Understanding Magnetism and Magnetic Fields

Bar Magnets

- Bar magnets have two poles: North and South.
- Like poles repel each other (N-N or S-S).
- Opposite poles attract each other (N-S).
- Can you think of examples where you observe this behavior?

Magnetic Fields

- Every magnet has a magnetic field that emanates from the North pole and enters the South pole.
- The strength of the magnetic field decreases with distance from the magnet.
- How do you visualize magnetic field lines?

Magnetic Field Interaction

- When two magnets are brought close, their magnetic fields interact.
- Fields can either reinforce (attraction) or cancel (repulsion).
- What happens when you place a North pole near a South pole?

Creating Magnetic Fields

- Magnetic fields are created by moving electric charges.
- A current-carrying wire generates a magnetic field around it.
- Can you describe how the right-hand rule helps determine the direction of the magnetic field?

Right-Hand Rule

- Curl your fingers around a wire with your thumb pointing in the direction of current.
- Your fingers show the direction of the magnetic field lines.
- Try this with a pen and visualize the magnetic field around it.

Magnetic Field Strength Formula

- The strength of the magnetic field (B) created by a long straight wire is given by:
- $B = (\mu_0 \times I) / (2\pi r)$
- Where:
- $\mu_0 = 4\pi \times 10^{-7}$ T·m/A (permeability of free space)
- I = current in amperes
- r = distance from the wire in meters

Magnetic Field Calculation Example

- Calculate the magnetic field strength at a point 2 cm from a wire carrying 45 A.
- Use the formula: $B = (\mu_0 \times I) / (2\pi r)$
- What is the result?

Magnetic Force on a Current-Carrying Wire

- The force (F) on a current-carrying wire in a magnetic field is given by:
- $F = I \times L \times B \times \sin(\theta)$
- Where:
- I = current
- L = length of the wire in the magnetic field
- B = magnetic field strength
- θ = angle between the wire and the magnetic field

Example of Magnetic Force Calculation

- A wire carrying 10 A experiences a force of 0.75 N in a magnetic field.
- If the length of the wire is 0.5 m, what is the magnetic field strength?
- Can you rearrange the formula to solve for B?

Magnetic Force Direction

- The direction of the magnetic force can be determined using the right-hand rule.
- Point your thumb in the direction of the current and your fingers in the direction of the magnetic field.
- What direction does your palm face?

Magnetic Field of a Solenoid

- A solenoid is a coil of wire that creates a uniform magnetic field when current flows through it.
- The magnetic field inside a solenoid is given by:
- $B = \mu_0 \times n \times I$
- Where:
- n = number of turns per unit length

Calculating Magnetic Field in a Solenoid

- Given a solenoid with 800 turns and a length of 0.15 m carrying 5 A, calculate the magnetic field.
- What is the formula you will use?

Torque on a Current-Carrying Loop

- The torque (τ) on a current-carrying loop in a magnetic field is given by:
- $\tau = n \times I \times A \times B \times \sin(\theta)$
- Where:
- A = area of the loop
- θ = angle between the magnetic field and the normal to the loop

Example of Torque Calculation

- A circular coil with a radius of 0.3 m and 50 loops carries a current of 8 A in a magnetic field of 5 T.
- What is the maximum torque exerted on the coil?
- Can you calculate it using the formula?

Equilibrium of a Current-Carrying Loop

- When a current-carrying loop is placed in a magnetic field, it experiences forces that can cause it to rotate.
- At equilibrium, the net torque is zero.
- How does the angle of the loop affect the torque?

Conclusion

- Magnetism is a fundamental force that affects charged particles and currents.
- Understanding magnetic fields and forces is crucial in physics.
- What applications of magnetism can you think of in everyday life?