Things to Memorize: Magnetic Forces and Fields

Cross Products and the First Right Hand Rule

- To find the magnitude of a cross product like $\vec{A} \times \vec{B}$, multiply $|A| \cdot |B| \cdot \sin(\theta)$
- To find the direction of the resultant vector use the **First Right Hand Rule**:
  1. Point your index finger in the direction of the first vector ($\vec{A}$).
  2. Bend your middle finger 90° and rotate your arm to point it in the direction of the second vector ($\vec{B}$).
  3. Your thumb will point in the direction of the resultant vector.
     Note: The resultant vector is always perpendicular to both of the original vectors.

Magnetic Force

- On a charged particle.
  - Magnetic fields exert forces on **moving, charged** particles.
  - Charged particles tend to move in a **circle** or **helix (spiral)** in a magnetic field.
  - Particles do not feel a force when they travel parallel or antiparallel to the magnetic field.
  - The Magentic Force on a particle is often canceled by an electrostatic force. In this case, particles of only a specific velocity can move through the area without colliding with the walls of the device.
- On a wire carrying current.
  - A wire will not feel a force if it carries current parallel or antiparallel to the magnetic field.
  - Even thought the formula is $F_b = I\vec{\ell} \times \vec{B}$, the direction of the first vector ($\vec{\ell}$) is in the direction of the current.

Magnetic Fields

- Moving charges generate magnetic fields.
- The direction of the magnetic field generated by a current-carrying wire is given by the **Second Right Hand Rule**:
  1. Point your thumb in the direction of the current flow.
  2. Pretend to grab the wire with your hand.
  3. The magnetic field will wrap around the wire in the direction your fingers point.
- The direction of the magnetic field generated by a coil or a loop of wire is given by the **Third Right Hand Rule**:
  1. Coil your fingers in the same direction as current flows.
  2. Your thumb points in the direction of the magnetic field.