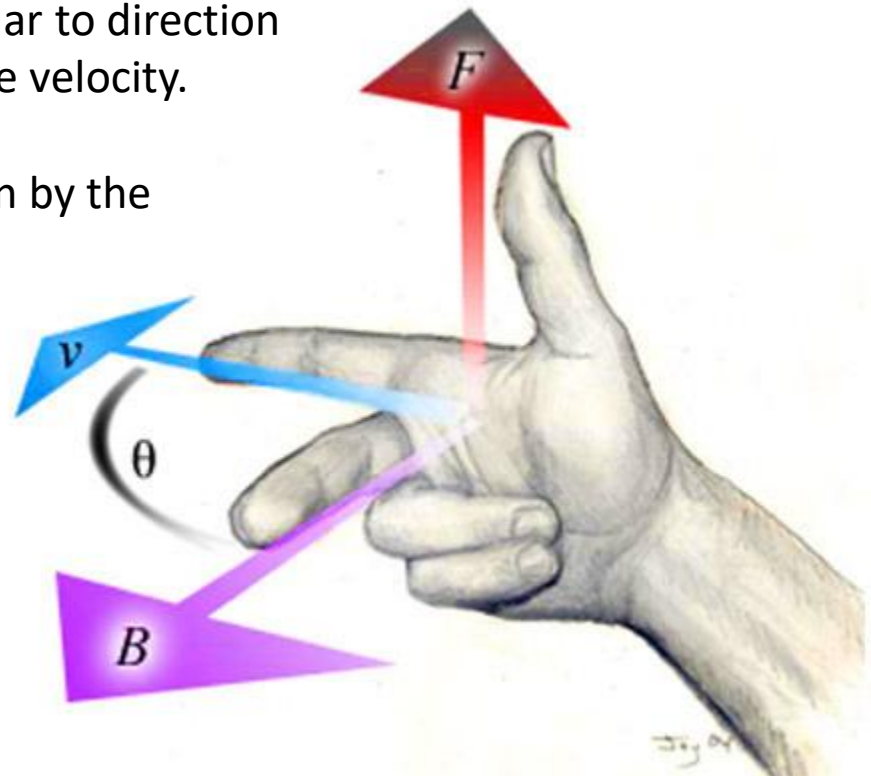


# Lorentz Force

Magnetic field  $\mathbf{B}$  acts on a charge  $q$  moving at velocity  $\mathbf{v}$  with the force known as Lorentz force:

$$\mathbf{F} = q\mathbf{v}\mathbf{B}$$

- Lorentz force is always directed perpendicular to direction of motion and to the magnetic field, and to the velocity.
- Direction of force for positive charge is given by the right hand rule:



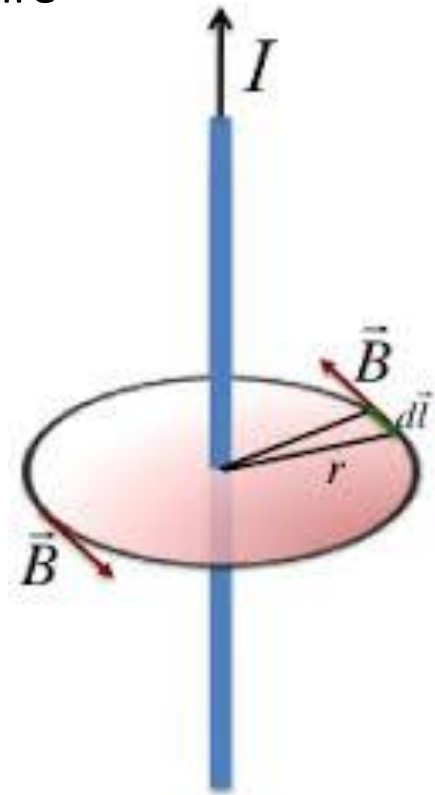
# Ampere's Law: Infinite Wire

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

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

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

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



# Homework

## Problem 1

Combine Lorentz and Ampere laws to find the force between two parallel wires carrying current  $I$  each. Length of each wire is  $L$ , and distance between them is  $d$ . Is the force attractive or repulsive, if the currents are flowing in the same direction? What if the currents are opposite?

## Problem 2

Two parallel wires of radius  $r=0.1 \text{ mm}$  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 copper is  $9000 \text{ kg/m}^3$ .