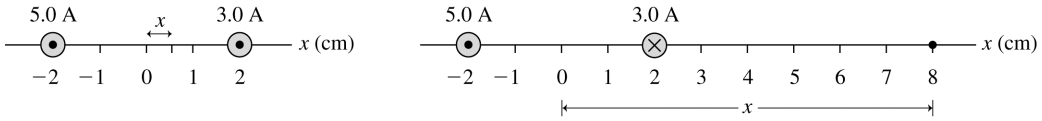
32.48. **Model:** The magnetic field is that of two long wires that carry current.

Visualize:



(a) **(b)**

Solve: **(a)** For $x > +2$ cm and for $x < -2$ cm, the magnetic fields due to the currents in the two wires add. The point where the two magnetic fields cancel lies on the x-axis in between the two wires. Let that point be a distance x away from the origin. Because the magnetic field of a long wire is $B = \mu_0 I/2\pi r$, we have

$$\frac{\mu_0}{2\pi}\frac{(5.0\text{ A})}{(0.02\text{ m} + x)} = \frac{\mu_0}{2\pi}\frac{(3.0\text{ A})}{(0.02\text{ m} - x)} \Rightarrow 5(0.02\text{ m} - x) = 3(0.02\text{ m} + x) \Rightarrow x = 0.005\text{ m} = 0.50\text{ cm}$$

(b) The magnetic fields due to the currents in the two wires add in the region -2.0 cm $< x < 2.0$ cm. For $x < -2.0$ cm, the magnetic fields subtract, but the field due to the 5.0 A current is always larger than the field due to the 3.0 A current. However, for $x > 2.0$ m, the two fields will cancel at a point on the x-axis. Let that point be a distance x away from the origin, so

$$\frac{\mu_0}{2\pi}\frac{5.0\text{ A}}{x + 0.02\text{ m}} = \frac{\mu_0}{2\pi}\frac{3.0\text{ A}}{x - 0.02\text{ m}} \Rightarrow 5(x - 0.02\text{ m}) = 3(x + 0.02\text{ m}) \Rightarrow x = 8.0\text{ cm}$$