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TY BTech EXTC

EWE - Tutorial I

Q1.] $E = \dfrac{V_0 - 0}{r^2\left(\frac{1}{a}-\frac{1}{b}\right)} = \dfrac{V_0}{r^2\left(\frac{1}{a}-\frac{1}{b}\right)}$, $J = \sigma E$ $\left[\because V_{(r=a)} = 0,\ V_{(r=b)} = V_0\right]$

$$\therefore I = \int J \cdot ds = \frac{V_0 \sigma}{\left(\frac{1}{a}-\frac{1}{b}\right)} \int_{\theta=0}^{\alpha}\int_{\phi=0}^{2\pi} \frac{1}{r^2} \cdot r^2 \sin\theta \, d\theta \, d\phi$$

$$= \cancel{\frac{2\pi V_0 \sigma}{\frac{1}{a}-\frac{1}{b}} \int_{\theta=0}^{\alpha} -[\cos(2\pi) - \cos(0)] \, d\theta}$$

$$= \frac{V_0 \sigma}{\left(\frac{1}{a}-\frac{1}{b}\right)} (-\cos\theta)\Big|_0^{\alpha}$$

$$\therefore R = \frac{V_0}{I} = \frac{\frac{1}{a}-\frac{1}{b}}{2\pi\sigma(1-\cos\alpha)} = \frac{1}{2\pi\sigma(1-\cos\alpha)}\left[\frac{1}{a}-\frac{1}{b}\right]$$

Hence, proved.

Q2.] We are given $H = \dfrac{10^6}{e} \sin(2\phi)\, a_p$ A/m

Now, we know that $\Psi = \int \bar{B} \cdot d\bar{s}$

$$= \mu_0 \int_{z=0}^{0.2}\int_{\phi=0}^{50^\circ} \frac{10^6}{\rho} \sin 2\phi \, \rho \, d\phi \, dz$$

$$= 4\pi \times 10^{-7} \times 10^6 (0.2)\left(-\frac{\cos(2\phi)}{2}\right)\Big|_0^{50^\circ}$$

$$= 0.04\pi(1 - \cos(100^\circ))$$

$$\therefore \boxed{\Psi = 0.1475 \text{ Wb}}$$