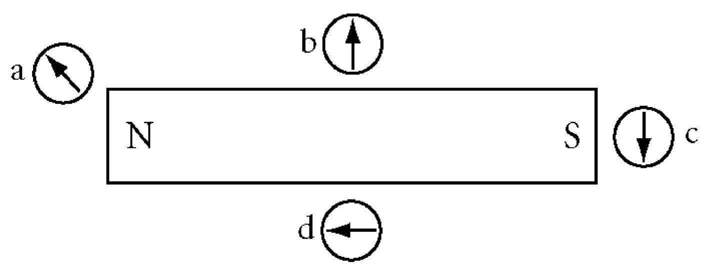
Name: ________________________ Class: ___________________ Date: __________ ID: A

Phys.G12-Q4W2-Magnetism-Qs.Bank

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. One useful way to model magnetic field strength is to define a quantity called magnetic flux Φ_M. Which of the following definitions for magnetic flux, Φ_M, is correct?
a. the number of field lines that cross a certain area
b. $AB\cos\theta$
c. (surface area) × (magnetic field component normal to the plane of surface)
d. all of the above

____ 2. All of the following statements about magnetic field lines around a permanent magnet are true *except* which one?
a. Magnetic field lines appear to end at the north pole of a magnet.
b. Magnetic field lines have no beginning or end.
c. Magnetic field lines always form a closed loop.
d. In a permanent magnet, the field lines actually continue within the magnet itself.



____ 3. Which compass needle orientation in the figure above might correctly describe the magnet's field at that point?
a. a
b. b
c. c
d. d

____ 4. A microscopic magnetic region composed of a group of atoms whose magnetic fields are aligned in a common direction is called a(n) ____. In most materials, when these groups are randomly distributed, the substance will show ____ no magnetism.
a. domain; no
b. pole; some
c. cell; unusual
d. ion; strong

____ 5. In a magnetized substance, the domains
a. are randomly oriented.
b. cancel each other.
c. line up mainly in one direction.
d. can never be reoriented.

____ 6. In a permanent magnet,
a. domain alignment persists after the external magnetic field is removed.
b. domain alignment becomes random after the external magnetic field is removed.
c. domains are always randomly oriented.
d. the magnetic fields of the domains cancel each other.

____ 7. A current in a long, straight wire produces a magnetic field. These magnetic field lines
a. radiate out from the wire to infinity.
b. come in from infinity to the wire.
c. form circles that pass through the wire.
d. form circles that go around the wire.

____ 8. A solenoid is in an upright position on a table. A counterclockwise current of electrons—when viewed from above—causes the solenoid to have a ____ magnetic pole at its bottom end. If a compass is placed at the top of the solenoid, the north pole of the compass would be ____.
a. north; attracted
b. south; attracted
c. north; repelled
d. south; repelled

____ 9. A solenoid is in an upright position on a table. A clockwise current of electrons—when viewed from above—causes the solenoid to have a ____ magnetic pole at its bottom end. If a compass is placed at the top of the solenoid, the north pole of the compass would be ____.
a. north; attracted
b. south; attracted
c. north; repelled
d. south; repelled

____ 10. When an iron rod is inserted into a solenoid coil's center, the magnetic field produced by the current in the loops
a. causes the iron to return to an unmagnetized state.
b. forces the domain in the iron out of alignment.
c. causes random orientation of the domains in the iron.
d. causes alignment of the domains in the iron.

____ 11. Which of the following modifications to a solenoid would be most likely to decrease the strength of its magnetic field?
a. removing its iron rod core and increasing the number of coils
b. increasing the current and reducing the number of coils
c. reducing the number of coils and inserting an iron core
d. decreasing the current and reducing the number of coils

____ 12. According to the right-hand rule, if a current-carrying wire is grasped in the right hand with the thumb in the direction of the current, the four fingers will curl in the direction of
a. the magnetic force, $\mathbf{F}_{\mathbf{magnetic}}$.
b. the magnetic field, **B**.
c. the current's velocity, **v**.
d. the current's path, **P**.

____ 13. The lines of the magnetic field around a current-carrying wire
a. point away from the wire.
b. point toward the wire.
c. form concentric circles around the wire.
d. are parallel with the wire.

____ 14. Under which of the following conditions is the net magnetic force on a charged particle equal to zero?
a. when the particle is stationary
b. when the particle is moving parallel to the magnetic field
c. when the particle is not charged
d. all of the above

____ 15. An electron moves north at a velocity of 4.5×10^{4} m/s and has a magnetic force of 7.2×10^{-18} N exerted on it. If the magnetic field points upward, what is the magnitude of the magnetic field?
a. 1.0 mT
b. 2.0 mT
c. 3.6 mT
d. 4.8 mT

____ 16. An electron that moves with a speed of 3.0×10^4 m/s perpendicular to a uniform magnetic field of 0.40 T experiences a force of what magnitude? ($q_e = 1.60 \times 10^{-19}$ C)

a. 2.2×10^{24} N
b. 1.9×10^{15} N
c. 4.8×10^{14} N
d. 0 N

____ 17. What is the path of an electron moving perpendicular to a uniform magnetic field?

a. straight line
b. circle
c. ellipse
d. parabola

____ 18. What is the path of an electron moving parallel to a uniform magnetic field?

a. straight line
b. circle
c. ellipse
d. parabola

____ 19. A 2.0 m wire segment carrying a current of 0.60 A oriented parallel to a uniform magnetic field of 0.50 T experiences a force of what magnitude?

a. 0.60 N
b. 0.30 N
c. 0.15 N
d. 0.0 N

____ 20. A current-carrying wire 0.50 m long is positioned perpendicular to a uniform magnetic field. If the current is 10.0 A and there is a resultant force of 3.0 N on the wire due to the interaction of the current and field, what is the magnetic field strength?

a. 0.60 T
b. 15 T
c. 1.8×10^3 T
d. 6.7×10^3 T

____ 21. Consider two long, straight, parallel wires, each carrying a current *I*. If the currents move in opposite directions,

a. the two wires will attract each other.
b. the two wires will repel each other.
c. the two wires will exert a torque on each other.
d. neither wire will exert a force on the other.

