Chapter 28: MAGNETIC FIELDS

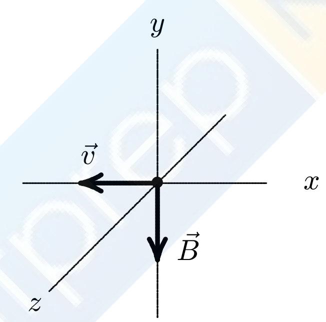
1. Units of a magnetic field might be:
   - A. C·m/s
   - B. C·s/m
   - C. C/kg
   - D. kg/C·s
   - E. N/C·m

   ans: D

2. In the formula $\vec{F} = q\vec{v} \times \vec{B}$:
   - A. $\vec{F}$ must be perpendicular to $\vec{v}$ but not necessarily to $\vec{B}$
   - B. $\vec{F}$ must be perpendicular to $\vec{B}$ but not necessarily to $\vec{v}$
   - C. $\vec{v}$ must be perpendicular to $\vec{B}$ but not necessarily to $\vec{F}$
   - D. all three vectors must be mutually perpendicular
   - E. $\vec{F}$ must be perpendicular to both $\vec{v}$ and $\vec{B}$

   ans: E

3. An electron moves in the negative x direction, through a uniform magnetic field in the negative y direction. The magnetic force on the electron is:



   - A. in the negative x direction
   - B. in the positive y direction
   - C. in the negative y direction
   - D. in the positive z direction
   - E. in the negative z direction

   ans: E

4. At any point the magnetic field lines are in the direction of:
   - A. the magnetic force on a moving positive charge
   - B. the magnetic force on a moving negative charge
   - C. the velocity of a moving positive charge
   - D. the velocity of a moving negative charge
   - E. none of the above

   ans: E

5. The magnetic force on a charged particle is in the direction of its velocity if:
   A. it is moving in the dir
   B. it is moving opposite to the direction of the field
   C. it is moving perpendicular to the field
   D. it is moving in some other direction
   E. never

   ans: E

6. A magnetic field exerts a force on a charged particle:
   A. always
   B. never
   C. if the particle is moving across the field lines
   D. if the particle is moving along the field lines
   E. if the particle is at rest

   ans: C

7. The direction of the magnetic field in a certain region of space is determined by firing a test charge into the region with its velocity in various directions in different trials. The field direction is:
   A. one of the directions of the velocity when the magnetic force is zero
   B. the direction of the velocity when the magnetic force is a maximum
   C. the direction of the magnetic force
   D. perpendicular to the velocity when the magnetic force is zero
   E. none of the above

   ans: A

8. An electron is moving north in a region where the magnetic field is south. The magnetic force exerted on the electron is:
   A. zero
   B. up
   C. down
   D. east
   E. west

   ans: A

9. A magnetic field CANNOT:
   A. exert a force on a charged particle
   B. change the velocity of a charged particle
   C. change the momentum of a charged particle
   D. change the kinetic energy of a charged particle
   E. change the trajectory of a charged particle

   ans: D

10. A proton (charge e), traveling perpendicular to a magnetic field, experiences the same force as an alpha particle (charge 2 ... atio of their speeds, $v_{\text{proton}}/v_{\text{alpha}}$, is:

A. 0.5
B. 1
C. 2
D. 4
E. 8

ans: C

11. A hydrogen atom that has lost its electron is moving east in a region where the magnetic field is directed from south to north. It will be deflected:

A. up
B. down
C. north
D. south
E. not at all

ans: A

12. A beam of electrons is sent horizontally down the axis of a tube to strike a fluorescent screen at the end of the tube. On the way, the electrons encounter a magnetic field directed vertically downward. The spot on the screen will therefore be deflected:

A. upward
B. downward
C. to the right as seen from the electron source
D. to the left as seen from the electron source
E. not at all

ans: C

13. An electron (charge $= -1.6 \times 10^{-19}$ C) is moving at 3×10^5 m/s in the positive x direction. A magnetic field of 0.8 T is in the positive z direction. The magnetic force on the electron is:

A. 0
B. 4×10^{-14} N, in the positive z direction
C. 4×10^{-14} N, in the negative z direction
D. 4×10^{-14} N, in the positive y direction
E. 4×10^{-14} N, in the negative y direction

ans: D

14. At one instant an electron (charge $= -1.6 \times 10^{-19}$ C) is moving in the xy plane, the components of its velocity being $v_x = 5 \times 10^5$ m/s and $v_y = 3 \times 10^5$ m/s. A magnetic field of 0.8 T is in the positive x direction. At that instant the magnitude of the magnetic force on the electron is:

A. 0
B. 2.6×10^{-14} N
C. 3.8×10^{-14} N
D. 6.4×10^{-14} N
E. 1.0×10^{-13} N

ans: C

15. At one instant an electron (charge $= -1.6 \times 10^{-19}$ C) is moving in the xy plane, the components of its velocity being $v_x =$ ... the positive x direction. At that instant the magnitude of the magnetic force on the electron is:

A. 0
B. 3.8×10^{-14} N
C. 5.1×10^{-14} N
D. 6.4×10^{-14} N
E. 7.5×10^{-14} N

ans: B

16. An electron travels due north through a vacuum in a region of uniform magnetic field $\vec{B}$ that is also directed due north. It will:

