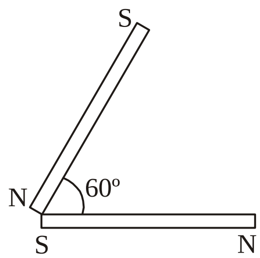
# Magnetic Effects of Current & Magnetism

**Choose the correct answers :**

1. North pole of a very strong magnet is brought near north pole of a weak magnet, placed on a light cork, floating in water. The weak magnet will
   (1) move away from the strong magnet
   (2) move towards the strong magnet
   (3) remain unaffected
   (4) turn sideways to avoid the north pole of strong magnet

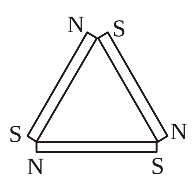
2. A thin rod of length $L$ is a magnet of magnetic moment $M$. If the same rod is gently bent in the form of a semicircle, then its magnetic moment will be
   (1) $M/\pi$ (2) $2M/\pi$
   (3) $M/2\pi$ (4) $M$

3. Two magnets of equal magnetic moments $M$ each are placed as shown in figure. The reusltant magnetic moment is



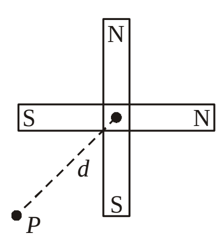

   (1) $M$ (2) $\sqrt{3}\ M$
   (3) $\sqrt{2}\,M$ (4) $M/2$

4. Three identical bar magnets each of magnetic moment $M$, are placed in the form of an equilateral triangle with north pole of one touching the south pole of the other. The net magnetic moment of the system is



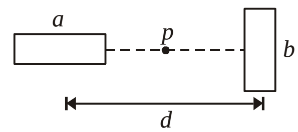

   (1) $3\,M$ (2) $3M/2$
   (3) $M\sqrt{3}$ (4) zero

5. Two short magnets of equal dipole moments $M$ are fastened perpendicularly at their centres as shown below. The magnetic field (magnitude) at point $P$, distant $d$ from the centre on the bisector of the right angle, is



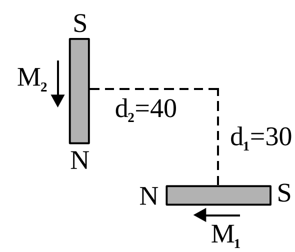

   (1) $\frac{\mu_0}{4\pi}\frac{M}{d^3}$ (2) $\frac{\mu_0}{4\pi}\frac{M\sqrt{2}}{d^3}$
   (3) $\frac{\mu_0}{4\pi}\frac{2M}{d^3}$ (4) $\frac{\mu_0}{4\pi}\frac{2\sqrt{2}M}{d^3}$

6. Figure shows two identical short magnetic dipoles $a$ and $b$ of magnetic moments $M$ each, placed at a separation $d$, with their axes perpendicular to each other. The magnetic field at the point $P$ mid way between the dipoles is




   (1) $2\mu_0 M/d^3$ (2) $2\sqrt{3}\,\mu_0 M/\pi d^3$
   (3) zero (4) $2\sqrt{5}\,\mu_0 M/\pi d^3$

7. Two short magnets of magnetic moments $M_1$ and $M_2$ are fixed on a table as shown in fig. What will be the magnitude of the magnetic field produced by these magnets at the point $P$, if $M_1$ = 2700 CGS units, $M_2$ = 3200 CGS units, $d_1$ = 30 cm and $d_2$ = 40 cm ?




   (1) 0.224 G (2) 0.112 G
   (3) 0.056 G (4) 0.320 G

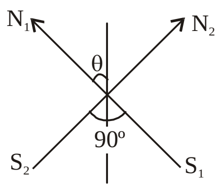
8. Earth's magnetic-field may be supposed to be due to a small bar magnet located at the centre of the earth. If the magnetic field at a point on the magnetic equator is $0.3 \times 10^{-4}$ T, what is the magnetic moment of such a bar magnet ? Radius of earth is 6400 km.
   (1) $7.8 \times 10^{24}$ A m$^2$ (2) $7.8 \times 10^{22}$ A m$^2$
   (3) $7.8 \times 10^{20}$ A m$^2$ (4) $7.8 \times 10^{26}$ A m$^2$

9. Two identical dipoles, each of magnetic moment 1.0 Am$^2$, are placed at a separation of 2m with their axes perpendicular to each other. The magnitude of magnetic field at a point midway between the dipoles would be
   (1) $\sqrt{3} \times 10^{-7}$ T (2) $1 \times 10^{-7}$ T
   (3) $\sqrt{5} \times 10^{-7}$ T (4) $2 \times 10^{-7}$ T

10. Two small bar magnets are placed along a line, at a certain distance $d$ apart. If the length of each magnet is negligible as compared to $d$, the force between them will be inversely proportional to

(1) $d^2$ (2) $d$
(3) $d^3$ (4) $d^4$

11. Two magnets of equal mass are joined at right angles to each other as shown in figure. The magnet $N_1S_1$ has a magnetic moment 3 times that of $N_2S_2$. This arrangement is pivoted so that it is free to rotate in the horizontal plane. When in equilibrium, what angle will the magnet $N_1S_1$ subtend with the magnetic meridian ?




(1) $\sin^{-1}(^1/_3)$ (2) $\cos^{-1}(^1/_3)$
(3) $\tan^{-1}(^1/_3)$ (4) $\sin^{-1}(^2/_3)$

12. A short magnet is placed horizontally along east-west direction. At a distance of 20 cm along its equatorial line, a small magnetic needle makes an angle of 45º with the magnetic meridian. If horizontal component of earth's magnetic field is 0.32 gauss, then the magnetic moment of the magnet is

(1) 0.64 $Am^2$ (2) 0.32 $Am^2$
(3) 1.28 $Am^2$ (4) 2.56 $Am^2$

13. A very small magnet is placed horizontally in the magnetic meridian with its S-pole pointing towards geographic north. The null point is obtained 20 cm away from the centre of the magnet. If horizontal component of earth's magnetic field is 0.3 G, then the magnetic moment of the magnet is

(1) 1.2 $Am^2$ (2) $1.2 \times 10^4$ $Am^2$
(3) 2.4 $Am^2$ (4) none of these

14. A short magnet lies in east-west direction. At a distance of 20 cm from its mid-point, on its end-on position, a small magnetic needle makes an angle of 60º with the magnetic meridian. If the magnetic moment of the magnet is 2.50 $Am^2$, then the horizontal component of the earth's magnetic field at that place is

(1) 0.32 G (2) 0.36 G
(3) 0.30 G (4) 0.24 G

15. The work done in turning a magnet of magnetic moment $M$ by an angle of 90º from the meridian is '$n$' times the corresponding work done to turn it through an angle of 60º, where $n$ is given by

(1) 1/2 (2) 2
(3) 1/4 (4) 1

16. A magnetic needle lying parallel to a magnetic field requires $W$ units of work to turn it through 30º. The torque needed to maintain the needle in this position will be

(1) $W$ (2) $\sqrt{3}\,W$
(3) $W/(2-\sqrt{3})$ (4) $W/(\sqrt{2}-1)$

17. The time period of a freely suspended thin magnet is 4 s. If it is broken in length into $n$ equal parts and one part is suspended in the same way, then its time period will be

(1) $4/n$ s (2) $4/n^2$ s
(3) $4/n^3$ s (4) $4n$ s

18. A magnet is suspended in such a way that it oscillates in the horizontal plane. It makes 20 oscillations per minute at a place where dip angle is 30º and 15 oscillations per minute at another place where dip angle is 60º. Ratio of the total earth's magnetic field at the two places is

(1) $3\sqrt{3}:8$ (2) $16:9\sqrt{3}$
(3) $4:9$ (4) $2\sqrt{3}:9$

19. Two magnets are held together in a vibration magnetometer and are allowed to oscillate in the earth's magnetic field. With like poles together, 12 oscillations per minute are made ; but with unlike poles together, only 4 oscillations per minute are made. The ratio of their magnetic moments is

(1) 3 : 1 (2) 2 : 1
(3) 5 : 3 (4) 5 : 4

20. A small bar magnet having a magnetic moment of $9 \times 10^{-4}$ $Am^2$ is suspended at its centre of gravity by a light torsionless string at a distance of $10^{-2}$ m vertically above a long straight horizontal wire carrying a current of 10 A. Find the time period of oscillation of the magnet about its equilibrium position assuming that the motion is undamped. The moment of inertia of the magnet is $18 \times 10^{-8}$ kg $m^2$.

(1) $\pi$ s (2) 2 s
(3) $2\pi$ s (4) 4 s

21. A tangent galvanometer is most sensitive when the angle made by the magnetic needle with the direction of horizontal component of earth's magnetic field is
(1) 30º
(2) 45º
(3) 60º
(4) any acurately measurable angle

22. A tangent galvanometer has 80 turns of wire. The internal and external diameters of the coils are 19 cm and 21 cm, respectively. The reduction factor of the galvanometer at a place, where $H = 0.32$ G, is
(1) 0.0064 A (2) 0.64 A
(3) 0.064 A (4) none of these

23. A compass needle whose magnetic moment is 0.06 Am$^2$, pointing geographical north at a certain place, where the horizontal component of earth's magnetic field is 40 mWb/m$^2$, experiences a torque $1.2\times10^{-3}$ Nm. What is the declination at the place ?
(1) 0º (2) 60º
(3) 45º (4) 30º

24. A dip needle lies initially in the magnetic meridian when it shows an angle of dip $\theta$ at a place. The dip circle is rotated through an angle $x$ in the horizontal plane and then it show an angle of dip $\theta'$. Then $\tan\theta'/\tan\theta$ is :
(1) $\cos x$ (2) $1/\sin x$
(3) $1/\tan x$ (4) $1/\cos x$

25. If a magnet is suspended at angle of 30º to the magnetic meridian, the dip needle makes an angle of 45º with the horizontal. The real angle of dip is
(1) $\tan^{-1}(\sqrt{3}/2)$ (2) $\tan^{-1}(\sqrt{3})$
(3) $\tan^{-1}(\sqrt{3}/\sqrt{2})$ (4) $\tan^{-1}(2/\sqrt{3})$

26. The plane of a dip circle is set in the geographic meridian and the apparent angle of dip is $\delta_1$. It is then set in a plane perpendicular to the geographic meridian. The apparent angle of dip now is $\delta_2$. The angle of declination $\theta$, at the place, is
(1) $\theta = \tan^{-1}\left[\dfrac{\tan\delta_2}{\tan\delta_1}\right]$ (2) $\theta = \tan^{-1}\left[\dfrac{\tan\delta_1}{\tan\delta_2}\right]$
(3) $\theta = \tan^{-1}(\tan\delta_1 . \tan\delta_2)$
(4) $\theta = \tan^{-1}(\tan\delta_1 - \tan\delta_2)$

27. The true value of dip at a place is 45º. If the plane of the dip circle is turned through 60º from the magnetic meridian, the apparent dip will be
(1) $\tan^{-1}(2)$ (2) $\tan^{-1}(\sqrt{3}/2)$
(3) $\tan^{-1}(\sqrt{2})$ (4) $\tan^{-1}(\sqrt{3})$

28. Permanent dipole moments exist in
(1) ferromagnetic substances only
(2) ferromagnetic and paramagnetic substances
(3) ferromagnetic, paramagnetic and diamagnetic substances
(4) none of these

29. A diamagnetic substance D, a paramagnetic substance P and a ferromagnetic substance F are brought in a uniform magnetic field. Diamagnetism will be produced in
(1) D only (2) D and P only
(3) D and F only (4) all of these

30. Ferromagnetism is shown by
(1) solids only
(2) solids and liquids only
(3) liquids and gases only
(4) solids, liquids and gases

31. For a paramagnetic material, the dependence of the magnetic susceptibility $\chi$ on the absolute temperature $T$ is given by ($C$ is a constant)
(1) $\chi = C/T$ (2) $\chi = CT$
(3) $\chi = CT^2$ (4) $\chi = C/T^2$

32. The relative permeability ($\mu_r$) of a substance is related to its susceptibility ($\chi$) is
(1) $\mu_r = 1 - \chi$ (2) $\mu_r = 1 + \chi$
(3) $\mu_r = 1 - \chi^2$ (4) $\mu_r = 1 + \chi^2$

33. Lines of constant dip are called
(1) isobaric lines (2) isogonic lines
(3) isoclinic lines (4) isodynamic lines

34. Magnetic effects of current were discovered by
(1) Faraday (2) Oersted
(3) Maxwell (4) Ampere

35. A galvanometer has a resistance $G$ and a current $i_g$ flowing in it produces full scale deflection. $S_1$ is the value of shunt, which converts it into an ammeter of range $0 \rightarrow I$ and $S_2$ is the value of the shunt for the range $0 \rightarrow 2I$. The ratio $S_1/S_2$ is
(1) $\dfrac{2I - i_g}{I - i_g}$ (2) $\dfrac{1}{2} \times \dfrac{I - i_g}{2I - i_g}$
(3) 2 (4) 1

36. With a resistance $R$, connected in series with a galvanometer of resistance 100 ohm, it acts as a voltmeter of range $0 \rightarrow V$. To double the range, a resistance of 1000 ohm is to be connected in series with $R$. Then the value of $R$ in ohm, is

(1) 1100 (2) 800
(3) 900 (4) 1000

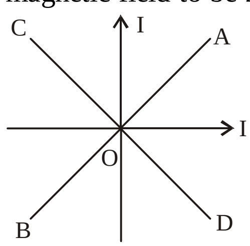
37. A voltmeter has a resistance of $G$ ohms and range of $V$ volts. The value of resistance used in series to convert it into a voltmeter of range $nV$ volts is

(1) $G/n$ (2) $(n-1)G$
(3) $nG$ (4) $G/(n-1)$

38. An ammeter has a resistance of $G$ ohms and a range of $I$ ampere. The value of resistance used in parallel to convert it into an ammeter of range $nI$ amperes is

(1) $G/n$ (2) $(n-1)G$
(3) $nG$ (4) $G/(n-1)$

39. Two equal electric currents are flowing perpendicular to each other as shown. Lines $AB$ and $CD$ are perpendicular to each other and symmetrically placed with respect to the currents. Where do you expect the resultant magnetic field to be zero ?




(1) On $AB$ (2) On both $AB$ and $CD$
(3) On $CD$ (4) On $OD$ and $BO$

40. Two wires, carrying currents and held parallel to each other, exert force on each other. This force due to electric currents is

(1) electrical in nature
(2) magnetic in nature
(3) both electrical as well as magnetic in nature
(4) molecular force

41. A wire placed vertically between the poles of a horse-shoe magnet, with its north pole to your right, carries a direct current flowing upwards. The wire will experience a force tending to deflect it

(1) to your left (2) to your right
(3) away from you (4) towards you

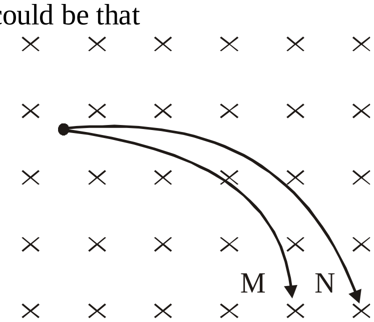
42. If a charged particle enters into a magnetic field of 5 T, at an angle of 90° to $\vec{B}$, with a velocity $\vec{v} = 3\vec{i} + 4\vec{j}$, then in near future its velocity can be

(1) $-3\vec{i} - 4\vec{j}$ (2) $-3\vec{i} + 4\vec{j}$
(3) $5\vec{i}$ (4) any of these

43. A charged particle enters into a magnetic field of 10 T and its velocity at a certain instant is $\vec{v} = 2\vec{i} + 3\vec{j}$ and its acceleration is $\vec{a} = 2\vec{i} + x\vec{j}$. Then the value of $x$ is

(1) $-3/2$ (2) $3/2$
(3) $-4/3$ (4) $2/3$

44. Two equally charged particles $M$ and $N$ enter a space of uniform magnetic field, with their velocities perpendicular to the magnetic field. The paths are as shown in figure. The possible reason for different paths could be that



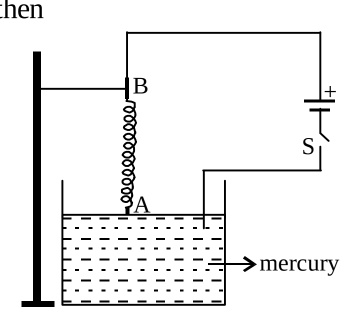

(1) the velocity of $M$ is greater than that of $N$
(2) the mass of $M$ is greater than that of $N$
(3) specific charge of $M$ is smaller than that of $N$
(4) the momentum of $M$ is smaller than that of $N$

45. Current density through a wire, carrying current is $J$. Magnetic induction, due to a small volume element $dV$ of the wire, at displacement vector $\vec{r}$ from it, is given by the relation : $d\vec{B} =$

(1) $\frac{\mu_0}{4\pi}.\frac{\vec{J}\times\vec{r}}{r^3}dV$ (2) $\frac{\mu_0}{4\pi}.\frac{\vec{r}\times\vec{J}}{r^3}.dV$

(3) $\frac{\mu_0}{4\pi}.\frac{Jd\vec{V}\times\vec{r}}{r^3}$ (4) $\frac{\mu_0}{4\pi}.\frac{J\,\vec{r}\times d\vec{V}}{r^3}$

46. A spring is held between two conducting rods $A$ and $B$. Rod $A$ just touches the surface of mercury and end $B$ is clamped to stand, as shown. When switch $S$ is closed, then



(1) *A* will move up and no current will flow in the circuit
(2) *A* will further immerse into the mercury
(3) *A* will start oscillating up and down
(4) Position of *A* will not change and will continue to be just touching the surface of mercury

47. If electron velocity is $(2\hat{i}+3\hat{j})$ and it is subjected to a magnetic field $4\hat{k}$, then its
(1) speed will change
(2) path will change
(3) both (1) and (2)
(4) none of these

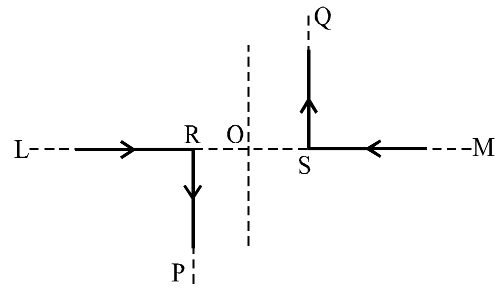
48. A proton moving with a constant velocity passes through a region of space without change in its velocity. If *E* and *B* represent electric and magnetic fields, respectively, then this region of space may *not* have
(1) $E \neq 0, B = 0$ (2) $E \neq 0, B \neq 0$
(3) $E = 0, B \neq 0$ (4) $E = 0, B = 0$

49. *Aurora Borealis* is a luminous electrical discharge in the upper layers of the atmosphere, more frequencly visible in
(1) polar regions
(2) equator
(3) the regions of earth's magnetic poles
(4) lunar eclipse

50. An electron moving in a circular orbit of radius *R*, with a peiod *T* is equivalent to a magnetic dipole of dipole moment
(1) $2\pi\ Re/T$ (2) $\pi eR/T$
(3) $\pi eR^2/T$ (4) $\pi\ R^2\ eT$

51. To produce a magnetic field of π tesla at the centre of a circular loop of diameter 1m, the current flowing through the loop is
(1) $5.0 \times 10^6$ A (2) $2.5 \times 10^6$ A
(3) $2.0 \times 10^6$ A (4) $10 \times 10^6$ A

52. A pair of stationary and infinitely long bent wires are placed in the *x*-*y* plane, as shown in fig. The wires carry currents of 10 ampere each, as shown. The segments *L* and *M* are along the *x*-axis. The segments *P* and *Q* are parallel to the *y*–axis such that OS = OR = 0.02 m. Find the magnitude and direction of the magnetic induction at the origin *O*.