____ 22. Consider two long, straight, parallel wires, each carrying a current *I*. If the currents move in the same direction,

a. the two wires will attract each other.
b. the two wires will repel each other.
c. the two wires will exert a torque on each other.
d. neither wire will exert a force on the other.

____ 23. A current-carrying conductor in and perpendicular to a magnetic field experiences a force that is

a. perpendicular to the current.
b. parallel to the current.
c. inversely proportional to the potential difference.
d. inversely proportional to the velocity.

Choose the best answer from the options that follow each question.

____ 24. Which of the following statements correctly describes the behavior of magnets?

a. Like poles attract each other, and unlike poles repel each other.
b. Like poles repel each other, and unlike poles attract each other.
c. Both like and unlike poles can attract and repel each other depending on the surrounding materials.
d. none of the above

____ 25. What do physicists call large groups of atoms whose net spins are aligned because of strong coupling between neighboring atoms?
a. magnetic zones
b. magnetic regions
c. magnetic sectors
d. magnetic domains

____ 26. How is the direction of a magnetic field, **B**, defined at any location?
a. the direction toward which the south pole of a compass needle points
b. the direction toward which the north pole of a compass needle points
c. the direction that is parallel to the imaginary magnetic field lines
d. the direction that is perpendicular to Earth's magnetic field

____ 27. What describes Φ_M?
a. magnetic flux
b. the number of field lines that cross a certain area
c. $AB\cos\theta$
d. all of the above

____ 28. Which of the following statements about the orientation and effects of Earth's magnetic field is *not* true?
a. The geographic North Pole of Earth is near the magnetic south pole.
b. A compass needle that can rotate both perpendicularly and parallel to the surface of Earth, points down at the magnetic south pole.
c. A compass needle always indicates the direction of true north.
d. The geographic South Pole of Earth corresponds to the magnetic north pole.

Choose the best answer from the options that follow each question.

____ 29. Which of the following terms correctly describes the shape of the magnetic field around a long, straight current-carrying wire?
a. cylindrical
b. parallel
c. perpendicular
d. elliptical

____ 30. In what direction do compass needles deflect in relation to the concentric circles of the magnetic field that is found around a current-carrying wire?
a. away from the concentric circles
b. perpendicular to the concentric circles
c. toward Earth's North Pole irrespective of the concentric circles
d. tangential to the concentric circles

____ 31. According to the right-hand rule, in what direction will the fingers curl?
a. in the direction of the current
b. in the direction of the magnetic field, **B**
c. in the direction of the magnetic field's movement
d. in the direction of the magnetic field's force

____ 32. Which of the following statements about the magnetic field, **B**, around a current-carrying wire is *not* true?
a. **B** is proportional to the current in the wire.
b. **B** is inversely proportional to the distance from the wire.
c. The lines of **B** form concentric circles about the wire.
d. **B** is independent of the current in the wire.

____ 33. The magnetic field of a current loop is most similar to that of a(n)
a. horseshoe magnet.
b. circular magnet.
c. bar magnet.
d. irregular magnet.

____ 34. Which of the following statements about the magnetic field lines of a solenoid is *not* true?
a. The field lines inside a solenoid point in the same direction and are nearly parallel.
b. The field lines inside a solenoid are uniformly spaced and close together.
c. The field lines outside a solenoid are uniformly spaced but further apart.
d. The field lines outside a solenoid do not always point in the same direction.

Choose the best answer from the options that follow each question.

____ 35. When does the magnetic force on a charge moving through a constant magnetic field reach its maximum value?
a. When the charge moves parallel to the magnetic field.
b. When the charge moves at any angle to the magnetic field.
c. When the charge moves perpendicular to the magnetic field.
d. When the charge is stationary to the magnetic field.

____ 36. Given the following equation, $B = \frac{F_{magnetic}}{qv}$, which of the following statements is true?
a. The magnetic field, **B**, is directly proportional to q.
b. The magnetic field, **B**, is directly proportional to v.
c. The magnetic field, **B**, is directly proportional to $F_{magnetic}$.
d. The magnetic field, **B**, is directly proportional to $F_{magnetic}$, q, and v.

____ 37. If $F_{magnetic} = 3.8 \times 10^{-13}$ N, $q = 1.60 \times 10^{-19}$ C, and $v = 2.4 \times 10^{6}$ m/s, use the equation, $B = \frac{F_{magnetic}}{qv}$, to find the magnitude of the magnetic field, **B**.
a. 9.9×10^{11} T
b. 9.9×10^{-27} T
c. 5.7×10^{39} T
d. 0.99 T

____ 38. Which of the following statements about the right-hand rule is *not* true?
a. The fingers indicate the direction of the magnetic field.
b. The thumb indicates the direction of a particle? ’s movement in the magnetic field.
c. The direction of the magnetic force is always parallel to the magnetic field.
d. The direction of the magnetic force exerted on a proton is out of the palm of the hand.

____ 39. A current is moving from north to south through a long wire that is lying horizontally on a table. What is the direction of the magnetic force if the magnetic field is directed up and out of the table?
a. toward the north
b. toward the east
c. toward the south
d. toward the west

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Choose the best answer from the options that follow each question.

____ 40. Which of the following situations is *not* true for magnets?
a. Like poles repel each other.
b. Unlike poles repel each other.
c. North poles repel each other.
d. A north pole and a south pole will attract each other.

____ 41. Where is the magnitude of the magnetic field around a permanent magnet greatest?
a. close to the poles
b. far from the poles
c. The magnitude is equal at all points on the field.
d. The magnitude depends on the material of the magnet.

____ 42. One useful way to model magnetic field strength is to define a quantity called magnetic flux Φ_M. Which of the following definitions for magnetic flux, Φ_M, is correct?
a. the number of field lines that cross a certain area
b. $AB\cos\theta$
c. (surface area) × (magnetic field component normal to the plane of surface)
d. all of the above

____ 43. All of the following statements about magnetic field lines around a permanent magnet are true *except* which one?
a. Magnetic field lines appear to end at the north pole of a magnet.
b. Magnetic field lines have no beginning or end.
c. Magnetic field lines always form a closed loop.
d. In a permanent magnet, the field lines actually continue within the magnet itself.

