \frac{\Sigma F_{y\prime y}}{\Sigma F_{x'x}} = \frac{4BI\alpha}{2BI\alpha} \Rightarrow \varepsilon\varphi\theta = 2$$

5B166

$F_{L\Lambda M} = BI\beta$

$F_{LKM} = 2BI\beta$

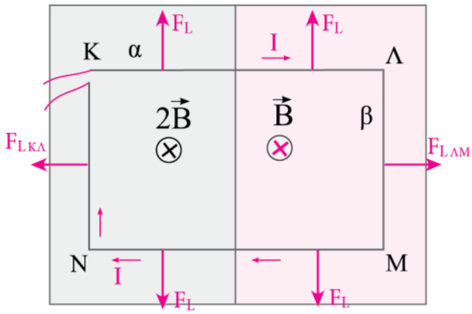
$\Sigma F = F_{LK\Lambda} - F_{L\Lambda M}$

$\Sigma F = 2BI\beta - BI\beta$

$\Sigma F = BI\beta$

$$\alpha = \frac{\Sigma F}{m} = \frac{BI\beta}{m}$$

Σωστό το (β)



5B167

$\Sigma\vec{Fx} = 0 \Rightarrow \vec{Fx} + \vec{F_1} + \vec{F_3} = 0 \Rightarrow$

$\vec{Fx} + \vec{F_1} - \vec{F_3} = 0 \Rightarrow$

$\vec{Fx} = \vec{F_1} - \vec{F_3}$

$\Sigma\vec{Fy} = 0 \Rightarrow \vec{Fy} + \vec{F_2} = 0 \Rightarrow$

$\vec{Fy} - \vec{F_2} = 0 \Rightarrow \vec{Fy} = \vec{F_2}$

$\vec{F} = \vec{Fx} + \vec{Fy}$

$F^2 = Fx^2 + Fy^2 \Rightarrow$

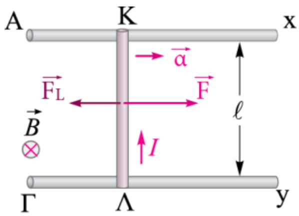
$\sqrt{F^2} = \sqrt{Fx^2 + Fy^2} \Rightarrow$

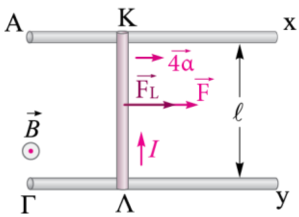
$F = \sqrt{(F_3 - F_1)^2 + F_2{}^2}$

Σωστό το (β)

5B168

Σωστό το (β)





$\Sigma F = m\alpha$

$F - F_L = m\alpha \Rightarrow\ F - BI\ell = m\alpha \quad (1)$

$\Sigma F = m\alpha$

$F + F_L = m4\alpha \Rightarrow\ F + BI\ell = 4m\alpha \quad (2)$

Από (1) και (2) ⇒

$$\frac{F - BI\ell}{F + BI\ell} = \frac{1}{4} \Rightarrow$$

$$4F - 4BI\ell = F + BI\ell \Rightarrow 3F = 5BI\ell$$

$$F = \frac{5}{3}BI\ell$$

5B169

$$\Sigma\tau_{(A)} = 0$$

$$W\,d_W + F_L \cdot \frac{\ell}{2} - T\,d_T = 0 \quad (1)$$

$$ημφ = \frac{d_W}{\frac{\ell}{2}} \Rightarrow d_W = \frac{\ell}{2}ημφ$$

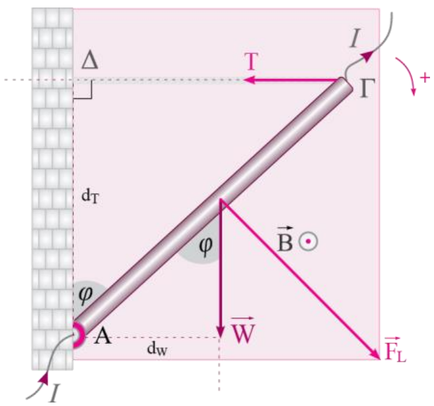
$$συνφ = \frac{d_T}{\ell} \Rightarrow d_T = \ell \cdot συνφ$$

Από (1) εχώ $mg\frac{\ell}{2}ημφ + BI\ell\frac{\ell}{2} = T \cdot \ell συνφ$

$$\frac{1}{2}mg \cdot \frac{\sqrt{3}}{2} + BI\ell\frac{1}{2} = T\frac{1}{2}$$

$$\frac{mg\sqrt{3}}{2} + BI\ell = T \Rightarrow T = BI\ell + \frac{mg\sqrt{3}}{2}$$

