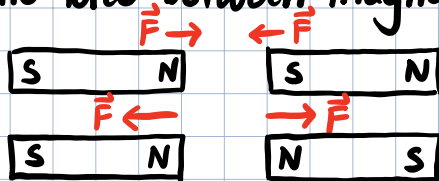


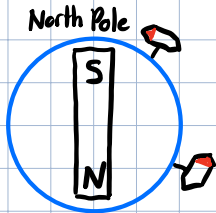
Magnetism

- First discovered by Ancient Greece/China; Renaissance Italy used for navigation
- North pole of a magnet points North, South pole points South
- The force between magnets:

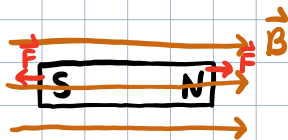


Unlike attract, like repel

- Earth acts as a magnet; geographic North = magnetic South

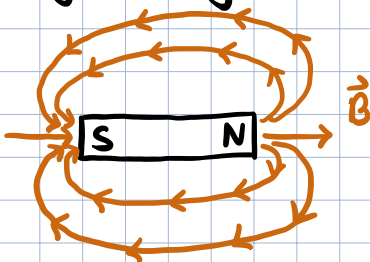


- Magnetic Field: Model to visualize and explain magnetic forces



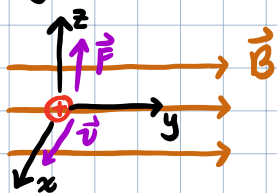
Magnet wants to be parallel to field

A magnet's magnetic field is similar to a dipole



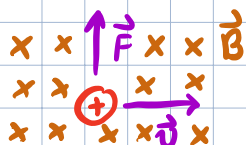
Unit is Tesla; $B_{\text{earth}} \approx 5 \times 10^{-5} \text{ T}$

- Magnetic forces act on moving electric charges



$$\vec{F} = q \vec{v} \times \vec{B} = qvB \sin(\theta)$$

\otimes = into page, \odot = out of page



Moves in a circle; $m \frac{v^2}{r} = qvB \sin(\theta) \rightarrow r = \frac{mv}{qB \sin(\theta)}$

$$T = \frac{2\pi r}{v} = \frac{2\pi m}{qB \sin(\theta)}, f = \frac{1}{T} = \frac{qB \sin(\theta)}{2\pi m}, \omega = 2\pi f = \frac{qB \sin(\theta)}{m}$$