____ 44. In a magnetized substance, the domains
a. are randomly oriented.
b. cancel each other.
c. line up mainly in one direction.
d. can never be reoriented.

____ 45. In soft magnetic materials such as iron, what happens when an external magnetic field is removed?
a. The domain alignment persists.
b. The orientation of domains fluctuates.
c. The material becomes a hard magnetic material.
d. The material returns to an unmagnetized state.

____ 46. Which statement describes Earth's magnetic declination?
a. the angle between Earth's magnetic field and Earth's surface
b. Earth's magnetic field strength at the equator
c. the tendency for Earth's field to reverse itself
d. the angle between true north and north indicated by a compass

____ 47. According to the right-hand rule, if a current-carrying wire is grasped in the right hand with the thumb in the direction of the current, the four fingers will curl in the direction of
a. the magnetic force, $F_{magnetic}$.
b. the magnetic field, B.
c. the current's velocity, v.
d. the current's path, P.

____ 48. The direction of the force on a current-carrying wire in an external magnetic field is
a. perpendicular to the current only.
b. perpendicular to the magnetic field only.
c. perpendicular to both the current and the magnetic field.
d. parallel to the current and to the magnetic field.

____ 49. What is the path of an electron moving parallel to a uniform magnetic field?
a. straight line
b. circle
c. ellipse
d. parabola

____ 50. A stationary positive charge, Q, is located in a magnetic field, B, which is directed toward the right. The direction of the magnetic force on Q is
a. toward the right.
b. up.
c. down.
d. There is no magnetic force.

____ 51. Consider two long, straight, parallel wires, each carrying a current I. If the currents move in opposite directions,
a. the two wires will attract each other.
b. the two wires will repel each other.
c. the two wires will exert a torque on each other.
d. neither wire will exert a force on the other.

____ 52. Consider two long, straight, parallel wires, each carrying a current I. If the currents move in the same direction,
a. the two wires will attract each other.
b. the two wires will repel each other.
c. the two wires will exert a torque on each other.
d. neither wire will exert a force on the other.

Choose the best answer from the options that follow each question.

____ 53. Which of the following statements about Earth's magnetic field is true?
a. The geographic North Pole of Earth and Earth's magnetic north pole are at the same location.
b. The geographic South Pole of Earth and Earth's magnetic north pole are relatively close to each other.
c. The north needle of a compass always points to the geographic North Pole of Earth.
d. The north needle of a compass points to Earth's magnetic north pole.

____ 54. Which of the following modifications to a solenoid would be most likely to decrease the strength of its magnetic field?
a. removing its iron rod core and increasing the number of coils
b. increasing the current and reducing the number of coils
c. reducing the number of coils and inserting an iron core
d. decreasing the current and reducing the number of coils

____ 55. Under which of the following conditions is the net magnetic force on a charged particle equal to zero?
a. when the particle is stationary
b. when the particle is moving parallel to the magnetic field
c. when the particle is not charged
d. all of the above

____ 56. An electron moves north at a velocity of 4.5×10^4 m/s and has a force of 7.2×10^{-18} N exerted on it. If the magnetic field points upward, what is the magnitude of the magnetic field?
a. 1.0 mT
b. 2.0 mT
c. 3.6 mT
d. 4.8 mT

____ 57. An electron moves across Earth's equator at a speed of 2.5×10^6 m/s and in a direction 35° north of east. At this point, Earth's magnetic field has a direction due north, is parallel to the surface, and has a value of 0.10×10^{-4} T. What is the magnitude of the force acting on the electron due to its interaction with Earth's magnetic field? ($q_e = 1.60 \times 10^{-19}$ C)
a. 5.1×10^{-18} N
b. 4.0×10^{-18} N
c. 3.3×10^{-18} N
d. 2.3×10^{-18} N

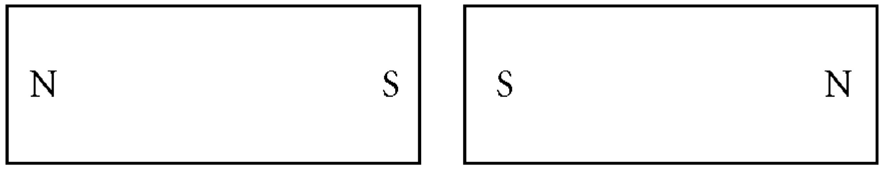
____ 58. If a proton is released at the equator and falls toward Earth under the influence of gravity, the magnetic force on the proton will be toward the _____ assuming the magnetic field is directed toward the north at this location.
a. north
b. south
c. east
d. west

____ 59. A 2.0 m wire segment carrying a current of 0.60 A oriented parallel to a uniform magnetic field of 0.50 T experiences a force of what magnitude?
a. 0.60 N
b. 0.30 N
c. 0.15 N
d. 0.0 N

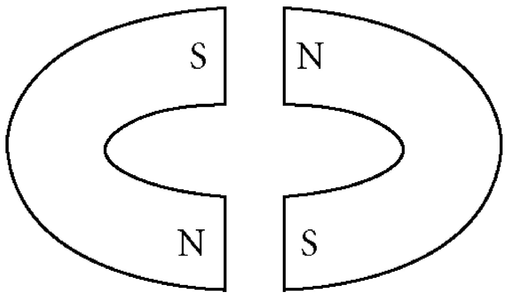
____ 60. A current-carrying conductor in and perpendicular to a magnetic field experiences a force that is
a. perpendicular to the current.
b. parallel to the current.
c. inversely proportional to the potential difference.
d. inversely proportional to the velocity.

