Quiz 4

1

Choose one of the following questions in Question 1 to answer

1. An infinitely long, straight conductor with a circular cross section of radius b carries a steady current I. Determine the magnetic flux density both inside and outside the conductor. Please show that

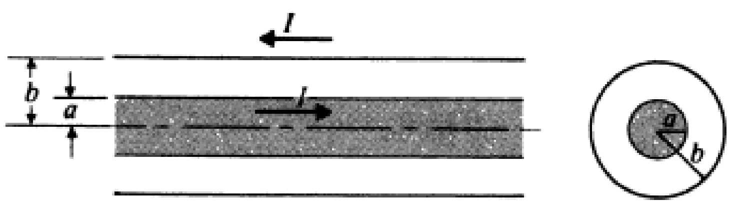
$$\boldsymbol{B_1} = \boldsymbol{a_\Phi} B_{\Phi 1} = \boldsymbol{a_\Phi} \frac{\mu_0 r_1 I}{2\pi b^2}, \quad r_1 \leq b$$

,

$$\boldsymbol{B_2} = \boldsymbol{a_\Phi} B_{\Phi 2} = \boldsymbol{a_\Phi} \frac{\mu_0 I}{2\pi r_2}, \quad r_2 \geq b$$

You can use $\oint_C \boldsymbol{B} \cdot dl = \mu_0 I$ in this question

2. An air coaxial transmission line has a solid inner conductor of inner radius b. Determine the inductance per unit length of the line.



You can use the definition $L = \frac{\Lambda}{I}$ where Λ is the flux linakge per unit length. *Hint: You can use* $d\Lambda' = \frac{2rdr}{a^2} d\Phi'$

2

Starting from the expression for vector magnetic potential $\boldsymbol{A}$ in

$$\boldsymbol{A} = \frac{\mu_0}{4\pi} \int_{V'} \frac{\boldsymbol{J}}{\boldsymbol{R}} dv'$$

, prove that

$$\boldsymbol{B} = \frac{\mu_0}{4\pi} \int_{V'} \frac{\boldsymbol{J} \times \boldsymbol{a_R}}{R^2} dv'$$

Furthermore, prove that $\boldsymbol{B}$ in

$$\boldsymbol{B} = \frac{\mu_0}{4\pi} \int_{V'} \frac{\boldsymbol{J} \times \boldsymbol{a_R}}{R^2} dv'$$

satisfies the fundamental postulates of magnetostatics in free space,

$$\nabla \times \boldsymbol{B} = 0$$

,

$$\nabla \times \boldsymbol{B} = \mu_0 \boldsymbol{J}$$