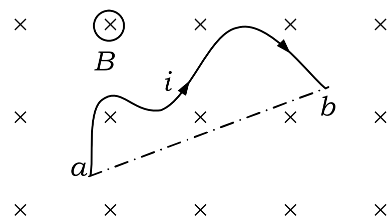
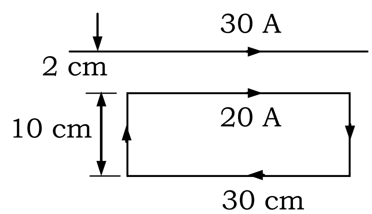
MAGNETIC EFFECT OF CURRENT

1. Figure shows a wire of arbitrary shape carrying a current i between points a and b. The length of the wire is L and the distance between points a and b is d. The wire lies in a plane at right angles to a uniform magnetic field B. Then the force on the wire is



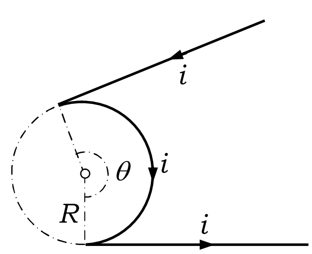
A) iLB
B) idB
C) $i(L-d)B$
D) none of the above

2. The resultant force due to a current carrying long wire on a current loop $ABCD$ in newtons will be (direction of current is clockwise) BC = 30 cm



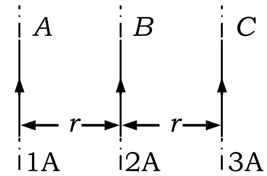
A) 1.8×10^{-3}
B) 0.36×10^{-3}
C) 1.5×10^{-3}
D) zero

3. A wire carrying current i has the configuration shown in figure. Two semi-infinite straight sections both tangent to the same circle are connected by a circular arc of central angle θ, along the circumference of the circle, with all sections lying in the same plane. If the magnetic field at the center of the circle is zero, then θ, is of the order



A) 1 rad
B) 2 rad
C) $2/\pi$ rad
D) $\pi/2$ rad

4. In the fig. A, B and C are current carrying wires. The direction of resultant force on the wire B will be



A) in the plane of paper and towards the right
B) perpendicular to plane, out of paper
C) in the plane of paper and towards the left
D) along the direction of current

5. A length (L) of wire carrying a current i is bent into a circular loop of one turn. The magnitude of magnetic field at the centre of this loop is B_1. Another identical current carrying wire of same length L is bent more sharply to give a double loop of half the first loop radius. The magnetic field at the center of second loop is B_2 then the ratio of B_2/B_1 is

A) 1 B) 4
C) 0.5 D) 0.25

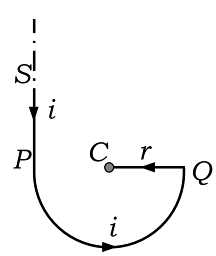
6. When an electron moves opposite to the direction of current carrying wire, a force F acts on it. If it moves perpendicular to the wire at same distance in same plane, then the force will be,

A) F B) $2F$
C) $F/2$ D) zero

7. Two infinitely long wires are aligned along x–axis and y–axis of coordinate system and each carries a current i. The magnitude of the magnetic field at a point (2, 3) metres is

A) zero B) $5\mu_o i/12\pi$
C) $\mu_o i/2\sqrt{13}\,\pi$ D) $\mu_o i/12\pi$

8. The magnetic field at the centre C of the arrangement shown in figure is



A) $\frac{\mu_o i}{4\pi r}(1+\pi)$ out of page B) $\frac{\mu_o i}{4\pi r}(\pi-1)$ out of page
C) $\frac{\mu_o i}{4r}(1+\pi)$ out of page D) cannot be determined

9. An electron moves in circular orbit of radius r cm with a speed v ms^{-1} in presence of magnetic field B. The energy gained by the electron in going once round the circular orbit is

