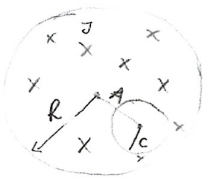
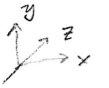
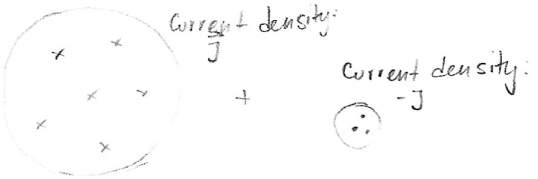
EM-2 Janvary 2012



Current density: $\vec{J}$



Find $\vec{B}$ inside the hole.



Use Ampere's Law: $\oint_C \vec{B} \cdot d\vec{l} = \mu_0 I$ $\quad I = J \cdot A$ $\quad A = \pi r^2 = \pi R^2$

Big cylinder:

$$B \cdot (2\pi R) = J\pi R^2 \mu_0 \rightarrow B = \frac{J\pi R^2 \mu_0}{2\pi R} = \frac{JR\mu_0}{2}$$

Little cylinder:

$$B \cdot (2\pi C) = -J\pi C^2 \mu_0 \rightarrow B = \frac{-JC\mu_0}{2}$$

To figure out the direction: $\vec{B} = \vec{J} \times \vec{r}$

Area of cylinder + hole: $\pi R^2 - \pi C^2 \rightarrow I = J(\pi R^2 - \pi C^2)$

$\vec{B}_B = \frac{\mu_0}{2} \vec{J} \times \vec{r}_1$ $\quad \vec{B}_L = \frac{\mu_0}{2} - \vec{J} \times \vec{r}_2$ $\quad \vec{A} + \vec{r}_2 = \vec{r}_1 \rightarrow \vec{A} = \vec{r}_1 - \vec{r}_2$

$\vec{B} = \frac{\mu_0}{2} \vec{J} \times \vec{A}$ → direction will be perpendicular to $\vec{J}$ and A $\Rightarrow \vec{B} = \frac{\mu_0 JR}{2} \hat{\phi}$

Draw $\vec{B}$