Σωστό το (γ)



5B170

Σωστό το (α)

$$\Sigma\tau_{(A)} = 0$$

$$T_w - T_{FL} = 0$$

$$mgd_w = F_L \cdot \frac{3\ell}{4} \quad (1)$$

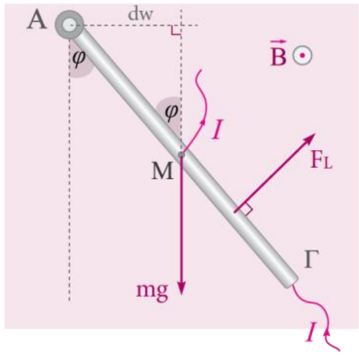
όπου $ημφ = \frac{d_w}{\frac{\ell}{2}} \Rightarrow d_w = \frac{\ell}{2}\,ημφ$

Οπότε η (1):

$$mg\,\frac{\ell}{2}\,ημφ = F_L \cdot \frac{3\ell}{4} \Rightarrow mg\;ημφ = \frac{3}{2}\,F_L \Rightarrow$$

$$mg\,ημφ = \frac{3}{2}\,BI\,\frac{\ell}{2} \Rightarrow mg\,ημφ = \frac{3}{4}\,B\,\frac{2mg}{3B\ell}\ell$$

$$ημφ = \frac{1}{2} \Rightarrow φ = 30°$$



5B171

Σωστό το (?)

Για τη ράβδο:

$$\Sigma\tau_{(A)} = 0$$

$$T\,\ell + mg\frac{\ell}{2} - F_L\frac{\ell}{2} = 0 \Rightarrow T\,\ell + mg\frac{\ell}{2} = F_L\frac{\ell}{2}$$

$$T + \frac{1}{2}mg = B\,I\,\frac{\ell}{2} \quad (1)$$

Για τον δίσκο:

$$\Sigma\tau_{(K)} = 0$$

$$T_{στ(max)}R - TR = 0 \Rightarrow T_{στ(max)} = T \Rightarrow μ\,N = T \quad (2)$$

όπου $\Sigma Fy'y = 0 \Rightarrow T + N = mg \Rightarrow$

$$N = mg - T \quad (3)$$

Από (2) και (3) $\Rightarrow$

$$μ\,(mg - T) = T \Rightarrow μ\,mg - μ\,T = T \Rightarrow$$

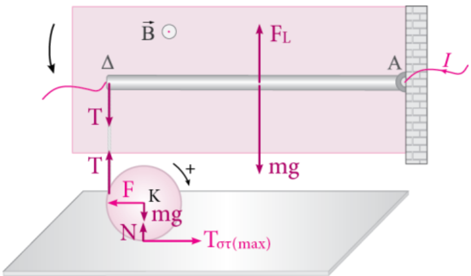
$$μ\,mg = T(1 + μ) \Rightarrow T = \frac{μ\,mg}{1 + μ} \quad (4)$$

Τέλος από τις σχέσεις (1) και (4)

$$\frac{μ\,mg}{1 + μ} + \frac{1}{2}\,mg = B\,I\frac{\ell}{2} \Rightarrow I = \frac{2μ\,mg}{B\,\ell\,(1 + μ)} + \frac{mg}{B\,\ell} \Rightarrow$$

$$I = \frac{2μ\,mg}{B\,\ell\,(1 + μ)} + \frac{mg\,(1 + μ)}{B\,\ell\,(1 + μ)} \Rightarrow$$

$$I = \frac{mg\,(2μ + 1 + μ)}{B\,\ell\,(1 + μ)} \Rightarrow I = \frac{mg\,(3μ + 1)}{B\,\ell\,(1 + μ)}$$



5B172

$F_{L(A)} = F_{L(\Gamma)}$

$\dfrac{\Delta P_{(A)}}{\Delta t} = \dfrac{\Delta P_{(\Gamma)}}{\Delta t} \Rightarrow \Delta P_{(A)} = \Delta P_{(\Gamma)}$

Σωστό το (γ)

5B173

Σωστό το (γ)

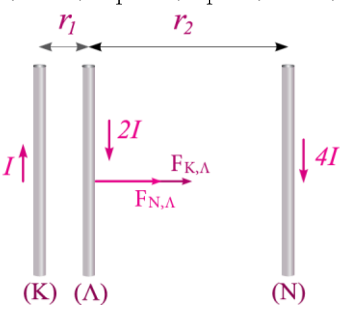
$F_{K1\Lambda} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I_K\,I_\Lambda}{r_1} \cdot \ell \Rightarrow \dfrac{F_{K1\Lambda}}{\ell} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{4\,I^2}{r_1} \quad (1)$

