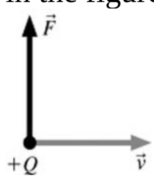
***Physics: Principle and Applications*, 7e (Giancoli)**
Chapter 20   Magnetism

20.1   Conceptual Questions

1) If you were to cut a small permanent bar magnet in half,
A) one piece would be a magnetic north pole and the other piece would be a south pole.
B) neither piece would be magnetic.
C) each piece would in itself be a smaller bar magnet with both north and south poles.
D) None of these statements is true.
Answer: C
Var: 1

2) A straight bar magnet is initially 4 cm long, with the north pole on the right and the south pole on the left. If you cut the magnet in half, the right half will
A) contain only a north pole.
B) contain a north pole on the right and a south pole on the left.
C) contain only a south pole.
D) no longer contain any poles.
Answer: B
Var: 1

3) Which one of the following statements is correct?
A) Earth's geographic north pole is the north pole of Earth's magnetic field.
B) Earth's geographic south pole is the south pole of Earth's magnetic field.
C) The north pole of a magnet points towards Earth's geographic north pole.
D) The north pole of a magnet points towards Earth's geographic south pole.
E) None of the above statements is correct.
Answer: C
Var: 1

4) A positive charge is moving to the right and experiences an upward magnetic force, as shown in the figure. In which direction must the magnetic field have a component?


A) to the right
B) to the left
C) upward
D) out of the page
E) into the page
Answer: E
Var: 1

5) A charged particle that is moving in a static uniform magnetic field
A) will always experience a magnetic force, regardless of its direction of motion.
B) may experience a magnetic force which will cause its speed to change.
C) may experience a magnetic force, but its speed will not change.
D) may experience a magnetic force, but its direction of motion will not change.
E) None of the above statements are true.
Answer: C
Var: 1

6) An electron moving along the $+x$-axis enters a magnetic field. If the electron experiences a magnetic deflection in the $-y$ direction, then the magnetic field must have a component
A) along the $+z$-axis
B) along the $-z$-axis
C) along the $-x$-axis
D) along the $+y$-axis
E) along the $-y$-axis
Answer: B
Var: 1

7) An electron, moving south, enters a magnetic field. Because of this field, the electron curves upward. We may conclude that the magnetic field must have a component
A) downward.
B) towards the east.
C) upward.
D) towards the west.
E) towards the north.
Answer: D
Var: 1

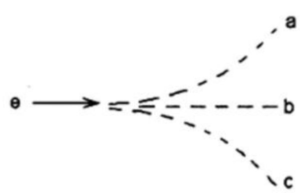
8) A proton, moving north, enters a magnetic field. Because of this field, the proton curves downward. We may conclude that the magnetic field must have a component
A) downward.
B) upward.
C) towards the east.
D) towards the west.
E) towards the north.
Answer: C
Var: 1

9) An electron, moving west, enters a magnetic field. Because of this field the electron curves upward. We may conclude that the magnetic field must have a component
A) towards the north.
B) towards the south.
C) upward.
D) downward.
E) towards the west.
Answer: A
Var: 1

10) A proton, moving west, enters a magnetic field. Because of this magnetic field the proton curves upward. We may conclude that the magnetic field must have a component
A) towards the west.
B) towards the east.
C) towards the south.
D) towards the north.
E) downward.
Answer: C
Var: 1

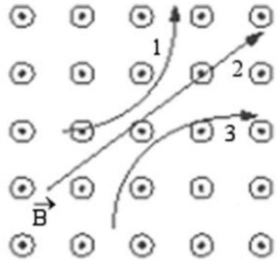
11) A proton, moving east, enters a magnetic field. Because of this magnetic field the proton curves downward. We may conclude that the magnetic field must have a component
A) towards the south.
B) towards the north.
C) towards the west.
D) upward.
E) downward.
Answer: A
Var: 1

12) An electron is moving to the right, as shown in the figure. Suddenly it encounters uniform magnetic field pointing out of the page. Which one of the three paths shown will it follow in the field?



A) path a
B) path b
C) path c
Answer: A
Var: 1

13) Three particles travel through a region of space where the magnetic field is out of the page, as shown in the figure. What are the signs of the charges of these three particles?



A) 1 is neutral, 2 is negative, and 3 is positive.
B) 1 is neutral, 2 is positive, and 3 is negative.
C) 1 is positive, 2 is neutral, and 3 is negative.
D) 1 is positive, 2 is negative, and 3 is neutral.
E) 1 is negative, 2 is neutral, and 3 is positive.
Answer: E
Var: 1

14) An electron moving in the +*y* direction, at right angles to a magnetic field, experiences a magnetic force in the -*x* direction. The direction of the magnetic field is in the
A) -*x* direction.
B) +*x* direction.
C) +*y* direction.
D) -*z* direction.
E) +*z* direction.
Answer: E
Var: 1

15) A charged particle moving along the +*x*-axis enters a uniform magnetic field pointing along the +*z*-axis. Because of an electric field along the +*y*-axis, the charge particle does not change velocity. What is the sign of this particle?
A) positive
B) negative
C) The particle could be either positive or negative.
D) None of the above choices is correct.
Answer: C
Var: 1

16) A charged particle moving along the +*x*-axis enters a uniform magnetic field pointing along the +*z*-axis. A uniform electric field is also present. Due to the combined effect of both fields, the particle does not change its velocity. What is the direction of the electric field?
A) along the -*y*-axis
B) along the +*y*-axis
C) along the -*x*-axis
D) along the +*x*-axis
E) along the -*z*-axis
Answer: B
Var: 1

17) A proton is to orbit Earth at the equator using Earth's magnetic field to supply part of the necessary centripetal force. In what direction should the proton move?
A) upward
B) northward
C) southward
D) eastward
E) westward
Answer: E
Var: 1

18) If a calculated quantity has units of $\frac{N \cdot s}{C \cdot m}$, that quantity could be

A) an electric field.
B) an electric potential.
C) μ_0.
D) a magnetic field.
E) a magnetic torque.
Answer: D
Var: 1

19) If a calculated quantity has units of T · m/A, that quantity could be
A) an electric field.
B) an electric potential.
C) μ_0.
D) a magnetic field.
E) a magnetic torque.
Answer: C
Var: 1

20) We observe that a moving charged particle experiences no magnetic force. From this we can definitely conclude that
A) no magnetic field exists in that region of space.
B) the particle must be moving parallel to the magnetic field.
C) the particle is moving at right angles to the magnetic field.
D) either no magnetic field exists or the particle is moving parallel to the field.
E) either no magnetic field exists or the particle is moving perpendicular to the field.
Answer: D
Var: 1

21) A charged particle moves with a constant speed through a region where a uniform magnetic field is present. If the magnetic field points straight upward, the magnetic force acting on this particle will be strongest when the particle moves
A) straight upward.
B) straight downward.
C) in a plane parallel to Earth's surface.
D) upward at an angle of 45° above the horizontal.
Answer: C
Var: 1

22) A negatively-charged particle moves across a constant uniform magnetic field that is perpendicular to the velocity of the particle. The magnetic force on this particle
A) causes the particle to speed up.
B) causes the particle to slow down.
C) causes the particle to accelerate.
D) is in the same direction as the particle's velocity.
E) is opposite the direction of the particle's velocity.
Answer: C
Var: 1

23) At a particular instant, a proton moves toward the east in a uniform magnetic field that is directed straight downward. The magnetic force that acts on it is
A) zero.
B) upward.
C) toward the north.
D) toward the south.
E) downward.
Answer: C
Var: 1

24) At a particular instant, an electron moves toward the east in a uniform magnetic field that is directed straight downward. The magnetic force that acts on it is
A) zero.
B) upward.
C) toward the north.
D) toward the south.
E) downward.
Answer: D
Var: 1

25) An electron has an initial velocity to the south but is observed to curve upward as the result of a magnetic field. This magnetic field must have a component
A) to the west.
B) to the east.
C) upward.
D) downward.
E) to the north.
Answer: A
Var: 1

26) A proton has an initial velocity to the south but is observed to curve upward as the result of a magnetic field. This magnetic field must have a component
A) to the west.
B) to the east.
C) upward.
D) downward.
E) to the north.
Answer: B
Var: 1

27) After landing on an unexplored Klingon planet, Spock tests for the direction of the magnetic field by firing a beam of electrons in various directions and by recording the following observations:
Electrons moving upward feel a magnetic force in the northwest direction.
Electrons moving horizontally toward the north are pushed downward.
Electrons moving horizontally toward the southeast are pushed upward.

