Physics 104 : Discussion 5a

2. (a) Find the direction of the force on a proton (a positively charged particle) moving through the magnetic fields in Figure P19.2, as shown. (b) Repeat part (a), assuming the moving particle is an electron.

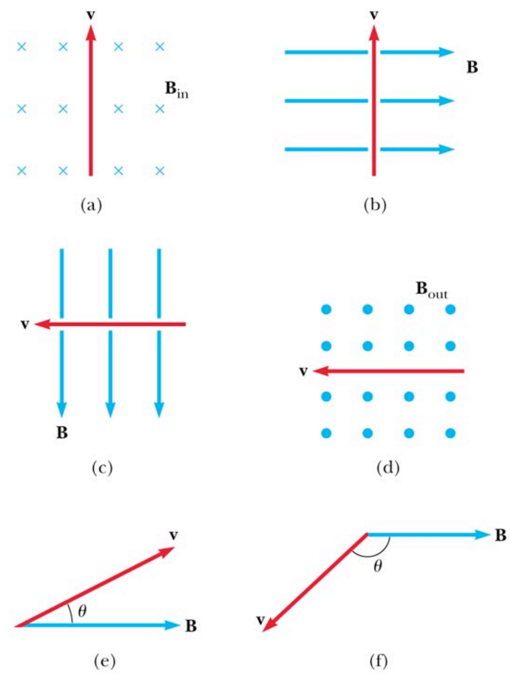

Figure P19.2

19.2 (a) For a positively charged particle, the direction of the force is that predicted by the right hand rule. These are:

(a′) **in plane of page and to left** (b′) **into the page**

(c′) **out of the page**

(d′) **in plane of page and toward the top**

(e′) **into the page** (f′) **out of the page**

(b) For a negatively charged particle, the direction of the force is exactly opposite what the right hand rule predicts for positive charges. Thus, the answers for part (b) are **reversed from those given in part (a)**.

4. Determine the initial direction of the deflection of charged particles as they enter the magnetic fields shown in Figure P19.4.

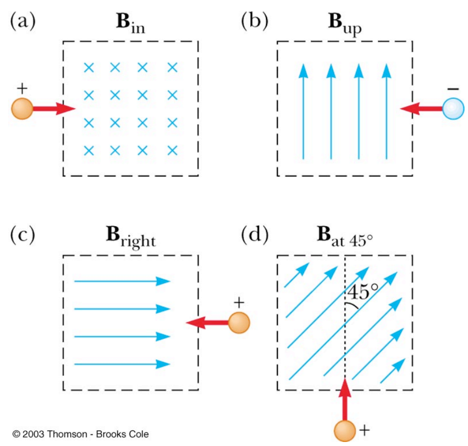

Figure P19.4

19.4 Hold the right hand with the thumb in the direction of **v** and the fingers in the direction of **B**. The palm will the face the direction of the force (and hence the deflection) if the particle has a positive charge. The results are

(a) toward top of page (b) out of the page, since the charge is negative.

(c) zero force (d) into the page

7. What velocity would a proton need to circle Earth 1 000 km above the magnetic equator, where Earth's magnetic field is directed horizontally north and has a magnitude of 4.00×10^{-8} T?

19.7 The gravitational force is small enough to be ignored, so the magnetic force must supply the needed centripetal acceleration. Thus,

$$m\frac{v^2}{r} = qvB\sin 90°\text{, or } v = \frac{qBr}{m} \quad \text{where } r = R_E + 1000\text{ km} = 7.38\times10^6\text{ m}$$

$$v = \frac{(1.60\times10^{-19}\text{ C})(4.00\times10^{-8}\text{ T})(7.38\times10^6\text{ m})}{1.67\times10^{-27}\text{ kg}} = \boxed{2.83\times10^7\text{ m/s}}$$

If **v** is toward the west and **B** is northward, **F** will be directed downward as required.

8. An electron is accelerated through 2 400 V from rest and then enters a region where there is a uniform 1.70-T magnetic field. What are the (a) maximum and (b) minimum magnitudes of the magnetic force this charge can experience?

19.8 The speed attained by the electron is found from $\frac{1}{2}mv^2 = |q|(\Delta V)$, or

$$v = \sqrt{\frac{2e(\Delta V)}{m}} = \sqrt{\frac{2(1.60 \times 10^{-19}\ \text{C})(2400\ \text{V})}{9.11 \times 10^{-31}\ \text{kg}}} = 2.90 \times 10^{7}\ \text{m/s}$$

(a) Maximum force occurs when the electron enters the region perpendicular to the field.

$$F_{max} = |q|vB\sin 90°$$

$$= (1.60 \times 10^{-19}\ \text{C})(2.90 \times 10^{7}\ \text{m/s})(1.70\ \text{T}) = \boxed{7.90 \times 10^{-12}\ \text{N}}$$

(b) Minimum force occurs when the electron enters the region parallel to the field.

$$F_{min} = |q|vB\sin 0° = \boxed{0}$$