A) mv^2/r B) $2\pi rmv$

C) zero D) none of the above

10. A ring of radius R and width b carries a surface charge of uniform density σ. It spins on its axis with frequency f. The magnetic field at the center is

A) $\mu_o \pi b\sigma / 2R$ B) $\mu_o \pi b\sigma f$

C) $\mu_o \pi b\sigma f / 2R$ D) none of the above

11. A plastic disc of radius R has a charge q uniformly distributed over its surface. If the disc is rotated at an angular frequency ω about its axis, the induction at the center of the disc is

A) $\mu_o q / 2\pi R$ B) $\mu_o \omega q / 2\pi R$

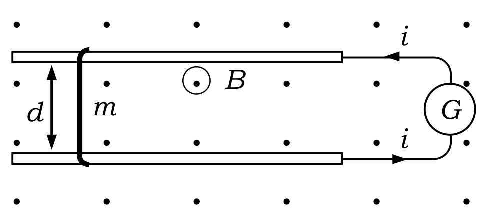
C) $\mu_o (2\pi q) / \omega R$ D) $\mu_o \omega q / 2\pi$

12. A spherical shell of radius R carries a surface charge of uniform density σ and spins on its axis with frequency f. The magnetic field at the center is

A) $4\pi\mu_o \sigma fR / 3$ B) $\mu_o \sigma f / 2R$

C) $4\pi\mu_o \sigma f / 2R$ D) none of the above

13. A metal wire of mass m slides without friction on two horizontal rails spaced a distance d apart. The track lies in a vertical uniform magnetic field B. A constant current i flows from generator along one rail, across the wire and back down the other rail. Assuming the wire to be at rest at t = 0, the velocity of the wire as a function of time is



A) zero B) $Bidt/m$ towards left

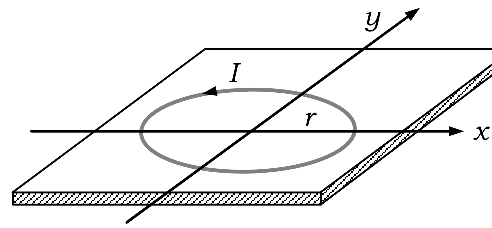
C) $Bidt/m$ towards right D) Bid towards left

14. Electron and proton of equal momentum enter a uniform field normal to the lines of force. If the radii of curvature of circular paths be r_e and r_p respectively then

A) $\frac{r_e}{r_p} = \frac{1}{1}$ B) $\frac{r_e}{r_p} = \frac{m_p}{m_e}$

C) $\frac{r_e}{r_p} = \sqrt{\frac{m_p}{m_e}}$ D) $\frac{r_e}{r_p} = \sqrt{\frac{m_e}{m_p}}$

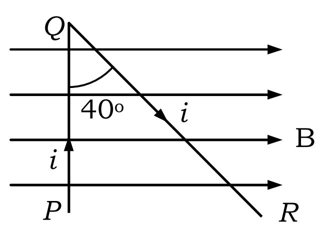
15. A circular loop of mass m and radius r is placed horizontally (x-y plane) on a table. A uniform magnetic field B is applied parallel to x-axis. The current i in the loop so that one edge just lifts from the table is



A) $mg/\pi r^2 B$ B) $mg/\pi r B$

C) $mg/2\pi r B$ D) zero

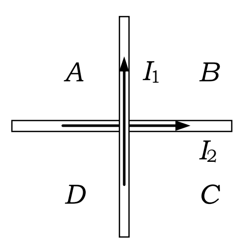
16. A wire PQR carrying a current i is bent as shown in figure. The wire is placed in the region of a uniform magnetic induction field B. PQ = 1 m and QR = 1.5 m. The ratio of the force on PQ and QR is (cos 40° = 0.766, sin 40° = 0.643)



A) 1 : 15 B) 1 : 1.15

C) 1 : 0.96 D) 0.96 : 1

17. As shown in the figure, two mutually perpendicular wires are placed very close to each other, but are not touching each other. The regions where the intensity of magnetic field may be zero is



