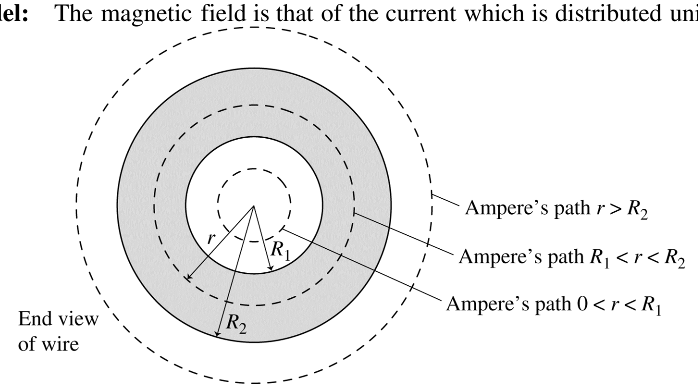
**32.61.** **Model:** The magnetic field is that of the current which is distributed uniformly in the hollow wire.
**Visualize:**




Ampere's integration paths are shown in the figure for the regions 0 m < $r < R_1$, $R_1 < r < R_2$, and $R_2 < r$.

**Solve:** For the region 0 m < $r < R_1$, $\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{through}}$ . Because the current inside the integration path is zero, $B = 0$ T. To find $I_{\text{through}}$ in the region $R_1 < r < R_2$, we multiply the current density by the area inside the integration path that carries the current. Thus,

$$I_{\text{through}} = \frac{I}{\pi\left(R_2^2 - R_1^2\right)}\pi\left(r^2 - R_1^2\right)$$

where the current density is the first term. Because the magnetic field has the same magnitude at every point on the circular path of integration, Ampere's law simplifies to

$$\oint \vec{B} \cdot d\vec{s} = B\int ds = B(2\pi r) = \mu_0 \frac{I\left(r^2 - R_1^2\right)}{\left(R_2^2 - R_1^2\right)} \Rightarrow B = \frac{\mu_0 I}{2\pi r}\left(\frac{r^2 - R_1^2}{R_2^2 - R_1^2}\right)$$

For the region $R_2 < r$, $I_{\text{through}}$ is simply $I$ because the loop encompasses the entire current. Thus,

$$\oint \vec{B} \cdot d\vec{s} = B\int ds = B2\pi r = \mu_0 I \Rightarrow B = \frac{\mu_0 I}{2\pi r}$$

**Assess:** The results obtained for the regions $r > R_2$ and $R_1 < r < R_2$ yield the same result at $r = R_2$. Also note that a hollow wire and a regular wire have the same magnetic field outside the wire.