A. be unaffected by the field
B. speed up
C. slow down
D. follow a right-handed corkscrew path
E. follow a left-handed corkscrew path

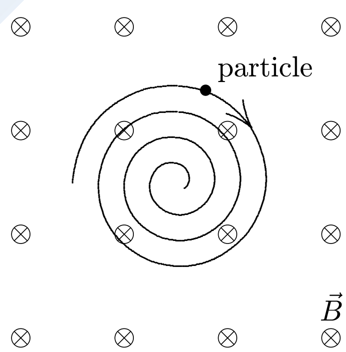
ans: A

17. At one instant an electron is moving in the positive x direction along the x axis in a region where there is a uniform magnetic field in the positive z direction. When viewed from a point on the positive z axis, it subsequent motion is:

A. straight ahead
B. counterclockwise around a circle in the xy plane
C. clockwise around a circle in the xy plane
D. in the positive z direction
E. in the negative z direction

ans: B

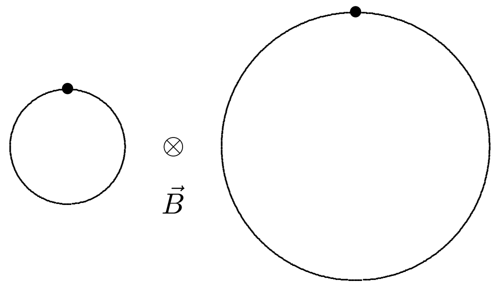
18. A uniform magnetic field is directed into the page. A charged particle, moving in the plane of the page, follows a clockwise spiral of decreasing radius as shown. A reasonable explanation is:



A. the charge is positive and slowing down
B. the charge is negative and slowing down
C. the charge is positive and speeding up
D. the charge is negative and speeding up
E. none of the above

ans: B

19. An electron and a proton each travel with equal speeds around circular orbits in the same uniform magnetic field, as on the diagram. Because the electron is less massive than the proton and because the electron is negatively charged and the proton is positively charged:



A. the electron travels clockwise around the smaller circle and the proton travels counterclockwise around the larger circle
B. the electron travels counterclockwise around the smaller circle and the proton travels clockwise around the larger circle
C. the electron travels clockwise around the larger circle and the proton travels counterclockwise around the smaller circle
D. the electron travels counterclockwise around the larger circle and the proton travels clockwise around the smaller circle
E. the electron travels counterclockwise around the smaller circle and the proton travels counterclockwise around the larger circle

ans: A

20. An electron is launched with velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$. The angle θ between $\vec{v}$ and $\vec{B}$ is between 0 and 90°. As a result, the electron follows a helix, its velocity vector $\vec{v}$ returning to its initial value in a time interval of:

A. $2\pi m/eB$
B. $2\pi mv/e$B
C. $2\pi mv\sin\theta/eB$
D. $2\pi mv\cos\theta/eB$
E. none of these

ans: A

21. An electron and a proton are both initially moving with the same speed and in the same direction at 90° to the same uniform magnetic field. They experience magnetic forces, which are initially:

A. identical
B. equal in magnitude but opposite in direction
C. in the same direction and differing in magnitude by a factor of 1840
D. in opposite directions and differing in magnitude by a factor of 1840
E. equal in magnitude but perpendicular to each other.

ans: B

22. An electron enters a region of uniform perpendicular $\vec{E}$ and $\vec{B}$ fields. It is observed that the velocity $\vec{v}$ of the electron i

A. $\vec{v}$ is parallel to $\vec{E}$ and has magnitude E/B
B. $\vec{v}$ is parallel to $\vec{B}$
C. $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ and has magnitude B/E
D. $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ and has magnitude E/B
E. the given situation is impossible

ans: D

23. A charged particle is projected into a region of uniform, parallel, $\vec{E}$ and $\vec{B}$ fields. The force on the particle is:

A. zero
B. at some angle $< 90°$ with the field lines
C. along the field lines
D. perpendicular to the field lines
E. unknown (need to know the sign of the charge)

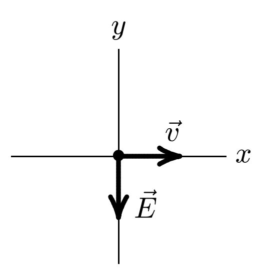
ans: B

24. A uniform magnetic field is in the positive z direction. A positively charged particle is moving in the positive x direction through the field. The net force on the particle can be made zero by applying an electric field in what direction?

A. Positive y
B. Negative y
C. Positive x
D. Negative x
E. Positive z

ans: B

25. An electron is traveling in the positive x direction. A uniform electric field $\vec{E}$ is in the negative y direction. If a uniform magnetic field with the appropriate magnitude and direction also exists in the region, the total force on the electron will be zero. The appropriate direction for the magnetic field is:



A. the positive y direction
B. the negative y direction
C. into the page
D. out of the page
E. the negative x direction

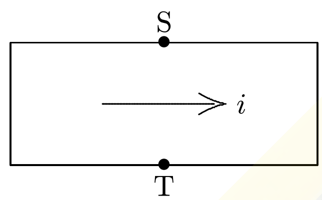
ans: C

26. An ion with a charge of $+3.2\times10^{-19}$ C is in a region where a uniform electric field of 5×10^4 V/m is perpendicular to a unifc eed must be:

A. 0
B. 1.6×10^4 m/s
C. 4.0×10^4 m/s
D. 6.3×10^4 m/s
E. any value but 0

ans: D

27. The current is from left to right in the conductor shown. The magnetic field is into the page and point S is at a higher potential than point T. The charge carriers are:



A. positive
B. negative
C. neutral
D. absent
E. moving near the speed of light

ans: A

28. Electrons (mass m, charge $-e$) are accelerated from rest through a potential difference V and are then deflected by a magnetic field $\vec{B}$ that is perpendicular to their velocity. The radius of the resulting electron trajectory is:

A. $(\sqrt{2eV/m})/B$
B. $B\sqrt{2eV}/m$
C. $(\sqrt{2mV/e})/B$
D. $B\sqrt{2mV}/e$
E. none of these

ans: C

29. In a certain mass spectrometer, an ion beam passes through a velocity filter consisting of mutually perpendicular fields $\vec{E}$ and $\vec{B}$. The beam then enters a region of another magnetic field $\vec{B}'$ perpendicular to the beam. The radius of curvature of the resulting ion beam is proportional to:

A. EB'/B
B. EB/B'
C. BB'/E
D. B/EB'
E. E/BB'

ans: E

30. A cyclotron operates with a given magnetic field and at a given frequency. If R denotes the radius of the final orbit, th

A. $1/R$
B. R
C. R^2
D. R^3
E. R^4

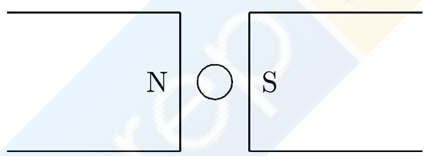
ans: C

31. J. J. Thomson's experiment, involving the motion of an electron beam in mutually perpendicular $\vec{E}$ and $\vec{B}$ fields, gave the value of:

A. mass of an electron
B. charge of an electron
C. Earth's magnetic field
D. charge/mass ratio for electrons
E. Avogadro's number

ans: D

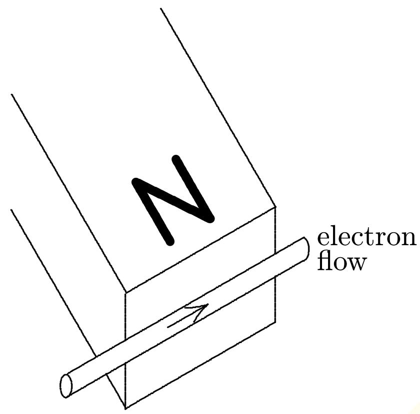
32. The diagram shows a straight wire carrying a flow of electrons into the page. The wire is between the poles of a permanent magnet. The direction of the magnetic force exerted on the wire is:



A. $\uparrow$
B. $\downarrow$
C. $\leftarrow$
D. $\rightarrow$
E. into the page

ans: A

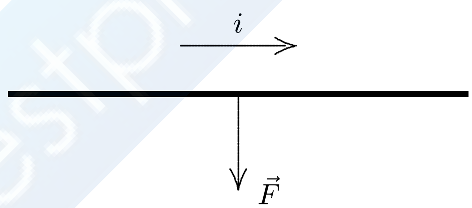
33. The figure shows the motion of electrons in a wire that is near the N pole of a magnet. The wire will be pushed:



A. toward the magnet
B. away from the magnet
C. downwards
D. upwards
E. along its length

ans: D

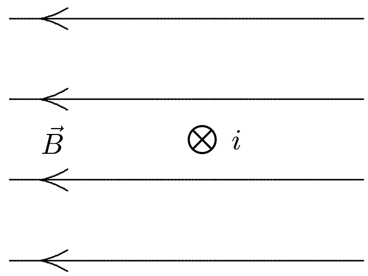
34. The diagram shows a straight wire carrying current i in a uniform magnetic field. The magnetic force on the wire is indicated by an arrow but the magnetic field is not shown. Of the following possibilities, the direction of the magnetic field is:



A. opposite the direction of the current
B. opposite the direction of $\vec{F}$
C. in the direction of $\vec{F}$
D. into the page
E. out of the page

ans: E

35. The figure shows a uniform magnetic field $\vec{B}$ directed to the left and a wire carrying a current into the page. The magnet



A. toward the top of the page
B. toward the bottom of the page
C. toward the left
D. toward the right
E. zero

ans: A

36. A loop of wire carrying a current of 2.0 A is in the shape of a right triangle with two equal sides, each 15 cm long. A 0.7 T uniform magnetic field is parallel to the hypotenuse. The resultant magnetic force on the two equal sides has a magnitude of:

A. 0
B. 0.21 N
C. 0.30 N
D. 0.41 N
E. 0.51 N

ans: A

37. A loop of wire carrying a current of 2.0 A is in the shape of a right triangle with two equal sides, each 15 cm long. A 0.7 T uniform magnetic field is in the plane of the triangle and is perpendicular to the hypotenuse. The magnetic force on either of the two equal sides has a magnitude of:

A. zero
B. 0.105 N
C. 0.15 N
D. 0.21 N
E. 0.25 N

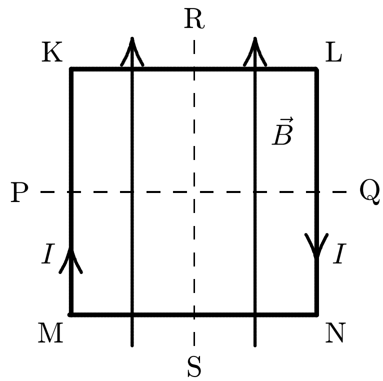
ans: C

38. A current is clockwise around the outside edge of this page and a uniform magnetic field is directed parallel to the page, from left to right. If the magnetic force is the only force acting on the page, the page will turn so the right edge:

A. moves toward you
B. moves away from you
C. moves to your right
D. moves to your left
E. does not move

ans: A

39. A square loop of wire lies in the plane of the page and carries a current I as shown. There is a uniform magnetic field $\vec{B}$] e:



A. about PQ with KL coming out of the page
B. about PQ with KL going into the page
C. about RS with MK coming out of the page
D. about RS with MK going into the page
E. about an axis perpendicular to the page.

ans: A

40. The units of magnetic dipole moment are:

A. ampere
B. ampere·meter
C. ampere·meter^2
D. ampere/meter
E. ampere/meter^2

ans: C

41. You are facing a loop of wire which carries a clockwise current of 3.0 A and which surrounds an area of $5.8 \times 10^{-2}\,\text{m}^2$. The magnetic dipole moment of the loop is:

A. $3.0\,\text{A}\cdot\text{m}^2$, away from you
B. $3.0\,\text{A}\cdot\text{m}^2$, toward you
C. $0.17\,\text{A}\cdot\text{m}^2$, away from you
D. $0.17\,\text{A}\cdot\text{m}^2$, toward you
E. $0.17\,\text{A}\cdot\text{m}^2$, left to right

ans: C

42. The magnetic torque exerted on a flat current-carrying loop of wire by a uniform magnetic field $\vec{B}$ is:

A. maximum when the plane of the loop is perpendicular to $\vec{B}$
B. maximum when the plane of the loop is parallel to $\vec{B}$
C. dependent on the shape of the loop for a fixed loop area
D. independent of the orientation of the loop
E. such as to rotate the loop around the magnetic field lines

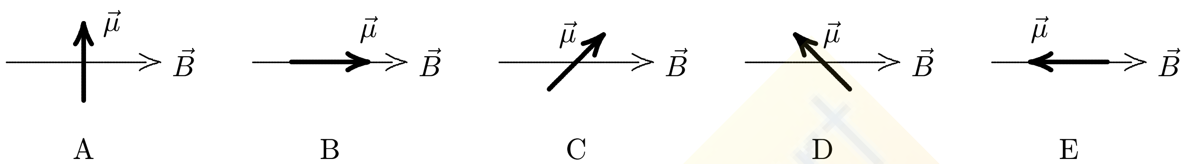
ans: B

43. A circular loop of wire with a radius of 20 cm lies in the xy plane and carries a current of 2 A, counterclockwise when vie[illegible]ent is:

A. $0.25\,\mathrm{A\cdot m^2}$, in the positive z direction
B. $0.25\,\mathrm{A\cdot m^2}$, in the negative z direction
C. $2.5\,\mathrm{A\cdot m^2}$, in the positive z direction
D. $2.5\,\mathrm{A\cdot m^2}$, in the negative z direction
E. $0.25\,\mathrm{A\cdot m^2}$, in the xy plane

ans: A

44. The diagrams show five possible orientations of a magnetic dipole $\vec{\mu}$ in a uniform magnetic field $\vec{B}$. For which of these does the magnetic torque on the dipole have the greatest magnitude?



ans: A

45. The magnetic dipole moment of a current-carrying loop of wire is in the positive z direction. If a uniform magnetic field is in the positive x direction the magnetic torque on the loop is:

A. 0
B. in the positive y direction
C. in the negative y direction
D. in the positive z direction
E. in the negative z direction

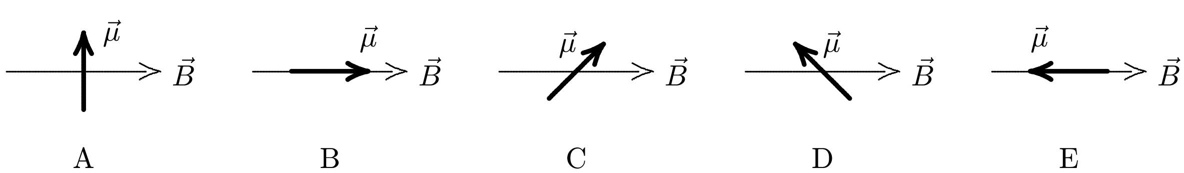
ans: B

46. For a loop of current-carrying wire in a uniform magnetic field the potential energy is a minimum if the magnetic dipole moment of the loop is:

A. in the same direction as the field
B. in the direction opposite to that of the field
C. perpendicular to the field
D. at an angle of 45° to the field
E. none of the above

ans: A

47. The diagrams show five possible orientations of a magnetic dipole $\vec{\mu}$ in a uniform magnetic field $\vec{B}$. For which of these is the potential energy the greatest?



ans: E

48. A loop of current-carrying wire has a magnetic dipole moment of $5 \times 10^{-4}\ \mathrm{A \cdot m^2}$. The moment initially is aligned with a [illegible] t is perpendicular to the field and hold it in that orientation, you must do work of:

A. 0
B. 2.5×10^{-4} J
C. -2.5×10^{-4} J
D. 1.0×10^{-3} J
E. -1.0×10^{-3} J

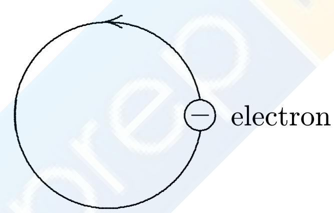
ans: B

Chapter 29: MAGNETIC FIELDS DUE TO CURRENTS

1. Suitable units for μ_0 are:
   A. tesla
   B. newton/ampere^2
   C. weber/meter
   D. kilogram·ampere/meter
   E. tesla·meter/ampere
   ans: E

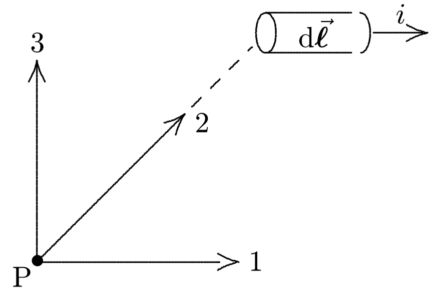
2. A "coulomb" is:
   A. one ampere per second
   B. the quantity of charge that will exert a force of 1 N on a similar charge at a distance of 1 m
   C. the amount of current in each of two long parallel wires, separated by 1 m, that produces a force of 2×10^{-7} N/m
   D. the amount of charge that flows past a point in one second when the current is 1 A
   E. an abbreviation for a certain combination of kilogram, meter and second
   ans: D

3. Electrons are going around a circle in a counterclockwise direction as shown. At the center of the circle they produce a magnetic field that is:



   A. into the page
   B. out of the page
   C. to the left
   D. to the right
   E. zero
   ans: A

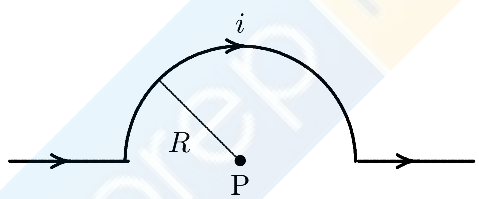
4. In the figure, the current element $i\,d\vec{\ell}$, the point P, and the three vectors (1, 2, 3) are all in the plane of the page. The dir



A. in the direction marked "1"
B. in the direction marked "2"
C. in the direction marked "3"
D. out of the page
E. into the page

ans: E

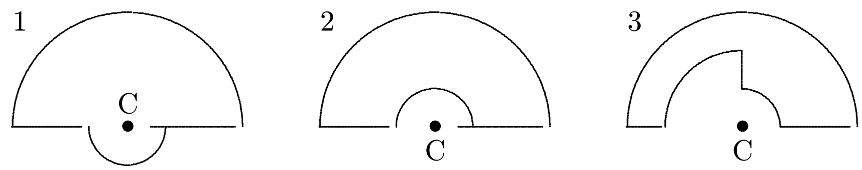
5. The magnitude of the magnetic field at point P, at the center of the semicircle shown, is given by:



A. $2\mu_0 i/R$
B. $\mu_0 i/R$
C. $\mu_0 i/4\pi R$
D. $\mu_0 i/2R$
E. $\mu_0 i/4R$

ans: E

6. The diagrams show three circuits consisting of concentric circular arcs (either half or quarter circles of radii r, $2r$, and [illegible] ank them according to the magnitudes of the magnetic fields they produce at C, least to greatest.



A. 1, 2, 3
B. 3, 2, 1
C. 1, 3, 2
D. 2, 3, 1
E. 2, 1, 3

ans: B

7. Lines of the magnetic field produced by a long straight wire carrying a current are:

A. in the direction of the current
B. opposite to the direction of the current
C. radially outward from the wire
D. radially inward toward the wire
E. circles that are concentric with the wire

ans: E

8. In an overhead straight wire, the current is north. The magnetic field due to this current, at our point of observation, is:

A. east
B. up
C. north
D. down
E. west

ans: E

9. A wire carrying a large current i from east to west is placed over an ordinary magnetic compass. The end of the compass needle marked "N" will point:

A. north
B. south
C. east
D. west
E. the compass will act as an electric motor, hence the needle will keep rotating

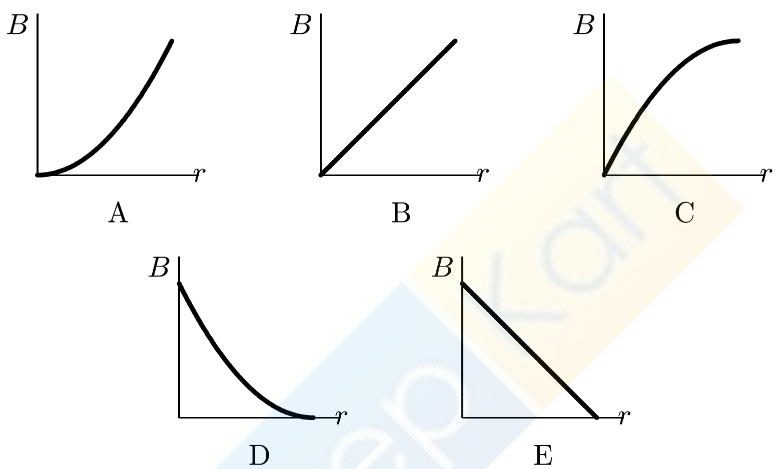
ans: B

10. The magnetic field outside a long straight current-carrying wire depends on the distance R from the wire axis accordi