A) A only B) B, D

C) A, B D) B only

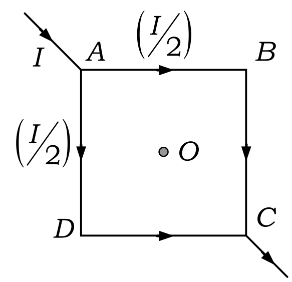
18. If an electron is moving in a circular path of radius R around the nucleus with frequency n, the magnetic field produced at the nucleus will be

A) $\mu_o n/2Re$ B) $\mu_o ne/2R$

C) $\mu_o ne^2/2R^2$ D) $\mu_o n^2 e/2R$

19. A wire is placed in a magnetic field along the direction of the field. If current is allowed to pass through the wire, then
A) no force will act on the wire
B) a force will act in the direction perpendicular to the magnetic lines of force
C) a force will act in the direction of magnetic field
D) a force will act in the direction opposite to the magnetic field

20. The ends of a diagonal of a square conducting wire frame are connected with source of current. The magnetic induction at its centre will be

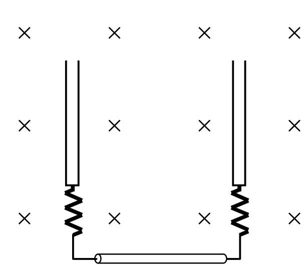


A) $4\mu_o/\pi a$
B) zero
C) $2\mu_o I/\pi a$
D) $\mu_o I/\pi a$

21. A straight horizontal stretch of copper wire carries a current i = 30 A. The linear mass density of the wire is 45 gm^{-1}. What is the magnitude of the magnetic field needed to float the wire, i.e., to be able to balance its weight is
A) 147 G
B) 441 G
C) 14.7 G
D) zero G

22. The magnetic dipole moment of a coil is 5.4×10^{-6} joule tesla^{-1} and it is lined up with an external magnetic field whose strength is 0.80 T. Then the work done in rotating the coil end for end ($\theta = 180^o$) is
A) 4.32 μJ
B) 2.16 μJ
C) 8.6 μJ
D) none of the above

23. A wire of length L and mass m is suspended by a pair of flexible loads in a magnetic field B (into the page). Then, the magnitude and direction of current required to remove the tension in the supporting leads is



A) mg/LB left to right
B) mg/LB right to left
C) zero current
D) none of the above

24. A long straight wire of radius R = 1.5mm carries a steady current i = 30A. Then the magnetic field at a radial distance r = 1mm from the centre of the wire is

A) zero
B) 4.0 mT
C) 2.67 mT
D) none of the above

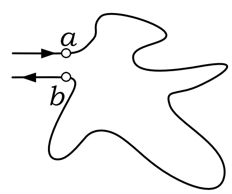
25. A cloud chamber photograph shows a pair of circular tracks emerging from a common point. The tracks have similar density of droplets but curve in opposite direction in a plane normal to the magnetic field maintained in the chamber. If the radius of curvature of the two tracks is same and one of the tracks is due to electron, then the other track is due to

A) electron
B) positron
C) proton
D) alpha

26. Two particles X and Y having equal charge after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of masses of X and Y is

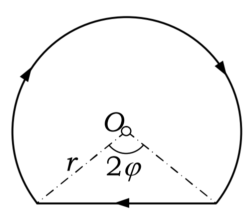
A) $\sqrt{R_1/R_2}$
B) R_2/R_1
C) $\left(R_1/R_2\right)^2$
D) R_1/R_2

27. A messy loop of limp wire is placed on a frictionless table and anchored at points a and b as shown in fig. If a steady current i is passed through, then wire will



A) try to form a circular loop
B) try to bunch up further
C) try to be in parallel as on left side
D) try to twist one over the other

