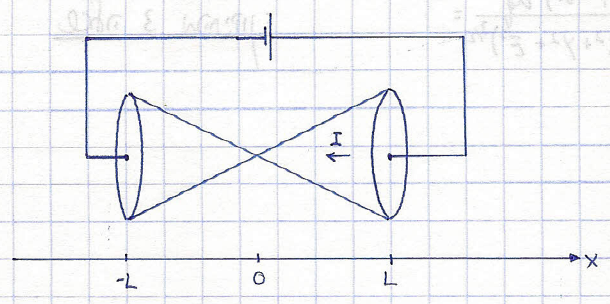
מבחן 66ב שאלה 3:

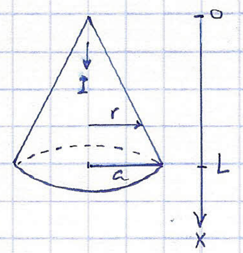


$I = \frac{V}{R}$

מעבר שאסור לפתוח בנט"מ:

$\rho_{(x)} = \rho_0 x^4$

$dR = \rho_{(x)} \frac{dl}{ds} = \rho_0 x^4 \frac{dx}{r_{(x)} dr d\theta} = \frac{\rho_0 L}{a} x^3 \frac{dx}{dr d\theta}$



$r_{(x)} = \frac{a}{L} x$

$\frac{1}{R_p} = \int \frac{1}{dR} = \int_0^{2\pi}\int_0^{r_{(x)}} \frac{a}{\rho_0 \frac{a}{L} x^3} \cdot \frac{dr d\theta}{dx} = \frac{2\pi a^2 x}{\rho_0 \frac{a}{L^2} x^3 dx} = \frac{2\pi a^2}{\rho_0 x^2 dx L^2}$

$R = \int R_p = \int_0^L \frac{\rho_0 x^2 dx L^2}{2\pi a^2} = \frac{\rho_0 L^5}{6\pi a^2}$

$R_T = 2R = \frac{\rho_0 L^5}{3\pi a^2}$

$I = \frac{V_0}{R_T} = \frac{3\pi V_0}{\rho_0 L^3}$

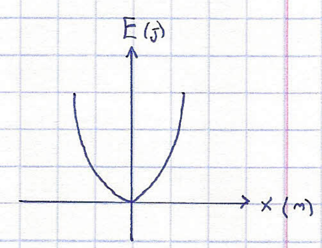
הדרך הנכונה:

$dR = \rho_{(x)} \frac{dx}{r_{(x)} dr d\theta}$

$\frac{1}{R_p} = \int_0^{2\pi}\int_0^{r_{(x)}} \frac{r_{(x)} dr d\theta}{\rho_{(x)} dx} = \frac{\pi r_{(x)}^2}{\rho_{(x)} dx} \rightarrow R_p = \frac{\rho_{(x)} dx}{\pi r_{(x)}^2}$

$R = \int_{-L}^{L} \frac{\rho_{(x)} dx}{\pi r_{(x)}^2} = \int_{-L}^{L} \frac{\rho_0 x^4 \, dx}{\pi \cdot \frac{a^2}{L^2} x^2} = \int_{-L}^{L} \frac{\rho_0 L^2 x^2 dx}{a^2 \pi} = \frac{2\rho_0 L^5}{3\pi a^2}$

$\vec{E} = \rho J = \rho_x \frac{I}{A_x} = \rho_0 x^4 \cdot \frac{3\pi a^2 V_0}{2\rho_0 L^5 \cdot \pi r_{(x)}^2} = \frac{3a^2 x^4 V_0}{2L^5 \cdot \frac{a^2}{L^2} x^2} = \frac{3x^2 V_0}{2L^3} = \frac{3V_0}{2L^3} \cdot x^2$



$\oint B \cdot dl = \mu_0 I_{(r)} \longrightarrow \vec{B} \cdot 2\pi r = \mu_0 I \Rightarrow \vec{B} = \frac{3\mu_0 a^2 V_0}{4\rho_0 L^5 r} \cdot \hat{\theta}$