Mr. Spock therefore concludes that the magnetic field at this landing site is in which direction?
A) toward the east
B) toward the northeast
C) toward the southwest
D) toward the southeast
E) toward the west
Answer: C
Var: 1

28) A charged particle is injected into a uniform magnetic field such that its velocity vector is perpendicular to the magnetic field lines. Ignoring the particle's weight, the particle will
A) move in a straight line.
B) follow a spiral path.
C) move along a parabolic path.
D) follow a circular path.
Answer: D
Var: 1

29) A charged particle is observed traveling in a circular path of radius R in a uniform magnetic field. If the particle were traveling twice as fast, the radius of the circular path would be
A) $2R$.
B) $4R$.
C) $8R$.
D) $R/2$.
E) $R/4$.
Answer: A
Var: 1

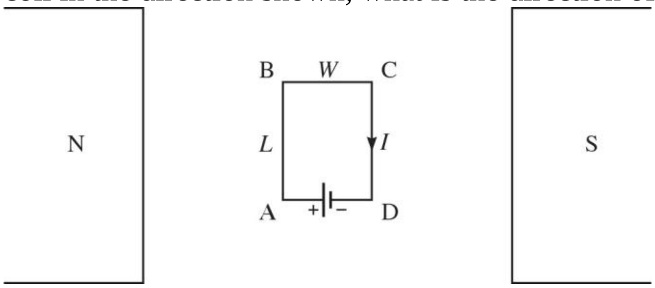
30) A particle carrying a charge of $+e$ travels in a circular path of radius R in a uniform magnetic field. If instead the particle carried a charge of $+2e$, the radius of the circular path would have been
A) $2R$.
B) $4R$.
C) $8R$.
D) $R/2$.
E) $R/4$.
Answer: D
Var: 1

31) A proton, moving in a uniform magnetic field, moves in a circle perpendicular to the field lines and takes time T for each circle. If the proton's speed tripled, what would now be its time to go around each circle?
A) $9T$
B) $3T$
C) T
D) $T/3$
E) $T/9$
Answer: C
Var: 1

32) If a calculated quantity has units of $\frac{\mathrm{N}}{\mathrm{A} \cdot \mathrm{m}}$, that quantity could be

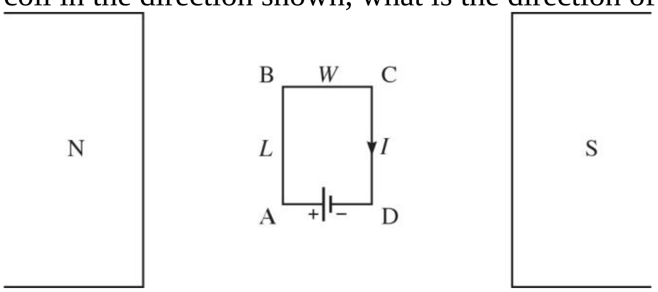
A) an electric field.
B) an electric potential.
C) μ_0.
D) a magnetic field.
E) a magnetic torque.
Answer: D
Var: 1

33) A rectangular coil, with corners labeled ABCD, has length *L* and width *w*. It is placed between the poles of a magnet, as shown in the figure If there is a current *I* flowing through this coil in the direction shown, what is the direction of the force acting on section AB of this coil?



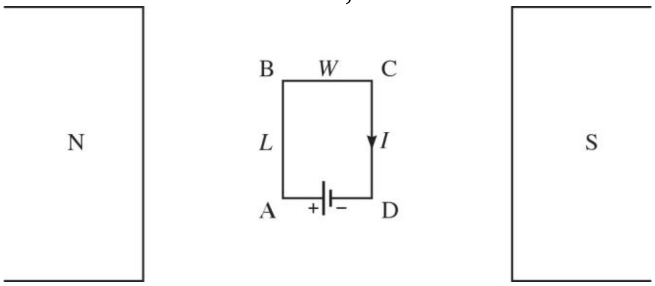
A) perpendicular to and into the page
B) perpendicular to and out of the page
C) in the direction of the magnetic field
D) in the opposite direction of the magnetic field
E) The force is zero.
Answer: A
Var: 1

34) A rectangular coil, with corners labeled ABCD, has length *L* and width *w*. It is placed between the poles of a magnet, as shown in the figure. If there is a current *I* flowing through this coil in the direction shown, what is the direction of the force acting on section CD of this coil?



A) perpendicular to and into the page
B) perpendicular to and out of the page
C) in the direction of the magnetic field
D) in the opposite direction of the magnetic field
E) The force is zero.
Answer: B
Var: 1

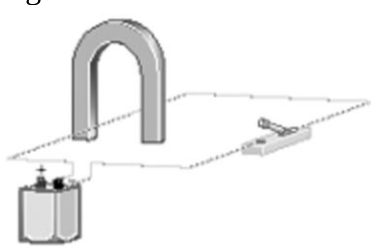
35) A rectangular coil, with corners labeled ABCD, has length *L* and width *w*. It is placed between the poles of a magnet, as shown in the figure If there is a current *I* flowing through this coil in the direction shown, what is the direction of the force acting on section BC of this coil?



A) perpendicular to and into the page
B) perpendicular to and out of the page
C) in the direction of the magnetic field
D) in the opposite direction of the magnetic field
E) The force is zero.
Answer: E
Var: 1

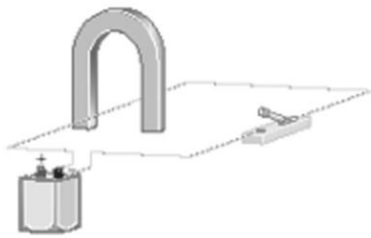
36) A wire is carrying current vertically downward. What is the direction of the force on this wire due to Earth's magnetic field?
A) horizontally towards the north
B) horizontally towards the south
C) horizontally towards the east
D) horizontally towards the west
E) vertically upward
Answer: C
Var: 1

37) When the switch is closed in the circuit shown in the figure, the wire between the poles of the horseshoe magnet deflects upward. From this you can conclude that the left end of the magnet is



A) a north magnetic pole.
B) a south magnetic pole.
C) There is not enough information given to answer the question.
Answer: B
Var: 1

38) For the horseshoe magnet shown in the figure, the left end is a north magnetic pole and the right end is a south magnetic pole. When the switch is closed in the circuit, which way will the wire between the poles of the horseshoe magnet initially deflect?



A) to the right
B) to the left
C) upward
D) downward
Answer: D
Var: 1

39) The direction of the force on a current-carrying wire in a magnetic field is
A) perpendicular only to the current.
B) perpendicular only to the magnetic field.
C) perpendicular to both the current and the magnetic field.
D) in the direction opposite to the current.
E) in same direction as the current.
Answer: C
Var: 1

40) The magnetic force on a current-carrying wire in a magnetic field is the strongest when
A) the current is in the direction of the magnetic field lines.
B) the current is in the direction opposite to the magnetic field lines.
C) the current is at a 180° angle with respect to the magnetic field lines.
D) the current is perpendicular to the magnetic field lines.
E) the current is at a 0° angle with respect to the magnetic field lines.
Answer: D
Var: 1

41) A vertical wire carries a current straight up in a region where the magnetic field vector points toward the north. What is the direction of the magnetic force on this wire?
A) downward
B) toward the north
C) toward the east
D) toward the west
E) upward
F) toward the south
Answer: D
Var: 1

42) Two long parallel wires are placed side-by-side on a horizontal table. If the wires carry current in the same direction,
A) one wire is lifted slightly while the other wire is forced downward against the table's surface.
B) both wires are lifted slightly.
C) the wires pull toward each other.
D) the wires push away from each other.
Answer: C
Var: 1

43) Two long parallel wires are placed side-by-side on a horizontal table. If the wires carry current in opposite directions,
A) one wire is lifted slightly while the other wire is forced downward against the table's surface.
B) both wires are lifted slightly.
C) the wires pull toward each other.
D) the wires push away from each other.
Answer: D
Var: 1

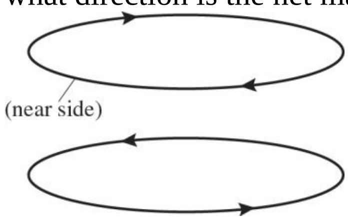
44) When two long parallel wires carry unequal currents, the magnitude of the magnetic force that one wire exerts on the other is F. If the current in both wires is now doubled, what is the magnitude of the new magnetic force on each wire?
A) 16F
B) 8F
C) 4F
D) 2F
E) $F\sqrt{2}$
Answer: C
Var: 1

45) Two long parallel wires are placed side-by-side on a horizontal table and carry current in the same direction. The current in one wire is 20 A, and the current in the other wire is 5 A. If the magnetic force on the 20-A wire has magnitude F, what is the magnitude of the magnetic force on the 5-A wire? No external magnetic fields are present.
A) 4F
B) 2F
C) F
D) F/2
E) F/4
Answer: C
Var: 1

46) Two long, parallel wires carry currents of different magnitudes. If the current in one of the wires is doubled and the current in the other wire is halved, what happens to the magnitude of the magnetic force that each wire exerts on the other?
A) It is doubled.
B) It stays the same.
C) It is tripled.
D) It is quadrupled.
E) It is reduced by a factor of two.
Answer: B
Var: 1

47) Two long, parallel wires carry currents of different magnitudes. If the amount of current in one of the wires is doubled, what happens to the magnitude of the force that each wire exerts on the other?
A) It is increased by a factor of 8.
B) It is increased by a factor of 4.
C) It is increased by a factor of 3.
D) It is increased by a factor of 2.
E) It is increased by a factor of $\sqrt{2}$
Answer: D
Var: 1

48) A ring with a clockwise current (as viewed from above the ring) is situated with its center directly above another ring, which has a counter-clockwise current, as shown in the figure. In what direction is the net magnetic force exerted on the top ring due to the bottom ring?