28. A current I flows through a thin wire shaped as shown in figure. The radius of the curved part of the wire is equal to R and the angle subtended by the straight part, at the centre O is 2φ. Then the magnetic field at the centre O is



A) $\frac{\mu_o I}{2\pi r}(\pi - \varphi + \tan\varphi)$
B) $\frac{\mu_o I}{2\pi r}(\pi - \varphi + \sin\varphi)$
C) $\frac{\mu_o I}{2\pi r}(\varphi + \sin\varphi)$
D) zero

29. An infinitely long straight wire is carrying an alternating current of *rms* value 10 A. Then the average magnetic field at a distance of 10 cm from the wire is

A) 2×10^{-5} T
B) 2×10^{-4} T
C) 2×10^{-6} T
D)

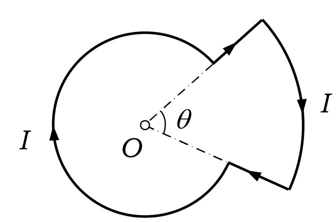
30. Three copper wires, each of length 1 m, are used to form three coils. The coils have, respectively, 1, 2 and 3 turns. If the same current flows in each coil, then the correct statement(s) is (are)
A) first coil has maximum magnetic moment
B) third coil has maximum magnetic field at the centre
C) the ratio B/M of the magnetic field at the centre of the coil and the magnetic moment of the coil is maximum for the third coil
D) all of the above

31. The distance between two infinitely long current carrying conductors is 0.5 cm. Each conductor carries a parallel current of 15 ampere. Then the force on 5 m piece of each conductor is
A) 9×10^{-5} N
B) 45×10^{-5} N
C) 9×10^{-3} N
D) 45×10^{-3} N

32. The magnetic field at the centre of a circular coil of radius r, carrying current I is B. Now from the same length of wire, a coil is formed having n turns. Then the magnetic flux density of the second coil will be
A) nB
B) n^2B
C) n^3B
D) B

33. The length of diagonal of a rectangular wire frame is d and the angle between the diagonals is equal to φ. The current flowing in the wire frame is I. Then the magnetic induction at the centre of the rectangular frame is
A) $\frac{\mu_o I}{\pi d}$
B) $\frac{4\mu_o I}{\pi d}$
C) $\frac{4\mu_o I}{\pi d \sin\varphi}$
D) $\frac{2\mu_o I \sin\varphi}{\pi d}$

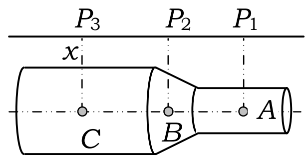
34. A thin wire is shaped as shown in figure. The magnetic induction at point O, in terms of current I and radii r and R and the angle θ is



A) $\frac{\mu_o I}{4\pi r}(2\pi - \theta)$
B) $\frac{\mu_o I\theta}{4\pi R}$
C) $\frac{\mu_o I}{4\pi}\left(\frac{2\pi - \theta}{r} + \frac{\theta}{R}\right)$
D) $\frac{\mu_o I}{4\pi}\left(\frac{2\pi - \theta}{r} - \frac{\theta}{R}\right)$

35. A current carrying circular coil is placed with its plane perpendicular to the magnetic meridian. Then a neutral point is obtained at a distance of 8 cm from the centre of the coil along the axis of the coil. Now the coil is rotated by 90°. If a magnetic needle is placed at the same distance of 8 cm from the centre of the coil, on the axis of the coil, then the needle will make the following angle with the axis of the coil
A) 30°
B) 45°
C) 15°
D) 60°

36. A long straight hollow conducting tube carrying a current has two sections A and C of unequal cross sections. They are joined by a conical section B. P_1, P_2 and P_3 are points on a line parallel to axis of conductor. The magnetic fields at P_1, P_2 and P_3 are B_1, B_2 and B_3 respectively. Then one may say



