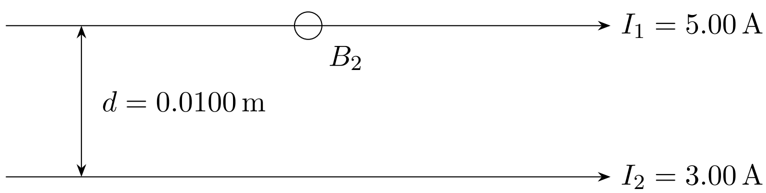
Physics 112: General Physics II: Electricity, Magnetism, and Optics
Magnetic Force between two parallel wires

Example: Parallel wires Two parallel wires are each 0.250 m long and are separated by a distance of 0.0100 m. The top wire (wire 1) carries a current 5.00 A, while the bottom wire (wire 2) carries a current 3.00 A in the same direction.



a. What is the magnetic field at the location of wire 1 due to wire 2? (Assume the field is the same as that of an infintely long wire, and ignore any effects of the Earth's magnetic field.)

b. What is the force on wire 1 due to wire 2?

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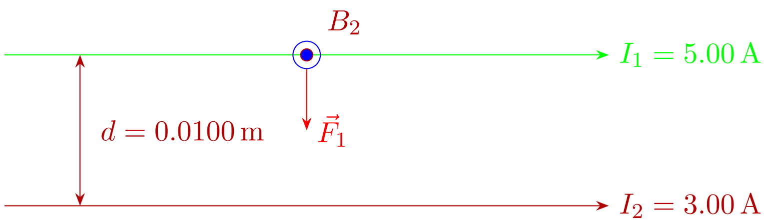
a. What is the magnetic field at the location of wire 1 due to wire 2? (Assume the field is the same as that of an infintely long wire.)

Using the right hand rule for the direction of the magnetic field due to wire 2, $\vec{B}_2$ comes out of the page near wire 1.



$$B_2 = \frac{\mu_0 I_2}{2\pi d} = \frac{(4\pi \times 10^{-7}\,\mathrm{Tm/A}) \times (3.00\,\mathrm{A})}{2\pi \times (0.0100\,\mathrm{m})}$$
$$B_2 = \boxed{6.00 \times 10^{-5}\,\mathrm{T}}$$

b. What is the force on wire 1 due to wire 2?

Wire 1 reacts to that field and experiences a force

$$\vec{F}_1 = I_1 \vec{L}_1 \times \vec{B}_2 = (5.00\,\mathrm{A}) \times (0.250\,\mathrm{m}) \times (6.00 \times 10^{-5}\,\mathrm{T})\,(-\hat{\jmath})$$
$$\vec{F}_1 = -7.50 \times 10^{-5}\,\mathrm{N}\,\hat{\jmath}$$

This is actually quite small, but can be measured with a delicate balance.