A) upward
B) downward
C) to the left
D) to the right
E) The net force is zero.
Answer: A
Var: 1

49) An object is hung using a metal spring. If now a current is passed through the spring, what will happen to this system?
A) The spring will contract, raising the weight.
B) The spring will extend, lowering the weight.
C) The weight will not move.
D) The spring will begin to swing like a pendulum.
E) None of these are true.
Answer: A
Var: 1

50) Which of the following are units for the magnetic moment? (There could be more than one correct choice.)
A) $\frac{\mathrm{T}}{\mathrm{N} \cdot \mathrm{m}}$
B) $\mathrm{A} \cdot \mathrm{m}^2$
C) $\mathrm{N} \cdot \mathrm{m}/\mathrm{T}$
D) T/m^2
Answer: B, C
Var: 1

51) The maximum torque on a flat current-carrying loop occurs when the angle between the plane of the loop's area and the magnetic field vector is
A) 0°
B) 45°
C) 90°
D) 135°
Answer: A
Var: 1

52) A flat circular wire loop lies in a horizontal plane on a table and carries current in a counterclockwise direction when viewed from above. At this point, the earth's magnetic field points to the north and dips below the horizontal. Which side of the coil tends to lift off of the table due to the magnetic torque on the loop?
A) the north side
B) the east side
C) the south side
D) the west side
E) The entire loop lifts straight up.
Answer: C
Var: 1

53) Two long parallel wires placed side-by-side on a horizontal table carry identical size currents in opposite directions. The wire on your right carries current directly toward you, and the wire on your left carries current directly away from you. From your point of view, the magnetic field at a point exactly midway between the two wires
A) points upward.
B) points downward.
C) points toward you.
D) points away from you.
E) is zero.
Answer: B
Var: 1

54) Two long parallel wires placed side-by-side on a horizontal table carry identical current straight toward you. From your point of view, the magnetic field at a point exactly between the two wires
A) points upward.
B) points downward.
C) points toward you.
D) points away from you.
E) is zero.
Answer: E
Var: 1

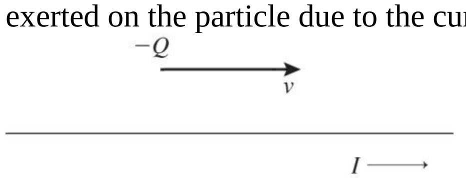
55) A long, straight, horizontal wire carries current toward the east. A proton moves toward the east alongside and just south of the wire. What is the direction of the magnetic force on the proton?
A) toward the north
B) toward the south
C) upward
D) downward
E) toward the east.
Answer: A
Var: 1

56) A long, straight, horizontal wire carries current toward the east. An electron moves toward the east alongside and just south of the wire. What is the direction of the magnetic force on the electron?
A) toward the north
B) toward the south
C) upward
D) downward
E) toward the west.
Answer: B
Var: 1

57) A wire lying in the plane of this page carries a current directly toward the top of the page. What is the direction of the magnetic force this current produces on an electron that is moving perpendicular to the page and outward from it on the left side of the wire?
A) perpendicular to the page and towards you
B) perpendicular to the page and away from you
C) toward the top of the page
D) toward the bottom of the page
E) The force is zero.
Answer: E
Var: 1

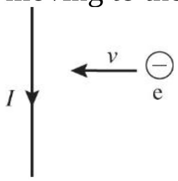
58) A long, straight wire carrying a current is placed along the *y*-axis. If the direction of the current is in the +*y* direction, what is the direction of the magnetic field due to this wire as you view it in such a way that the current is coming directly toward you?
A) clockwise, around the *x*-axis
B) counterclockwise, around the *x*-axis
C) counterclockwise, around the *z*-axis
D) counterclockwise, around the *y*-axis
E) clockwise, around the *y*-axis
Answer: D
Var: 1

59) A negatively charged particle -*Q* is moving to the right, directly above a wire having a current *I* flowing to the right, as shown in the figure. In what direction is the magnetic force exerted on the particle due to the current?



A) into the page
B) out of the page
C) downward
D) upward
E) The magnetic force is zero because the velocity is parallel to the current.
Answer: D
Var: 1

60) A wire lying in the plane of the page carries a current toward the bottom of the page, as shown in the figure. What is the direction of the magnetic force it produces on an electron that is moving to the left directly toward the wire, as shown?



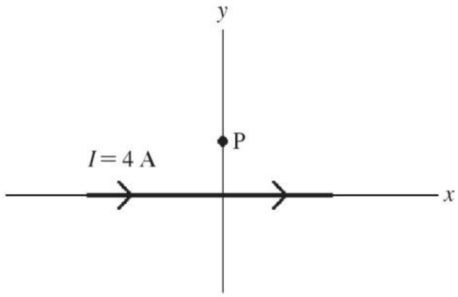
A) straight into the page
B) straight out of the page
C) directly toward the top of the page
D) directly toward the bottom of the page
E) directly to the left away from the wire
Answer: D
Var: 1

61) A very long straight current-carrying wire produces a magnetic field of 20 mT at a distance *d* from the wire. To measure a field of 5 mT due to this wire, you would have to go to a distance from the wire of
A) 16*d*.
B) 8*d*.
C) 4*d*.
D) 2*d*.
E) $d\sqrt{2}$
Answer: C
Var: 1

62) The magnetic field at a distance of 2 cm from a long straight current-carrying wire is 4 μT. What is the magnetic field at a distance of 4 cm from this wire?
A) 2 μT
B) 4 μT
C) 6 μT
D) 8 μT
E) 10 μT
Answer: A
Var: 1

63) The magnetic field at a distance of 2 cm from a long straight current-carrying wire is 4 μT. What is the magnetic field at a distance of 1 cm from this wire?
A) 2 μT
B) 4 μT
C) 6 μT
D) 8 μT
E) 10 μT
Answer: D
Var: 1

64) A long straight wire carrying a 4-A current is placed along the *x*-axis as shown in the figure. What is the direction of the magnetic field at a point P due to this wire?



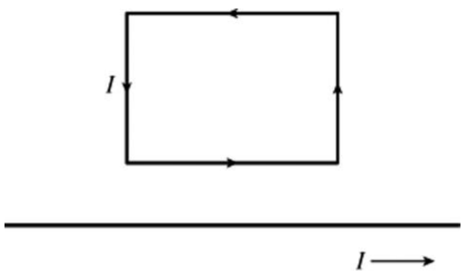
A) into the plane of the page
B) out of the plane of the page
C) along the -*x*-axis
D) along the +*x*-axis
E) along the +*y*-axis
Answer: B
Var: 1

65) Which one of the following statements is correct?
A) When a current-carrying wire is in your right hand, with your thumb in the direction of the current, your fingers point opposite to the direction of the magnetic field lines.
B) When a current-carrying wire is in your right hand, with your thumb in the direction of the current, your fingers point in the direction of the magnetic field lines.
C) When a current-carrying wire is in your left hand, with your thumb in the direction of the current, your fingers point in the direction of the magnetic field lines.
Answer: B
Var: 1

66) A vertical wire carries a current vertically downward. To the east of this wire, the magnetic field points
A) north.
B) east.
C) south.
D) down.
Answer: C
Var: 1

67) A horizontal wire carries a current straight toward you. From your point of view, the magnetic field caused by this current
A) points directly away from you.
B) points to the left.
C) circles the wire in a clockwise direction.
D) circles the wire in a counter-clockwise direction.
Answer: D
Var: 1

68) A long straight wire has a constant current flowing to the right. A rectangular metal loop is situated above the wire, and also has a constant current flowing through it, as shown in the figure. Which one of the following statements is true?



A) The net magnetic force on the rectangle is upward, and there is also a nonzero torque on the rectangle.
B) The net magnetic force on the rectangle is zero, and the net torque on it is zero.
C) The net magnetic force on the rectangle is downward, and there is also a nonzero torque on the rectangle.
D) The net magnetic force on the rectangle is zero, but there is a nonzero torque on the rectangle.
E) The net magnetic force on the rectangle is downward, and the net torque on it is zero.
Answer: E
Var: 1

69) Consider an ideal solenoid of length L, N windings, and radius b (L is much longer than b). A current I is flowing through the wire windings. If the radius of the solenoid is doubled to $2b$, but all the other quantities remain the same, the magnetic field inside the solenoid will
A) remain the same.
B) become twice as strong as initially.
C) become one-half as strong as initially.
D) become four times as strong as initially.
E) become one-fourth as strong as initially.
Answer: A
Var: 1

70) Consider an ideal solenoid of length L, N windings, and radius b (L is much longer than b). A current I is flowing through the wire windings. If the length of the solenoid becomes twice as long (to $2L$), but all other quantities remained the same, the magnetic field inside the solenoid will
A) remain the same.
B) become twice as strong as initially.
C) become one-half as strong as initially.
D) become four times as strong as initially.
E) become one-fourth as strong as initially.
Answer: C
Var: 1

71) When you double the number of windings in an ideal solenoid while keeping all other parameters (radius, length and current) fixed, the magnetic field at the center of the solenoid will
A) double.
B) triple.
C) quadruple.
D) be reduced by a factor of one-half.
E) be reduced by a factor of one-fourth.
Answer: A
Var: 1

72) In a velocity selector consisting of perpendicular electric and magnetic fields, the speeds of the charged particles passing through the selector are increased or decreased until they are equal to the desired speed.
A) True
B) False
Answer: B
Var: 1

73) In a certain velocity selector consisting of perpendicular electric and magnetic fields, the charged particles move toward the east, and the magnetic field is directed to the north. What direction should the electric field point?
A) toward the east
B) toward the west
C) toward the south
D) upward
E) downward
Answer: E
Var: 1

