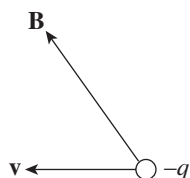


Chapter 8 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

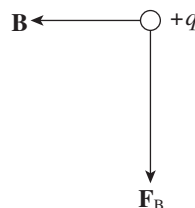
- Which of the following is/are true concerning magnetic forces and fields? Select two answers.
 - The magnetic field lines due to a current-carrying wire radiate away from the wire.
 - The kinetic energy of a charged particle can be increased by a magnetic force.
 - A charged particle can move through a magnetic field without feeling a magnetic force.
 - A moving charged particle generates a magnetic field.
- Two long wires carry a non-zero current I . At the location midway between the two wires, there will be a magnetic field strength of 0 T only if which of the following is true?
 - The wires are perpendicular to one another.
 - The wires must be coiled to create solenoids.
 - The wires must be parallel and the current must flow in the same direction.
 - The wires must be parallel and the current must flow in opposite directions.
- A particle of charge $-q$ moves to the left at speed v through a uniform magnetic field $\mathbf{B}$ which points into the second quadrant, as shown below.



A second experiment is performed which results in the same magnitude and same direction of the magnetic force on the particle. Which of the following could NOT be the conditions for the new experiment?

- $\mathbf{B}$ is unchanged, but q is now positive and $\mathbf{v}$ is directed to the right.
- The charge is still negative, but $\mathbf{v}$ and $\mathbf{B}$ are rotated 90° into the plane of the paper so that $\mathbf{v}$ is directed along the $-z$ -axis.
- The charge is still negative, but $\mathbf{v}$ and $\mathbf{B}$ are rotated 90° counterclockwise so that $\mathbf{v}$ is directed along the $-y$ -axis.
- $\mathbf{v}$ is unchanged, but q is now positive and $\mathbf{B}$ is rotated 180° to point into the fourth quadrant.

- In the figure below, what must be the direction of the particle's velocity, $\mathbf{v}$?

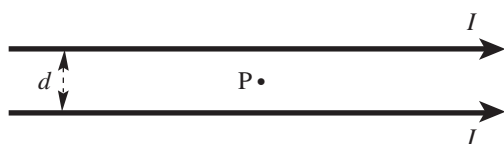


- Downward, in the plane of the page
 - Upward, in the plane of the page
 - Out of the plane of the page
 - Into the plane of the page
- An experiment is performed with a long current carrying wire in a region free from any other magnetic fields. The current is varied and the field strength is recorded. Which of the following statements about a graph of $\mathbf{B}$ versus $\mathbf{I}$ is true?
 - The slope of the graph is directly proportional to the square of the distance the magnetic field strength was measured from the wire.
 - The slope of the graph is directly proportional to the distance the magnetic field strength was measured from the wire.
 - The slope of the graph is inversely proportional to the square of the distance the magnetic field strength was measured from the wire.
 - The slope of the graph is inversely proportional to the distance the magnetic field strength was measured from the wire.
 - Which of the following situations would result in the largest magnetic field?
 - Measuring at a distance r from a wire carrying a current of I .
 - Measuring at a distance $2r$ from a wire carrying a current of $I/2$.
 - Measuring at a distance $r/2$ from a wire carrying a current of $2I$.
 - All four measurements would result in the same magnetic field.

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?

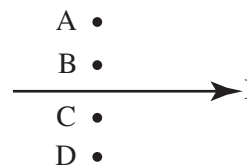
(A) The force per unit length on Wire 1 is twice the force per unit length on Wire 2.
 (B) The force per unit length on Wire 2 is twice the force per unit length on Wire 1.
 (C) The force per unit length on Wire 1 is 0.0003 N/m, away from Wire 2.
 (D) The force per unit length on Wire 1 is 0.001 N/m,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

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



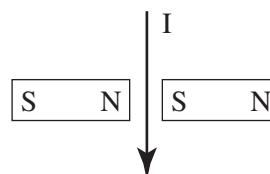
(A) $2\mu_0 I/(\pi d)$, into the plane of the page
 (B) $\mu_0 I/(2\pi d)$, out of the plane of the page
 (C) $\mu_0 I/(2\pi d)$, into the plane of the page
 (D) Zero

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

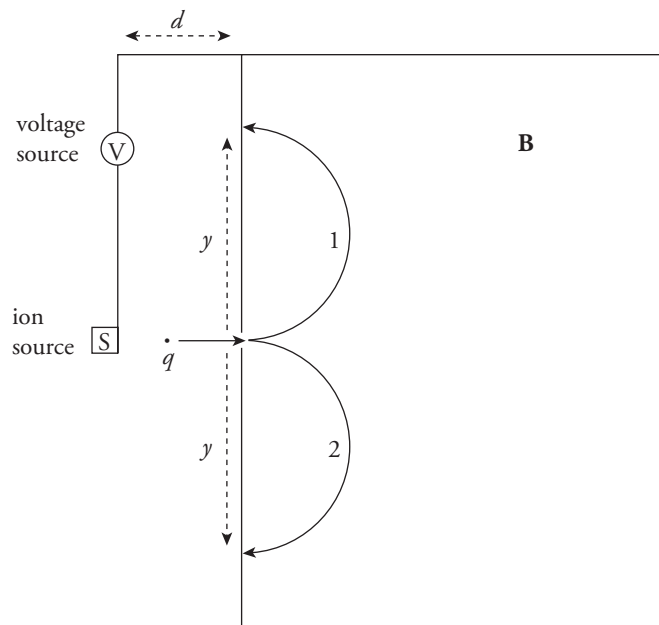
10. What is the direction of force acting on the current-carrying wire as shown below?



(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, $\mathbf{B}$. 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 .



- What is the acceleration of an ion of charge q just before it enters the magnetic field?
- Find the speed with which an ion of charge q enters the magnetic field.
- Which semicircular path, 1 or 2, would a cation follow?
 - Which semicircular path, 1 or 2, would an anion follow?
- Determine the mass of a cation entering the apparatus in terms of y , q , $\mathbf{B}$, and V .
- Once a cation of charge q enters the magnetic field, how long does it take to strike the photographic plate?
- What is the work done by the magnetic force in the spectrograph on a cation of charge q ?

2. A region of uniform magnetic field directed into the page (in the $-z$ direction) is generated. A positively charged particle travelling in the $+x$ direction at a speed v enters the region of the magnetic field, as shown below.



- What direction is the magnetic force on the particle at the instant when it enters the magnetic field region?
- Some time passes while the particle continues to move in the region of the magnetic field under the influence of the magnetic force.
 - How will the new speed v_{new} compare to the initial speed v ?
 - How will new velocity $\vec{v}_{\text{new}}$ compare to the initial velocity $\vec{v}$? Describe both the magnitude of the velocity as well as its components in comparing it to the initial velocity.
- More time passes and the particle leaves the region of the magnetic field. For each position A, B, C, and D on the diagram below, state whether that position could be the position where the particle leaves the region of the magnetic field or not. For each position that you state is a possible exit position, draw the path on the diagram below that the particle would take from the dot where it enters the magnetic field to the letter where it exits.

