5. An electron moves through a uniform magnetic field given by \( \vec{B} = B_x \hat{i} + (3.0B_y) \hat{j} \). At a particular instant, the electron has velocity \( \vec{v} = (2.0 \hat{i} + 4.0 \hat{j}) \) m/s and the magnetic force acting on it is \( (6.4 \times 10^{-19} \text{ N}) \hat{k} \). Find \( B_x \).

17. 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 1 u = 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 \( B = 1.20 \) T. Calculate (a) its speed, (b) its period of revolution, (c) its kinetic energy, and (d) the potential difference through which it would have to be accelerated to achieve this energy.

31. A particular type of fundamental particle decays by transforming into an electron e\(^-\) and a positron e\(^+\). Suppose the decaying particle is at rest in a uniform magnetic field \( \vec{B} \) of magnitude 3.53 mT and the e\(^-\) and e\(^+\) move away from the decay point in paths lying in a plane perpendicular to \( \vec{B} \). How long after the decay do the e\(^-\) and e\(^+\) collide?

42. The bent wire shown in Fig. 28-41 lies in a uniform magnetic field. Each straight section is 2.0 m long and makes an angle of \( \theta = 60^\circ \) with the x axis, and the wire carries a current of 2.0 A. What is the net magnetic force on the wire in unit-vector notation if the magnetic field is given by (a) 4.0k T and (b) 4.0i T?
Figure 28-44 shows a rectangular 20-turn coil of wire, of dimensions 10 cm by 5.0 cm. It carries a current of 0.10 A and is hinged along one long side. It is mounted in the $xy$ plane, at angle $\theta = 30^\circ$ to the direction of a uniform magnetic field of magnitude 0.50 T. In unit-vector notation, what is the torque acting on the coil about the hinge line?

A wire lying along a $y$ axis from $y = 0$ to $y = 0.250$ m carries a current of 2.00 mA in the negative direction of the axis. The wire fully lies in a nonuniform magnetic field that is given by $\vec{B} = (0.300 \text{ T/m})\hat{y}\hat{i} + (0.400 \text{ T/m})\hat{y}\hat{j}$. In unit-vector notation, what is the magnetic force on the wire?

A 1.0 kg copper rod rests on two horizontal rails 1.0 m apart and carries a current of 50 A from one rail to the other. The coefficient of static friction between rod and rails is 0.60. What are the (a) magnitude and (b) angle (relative to the vertical) of the smallest magnetic field that puts the rod on the verge of sliding?