74) When a ferromagnetic material is placed in an external magnetic field, the net magnetic field of its magnetic domains becomes
A) smaller.
B) zero.
C) larger.
Answer: C
Var: 1

20.2 Problems

1) A proton moving at 5.0×10^4 m/s horizontally enters a region where a magnetic field of 0.12 T is present, directed vertically downward. What magnitude force acts on the proton due to this field?
($e = 1.60 \times 10^{-19}$ C)
Answer: 9.6×10^{-16} N
Var: 1

2) A geophysicist measures the magnetic force on a proton that is moving vertically downward at a point 1.996 km/s at the earth's equator. At that location, the earth's magnetic magnetic field is horizontal and has a strength of 0.40×10^{-4} T. What are the magnitude and direction of the force she will measure? ($e = 1.60 \times 10^{-19}$ C)
Answer: 1.3×10^{-20} N, toward the east
Var: 1

3) An electron moves with a speed of 5.0×10^4 m/s perpendicular to a uniform magnetic field of magnitude 0.20 T. What is the magnitude of the magnetic force on the electron? ($e = 1.60 \times 10^{-19}$ C)
A) 4.4×10^{-14} N
B) 1.6×10^{-15} N
C) 5×10^{-20} N
D) 2.6×10^{-24} N
E) zero
Answer: B
Var: 3

4) An electron traveling toward the magnetic north with speed 400 km/s enters a region where the earth's magnetic field has the magnitude 5.0×10^{-5} T and is directed downward at 45° below horizontal. What magnitude magnetic force acts on the electron? ($e = 1.60 \times 10^{-19}$ C)
Answer: 2.3×10^{-18} N
Var: 1

5) A proton travels at a speed of 5.0×10^7 m/s through a 1.0-T magnetic field. What is the magnitude of the magnetic force on the proton if the angle between the proton's velocity and the magnetic field vector is 30°? ($e = 1.60 \times 10^{-19}$ C)
A) 2.0×10^{-14} N
B) 4.0×10^{-14} N
C) 2.0×10^{-12} N
D) 4.0×10^{-12} N
Answer: D
Var: 1

6) A proton, with mass 1.67×10^{-27} kg and charge $+1.6 \times 10^{-19}$ C, is sent with velocity 2.3×10^4 m/s in the $+x$ direction into a region where there is a uniform electric field of magnitude 780 V/m in the $+y$ direction. What must be the magnitude and direction of the uniform magnetic field in the region if the proton is to pass through undeflected? Assume that the magnetic field has no x component and neglect gravitational effects.

Answer: 3.4×10^{-2} T, $+z$ direction

Var: 50+

7) A proton is projected with a velocity of 7.0 km/s into a magnetic field of 0.60 T perpendicular to the motion of the proton. What is the magnitude of the magnetic force that acts on the proton? ($e = 1.60 \times 10^{-19}$ C)

A) 0 N

B) 3.4×10^{-16} N

C) 4.2×10^{-16} N

D) 13×10^{-16} N

E) 6.7×10^{-16} N

Answer: E

Var: 1

8) A proton moving eastward with a velocity of 5.0 km/s enters a magnetic field of 0.20 T pointing northward. What are the magnitude and direction of the force that the magnetic field exerts on the proton? ($e = 1.60 \times 10^{-19}$ C)

A) 0 N

B) 1.6×10^{-16} N upwards

C) 1.6×10^{-16} N downwards

D) 1.1×10^{-16} N eastwards

E) 4.4×10^{-16} N westwards

Answer: B

Var: 1

9) A proton moving with a velocity of 4.0×10^4 m/s enters a magnetic field of 0.20 T. If the angle between the velocity of the proton and the direction of the magnetic field is 60°, what is the magnitude of the magnetic force on the proton? ($e = 1.60 \times 10^{-19}$ C)

A) 1.8×10^{-15} N

B) 0.60×10^{-15} N

C) 1.1×10^{-15} N

D) 2.2×10^{-15} N

E) 3.3×10^{-15} N

Answer: C

Var: 1

10) A proton moving with a velocity of 4.0×10^{4} m/s along the +y-axis enters a magnetic field of 0.20 T directed towards the -x-axis. What is the magnitude of the magnetic force acting on the proton? ($e = 1.60 \times 10^{-19}$ C)
A) 8.0×10^{-15} N
B) 3.9×10^{-15} N
C) 2.6×10^{-15} N
D) 0 N
E) 1.3×10^{-15} N
Answer: E
Var: 1

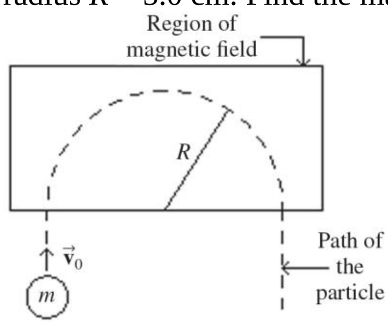
11) An electron moves with a speed of 3.0×10^{4} m/s perpendicular to a uniform magnetic field of 0.40 T. What is the magnitude of the magnetic force on the electron? ($e = 1.60 \times 10^{-19}$ C)
A) 4.8×10^{-14} N
B) 1.9×10^{-15} N
C) 5×10^{-20} N
D) 2.2×10^{-24} N
E) 0 N
Answer: B
Var: 3

12) An electron moves with a speed of 8.0×10^{6} m/s along the +x-axis. It enters a region where there is a magnetic field of 2.5 T, directed at an angle of 60° to the +x-axis and lying in the xy-plane. Calculate the magnitude of the magnetic force on the electron. ($e = 1.60 \times 10^{-19}$ C)
A) 2.8×10^{-10} N
B) 3.2×10^{-10} N
C) 2.8×10^{-12} N
D) 3.2×10^{-12} N
E) 0 N
Answer: C
Var: 1

13) An electron moves with a speed of 8.0×10^{6} m/s along the +x-axis. It enters a region where there is a magnetic field of 2.5 T, directed at an angle of 60° to the +x-axis and lying in the xy-plane. Calculate the magnitude of the acceleration of the electron. ($e = 1.60 \times 10^{-19}$ C, m_{e1} = 9.11×10^{-31} kg)
A) 1.3×10^{18} m/s^2
B) 3.0×10^{18} m/s^2
C) 1.3×10^{-18} m/s^2
D) 3.0×10^{-18} m/s^2
E) 0 m/s^2
Answer: B
Var: 1

14) A proton is accelerated from rest through 0.50 kV. It then enters a uniform magnetic field of 0.30 T that is oriented perpendicular to its direction of motion.
(a) What is the radius of the path the proton follows in the magnetic field?
(b) How long does it take the proton to make one complete circle in the magnetic field?.
Answer: (a) 11 mm (b) 0.22 μs
Var: 1

15) In the figure, a small particle of charge -1.9 x 10^{-6} C and mass $m = 3.1 \times 10^{-12}$ kg has speed $v_0 = 8.1 \times 10^3$ m/s as it enters a region of uniform magnetic field. The particle is initially traveling perpendicular to the magnetic field and is observed to travel in the semicircular path shown with radius R = 5.0 cm. Find the magnitude and direction of the magnetic field in the region.



Answer: 0.26 T, into the paper
Var: 50+

16) A proton having a speed of 3.0 × 10^6 m/s in a direction perpendicular to a uniform magnetic field moves in a circle of radius 0.20 m within the field. What is the magnitude of the magnetic field? (e = 1.60 × 10^{-19} C, m_{proton} = 1.67 × 10^{-27} kg)
A) 0.080 T
B) 0.16 T
C) 0.24 T
D) 0.32 T
E) 0.36 T
Answer: B
Var: 1

17) An electron moving perpendicular to a uniform magnetic field of 3.2 × 10^{-2} T moves in a circle of radius 0.40 cm. How fast is this electron moving? (e = 1.60 × 10^{-19} C, $m_{electron}$ = 9.11 × 10^{-31}kg)
A) 2.2 × 10^7 m/s
B) 1.9 × 10^7 m/s
C) 1.9 × 10^6 m/s
D) 3.0 × 10^7 m/s
E) 0.80 × 10^7 m/s
Answer: A
Var: 1

18) An electron moving perpendicular to a uniform magnetic field of 0.22 T moves in a circle with a speed of 1.5×10^{7} m/s. What is the radius of the circle? ($e = 1.60 \times 10^{-19}$ C, $m_{\text{electron}} = 9.11 \times 10^{-31}$kg)
A) 1.5 mm
B) 0.22 mm
C) 2.2 mm
D) 0.39 mm
E) 3.9 mm
Answer: E
Var: 1

19) An electron is accelerated from rest through a potential difference of 3.75 kV. It enters a region where a uniform 4.0-mT magnetic field is perpendicular to the velocity of the electron. Calculate the radius of the path this electron will follow in the magnetic field. ($e = 1.60 \times 10^{-19}$ C, $m_{\text{electron}} = 9.11 \times 10^{-31}$ kg)
A) 1.2 cm
B) 2.2 cm
C) 3.2 cm
D) 4.2 cm
E) 5.2 cm
Answer: E
Var: 1