A) $B_1 = B_2 = B_3$
B) $B_1 = B_3 \neq B_2$
C) $B_1 < B_2 < B_3$
D) $B_1 > B_2 > B_3$

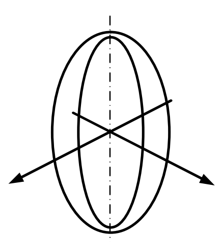
37. An electron beam passes through a magnetic field B Tesla and an electric field of $E\,\text{Vm}^{-1}$ acting simultaneously and in mutually perpendicular directions. If the electron beam remains un-deflected, the speed of electron beam must be

A) E/B
B) B/E
C) EB
D) E^2/B

38. A helium nucleus makes full rotation in a circles of radius 0.8 m in 2 seconds. The value of the magnetic field B at the centre of the circle will be (μ_o = permeability constant)

A) $10^{-19}/\mu_o$
B) $10^{-19}\mu_o$
C) $2 \times 10^{-19}\mu_o$
D) $2\times10^{-19}/\mu_o$

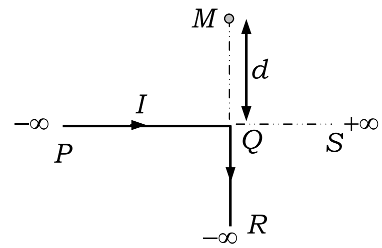
39. Two insulated rings one of slightly smaller diameter than the other are suspended along their common diameters as shown. Initially the planes of rings are mutually perpendicular. When a steady current is set up in each of them



A) the two rings rotate into a common plane
B) the inner ring oscillates about its initial position
C) the inner ring stays stationary while the outer one moves into the plane of the inner ring
D) the outer ring remains stationary, while the inner ring moves into the plane of the outer ring

40. An infinitely long conductor PQR is bent to form a right angle as shown. The magnetic field due to this current at point M is H_1. Now another infinite long straight conductor QS is connected to Q, so that the current is $I/2$ in QR as well as

in QS, the current in PQ remaining unchanged. The magnetic field at M is now H_2. the ratio of H_1/H_2 is given by



A) $1/2$ B) 1

C) $2/3$ D) 2

41. A coil having N turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When the current I passes through the coil, magnetic field at the centre is

A) $\frac{\mu_o NI}{b}$ B) $\frac{2\mu_o NI}{a}$

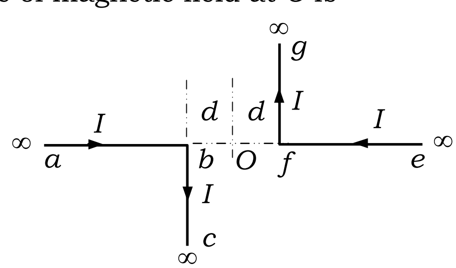
C) $\frac{\mu_o NI}{2(b-a)}\log_e \frac{b}{a}$ D) $\frac{2\mu_o NI}{(b-a)}\log_e \frac{b}{a}$

42. A current is flowing in a circular coil of radius R and the magnetic field at the centre is B_o. At what distance on the axis of coil (from centre) the magnetic field will be $B_o/8$

A) $\sqrt{7}R$ B) $\sqrt{3}R$

C) $2R$ D) $8R$

43. Two long thin wires ABC and EFG are shown in figure. They carry current I as shown. The magnitude of magnetic field at O is



A) zero B) $\frac{\mu_o I}{4\pi d}$

C) $\frac{\mu_o I}{2\pi d}$ D) $\frac{\mu_o I}{2\sqrt{2}\pi d}$

44. A solenoid of length 0.4 m and radius 0.3 m contains 1000 turns of a tightly wound wire. If the current in the coil is 5 mA, then the magnetic field at one end of the coil is