(1) $10^{-4}$ T perpendicularly outwards
(2) $10^{-4}$ T perpendicularly inwards
(3) zero
(4) none of these

53. For a given length *L* of a wire carrying a current *I*, how many circular turns would produce the maximum magnetic moment ?
(1) 1 (2) 2
(3) π (4) As many as possible

54. A very long bar magnet is placed with its north pole coinciding with the centre of a circular loop carrying an electric current *I*. The magnetic field due to the magnet at a point on the periphery of the wire is *B*. The radius of the loop is *a*. The force on the wire is
(1) nearly $2\pi a\ IB$ perpendicular to the plane of wire
(2) $2\pi a\ IB$ in the plane of the wire
(3) $\pi a\ IB$ along the magnet
(4) zero

55. A solenoid of length 10 cm and radius 1 cm contains 200 turns and carries a current of 10 A. The value of pole strength of each pole is
(1) 2 Am (2) 2π Am
(3) 4π Am (4) 10π Am

56. A toroidal solenoid has 3000 turns and a mean radius of 10 cm. It has soft iron core of relative permeability 2000. When a current of 1.0 A passes throguh the solenoid, the magnitude of the magnetic field in the core of the solenoid is
(1) 9.0 T (2) 4.5 T
(3) 6.0 T (4) 12 T

57. An electron of mass $0.9 \times 10^{-30}$ kg under the action of a magnetic field moves in a circle of 2.0 cm radius at a speed of $3 \times 10^6$ m/s. If a proton of mass $1.8 \times 10^{-27}$ kg were to move in a circle of the same radius and if it were acted upon by the same field then its speed

(1) will be $3 \times 10^{-6}$ m/sec
(2) will be $1.5 \times 10^{3}$ m/sec
(3) will be $1.6 \times 10^{4}$ m/sec
(4) cannot be estimated from the given data

58. The earth has a magnetic dipole moment of $7.8 \times 10^{22}$ Am$^2$. What approximate current would have to be set up in a single turn of wire going around the earth at its magnetic equator if we wish to set up such a dipole through magnetic effect of current ? Given the radius of earth to be $6.4 \times 10^3$ km.
(1) $6 \times 10^6$ A (2) $4 \times 10^6$ A
(3) $6 \times 10^8$ A (4) $4 \times 10^8$ A

59. Two concentric coils of 10 turns each are situated in the same plane. Their radii are 20 cm and 40 cm and these carry, respectively, 0.2 A and 0.3 A current in opposite directions. The magnetic field (in Wb/m$^2$) at the centre is
(1) $(35/4)\ \mu_0$ (2) $(\mu_0/80)$
(3) $(7/80)\ \mu_0$ (4) $(5/4)\ \mu_0$

60. Two particles each of mass *m* and charge *q*, are attached to the two ends of a light rod of length 2*R*. The rod is rotated at constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod, is
(1) $\frac{q}{2m}$ (2) $\frac{q}{m}$
(3) $\frac{2q}{m}$ (4) $\frac{q}{\pi m}$

61. A wire of length *L* m carrying a current I ampere is bent in the form of a circle. Its magnetic moment will be
(1) $\frac{IL}{4\pi}$ (2) $\frac{IL^2}{4\pi}$
(3) $\frac{I^2L^2}{4\pi}$ (4) $\frac{LI^2}{4\pi}$

62. Consider a thick wire of radius *a* and carrying current *I*. Then the magnetic field at a point, distant *a*/2 from its axis is
(1) 0 (2) $\frac{\mu_0 I}{4\pi a}$
(3) $\frac{\mu_0 I}{2\pi a}$ (4) $\frac{\mu_0 I}{\pi a}$

63. In the above question, at what distance from the surface of the thick wire, the magnetic field is same as at a distance *a*/2 from the axis ?
(1) *a*/4 (2) *a*/2
(3) *a* (4) 2*a*

64. A circular current carrying coil has a radius *R*. The distance from the centre of the coil, on the axis where the magnetic induction will be 1/8th to its value at the centre of the coil, is
(1) 1.73 *R* (2) 0.7 *R*
(3) 1.15 *R* (4) 0.58 *R*

65. Through two parallel wires *A* and *B*, 10 A and 2 A of currents are passed, respectively, in the opposite directions. If the wire *A* is infinitely long and the length of the wire *B* is 2 m, force on the wire *A*, which is situated at 10 cm distance from *B*, will be
(1) $8 \times 10^{-5}$ N (2) $4 \times 10^{-7}$ N
(3) $4 \times 10^{-5}$ N (4) $8 \times 10^{-7}$ N

66. A particle carrying a charge equal to 100 times the charge on an electron, is rotating at the rate of one rotation per second in a circular path of radius 0.8 m. The value of the magnetic field produced at the centre will be ($\mu_0$ = permeability of free space)
(1) $10^{-7}/\mu_0$ Wb/m$^2$ (2) $10^{-17}\ \mu_0$ Wb/m$^2$
(3) $10^{-6}\ \mu_0$ Wb/m$^2$ (4) $10^{-7}\ \mu_0$ Wb/m$^2$

67. A long straight wire carries a current of 10 A. An electron travels with a velocity of $5 \times 10^6$ m s$^{-1}$, parallel to the wire 0.1 m from it, and in a direction opposite to that of the current. The force experienced by the electron, while moving along its path, is
(1) $1.6 \times 10^{-17}$ N (2) $1.6 \times 10^{-18}$ N
(3) $3.2 \times 10^{-18}$ N (4) $0.8 \times 10^{-19}$ N

68. A coil in the shape of an equilateral triangle of side 0.02 m is suspended from a vertex such that it is hanging in a vertical plane between the pole pieces of a permanent magnet producing a horizontal magnetic field of $5 \times 10^{-2}$ T. Find the couple acting on the coil when a current of 0.1 A is passed through it and the magnetic field is parallel to its plane.
(1) $17.32 \times 10^{-7}$ Nm (2) $8.66 \times 10^{-7}$ Nm
(3) $8.66 \times 10^{-5}$ Nm (4) zero

69. If a proton of mass $1.67 \times 10^{-27}$ kg is made to circulate around the earth of radius 6,400 km, along its equator, with a speed of $1 \times 10^7$ m s$^{-1}$ then the minimum magnetic field required to act at the equator is

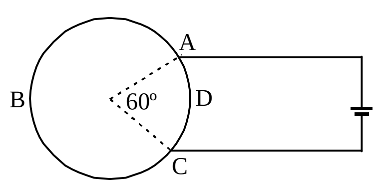
(1) $1.43 \times 10^{-8}$ T (2) $2.63 \times 10^{-8}$ T
(3) $1.63 \times 10^{-8}$ T (4) $3.16 \times 10^{-8}$ T

70. A proton with velocity $10^6$ m s$^{-1}$ moves vertically downward through a uniform magnetic field of magnitude 1.5 T, pointing horizontally, from east of west. Force acting on the proton is
(1) zero
(2) $2.4 \times 10^{-13}$ N, towards north
(3) $2.4 \times 10^{-13}$ N, towards south
(4) $2.4 \times 10^{-13}$ N, towards east

71. In a hydrogen atom, the electron moves in an orbit of radius 0.53 Å with a speed of $2.2 \times 10^6$ m s$^{-1}$. The magnetic moment associated with the hydrogen atom is equal to
(1) $1.26 \times 10^{-23}$ Am$^2$ (2) $1.06 \times 10^{-23}$ Am$^2$
(3) $0.93 \times 10^{-23}$ Am$^2$ (4) $1.17 \times 10^{-23}$ Am$^2$

72. A proton enters a magnetic field of induction $(3\hat{i} + 2\hat{j})$ tesla with a velocity of $(5 \times 10^5 \hat{i})$ m s$^{-1}$. The force acting on the particle is
(1) $-3.2 \times 10^{-13}\ \hat{k}$ newton
(2) $+1.6 \times 10^{-13}\ \hat{k}$ newton
(3) zero
(4) $-1.6 \times 10^{-13}\ \hat{k}$ dynes

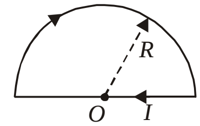
73. A cell is connected across the two points $A$ and $C$ of a circular wire $ABCD$ of centre $O$, as shown. The magnetic induction at $O$, due to current in arc $ABC$ is $B_1$ and that due to arc $ADC$ is $B_2$. The ratio of magnitudes of $B_1$ and $B_2$ at $O$ is




(1) 6 : 1 (2) 5 : 1
(3) 3 : 1 (4) 1 : 1

74. A proton, a deuteron and an α-particle accelerated through the same potential difference enter a region of uniform magnetic field $B$, moving at right angle to $B$. What is the ratio of radii of their curved path ?
(1) $1 : 1 : \sqrt{2}$ (2) $\sqrt{2} : \sqrt{2} : 1$
(3) $1 : \sqrt{2} : \sqrt{2}$ (4) $\sqrt{2} : 1 : 1$

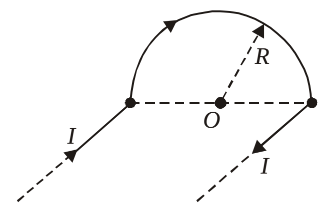
75. The magnitude of force acting on a unit length of thin wire, carrying current $I$, at $O$, if the wire is bent as shown, is




(1) $\mu_0 I^2 / 2R$ (2) $\mu_0 I^2 / 4R$
(3) $\mu_0 I / 2R$ (4) $\mu_0 I^2 / \pi R$

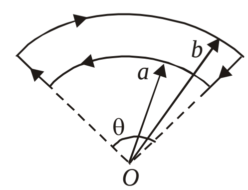
76. A square frame of side $l$ carries a current $I$. The magnetic field at its centre is $B$. The same current is passed through a circular coil having the same perimeter as the square. The field at the centre of the circular coil is $B'$. The ratio $B/B'$ is
(1) $8\sqrt{2} / \pi^2$ (2) $8\sqrt{2} / \pi$
(3) $4\sqrt{2} / \pi$ (4) $4\sqrt{2} / \pi^2$

77. The magnetic induction at the point $O$, if the wire is carrying current $I$, is



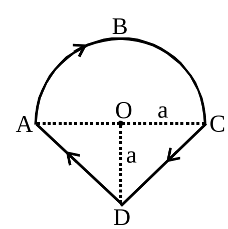

(1) $\mu_0 I / 2R$ (2) $\mu_0 I / 2\pi R$
(3) $\mu_0 I(\pi^2 + 4)^{1/2} / 4\pi R$ (4) $\mu_0 I(\pi^2 - 4)^{1/2} / 4\pi R$

78. The figure given below shows a current loop having two circular arcs joined by two radial lines.




The magnetic field at $O$ is
(1) $\frac{\mu_0 I\theta}{2\pi ab}(b-a)$ (2) $\frac{\mu_0 I\theta}{4\pi ab}(b-a)$
(3) zero (4) $\frac{\mu_0 I\theta}{3\pi ab}(b+a)$

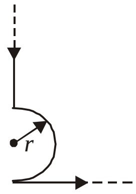
79. $ABC$ is a semi-circular wire of radius $a$. If $I$ is the current flowing through the wire, then the magnitude of the magnetic induction at $O$ will be



(1) $\frac{\mu_0 I}{4\pi a}[\pi+4\sqrt{2}]$ (2) $\frac{\mu_0 I}{4\pi a}[\pi+2\sqrt{2}]$

(3) $\frac{\mu_0 I}{4\pi a}[\pi+2]$ (4) $\frac{\mu_0 I}{4\pi a}[\pi+4]$

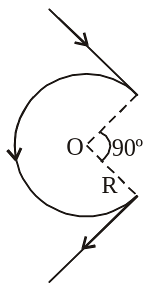
80. The magnitude of magnetic induction at the centre $O$ in the following figure is




(1) $\frac{\mu_0 I}{4\pi r}$ (2) zero

(3) $\frac{\mu_0 I(\pi-1)}{4\pi r}$ (4) $\frac{\mu_0 I(\pi+1)}{4\pi r}$

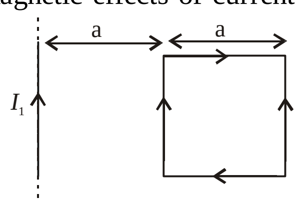
81. Calculate $B$ at $O$ in case of networks shown in figure




(1) $\frac{\mu_0}{4\pi}\frac{I}{R}[3\pi - 2]$ (2) $\frac{\mu_0}{4\pi}\frac{I}{R}[3\pi + 2]$

(3) $\frac{\mu_0}{4\pi}\frac{I}{R}[\frac{3\pi}{2} - 2]$ (4) $\frac{\mu_0}{4\pi}\frac{I}{R}[\frac{3\pi}{2} + 2]$

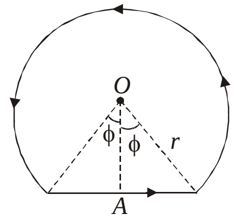
82. A square wire carrying current $I_2$ is placed in the field of a long wire carrying current $I_1$ as shown in figure. Calculate the net force on the square wire due to magnetic effects of current




(1) $\frac{\mu_0}{4\pi}\frac{I_1 I_2}{2a}$ (2) $\frac{\mu_0}{4\pi}.\frac{I_1 I_2}{a}$

(3) $\frac{\mu_0}{4\pi}.I_1 I_2$ (4) zero

83. A current of $i$ ampere flows through a conductor, which is partly circular arc and partly straight line, as shown in the following figure. $O$ is the centre of the circular part of the conductor. The magnetic induction at $O$ is



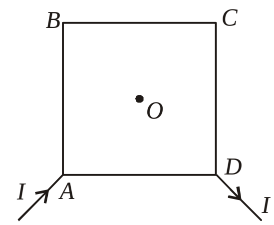

(1) zero

(2) $\left(\frac{\mu_0}{4\pi}\right)\frac{i}{r}(2\pi - 2\phi)$

(3) $\left(\frac{\mu_0}{4\pi}\right)\left(\frac{i}{r}\right)$ (2 tan $\phi$)

(4) $\left(\frac{\mu_0}{4\pi}\right)\left(\frac{2i}{r}\right)$ $[\pi - \phi + \tan\phi]$

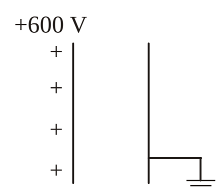
84. Current $I$ enters end $A$ of a wire in the form of a square $ABCD$. If $L$ is the length of each side of the square, then magnetic field at the centre $O$ of the square is




(1) $3.\frac{\mu_0 I}{\pi.L}$ (2) $\frac{3}{4}.\frac{\mu_0 I}{\pi.L}$

(3) $\frac{\mu_0 I}{2\pi.L}$ (4) zero

85. A potential difference of 600 V is applied across the plates of a parallel plate capacitor placed in a magnetic field. The separation between the plates is 3 mm. An electron, projected vertically upward parallel to plates with a velocity of $2 \times 10^6$ m s$^{-1}$, moves undeflected between the plates. The magnitude and direction of magnetic field in the region between the plates of the capacitor is



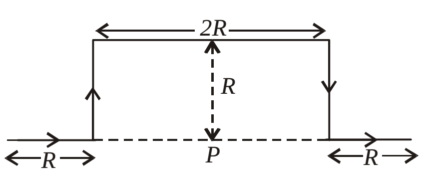
(1) 0.1 T, parallel to the plane of paper, from positive to negative plate
(2) 0.1 T, parallel to the plane of paper from negative to positive plate
(3) 0.1 T, perpendicular to plane of paper, acting perpendicularly outward.
(4) 0.1 T, perpendicular to plane of paper, acting perpendicularly inward.

86. Current $I$ is flowing through a wire in the form of an equilateral triangle of side $a$. The magnitude of magnetic field at its centroid is
(1) $\frac{\mu_0}{4\pi}\frac{I}{a}\times 18$ (2) $\frac{\mu_0}{4\pi}\frac{I}{a}\times 9$
(3) $\frac{\mu_0}{4\pi}\frac{I}{a}\times 6$ (4) $\frac{\mu_0}{4\pi}\frac{I}{a}\times 3$

87. In the Bohr model of hydrogen atom, if electron is circulating around the nucleus in the circular path of radius $5.1 \times 10^{-11}$ m and at a frequency of $6.8 \times 10^{15}$ rev/sec, then magnetic induction $B$ at the centre of the orbit is
(1) 14.3 WB $m^{-2}$ (2) 17.4 Wb $m^{-2}$
(3) 16.5 Wb $m^{-2}$ (4) 13.4 Wb $m^{-2}$

88. A circular coil of 100 turns has an effective radius of 5 cm and carries a current of 0.1 A. It is held with its plane perpendicular to the magnetic field of induction 1.5 Wb $m^{-2}$. From this position, the work done to rotate it through an angle of 180º is
(1) 75 $\pi$ mJ (2) 50 $\pi$ mJ
(3) 150 $\pi$ mJ (4) 60 $\pi$ mJ

89. The magnetic field due to current $I$, flowing in the wire shown, at point $P$ is




(1) $\frac{\mu_0 I}{4\pi R}(2+\sqrt{2})$ (2) $\frac{\mu_0 I}{4\pi R}\times 2\sqrt{2}$
(3) $\frac{\mu_0 I}{4\pi R}\times 4\sqrt{2}$ (4) $\frac{\mu_0 I}{4\pi R}(4+\sqrt{2})$

90. The cyclotron frequency of an electron, gyrating in magnetic field of 1.0 T, is approximately
(1) 28 MHz (2) 280 MHz
(3) 2.8 GHz (4) 28 GHz

91. If a proton and an $\alpha$-particle, while moving at right angle to the direction of same magnetic field, have equal radius of their circular paths, then the ratio of their kinetic energies is
(1) 2 : 1 (2) 4 : 1
(3) 1 : 1 (4) $2\sqrt{2}:1$

92. The maximum energy of a dueterons coming out of cyclotron accelerator is 20 MeV. The maximum energy of protons that can be obtained from this acccelerator is
(1) 10 MeV (2) 20 MeV
(3) 30 MeV (4) 40 MeV

93. A soft iron ring has a mean length of 0.2$\pi$ m and an area of cross-section of $5 \times 10^{-4}$ $m^2$. It is uniformly wound with 2000 turns carrying a current of 2A and the magnetic flux in the iron is $8 \times 10^{-3}$ Wb. What is the relative permeability of iron ?
(1) 1000 (2) 4000
(3) 3000 (4) 2000

94. A charge $Q$ is spread uniformly over an insulated ring of radius $R$. What is the magnetic moment of the ring if it is rotated with an angular velocity $\omega$ with respect to the normal axis ?
(1) $\frac{1}{2} QR^2\omega$ (2) $\frac{1}{2} Q^2R\omega$
(3) $\frac{1}{2} QR\omega$ (4) $\frac{1}{2} QR^2\omega^2$

95. Charge $q$ is uniformly distributed on a disc of radius $r$. If the disc is rotated with a frequency $\nu$, then magnetic field induction at the centre will be
(1) $\frac{\mu_0 q}{\nu r}$ (2) $\frac{\mu_0 q \nu}{r}$
(3) $\frac{\mu_0 q}{2\nu r}$ (4) $\frac{\mu_0 q\nu}{2r}$

96. A charge $Q$ is spread uniformly over a thin, insulated ring of mean radius $R$. If the ring is rotated with an angular velocity $\omega$, about its normal axis, then the effective current in the rotating ring would be
(1) $Q\omega/2$ (2) $Q\omega/\pi$
(3) $Q\omega/2\pi$ (4) $Q\,2\pi/\omega$

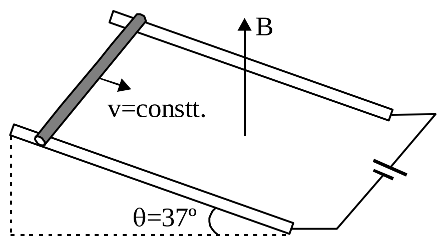
97. A thin circular wire of radius $R$ is palced in x-y plane. A uniform magnetic field of intensity $B$ acts along $x$-axis. If $m$ is the mass of the wire, then what minimum current should be passed through the wire so that it is just lifted at one of its ends ?

(1) $\frac{mg}{\pi BR}$ (2) $\frac{2mg}{\pi BR}$

(3) $\frac{mg}{\pi BR^2}$

(4) No amount of current can lift it

98. Two conducting rails are connected to a source of e.m.f. and form an incline as shown in fig. A bar of mass 50 g slides without friction down the incline through a vertical magnetic field $B$. If the length of the bar is 50 cm and a current of 2.5 A is provided by the battery, for what value of $B$ will the bar slide at a constant velocity ? [$g$ = 10 m/s$^2$, sin 37º = 3/5]




(1) 0.6 T (2) 0.5 T
(3) 0.75 T (4) 0.3 T

99. Two electrons are moving parallel to each other with equal speed $v$, along same direction. The ratio of magnetic and electrical forces between them is

(1) 1 : 2 (2) $v^2 : c^2$
(3) $c : v$ (4) $c^2 : v^2$

100. Two circular coils, each of radius $a$, are held co-axially with the separation between their centres as $a$ (such a combination of two coils is called Helm hottz coils). If current in each coil is $I$ and the directions of currents in both are same, then the magnetic field at the mid-point of the two centres of the coil would be

(1) $\frac{4\mu_0 I}{5\sqrt{5}a}$ (2) $\frac{4\mu_0 I}{3\sqrt{3}a}$

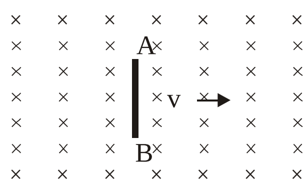
(3) $\frac{8\mu_0 I}{5\sqrt{5}a}$ (4) $\frac{8\mu_0 I}{3\sqrt{3}a}$

**Choose the correct answers :**

1. Induced electrical field is produced by
   (1) moving electrical charges
   (2) varying electrical field
   (3) varying magnetic field
   (4) varying electrical as well as magnetic fields

2. When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance
   (1) remains the same (2) is halved
   (3) is doubled (4) becomes four times

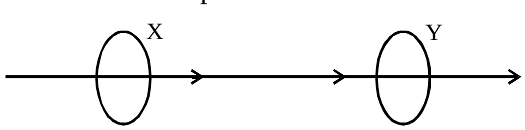
3. If a rod *AB* moves with a uniform velocity *v* in a uniform magnetic field, as shown in figure, then




   (1) the rod becomes electrically charged
   (2) the end *A* becomes positively charged
   (3) the end *B* becomes positively charged
   (4) the rod becomes hot because of Joule heating

4. Out of the following, find the equation which is *not* a Maxwell equation.
   (1) $\oint \vec{B}\cdot\vec{ds} = 0$ (2) $\oint \vec{E}\cdot\vec{ds} = q/\varepsilon_0$
   (3) $\oint \vec{B}\cdot\vec{dl} = \mu_0 I$ (4) $\oint \vec{E}\cdot\vec{dl} = -d\phi_B/dt$

5. Two loops *X* and *Y* shown in the figure have their planes parallel to each other. A clockwise current flows in the loop *X*. The loops will repel each other if the current in loop *X* is



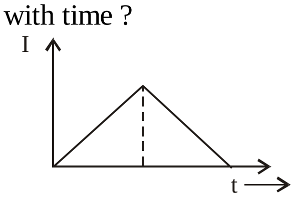

   (1) decreasing (2) sinusoidal
   (3) increasing (4) constant

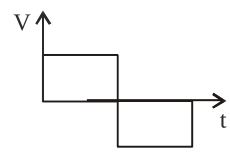
6. A rectangular coil passes through the set of plates *AB* and *CD* moving at uniform speed. The plane of the coil is parallel to the plates. A uniform electric field exists between *AB* and a uniform magnetic field within *CD*. An emf will be induced in the coil
   *A* __________ *B* __________
   *C* __________ *D* __________
   (1) when it enters and leaves the plates *CD*.
   (2) moves completely within plates *CD*.
   (3) when it enters and leaves the plates *AB*
   (4) when it enters and leaves both *AB* and *CD*.

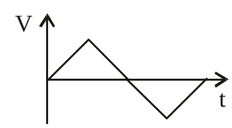
7. Consider the following three statements :
   (i) lines of magnetic field must be closed
   (ii) lines of electric field must be closed
   (iii) lines of induced electric field must be closed

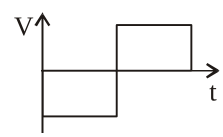
   Out of the above statements,
   (1) only (i) is correct
   (2) only (i) and (ii) are correct
   (3) only (i) and (iii) are correct
   (4) all the three are correct

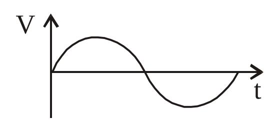
8. The current *I* in an inductance coil varies with time t according to the graph shown in figure. Which one of the following plots shows the variation of voltage in the coil with time ?




