| Hinkle, Zachary | EM Griffiths | 07/30/18 | 1/1 |
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5.14

a) $\int \vec{B}\cdot d\vec{l} = \mu_0 I_{enc}$, for $s < a$, $I_{enc} = 0$, so $\vec{B} = 0$.

for $s \geq a$ $I_{enc} = I$, so

$B\int dl = B 2\pi s = \mu_0 I \Rightarrow \vec{B} = \frac{\mu_0 I}{2\pi s}\hat{\phi}$ (assuming $\hat{I} = \hat{z}$).

b) For problem 5.5, $\vec{J}(s) = \frac{I}{2\pi a s}\hat{I}$. Aligning our axis s.t. $\hat{I} = \hat{z}$,

$\vec{J}(s) = \frac{I}{2\pi a s}\hat{z}$. Then $I_{enc} = \int_S \vec{I}\cdot d\vec{a}$. we may as well choose a disk perpendicular to $\vec{J}$ so that $da = s\,ds\,d\theta\,\hat{z}$

Then $I_{enc} = \int \vec{J}\cdot d\vec{a} = \frac{I}{2\pi a}\int \frac{s\,ds\,d\theta}{s} = \frac{Is}{2\pi a}2\pi = I\left(\frac{s}{a}\right)$

$B\int dl$ is again equal to $B2\pi s$. So

$\int \vec{B}\cdot d\vec{l} = B\int dl = \mu_0 I_{enc} \Rightarrow B 2\pi s = \mu_0 I\left(\frac{s}{a}\right)$

$\Rightarrow \vec{B} = \frac{\mu_0 I}{2\pi a}\hat{\phi}$