Short Answer

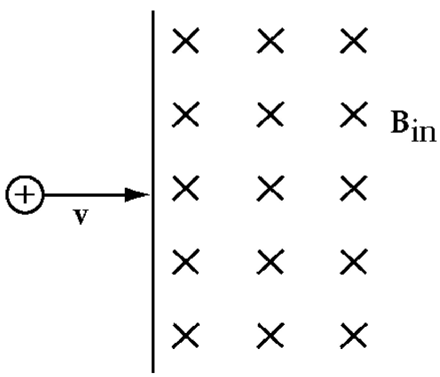
1. If the head of an iron nail touches a magnet, the nail will become magnetized. If the nail touches the north pole of the magnet, what kind of pole is at the head of the nail? Explain.



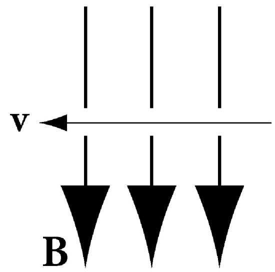
2. Will the magnets in the figure above attract or repel each other?



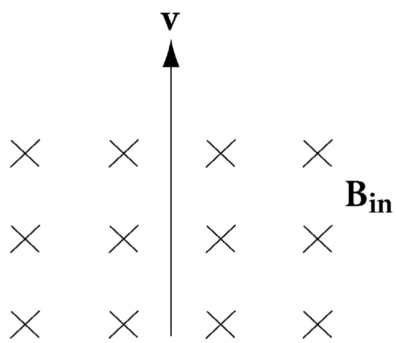
3. Will the magnets in the figure above attract or repel each other?
4. Which magnetic pole is at the geographic North Pole of Earth?
5. What is magnetic declination, and where on Earth would the magnetic declination be zero?
6. Explain how the right-hand rule describes the magnetic field produced by the current in a straight conductor.



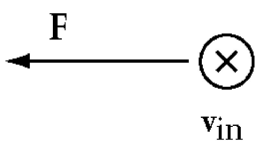
7. Find the direction of the force on a proton moving through the magnetic field shown above.



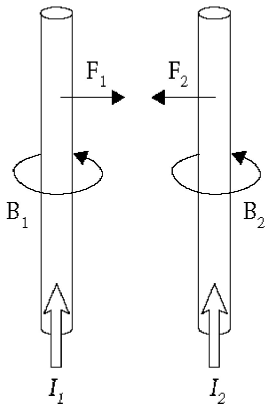
8. Find the direction of the force on an electron moving through the magnetic field shown above.



9. Find the direction of the force on an electron moving through the magnetic field shown above.

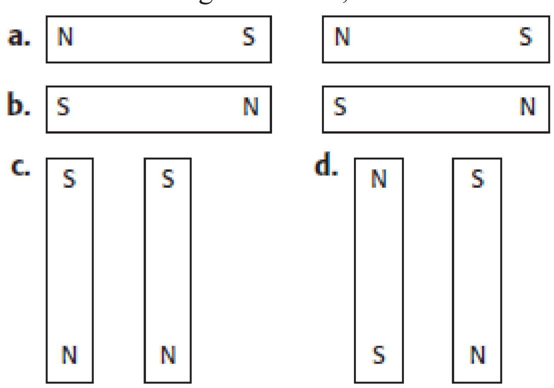


10. A negative charge is moving through a magnetic field. The direction of motion and the direction of the force acting on it at one moment are shown in the figure above. Find the direction of the magnetic field.

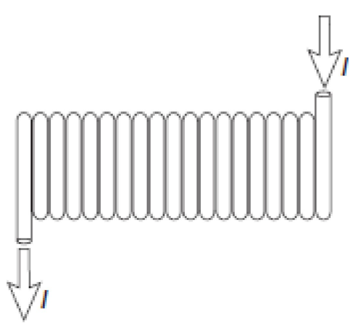


11. Use the right-hand rule and the figure above to explain why the two wires exert an attractive force on each other.

12. For each of the figures below, indicate whether the magnets will attract or repel one another.



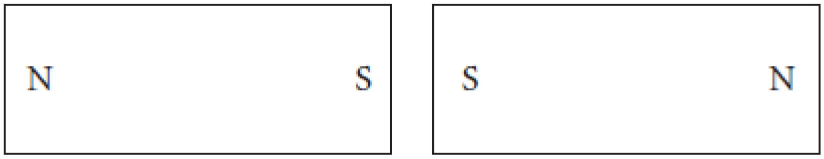
13. Draw magnetic field lines around the figure below and label its north and south magnetic poles.



14. Why does a current-carrying wire experience a magnetic force when the wire is placed perpendicular to the magnetic field?

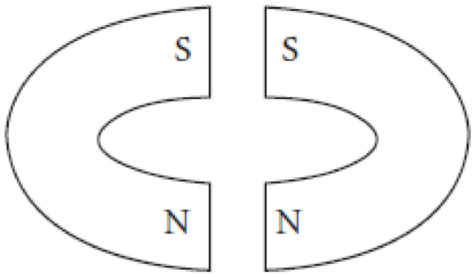
15. Why do magnetic poles always occur in pairs?

16.



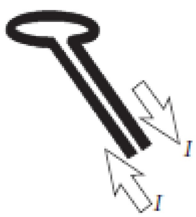
Will the magnets in the figure above attract or repel each other?

17.

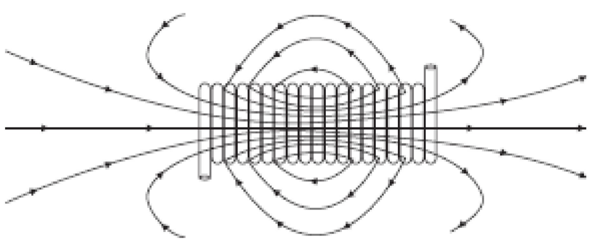


Will the magnets in the figure above attract or repel each other?

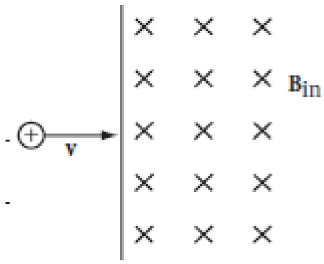
18. Use the right-hand rule to determine the direction of the magnetic field within the loop from the figure below. Since the magnetic field of a current-carrying loop resembles that of a bar magnet, is the north pole of the current-carrying loop above or below the loop?