(1) 

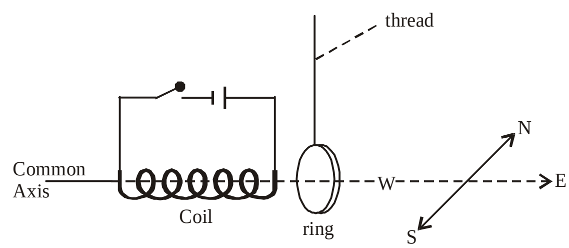
(2) 


(3) 

(4) 


9. Which one of the following statements is *wrong* about induced electric field produced by changing magnetic field ?
   (1) It forms closed loops (like magnetic field lines)
   (2) Electric potential cannot be associated with it
   (3) It is non-conservative
   (4) None of these

10. An aluminium ring hangs vertically from a thread with its axis pointing east-west. A coil is fixed near to the ring and coaxial with it.



What is the initial motion of the aluminium ring when the current in the coil is switched on ?

(1) Remains at rest (2) Moves towards S

(3) Moves towards W (4) Moves towards E

11. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant, uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. Select the correct statement from the following :

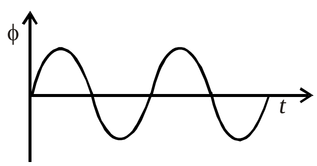
(1) The entire rod is at the same potential

(2) There is an electric field in the rod

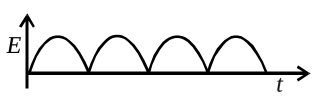
(3) The electric potential is highest at the centre of the rod and decreases towards its ends

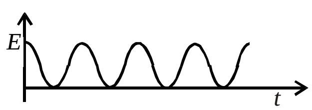
(4) The electric potential is lowest at the centre of the rod and increases towards its ends

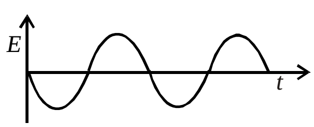
12. The magnetic flux $\phi$ through a coil varies with time $t$ as shown in the diagram.

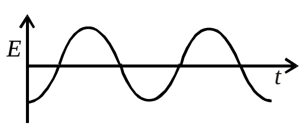



Which graph best represents the variation of the e.m.f. $E$ induced in the coil with time $t$ ?

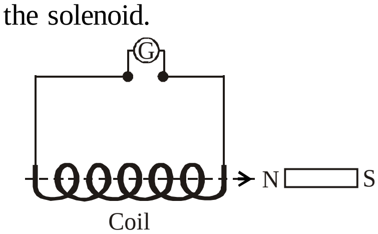
(1) 


(2) 

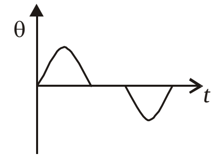

(3) 

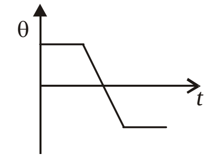

(4) 

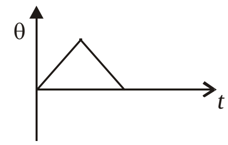

13. A short bar magnet passes at a steady speed right through a long solenoid. A galvanometer is connected across the solenoid.

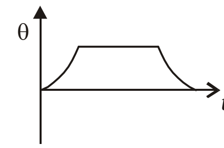



Which graph best represents the variation of the galvanometer deflection θ with time $t$ ?

(1) 


(2) 


(3) 


(4) 


14. A cylindrical magnet is kept along the axis of a circular coil. On rotating the magnet about its axis, the coil will have induced in it,

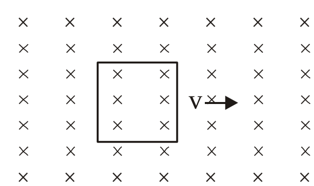
(1) no current

(2) a current

(3) only an e.m.f.

(4) both an e.m.f. and a current

15. A conducting square of side $l$ and resistance $R$ moves in its plane with a uniform velocity $v$ perpendicular to one of its side. A uniform and constant magnetic field $B$ exists along the perpendicular to the plane of the loop as shown in figure. The current induced in the loop is



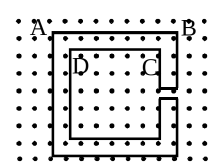

(1) $Blv / R$ clockwise

(2) $Blv / R$ anticlockwise

(3) $2Blv / R$ anticlockwise

(4) zero

16. A wire is bent to form a double loop and then is placed in a region in which magnetic field is decreasing at a constant rate. The induced currents in the wire are




(1) along $CD$ and along $BA$

(2) along $DC$ and along $AB$

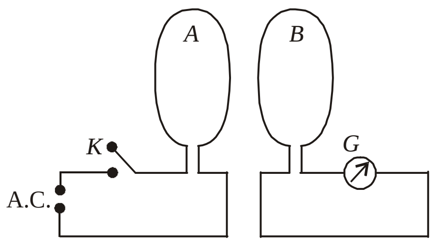
(3) along $CD$ and along $AB$

(4) along $DC$ and along $BA$

17. A horse-shoe magnet is placed in the vertical position with its north pole on the upper side. A sheet of copper is pushed into the gap of the magnet. On viewing from above the eddy currents in the sheet would flow in

(1) north direction (2) anticlockwise direction
(3) south direction (4) clockwise direction

18. Figure shows two coils $A$ and $B$ placed parallel to each other at a very small distance. Coil $A$ is connected to an A.C. supply. $G$ is very sensitive galvanometer. When the key is closed,

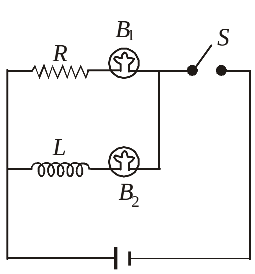



(1) constant deflection will be observed in the galvanometer for a 50 Hz supply
(2) visible small variations will be observed in the galvanometer for 50 Hz input
(3) oscillations in the galvanometer may be observed when the input A.C. voltage has frequency 1 to 2 Hz
(4) no vibration will be observed in the galvanometer even when the input A.C. voltage is 1 to 2 Hz.

19. The back emf in a dc motor is maximum when
(1) the motor has picked up maximum speed
(2) the motor has just started moving
(3) the speed of the motor is still on the rise
(4) the motor has just been switched off

20. A metallic ring with a cut is held horizontally and a magnet is allowed to fall vertically through the ring. Then the acceleration of this magnet is
(1) equal to $g$
(2) more than $g$
(3) less than $g$
(4) some times less and some times more than $g$

21. Following figure shows two bulbs $B_1$ and $B_2$, resistor $R$ and an inductor $L$ connected to a battery. When $S$ is switched off



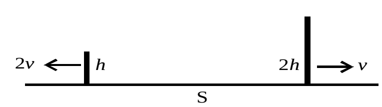

(1) both $B_1$ and $B_2$ die out promptly
(2) both $B_1$ and $B_2$ die out with some delay
(3) $B_2$ dies out promptly but $B_1$ with some delay
(4) $B_1$ dies out promptly but $B_2$ with some delay

22. A galvanometer is connected to the secondary coil. The galvanometer shows an instantaneous maximum deflection of 7 divisions when current is started in the primary coil of the solenoid. Now if the primary coil is rotated through 180º, then the new instantaneous maximum deflection will be
(1) 7 units (2) 14 units
(3) 0 unit (4) 21 units

23. An aeroplane is flying horizontally with a velocity of 720 km/hr. The distance between the tips of the wings of the aeroplane is 25 m. The vertical component of earth's magnetic field is $4 \times 10^{-4}$ weber/m$^2$. The induced e.m.f. is
(1) 2 V (2) 200 V
(3) 2 mV (4) 2 kV

24. The two rails of a railway track insulated from each other and the ground, are connected to millivoltmeter. What is the reading of the millivoltmeter when a train passes at a speed of 180 km/hr along the track, given that the vertical component of earth's magnetic field is $0.2 \times 10^{-4}$ wb/m$^2$ and rails are separated by 1 m ?
(1) $10^{-2}$ volt (2) 10 mV
(3) 1 volt (4) 1 mV

25. Two conducting rods of heights $h$ and $2h$ move in opposite directions with velocities $2v$ and $v$, respectively, with their lower ends in contact with the conducting surface $S$. There is a uniform magnetic field of induction $B$ perpendicular to the plane of their motion. The potential difference between the highest points of the two rods is



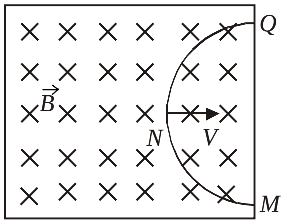

(1) zero (2) $2Bhv$
(3) $4Bhv$ (4) $8Bhv$

26. The magnitude of the earth's magnetic field at a place is $B_0$ and the angle of dip is $\delta$. A horizontal conductor of length $l$, lying north-south, moves eastwards with a velocity $v$. The emf induced across the rod is
(1) zero (2) $B_0lv$
(3) $B_0lv \sin \delta$ (4) $B_0lv \cos \delta$

27. In the previous question, if the conductor lies east-west and moves vertically up with a speed $v$, then the induced emf is

(1) zero (2) $B_0lv$
(3) $B_0lv \sin \delta$ (4) $B_0lv \cos \delta$

28. A thin semicircular conducting ring of radius $R$ is moving with its plane horizontal in a vertical magnetic induction $B$ (see figure).




At the position $MNQ$, when the speed of ring is $V$, potential difference developed across the ring is
(1) $2RBV$ and $M$ is at higher potential
(2) $BV\pi r^2/2$ and $M$ is at higher potential
(3) $\pi RBV$ and $Q$ is at higher potential
(4) $2RBV$ and $Q$ is at higher potential

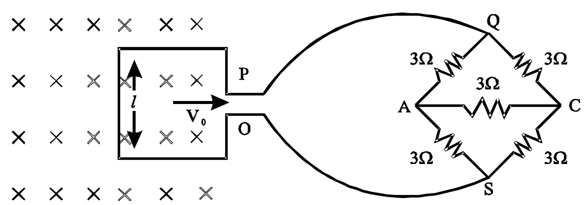
29. A rod of length $x$ is rotated about an axis, perpendicular to its length and passing through its centre, with an angular velocity $\omega$ in a uniform magnetic induction $B$. The potential difference across its two ends is
(1) $\frac{B\omega x^2}{2}$ (2) $\frac{B\omega x^2}{8}$
(3) zero (4) none of these

30. A horizontal ring of radius $r$ spins about its axis with an angular velocity $\omega$ is a uniform vertical magnetic field of magnitude $B$. The induced emf in the ring is
(1) zero (2) $\pi r^2 \omega B$
(3) $^1/_2 r^2 \omega B$ (4) $r^2 \omega B$

31. A circular copper disc of radius 5 cm rotates at 30 rev/sec about an axis through its centre and at right angles to the disc. A uniform magnetic field of induction B of 1 Wb/metre$^2$ is perpendicular to disc. What potential difference is developed between the axis of the disc and rim ?
(1) 0.023 V (2) 0.23 V
(3) 23 V (4) 230 V

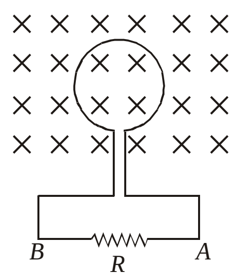
32. A metal rod of resistance $R$ is fixed along a diameter of a conducting ring of radius $r$. There is magnetic field of magnitude $B$, perpendicular to the plane of the loop. The ring spins with an angular velocity $\omega$ about its axis. The centre of the ring is joined to its rim by an external conducting wire $W$. The current in the wire $W$ will be
(1) zero (2) $\frac{B\omega r^2}{2R}$
(3) $\frac{B\omega r^2}{R}$ (4) $\frac{B\omega r^2}{4R}$

33. A square metal wire loop of side 10 cm and resistance 1 ohm is moved with a constant velocity $v_0$ in a uniform magnetic field of induction $B$ = 2 Wb/m$^2$, as shown in fig. The magnetic field lines are perpendicular to the plane of the loop. The loop is connected to a network of resistances, each of value 3 ohm. The resistance of the leads wires OS and PQ are negligible. What should be the speed of the loop so as to have a steady current of 1 mA in the loop ?




(1) 4 cm s$^{-1}$ (2) 3 cm s$^{-1}$
(3) 2 cm s$^{-1}$ (4) 1 cm s$^{-1}$

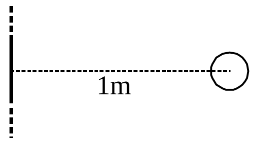
34. The magnetic flux passing perpendicular to the plane of the coil and directed into the paper (see figure) is varying according to the relation $\phi_B = 6t^2 + 7t + 1$, where $\phi_B$ is in milliwebers, and $t$ is in second. What is the magnitude of e.m.f. induced in the loop when $t$ = 2 seconds and the direction of current through resistor $R$ ?




(1) 31 mV; current from $A$ to $B$
(2) 31 mV; current from $B$ to $A$
(3) 17 mV; current from $A$ to $B$
(4) 17 mV; current from $B$ to $A$

35. Flux $\phi$ (in weber) in a closed circuit of resistance 10 ohm varies with time $t$ ( in sec) according to the equation $\phi = 6t^2 - 5t + 1$. What is the magnitude of the induced current at t = 0.25 s ?
(1) 1.2 A (2) 0.8 A
(3) 0.6 A (4) 0.2 A

36. A current $I = 3.36\ (1+2t) \times 10^{-2}$ A increases at a steady rate in a long straight wire. A small circular loop of radius $10^{-3}$ m has its plane parallel to the wire and is placed at a distance of 1 m from the wire. The resistance of the loop is $8.4 \times 10^{-4}\ \Omega$. The magnitude and direction of induced current in the loop is




(1) $16\ \pi \times 10^{-12}$ A, clockwise
(2) $16\ \pi \times 10^{-12}$ A, anti-clockwise
(3) $8\ \pi \times 10^{-12}$ A, clockwise
(4) $8\ \pi \times 10^{-12}$ A, anti-clockwise

37. A coil of area 100 cm$^2$ has 500 turns. Magnetic field of 0.1 Weber/metre$^2$ is perpendicular to the coil. The field is reduced to zero in 0.1 second. The induced e.m.f. in the coil is

(1) 1 V (2) 5 V
(3) 50 V (4) zero

38. A wheel with 10 metallic spokes, each 0.5 m long, is rotating with a speed of 120 rev/min in a plane normal to earth's magnetic field of magnitude 0.40 G. The induced e.m.f. between the axle and the rim of the wheel is nearly

(1) 83 μV (2) 33 μV
(3) 48 μV (4) 63 μV

39. A coil of mean area 500 cm$^2$ and having 1000 turns is held perpendicular to a uniform magnetic field of 0.4 gauss. The coil is turned through 180º in 0.1 sec. The average induced e.m.f., at the ends of the coil, is

(1) 4.0 V (2) 0.04 V
(3) 0.25 V (4) 2.5 V

40. A coil of area 100 cm$^2$ having 50 turns is perpendicular to a magnetic field of intensity 0.02 weber/m$^2$. The resistance of the coil is 2 Ω. If it is removed in 1 sec. from the magnetic field, the induced current produced in the coil, is

(1) 100 mA (2) 50 mA
(3) 10 mA (4) 5 mA

41. A coil of mean area 500 cm$^2$ and having 1000 turns is held perpendicular to a uniform field of 0.4 gauss. The coil is turned through 180º in 0.1 second. Then the average induced charge, when total resistance of the circuit is 20 ohm will be

(1) $2 \times 10^{-4}$ C (2) $4 \times 10^{-4}$ C
(3) $2 \times 10^{-6}$ C (4) $4 \times 10^{-6}$ C

42. A loop of area 0.1 m$^2$ rotates with a speed of 60 rev/s with the axis of rotation, perpendicular to a magnetic field $B$ = 0.4 T. If there are 100 turns in the loop, the maximum voltage induced in the loop is

(1) 15.07 V (2) 150.7 V
(3) 1507 V (4) 250 V

43. A rectangular coil of 20 turns and area of cross-section 25 cm$^2$ has a resistance of 10 ohm. If a magnetic field which is perpendicular to the plane of the coil changes at a rate of 1000 tesla per sec, then the current in the coil is

(1) 1.0 ampere (2) 50 ampere
(3) 0.5 ampere (4) 5.0 ampere

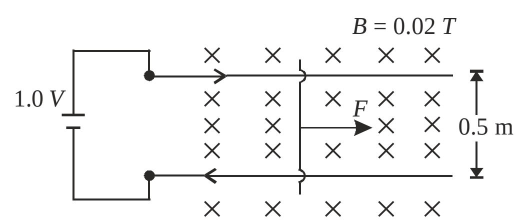
44. A coil of 160 turns of cross-sectional area 250 cm$^2$ rotates at an angular velocity of 300 rad/sec about an axis parallel to the plane of the coil in a uniform magnetic field of 0.6 weber/metre$^2$. If the coil is connected to a resistance of 200 ohm, the amplitude of current through the resistance is

(1) 6.4 A (2) 7.2 A
(3) 1.8 A (4) 3.6 A

45. A closed coil having 50 turns, area 300 cm$^2$, is rotated from a position where its plane makes an angle of 45º with a magnetic field of flux density 2.0 web/m$^2$ to a position perpendicular to the field in a time of 0.1 sec. The average e.m.f. induced in the coil is

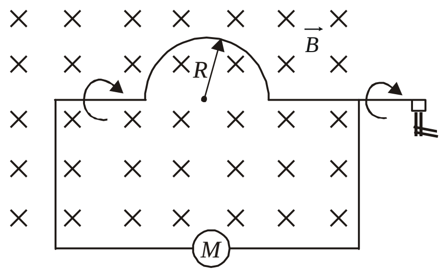
(1) 8.8 V (2) 21.21 V
(3) 17.6 V (4) none of these

46. Two long parallel wires of zero resistance are connected to each other by a battery of 1.0 volt. The separation between the wires is 0.5 m. A metallic bar, which is perpendicular to the wires and of resistance 10 Ω moves on these wires when magnetic field of 0.02 Tesla is acting perpendicular to the plane containing the bar and the wires. Find the steady state velocity of the bar.



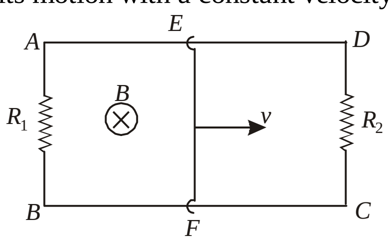

(1) 100 ms$^{-1}$ (2) 10 ms$^{-1}$
(3) 50 ms$^{-1}$ (4) 20 ms$^{-1}$

47. A stiff wire bent into a semicircle of radius $R$ is rotated at a frequency $f$ in a uniform magnetic field $B$. If this circuit has negligible resistance and the internal resistance of the ammeter is 1000 ohm, the amplitude of induced current, shown by ammeter is




(1) $\pi^2 R^2 Bf$ mA (2) $\pi R^2 Bf$ mA
(3) $\pi^2 R^2 B^2 f$ mA (4) $\pi R^2 B^2 f$ mA

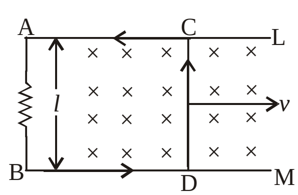
48. A rectangular loop with a sliding connector of length $l$ is located in a uniform magnetic field perpendicular to the loop plane (see figure). The magnetic induction is equal to $B$. The connector has negligible resistance and the sides $AB$ and $CD$ have resistances $R_1$ and $R_2$, respectively. Neglecting the self inductance of the loop, find the current flowing in the connector during its motion with a constant velocity $v$.