A. R
B. $1/R$
C. $1/R^2$
D. $1/R^3$
E. $1/R^{3/2}$

ans: B

11. Which graph correctly gives the magnitude of the magnetic field outside an infinitely long straight current-carrying wire as a function of the distance r from the wire?



ans: D

12. The magnetic field a distance 2 cm from a long straight current-carrying wire is 2.0×10^{-5} T. The current in the wire is:

A. 0.16 A
B. 1.0 A
C. 2.0 A
D. 4.0 A
E. 25 A

ans: C

13. Two long parallel straight wires carry equal currents in opposite directions. At a point midway between the wires, the magnetic field they produce is:

A. zero
B. non-zero and along a line connecting the wires
C. non-zero and parallel to the wires
D. non-zero and perpendicular to the plane of the two wires
E. none of the above

ans: D

14. Two long straight wires are parallel and carry current in the same direction. The currents are 8.0 and 12 A and the wire [illegible] oint midway between the wires is.

A. 0
B. 4.0×10^{-4}
C. 8.0×10^{-4}
D. 12×10^{-4}
E. 20×10^{-4}

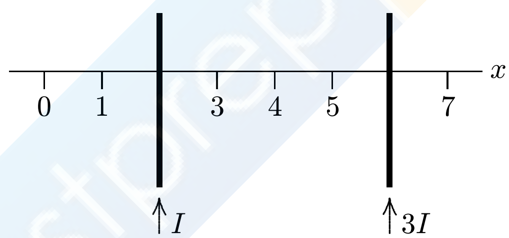
ans: B

15. Two long straight wires are parallel and carry current in opposite directions. The currents are 8.0 and 12 A and the wires are separated by 0.40 cm. The magnetic field in tesla at a point midway between the wires is:

A. 0
B. 4.0×10^{-4}
C. 8.0×10^{-4}
D. 12×10^{-4}
E. 20×10^{-4}

ans: E

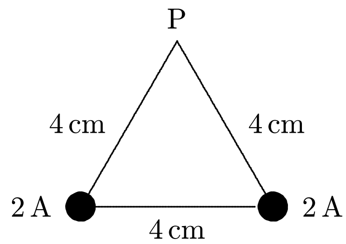
16. Two long straight current-carrying parallel wires cross the x axis and carry currents I and $3I$ in the same direction, as shown. At what value of x is the net magnetic field zero?



A. 0
B. 1
C. 3
D. 5
E. 7

ans: C

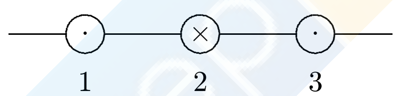
17. Two long straight wires pierce the plane of the paper at vertices of an equilateral triangle as shown below. They each c [illegible] rtex (P) has magnitude (in T):



A. 1.0×10^{-5}
B. 1.7×10^{-5}
C. 2.0×10^{-5}
D. 5.0×10^{-6}
E. 8.7×10^{-6}

ans: B

18. The diagram shows three equally spaced wires that are perpendicular to the page. The currents are all equal, two being out of the page and one being into the page. Rank the wires according to the magnitudes of the magnetic forces on them, from least to greatest.



A. 1, 2, 3
B. 2, 1 and 3 tie
C. 2 and 3 tie, then 1
D. 1 and 3 tie, then 2
E. 3, 2, 1

ans: B

19. Two parallel wires carrying equal currents of 10 A attract each other with a force of 1 mN. If both currents are doubled, the force of attraction will be:

A. 1 mN
B. 4 mN
C. 0.5 mN
D. 0.25 mN
E. 2 mN

ans: B

20. Two parallel long wires carry the same current and repel each other with a force F per unit length. If both these curre [illegible] unit length becomes:

A. $2F/9$
B. $4F/9$
C. $2F/3$
D. $4F/3$
E. $6F$

ans: D

21. Two parallel wires, 4 cm apart, carry currents of 2 A and 4 A respectively, in the same direction. The force per unit length in N/m of one wire on the other is:

A. 1×10^{-3}, repulsive
B. 1×10^{-3}, attractive
C. 4×10^{-5}, repulsive
D. 4×10^{-5}, attractive
E. none of these

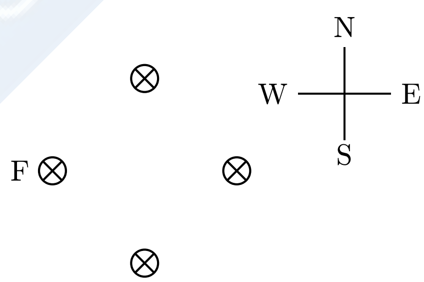
ans: D

22. Two parallel wires, 4 cm apart, carry currents of 2 A and 4 A respectively, in opposite directions. The force per unit length in N/m of one wire on the other is:

A. 1×10^{-3}, repulsive
B. 1×10^{-3}, attractive
C. 4×10^{-5}, repulsive
D. 4×10^{-5}, attractive
E. none of these

ans: C

23. Four long straight wires carry equal currents into the page as shown. The magnetic force exerted on wire F is:



A. north
B. east
C. south
D. west
E. zero

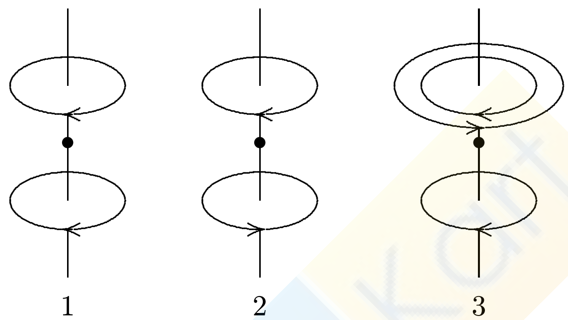
ans: B

24. A constant current is sent through a helical coil. The coil:

A. tends to get shorter
B. tends to get longer
C. tends to rotate about its axis
D. produces zero magnetic field at its center
E. none of the above

ans: A

25. The diagram shows three arrangements of circular loops, centered on vertical axes and carrying identical currents in the directions indicated. Rank the arrangements according to the magnitudes of the magnetic fields at the midpoints between the loops on the central axes.