$F_{N1\Lambda} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I_N\,I_\Lambda}{r_2} \cdot \ell \Rightarrow \dfrac{F_{N1\Lambda}}{\ell} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{16\,I^2}{16\,r_1} \quad (2)$

Οπότε:

$\dfrac{\Sigma F}{\ell} = \dfrac{F_{K1\Lambda}}{\ell} + \dfrac{F_{N1\Lambda}}{\ell} \Rightarrow$

$\dfrac{\Sigma F}{\ell} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{4\,I^2}{r_1} + \dfrac{\mu_0}{4\pi} \cdot \dfrac{I^2}{r_1} \Rightarrow \dfrac{\Sigma F}{\ell} = \dfrac{5\,\mu_0\,I^2}{4\pi\,r_1}$



5B174

$B_1 = \dfrac{K_0}{4\pi} \cdot \dfrac{2\,I_1}{r} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I}{r}$

$B_2 = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I_2}{3r} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{4\,I}{3r}$

Αφού $B_1 > B_2$

$B_{1,2} = B_1 - B_2 \Rightarrow B_{1,2} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I}{3r}$

Οπότε στον ΑΓ:

$F_{L(A\Gamma)} = B_{1,2}\,I_3\,\alpha \Rightarrow F_{L(A\Gamma)} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I}{3r}\,I\,r \Rightarrow$

$F_{L(A\Gamma)} = \dfrac{1}{6} \cdot \dfrac{\mu_0\,I^2}{\pi} \Rightarrow B_3 = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I_1}{2r} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I}{2r}$

$B_4 = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\,I_2}{2r} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{4\,I}{2r}$

Αφού $B_4 > B_3$

$B_{3,4} = B_4 - B_3 \Rightarrow B_{3,4} = \dfrac{\mu_0}{4\pi} \cdot \dfrac{I}{r}$

Οπότε στον ΔΖ:

$F_{L(\Delta Z)} = B_{3,4}\,I_3\,\alpha$

$F_{L(\Delta Z)} = \dfrac{\mu_0}{4\pi}\,\dfrac{I}{r}\,I\,r \Rightarrow F_{L(\Delta Z)} = \dfrac{1}{4}\,\dfrac{\mu_0\,I^2}{\pi}$

Οι δυνάμεις Laplace στους AZ_1 αλληλοεξουδετερώνονται

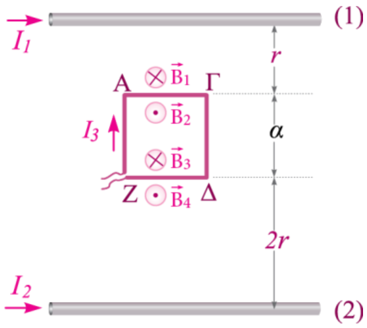
Τελικά

$F_{L(o\lambda)} = F_{L(A\Gamma)} + F_{L(\Delta Z)} \Rightarrow$

$F_{L(o\lambda)} = \dfrac{1}{6} \cdot \dfrac{\mu_0\,I^2}{\pi} + \dfrac{1}{4} \cdot \dfrac{\mu_0\,I^2}{\pi} \Rightarrow$

$F_{L(o\lambda)} = \dfrac{1}{6} \cdot \dfrac{\mu_0\,I^2}{\pi} + \dfrac{1}{4} \cdot \dfrac{\mu_0\,I^2}{\pi} \Rightarrow$

$F_{L(o\lambda)} = \dfrac{5}{12} \cdot \dfrac{\mu_0\,I^2}{\pi}$



5B175

Για τον (1):

$\vec{\Sigma F} = \vec{0} \Rightarrow -2F_{\varepsilon\lambda} + F'_L - W = 0 \Leftrightarrow$

$F'_L - W = F_{\varepsilon\lambda} \quad (1)$

$\vec{\Sigma F} = \vec{0} \Rightarrow 2F_{\varepsilon\lambda} - W - F_L = 0 \Leftrightarrow$

$2F_{\varepsilon\lambda} + W + F_L = 0 \overset{(1)}{\Longrightarrow} F'_L - W = W + F_L \Leftrightarrow$

$\dfrac{3\mu_0 I_1\,I_2 \cdot \ell}{2\pi \cdot 2d} - \dfrac{2\mu_0 I_1\,I_2 \cdot \ell}{2 \cdot 2\pi \cdot d} = 2W \Leftrightarrow$

$\dfrac{\mu_0 I_1\,I_2 \cdot \ell}{4\pi d} = 2mg \Leftrightarrow \dfrac{\mu_0 I_1\,I_2 \cdot \ell}{8\pi g d} = m$

Σωστό το (β)