19. What is the name of the device shown below? Which end is the south pole? Is the current entering or leaving the wire coil at the top right?



20. Find the direction of the force on a proton moving through the magnetic field shown below.



Problem

1. An electron moves north at a velocity of 9.9×10^4 m/s and has a magnetic force of 5.9×10^{-18} N west exerted on it. If the magnetic field points upward, what is the magnitude of the magnetic field?

2. A proton moves north at a velocity of 9.2×10^4 m/s and has a magnetic force of 3.2×10^{-18} N east exerted on it. If the magnetic field points upward, what is the magnitude of the magnetic field?

3. An electron is moving parallel to the Earth's surface at the equator in a direction 12° south of east. Its velocity is 9.2×10^4 m/s and a magnetic force of 9.4×10^{-18} N is exerted on the electron. If the magnetic field points south at this location, what is the direction of the magnetic force on the electron and the magnitude of the magnetic field?

4. A proton moves perpendicularly to a magnetic field that has a magnitude of 9.45×10^{-2} T. A magnetic force of 6.54×10^{-14} N is acting on it. If the proton moves a total distance of 0.225 m in the magnetic field, how long does it take for the proton to move across the magnetic field? If the magnetic force is directed north and the magnetic field is directed upward, what was the proton's velocity?

5. A wire 76 m long carries a current of 17 A from west to east. If a magnetic field of 7.5×10^{-4} T directed toward the south is acting on the wire, find the direction and magnitude of the magnetic force.

6. The magnetic force on a straight wire 0.69 m long is 1.5×10^{-3} N. The current in the wire is 16.9 A. What is the magnitude of the magnetic field that is perpendicular to the wire?

7. The magnetic force on a wire 133 cm long is 9.82×10^{-7} N. If 2.96×10^{20} electrons move through the wire in 8.39 s, what is the magnitude of the magnetic field that is perpendicular to the wire?

8. A wire 248 m long carries a 27.6 A current from east to west. A magnetic force of 9.12×10^{-2} N is directed downward. A proton is moving west to east with a velocity of 3.34×10^7 m/s. What is the direction and magnitude of the magnetic force acting on the proton as it moves through the wire's magnetic field?

9. An electron moves north at a velocity of 9.8×10^4 m/s and has a magnetic force of 5.6×10^{-18} N west exerted on it. If the magnetic field points upward, what is the magnitude of the magnetic field?

10. A wire 48 m long carries a current of 18 A from west to east. If a magnetic field of 8.3×10^{-4} T directed toward the south is acting on the wire, find the direction and magnitude of the magnetic force.

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Answer Section

MULTIPLE CHOICE

1. ANS: D	PTS: 1	DIF: I	OBJ: 19-1.2
2. ANS: A	PTS: 1	DIF: I	OBJ: 19-1.2
3. ANS: A	PTS: 1	DIF: II	OBJ: 19-1.2
4. ANS: A	PTS: 1	DIF: I	OBJ: 19-1.2
5. ANS: C	PTS: 1	DIF: I	OBJ: 19-1.2
6. ANS: A	PTS: 1	DIF: I	OBJ: 19-1.2
7. ANS: D	PTS: 1	DIF: I	OBJ: 19-2.1
8. ANS: D	PTS: 1	DIF: II	OBJ: 19-2.1
9. ANS: A	PTS: 1	DIF: II	OBJ: 19-2.1
10. ANS: D	PTS: 1	DIF: I	OBJ: 19-2.1
11. ANS: D	PTS: 1	DIF: II	OBJ: 19-2.1
12. ANS: B	PTS: 1	DIF: I	OBJ: 19-2.2
13. ANS: C	PTS: 1	DIF: I	OBJ: 19-2.2
14. ANS: D	PTS: 1	DIF: II	OBJ: 19-3.1

15. ANS: A

Given

$v = 4.5 \times 10^4$ m/s

$q_{electron} = 1.60 \times 10^{-19}$ C

$F_{magnetic} = 7.2 \times 10^{-18}$ N

Solution

$$B = \frac{F_{magnetic}}{q_{electron} v} = \frac{\left(7.2 \times 10^{-18}\ \text{N}\right)}{\left(1.60 \times 10^{-19}\,\text{C}\right)\left(4.5 \times 10^{4}\ \text{m/s}\right)} = 1.0 \times 10^{-3}\ \text{T or } 1.0\ \text{mT}$$

PTS: 1 DIF: IIIA OBJ: 19-3.1

16. ANS: B

Given

$v = 3.0 \times 10^4$ m/s

$q_{electron} = 1.60 \times 10^{-19}$ C

$B = 0.40$ T

Solution

Rearrange equation, $B = \dfrac{F_{magnetic}}{qv}$, and solve for $F_{magnetic}$.

$$F_{magnetic} = q_{electron} vB = \left(1.60 \times 10^{-19}\ \text{C}\right)\left(3.0 \times 10^4\ \text{m/s}\right)(0.40\ \text{T}) = 1.9 \times 10^{-15}\ \text{N}$$

PTS: 1 DIF: IIIB OBJ: 19-3.1

17. ANS: B	PTS: 1	DIF: I	OBJ: 19-3.2
18. ANS: A	PTS: 1	DIF: I	OBJ: 19-3.2
19. ANS: D	PTS: 1	DIF: IIIB	OBJ: 19-3.3

20. ANS: A

Given

$I = 10.0$ A

$l = 0.50$ m

$F_{magnetic} = 3.0$ N

Solution

Rearrange the equation, $F_{magnetic} = BIl$, and solve for B.

$$B = \frac{F_{magnetic}}{Il} = \frac{(3.0\ \text{N})}{(10.0\ \text{A})(0.50\ \text{m})} = 0.60\ \text{T}$$

