Lorentz Force

$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

- Electric force can accelerate objects by changing their speed and/or direction.
- Electric force can do work, $W_E = \int q\vec{E} \cdot d\vec{s}$

- Magnetic force can only accelerate objects by changing their direction. (Acts perpendicular to velocity.)
- Magnetic force does not do work,

$W_B = \int (q\vec{v} \times \vec{B}) \cdot \vec{v} dt = 0$ (where $\vec{v} = \frac{d\vec{s}}{dt}$)

Magnetic Forces on Currents

Consider charges moving in a wire in a magnetic field.

$\vec{B}\otimes$

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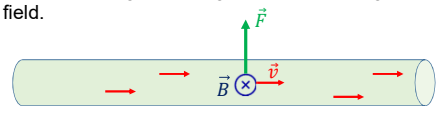


$\vec{F} = q\vec{v} \times \vec{B}$

$\vec{B}\otimes$

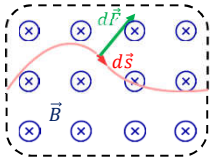
$\vec{F} = q\frac{\Delta\vec{s}}{\Delta t} \times \vec{B}$

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

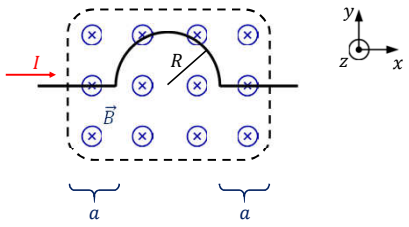
Magnetic Forces on Currents
Curved wires

$$\vec{F} = \int d\vec{F}$$

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



Example: A section of current-carrying wire is in a uniform magnetic field, as illustrated. Determine the net force on the wire.



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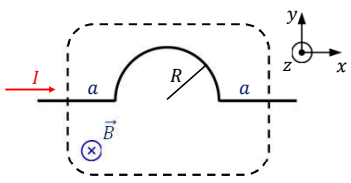

Example: A quarter of a circular loop of current-carrying wire is in a uniform magnetic field, as illustrated. Determine the net force on the wire.