(1) $\dfrac{Blv}{R_1+R_2}$ (2) $\dfrac{Blv}{\sqrt{R_1 R_2}}$

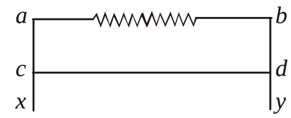
(3) $\dfrac{Blv(R_1+R_2)}{R_1R_2}$ (4) $\dfrac{Blv R_1 R_2}{R_1+R_2}$

49. Two parallel wires $AL$ and $BM$ placed at a distance $l$ are connected by a resistor $R$ and placed in a magnetic field $B$ which is perpendicular to the plane containing the wires. Another wire $CD$ now connects the two wires perpendicularly and made to slide with velocity $v$. Force acting on the wire is




(1) $B^2l^2v^2/R$ (2) $B^2lv/R$
(3) $B^2l^2v/R$ (4) $Blv/R$

50. A wire $cd$ of length $l$ and mass $m$, is sliding without friction on conducting rail $ax$ and $by$ as shown. The vertical rails are connected to each other with a resistance $R$ between $a$ and $b$. A uniform magnetic field $B$ is applied perpendicular to the plane of $abcd$ such that $cd$ moves with a constant velocity of




(1) $mgR/Bl$ (2) $mgR/Bl^2$
(3) $mgR/B^2l^2$ (4) $mgR/B^2l$

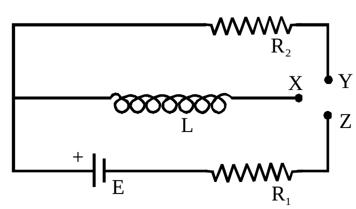
51. Calculate the inductance of a 25 cm long solenoid if it has 1000 turns and radius of its circular cross-section is 5 cm. (Take $\pi^2 = 10$)
(1) 0.4 H (2) 0.5 H
(3) 0.04 H (4) 0.05 H

52. On a cylindrical rod, two coils are wound tightly one above the other. Their coefficient of mutual induction, if the inductance of each coil is 0.1 H, is
(1) 0.1 H (2) 0.2 H
(3) $0.1\sqrt{2}$ H (4) zero

53. Calculate the self inductance of a coil of 100 turns, if a current of 2 amp. gives rise to magnetic flux of $5 \times 10^{-5}$ weber through a coil.
(1) 10 mH (2) 7.5 mH
(3) 2.5 mH (4) 5.0 mH

54. In the above question, calculate the magnetic energy stored in the medium surrounding the coil for the above value of current.
(1) 2.5 mJ (2) 5.0 mJ
(3) 0.5 mJ (4) 1.0 mJ

55. In the circuit shown, $X$ is joined to $Z$ for a long time, and then $X$ is joined $Y$. The total heat produced in $R_2$ would be




(1) $\dfrac{LE^2}{2R_2^2}$ (2) $\dfrac{LE^2}{2R_1^2}$

(3) $\dfrac{LE^2R_2}{2R_1^3}$ (4) $\dfrac{LE^2}{2R_1R_2}$

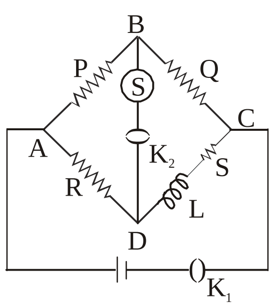
56. A capacitor of capacity 2 μF is charged to a potential difference of 12 V. It is then connected across an inductor of inductance 0.6 mH. The current in the circuit at a time when the p.d. across the capacitor is 6.0 V would be
(1) 0.6 A (2) 1.2 A
(3) 2.4 A (4) 3.6 A

57. The inductance of a 25 cm long solenoid is 0.01 H. If the radius of its circular cross-section is 5 cm and $\pi^2 = 10$, then the number of turns of its coil is
(1) 400 (2) 1000
(3) 250 (4) 500

58. A 50 Hz a.c. current of crest value 1 A flows through the primary of a transformer. If the mutual inductance between the primary and secondary be 1.5 H, the crest voltage induced in the secondary is
(1) 75 V (2) 150 V
(3) 225 V (4) 300 V

59. When the current in a coil changes from 2 A to 4 A in 0.05 sec., an e.m.f. of 8 volt is induced in the coil. The coefficient of self inductor of the coil is
(1) 0.1 henry (2) 0.2 henry
(3) 0.4 henry (4) 0.8 henry

60. The resistances $P$, $Q$, $R$ and $S$ in the bridge shown are so adjusted that the galvanometer shows no deflection when both the keys $K_1$ and $K_2$ are inserted. The galvanometer will show a momentary deflection if




(1) first $K_2$ is inserted and then $K_1$
(2) first $K_1$ is inserted and then $K_2$
(3) $K_1$ and $K_2$ are both inserted and then an additional small resistance is put in the arm $BD$
(4) in all the above cases

61. The current in a coil of self-inductance 2.0 henry is increasing according to $I = 2 \sin t^2$ A. The amount of energy spent during the period when the current changes from 0 to 2 A is
(1) 4.0 J (2) 4.8 J
(3) 6.0 J (4) 6.4 J

62. Two different coils have self-inductances $L_1 = 8$ mH and $L_2 = 2$ mH. In both the coils, energy stored is same. At that instant, the currents $I_1$ and $I_2$ in the two coils are related as $I_1/I_2$ equal to
(1) 1 (2) 1/4
(3) 4/1 (4) 1/2

63. In the above question, if $W_1$ and $W_2$ are the energies stored in the two coils at the instant current through the coils is same, then $W_2/W_1$ is equal to
(1) 1 (2) 1/4
(3) 4/1 (4) 1/2

64. A motor having an armature of resistance 2.0 ohm operates on 220 V mains. At its full speed, it developes a back e.m.f. of 210 V. The current in the armature when motor is running at full speed is
(1) 2.5 A (2) 5.0 A
(3) 10.0 A (4) 110 A

65. When a D.C. motor has maximum output of power, its efficiency is
(1) 50%
(2) $33\frac{1}{3}$%
(3) nearly 90%
(4) nearly but less than 100%

66. Which of the following statement is *wrong*?
(1) $\eta$ of d.c. motor = $\frac{\text{back e.m.f.}}{\text{applied e.m.f.}}$
(2) The back e.m.f. is due to increase in magnetic flux linked with rotor, rotating in magnetic field.
(3) For efficient d.c. motor, back e.m.f. equals applied e.m.f. across it.
(4) Dimensions of back e.m.f. are $ML^2 T^{-3} A^{-1}$

67. An electric motor runs on a D.C. source of e.m.f. $E$ and internal resistance $r$. Then the power output of the source is maximum when the current drawn by the motor is (suppose resistance of armature zero)
(1) $E/2r$ (2) $E/r$
(3) $\infty$ (4) 0

68. In a DC motor, as rotor moves in a magnetic field, induced back e.m.f. is produced in it. If E is the applied e.m.f., then the efficiency of D.C motor is
(1) $\frac{e}{E}$ (2) $\frac{E-e}{E}$
(3) $\frac{E}{E+e}$ (4) $\frac{E-e}{E+e}$

69. An e.m.f. of 300 V is applied across a motor and when it is switched on, a current of 5 A flows through it. If at maximum speed, the current is 3A, the back e.m.f. at maximum speed is
(1) $300 \times \frac{3}{5}$ V (2) $300 \times \frac{2}{5}$ V
(3) $300 \times \frac{1}{5}$ V (4) $300 \times \frac{4}{5}$ V

70. An electric motor runs on a d.c. source of emf 200 V and draws a current of 10 A. If the efficiency of the motor is 40%, then the resistance of its armature is
(1) 6 Ω (2) 8 Ω
(3) 12 Ω (4) 16 Ω

71. A simple electric motor has an armature of resistance 1Ω and runs from a d.c. source of 12 V. When unloaded, it draws a current of 2A. When a certain load is connected, its speed becomes one-half of its unloaded value. Then the current it draws is
(1) 2 A (2) 4 A
(3) 7 A (4) 14 A

72. An inductor of 0.1 H is in series with a resistance of 10 Ω. When it is connected across a D.C. source, the time in which current grows to half the maximum value, is about
(1) 1 ms (2) 7 ms
(3) 3.5 ms (4) 0.693 ms

73. Two coils of self inductances $L_1$ and $L_2$ are placed so close together that effective flux in one coil is completely linked with the other. If $M$ is the mutual inductance between them, then
(1) $M = L_1 + L_2$ (2) $M = (L_1+L_2)/2$
(3) $M = \sqrt{L_1^2 + L_2^2}$ (4) $M = \sqrt{L_1 L_2}$

74. Two coils of negligible mutual inductance, each of self inductance $L$, are closely wound in series. If the sense of their windings are opposite, the equivalent inductance is
(1) 4 $L$ (2) 2 $L$
(3) zero (4) $L/4$

75. A resistance of 10 Ω is in series with an inductor of 0.1 H. At steady state of current through the circuit, if heat produced in the resistor is 40 W, then the energy stored in the inductor is
(1) 0.1 J (2) 4.0 J
(3) 0.2 J (4) 0.4 J

76. $L_1$ and $L_2$ are the self inductances of two coils and $M$ is the mutual inductance between the two. The ratio $M/\sqrt{L_1 L_2}$ is called
(1) coefficient of coupling of the coils
(2) efficiency of the coil
(3) quality factor of the coils
(4) relation of mutual and self inductances of coils

77. Velocity of electromagnetic waves in a medium is
(1) $(\varepsilon_0\ \mu_0)^{-1/2}$ (2) $(\varepsilon_0 \varepsilon_r\ \mu_0 \mu_r)^{-1/2}$
(3) $3 \times 10^8$ ms$^{-1}$ (4) $(\varepsilon_0 \varepsilon_r / \mu_0 \mu_r)^{+1/2}$

78. Which of the following pairs of space and time varying $E$ and $B$ fields would generate a plane electromagnetic wave travelling along the $Z$ direction?
(1) $E_x, B_y$ (2) $E_y, B_x$
(3) $E_x, B_z$ (4) $E_z, B_x$

79. $\mu_0$ is the permeability of free space or vacuum. Dimensions of $\mu_0 c$ are same as that of
(1) conductance (2) impedence
(3) Plank's constant (4) Boltzmann's constant

80. The wave impedance of free space is
(1) zero (2) 377 Ω
(3) $2.65 \times 10^{-3}$ Ω (4) 0.01 Ω

81. The energy in eV, associated with a photon of wavelength 1 m, is nearly
(1) $6.2 \times 10^{-6}$ eV (2) $1.24 \times 10^{-6}$ eV
(3) $1.99 \times 10^{-6}$ eV (4) $6.63 \times 10^{-6}$ eV

82. At what value of electric field intensity in vacuum, the volume energy density of this field is same as that of magnetic field with induction $B$ of 1.0 T, also in vacuum ?
(1) 1.0 V/m (2) $1.732 \times 10^4$ V/m
(3) $3 \times 10^8$ V/m (4) None of these

83. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of $2 \times 10^{10}$ Hz and amplitude 48 Vm$^{-1}$. The total average energy density is nearly
(1) $0.5 \times 10^{-8}$ Jm$^{-3}$ (2) $2 \times 10^{-8}$ Jm$^{-3}$
(3) $1 \times 10^{-8}$ Jm$^{-3}$ (4) $\sqrt{2} \times 10^{-8}$ Jm$^{-3}$

84. Radio waves with wavelength 300π metres are transmitted from a transmitter. An inductance is connected in series with a capacitor of 1.0μF to receive these waves. The inductance of the coil is
(1) $2.5 \times 10^{-6}$ H (2) $2.5 \times 10^{-7}$ H
(3) $2.5 \times 10^{-5}$ H (4) $2.5 \times 10^{-9}$ H

85. If $E$ and $B$ denote electric and magnetic fields respectively, then which one of the following is dimensionless ?
(1) $\mu_0 \epsilon_0 E/B$ (2) $\mu_0 \epsilon_0 B/E$
(3) $\sqrt{\mu_0 \epsilon_0}\ . E/B$ (4) $\sqrt{\mu_0 \epsilon_0}\ . B/E$

86. Light with an average energy flux of 18 Watt/cm$^2$ falls on a non-reflecting surface, at normal incidence, of area 20 cm$^2$. The average force exerted by the light on this surface during 30 minutes is

(1) $2.16 \times 10^{-3}$ N (2) $0.6 \times 10^{-6}$ N
(3) $2.4 \times 10^{-6}$ N (4) $1.2 \times 10^{-6}$ N

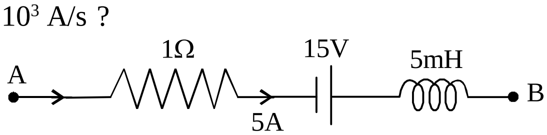
87. A plane electromagnetic wave of frequency 25 MHz travels in free space along *x*-direction. At a particular point in space and time, electric field intensity $\vec{E}$ of the wave is $6.3\,\hat{j}$ Vm$^{-1}$. At this point, magnetic field intensity $\vec{B}$ of the wave is

(1) $2.1 \times 10^{-8}\,\hat{k}$ T (2) $2.1 \times 10^{-8}\,\hat{j}$ T
(3) $-2.1 \times 10^{-8}\,\hat{j}$ T (4) $-2.1 \times 10^{-8}\,\hat{k}$ T

88. An observer is at a distance of one metre from a point light source whose power output is 1 kW. Calculate the magnitude of electric field, assuming that the source is monochromatic, radiating uniformly in all directions and that at the point of observation the wave is plane.

(1) $100\sqrt{2}$ Vm$^{-1}$ (2) $100\sqrt{3}$ Vm$^{-1}$
(3) $100/\sqrt{2}$ Vm$^{-1}$ (4) $100/\sqrt{3}$ Vm$^{-1}$

89. The network shown in fig. is a part of a complete circuit. What is the potential difference $V_B - V_A$, when the current $I$ is 5*A* and is decreasing at a rate of $10^3$ A/s ?




(1) 20 V (2) – 25 V
(3) 15 V (4) 10 V

90. An infinitesimal bar magnet of dipole moment $M$ is pointing and moving with speed $v$ in the *x*-direction. A closed circular conducting loop of radius $a$ and negligible self-inductance lies in the *y*-*z* plane with its centre at $x = 0$ and its axis coinciding with *x*-axis. Find the induced current in the circular loop, if the resistance of the loop is $R$. Assume that the distance $x$ of the magnet from the centre of the loop is much greater than $a$.

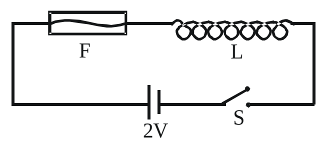
(1) $\frac{\mu_0}{4\pi}.\frac{6\pi Ma^2}{Rx^4}.v$ (2) $\frac{\mu_0}{4\pi}.\frac{6\pi Ma^2}{Rx^2}.v$

(3) $\frac{\mu_0}{4\pi}.\frac{3\pi Ma^2}{Rx^4}.v$ (4) $\frac{\mu_0}{4\pi}.\frac{3\pi Ma^2}{Rx^2}.v$

91. A conductor $PQ$, with $\overrightarrow{PQ} = \vec{r}$, moves with a velocity $\vec{v}$ in a uniform magnetic field of induction $\vec{B}$. The emf induced in the rod is

(1) $(\vec{v} \times \vec{B}).\vec{r}$ (2) $\vec{v}.(\vec{r} \times \vec{B})$
(3) $\vec{B}.(\vec{r} \times \vec{v})$ (4) $|\vec{r} \times (\vec{v} \times \vec{B})|$

92. In the circuit shown, the cell is ideal. The coil has an inductance of 4 H and zero resistance. $F$ is a fuse wire of negligible resistance and will blow when the current through it reaches 5A. The switch is closed at $t = 0$. Then the fuse will blow




(1) almost instantly (2) after 5 sec.
(3) after 10 sec. (4) after 20 sec.

93. Three identical rings move with the same speed on a horizontal surface in a uniform horizontal magnetic field normal to the planes of the rings. The first (*A*) slips without rolling, the second (*B*) rolls without slipping, and the third (*C*) rolls with slipping. Then,

(1) the same emf is induced in any of the rings
(2) no emf is induced in any of the rings
(3) in each ring all points are at the same potential
(4) *B* develops the maximum induced emf, and *A*, the least

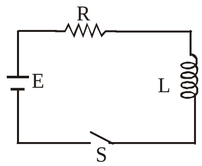
94. A small coil of radius $r$ is placed at the centre of a large coil of radius $R$, where $R >> r$. The two coils are coplanar. The mutual induction between the coils is proportional to

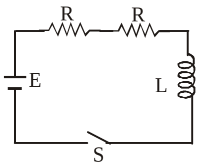
(1) $r/R$ (2) $r^2/R$
(3) $r^2/R^2$ (4) $r/R^2$

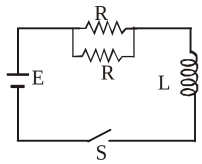
95. Two coils, $A$ and $B$ are linked such that emf $E$ is induced in $B$ when the current in $A$ is changing at the rate of $\dot{I}$. If now the current flowing through $B$ is $i$, then the magnetic flux linked with $A$ would be

(1) $Ei/\dot{I}$ (2) $E\dot{I}/i$
(3) $\dot{I}i/E$ (4) $E\dot{I}i$

96. In which of the following circuits, rate of growth of current is maximum just after the switch $S$ is closed ?

(1) 


(2) 


(3) 


(4) Equal in all the cases

97. A radiowave of intensity 1 $Wm^{-2}$ is reflected by a surface. The pressure exerted on the surface is
(1) $6.67 \times 10^{-9}$ $Nm^{-2}$ (2) $3.33 \times 10^{-9}$ $Nm^{-2}$
(3) $6.67 \times 10^{-8}$ $Nm^{-2}$ (4) $3.33 \times 10^{-8}$ $Nm^{-2}$

98. A capacitor of capacitance 80 pF is being charged by an external source. The charging current is constant and is equal to 0.15 A. The rate of change of potential difference across the plates is
(1) $18.75 \times 10^{9}$ $Vs^{-1}$ (2) $1.875 \times 10^{9}$ $Vs^{-1}$
(3) $12.0 \times 10^{9}$ $Vs^{-1}$ (4) $1.2 \times 10^{9}$ $Vs^{-1}$

99. The magnetic flux linked with a coil is $\phi$ and the emf induced in it is $e$. Then,
(1) if $\phi = 0$, $e$ must be 0
(2) if $\phi \neq 0$, $e$ cannot be 0
(3) if $e$ is not 0, $\phi$ may or may not be 0
(4) none of the above is correct

100. At $t = 0$, an inductor of zero resistance is joined to a cell of emf $\varepsilon$ through a resistance. The current increases with a time constant $\tau$. The emf across the coil after time $t$ is
(1) $\varepsilon t/\tau$ (2) $\varepsilon(1-e^{-t/\tau})$
(3) $\varepsilon e^{-t/\tau}$ (4) $\varepsilon e^{-2t/\tau}$

* * * * *

**Choose the correct answers :**

1. The instant value of alternating voltage of electrical power supplied in India is
   (1) $220 \sin 50 \pi t$ V (2) $310 \sin 314\, t$ V
   (3) $220 \sin 314\, t$ V (4) $310 \sin 100\, t$ V

2. In general, in an alternating current circuit,
   (1) the average value of current is zero
   (2) the average value of square of current is zero
   (3) average power dissipated is zero
   (4) the phase difference between voltage and current is zero

3. In an *ac* current, over a complete cycle, average value of
   (1) current as well as of power are zero
   (2) both current as well as of power are non-zero
   (3) current is zero but that of power is non-zero
   (4) current is non-zero but that of power is zero

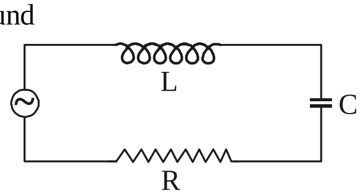
4. Which of the following pairs have different units ?
   (1) Impedance and reactance
   (2) $RC$ and $L/R$
   (3) Resistance and capacitance
   (4) Electromotive force and electric potential

5. Which of the following does *not* represent 'form factor' of *ac* ?
   (1) $I_{rms}/I_{av}$ (2) $E_{rms}/E_{av}$
   (3) 1.11 (4) $2\sqrt{2}/\pi$

6. Resonant frequency of $LCR$ circuit depends on
   (1) applied frequency of AC source
   (2) values of $L$, $C$ and $R$ only
   (3) values of $L$ and $C$ only
   (4) values of $L$ and $R$ only

7. In a resonant $LCR$ circuit, if resistance, capacitance and inductance are decreased by 10% each, then the new resonant frequency
   (1) will decrease by 10%
   (2) will increase by 10%
   (3) will increase by 11%
   (4) will increase by 11.7%

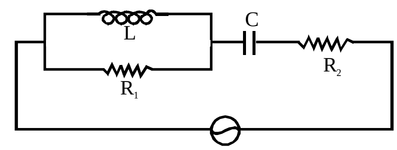
8 In the circuit shown below, $L = 1\ \mu$H, $C = 1$ nF and $R = 100\ \Omega$. The natural frequency of the circuit is around




   (1) 5 MHz (2) 50 kHz
   (3) 10 MHz (4) 1 MHz

9. A bulb is switched on and the applied a.c. voltage remains constant all the time. The intensity of light emitted by it will
   (1) remains constant all the time
   (2) increase from initial value before stabilising
   (3) decrease from initial value before stabilising
   (4) be fluctuating and it can also be observed

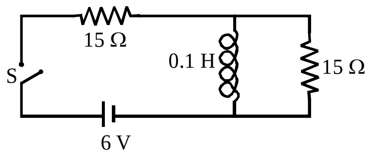
10. In the circuit shown, if $V_L$ and $V_{R_1}$ are potential differences across $L$ and $R_1$ respectively and $I_L$ and $I_{R_1}$ are the respective currents, then




   (1) $V_L$ and $V_{R_1}$ as well as $I_L$ and $I_{R_1}$ are in same phase
   (2) $I_L$ lags behind $I_{R_1}$ in phase by $\pi/2$ and $V_L$ also lags behind $V_{R_1}$ in phase by $\pi/2$
   (3) $V_L$ and $V_R$ are in phase but $I_{R_1}$ leads $I_L$ in phase by $\pi/2$
   (4) $V_L$ and $V_{R_1}$ are in phase but $I_L$ leads $I_{R_1}$ in phase by $\pi/2$

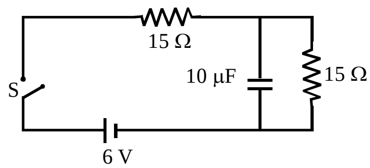
11. In the above question, if $V_C$ and $V_{R_2}$ are potential differences across $C$ and $R_2$, respectively, and $I_C$ and $I_{R_2}$ are their respective currents, then
   (1) $V_C$ and $I_{R_2}$ as well as $I_C$ and $I_{R_2}$ are in same phase
   (2) $V_C$ lags behind $V_{R_2}$ as well as $I_C$ lags behind $I_{R_2}$ in phase by $\pi/2$
   (3) $V_C$ leads $V_{R_2}$ in phase by $\pi/2$ but $I_C$ and $I_{R_2}$ are in same phase
   (4) $V_C$ lags behind $V_{R_2}$ in phase by $\pi/2$ but $I_C$ and $I_{R_2}$ are in phase

12. In the following circuit, when the circuit is closed, the initial and the final currents through the inductor are, respectively,




(1) 0 and 0.2 A (2) 0.2 A and 0.4 A
(3) 0.4 A and 0.2 A (4) 0 and 0.4 A

13. In the following circuit, when the circuit is closed, the initial and the final currents drawn from the cell are, respectively




(1) 0 and 0.2 A (2) 0.2 A and 0.4 A
(3) 0.4 A and 0.2 A (4) 0 and 0.4 A

14. When electric device $X$ is connected to a 220 V, 50 Hz supply, the current is 0.5 A and is in phase with the applied voltage. When another device $Y$ is connected to the same supply the current is again 0.5 A but it leads the applied voltage in phase by $\pi/2$. Now, if both $X$ and $Y$, joined in series, are applied across the same source, then current in the circuit would be
(1) 0.50 A (2) 0.45 A
(3) 0.35 A (4) 0.30 A

15. In the above question, electrical devices $X$ and $Y$ are, respectively,
(1) a resistor and an inductor
(2) an inductor and a capacitor
(3) a resistor and a capacitor
(4) a capacitor and an inductor

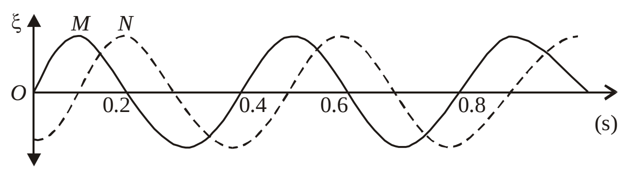
16. In $LCR$ circuit, volage leads current in phase by 45º. The ratio of power consumed in 'complete $LCR$ circuit' and 'resistance $R$' alone is
(1) $\sqrt{2} : 1$ (2) $1 : (\sqrt{2} - 1)$
(3) $(\sqrt{2} + 1) : 1$ (4) $1 : 1$

17. The ratio of mean value over half cycle to rms value of a.c. is
(1) $2 : \pi$ (2) $2\sqrt{2} : \pi$
(3) $\sqrt{2} : 1$ (4) $\sqrt{2} : \pi$

18. In series $LCR$ circuit, voltage lags behind the current when (where $\omega_0$ is resonant frequency)
(1) $\omega < \omega_0$ (2) $\omega = \omega_0$
(3) $\omega > \omega_0$ (4) none of these

19. In an $LCR$ series circuit, if $\omega^2 > \frac{1}{LC}$, then
(1) applied voltage leads the current
(2) applied voltage lags behind the current
(3) applied voltage is in phase with the current
(4) no relation of phase, between applied voltage and the current, can be established from the given relation

20. Two sinusoidal voltages of the same frequency are shown in the diagram.




What is the frequency, and the phase relationship between the voltages ?

| | Frequency in Hz | Phase lead of N over M in radians |
|---|---|---|
| (1) | 0.4 | $-\pi/4$ |
| (2) | 2.5 | $-\pi/2$ |
| (3) | 2.5 | $+\pi/2$ |
| (4) | 2.5 | $-\pi/4$ |

21. A 20 volt *ac* is applied to a circuit consisting of a resistance and a coil with a negligible resistance. If the voltage across the resistance is 12 volts, the voltage across the coil is
(1) 16 volts (2) 6 volts
(3) 8 volts (4) 10 volts

22. The peak value of an alternating e.m.f. $E = E_0 \cos \omega t$ is 10 volts and its frequency is 50 Hz. At a time $t$ = 1/600 s, the instantaneous value of the e.m.f. is
(1) 1 volts (2) $5\sqrt{3}$ volts
(3) 5 volts (4) 10 volts

23. In an *ac* circuit, the instantaneous values of e.m.f. and current are $E = 200 \sin 314\,t$ volts and $I = \sin (314\,t + \pi/3)\,A$. The average power consumed in watts is
(1) 100 (2) 200
(3) 50 (4) 25

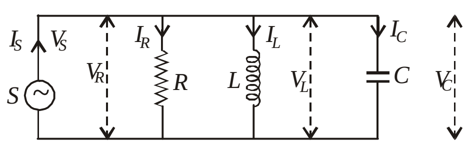
24. An alternating voltage, $E$ (in volt) = $200\sqrt{2}$ sin 100 $t$ is connected to one micro farad capacitor through an *ac* ammeter. The reading of the ammeter would be
(1) 40 mA (2) 20 mA
(3) 10 mA (4) 80 mA

25. An inductive coil has a resistance of 100 Ω. When an *ac* signal of frequency 1000 Hz is fed to the coil, the applied voltage leads the current by 45°. What is the inductance of the coil ?
(1) 20 mH (2) 12 mH
(3) 16 mH (4) 10 mH

26. The alternating voltage, $E = 220 \sin(\omega t + \pi/6)$ and the alternating current, $I = \sin(\omega t - \pi/6)$ pass through a circuit. If $E$ is in volts and $I$ is in ampere, then power consumed in the circuit is
(1) 55 W (2) $55\sqrt{3}$ W
(3) 110 W (4) zero

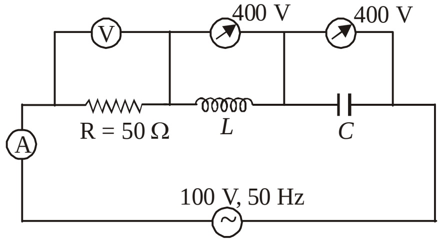
27. In *LCR* series circuit, phase between
(i) current through $L$ and current through $C$ and
(ii) voltage across $L$ and voltage across $C$,
are respectively,
(1) π/2, π/2 (2) 0, π/2
(3) π/2, π (4) 0, π

28. An *ac* source is connected in parallel with an *L-C-R* circuit as shown. Let $I_S$, $I_R$, $I_L$ and $I_C$ denote the currents through the circuit, the resistor, the inductor and the capacitor, respectively, and $V_S$, $V_R$, $V_L$ and $V_C$ denote the voltages across the corresponding components. Then,




(1) $V_S = V_R + V_L + V_C$ (2) $I_S = I_R + I_L + I_C$
(3) $(I_R, I_L, I_C) < I_S$ (4) $I_L$, $I_C$ may be > $I_S$

29. In the series *L-C-R* circuit (see figure), the voltmeter and ammeter readings are




(1) $V$ = 100 volt, $I$ = 2 amp.
(2) $V$ = 100 volt, $I$ = 5 amp.
(3) $V$ = 1000 volt, $I$ = 2 amp.
(4) $V$ = 300 volt, $I$ = 1 amp.

30. Wattless current is the current flowing through
(1) a resonant *LCR* series circuit
(2) a resonant *LCR* parallel circuit
(3) a pure non-ohmic inductor
(4) an oscillatory *LC* circuit

31. An inductance has a high resistance to *ac* and low to *dc*. When a *dc* voltage source having some *ac* component superimposed on it sends current through an inductance to a load resistance, then
(1) the *dc* voltage falls appreciably across the load and *ac* component falls only a small amount
(2) the *ac* and *dc* voltage fall by the same small percentage
(3) the *ac* voltage falls appreciably across the load and *dc* voltage falls by only a small amount
(4) both *ac* and *dc* voltage fall to nearly zero

32. In *LCR* circuit, applied voltage leads current in phase by $\cos^{-1}$ (12/13). If ohmic resistance is 30 Ω, then the impedence and the reactance of the circuit are, respectively,
(1) 36 Ω and 12.5 Ω (2) 32.5 Ω and 10.0 Ω
(3) 32.5 Ω and 12.0 Ω (4) 32.5 Ω and 12.5 Ω

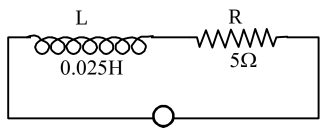
33. A sinusoidal supply of frequency 100 Hz and r.m.s. voltage 12 V is connected to a 2.1 μF capacitor. What is the r.m.s. value of the current ?
(1) 11.2 mA (2) 18.54 mA
(3) 22.4 mA (4) 15.84 mA

34. When 100 volt *dc* is applied across a solenoid, a current of 1.0 *A* flows in it. When 100 volt *ac* is applied across the same coil, the current drops to 0.5 *A*. If the frequency of *ac* source is 50 Hz, the impedance and inductance of the solenoid are
(1) 200 ohm and 0.55 henry
(2) 100 ohm and 0.86 henry
(3) 200 ohm and 1.0 henry
(4) 100 ohm and 0.93 henry

35. A choke coil has
(1) high inductance and low resistance
(2) low inductance and low resistance
(3) high inductance and high resistance
(4) low inductance and high resistance

36. Average value of alternating voltage of amplitude $E_0$, over complete cycle is zero. But average value of same alternating voltage over quarter cycle is
(1) $E_0/\pi$ (2) $2E_0/\pi$
(3) $E_0/2\pi$ (4) zero

37. For the $LR$ circuit shown in figure, the phase angle, for frequency of $a.c.$ $100/\pi$ Hz, would be




(1) 60° (2) 45°
(3) 30° (4) 90°

38. In series $LR$ circuit $Z_L = 3R$. Now capacitor with $Z_C = R$ is added in series. Ratio of new to old power factor is
(1) $\sqrt{2}$ (2) $1/\sqrt{2}$
(3) 2 (4) 1

39. A capacitor is having a capacitance of 2pF. Electric potential across the capacitor is changing with a value of $10^{12}$ volt/sec. The displacement current is
(1) 2 A (2) 3 A
(3) 6 A (4) 9 A

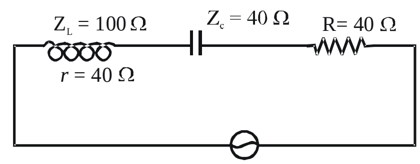
40. Inductive reactance of 25 Ω and capacitive reactance of 75 Ω are connected in series across 250 V a.c. mains. The rms voltage across the capacitor is
(1) 187.5 V (2) 250 V
(3) 375 V (4) 125 V

41. The capacitor of an oscillatory circuit of negligible resistance is enclosed in a container. When the container is evacuated, the frequency of the circuit is $n_1$ and when it is filled with a gas, the frequency changes to $n_2$. The dielectric constant of the gas is
(1) $\sqrt{n_1/n_2}$ (2) $\sqrt{n_2/n_1}$
(3) $(n_1/n_2)^2$ (4) $(n_2/n_1)^2$

42. A resistor of 12Ω, a capacitor of reactance 14 Ω and an inductor of reactance 30 Ω are joined in series and placed across 200 V, 50 Hz ac supply. Potential difference across the inductor would be
(1) 90 V (2) 200 V
(3) 160 V (4) 300 V

43. A circuit consisting of an inductance and a resistance are joined to a 200 V $ac$ supply and the current drawn is 10 A. If power used in the circuit is 1500 W, then the power factor of the circuit is
(1) 3/4 (2) 2/15
(3) 2/3 (4) 3/5

44. In the following circuit, the power factor is




(1) 0.2 (2) 0.4
(3) 0.6 (4) 0.8

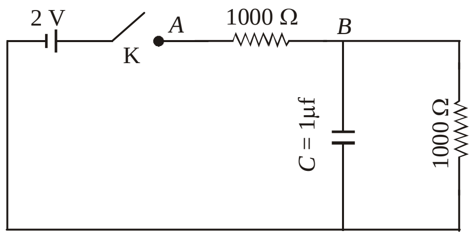
45. In pure charged $LC$ circuit, $L$ = 0.1 H and $C$ = 10 μF. If the maximum current in the circuit, at any instant is 10 A, then that at any other instant maximum charge across the capacitor can be
(1) 0.02 C (2) 0.01 C
(3) 0.05 C (4) 0.04 C

46. The peak value of current is 10 A and its frequency is 50 Hz. Starting from zero, the value of current becomes rms value after a time of
(1) $2\sqrt{2}$ ms (2) $5/\sqrt{2}$ ms
(3) 2.5 ms (4) 5.0 ms

47. In $LCR$ series circuit, $R$ = 100 Ω, $L$ = 0.3 H and $C$ = 40 μF and applied voltage is 300 sin 250 $t$ volt. To make the circuit resonant, additional ............ should be added in series
(1) inductance of 0.1 H
(2) inductance of 0.3 H
(3) capacitance of 20 μF
(4) capacitance of 40 μF

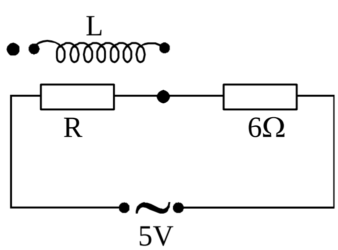
48. Inductor of what reactance should be added in series with a resistor of 20 Ω to reduce the power loss by 50% ?
(1) $10\sqrt{3}$ Ω (2) $20\sqrt{3}$ Ω
(3) $10/\sqrt{3}$ Ω (4) $20/\sqrt{3}$ Ω

49. When the key $K$ is pressed at time $t$ = 0, which of the following statements about the current $I$ in the resistor $AB$ of the following circuit is true ?




(1) $I = 2$ mA at all $t$
(2) $I$ oscillates between 1 mA and 2 mA
(3) $I = 2$ mA finally
(4) At $t = 0$, $I = 2$ mA and with time it goes to 1 mA

50. Two resistors are connected in series across a 5V. r.m.s. source of alternating potential. The potential difference across the 6Ω resistor is found to be 3V r.m.s. If $R$ is replaced by a pure indeuctor $L$ of such magnitude that the current remains unchanged, what is the potential difference across $L$ ?




(1) 2 V (2) 3 V
(3) 4 V (4) 5V

51. An ideal coil of 10 H is joined in series with a resistance of 5 ohm and a battery of 5 V. 2 sec after joining, the current flowing (in ampere) in the circuit will be
(1) $e^{-1}$ (2) $(1 - e^{-1})$
(3) $(1 - e)$ (4) $e$

52. A cell of 1.5 V is connected across an inductor of 2 mH in series with a 2 Ω resistor. What is the rate of growth of current, immediately after the cell is switched on ?
(1) 150 $As^{-1}$ (2) 750 $As^{-1}$
(3) 450 $As^{-1}$ (4) 7.5 $As^{-1}$

53. An $LCR$ series circuit with 100Ω resistance is connected to an $ac$ source of 200 V and angular frequency 300 rad/s. When only the capacitance is removed, the current lags behind the voltage by 60º. When only the inductance is removed, the current leads the voltage by 60º. The power dissipated in the $LCR$ circuit is
(1) zero (2) 200 W
(3) 300 W (4) 400 W

54. A choke coil is needed to operate an arc lamp at 160 V (rms) and 50 Hz. The arc lamp has an effective resistance of 9.6 Ω when running at 10 A (rms) The inductance of the choke coil needed is nearly
(1) 48 mH (2) 40 mH
(3) 60 mH (4) 96 mH

55. The electric current in an $ac$ circuit is given by $I = I_0 \sin \omega t$. What is the time taken by the current to change from its maximum value to the rms value ?
(1) T/6 (2) T/4
(3) T/8 (5) T/3

56. A coil having an inductance of (1/π) H is connected in series with a resistance of 300 ohm. If 200 volts from a 200 cycle source are impressed across the combination, the current in the circuit is
(1) 0.4 A (2) 0.6 A
(3) 0.8 A (4) 1.0 A

57. In a region of uniform magnetic induction $B = 10^{-2}$ tesla, a circular coil of radius 30 cm and resistance $\pi^2$ ohm is rotated about an axis which is perpendicular to the direction of $B$ and which forms a diameter of the coil. If the coil rotates at 200 rpm, the amplitude of the alternating current induced in the coil is
(1) $4\pi^2$ mA (2) 200 mA
(3) 6 mA (4) 30 mA

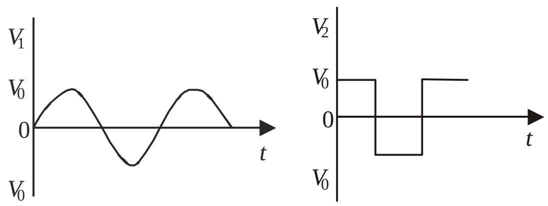
58. In $LR$ series circuit, current lags voltage by phase angle of π/3. If $R$ = 10 Ω, then inductive reactance of the circuit is
(1) 5.0 Ω (2) 17.32 Ω
(3) 20 Ω (4) 8.66 Ω

59. A coil takes a current of 2.0 A and 200 W power from an $ac$ source of 220 V, 50 Hz. If inductance of coil is 0.1 H then the resistance of the coil is
(1) 200 Ω (2) 98 Ω
(3) 50 Ω (4) 75 Ω

60. Power factor of $LCR$ series circuit is 0.5. If reactance of the circuit is 173.2 Ω, then the impedance of the circuit is
(1) 300 Ω (2) 346.4 Ω

(3) $200\ \Omega$ (4) $200\sqrt{3}\ \Omega$

61. The sinusoidal potential difference $V_1$ shown in figure (a), applied across a resistor $R$, produces heat at a mean rate $W$.




(a) (b)

What is the mean rate of production of heat when the square-wave potential difference $V_2$ shown in figure (b) is applied across the resistor ?

(1) $W/2$ (2) $W$

(3) $\sqrt{2}\,W$ (4) $2W$

62. In an $LCR$ series circuit $R = 100\ \Omega$, $L = 1.0$ H and $C = 10\ \mu$F. If an alternating voltage $250 \sin 100\,\pi t$ volts is applied across the circuit, the power loss in the circuit (take $\pi^2 = 10$)

(1) may be zero (2) is 825 W

(3) 625 W (4) is 312.5 W

63. An ideal coil of 10 H is joined in series with a resistance of 5 ohm and a battery of 10 V. Two seconds after completing the circuit, the current flowing in the circuit will be nearly

(1) 0.74 A (2) 1.26 A

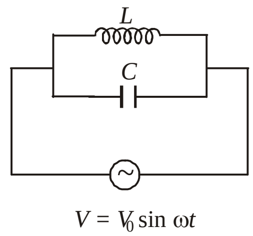
(3) 0.37 A (4) 1.11 A

64. An $LCR$ series circuit with $100\ \Omega$ resistance is connected to an ac source of 200 V and angular frequency 300 rad/s. When only the capacitance is removed, the current lags behind the voltage by 60º. When only the inductance is removed, the current leads the voltage by 60º. The current in the $LCR$ circuit is

(1) 0.5 A (2) 1.0 A

(3) 2.0 A (4) 2.5 A

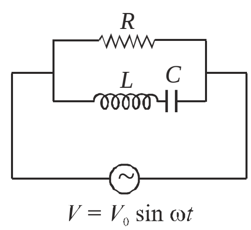
65. In the following circuit current through inductor is 0.9 A, while the current through capacitor is 0.4 A. The current delivered by a.c. source is




(1) 0.9 A (2) 1.3 A

(3) 0.5 A (4) approx. 1 A

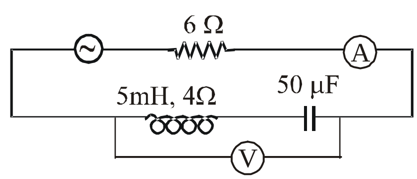
66. The current in resistance $R$ at resonance is




(1) zero (2) minimum but finite

(3) infinite (4) maximum but finite

67. In the circuit shown, the $ac$ source gives voltage, $V = 20 \cos (2000\,t)$ volt. Neglecting source resistance, the voltmeter and ammeter readings will be




(1) 0 V, 1.4 A (2) 14.14 V, 1.4 A

(3) 0 V, 2.36 A (4) 7.07 V, 1.4 A

68. Voltage across series $LCR$ circuit is 200 V. If voltage across $R$ is 120 V and voltage across $C$ is 160 V, then voltage across is $L$ is

(1) zero (2) 160 V

(3) 320 V (4) –80 V

69. For what value of inductance, $LC$ circuit of capacitance $5\ \mu$F will have a resonant frequency of $500/\pi$ ?

(1) 20 mH (2) 0.2 H

(3) $0.2\pi$ H (4) 0.4 H

70. Circuit $A$ is $LCR$ series circuit and circuit $B$ is $LCR$

parallel circuit. When both the circuits are resonant,
(1) current is maximum in both
(2) current is minimum in both
(3) current is maximum in $A$ but minimum in $B$
(4) current is minimum in $A$ but maximum in $B$

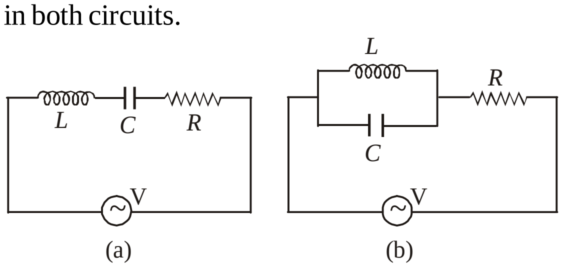
71. A 200 km long telegraph wire has a capacitance of 0.0125 μF/km. If it carries an alternating current of 5 kc/s, what should be the value of an inductance required to be connected in series so that impedance is minimum ? (take $\pi^2 = 10$)
(1) 0.72 mH (2) 0.40 mH
(3) 0.60 mH (4) 200 mH

72. In $LCR$ circuit, voltage leads current in phase by 60º. If $R = 10\ \Omega$ and $Z_C = 5.68\ \Omega$, then $Z_L$ is
(1) 23 Ω (2) 15.68 Ω
(3) 21 Ω (4) 18.32 Ω

73. A 100 volt *ac* source of frequency 500 hertz is connected to a $LCR$ circuit with $L = 8.0$ millihenry, $C = 12.5$ microfarad and $R = 10$ ohm, all connected in series. Find the potential difference across the resistance. (take $\pi^2 = 10$)
(1) 80 V (2) 76.2 V
(3) 85.6 V (4) 100 V

74. An electric lamp which runs at 40 volt battery and consumes 10 amperes current is connected to *ac* mains at 100 volts, 50 cycles per second. Calculate the inductive reactance of the required choke.
(1) 4.6 Ω (2) 6 Ω
(3) 9.2 Ω (4) 10.8 Ω

75. An *ac* source is connected to two circuits as shown. Obtain the current through resistance $R$ at resonance in both circuits.




(1) 0, 0 (2) $\frac{V}{R}, \frac{V}{R}$
(3) $0, \frac{V}{R}$ (4) $\frac{V}{R}, 0$

76. An alternating e.m.f. of 200 volts and 50 cycle/second is applied to a capacitor in series with a 20 V 5 W lamp. Find the capacitive reactance of the capacitor to run the lamp.
(1) 720 Ω (2) 796 Ω
(3) 1000 Ω (4) 850 Ω

77. In order to obtain a time constant of 10 seconds in an $RC$ circuit containing a resistance of $10^3\ \Omega$, the capacitance of the capacitor should be
(1) 10 μF (2) 100 μF
(3) 1000 μF (4) 10000 μF

78. A group of electric lamps having a total power rating of 1000 watt is supplied by an a.c. voltage
$E = 200 \sin(310t + 60^\circ)$
Then the r.m.s. value of the circuit current is
(1) 10 amp (2) $10\sqrt{2}$ amp
(3) 20 amp (4) $20\sqrt{2}$ amp

79. A wave of wavelength 300 metre can be transmitted by a transmission centre. A capacitor of capacitance 2.4 μF is available. Calculate the inductance of the required coil for a resonant circuit. (take $\pi^2 = 10$)
(1) $2.04 \times 10^{-8}$ (2) $0.72 \times 10^{-8}$ H
(3) $1.04 \times 10^{-8}$ H (4) $1.44 \times 10^{-8}$ H

80. The capacitor of an oscillatory circuit of negligible resistance is enclosed in a container. When the container is evacuated, the frequency of the circuit is 150 kHz; and when the container is filled with a gas, its frequency changes by 20%. The dielectric constant of the gas is
(1) 5/4 (2) 25/16
(3) 6/5 (4) 36/25

81. An inductor of 1 H carries a current of 2 A. To prevent sparking at the switch when the circuit is switched off, a capacitor of 4 μF is connected across it. The voltage rating of the capacitor should be
(1) 160 V (2) 800 V
(3) 400 V (4) 1000 V

82. A power transformer (100% efficient) is used to step-up an alternating voltage of emf of 220 V to 4.4 kV to transmit power of 6.6 kW. If the primary has 1000 turns, then secondary current is
(1) 2.2 A (2) 1.5 A
(3) 4.4 A (4) 3.0 A

83. A step-down transformer is used to reduce the main supply of 220 V to 11 V. If the input power is 1100 W and the output current is 90 A , then the efficiency of the transformer is
(1) 99 % (2) 88 %
(3) 95 % (4) 90 %

84. The power loss in a transformer working on 220 V *ac* supply is 30%. The ratio of primary to secondary current when output voltage is 110 V is
(1) 1 : 2 (2) 2 : 1
(3) 1 : 1 (4) 5 : 7

85. A transformer is used to light 140 watt 24 volt lamp from 240 volt AC mains. The current in the main cable is 0.7 amp. Efficiency of the transformer is
(1) 63.8 % (2) 84 %
(3) 83.3 % (4) 48 %

86. In a step up transformer, the turn ratio is 3 : 2. A battery of emf 4.5 V is connected across the primary. The voltage developed in the secondary would be
(1) 4.5 V (2) 3.0 V
(3) 1.5 V (4) zero

87. At resonant angular frequency $\omega_0$, current is maximum in *LCR* series circuit. Around this frequency on both sides (±) of $\omega_0$, there are angular frequencies ($\omega_1 = \omega_0 + \Delta\omega$ and $\omega_2 = \omega_0 - \Delta\omega$) at which power consumed in the circuit becomes 1/2 that consumed at resonant frequency. Then $\Delta\omega = \omega_1 - \omega_0 = \omega_0 - \omega_2$ is found to be equal to
(1) $R/2L$ (2) $2R/L$
(3) $R/L$ (4) $L/R$

88. Quality factor $Q$ is a measure of sharpness of resonance. Mathematically, $Q$ is equal to ($\omega_0$ is resonant angular frequency of the circuit)
(1) $\frac{\omega_0 R}{L}$ (2) $\frac{\omega_0 L}{R}$
(3) $\frac{\omega_0}{CR}$ (4) $\frac{\omega_0}{RL}$

89. A 3.0 H inductor is placed in series with 10 Ω resistor and an emf of 3.0 V is applied across the combination. The current in the circuit at $t$ = 0.3 sec. is
(1) 0.23 A (2) 0.19 A
(3) 0.31 A (4) 0.37 A

90. In the above question rate at which the energy is stored in the circuit, in the form of magnetic field, at $t$ = 0.3 sec., is
(1) zero (2) 0.12 W
(3) 0.18 W (4) 0.21 W

91. Across *LR* series circuit, a *dc* source of emf $E$ and of negligible resistance is applied. Initial rate of growth of current through the inductor would be
(1) zero (2) $E/L$
(3) $ER/L$ (4) $E/R$

92. Across *RC* series circuit, a *dc* source of emf $E$ and of negligible resistance is applied. Initial current through the capacitor would be
(1) zero (2) $E/C$
(3) $ER/C$ (4) $E/R$

93. An *ac* source of angular frequency ω is fed across a resistor $R$ and a capacitor $C$ is series. The current registered is $I$. If now the frequency of source is changed to ω/4 (but maintaining the same voltage), the current in the circuit is found to be halved. The ratio of $R$ and the original reactance at frequency ω is equal to
(1) 1/2 (2) 2/1
(3) 2/3 (4) $\sqrt{2/3}$

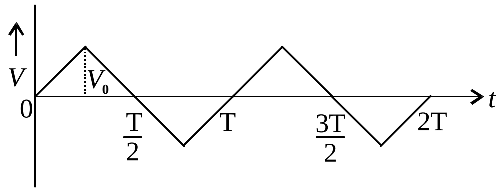
94. A capacitor of capacitance 0.5 μF is discharged through a resistance of 10 MΩ. The time taken for half the charge to escape from the capacitance is nearly (take $\log_e 2 = 0.693$)
(1) 3.5 s (2) 0.35 s
(3) 3.5 ms (4) 0.70 s

95. A capacitor is charged to 4V and then fully discharged via a low resistance milliammeter by a vibrating switch which repeats the sequence 50 times each second. If the meter gives a steady reading of 1 mA, the capacitance is
(1) 1 μF (2) 2 μF
(3) 5 μF (4) 8 μF

96. The electric current in a circuit is given by $I = (3I_0/T)t$ for some time. The *rms* current for the period $t = 0$ to $t = T$, is
(1) $\sqrt{3}\, I_0$ (2) $3I_0/\sqrt{2}$

(3) $\sqrt{2}\ I_0$ (4) none of these

97. The average value of voltage for triangular wave having peak value $V_0$, as shown in fig., is




(1) $V_0 / 4$ (2) $V_0 / 2$

(3) $V_0 / \sqrt{2}$ (4) $V_0 / \sqrt{3}$

98. In the above question, *rms* value of voltage of triangular wave is

(1) $V_0 / 4$ (2) $V_0 / 2$

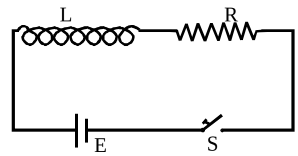
(3) $V_0 / \sqrt{2}$ (4) $V_0 / \sqrt{3}$

99. The current through a 1.0 H inductor varies sinusoidally with an amplitude of 0.5 A and a frequency of 50 Hz. Potential difference across the terminals of the inductor is

(1) 222 V (2) 111 V

(3) 157 V (4) 100 V

100. In the circuit shown in switch $S$ is closed at time $t$ = 0. The charge which passes through the battery in one time-constant is




(1) $\frac{EL}{eR^2}$ (2) $\frac{eL}{ER^2}$

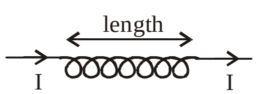
(3) $\frac{eR^2E}{L}$ (4) $E\left(\frac{L}{R}\right)$

## Assertion-Reason Type Questions (For AIIMS)

**Each of the questions given below consists of two statements, an assertion (*A*) and reason (*R*). Darken the number corresponding to the appropriate alternative on the answer sheet as follows :**

(1) If both ***A*** and ***R*** are true and ***R*** is the correct explanation of ***A***, then mark **1**
(2) If both ***A*** and ***R*** are true but ***R*** is not the correct explanation of ***A***, then mark **2**
(3) If ***A*** is true but ***R*** is false, then mark **3**
(4) If both ***A*** and ***R*** are false, then mark **4**

1. *A*. At any point along the axial line of a wire, carrying current, the magnetic field is zero.
   *R*. A line has no thickness and so encloses no current.
2. *A*. Two wires carrying currents in the same direction, when brought near and parallel to each other, are found to attract each other.
   *R*. The force of attraction is due to electric field produces by the electrons moving in the wires.
3. *A*. When a moving charge enters a magnetic field, a force acts on it. This force does the work in changing the direction of moving charge in the magnetic field.
   *R*. Work must be done on the charge to change the direction of its motion.
4. *A*. When current flows in the coil, shown below, then the length of the coil is found to be decreased.




   *R*. Heat produced in the wire of the coil increases the cross-section of the coil, thereby reducing its length.
5. *A*. High speed protons, present in the cosmic rays, cannot fall on the equator of the earth.
   *R*. Direction of magnetic field of the earth at the equator is perpendicular to the direction of motion of falling vertically downward towards the equator.
6. *A*. In a bar magnet, there exist two poles, but it is very difficult to locate their positions.
   *R*. A pole of the magnet is the point in it where the magnetic lines of force of the magnet meet.
7. *A*. Magnetic lines of force exist inside the bar magnet.
   *R*. Magnetic lines of force are closed.
8. *A*. A tangent galvanometer was earlier used to measure currents (and hence named galvanometer). The error in the measurement of the current is minimum, when deflection produced in its needle is 45º (after proper setting the apparatus before experiment).
   *R*. $\tan 45^\circ = 1$.
9. *A*. Between the ends of the wings of an aeroplane, flying in the sky, there is always some electrical potential difference.
   *R*. Atmospheric charge is responsible for producing this potential difference.
10. *A*. If magnetic flux is changing through a coil, then induced emf produced at its ends is directly proportional to the rate of change of magnetic flux through it.
    *R*. The direction of induced emf produced is in accordance with Lenz's law.
11. *A*. When two terminals from a cell are connected to any two points on a circular wire, then the magnetic field at the centre of the circular wire is always found to be zero.
    *R*. The two points on the circular wire produce two chords in which currents flow in different directions. The magnetic fields at the centre of the circular wire, due to these chords have equal magnitudes but opposite directions.
12. *A*. If a charged particle enters a region having both electric field and magnetic field, then it will pass through this region, without any deviation in the direction of its motion.
    *R*. Forces on moving charge due to electric field and magnetic field are always in opposite directions.
13. *A*. In *LCR* series circuit, the phase difference between potentials across the inductor and capacitor is $\pi$.
    *R*. The phase difference of currents through inductor and capacitor is zero in *LCR* series circuit.

14. *A.* Power loss in electrical *LCR* circuit is maximum when the circuit is resonant in nature.

    *R.* In this case, applied voltage and current are in phase with each other.

15. *A.* In ac circuits, no conduction current flows through the capacitor, though the conduction current flows through the resistor as well as inductor.

    *R.* A capacitor offers no reactance to flow of conduction current through it.

16. *A.* There is no loss of electrical power when ac current is passing through a pure inductor.

    *R.* Through a pure inductor, current and applied voltage have a phase difference of $\pi/2$.

# ANSWERS TO ASSIGNMENT

## MAGNETIC EFFECTS OF CURRENT & MAGNETISM

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (2) | 2. | (2) | 3. | (1) | 4. | (4) | 5. | (4) |
| 6. | (4) | 7. | (2) | 8. | (2) | 9. | (3) | 10. | (4) |
| 11. | (3) | 12. | (4) | 13. | (1) | 14. | (2) | 15. | (2) |
| 16. | (3) | 17. | (3) | 18. | (2) | 19. | (4) | 20. | (3) |
| 21. | (2) | 22. | (3) | 23. | (4) | 24. | (4) | 25. | (1) |
| 26. | (2) | 27. | (1) | 28. | (2) | 29. | (4) | 30. | (1) |
| 31. | (1) | 32. | (2) | 33. | (3) | 34. | (2) | 35. | (1) |
| 36. | (3) | 37. | (2) | 38. | (4) | 39. | (1) | 40. | (2) |
| 41. | (4) | 42. | (4) | 43. | (3) | 44. | (4) | 45. | (1) |
| 46. | (3) | 47. | (2) | 48. | (1) | 49. | (3) | 50. | (3) |
| 51. | (2) | 52. | (1) | 53. | (1) | 54. | (1) | 55. | (2) |
| 56. | (4) | 57. | (2) | 58. | (3) | 59. | (4) | 60. | (1) |
| 61. | (2) | 62. | (2) | 63. | (3) | 64. | (1) | 65. | (1) |
| 66. | (4) | 67. | (1) | 68. | (2) | 69. | (3) | 70. | (2) |
| 71. | (3) | 72. | (2) | 73. | (4) | 74. | (3) | 75. | (2) |
| 76. | (1) | 77. | (3) | 78. | (2) | 79. | (4) | 80. | (3) |
| 81. | (3) | 82. | (3) | 83. | (4) | 84. | (4) | 85. | (4) |
| 86. | (1) | 87. | (4) | 88. | (1) | 89. | (2) | 90. | (4) |
| 91. | (3) | 92. | (4) | 93. | (4) | 94. | (1) | 95. | (2) |
| 96. | (3) | 97. | (1) | 98. | (4) | 99. | (2) | 100. | (3) |

## Electromagnetic Induction & E.M. Waves

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (3) | 2. | (3) | 3. | (2) | 4. | (3) | 5. | (3) |
| 6. | (1) | 7. | (3) | 8. | (3) | 9. | (4) | 10. | (4) |
| 11. | (2) | 12. | (4) | 13. | (1) | 14. | (1) | 15. | (4) |
| 16. | (4) | 17. | (2) | 18. | (3) | 19. | (1) | 20. | (1) |
| 21. | (2) | 22. | (2) | 23. | (1) | 24. | (4) | 25. | (4) |
| 26. | (3) | 27. | (4) | 28. | (4) | 29. | (3) | 30. | (1) |
| 31. | (2) | 32. | (4) | 33. | (3) | 34. | (2) | 35. | (4) |
| 36. | (2) | 37. | (2) | 38. | (4) | 39. | (2) | 40. | (4) |
| 41. | (1) | 42. | (3) | 43. | (4) | 44. | (4) | 45. | (2) |
| 46. | (1) | 47. | (1) | 48. | (3) | 49. | (3) | 50. | (3) |
| 51. | (3) | 52. | (1) | 53. | (3) | 54. | (2) | 55. | (2) |
| 56. | (1) | 57. | (4) | 58. | (4) | 59. | (2) | 60. | (3) |
| 61. | (1) | 62. | (4) | 63. | (2) | 64. | (2) | 65. | (1) |
| 66. | (3) | 67. | (1) | 68. | (1) | 69. | (2) | 70. | (3) |
| 71. | (3) | 72. | (2) | 73. | (4) | 74. | (3) | 75. | (4) |
| 76. | (1) | 77. | (2) | 78. | (3) | 79. | (2) | 80. | (2) |
| 81. | (2) | 82. | (3) | 83. | (1) | 84. | (2) | 85. | (3) |
| 86. | (4) | 87. | (1) | 88. | (2) | 89. | (3) | 90. | (1) |
| 91. | (1) | 92. | (3) | 93. | (1) | 94. | (2) | 95. | (1) |
| 96. | (4) | 97. | (1) | 98. | (2) | 99. | (3) | 100. | (3) |

## Alternating Current

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (2) | 2. | (1) | 3. | (3) | 4. | (3) | 5. | (4) |
| 6. | (3) | 7. | (3) | 8. | (1) | 9. | (3) | 10. | (3) |
| 11. | (4) | 12. | (4) | 13. | (3) | 14. | (3) | 15. | (3) |
| 16. | (4) | 17. | (2) | 18. | (1) | 19. | (1) | 20. | (2) |
| 21. | (1) | 22. | (2) | 23. | (3) | 24. | (2) | 25. | (3) |
| 26. | (1) | 27. | (4) | 28. | (4) | 29. | (1) | 30. | (3) |
| 31. | (1) | 32. | (4) | 33. | (4) | 34. | (1) | 35. | (1) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 36. | (2) | 37. | (2) | 38. | (1) | 39. | (1) | 40. | (3) |
| 41. | (3) | 42. | (4) | 43. | (1) | 44. | (4) | 45. | (2) |
| 46. | (3) | 47. | (1) | 48. | (2) | 49. | (4) | 50. | (3) |
| 51. | (2) | 52. | (2) | 53. | (4) | 54. | (2) | 55. | (3) |
| 56. | (1) | 57. | (3) | 58. | (2) | 59. | (3) | 60. | (3) |
| 61. | (4) | 62. | (4) | 63. | (2) | 64. | (3) | 65. | (3) |
| 66. | (4) | 67. | (1) | 68. | (3) | 69. | (2) | 70. | (3) |
| 71. | (2) | 72. | (1) | 73. | (4) | 74. | (3) | 75. | (2) |
| 76. | (2) | 77. | (4) | 78. | (2) | 79. | (3) | 80. | (2) |
| 81. | (4) | 82. | (2) | 83. | (4) | 84. | (4) | 85. | (3) |
| 86. | (4) | 87. | (1) | 88. | (2) | 89. | (2) | 90. | (4) |
| 91. | (2) | 92. | (4) | 93. | (2) | 94. | (1) | 95. | (3) |
| 96. | (1) | 97. | (2) | 98. | (4) | 99. | (2) | 100. | (1) |

## Assertion-Reason Type Questions (for AIIMS)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (1) | 2. | (3) | 3. | (4) | 4. | (3) | 5. | (1) |
| 6. | (4) | 7. | (1) | 8. | (2) | 9. | (3) | 10. | (2) |
| 11. | (1) | 12. | (4) | 13. | (2) | 14. | (1) | 15. | (3) |
| 16. | (1) | | | | | | | | |

## CBSE - PMT

1. The electric field part of an electromagnetic wave in a medium is represented by $E_x = 0$

$$E_y = 2.5\frac{N}{C}\cos\left[\left(2\pi\times10^6\frac{rad}{m}\right)t-\left(\pi\times10^{-2}\frac{rad}{s}\right)x\right];$$

$E_z = 0$. The wave is 9]

(1) moving along $-x$ direction with frequency $10^6$ Hz and wavelength 200 m.

(2) moving along $y$ direction with frequency $2\pi \times 10^6$ Hz and wavelength 200 m.

(3) moving along $x$ direction with frequency $10^6$ Hz and wavelength 100 m.

(4) moving along $x$ direction with frequency $10^6$ Hz and wavelength 200 m.

2. A bar magnet having a magnetic moment of $2 \times 10^4$ $JT^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4}$ T exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is ]

(1) 2J (2) 0.6 J

(3) 12 J (4) 6 J

3. The magnetic force acting on a charged particle of charge –2μc in a magnetic field of 2T acting in $y$ direction, when the particle velocity is

$(2\hat{i}+3\hat{j})\times10^6\ ms^{-1}$, is

(1) 8 N in $z$ direction

(2) 8 N in $-z$ direction

(3) 4 N in $z$ direction

(4) 8 N in $y$ direction

4. A conducting circular loop is placed in a uniform magnetic field 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 mm/s. The induced *emf* in the loop when the radius is 2 cm is [CBSE 2009]

(1) 1.6 π μV (2) 3.2 π μV

(3) 4.8 π μV (4) 0.8 π μV

5. A galvanometer having a coil resistance of 60 Ω shows full scale deflection when a current of 1.0 amp passes through it. It can be converted into an ammeter to read currents upto 5.0 amp by

(1) putting in parallel a resistance of 15 Ω

(2) putting in parallel a resistance of 240 Ω

(3) putting in series a resistance of 15 Ω

(4) putting in series a resistance of 240 Ω

6. Under the influence of a uniform magnetic field, a charged particle moves with constant speed V in a circle of radius R. The time period of rotation of the particle

(1) depends on both V and R

(2) depends on V and not on R

(3) depends on R and not on V

(4) is independent of both V and R

7. Power dissipated in an LCR series circuit connected to an a.c. source of *emf* ε is

(1) $\varepsilon^2 R \Big/ \sqrt{R^2+\left(Lw-\frac{1}{Cw}\right)^2}$

(2) $\varepsilon^2 R \Big/ \left[R^2+\left(Lw-\frac{1}{Cw}\right)^2\right]$

(3) $\varepsilon^2\sqrt{R^2+\left(Lw-\frac{1}{Cw}\right)^2} \Big/ R$

(4) $\dfrac{\varepsilon^2\left[R^2+\left(Lw-\frac{1}{Cw}\right)^2\right]}{R}$

8. A rectangular, a square, a circular and an elliptical loop, all in the $(x - y)$ plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{V} = v\hat{i}$. The magnetic field is directed along the negative $z$ axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for

(1) any of the four loops

(2) the rectangular, circular and elliptical loops

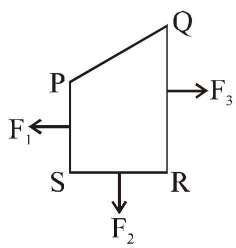
(3) the circular and the elliptical loops

(4) only the elliptical loop

9. If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is

]

(1) attracted by both the poles
(2) repelled by both the poles
(3) repelled by the north pole and attracted by the south pole
(4) attracted by the north pole and repelled by the south pole

10. 


A closed loop *PQRS* carrying current is placed in a uniform magnetic field. If the magnetic forces on segments *PS*, *SR* and *RQ* are $F_1$, $F_2$ and $F_3$ respectively and are in the plane of the paper and along the directions shown, the force on the segment *QP* is

(1) $F_3 - F_1 - F_2$ (2) $\sqrt{(F_3 - F_1)^2 + F_2^2}$
(3) $\sqrt{(F_3 - F_1)^2 - F_2^2}$ (4) $F_3 - F_1 + F_2$

11. A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3}$ ω*b*. The self-inductance of the solenoid is

(1) 2.5 henry (2) 2.0 henry
(3) 1.0 henry (4) 4.0 henry

12. Curie temperature is the temperature above which

(1) ferromagnetic material becomes paramagnetic material
(2) paramagnetic material becomes diamagnetic material
(3) paramagnetic material becomes ferromagnetic material
(4) ferromagnetic material becomes diamagnetic material

13. A galvanometer of resistance 50Ω is connected to a battery of 3V alongwith a resistance of 2950Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be
(1) 5050 Ω (2) 5550 Ω
(3) 6050 Ω (4) 4450 Ω

14. A beam of electrons passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off and the same magnetic field is maintained, the electrons move

(1) in a circular orbit
(2) along a parabolic path
(3) along a straight line
(4) in an elliptical orbit

15. In a mass spectrometer used for measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular paths of radius R using a magnetic field B. If V and B are kept constant, the ratio $\left(\frac{\text{charge on the ion}}{\text{mass of the ion}}\right)$ will be proportional to

(1) $\frac{1}{R^2}$ (2) $R^2$
(3) R (4) $\frac{1}{R}$

16. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature then it will show
(1) anti ferromagnetism
(2) no magnetic property
(3) diamagnetism
(4) paramagnetism

17. Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with constant speed V. The time period of the motion

(1) depends on both R and V
(2) is independent of both R and V
(3) depends on R and not on V
(4) depends on V and not on R

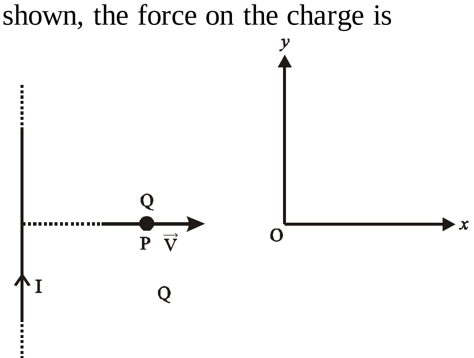
18. When a charged particle moving with velocity V is subjected to a magnetic field of induction B, the force on it is non-zero. This implies that
(1) angle between V and B can have any value other than zero and 180°
(2) angle between V and B is either zero or 180°
(3) angle between V and B is necessarily 90°
(4) angle between V and B can have any value other than 90°

19. Two coils of self inductances 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is
(1) 4 mH (2) 16 mH
(3) 10 mH (4) 6 mH

20. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency *f*. If L is doubled and C is changed to 4C, the frequency will be
(1) $f/2\sqrt{2}$ (2) $f/2$
(3) $f/4$ (4) $8f$

21. An electron moves in a circular orbit with a uniform speed *v*. It produces a magnetic field *B* at the centre of the circle. The radius of the circle is proportional to
(1) $\sqrt{\frac{v}{B}}$ (2) $\frac{v}{B}$
(3) $\frac{B}{v}$ (4) $\sqrt{\frac{B}{v}}$

22. A very long straight wire carries a current *I*. At the instant when a charge +*Q* at point *P* has velocity $\vec{V}$, as shown, the force on the charge is

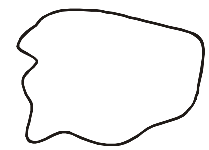



]

(1) along *ox* (2) opposite to *oy*
(3) along *oy* (4) opposite to *ox*

23. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by $\mu_d$, $\mu_p$ and $\mu_f$ respectively, then
(1) $\mu_p = 0$ and $\mu_f \neq 0$
(2) $\mu_d \neq 0$ and $\mu_p = 0$
(3) $\mu_d \neq 0$ and $\mu_f \neq 0$
(4) $\mu_d = 0$ and $\mu_p \neq 0$

24. As a result of change in the magnetic flux linked to the closed loop shown in the figure, an e.m.f. *V* volt is induced in the loop. The work done (joules) in taking a charge *Q* coulomb once along the loop is



(1) $QV$ (2) $QV/2$
(3) $2QV$ (4) zero

25. A coil in the shape of an equilateral triangle of side *l* is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in plane of the coil. If due to a current *i* in the triangle a torque τ acts on it, the side *l* of the triangle is ]
(1) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)$ (2) $\frac{1}{\sqrt{3}}\frac{\tau}{Bi}$
(3) $2\left(\frac{\tau}{\sqrt{3}\,Bi}\right)^{\frac{1}{2}}$ (4) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)^{\frac{1}{2}}$

26. A coil of 40 henry inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 volt battery. The time constant of the circuit is
(1) 20 seconds (2) 5 seconds
(3) 1/5 seconds (4) 40 seconds

27. The unit of permittivity of free space, $\varepsilon_0$, is
(1) Coulomb$^2$/(Newton-metre)$^2$
(2) Coulomb/Newton-metre
(3) Newton-metre$^2$/Coulomb$^2$
(4) Coulomb$^2$/Newton-metre$^2$

28. The magnetic flux through a circuit of resistance *R* changes by an amount Δϕ in a time Δ*t*. Then the total quantity of electric charge *Q* that passes any point in the circuit during the time Δ*t* is represented by
(1) $Q = R \cdot \frac{\Delta\phi}{\Delta t}$ (2) $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$
(3) $Q = \frac{\Delta\phi}{R}$ (4) $Q = \frac{\Delta\phi}{\Delta t}$

29. A diamagnetic material in a magnetic field moves
(1) from weaker to the stronger parts of field
(2) perpendicular to the field
(3) from stronger to the weaker parts of field
(4) in one of the above directions

30. A bar magnet is oscillating in the Earth's magnetic field with a preiod $T$. What happens to its period and motion if its mass is quadrupled ?
(1) Motion remains S.H. with time period = $2T$
(2) Motion remains S.H. with time period = $4T$
(3) Motion remains S.H. and period remains nearly constant
(4) Motion remains S.H. with time period

31. A long solenoid carrying a current produces a magnetic field $B$ along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magetic field is
(1) $B$ (2) $2B$
(3) $4B$ (4) $B/2$

32. A square current carrying loop is suspended in a uniform magnetic field acting in the plane of the loop. If the force on one arm of the loop is $\vec{F}$, the net force on the remaining three arms of the lopp is
(1) $\vec{F}$ (2) $3\vec{F}$
(3) $-\vec{F}$ (4) $-3\vec{F}$

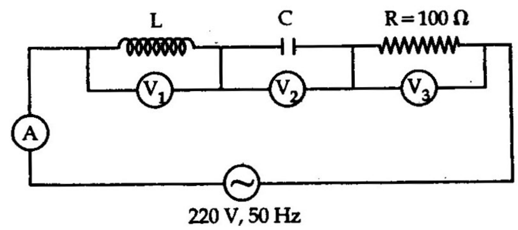
33. A thin ring of radius $R$ meter has charge $q$ coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of $f$ revolutions/s. The value of magnetic induction in Wb/m$^2$ at the centre of the right is
(1) $\frac{\mu_0 qf}{2R}$ (2) $\frac{\mu_0 qf}{2\pi R}$
(3) $\frac{\mu_0 q}{2\pi f R}$ (4) $\frac{\mu_0 q}{2 f R}$

34. Electromagnets are made of soft iron because soft iron has ]
(1) high retentivity and low coercive force
(2) low retentivity and high coercive force
(3) high retentivity and high coercive force
(4) low retentivity and low coercive force

35. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earths' field by placing a current carrying wire, the new time period of magnet will be
(1) 4$s$ (2) 1$s$
(3) 2$s$ (4) 3$s$

36. A conducting circular loop is placed in a uniform magnetic field, $B$ = .025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mms$^{-1}$. The induced e.m.f. when the radius is 2 cm, is
(1) 2 μV (2) 2 πμV
(3) πμV (4) $\frac{\pi}{2}$ μV

37. In the given circuit the reading of voltmeter $V_1$ and $V_2$ are 300 volts each. The reading of the voltmeter $V_3$ and ammeter A are respectively




(1) 100 V, 2.0 A (2) 150 V, 2.2 A
(3) 220 V, 2.2 A (4) 220 V, 2.0 A

38. A 220-volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is ]
(1) 5.0 ampere (2) 3.6 ampere
(3) 2.8 ampere (4) 2.5 ampere

39. The electric and the magnetic field, associated with an e.m. wave, propagating along the +z-axis, can be represented by
(1) $\left[\vec{E} = E_o\hat{i},\ \vec{B} = B_o\hat{j}\right]$
(2) $\left[\vec{E} = E_o\hat{k},\ \vec{B} = B_o\hat{i}\right]$
(3) $\left[\vec{E} = E_o\hat{j},\ \vec{B} = B_o\hat{i}\right]$
(4) $\left[\vec{E} = E_o\hat{j},\ \vec{B} = B_o\hat{k}\right]$

40. An ac voltage is applied to a resistance R and an inductor L in series. If R and the inductive reactance are both equal to 3Ω, the phase difference between the applied voltage and the current in the circuit is
(1) π/6 (2) π/4
(3) π/2 (4) zero

41. There are four light weight rod samples A, B, C, D separately suspended by threads. A bar magnet is slowly brought near each sample and the following observations are noted:
(i) A is feebly repelled
(ii) B is feebly attracted
(iii) C is strongly attracted
(iv) D remains unaffected
Which one of the following is true?

(1) B is of a paramagnetic material
(2) C is of a diamagnetic material
(3) D is of a ferromagnetic material
(4) A is of a non-magnetic material

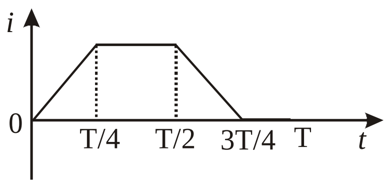
42. In an ac circuit an alternating voltage $e = 200\sqrt{2}\sin 100t$ volts is connected to a capacitor of capacity 1 μF. The r.m.s value of the current in the circuit is

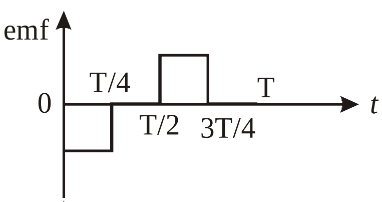
(1) 10 mA (2) 100 mA
(3) 200 mA (4) 20 mA

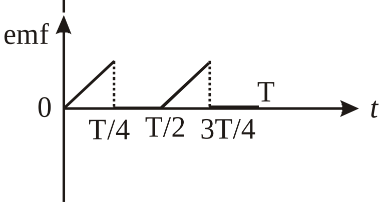
43. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron

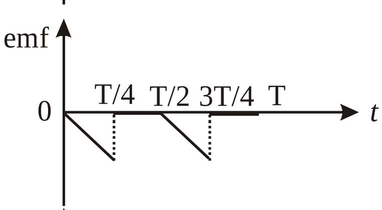
(1) will turn towards right of direction of motion
(2) speed will decrease
(3) speed will increase
(4) will turn towards left of direction of motion

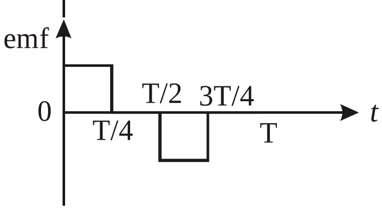
44. The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be




(1)



(2)



(3)



(4)



45. A coil of resistance 400 Ω is placed in a magnetic field. If the magnetic flux $\phi$ (wb) linked with the coil varies with time $t$ (sec) as $\phi = 50t^2 + 4$, the current in the coil at $t = 2$ sec is

(1) 1 A (2) 0.5 A
(3) 0.1 A (4) 2 A

46. Two similar coils of radius R are lying concentrically with their planes at right angles to each other. The currents flowing in them are I and 2I, respectively. The resultant magnetic field induction at the centre will be

(1) $\frac{\mu_0 I}{R}$ (2) $\frac{\sqrt{5}\mu_0 I}{2R}$

(3) $\frac{3\mu_0 I}{2R}$ (4) $\frac{\mu_0 I}{2R}$

47. A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It:

(1) will stay in east-west direction only
(2) will become rigid showing no movement
(3) will stay in any position
(4) will stay in north-south direction only

48. The electric field associated with an e.m. wave in vacuum is given by $\vec{E} = \hat{i}\,40\cos(kz - 6\times10^{-8}t)$, where $E$, $z$ and $t$ are in volt/m, meter and seconds respectively. The value of wave vector $k$ is

(1) 3 $m^{-1}$ (2) 2 $m^{-1}$
(3) 0.5 $m^{-1}$ (4) 6 $m^{-1}$

49. An alternating electric field, of frequency $v$, is applied across the dees (radius = R) of a cyclotron that is being used to accelerate protons (mass = m). The operating magnetic field (B) used in the cyclotron and the kinetic energy (K) of the proton beam, produced by it, are given by

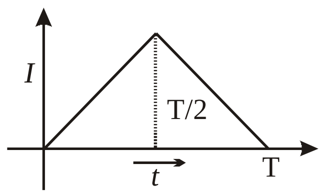
(1) $B = \frac{mv}{e}$ and $K = m^2\pi v R^2$

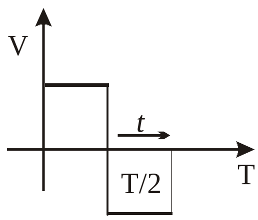
(2) $B = \frac{mv}{e}$ and $K = 2m\pi^2 v^2 R^2$

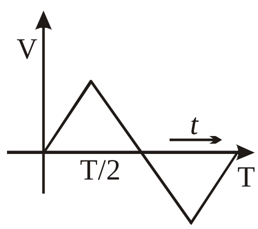
(3) $B = \frac{2\pi mv}{e}$ and $K = m^2\pi v R^2$

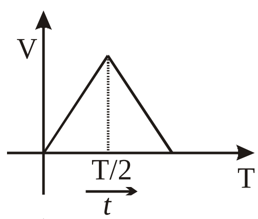
(4) $B = \frac{2\pi mv}{e}$ and $K = 2m\pi^2 v^2 R^2$

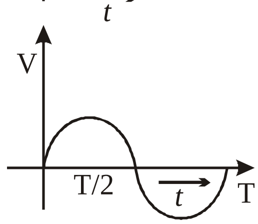
50. The current (I) in the inductance is varying with time according to the plot shown in figure. Which one of the following is the correct variation of voltage with time in the coil?




(1)



(2)



(3)



(4)



51. In an electrical circuit R, L, C and an a.c voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is

(1) $\frac{\sqrt{3}}{2}$ (2) $\frac{1}{2}$

(3) $\frac{1}{\sqrt{2}}$ (4) 1

## CBSE MAINS

1. A current loop constants of two identical semicircular parts each of radius R, one lying in the $x - y$ plane and the other in $x - z$ plane. If the current in the loop is $i$. The resultant magnetic field due to the two semicircular parts at their common centre is

(1) $\frac{\mu_0 i}{2\sqrt{2}R}$ (2) $\frac{\mu_0 i}{2R}$

(3) $\frac{\mu_0 i}{4R}$ (4) $\frac{\mu_0 i}{\sqrt{2}R}$

2. A closely wound solenoid of 2000 turns and area of cross-section $1.5 \times 10^{-4}$ m$^2$ carries a current of 2.0 A. It is suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field $5 \times 10^{-2}$ Tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be

(1) $3 \times 10^{-3}$ N.m (2) $1.5 \times 10^{-3}$ N.m
(3) $1.5 \times 10^{-2}$ N.m (4) $3 \times 10^{-2}$ N.m

3. A particle having mass of $10^{-2}$ kg carries a charge of $5 \times 10^{-8}$ C. The particle is given an initial horizontal velocity of $10^5$ ms$^{-1}$ in the presence of electric field $\vec{E}$ and magnetic field $\vec{B}$. To keep the particle moving in a horizontal direction, it is necessary that:

(a) $\vec{B}$ should be perpendicular to the direction of velocity and $\vec{E}$ should be along the direction of velocity.

(b) Both $\vec{B}$ and $\vec{E}$ should be along the direction of velocity

(c) Both $\vec{B}$ and $\vec{E}$ are mutually perpendicular and perpendicular to the direction of velocity.

(d) $\vec{B}$ should be along the direction of velocity and $\vec{E}$ should be perpendicular to the direction of velocity.

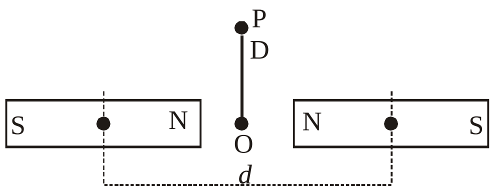
Which one of the following pairs of statements is possible?

(1) (a) and (c) (2) (c) and (d)
(3) (b) and (c) (4) (b) and (d)

4. The magnetic moment of a diamagnetic atom is

(1) much greater than one
(2) 1
(3) between zero and one
(4) equal to zero

5. Two identical bar magnets are fixed with their centres at a distance *d* apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the figure.




The force on the charge Q is ]

(1) zero
(2) directed along OP
(3) directed along PO
(4) directed perpendicular to the plane of paper

6. A galvanometer of resistance, G, is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be puit in series with the galvanometer is

(1) $\frac{G}{(S+G)}$ (2) $\frac{S^2}{(S+G)}$
(3) $\frac{SG}{(S+G)}$ (4) $\frac{G^2}{(S+G)}$

7. A thermocouple of negligible resistance produces an e.m.f of 40 μV/°C in the linear range of temperature. A galvanometer of resistance 10 ohm whose sensitivity is 1 μA/div, is employed with the thermocouple. The smallest value of temperature difference that can be detected by the system will be

(1) 0.25°C (2) 0.5°C
(3) 1°C (4) 0.1°C

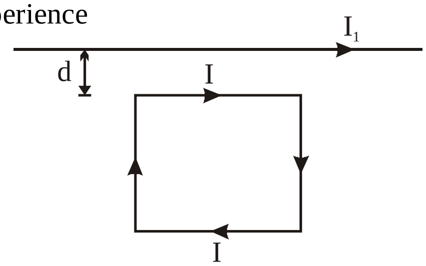
8. Charge $q$ is uniformly spread on a thing ring of radius R. The ring rotates about its axis with a uniform frequency $f$ Hz. The magnitude of magnetic induction at the centre of the ring is

(1) $\frac{\mu_o q f}{2\pi R}$ (2) $\frac{\mu_o q f}{2R}$
(3) $\frac{\mu_o q}{2 f R}$ (4) $\frac{\mu_o q}{2\pi f R}$

9. A short bar magnet of magnetic moment $0.4\ J\ T^{-1}$ is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is

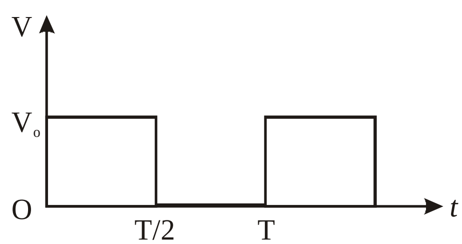
(1) 0.064 J (2) – 0.064 J
(3) zero (4) – 0.082 J

10. A square loop, carrying a steady current I, is placed in a horizontal plane near a long straight conductor carrying a steady current $I_1$ at a distance *d* from the conductor as shown in figure. The loop will experience




(1) a net attractive force towards the conductor
(2) a net repulsive force away from the conductor
(3) a net torque acting upward perpendicular to the horizontal plane
(4) a net torque acting downward normal to the horizontal plane

11. The r.m.s value of potential difference V shown in the figure is




(1) $V_o/\sqrt{3}$ (2) $V_o$
(3) $V_o/\sqrt{2}$ (4) $V_o/2$

12. A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be

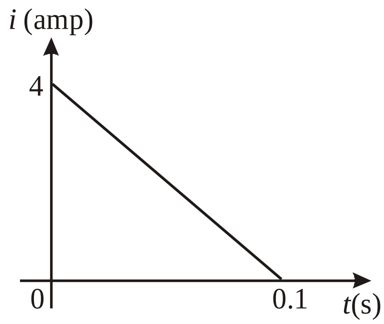
(1) 2.0 A (2) 4.0 A
(3) 8.0 A (4) $\frac{20}{\sqrt{13}}$ A

13. A proton carrying 1 MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an $\alpha$-particle to describe a circle of same radius in the same field?
(1) 4 MeV (2) 2 MeV
(3) 1 MeV (4) 0.5 MeV

14. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to
(1) unity
(2) the speed of light in vacuum
(3) reciprocal of speed of light in vacuum
(4) the ratio of magnetic permeability to the electric susceptibility of vacuum

15. A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3}$ J of work to turn it through 60°. The torque needed to maintain the needle in this position will be
(1) $\frac{3}{2}J$ (2) $2\sqrt{3}$ J
(3) 3 J (4) $\sqrt{3}$ J

16. In a coil of resistance of 10 Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is




(1) 4 (2) 8
(3) 2 (4) 6

17. The instantaneous values of alternating current and voltages in a circuit are given as

$$i = \frac{1}{\sqrt{2}}\sin(100\pi t) \text{ ampere}$$

$$e = \frac{1}{\sqrt{2}}\sin(100\pi t + \frac{\pi}{3}) \text{ volt}$$

The average power in Watts consumed in the circuit is

(1) $\frac{1}{8}$ (2) $\frac{1}{4}$
(3) $\frac{\sqrt{3}}{4}$ (4) $\frac{1}{2}$

## NEET

1. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when:
(1) a capacitance of reactance $X_C = X_L$ is included in the same circuit
(2) an iron rod is inserted in the coil
(3) frequency of the AC source is decreased
(4) number of turns in the coil is reduced

2. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is
(1) Microwaves are heat waves, so always produce heating
(2) Infrared waves produce heating in a microwave oven
(3) The frequency of the microwaves must match the resonant frequency of the water molecules
(4) The frequency of the microwaves has no relation with natural frequency of water molecules

3. When a proton is released form rest in a room, it starts with an initial acceleration $a_0$ towards west. When it is projected towards north with a speed $v_0$ it moves with an initial acceleration $3a_0$ toward west. The electric and magnetic fields in the room are

(1) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_o}$ up

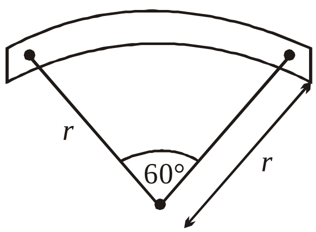
(2) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_o}$ down

(3) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_o}$ up

(4) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_o}$ down

4. A current loop in a magnetic field
   (1) can be in equilibrium in two orientations, both the equilibrium states are unstable
   (2) can be in equilibrium in two orientations, one stable while the other is unstable
   (3) experiences a torque whether the field is uniform or non uniform in all orientations
   (4) can be in equilibrium in one orientation

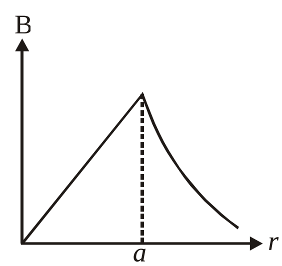
5. A bar magnet of length '*l*' and magnetic dipole moment M is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be

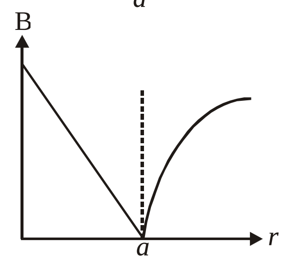


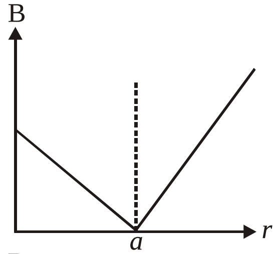

(1) $\frac{2}{\pi}M$  (2) $\frac{M}{2}$
(3) M  (4) $\frac{3}{\pi}M$

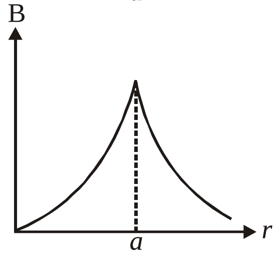
## DPMT

1. A long straight wire of a circular cross-section (radius *a*) carries a steady current I and the current I is uniformly distributed across this cross-section. Which of the following plots represents the variation of magnitude of magnetic field B with distance *r* from the centre of the wire?

