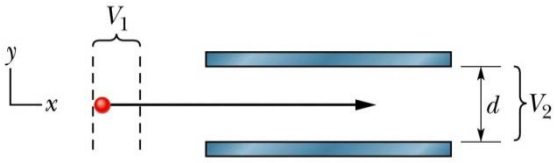
Chapter 22
Example Problems

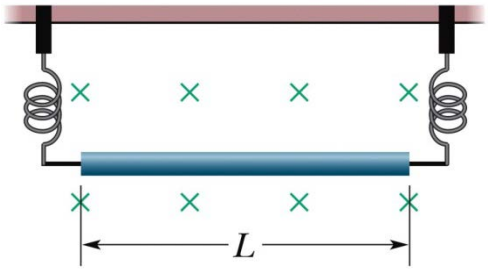
1. A uniform magnetic field, **B,** with magnitude 1.2 mT, is directed vertically upward throughout the volume of a laboratory chamber. A proton with kinetic energy 5.3 MeV and mass 1.67×10^{-27} kg enters the chamber, moving horizontally from south to north. What magnetic deflecting force acts on the proton as it enters the chamber? Neglect the Earth's magnetic field.

2. In the figure, an electron accelerated from rest through potential difference V_1 = 1.00 kV enters the gap between two parallel plates having separation d = 20.0 mm and potential difference V_2 = 100 V. The lower plate is at the lower potential. Neglect fringing and assume that the electron's velocity vector is perpendicular to the electric field vector between the plates. What is the magnitude of the uniform magnetic field which allows the electron to travel in a straight line in the gap?



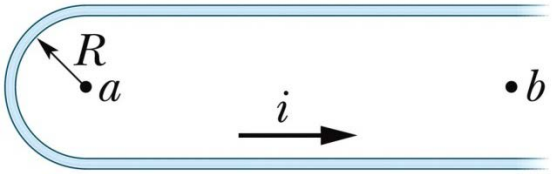
3. An alpha particle can be produced in certain radioactive decays of nuclei and consists of two protons and two neutrons. The particle has a charge of $q = +2e$ and a mass of 4.00 u, where u is the atomic mass unit, with $1u = 1.661 \times 10^{-27}$ kg. Suppose an alpha particle travels in a circular path of radius 4.50 cm in a uniform magnetic field with $\mathbf{B} = 1.20$ T. Calculate its
    a. Speed
    b. Period of revolution
    c. Kinetic energy in eV
    d. Potential difference through which it would have to be accelerated to achieve this energy

4. A 13.0 g wire of length 62.0 cm is suspended by a pair of flexible leads in a uniform magnetic field of magnitude 0.440 T. What is the magnitude and direction of current required to remove the tension in the supporting leads?

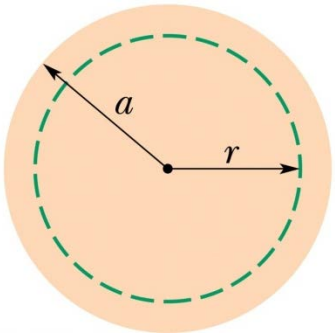


5. A circular wire loop of radius 15.0 cm carries a current of 2.60 A. It is placed so that the normal to its plane makes an angle of 41.0° with a uniform magnetic field of magnitude 12.0 T. What is the magnitude of the torque acting on the loop?

6. A current of 10 A is set up in a long hairpin conductor formed by bending a wire into a semicircle of radius R = 5.0 mm. Point b is midway between the straight sections and so distant from the semicircle that each straight section can be approximated as being an infinite wire. What are the magnitude of the magnetic field at a and b?



7. The figure below shows a cross section across a diameter of a long cylindrical conductor of radius a = 2.00 cm carrying uniform current 170.0 A. What is the magnitude of the current's magnetic field at following radial distances?



   a. 0.00 cm
   b. 1.00 cm
   c. 2.00 cm (wire's surface)
   d. 4.00 cm

8. A solenoid has a length of 1.23 m and inner diameter of 3.55 cm and it carries a current of 5.57 A. It consists of five close-packed layers, each with 850 turns along the length. What is the magnetic field at the center?

9. The figure below shows an arrangement known as a Helmholtz coil. It consists of two circular coaxial coils, each of 200 turns and radius R = 25.0 cm, separated by a distance s = R. The two coils carry equal current of 12.2 mA in the same direction. Find the magnitude of the net magnetic field at point P, midway between the coils.