A. 1, 2, 3
B. 2, 1, 3
C. 2, 3, 1
D. 3, 2, 1
E. 3, 1, 2

ans: C

26. Helmholtz coils are commonly used in the laboratory because the magnetic field between them:

A. can be varied more easily than the fields of other current arrangements
B. is especially strong
C. nearly cancels Earth's magnetic field
D. is parallel to the plane of the coils
E. is nearly uniform

ans: E

27. If the radius of a pair of Helmholtz coils is R then the distance between the coils is:

A. $R/4$
B. $R/2$
C. R
D. $2R$
E. $4R$

ans: C

28. If R is the distance from a magnetic dipole, then the magnetic field it produces is proportional to:

A. R
B. $1/R$
C. R^2
D. $1/R^2$
E. $1/R^3$

ans: E

29. A square loop of current-carrying wire with edge length a is in the xy plane, the origin being at its center. Along which of the following lines can a charge move without experiencing a magnetic force?

A. $x = 0$, $y = a/2$
B. $x = a/2$, $y = a/2$
C. $x = a/2$, $y = 0$
D. $x = 0$, $y = 0$
E. $x = 0$, $z = 0$

ans: D

30. In Ampere's law, $\oint \vec{B} \cdot d\vec{s} = \mu_0 i$, the integration must be over any:

A. surface
B. closed surface
C. path
D. closed path
E. closed path that surrounds all the current producing $\vec{B}$

ans: D

31. In Ampere's law, $\oint \vec{B} \cdot d\vec{s} = \mu_0 i$, the symbol $d\vec{s}$ is:

A. an infinitesimal piece of the wire that carries current i
B. in the direction of $\vec{B}$
C. perpendicular to $\vec{B}$
D. a vector whose magnitude is the length of the wire that carries current i
E. none of the above

ans: E

32. In Ampere's law, $\oint \vec{B} \cdot d\vec{s} = \mu_0 i$, the direction of the integration around the path:

A. must be clockwise
B. must be counterclockwise
C. must be such as to follow the magnetic field lines
D. must be along the wire in the direction of the current
E. none of the above

ans: E

33. A long straight wire carrying a 3.0 A current enters a room through a window 1.5 m high and 1.0 m wide. The path inte

A. 0.20
B. 2.5×10^{-7}
C. 3.0×10^{-7}
D. 3.8×10^{-6}
E. none of these

ans: D

34. Two long straight wires enter a room through a door. One carries a current of 3.0 A into the room while the other carries a current of 5.0 A out. The magnitude of the path integral $\oint \vec{B} \cdot d\vec{s}$ around the door frame is:

A. $2.5 \times 10^{-6}\,\mathrm{T \cdot m}$
B. $3.8 \times 10^{-6}\,\mathrm{T \cdot m}$
C. $6.3 \times 10^{-6}\,\mathrm{T \cdot m}$
D. $1.0 \times 10^{-5}\,\mathrm{T \cdot m}$
E. none of these

ans: A

35. If the magnetic field $\vec{B}$ is uniform over the area bounded by a circle with radius R, the net current through the circle is:

