

32.14. Model: Assume the wires are infinitely long.

Visualize: Please refer to Figure Ex31.14.

Solve: The magnetic field strength at point 1 is

$$\begin{aligned}\vec{B}_{\text{at } 1} &= \vec{B}_{\text{top}} + \vec{B}_{\text{bottom}} = \left(\frac{\mu_0 I}{2\pi d}, \text{ out of page} \right)_{\text{top}} + \left(\frac{\mu_0 I}{2\pi d}, \text{ into page} \right)_{\text{bottom}} \\ \Rightarrow B_{\text{at } 1} &= \frac{\mu_0 I}{2\pi} \left(\frac{1}{2 \text{ cm}} - \frac{1}{(4+2) \text{ cm}} \right) = (2 \times 10^{-7} \text{ T m / A})(10 \text{ A}) \left(\frac{1}{2 \times 10^{-2} \text{ m}} - \frac{1}{6 \times 10^{-2} \text{ m}} \right) \\ \Rightarrow \vec{B}_{\text{at } 1} &= (6.67 \times 10^{-5} \text{ T}, \text{ out of page})\end{aligned}$$

At points 2 and 3,

$$\begin{aligned}\vec{B}_{\text{at } 2} &= \left(\frac{\mu_0 I}{2\pi d}, \text{ into page} \right) + \left(\frac{\mu_0 I}{2\pi d}, \text{ into page} \right) = (2.0 \times 10^{-4} \text{ T}, \text{ into page}) \\ \vec{B}_{\text{at } 3} &= \left(\frac{\mu_0 I}{2\pi d}, \text{ into page} \right) + \left(\frac{\mu_0 I}{2\pi d}, \text{ out of page} \right) = (6.67 \times 10^{-5} \text{ T}, \text{ out of page})\end{aligned}$$