

## Magnetic force

### On a charged particle moving in a magnetic field

$$\vec{F}_B = q\vec{v} \times \vec{B}$$

The magnitude is:

$$|\vec{F}_B| = |q||\vec{v}||\vec{B}|\sin\theta$$

### Wire

The magnetic force exerted on a very small segment  $d\vec{s}$  is:

$$d\vec{F}_B = I d\vec{s} \times \vec{B}$$

Thus for a straight segment:

$$\vec{F}_B = I\vec{L} \times \vec{B}$$

where  $\vec{L}$  is a vector that points in the direction of the current  $I$  and has a magnitude equal to the length  $L$  of the segment.

### Direction

**Figure 29.5** Two right-hand rules for determining the direction of the magnetic force  $\vec{F}_B = q\vec{v} \times \vec{B}$  acting on a particle with charge  $q$  moving with a velocity  $\vec{v}$  in a magnetic field  $\vec{B}$ . (a) In this rule, the magnetic force is in the direction in which your thumb points. (b) In this rule, the magnetic force is in the direction of your palm, as if you are pushing the particle with your hand.

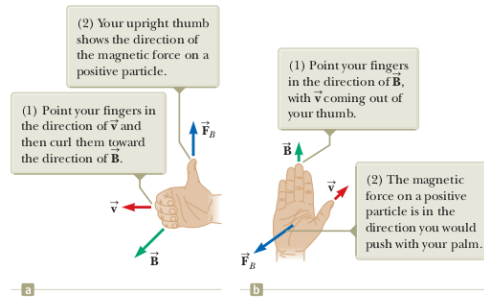


Figure 1:

### Unit

$$1T = 1 \frac{N}{C \cdot m/s} = 1 \frac{N}{A \cdot m} = 10^4 G$$

## Exercises

- 2.** Determine the initial direction of the deflection of charged particles as they enter the magnetic fields shown in Figure P29.2.

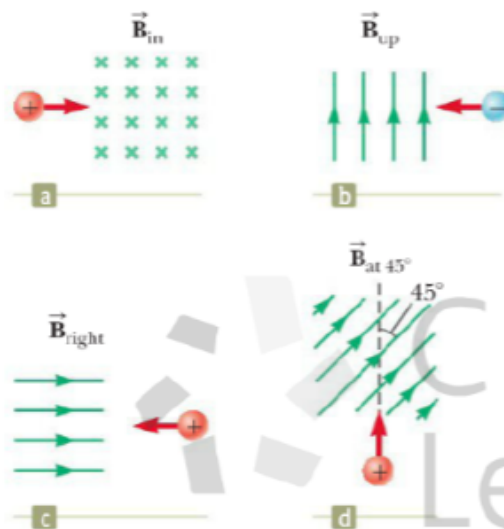


Figure P29.2

Figure 2:

- 65. Review.** A 0.200-kg metal rod carrying a current of 10.0 A glides on two horizontal rails 0.500 m apart. If the coefficient of kinetic friction between the rod and rails is 0.100, what vertical magnetic field is required to keep the rod moving at a constant speed?

Answer: **65.** 39.2 mT

Figure 3: