Chapter 8 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

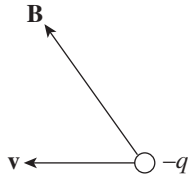
1. Which of the following is/are true concerning magnetic forces and fields? Select two answers.

   (A) The magnetic field lines due to a current-carrying wire radiate away from the wire.
   (B) The kinetic energy of a charged particle can be increased by a magnetic force.
   (C) A charged particle can move through a magnetic field without feeling a magnetic force.
   (D) A moving charged particle generates a magnetic field.

2. The velocity of a particle of charge $+4.0 \times 10^{-9}$ C and mass 2×10^{-4} kg is perpendicular to a 0.1-tesla magnetic field. If the particle's speed is 3×10^{4} m/s, what is the acceleration of this particle due to the magnetic force?

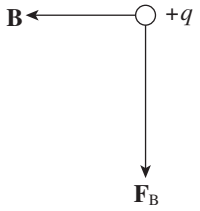
   (A) 0.0006 m/s^2
   (B) 0.006 m/s^2
   (C) 0.06 m/s^2
   (D) 0.6 m/s^2

3. In the figure below, what is the direction of the magnetic force $\mathbf{F}_B$?



   (A) Downward, in the plane of the page
   (B) Upward, in the plane of the page
   (C) Out of the plane of the page
   (D) Into the plane of the page

4. In the figure below, what must be the direction of the particle's velocity, **v** ?



   (A) Downward, in the plane of the page
   (B) Upward, in the plane of the page
   (C) Out of the plane of the page
   (D) Into the plane of the page

5. Due to the magnetic force, a positively charged particle executes uniform circular motion within a uniform magnetic field, **B**. If the charge is q and the radius of its path is r, which of the following expressions gives the magnitude of the particle's linear momentum?

   (A) qBr
   (B) qB/r
   (C) $q/(Br)$
   (D) $B/(qr)$

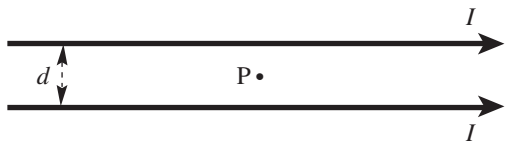
6. A straight wire of length 2 m carries a 10-amp current. How strong is the magnetic field at a distance of 2 cm from the wire?

   (A) 1×10^{-5} T
   (B) 2×10^{-5} T
   (C) 1×10^{-4} T
   (D) 2×10^{-4} T

7. Two long, straight wires are hanging parallel to each other and are 1 cm apart. The current in Wire 1 is 5 A, and the current in Wire 2 is 10 A, in the same direction. Which of the following best describes the magnetic force per unit length felt by the wires?

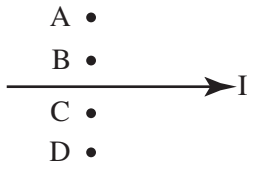
   (A) The force per unit length on Wire 1 is twice the force per unit length on Wire 2.
   (B) The force per unit length on Wire 2 is twice the force per unit length on Wire 1.
   (C) The force per unit length on Wire 1 is 0.0003 N/m, away from Wire 2.
   (D) The force per unit length on Wire 1 is 0.001 N/m, toward Wire 2.

8. In the figure below, what is the magnetic field at the Point P, which is midway between the two wires?



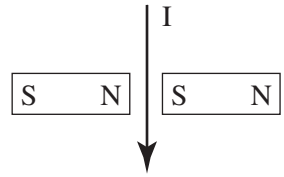
(A) $2\mu_0 I/(\pi d)$, into the plane of the page
(B) $\mu_0 I/(2\pi d)$, out of the plane of the page
(C) $\mu_0 I/(2\pi d)$, into the plane of the page
(D) Zero

9. Here is a section of a wire with a current moving to the right. Where is the magnetic field strongest and pointing INTO the page?



(A) A
(B) B
(C) C
(D) D

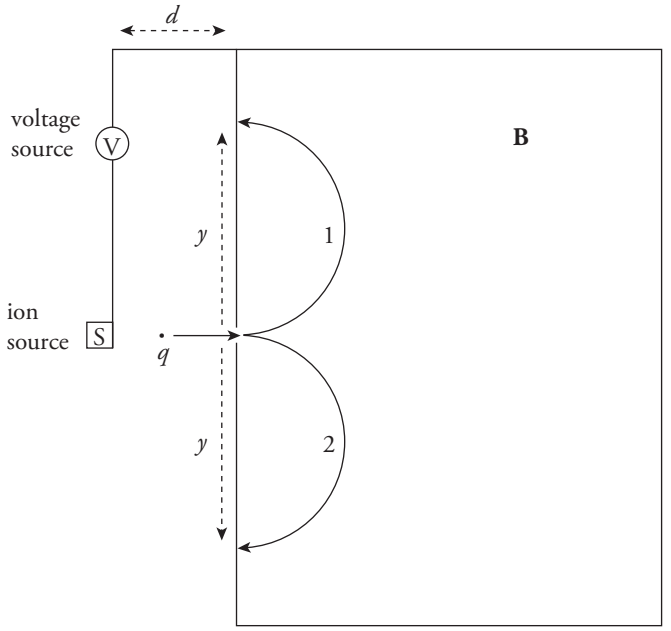
10. What is the direction of force acting on the current-carrying wire as shown below?



(A) To the bottom of the page
(B) Into the page
(C) Out of the page
(D) To the right of the page

Section II: Free Response

1. The diagram below shows a simple mass spectrograph. It consists of a source of ions (charged atoms) that are accelerated (essentially from rest) by the voltage V and enter a region containing a uniform magnetic field, **B**. The polarity of V may be reversed so that both positively charged ions (cations) and negatively charged ions (anions) can be accelerated. Once the ions enter the magnetic field, they follow a semicircular path and strike the front wall of the spectrograph, on which photographic plates are constructed to record the impact. Assume that the ions have mass m.



(a) What is the acceleration of an ion of charge q just before it enters the magnetic field?

(b) Find the speed with which an ion of charge q enters the magnetic field.

(c) (i) Which semicircular path, 1 or 2, would a cation follow?

(ii) Which semicircular path, 1 or 2, would an anion follow?

(d) Determine the mass of a cation entering the apparatus in terms of y, q, **B**, and V.

(e) Once a cation of charge q enters the magnetic field, how long does it take to strike the photographic plate?

(f) What is the work done by the magnetic force in the spectrograph on a cation of charge q?

2. A particle accelerator has a collision that results in a photon, an anti-bottom quark, and a charm quark. The magnetic field is 6.00×10^{-8} T and can be described as into the page. A photon has no charge and has an upper theoretical mass of 3.6×10^{-52} kg. The charm quark has a mass of 2.23×10^{-27} kg, a charge of 1.07×10^{-19} C, and a velocity of 40.1 m/s. The anti-bottom quark has a mass of 7.49×10^{-27} kg and orbits with a radius of 92.7 m at a velocity of 41.5 m/s in a clockwise manner.

   (a) What is the orbital radius of the photon?

   (b) What is the orbital radius of the charm quark?

   (c) What is the charge of the anti-bottom quark?