PTS: 1 DIF: IIIB OBJ: 19-3.3

21. ANS: B	PTS: 1	DIF: I	OBJ: 19-3.3
22. ANS: A	PTS: 1	DIF: I	OBJ: 19-3.3
23. ANS: A	PTS: 1	DIF: II	OBJ: 19-3.3
24. ANS: B	PTS: 1	TOP: Chapter 19 Section Quiz 1	
25. ANS: D	PTS: 1	TOP: Chapter 19 Section Quiz 1	
26. ANS: B	PTS: 1	TOP: Chapter 19 Section Quiz 1	
27. ANS: D	PTS: 1	TOP: Chapter 19 Section Quiz 1	
28. ANS: C	PTS: 1	TOP: Chapter 19 Section Quiz 1	
29. ANS: A	PTS: 1	TOP: Chapter 19 Section Quiz 2	
30. ANS: D	PTS: 1	TOP: Chapter 19 Section Quiz 2	
31. ANS: B	PTS: 1	TOP: Chapter 19 Section Quiz 2	
32. ANS: D	PTS: 1	TOP: Chapter 19 Section Quiz 2	

33. ANS: C PTS: 1 TOP: Chapter 19 Section Quiz 2
34. ANS: C PTS: 1 TOP: Chapter 19 Section Quiz 2
35. ANS: C PTS: 1 TOP: Chapter 19 Section Quiz 3
36. ANS: C PTS: 1 TOP: Chapter 19 Section Quiz 3
37. ANS: D

Given

$F_{magnetic} = 3.8 \times 10^{-13}$ N

$q = 1.60 \times 10^{-19}$ C

$v = 2.4 \times 10^{6}$ m/s

Solution

$$B = \frac{F_{magnetic}}{qv}$$

$$B = \frac{(3.8 \times 10^{-13}\text{N})}{(1.60 \times 10^{-19}\text{C})(2.4 \times 10^{6}\text{m/s})} = 0.99\ \text{T}$$

PTS: 1 TOP: Chapter 19 Section Quiz 3

38. ANS: C PTS: 1 TOP: Chapter 19 Section Quiz 3
39. ANS: D PTS: 1 TOP: Chapter 19 Section Quiz 3
40. ANS: B PTS: 1 TOP: Chapter 19 Test A
41. ANS: A PTS: 1 TOP: Chapter 19 Test A
42. ANS: D PTS: 1 TOP: Chapter 19 Test A
43. ANS: A PTS: 1 TOP: Chapter 19 Test A
44. ANS: C PTS: 1 TOP: Chapter 19 Test A
45. ANS: D PTS: 1 TOP: Chapter 19 Test A
46. ANS: D PTS: 1 TOP: Chapter 19 Test A
47. ANS: B PTS: 1 TOP: Chapter 19 Test A
48. ANS: C PTS: 1 TOP: Chapter 19 Test A
49. ANS: A PTS: 1 TOP: Chapter 19 Test A
50. ANS: D PTS: 1 TOP: Chapter 19 Test A
51. ANS: B PTS: 1 TOP: Chapter 19 Test A
52. ANS: A PTS: 1 TOP: Chapter 19 Test A
53. ANS: B PTS: 1 TOP: Chapter 19 Test B
54. ANS: D PTS: 1 TOP: Chapter 19 Test B
55. ANS: D PTS: 1 TOP: Chapter 19 Test B
56. ANS: A

Given

$v = 4.5 \times 10^{4}$ m/s

$q_{electron} = 1.60 \times 10^{-19}$ C

$F_{magnetic} = 7.2 \times 10^{-18}$ N

Solution

$$B = \frac{F_{magnetic}}{q_{electron}v} = \frac{(7.2 \times 10^{-18} N)}{(1.60 \times 10^{-19} C)(4.5 \times 10^{4} m/s)} = 1.0 \times 10^{-3}\ \text{T or } 1.0\ \text{mT}$$

PTS: 1 TOP: Chapter 19 Test B

57. ANS: C
Given
$v = 2.5 \times 10^6$ m/s
$q_{electron} = 1.60 \times 10^{-19}$ C
$B = 0.10 \times 1024$ T
$\theta = 35°$ north of east
Solution
Since only the magnetic field component that is perpendicular to the electron's motion contributes to the magnetic field strength, $B_{net} = B\cos\theta$. *Therefore,* $B_{net} = (0.10 \times 10^{-4}\ T)(\cos 35°) = 8.2 \times 10^{-6}$ T.
Rearrange equation, $B = \dfrac{F_{magnetic}}{qv}$, $F_{magnetic} = q_{electron}vB = (1.60 \times 10^{-19}\ C)(2.5 \times 10^6\ m/s)$
$(8.2 \times 10^{-6}\ T) = 3.3 \times 10^{-18}$ N

PTS: 1 TOP: Chapter 19 Test B

58. ANS: C PTS: 1 TOP: Chapter 19 Test B

59. ANS: D
Given
$B = 0.50$ T
$I = 0.60$ A
$l = 2.0$ m
Solution
Since the wire is oriented parallel to the magnetic field, $B_{net} = 0.0$ T.
$F_{magnetic} = BIl = (0.0\ T)(0.60\ A)(2.0\ m) = 0.0$ N

PTS: 1 TOP: Chapter 19 Test B

60. ANS: A PTS: 1 TOP: Chapter 19 Test B

SHORT ANSWER

1. ANS:
The end of the magnetized nail touching the north pole of the magnet must be a south pole. Otherwise, the magnet would repel the nail.

PTS: 1 DIF: II OBJ: 19-1.1

2. ANS:
repel

PTS: 1 DIF: I OBJ: 19-1.1

3. ANS:
attract

PTS: 1 DIF: I OBJ: 19-1.1

4. ANS:
The magnetic south pole is located at the geographic North Pole of Earth.

PTS: 1 DIF: I OBJ: 19-1.3

5. ANS:
Magnetic declination is the difference between true north, which is defined by the axis of rotation of Earth, and north indicated by a compass, which varies from point to point. An imaginary line running north-south near the center of North America currently has zero declination.

PTS: 1 DIF: I OBJ: 19-1.3

6. ANS:
If a wire is grasped in the right hand with the thumb pointing in the direction of the current, the fingers will curl in the direction of the magnetic field. The curling fingers illustrate that the magnetic field induced by a current around a straight conductor forms concentric circles.

PTS: 1 DIF: I OBJ: 19-2.1

7. ANS:
up, toward the top of the page

PTS: 1 DIF: IIIA OBJ: 19-3.2

8. ANS:
into the page

PTS: 1 DIF: IIIA OBJ: 19-3.2

9. ANS:
to the right

PTS: 1 DIF: IIIA OBJ: 19-3.2

10. ANS:
up, toward the top of the page

PTS: 1 DIF: IIIA OBJ: 19-3.2

11. ANS:
According to the right-hand rule, as the current in one wire interacts with the magnetic field in the other wire, opposing (i.e., attractive) magnetic forces are induced. Because the current is in the same direction in both wires, the resulting magnetic forces are attractive.

PTS: 1 DIF: II OBJ: 19-3.3

12. ANS:
(a) attract
(b) attract
(c) repel
(d) attract

PTS: 1 TOP: Chapter 19 Section Quiz 1

13. ANS:
External lines should extend out from the figure’s right end and enter the figure’s left end. Internal lines should be close together and nearly parallel. The right end of the figure should be labeled N while the left end is labeled S.

PTS: 1 TOP: Chapter 19 Section Quiz 2

14. ANS:
Answers may vary. Sample answer: The electric particles moving through the wire are also moving through the magnetic field. The resultant force on the wire is the sum of the individual magnetic forces on the charged particles.

PTS: 1 TOP: Chapter 19 Section Quiz 3

15. ANS:
Magnetic poles cannot be isolated no matter how many times a magnet is cut or subdivided.

PTS: 1 TOP: Chapter 19 Test A

16. ANS:
repel

PTS: 1 TOP: Chapter 19 Test A

17. ANS:
attract

PTS: 1 TOP: Chapter 19 Test A

18. ANS:
With the thumb in the direction of the current, the fingers will curl down around the loop. Thus the magnetic field points downward around the loop. The north pole of the loop is below the loop, since the magnetic field appears to be exiting the loop area.

PTS: 1 TOP: Chapter 19 Test B

19. ANS:
solenoid; left end, since the magnetic field lines are entering the solenoid at this end; Using the right-hand rule, the current is entering the wire at the top right.

PTS: 1 TOP: Chapter 19 Test B

20. ANS:
up, toward the top of the page

PTS: 1 TOP: Chapter 19 Test B

PROBLEM

1. ANS:
   3.7×10^{-4} T

   Given

   $\mathbf{v} = 9.9 \times 10^{4}$ m/s, north

   $q_{electron} = 1.60 \times 10^{-19}$C

   $\mathbf{F}_{\mathbf{magnetic}} = 5.9 \times 10^{-18}$ N, west

   Solution

   $$B = \frac{F_{magnetic}}{q_{electron}v} = \frac{\left(5.9 \times 10^{-18}\ \text{N}\right)}{\left(1.60 \times 10^{-19}\text{C}\right)\left(9.9 \times 10^{4}\ \text{m/s}\right)} = 3.7 \times 10^{-4}\ \text{T}$$

   PTS: 1 DIF: IIIA OBJ: 19-3.1

2. ANS:
   2.2×10^{-4} T

   Given

   $\mathbf{v} = 9.2 \times 10^{4}$ m/s, north

   $q_{proton} = 1.60 \times 10^{-19}$C

   $\mathbf{F}_{\mathbf{magnetic}} = 3.2 \times 10^{-18}$ N, east

   Solution

   $$B = \frac{F_{magnetic}}{q_{proton}v} = \frac{\left(3.2 \times 10^{-18}\ \text{N}\right)}{\left(1.60 \times 10^{-19}\text{C}\right)\left(9.2 \times 10^{4}\ \text{m/s}\right)} = 2.2 \times 10^{-4}\ \text{T}$$

   PTS: 1 DIF: IIIA OBJ: 19-3.1

3. ANS:
Using the right-hand rule and noting that the charged particle is an electron, $\mathbf{F}_{\mathbf{magnetic}}$ is upward.

6.5×10^{-4} T

Given

$v = 9.2 \times 10^4$ m/s

$\theta = 12°$ south of east

$q_{electron} = 1.60 \times 10^{-19}$ C

$F_{magnetic} = 9.4 \times 10^{-18}$ N

B direction is south.

Solution
Using the right-hand rule and noting that the charged particle is an electron, $\mathbf{F}_{\mathbf{magnetic}}$ is upward.

Only the magnetic field component that is perpendicular to the electron's motion contributes to the magnetic field strength, so $B_{net} = B\cos\theta$.

Substituting $B\cos\theta$ into the equation, $B = \dfrac{F_{magnetic}}{qv}$, results in $B\cos\theta = \dfrac{F_{magnetic}}{qv}$.

$$B = \frac{F_{magnetic}}{q_{electron} v\cos\theta} = \frac{\left(9.4 \times 10^{-18}\ \text{N}\right)}{\left(1.60 \times 10^{-19}\ \text{C}\right)\left(9.2 \times 10^{4}\ \text{m/s}\right)(\cos 12°)}$$

$$B = \frac{\left(9.4 \times 10^{-18}\ \text{N}\right)}{\left(1.60 \times 10^{-19}\ \text{C}\right)\left(9.2 \times 10^{4}\ \text{m/s}\right)(0.98)}$$