20) A doubly charged ion with speed 6.9×10^{6} m/s enters a uniform 0.80-T magnetic field, traveling perpendicular to the field. Once in the field, it moves in a circular arc of radius 30 cm. What is the mass of this ion? ($e = 1.60 \times 10^{-19}$ C)
A) 11×10^{-27} kg
B) 6.7×10^{-27} kg
C) 3.3×10^{-27} kg
D) 8.2×10^{-27} kg
Answer: A
Var: 1

21) A proton, starting from rest, accelerates through a potential difference of 1.0 kV and then moves into a magnetic field of 0.040 T at a right angle to the field. What is the radius of the proton's resulting orbit? ($e = 1.60 \times 10^{-19}$ C, $m_{\text{proton}} = 1.67 \times 10^{-27}$ kg)
A) 0.080 m
B) 0.11 m
C) 0.14 m
D) 0.17 m
Answer: B
Var: 1

22) A charged particle of mass 0.0040 kg is subjected to a 4.0-T magnetic field which acts at a right angle to its motion. If the particle moves in a circle of radius 0.10 m at a speed of 2.0 m/s, what is the magnitude of the charge on the particle?
A) 0.020 C
B) 50 C
C) 0.00040 C
D) 2500 C
Answer: A
Var: 50+

23) Alpha particles, each having a charge of +2*e* and a mass of 6.64×10^{-27} kg, are accelerated in a uniform 0.80-T magnetic field to a final orbit radius of 0.30 m. The field is perpendicular to the velocity of the particles. How long does it take an alpha particle to make one complete circle in the final orbit? ($e = 1.60 \times 10^{-19}$ C)
A) 0.15 μs
B) 0.25 μs
C) 0.33 μs
D) 0.40 μs
E) 0.49 μs
Answer: A
Var: 1

24) Alpha particles, each having a charge of +2*e* and a mass of 6.64×10^{-27} kg, are accelerated in a uniform 0.50 T magnetic field to a final orbit radius of 0.50 m. The field is perpendicular to the velocity of the particles. What is the kinetic energy of an alpha particle in the final orbit? (1 eV = 1.60×10^{-19} J, $e = 1.60 \times 10^{-19}$ C)
A) 3.0 MeV
B) 2.6 MeV
C) 3.4 MeV
D) 3.9 MeV
E) 4.3 MeV
Answer: A
Var: 50+

25) A wire along the *z*-axis carries a current of 4.9 A in the +*z* direction. Find the magnitude and direction of the force exerted on a 3.3-cm long length of this wire by a uniform magnetic field pointing in the -*x* direction having a magnitude 0.43 T.
Answer: 0.070 N, -*y* direction
Var: 50+

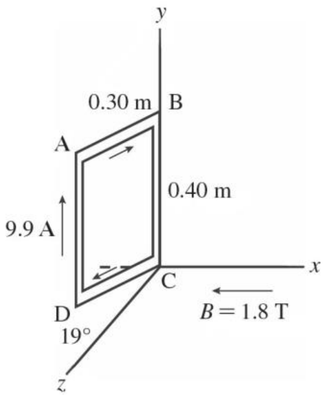
26) A 2.0-m straight wire carrying a current of 0.60 A is oriented parallel to a uniform magnetic field of 0.50 T. What is the magnitude of the magnetic force on it?
A) zero
B) 0.15 N
C) 0.30 N
D) 0.60 N
Answer: A
Var: 2

27) A straight wire carries a current of 10 A at an angle of 30° with respect to the direction of a uniform 0.30-T magnetic field. Find the magnitude of the magnetic force on a 0.50-m length of the wire.
A) 0.75 N
B) 1.5 N
C) 3.0 N
D) 6.0 N
Answer: A
Var: 1

28) What is the force per meter on a straight wire carrying 5.0 A when it is placed in a magnetic field of 0.020 T so that the wire makes an angle of 27° with respect to the magnetic field lines.
A) 0.022 N/m
B) 0.045 N/m
C) 0.17 N/m
D) 0.26 N/m
Answer: B
Var: 1

29) A thin copper rod 1.0 m long has a mass of 0.050 kg and is in a magnetic field of 0.10 T. What minimum current in the rod is needed in order for the magnetic force to balance the weight of the rod?
A) 1.2 A
B) 2.5 A
C) 4.9 A
D) 9.8 A
Answer: C
Var: 1

30) A rigid rectangular loop, measuring 0.30 m by 0.40 m, carries a current of 9.9 A, as shown in the figure. A uniform external magnetic field of magnitude 1.8 T in the -*x* direction is present. Segment CD is in the *xz*-plane and forms a 19° angle with the *z*-axis, as shown. What is the *y* component of the magnetic force on segment AB of the loop?



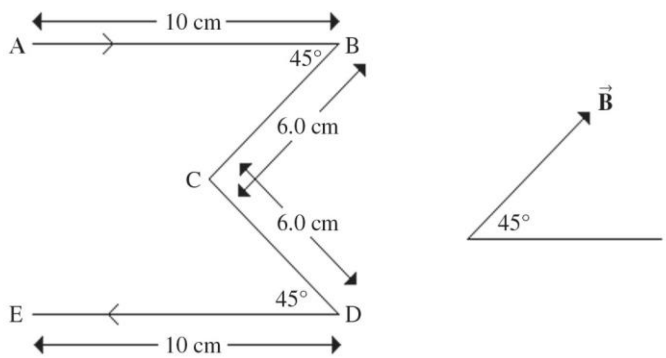
A) +5.1 N
B) -5.1 N
C) +1.7 N
D) -1.7 N
E) 0.0 N
Answer: A
Var: 1

31) A straight wire that is 0.60 m and carrying a current of 2.0 A is placed at an angle with respect to the magnetic field of strength 0.30 T. If the wire experiences a force of magnitude 0.18 N, what angle does the wire make with respect to the magnetic field?
A) 20°
B) 25°
C) 30°
D) 35°
E) 60°
Answer: C
Var: 1

32) A straight wire is carrying a current of 2.0 A. It is placed at an angle of 60° with respect to a magnetic field of strength 0.20 T. If the wire experiences a force of 0.40 N, what is the length of the wire?
A) 1.0 m
B) 1.2 m
C) 1.4 m
D) 1.6 m
E) 1.8 m
Answer: B
Var: 1

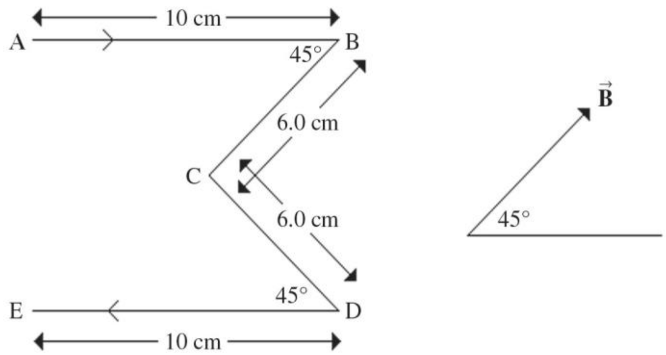
33) A straight 1.0-m long wire is carrying a current. The wire is placed perpendicular to a magnetic field of strength 0.20 T. If the wire experiences a force of 0.60 N, what is the current in the wire?
A) 2.0 A
B) 1.0 A
C) 3.0 A
D) 4.0 A
E) 5.0 A
Answer: C
Var: 1

34) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.75 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section AB of this wire?



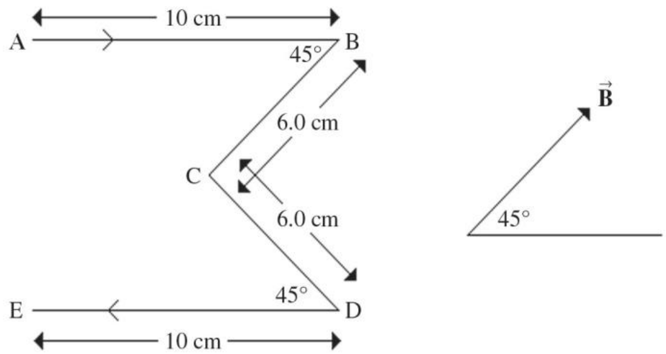
A) 0.20 N perpendicular out of the page
B) 0.40 N perpendicular out of the page
C) 0.11 N perpendicular out of the page
D) 0.20 N perpendicular into the page
E) 0.11 N perpendicular into the page
Answer: C
Var: 5

35) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.65 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section BC of this wire?



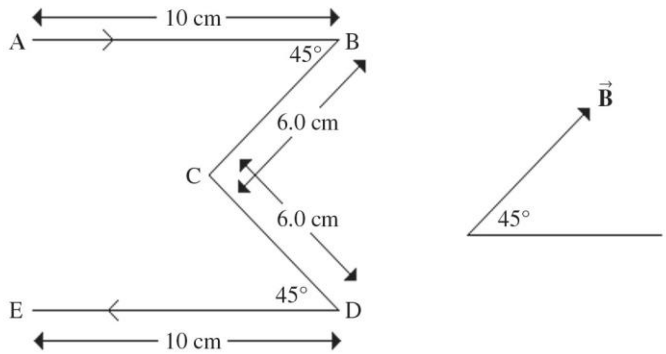
A) 0 N
B) 0.090 N perpendicular out of the page
C) 0.090 N perpendicular into the page
D) 0.060 N perpendicular out of the page
E) none of the above
Answer: A
Var: 5

36) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.55 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section CD of this wire?



