HW-CH28

1. (a) Find the frequency of revolution of an electron with an energy of 100 eV in a uniform magnetic field of magnitude 35.0 μT. (b) Calculate the radius of the path of this electron if its velocity is perpendicular to the magnetic field.

2. In a certain cyclotron a proton moves in a circle of radius 0.500 m. The magnitude of the magnetic field is 1.00 T. (a) What is the oscillator frequency? (b) What is the kinetic energy of the proton, in electron-volts?

3. Prove that the relation $\tau = NiAB\sin\theta$ holds not only for the rectangular loop of Fig. 28-19 but also for a closed loop of any shape. (*Hint:* Replace the loop of arbitrary shape with an assembly of adjacent long, thin, approximately rectangular loops that are nearly equivalent to the loop of arbitrary shape as far as the distribution of current is concerned.)

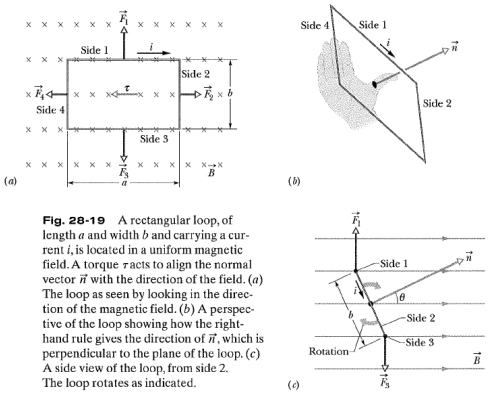

Fig. 28-19 A rectangular loop, of length a and width b and carrying a current i, is located in a uniform magnetic field. A torque τ acts to align the normal vector $\vec{n}$ with the direction of the field. (*a*) The loop as seen by looking in the direction of the magnetic field. (*b*) A perspective of the loop showing how the right-hand rule gives the direction of $\vec{n}$, which is perpendicular to the plane of the loop. (*c*) A side view of the loop, from side 2. The loop rotates as indicated.

4. Two concentric, circular wire loops, of radii $r_1 = 20.0$ cm and $r_2 = 30.0$ cm, are located in an xy plane; each carries a clockwise current of 7.00 A (Fig. 28-47). (a.) Find the magnitude of the net magnetic dipole moment of the system. (b) Repeat for reversed current in the inner loop.

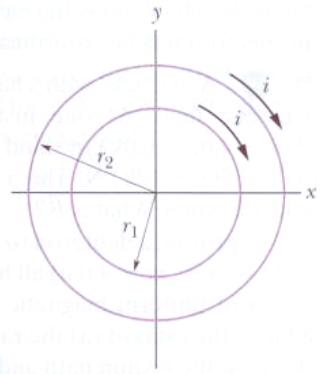

Fig. 28-47 Problem 55.

5. Figure 28-48 shows a current loop $ABCDEFA$ carrying a current $i = 3.00$ A. The sides of the loop are parallel to the coordinate axes shown, with $AB = 20.0$ cm, $BC = 30.0$ cm, and $FA = 10.0$ cm. In unit-vector notation, what is the magnetic dipole moment of this loop? (*Hint:* Imagine equal and opposite currents i in the line segment AD; then treat the two rectangular loops $ABCDA$ and $ADEFA$.)

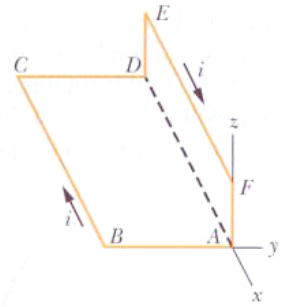

Fig. 28-48
Problem 60.

6. A beam of electrons whose kinetic energy is K emerges from a thin-foil "window" at the end of an accelerator tube. A metal plate at distance d from this window is perpendicular to the direction of the emerging beam (Fig. 28-52). (a) Show that we can prevent the beam from hitting the plate if we apply a uniform magnetic field

such that $B \geq \sqrt{\frac{2mK}{e^2 d^2}}$ in which m and e are the electron mass and charge. (b) How should $\vec{B}$ be oriented?

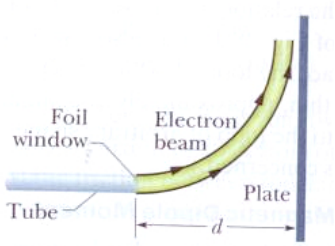

Fig. 28-52 Problem 72.