A. 0
B. $2\pi RB/\mu_0$
C. $\pi R^2 B/\mu_0$
D. $RB/2\mu_0$
E. $2RB/\mu_0$

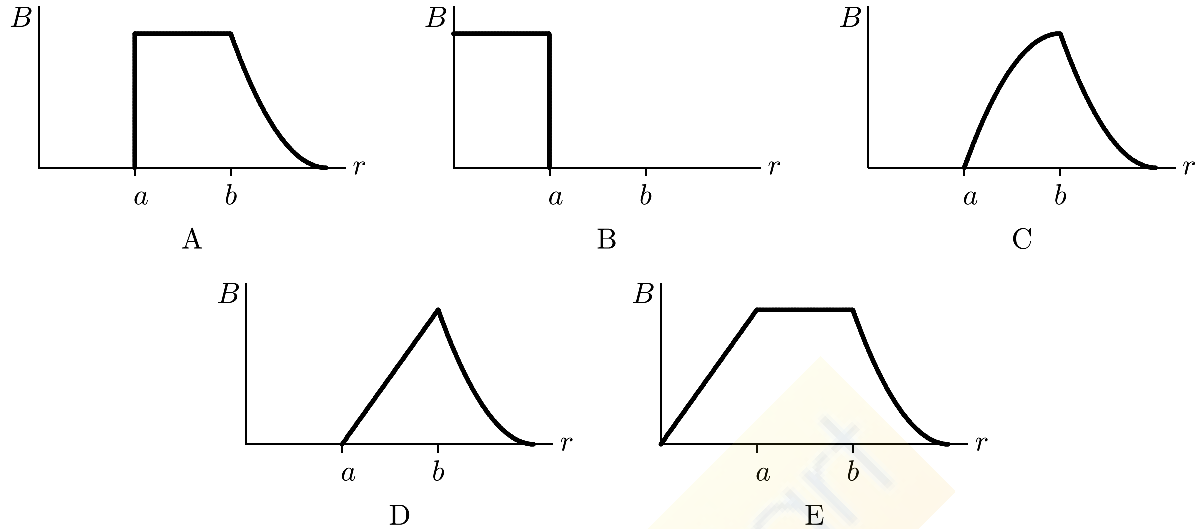
ans: A

36. The magnetic field at any point is given by $\vec{B} = A\vec{r} \times \hat{\mathrm{k}}$, where $\vec{r}$ is the position vector of the point and A is a constant. The net current through a circle of radius R, in the xy plane and centered at the origin is given by:

A. $\pi AR^2/\mu_0$
B. $2\pi AR/\mu_0$
C. $4\pi AR^3/3\mu_0$
D. $2\pi AR^2/\mu_0$
E. $\pi AR^2/2\mu_0$

ans: D

37. A hollow cylindrical conductor (inner radius = a, outer radius = b) carries a current i uniformly spread over its sectio[illegible] nce r from the center of the cy[illegible]



ans: C

38. A long straight cylindrical shell carries current i parallel to its axis and uniformly distributed over its cross section. The magnitude of the magnetic field is greatest:

A. at the inner surface of the shell
B. at the outer surface of the shell
C. inside the shell near the middle
D. in hollow region near the inner surface of the shell
E. near the center of the hollow region

ans: B

39. A long straight cylindrical shell has inner radius R_i and outer radius R_o. It carries current i, uniformly distributed over its cross section. A wire is parallel to the cylinder axis, in the hollow region ($r < R_i$). The magnetic field is zero everywhere outside the shell ($r > R_o$). We conclude that the wire:

A. is on the cylinder axis and carries current i in the same direction as the current in the shell
B. may be anywhere in the hollow region but must be carrying current i in the direction opposite to that of the current in the shell
C. may be anywhere in the hollow region but must be carrying current i in the same direction as the current in the shell
D. is on the cylinder axis and carries current i in the direction opposite to that of the current in the shell
E. does not carry any current

ans: D

40. A long straight cylindrical shell has inner radius R_i and outer radius R_o. It carries a current i, uniformly distributed over [illegible] low region ($r < R_i$). The magnetic field is zero everywhere in the hollow region. We conclude that the wire:

A. is on the cylinder axis and carries current i in the same direction as the current in the shell
B. may be anywhere in the hollow region but must be carrying current i in the direction opposite to that of the current in the shell
C. may be anywhere in the hollow region but must be carrying current i in the same direction as the current in the shell
D. is on the cylinder axis and carries current i in the direction opposite to that of the current in the shell
E. does not carry any current

ans: E

41. The magnetic field B inside a long ideal solenoid is independent of:

A. the current
B. the core material
C. the spacing of the windings
D. the cross-sectional area of the solenoid
E. the direction of the current

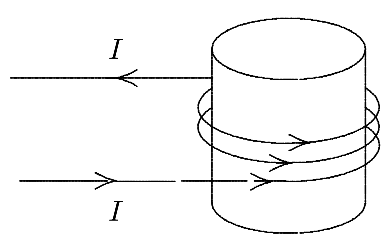
ans: D

42. Two long ideal solenoids (with radii 20 mm and 30 mm, respectively) have the same number of turns of wire per unit length. The smaller solenoid is mounted inside the larger, along a common axis. The magnetic field within the inner solenoid is zero. The current in the inner solenoid must be:

A. two-thirds the current in the outer solenoid
B. one-third the current in the outer solenoid
C. twice the current in the outer solenoid
D. half the current in the outer solenoid
E. the same as the current in the outer solenoid

ans: E

43. Magnetic field lines inside the solenoid shown are:



A. clockwise circles as one looks down the axis from the top of the page
B. counterclockwise circles as one looks down the axis from the top of the page
C. toward the top of the page
D. toward the bottom of the page
E. in no direction since $B = 0$

ans: C

44. Solenoid 2 has twice the radius and six times the number of turns per unit length as solenoid 1. The ratio of the magnet

A. 2
B. 4
C. 6
D. 1
E. 1/3

ans: C

45. A solenoid is 3.0 cm long and has a radius of 0.50 cm. It is wrapped with 500 turns of wire carrying a current of 2.0 A. The magnetic field at the center of the solenoid is:

A. 9.9×10^{-8} T
B. 1.3×10^{-3} T
C. 4.2×10^{-2} T
D. 16 T
E. 20 T

ans: C

46. A toroid with a square cross section carries current i. The magnetic field has its largest magnitude:

A. at the center of the hole
B. just inside the toroid at its inner surface
C. just inside the toroid at its outer surface
D. at any point inside (the field is uniform)
E. none of the above

ans: B

47. A toroid has a square cross section with the length of an edge equal to the radius of the inner surface. The ratio of the magnitude of the magnetic field at the inner surface to the magnitude of the field at the outer surface is:

A. 1/4
B. 1/2
C. 1
D. 2
E. 4

ans: D