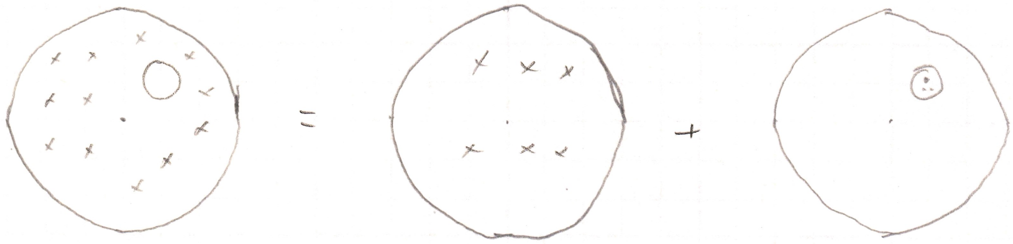
5.6 Assuming the current is flowing in the $\hat{z}$ direction. Following the principle of linear superposition, we have



For current density λ in the $\hat{z}$ direction, the magnetic induction is

Using Ampère's law, we have

$$\oint_{\partial S} \vec{B} \cdot d\vec{l} = \int_S (\nabla \times \vec{B}) \, d\vec{s} = \mu_0 \int_S \vec{J} \cdot d\vec{s} \quad \Rightarrow \quad B \cdot 2\pi r = \mu_0 \lambda \pi r^2$$

Taking into account of direction, $\vec{B} = \frac{\mu_0 \lambda}{2} \hat{z} \times \vec{r}$

For any point in the hole, the magnetic induction from the large cylinder is

$$\vec{B}_{out} = \frac{\mu_0 \lambda}{2} \hat{z} \times \vec{R},$$

and from the inner cylinder is

$$\vec{B}_{in} = \frac{\mu_0 \lambda}{2} (-\hat{z} \times \vec{r})$$

Then. $\vec{B} = \vec{B}_{out} + \vec{B}_{in} = \frac{\mu_0 \lambda}{2} \hat{z} \times (\vec{R} - \vec{r}) = \frac{\mu_0 \lambda}{2} \hat{z} \times \vec{d}$.

where $\vec{d}$ is the vector from the center of the outer cylinder to the center of the inner cylinder.