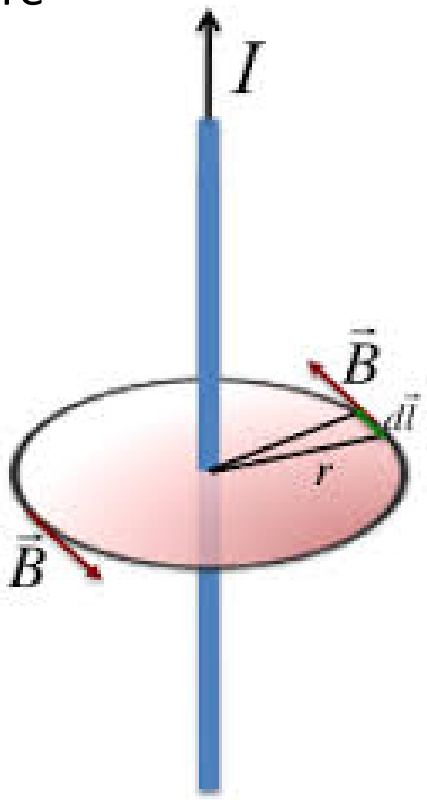
Ampere's Law: Infinite Wire

Consider a straight infinite wire carrying current I. Ampere's Law determines the strength of magnetic field at distance r from the wire

$$B = \frac{\mu_0 I}{2\pi r}$$

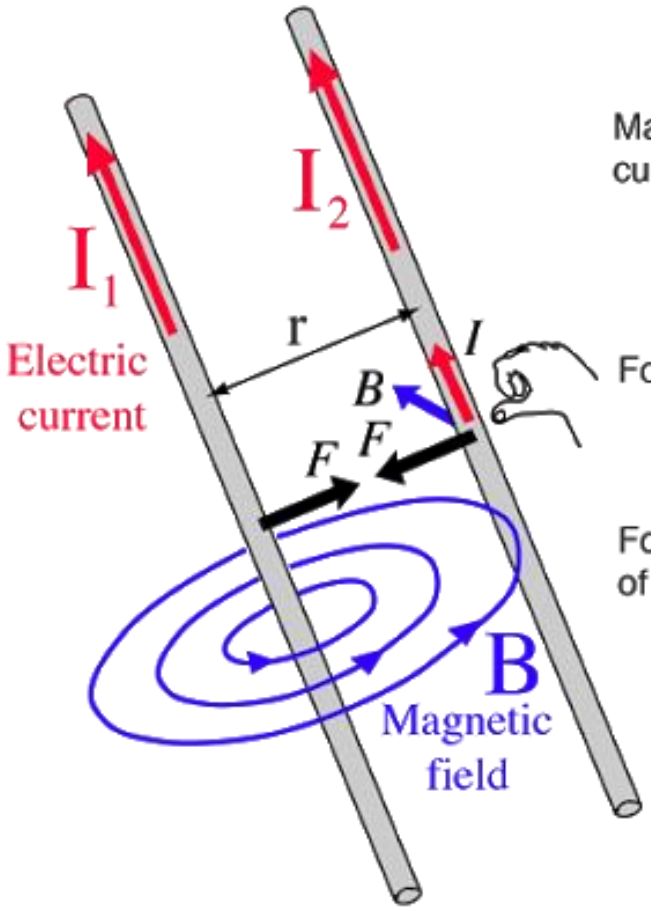
$$\mu_0 = 4\pi \times 10^7 N/A^2$$



Direction of B is determined by the right-hand rule.

Magnetic Force Between Wires

We combine Ampere's Law with Lorenz Force, ***F=IΔLB:***



Magnetic field at wire 2 from current in wire 1:

$$B = \frac{\mu_0 I_1}{2\pi r}$$

Force on a length ΔL of wire 2:

$$F = I_2 \Delta L B$$

Force per unit length in terms of the currents:

$$\frac{F}{\Delta L} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

Homework

Problem 1

Two parallel wires of radius ***r=0.1 mm*** each, are placed right next to each other (i. e. distance between their centers is 2r). The same current ***I*** is run through each wire. Find the value of ***I***, at which the magnetic force between the wires is equal to the weight of each of them. Density of cupper is ***9000 kg/m^3***.