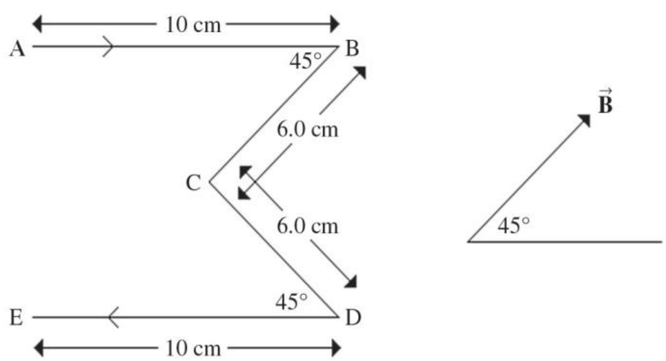
A) 0.066 N perpendicular into the page
B) 0.40 N perpendicular out of the page
C) 0.066 N perpendicular out of the page
D) 0.40 N perpendicular into the page
E) 0.20 N perpendicular out of the page
Answer: C
Var: 1

37) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E, as shown in the figure. It is placed in a uniform magnetic field of 0.85 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the force acting on section DE of this wire?



A) 0.30 N perpendicular out of the page
B) 0.12 N perpendicular into the page
C) 0.30 N perpendicular into the page
D) 0.12 N perpendicular out of the page
E) 0.20 N perpendicular out of the page
Answer: B
Var: 5

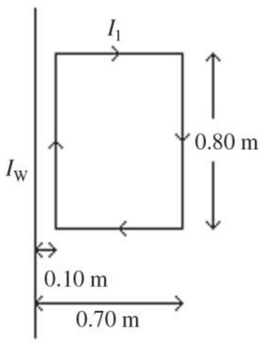
38) A wire in the shape of an "M" lies in the plane of the paper. It carries a current of 2.0 A, flowing from A to E. It is placed in a uniform magnetic field of 0.85 T in the same plane, directed as shown on the right side of the figure. The figure indicates the dimensions of the wire. Note that AB is parallel to DE and to the baseline from which the magnetic field direction is measured. What are the magnitude and direction of the net force acting on this wire?



A) 0.40 N perpendicular out of the page
B) 0.10 N perpendicular into the page
C) 0.40 N perpendicular into the page
D) 0.10 N perpendicular out of the page
E) 0.20 N perpendicular out of the page
Answer: D
Var: 5

39) Two long parallel wires separated by 7.5 cm each carry 3.3 A in opposite directions. ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
(a) What magnetic force per length acts on each of the wires? Is it attractive or repulsive?
(b) Find the magnitude of the magnetic field midway between the two wires.
Answer: (a) 2.9×10^{-5} N/m, repulsive (b) 3.5×10^{-5} T
Var: 7

40) In the figure, a rectangular current loop is carrying current I_1 = 7.0 A, in the direction indicated, near a long wire carrying a current I_W. The long wire is parallel to the sides of the rectangle. The rectangle loop has length 0.80 m and its sides are 0.10 m and 0.70 m from the wire. If the net force on the loop is to have magnitude 1.7×10^{-6} N and is to be directed towards the wire, what must be the magnitude and direction (from top to bottom or from bottom to top in the sketch) of the current I_W in the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)



Answer: 0.18 A, from bottom to top
Var: 50+

41) Two parallel straight wires are 7.0 cm apart and 50 m long. Each one carries a 18-A current in the same direction. One wire is securely anchored, and the other is attached in the center to a movable cart. If the force needed to move the wire when it is not attached to the cart is negligible, with what magnitude force does the wire pull on the cart? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 46 mN
B) 37 mN
C) 66 mN
D) 93 mN
Answer: A
Var: 1

42) Two long parallel wires that are 0.30 m apart carry currents of 5.0 A and 8.0 A in the opposite direction. Find the magnitude of the force per unit length that each wire exerts on the other wire and indicate if the force is attractive or repulsive. ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 2.7×10^{-5} N repulsive
B) 7.2×10^{-5} N repulsive
C) 3.4×10^{-5} N attractive
D) 2.7×10^{-5} N attractive
E) 7.2×10^{-5} N attractive
Answer: A
Var: 1

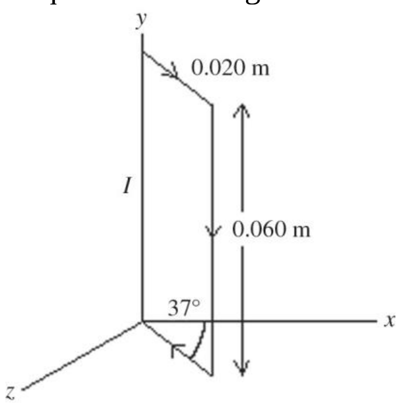
43) Two long parallel wires are 0.400 m apart and carry currents of 4.00 A and 6.00 A. What is the magnitude of the force per unit length that each wire exerts on the other wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 2.00 μN/m
B) 5.00 μN/m
C) 12.0 μN/m
D) 16.0 μN/m
E) 38.0 μN/m
Answer: C
Var: 5

44) A flat circular coil has 250 identical loops of very thin wire. Each loop has an area of 0.12 m^2 and carries 15 mA of current. This coil is placed in a magnetic field of 0.050 T oriented at 30° to the plane of the loop. What is the magnitude of the magnetic moment of the coil?
Answer: 0.45 A · m^2
Var: 1

45) A flat coil containing 25 identical loops carries 6.4 A of current. When it is placed in a uniform magnetic field of 0.22 T that is oriented parallel to the plane of the coil, the magnetic torque on it is 3.7 N · m.
(a) What is the magnetic moment of the coil?
(b) What is the area of each loop?
Answer: (a) 17 A · m^2 (b) 0.11 m^2
Var: 1

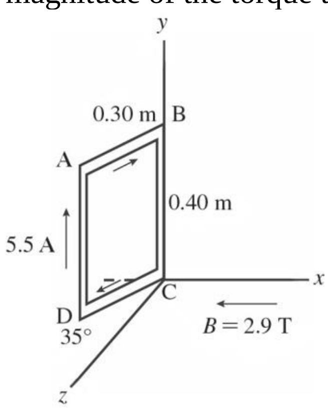
46) What is the magnetic moment of a rectangular loop having 120 turns that carries 6.0 A if its dimensions are 4.0 cm × 8.0 cm?
A) 0.23 A · m^2
B) 2.3 A · m^2
C) 23 A · m^2
D) 230 A · m^2
Answer: B
Var: 1

47) In the figure, the rectangular loop is pivoted about one side (of length 0.060 m), that coincides with the *y*-axis. The end (length 0.020 m) of the loop that lies in the *xz*-plane makes an angle of 37° with the *x*-axis as shown. The loop carries a current of I = 69 A in the direction shown. (In the side of the loop that is along the *y*-axis the current is in the +*y* direction.) If there is a uniform magnetic field of magnitude 9.7 T in the -*x* direction, find the magnitude of the torque that this magnetic field exerts on the loop.



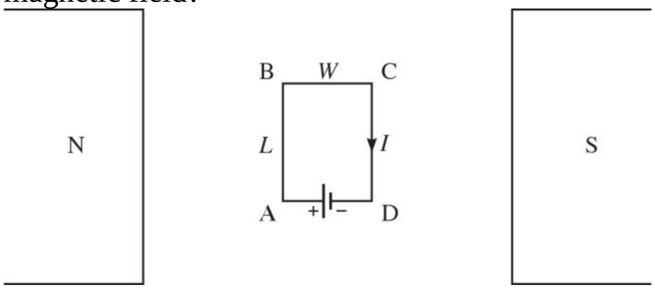
Answer: 0.64 N · m
Var: 1

48) A rigid rectangular loop, measuring 0.30 m by 0.40 m, carries a current of 5.5 A, as shown in the figure. A uniform external magnetic field of magnitude 2.9 T in the -*x* direction is present. Segment CD is in the *xz*-plane and forms a 35° angle with the *z*-axis, as shown. What is the magnitude of the torque that the magnetic field exerts on the loop?



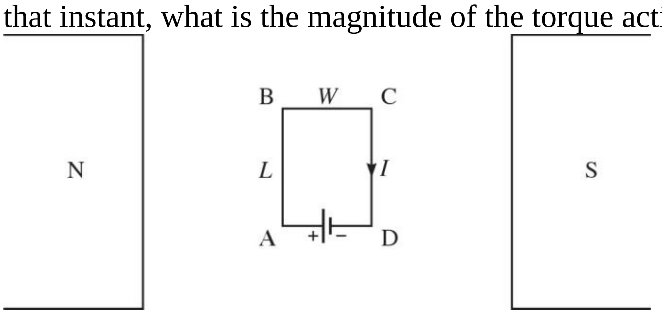
A) 1.1 N · m
B) 0.73 N · m
C) 1.3 N · m
D) 1.4 N · m
E) 1.6 N · m
Answer: A
Var: 1

49) A flat rectangular loop of wire is placed between the poles of a magnet, as shown in the figure. It has dimensions w = 0.60 m and L = 1.0 m, and carries a current I = 2.0 A in the direction shown. The magnetic field due to the magnet is uniform and of magnitude 0.80 T. The loop rotates in the magnetic field and at one point the plane of the loop makes a 30° angle with the field. At that instant, what is the magnitude of the torque acting on the wire due to the magnetic field?