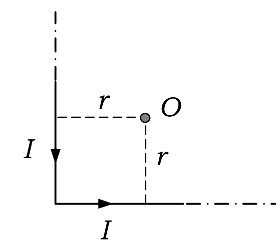
A) 6.28×10^{-6} T B) 7.85×10^{-6} T

C) 3.14×10^{-6} T D) none of the above

45. A small circular coil of n turns and radius r is placed at the centre of another big circular coil of radius R and number of turns N. Initially the two coils are coplanar and the same current I flows through both the coils. Then the amount of work done in rotating the small coil about any of its diameter by an angle π will be

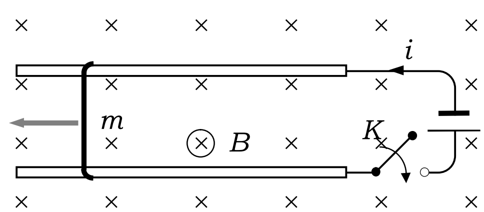
A) $\frac{\mu_o \pi n N r^2 I^2}{2R}$
B) $\frac{\mu_o \pi n N r^2 I^2}{R}$
C) $\frac{2\mu_o \pi n N r^2 I^2}{R}$
D) zero

46. zeroA current carrying wire is bent in the L shape as shown in figure. The length of both arms extend to infinity. Then the magnetic field at O is



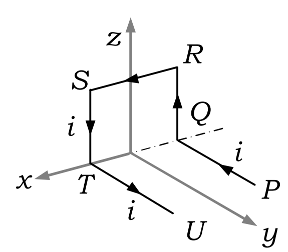
A) zero
B) $\frac{\mu_o I}{2\pi r}$
C) $\frac{\mu_o I}{2\pi r}\left(1+\frac{1}{\sqrt{2}}\right)$
D) $\frac{\mu_o I}{4\pi r}\left(1+\frac{1}{\sqrt{2}}\right)$

47. A wire of length l and mass m is placed on very long frictionless rails, which are placed horizontally in downward magnetic field. At time t = 0, the switch K is connected. The acceleration of the wire just after current i establishes in the wire is



A) zero
B) i/B
C) $\frac{ilB}{m}$
D) it/mB

48. A current i is flowing in a conductor $PQRSTU$ bent as shown in the figure. Each section of the conductor has length L. A uniform magnetic field B is applied parallel to Y-axis. Then the force on the conductor is

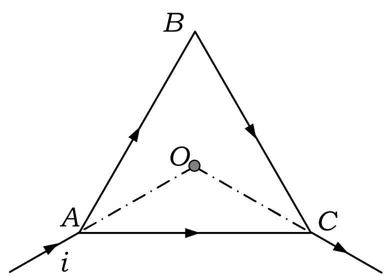


A) iLB in $+z$ direction
B) iLB in $-z$ direction
C) zero
D) $5iLB$ in $+x$ direction

49. There are two identical circular coils of the same radius r and the same number of turns N. The magnetic field at the centre of one coil is equal to the magnetic field at a distance r on the axis from the centre of the second coil. Then the ratio of the currents in the two coils is

A) 2
B) $1/2$
C) $2\sqrt{2}$
D) $1/2\sqrt{2}$

50. An equilateral triangle of side length l is formed from a piece of uniform resistance wire. The current is fed as shown. Then the magnitude of the magnetic field at its centre O is



A) $\sqrt{3}\mu_o I/2\pi l$
B) $3\sqrt{3}\mu_o I/2\pi l$
C) $\mu_o I/2\pi l$
D) zero

Answer to Magnetic effect of current

01. B)	02. C)	03. B)	04. A)	05. B)	06. A)	07. D)	08. A)	09. C)	10. B)
11. B)	12. A)	13. B)	14. A)	15. B)	16. B)	17. B)	18. B)	19. A)	20. B)
21. A)	22. C)	23. A)	24. C)	25. B)	26. C)	27. A)	28. A)	29. D)	30. D)
31. D)	32. B)	33. C)	34. C)	35. B)	36. A)	37. A)	38. B)	39. A)	40. C)
41. C)	42. B)	43. C)	44. A)	45. B)	46. C)	47. C)	48. D)	49. A)	50. D)