محمدحسین جواهری فیزیک ۲ ـ استاد زمانی کارشناسی کامپیوتر / آزاد کرج
شماره دانشجویی: ۴۰۲۰۵۳۰۱۰۷
تاریخ: ۱۴۰۵/۰۴/۲۱

۱- $\frac{4}{3}\pi R^3 = 2\left(\frac{4}{3}\pi R'^3\right) \Rightarrow R^3 = 2R'^3 \Rightarrow R' = \frac{R}{\sqrt[3]{2}} \Rightarrow C = 4\pi\varepsilon_0 R'$

$\Rightarrow C = 4\pi\varepsilon_0 \frac{R}{\sqrt[3]{2}}$

۲- $U = \frac{1}{2}CV^2 \Rightarrow U' = 1.1U \Rightarrow U' = \frac{1}{2}CV'^2 \Rightarrow \frac{U'}{U} = \frac{V'^2}{V^2} = 1.1 \Rightarrow$

$\frac{V'}{V} = \sqrt{1.1} \Rightarrow \frac{V'-V}{V} \times 100 = (\sqrt{1.1}-1)\times 100 \Rightarrow \Delta V = 4.88\%$

$\Rightarrow \Delta U = 4.9\%$

۳- $r(u) = a + \frac{b-a}{L}u \Rightarrow A(u) = \pi r^2(u) \Rightarrow dR = \rho\frac{du}{A(u)} \Rightarrow$

$dR = \frac{\rho du}{\pi(a+\frac{b-a}{L}u)^2} \Rightarrow R = \frac{\rho}{\pi}\int_0^L \frac{du}{(a+\frac{b-a}{L}u)^2} \Rightarrow u = a + \frac{b-a}{L}u \Rightarrow$

$du = \frac{L}{b-a}du \Rightarrow R = \frac{\rho L}{\pi(b-a)}\int_a^b \frac{du}{u^2} = \frac{\rho L}{\pi(b-a)}\left[-\frac{1}{u}\right]_a^b = \frac{\rho L}{\pi(b-a)}\left(\frac{1}{a}-\frac{1}{b}\right)$

$\Rightarrow \frac{1}{a}-\frac{1}{b} = \frac{b-a}{ab} \Rightarrow R = \frac{\rho L}{\pi ab}$

۴- $\rho = I^2R, \rho' = 2\rho \Rightarrow \frac{\rho'}{\rho} = \frac{I'^2R'}{I^2R} \Rightarrow 2 = 4\frac{R'}{R} \Rightarrow \frac{R'}{R} = \frac{2}{4} \Rightarrow$

$\frac{R'}{R} = \frac{1}{8}$ $R = \rho\frac{L}{A}$ $AL = A'L' \Rightarrow u = \frac{L'}{L} \Rightarrow \frac{A'}{A} = \frac{1}{a} \Rightarrow \frac{R'}{R} = \frac{L'A}{LA'} = u^2$

$u^2 = \frac{1}{8} \Rightarrow \frac{L'}{L} = \sqrt{\frac{1}{8}} = 1.27,\ \frac{A'}{A} = \frac{1}{a} = \sqrt{\frac{1}{8}} \approx 0.71$

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۵- $V_{ab} = V_a - V_b \Rightarrow V_{ab} = I_1 R_1 + \mathcal{E}_1 \Rightarrow I_1 = \frac{V_{ab} - \mathcal{E}_1}{2R_1} \Rightarrow V_{ab} = R_2 I_2 + \mathcal{E}_2 \Rightarrow$

$I_2 = \frac{V_{ab} - \mathcal{E}_2}{R_2}$, $V_{ab} = 2R_1 I_3 + \mathcal{E}_3 \Rightarrow I_3 = \frac{V_{ab} - \mathcal{E}_3}{2R_1} \Rightarrow I_1 + I_2 + I_3 = 0 \Rightarrow$

$\frac{V_{ab} - \mathcal{E}_1}{2R_1} + \frac{V_{ab} - \mathcal{E}_2}{R_2} + \frac{V_{ab} - \mathcal{E}_3}{2R_1} = 0 \Rightarrow R_2(V_{ab} - \mathcal{E}_1) + 2R_1(V_{ab} - \mathcal{E}_2) + R_2(V_{ab} - \mathcal{E}_3) =$

$\Rightarrow 2(R_1 + R_2) V_{ab} = R_2(\mathcal{E}_1 + \mathcal{E}_3) + 2R_1\mathcal{E}_2 \Rightarrow \boxed{V_{ab} = \frac{R_2(\mathcal{E}_1 + \mathcal{E}_3) + 2R_1\mathcal{E}_2}{2(R_1 + R_2)}} \Rightarrow$

$\boxed{I_1 = \frac{V_{ab} - \mathcal{E}_1}{2R_1}}$, $\boxed{I_2 = \frac{V_{ab} - \mathcal{E}_2}{R_2}}$, $\boxed{I_3 = \frac{V_{ab} - \mathcal{E}_3}{2R_1}} \Rightarrow \boxed{I_2 = \frac{\mathcal{E}_1 + \mathcal{E}_3 - 2\mathcal{E}_2}{2(R_1 + R_2)}}$

۶- $V_C = \mathcal{E} \Rightarrow Q = C\mathcal{E}$, $W_{منبع} = \int_0^Q \mathcal{E}\, dq \Rightarrow W_{منبع} = \mathcal{E}Q \Rightarrow W_{منبع} = \mathcal{E}(C\mathcal{E}) = C\mathcal{E}^2 \Rightarrow U_C = \frac{1}{2} C V_C^2$

$\Rightarrow U_C = \frac{1}{2} C\mathcal{E}^2 \Rightarrow \frac{U_C}{W_{منبع}} = \frac{\frac{1}{2}C\mathcal{E}^2}{C\mathcal{E}^2} = \frac{1}{2} \Rightarrow \boxed{U_C = \frac{1}{2} W_{منبع}}$

۷- $\vec{v} \cdot \vec{B} = |\vec{v}||\vec{B}|\cos\theta = 20 \times 20 + (-20)(-10) + 10 \times 20 = 400 \Rightarrow |\vec{v}| = \sqrt{20^2 + 20^2 + 10^2} = 30$

$|\vec{B}| = \sqrt{20^2 + (-10)^2 + (-20)^2} = \sqrt{900}\ mT \Rightarrow \cos\theta = \frac{400}{\sqrt{900} \times \sqrt{900}} = \frac{4}{9} \Rightarrow \theta = \cos^{-1}\frac{4}{9} = 63.5^\circ$

$v_{\perp} = v\sin\theta = \sqrt{900}\sqrt{1 - (\frac{4}{9})^2} = 29.8\ m/s$, $B = \sqrt{900}\ mT = 0.03\ T$ (ب

$Br = \frac{m v_{\perp}}{|q|B} \Rightarrow m_e = 9.11 \times 10^{-31}$, $|q_e| = 1.6 \times 10^{-19} \Rightarrow r = \frac{9.11 \times 10^{-31} \times 29.8}{1.6 \times 10^{-19} \times 0.03} = 5.6 \times 10^{-9}\ m$ (الف

$T = \frac{2\pi r}{v}$, $I = \frac{|q|}{T} \Rightarrow I = \frac{|q|v}{2\pi r} \Rightarrow A = \pi r^2$, $\mu = IA \Rightarrow \mu = \frac{|q|v}{2\pi r} \times \pi r^2 = \frac{|q|vr}{2}$

$T = \mu B \sin\theta \xrightarrow{\theta_{max} = 90^\circ} \boxed{T_{max} = \mu B = \frac{|q|vBr}{2}}$