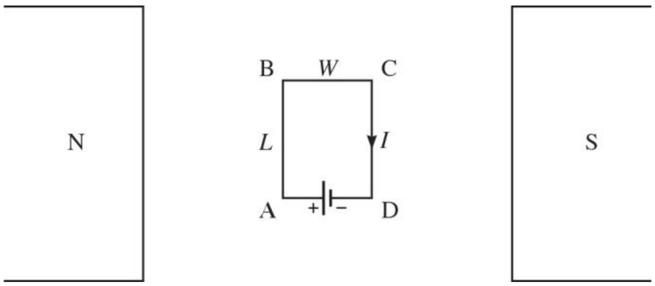
A) 0.30 N · m
B) 0.40 N · m
C) 0.48 N · m
D) 0.83 N · m
E) 0.96 N · m
Answer: C
Var: 1

50) A flat rectangular loop of wire is placed between the poles of a magnet, as shown in the figure. It has dimensions w = 0.60 m and L = 1.0 m, and carries a current I = 2.0 A in the direction shown. The magnetic field due to the magnet is uniform and of magnitude 0.80 T. The loop rotates in the magnetic field and at one point the plane of the loop is parallel to the field. At that instant, what is the magnitude of the torque acting on the wire due to the magnetic field?



A) 0.00 N · m
B) 0.40 N · m
C) 0.48 N · m
D) 0.83 N · m
E) 0.96 N · m
Answer: E
Var: 1

51) A flat rectangular loop of wire is placed between the poles of a magnet, as shown in the figure. It has dimensions w = 0.60 m and L = 1.0 m, and carries a current I = 2.0 A in the direction shown. The magnetic field due to the magnet is uniform and of magnitude 0.80 T. The loop rotates in the magnetic field and at one point the plane of the loop is perpendicular to the field. At that instant, what is the magnitude of the torque acting on the wire due to the magnetic field?



A) 0.00 N · m
B) 0.40 N · m
C) 0.48 N · m
D) 0.83 N · m
E) 0.96 N · m
Answer: A
Var: 1

52) A flat circular coil of wire having 200 turns and diameter 6.0 cm carries a current of 7.0 A. It is placed in a magnetic field of 0.60 T with the plane of the coil making an angle of 30° with the magnetic field. What is the magnitude of the magnetic torque on the coil?
A) 2.1 N · m
B) 1.2 N · m
C) 3.9 N · m
D) 5.4 N · m
E) 1.0 N · m
Answer: A
Var: 50+

53) A flat circular coil has 200 identical loops of very thin wire. Each loop has an area of 0.12 m^2 and carries 0.50 A of current. This coil is placed in a magnetic field of 0.050 T oriented at 30° to the plane of the loop. What is the magnitude of the magnetic torque on the coil?
A) 0.25 N · m
B) 0.52 N · m
C) 2.5 N · m
D) 5.2 N · m
Answer: B
Var: 1

54) A flat circular loop carrying a current of 2.0 A is in a magnetic field of 3.5 T. The loop has an area of 0.12 m^2 and its plane is oriented at a 37° angle to the field. What is the magnitude of the magnetic torque on the loop?
A) 0.10 N · m
B) 0.51 N · m
C) 0.67 N · m
D) 46 N · m
Answer: C
Var: 1

55) A flat circular loop of wire is in a uniform magnetic field of 0.30 T. The diameter of the loop is 1.0 m, and a 2.0-A current flows in it. What is the magnitude of the magnetic torque on the loop when the plane of the loop is parallel to the magnetic field?
A) 0.00 N · m
B) 0.41 N · m
C) 0.47 N · m
D) 0.52 N · m
Answer: C
Var: 1

56) A flat rectangular loop of wire carrying a 4.0-A current is placed in a uniform 0.60-T magnetic field. The magnitude of the torque acting on this loop when the plane of the loop makes a 30° angle with the field is measured to be 1.1 N · m. What is the area of this loop?
A) 0.20 m^2
B) 0.40 m^2
C) 0.26 m^2
D) 0.80 m^2
E) 0.53 m^2
Answer: E
Var: 1

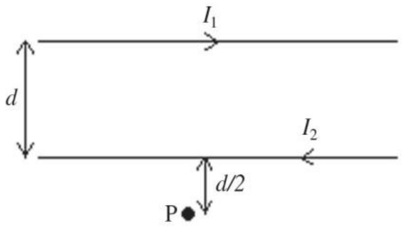
57) A flat circular loop of wire of radius 0.50 m that is carrying a 2.0-A current is in a uniform magnetic field of 0.30 T. What is the magnitude of the magnetic torque on the loop when the plane of its area is perpendicular to the magnetic field?
A) 0.00 N · m
B) 0.41 N · m
C) 0.47 N · m
D) 0.52 N · m
E) 0.58 N · m
Answer: A
Var: 1

58) A flat square coil of wire measures 9.5 cm on each side and contains 175 turns of very thin wire. It carries a current of 6.3 A in a uniform 0.84-T magnetic field. What angle less than 90° should the plane of this coil make with the magnetic field direction so that the magnitude of the magnetic torque on it is 6.5 N · m?
Answer: 39°
Var: 1

59) A flat circular wire loop of area 0.25 m^2 carries a current of 5.0 A. This coil lies on a horizontal table with the current flowing in the counterclockwise direction when viewed from above. At this point, the earth's magnetic field is 1.2×10^{-5} T directed 60° below the horizontal. What is the magnitude of the torque that the earth's magnetic field exerts on this loop?
A) 2.5×10^{-6} N · m
B) 5.0×10^{-6} N · m
C) 7.5×10^{-6} N · m
D) 1.0×10^{-5} N · m
Answer: C
Var: 1

60) At a point 10 m away from a long straight thin wire, the magnetic field due to the wire is 0.10 mT. What current flows through the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
Answer: 5.0 kA
Var: 1

61) In the figure, the two long straight wires are separated by a distance of $d = 0.40$ m. The currents are $I_1 = 1.0$ A to the right in the upper wire and $I_2 = 8.0$ A to the left in the lower wire. What are the magnitude and direction of the magnetic field at point P, that is a distance $d/2 = 0.20$ m below the lower wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)

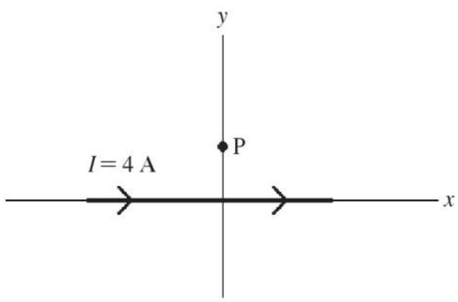


Answer: B = 7.7×10^{-6} T, out of the plane of the paper.
Var: 50+

62) A high power line carries a current of 1.0 kA. What is the strength of the magnetic field this line produces at the ground, 10 m away? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 4.7 μT
B) 6.4 μT
C) 20 μT
D) 56 μT
Answer: C
Var: 1

63) A long wire carrying a 2.0-A current is placed along the *y*-axis. What is the magnitude of the magnetic field at a point that is 0.60 m from the origin along the *x*-axis? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 0.67 μT
B) 1.3 μT
C) 0.12 μT
D) 6.7 T
E) 12 T
Answer: A
Var: 1

64) A long straight wire carrying a 4-A current is placed along the *x*-axis as shown in the figure. What is the magnitude of the magnetic field at a point P, located at y = 2 cm, due to the current in this wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)



A) 20 μT
B) 30 μT
C) 40 μT
D) 50 μT
E) 60 μT
Answer: C
Var: 1

65) At point P the magnetic field due to a long straight wire carrying a current of 2.0 A is 1.2 μT. How far is P from the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 11 cm
B) 22 cm
C) 33 cm
D) 44 cm
E) 55 cm
Answer: C
Var: 1

66) The magnetic field due to the current in a long, straight wire is 8.0 μT at a distance of 4.0 cm from the center of the wire. What is the current in the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 0.20 A
B) 0.40 A
C) 0.80 A
D) 3.2 A
E) 1.6 A
Answer: E
Var: 1

67) The magnetic field at point P due to a 2.0-A current flowing in a long, straight, thin wire is 8.0 μT. How far is point P from the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 2.0 cm
B) 2.5 cm
C) 4.0 cm
D) 5.0 cm
E) 10 cm
Answer: D
Var: 1

68) The magnitude of the magnetic field that a long and extremely thin current-carrying wire produces at a distance of 3.0 µm from the center of the wire is 2.0×10^{-3} T. How much current is flowing through the wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 30 mA
B) 190 mA
C) 19 mA
D) 380 mA
Answer: A
Var: 1

69) A very long thin wire produces a magnetic field of 0.0020×10^{-4} T at a distance of 1.0 mm from the wire. What is the magnitude of the current? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 1.0 mA
B) 2.0 mA
C) 4000 mA
D) 3100 mA
Answer: A
Var: 27

70) How much current must flow through a long straight wire for the magnetic field strength to be 1.0 mT at 1.0 cm from a wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 50 mA
B) 9.2 A
C) 16 A
D) 50 A
E) 5.0 mA
Answer: D
Var: 1

