Q1

$$\vec{B} = \frac{\mu_0}{4\pi} \int_{S'} \frac{J_s \times (\vec{r} - \vec{r}')}{|\vec{r} - \vec{r}'|^3} ds'$$

$$= \frac{\mu_0}{4\pi} \int_{a}^{2a} \int_{0}^{2\pi} \frac{-J_0 r' \sin\left(\frac{\pi}{a} r'\right) \vec{e}_\phi \times (\vec{e}_\rho)\, r'\, dr'\, d\phi}{(r')^2}$$

$$\vec{B} = -\vec{e}_z \frac{\mu_0 J_0 a}{\pi}$$

I accept and abide the Honor Code of ITU

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$r = z\vec{e}_z \qquad r' = a\vec{e}_\rho = a\cos\phi' e_x + a\sin\phi' \vec{e}_y$

$$\vec{B} = \frac{\mu I}{4\pi} \oint \frac{da' \times (r - r')}{|r - r'|^3} \; a\, d\phi\, \vec{e}_\phi$$

$$\vec{B} = \frac{\mu I}{4\pi} \oint \frac{a\, d\phi\,(-\sin\phi' \vec{e}_x + \cos\phi' \vec{e}_y) \times (-a\cos\phi' \vec{e}_x - a\sin\phi' \vec{e}_y + z\vec{e}_z)}{(a^2 + z^2)^{3/2}}$$

$$\vec{B} = \frac{\mu I}{4\pi} \int_0^{2\pi} \frac{az\cos\phi' \vec{e}_x + az\sin\phi' \vec{e}_y + a^2 \vec{e}_z}{(a^2 + z^2)^{3/2}} \, d\phi'$$

$$\vec{B}(\vec{r}) = \frac{I a^2 \vec{e}_z}{2(a^2 + z^2)^{3/2}}$$

Q2/a