$B = 6.5 \times 10^{-4}$ T

PTS: 1 DIF: IIIC OBJ: 19-3.1

4. ANS:
5.20×10^{-8} s; 4.33×10^{6} m/s, west

Given

$\mathbf{B} = 9.45 \times 10^{-2}$ T, upward

$\mathbf{F}_{\mathbf{magnetic}} = 6.54 \times 10^{-14}$ N, north

$q_{proton} = 1.60 \times 10^{-19}$ C

$\Delta x = 0.225$ m

Solution

$$v = \frac{\Delta x}{\Delta t}$$

$$B = \frac{F_{magnetic}}{q_{proton} v} = \frac{F_{magnetic}}{q_{proton}\left(\frac{\Delta x}{\Delta t}\right)}$$

$$\Delta t = \frac{B q_{proton} \Delta x}{F_{magnetic}} = \frac{\left(9.45 \times 10^{-2}\ \text{T}\right)\left(1.60 \times 10^{-19}\ \text{C}\right)(0.225\ \text{m})}{\left(6.54 \times 10^{-14}\ \text{N}\right)} = 5.20 \times 10^{-8}\ \text{s}$$

$$v = \frac{\Delta x}{\Delta t} = \frac{(0.225\ \text{m})}{\left(5.20 \times 10^{-8}\ \text{s}\right)} = 4.33 \times 10^{6}\ \text{m/s}$$

From the right-hand rule, the proton must be moving toward the west.

$\mathbf{v} = 4.33 \times 10^{6}$ m/s, west

PTS: 1 DIF: IIIC OBJ: 19-3.1

5. ANS:
9.7×10^{-1} N, downward

Given

$B = 7.5 \times 10^{-4}$ T

$I = 17$ A

$l = 76$ m

Solution

From the right-hand rule, the magnetic force on a positive current must be directed downward.

$F_{magnetic} = BIl = \left(7.5 \times 10^{-4}\ \text{T}\right)(17\ \text{A})(76\ \text{m}) = 9.7 \times 10^{-1}\ \text{N}$

$\mathbf{F}_{\mathbf{magnetic}} = 9.7 \times 10^{-1}$ N, downward

PTS: 1 DIF: IIIA OBJ: 19-3.3

6. ANS:
1.3×10^{-4} T

Given

$F_{magnetic} = 1.5 \times 10^{-3}$ N

$I = 16.9$ A

$l = 0.69$ m

Solution

$F_{magnetic} = BIl$

$$B = \frac{F_{magnetic}}{Il} = \frac{\left(1.5 \times 10^{-3}\ \text{N}\right)}{(16.9\ \text{A})(0.69\ \text{m})} = 1.3 \times 10^{-4}\ \text{T}$$

PTS: 1 DIF: IIIA OBJ: 19-3.3

7. ANS:
1.31×10^{-8} T

Given

$F_{magnetic} = 9.82 \times 10^{-7}$ N

$l = 133$ cm $= 1.33$ m

$N_{electrons} = 2.96 \times 10^{20}$

$q_{electron} = 1.60 \times 10^{-19}$ C

$\Delta t = 8.39$ s

Solution

$F_{magnetic} = BIl$

$$I = \frac{\Delta Q}{\Delta t} = \frac{q_{electron} N_{electrons}}{\Delta t}$$

$$B = \frac{F_{magnetic}}{Il} = \frac{F_{magnetic}}{\left(\dfrac{q_{electron} N_{electrons}}{\Delta t}\right) l} = \frac{F_{magnetic} \Delta t}{q_{electron} N_{electrons} l}$$

$$B = \frac{\left(9.82 \times 10^{-7} \text{ N}\right)(8.39 \text{ s})}{\left(1.60 \times 10^{-19} \text{ C/electron}\right)\left(2.96 \times 10^{20} \text{ electrons}\right)(1.33 \text{ m})} = 1.31 \times 10^{-8} \text{ T}$$

PTS: 1 DIF: IIIB OBJ: 19-3.3

8. ANS:
7.11×10^{-17} N, upward

Given

$\mathbf{F}_{\mathbf{magnetic,wire}} = 9.12 \times 10^{-2}$ N, downward

$l = 248$ m

$I = 27.6$ A

$\mathbf{v} = 3.34 \times 10^{7}$ m/s, east

$q_{proton} = 1.60 \times 10^{-19}$ C

Solution

First, find the magnitude and direction of B_{wire}.

$$B_{wire} = \frac{F_{magnetic,wire}}{Il} = \frac{\left(9.12 \times 10^{-2}\ \text{N}\right)}{(27.6\ \text{A})(248\ \text{m})} = 1.33 \times 10^{-5}\ \text{T}$$

From the right-hand rule, the magnetic field produced by the positive westward current must be directed to the north. The magnetic field from the wire exerts a force on the proton.

$$B = \frac{F_{magnetic}}{qv}$$

$$B_{wire} = \frac{F_{magnetic,proton}}{q_{proton}v}$$

$$F_{magnetic,proton} = B_{wire}q_{proton}v = \left(1.33 \times 10^{-5}\ \text{T}\right)\left(1.60 \times 10^{-19}\ \text{C}\right)\left(3.34 \times 10^{7}\ \text{m/s}\right) = 7.11 \times 10^{-17}\ \text{N}$$

From the right-hand rule, the magnetic force on the proton moving east must be upward.

$\mathbf{F}_{\mathbf{magnetic,proton}} = 7.11 \times 10^{-17}$ N, upward

PTS: 1 DIF: IIIC OBJ: 19-3.3

9. ANS:
3.6×10^{-4} T
Given
$v = 9.8 \times 10^4$ m/s, north
$q_{electron} = 1.60 \times 10^{-19}$ C
$F_{magnetic}$ 5 5.6×10^{-18} N, west
Solution
$$B = \frac{Fmagnetic}{q_{electron}v} = \frac{(5.6 \times 10^{-18}\text{N})}{(1.60 \times 10^{-19}C)(9.8 \times 10^4 m/s)} = 3.6 \times 10^{-4}\text{ T}$$

PTS: 1 TOP: Chapter 19 Test A

10. ANS:
7.2×10^{-1} N, downward
Given
$B = 8.3 \times 10^{-4}$ T
$I = 18$ A
$l = 48$ m
Solution
$F_{magnetic} = BIl$
$(8.3 \times 10^{-4}\text{ T})(18\text{ A})(48\text{ m}) = 7.2 \times 10^{-1}$ N, downward

PTS: 1 TOP: Chapter 19 Test B