71) At what distance from a long straight wire carrying a current of 5.0 A is the magnitude of the magnetic field due to the wire equal to the strength of Earth's magnetic field of about 5.0×10^{-5} T? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 1.0 mm
B) 1.0 cm
C) 2.0 cm
D) 3.0 cm
E) 4.0 cm
Answer: C
Var: 1

72) Two long parallel wires that are 0.40 m apart carry currents of 10 A in opposite directions. What is the magnetic field strength in the plane of the wires at a point that is 20 cm from one wire and 60 cm from the other? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 3.3 μT
B) 6.7 μT
C) 33 μT
D) 67 μT
Answer: B
Var: 1

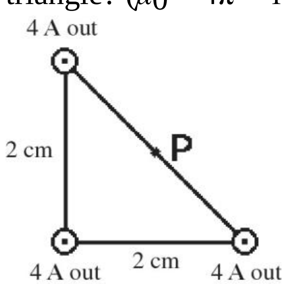
73) Two long parallel wires carry currents of 20 A and 5.0 A in opposite directions. The wires are separated by 0.20 m. What is the strength of the magnetic field midway between the two wires? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 1.0×10^{-5} T
B) 2.0×10^{-5} T
C) 3.0×10^{-5} T
D) 4.0×10^{-5} T
E) 5.0×10^{-5} T
Answer: E
Var: 1

74) Two long parallel wires carry currents of 20 A and 5.0 A in opposite directions. The wires are separated by 20 cm. At what point between the two wires do they produce the same strength magnetic field?
A) 4.0 cm from the 20 A wire
B) 8.0 cm from the 20 A wire
C) 12 cm from the 20 A wire
D) 16 cm from the 20 A wire
E) 18 cm from the 20 A wire
Answer: D
Var: 1

75) Three long parallel wires each carry 2.0-A currents in the same direction. The wires are oriented vertically, and they pass through three of the corners of a horizontal square of side 4.0 cm. What is the magnitude of the magnetic field at the fourth (unoccupied) corner of the square due to these wires? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 1.2 μT
B) 2.1 μT
C) 12 μT
D) 21 μT
E) 0 T

Answer: D
Var: 1

76) Three very long, straight, parallel wires each carry currents of 4.0 A, directed out of the page as shown in the figure. These wires pass through the vertices of a right isosceles triangle as shown. Assume that all the quantities shown in the figure are accurate to two significant figures. What is the magnitude of the magnetic field at point P at the midpoint of the hypotenuse of the triangle? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)



A) 4.4 μT
B) 18 μT
C) 57 μT
D) 130 μT
E) 1.8 μT
Answer: C
Var: 1

77) An ideal solenoid having 200 turns and carrying a current of 2.0 A is 25 cm long. What is the magnitude of the magnetic field at the center of the solenoid? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
Answer: 2.0 mT
Var: 1

78) In order to trap the starship Enterprise, the diabolical Klingons build a huge ideal solenoid 10 light-years long with a diameter of 2.0 million kilometers. Every kilometer of length of the solenoid contains 100 turns of wire. What magnetic field strength is produced near the center of the solenoid using a current of 2.00 kA? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
Answer: 251 μT
Var: 1

79) An ideal solenoid 20 cm long is wound with 5000 turns of very thin wire. What strength magnetic field is produced at the center of the solenoid when a current of 10 A flows through it? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 0.0063 T
B) 0.20 T
C) 3.2 T
D) 4.8 T
E) 0.31 T
Answer: E
Var: 1

80) An ideal solenoid having a coil density of 5000 turns per meter is 10 cm long and carries a current of 4.0 A. What is the strength of the magnetic field at its center?
A) 3.1 mT
B) 6.2 mT
C) 13 mT
D) 25 mT
Answer: D
Var: 1

81) An ideal solenoid of length 10 cm consists of a wire wrapped tightly around a wooden core. The magnetic field strength is 4.0 T inside the solenoid. If the solenoid is stretched to 25 cm by applying a force to it, what does the magnetic field become?
A) 1.6 T
B) 10.0 T
C) 20 T
D) 4.0 T
Answer: A
Var: 50+

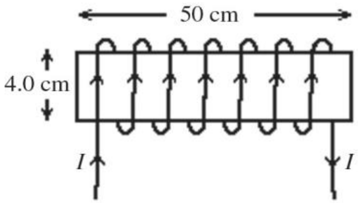
82) An ideal solenoid that is 34.0 cm long is carrying a current of 2.00 A. If the magnitude of the magnetic field generated at the center of the solenoid is 9.00 mT, how many turns of wire does this solenoid contain? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 860
B) 1590
C) 2320
D) 3180
E) 1220
Answer: E
Var: 1

83) How much current must pass through a 400-turn ideal solenoid that is 4.0 cm long to generate a 1.0-T magnetic field at the center? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 0.013 A
B) 13 A
C) 22 A
D) 40 A
E) 80 A
Answer: E
Var: 1

84) How many turns should a 10-cm long ideal solenoid have if it is to generate a 1.5-mT magnetic field when 1.0 A of current runs through it? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 12
B) 15
C) 120
D) 1200
E) 3200
Answer: C
Var: 1

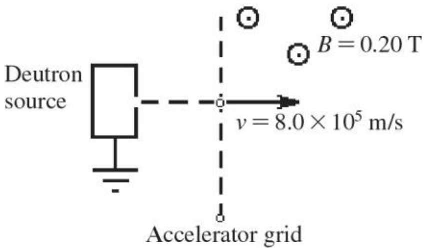
85) An ideal solenoid with 400 turns has a radius of 0.040 m and is 40 cm long. If this solenoid carries a current of 12 A, what is the magnitude of the magnetic field at the center of the solenoid? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 16 mT
B) 4.9 mT
C) 15 mT
D) 6.0 mT
E) 9.0 mT
Answer: C
Var: 5

86) An ideal solenoid is wound with 470 turns on a wooden form that is 4.0 cm in diameter and 50 cm long. The windings carry a current in the sense shown in the figure. The current produces a magnetic field of magnitude 4.1 mT, at the center of the solenoid. What is the current I in the solenoid windings? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)



A) 3.5 A
B) 3.0 A
C) 2.6 A
D) 4.3 A
E) 3.9 A
Answer: A
Var: 50+

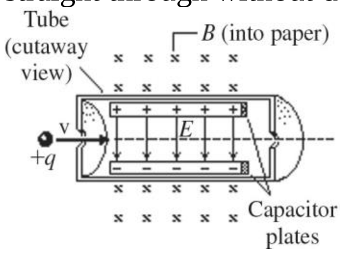
87) The figure shows a mass spectrograph that is operated with deuterons, which have a charge of $+e$ and a mass of 3.34×10^{-27} kg. The deuterons emerge with negligible velocity from the source, which is grounded. The speed of the deuterons as they pass through the accelerator grid is 8.0×10^5 m/s. A uniform magnetic field of magnitude B = 0.20 T, directed out of the plane, is present to the right of the grid and is perpendicular to the velocity of the deuterons. The deuterons make a circular orbit in the magnetic field. What is the radius of this orbit, and what is the initial direction of their deflection just as they enter the magnetic field? ($e = 1.60 \times 10^{-19}$ C)



A) 62 mm, upward
B) 71 mm, upward
C) 62 mm, downward
D) 69 mm, downward
E) 84 mm, downward
Answer: E
Var: 1

88) In a mass spectrometer, a single-charged particle has a speed of 1.00×10^6 m/s and enters a uniform magnetic field of 0.200 T at a right angle to the field. The radius of the resulting circular orbit is 20.75 cm. What is the mass of the particle? ($e = 1.60 \times 10^{-19}$ C)
A) 3.20×10^{-27} kg
B) 6.64×10^{-27} kg
C) 1.67×10^{-27} kg
D) 9.11×10^{-31} kg
Answer: B
Var: 1

89) The figure shows a velocity selector that can be used to measure the speed of a charged particle. A beam of particles of charge $+q$ is directed along the axis of the instrument. A parallel plate capacitor sets up an electric field E which is oriented perpendicular to a uniform magnetic field B. If the plates are separated by 3.0 mm and the value of the magnetic field is 0.30 T, what potential difference between the plates will allow particles of speed $v = 5.0 \times 10^5$ m/s to pass straight through without deflection?



A) 450 V
B) 1400 V
C) 2800 V
D) 140 V
E) 70 V
Answer: A
Var: 50+

90) A beam of electrons is accelerated through a potential difference of 1.0 kV before entering a velocity selector. If the magnetic field of the velocity selector has a magnitude of 0.010 T, what magnitude of the electric field is required if the electrons are not to be deflected as they pass through the velocity selector? (($e = 1.60 \times 10^{-19}$ C, $m_{\text{electron}} = 9.11 \times 10^{-31}$ kg)
A) 5.9×10^3 V/m
B) 1.9×10^5 V/m
C) 6.0×10^5 V/m
D) 7.2×10^6 V/m
E) 1.1×10^5 V/m
Answer: B
Var: 1

91) A singly-charged ion enters a velocity selector that has a 0.18-T magnetic field perpendicular to an electric field of 1.6 kV/m, with both fields perpendicular to the velocity of the ion. The same magnetic field is then used to deflect the ion into a circular path of radius 12.5 cm. (e = 1.60×10^{-19} C)
(a) What velocity was selected by the velocity selector?
(b) What was the mass of the ion?
Answer: (a) 8.9 km/s (b) 4.1×10^{-25} kg
Var: 6