

21. (a) If the currents are parallel, the two fields are in opposite directions in the region between the wires. Since the currents are the same, the total field is zero along the line that runs halfway between the wires. There is no possible current for which the field does not vanish.
- (b) If the currents are antiparallel, the fields are in the same direction in the region between the wires. At a point halfway between they have the same magnitude, $\mu_0 i / 2\pi r$. Thus the total field at the midpoint has magnitude $B = \mu_0 i / \pi r$ and

$$i = \frac{\pi r B}{\mu_0} = \frac{\pi(0.040 \text{ m})(300 \times 10^{-6} \text{ T})}{4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}} = 30 \text{ A} .$$