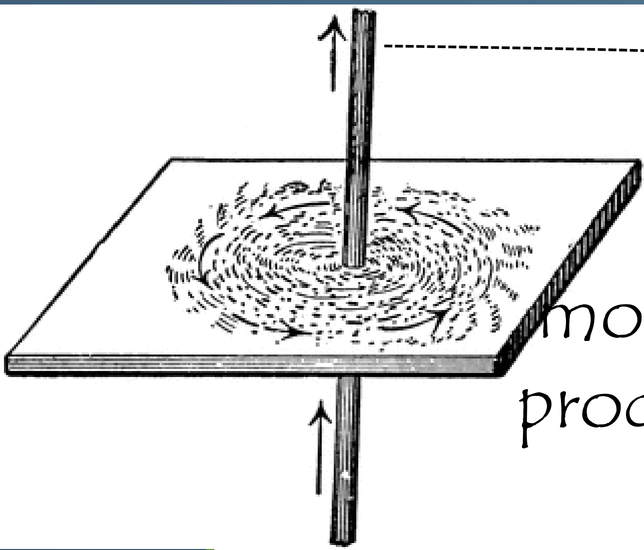


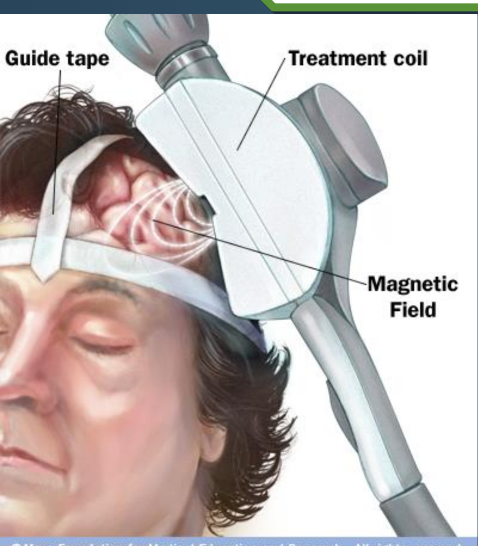
Observation:
a current of moving charged particles produces a magnetic field around the current.

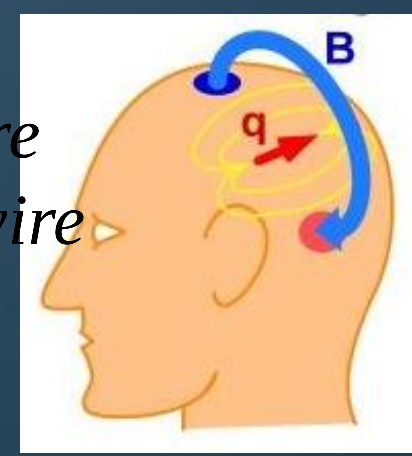
Chapter 29

Magnetic Fields due to Currents

Magnetic field due to

- *a current in a long straight wire*
- *a current in a circular arc of wire*
- *Brain activity...*





29-2 Magnetic Field due to a Current

Learning Objectives

29.01 Sketch a current-length element in a wire and indicate the direction of the magnetic field that it sets up at a given point near the wire.

29.02 For a given point near a wire and a given current-element in the wire, determine the magnitude and direction of the magnetic field due to that element.

29.03 Identify the magnitude of the magnetic field set up by a current-length element at a point in line with the direction of that element.

29.04 For a point to one side of a long straight wire carrying current, apply the relationship between the magnetic field magnitude, the current, and the distance to the point.

29.05 For a point to one side of a long straight wire carrying current, use a right-hand rule to determine the direction of the magnetic field vector.

29.06 Identify that around a long straight wire carrying current, the magnetic field lines form circles.

29-2 Magnetic Field due to a Current

Learning Objectives (Contd.)

29.07 For a point to one side of the end of a semi-infinite wire carrying current, apply the relationship between the magnetic field magnitude, the current, and the distance to the point.

29.08 For the center of curvature of a circular arc of wire carrying current, apply the relationship between the magnetic field magnitude, the current, the radius of curvature, and the angle subtended by the arc (in radians).

29.09 For a point to one side of a short straight wire carrying current, integrate the Biot–Savart law to find the magnetic field set up at the point by the current.

29-3 Force Between Two Parallel Currents

Learning Objectives

29.10 Given two parallel or anti-parallel currents, find the magnetic field of the first current at the location of the second current and then find the resulting force acting on that second current.

29.11 Identify that parallel currents attract each other, and anti-parallel currents repel each other.

29.12 Describe how a rail gun works.

29-4 Ampere’s Law

Learning Objectives

29.13 Apply Ampere’s law to a loop that encircles current.

29.14 With Ampere’s law, use a right-hand rule for determining the algebraic sign of an encircled current.

29.15 For more than one current within an Amperian loop, determine the net current to be used in Ampere’s law.

29.16 Apply Ampere’s law to a long straight wire with current, to find the magnetic field magnitude inside and outside the wire, identifying that only the current encircled by the the Amperian loop matters.

29-5 Solenoids and Toroids

Learning Objectives

29.17 Describe a solenoid and a toroid and sketch their magnetic field lines.

29.18 Explain how Ampere's law is used to find the magnetic field inside a solenoid.

29.19 Apply the relationship between a solenoid's internal magnetic field B, the current i, and the number of turns per unit length n of the solenoid.

29.20 Explain how Ampere's law is used to find the magnetic field inside a toroid.

29.21 Apply the relationship between a toroid's internal magnetic field B, the current i, the radius r, and the total number of turns N.

29-6 A Current-Carrying Coil as a Magnetic Dipole

Learning Objectives

29.22 Sketch the magnetic field lines of a flat coil that is carrying current.

29.23 For a current-carrying coil, apply the relationship between the dipole moment magnitude μ and the coil's current i, number of turns N, and area per turn A.

29.24 For a point along the central axis, apply the relationship between the magnetic field magnitude B, the magnetic moment μ, and the distance z from the center of the coil.