(1)


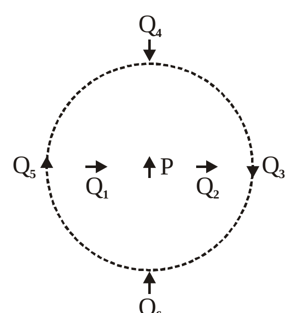

(2)



(3)



(4)


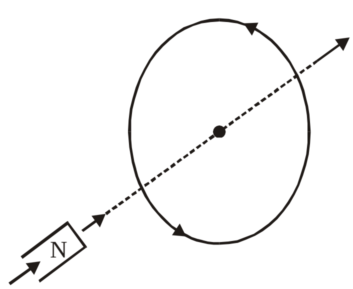

2. A galvanometer coil has a resistance of 10 Ω and the meter shows full scale deflection for a current of 1 mA. The shunt resistance required to convert the galvanometer into an ammeter of range 0-100 mA is about
   (1) 10 Ω  (2) 1 Ω
   (3) 0.1 Ω  (4) 0.01 Ω

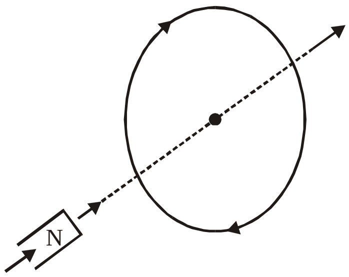
3. The figure below shows the various positions (labelled by subscripts) of small magnetized needles P and Q. The arrows show the direction of their magnetic moment. Which configuration corresponds to the lowest potential energy all the configurations show?

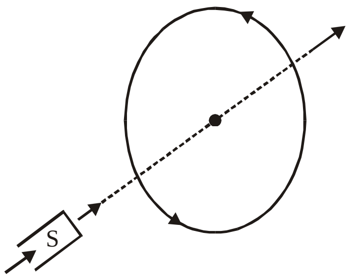


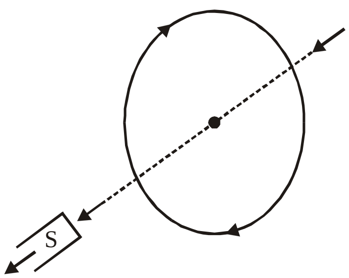

   (1) $PQ_3$  (2) $PQ_4$
   (3) $PQ_5$  (4) $PQ_6$

4. Which of the following figures correctly depicts the Lenz's law? The arrows show the movement of the labelled pole of a bar magnet into a closed circular loop and the arrows on the circle show the direction of the induced current

(1)


(2) 


(3) 

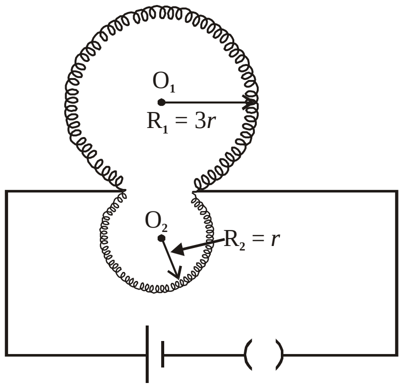

(4) 


5. An a.c., voltage is applied to a pure inductor L, drives a current in the inductor. The current in the inductor would be
   (1) ahead of the voltage by $\pi/2$
   (2) lagging the voltage by $\pi/2$
   (3) ahead of the voltage by $\pi/4$
   (4) lagging the voltage by $3\pi/4$
6. Earth's magnetic field is ]
   (1) $10^{-4}$ T (2) $10^{-5}$T
   (3) $10^{-6}$T (4) none of these
7. Frequency of cyclotron does not depend upon
   (1) charge (2) mass
   (3) velocity (4) $\frac{q}{m}$
8. In *L-C-R* resonant circuit what is phase angle; $\phi$
   (1) 90º (2) 180º
   (3) 0º (4) 60º
9. In *R-C* circuit $\omega$ = 100 rod/sec, $R = 100\ \Omega$, $C = 20\mu F$. What is impedence.
   (1) 510Ω (2) 200Ω
   (3) 250Ω (4) 300Ω
10. Lead is
   (1) Diamagnetic (2) Paramagnetic
   (3) Ferromagnetic (4) None of these
11. $M = xH$ is applicable
   (1) Iron (2) Bismuth
   (3) Copper (4) Nickil
12. Self inductance of solenoid is proportional to
   (1) $\frac{NA}{l}$ (2) $\frac{NA^2}{l}$
   (3) $\frac{A}{L}$ (4) $\frac{N^2A}{l}$
13. Series AC circuit has inductance L, resistance R and angular frequency $\omega$, the quality factor Q is
   (1) $\left(\frac{\omega L}{R}\right)^2$ (2) $\frac{\omega L}{R}$
   (3) $\frac{R}{\omega L}$ (4) $\left(\frac{R}{\omega L}\right)^2$
14. Mass of proton is $1.6 \times 10^{-27}$ kg. The proton enters in the magnetic field of 2 T at an angle 30° with direction of field. The velocity of proton is $2 \times 10^7$ m/s. The radius of path described by proton is
   (1) 3 cm (2) 4 cm
   (3) 5 cm (4) 6 cm
15. Electron is moving perpendicular to *z*-axis the magnetic field $B_0$ is present along the z-axis the radius of circular path is *a*. Angular momentum is
   (1) $eB_0a^2$ (2) 0
   (3) $e^2B_0^2a^2$ (4) $eB_0a$
16. And inductor of inductance 10 H is connected in series with a resistance R = 6 ohm. A 12 volt battery is connected for a long time. When the circuit is switched off, the induced emf in inductor, if curren
   (1) 1000 V (2) 2000 V
   (3) 3000 V (4) 4000 V
17. At a certain place on earth $B_H = 1/\sqrt{3}\ B_V$ dip angle

is

(1) 60° (2) 30°
(3) 45° (4) 90°

18. Two circular coils whose radii are in ratio of 1 : 3, are joined as shown in the figure. What is ratio of magnetic field at their centres.




(1) 1 : 1 (2) 1 : 3
(3) 9 : 1 (4) 1 : 9

19. What maximum frequency can be reflected from ionosphere

(1) 5 MHz (2) 5 GHz
(3) 5 KHz (4) 50 MHz

20. Permanent magnet has properties - retentivity and ceoricitivty respectively ]

(1) high-high (2) low-low
(3) low-high (4) high-low

21. A proton moving vertically downward enters in a magnetic field pointing towards north. In which direction proton will deflect

(1) East (2) West
(3) North (4) South

22. Induced emf in the coil depends upon

(1) conductivity of coil
(2) amount of flux
(3) rate of change of linked flux
(4) resistance of coil

23. Unit of magnetic flux is

(1) tesla (2) oersted
(3) weber (4) gauss

24. An electron, moving in a uniform magnetic field of induction of intensity $\vec{B}$, has its radius directly proportional to

(1) its charge (2) magnetic field
(3) speed (4) none of these

25. A magnet of dipole moment $M$ is aligned in equilibrium position in a magnetic field of intensity $B$. The work done to rotate it through an angle θ with the magnetic field, is

(1) $MB \sin \theta$ (2) $MB \cos \theta$
(3) $MB(1 - \cos \theta)$ (4) $MB(1 - \sin \theta)$

26. A rod of length $L$ is rotated in a uniform magnetic field of intensity $B$ with angular velocity ω about an axis, perpendicular to its length and passing through its centre. The potential difference produced across its two ends would be

(1) $^1/_2 B\omega L^2$ (2) $^1/_8 B\omega L^2$
(3) zero (4) $^1/_4 B\omega L^2$

27. A bird is sitting on a cable. When current is passed through the cable, the birds fly off. This is due to

(1) Joule's heating
(2) em radiations produced by cable
(3) the cable starts vibrating
(4) none of these

28. Susceptibility of ferromagnetic material is

(1) directly proportional to temperature
(2) inversely proportional to temperature
(3) independent of temperature
(4) inversely proportional to (tempreature)$^2$

29. The frequency of cyclotron motion of a charged particle in a magnetic field is independent of its

(1) charge $e$ (2) mass $m$
(3) velocity (4) $e/m$ ratio

30. The relative magnetic permeability of ferromagnetic materials is of the order of

(1) 10 (2) 100
(3) 1000 (4) 10000

31. A solenoid is placed inside another solenoid, the length of both being equal carrying same magnitude of current. The other parameters like radius and number of turns are in the ratio 1 : 2 for the two solenoids. The mutual inductance on each other would be

(1) $M_{12} = M_{21}$ (2) $M_{12} = 2 M_{21}$
(3) $2M_{12} = M_{21}$ (4) $M_{12} = 4 M_{21}$

32. The average magnetic energy density of an electromagnetic wave of wavelength λ travelling

in free space is given by

(1) $\frac{B^2}{2\lambda}$ (2) $\frac{B^2}{2\mu_0}$

(3) $\frac{2B^2}{\mu_0\lambda}$ (4) $\frac{B}{\mu_0\lambda}$

33. The numerical aperture for a human eye is of the order of

(1) 1 (2) 0.1

(3) 0.01 (4) 0.001

34. The radius of a copper nucleus is of the order of

(1) $10^{-16}$ m (2) $10^{-14}$ m

(3) $10^{-12}$ m (4) $10^{-9}$ m

35. The magnetic field in a plane electromagnetic wave is given by $B_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$. This electromagnetic wave is

(1) a visible light (2) an infrared wave

(3) a microwave (4) a radio wave

36. Which of these particles (having the same kinetic energy) has the shortest de Broglie wavelength?

(1) electron (2) alpha particle

(3) proton (4) neutron

37. A radioactive isotope has a half-life of T years. How long will it take the activity to reduce to 1% of its original value?

(1) 3.2 T years (2) 4.6 T years

(3) 6.6 T years (4) 9.2 T years

38. Although Carbon, Silicon and Germanium have same lattice structure and four valence electrons each, their band structure leads to the energy gaps as

(1) $E_g(Si) < E_g(Ge) < E_g(C)$

(2) $E_g(Si) > E_g(Ge) < E_g(C)$

(3) $E_g(Si) < E_g(Ge) > E_g(C)$

(4) $E_g(Si) > E_g(Ge) > E_g(C)$

39. When an AC voltage is applied to a LCR circuit, which of the following is true?

(1) I and V are out of phase with each other in R

(2) I and V are in phase in L while in C, they are out of phase

(3) I and V are out of phase in both, C and L

(4) I and V are out of phase in L and in phase in C

40. For a medium with permittivity ε and permeability μ, the velocity of light is given by

(1) $\sqrt{\mu/\varepsilon}$ (2) $\sqrt{\mu\varepsilon}$

(3) $1/\sqrt{\mu\varepsilon}$ (4) $\sqrt{\varepsilon\mu}$

41. A proton travelling at 23° w.r.t. the direction of a magnetic field of strength 2.6 mT experiences a magnetic force of $6.5 \times 10^{-17}$ N. What is the speed of the proton?

(1) $2 \times 10^5$ m/sec (2) $4 \times 10^5$ m/sec

(3) $6 \times 10^5$ m/sec (4) $8 \times 10^5$ m/sec

42. What uniform magnetic field applied perpendicular to a beam of electrons moving at $1.3 \times 10^6$ m/sec, is required to make the electrons travel in a circular arc of radius 0.35 m?

(1) $2.1 \times 10^{-5}$ G (2) $6 \times 10^{-5}$ T

(3) $2.1 \times 10^{-5}$ T (4) $6 \times 10^{-5}$ G

43. A transformer has 500 primary turns and 10 secondary turns. If the secondary has a resistive load of 15 Ω, the currents in the primary and secondary respectively, are

(1) 0.16 A, $3.2 \times 10^{-3}$ A

(2) $3.2 \times 10^{-3}$A, 0.16 A

(3) 0.16 A, 0.16 A

(4) $3.2 \times 10^{-3}$ A, $3.2 \times 10^{-3}$ A

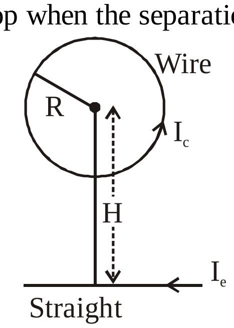
## AIIMS

1. The magnetic moment has dimensions of

(1) $[L A]$ (2) $[L^2 A]$

(3) $[LT^{-1} A]$ (4) $[L^2T^{-1} A]$

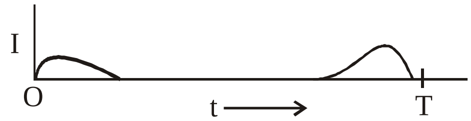
2. Circular loop of a wire and a long straight wire carry currents $I_c$ and $I_e$, respectively as shown in figure. Assuming that these are placed in the same plane. The magnetic fields will be zero at the centre of the loop when the separation $H$ is

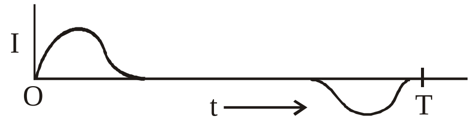


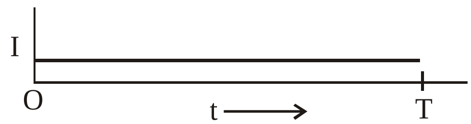

(1) $\frac{I_e R}{I_c \pi}$ (2) $\frac{I_c R}{I_e \pi}$

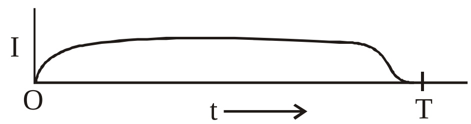
(3) $\frac{\pi I_c}{I_e R}$ (4) $\frac{I_c \pi}{I_c R}$

3. A metallic ring is dropped down, keeping its plane perpendicular to a constant and horizontal magnetic field. The ring enters the region of magnetic field at $t = 0$ and completely emerges out at $t = T$ sec. The current in the ring varies as ]

(1) 


(2) 


(3) 


(4) 

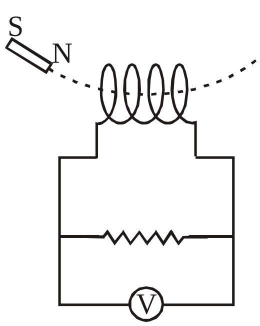

4. A conducting ring of radius 1 meter is placed in an uniform magnetic field B of 0.01 Tesla oscillating with frequency 100 Hz with its plane at right angles to B. What will be the induced electric field ?

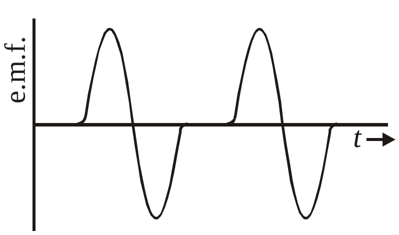
(1) $\pi$ volts/m (2) $2\pi$ volts/m
(3) 10 volts/m (4) 62 volts/m

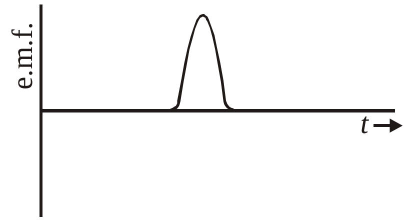
5. The magnetic moment ($\mu$) of a revolving electron around the nucleus varies with principal quantum number $n$ as ]

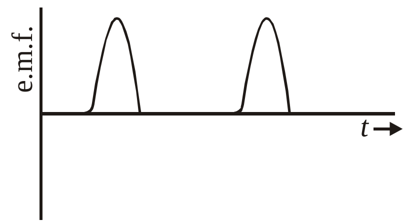
(1) $\mu \propto n$ (2) $\mu \propto 1/n$
(3) $\mu \propto n^2$ (4) $\mu \propto 1/n^2$

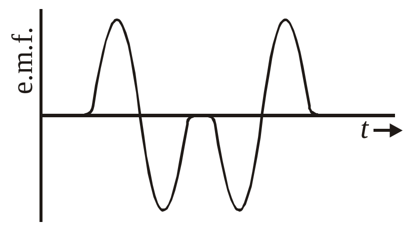
6. A magnet is made to oscillate with a particular frequency, passing through a coil as shown in figure. The time variation of the magnitude of e.m.f. generated across the coil during one cycle is




(1) 


(2) 


(3) 


(4) 

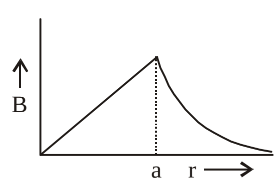

7. A proton and an $\alpha$-particle, moving with the same velocity, enter into a uniform mgnetic field, acting normal to the plane of their motion. The ratio of the radii of the circular paths described by the proton and $\alpha$-particle is

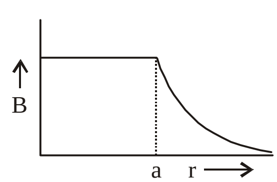
(1) 1 : 2 (2) 1 : 4
(3) 1 : 16 (4) 4 : 1

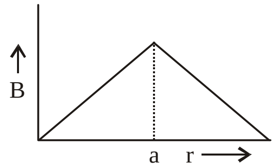
8. Two parallel beams of positrons moving in the same direction will

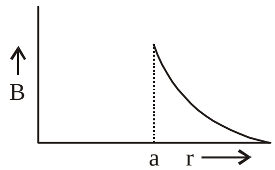
(1) Repel each other
(2) Will not interact with each other
(3) Attract each other
(4) Be deflected normal to the plane containing the two beams

9. The magnetic field due to a straight conductor of uniform cross section of radius $a$ and carrying a steady current is represented by ]

(1) 


(2) 

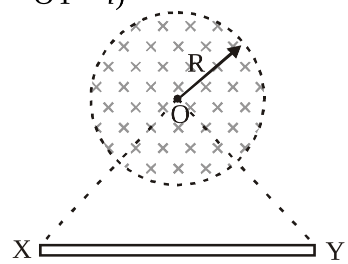
(3) 


(4) 


10. Liquid oxygen remains suspended between two pole faces of a magnet because it is
    (1) diamagnetic
    (2) paramagnetic
    (3) ferromagnetic
    (4) antiferromagnetic
11. The magnetic moment of a current ($I$) carrying circular coil of radius ($r$) and number of turns ($n$) varies as
    (1) $1/r^2$ (2) $1/r$
    (3) $r$ (4) $r^2$
12. The cyclotron frequency of an electron gyrating in a magnetic field of 1 T is approximately
    (1) 28 MHz (2) 280 MHz
    (3) 2.8 GHz (4) 28 GHz
13. Using mass ($M$), length ($L$), time ($T$) and current ($A$) as fundamental quantities, the dimension of permittivity is
    (1) $ML^{-2}T^2A$
    (2) $M^{-1}L^{-3}T^4A^2$
    (3) $MLT^{-2}A$
    (4) $ML^2T^{-1}A^2$
14. The earth's magnetic field at a given point is $0.5 \times 10^{-5}$ Wb m$^{-2}$. This field is to be annulled by magnetic induction at the centre of a circular conducting loop of radius 5.0 cm. the current required to be flown in theloop is nearly
    (1) 0.2 A (2) 0.4 A
    (3) 4 A (4) 40 A
15. A frog can be levitated in a magnetic field produced by a current in a vertical solenoid placed below the frog. This is possible because the bdy of the frog behaves as
    (1) paramagnetic
    (2) diamagnetic
    (3) ferromagnetic
    (4) antiferromagnetic

## Science Olympiad

1. Uniform magnetic field is present in circular region of radius R on a table. A conducting rod of length $l\sqrt{2}$ is symmetrically placed as shown in the figure. If magnetic field changes with time ($t$) as $B = B_0 \sin \omega t$. The maximum induced emf on rod is (given OX = OY = $l$)




[Science Olympiad 2007]

   (1) $\frac{\pi B_0 \omega R^2}{4}$ (2) $B_0\omega\pi R^2$
   (3) $B_0\omega$ (4) zero
2. A rod of length 2 m is moving with velocity 5 m/sec at an angle 30° with magnetic field B = 4 T. Potential difference across ends of the rod
   (1) 20 V
   (2) $20\sqrt{3}$ V
   (3) can't be determined bused upon given information
   (4) zero, because flux is not changing
3. A conducting wire placed in uniform magnetic field. Some charge is made to flows throug it so that the wire jumps to a height of $h$. Arrangement was designed accordingly. If mass of the wire is $m$, length $l$ and it was placed in magnetic field B, the charge that flown through wire is
   (1) inversely proportional to mass
   (2) directly proportional to B
   (3) directly proportional to $l$
   (4) Inversely proportional to both B and $l$

# ANSWERS :
## QUESTIONS FROM COMPETITIVE EXAMS

### CBSE PMT

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (4) | 2. | (4) | 3. | (2) | 4. | (2) | 5. | (4) |
| 6. | (4) | 7. | (2) | 8. | (3) | 9. | (2) | 10. | (2) |
| 11. | (3) | 12. | (1) | 13. | (4) | 14. | (1) | 15. | (1) |
| 16. | (4) | 17. | (2) | 18. | (1) | 19. | (1) | 20. | (1) |
| 21. | (1) | 22. | (3) | 23. | (4) | 24. | (1) | 25. | (3) |
| 26. | (2) | 27. | (4) | 28. | (3) | 29. | (3) | 30. | (1) |
| 31. | (1) | 32. | (3) | 33. | (1) | 34. | (4) | 35. | (1) |
| 36. | (3) | 37. | (2) | 38. | (1) | 39. | (1) | 41. | (2) |
| 41. | (1) | 42. | (4) | 43. | (2) | 44. | (1) | 45. | (2) |
| 46. | (2) | 47. | (2) | 48. | (2) | 49. | (4) | 50. | (1) |
| 51. | (4) | | | | | | | | |

### CBSE PMT MAINS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (1) | 2. | (3) | 3. | (3) | 4. | (4) | 5. | (1) |
| 6. | (4) | 7. | (1) | 8. | (2) | 9. | (2) | 10. | (1) |
| 11. | (3) | 12. | (2) | 13. | (3) | 14. | (3) | 15. | (3) |
| 16. | (3) | 17. | (1) | | | | | | |

### NEET

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (2) | 2. | (3) | 3. | (4) | 4. | (2) | 5. | (4) |

### DPMT

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (1) | 2. | (3) | 3. | (4) | 4. | (2) | 5. | (1) |
| 6. | (2) | 7. | (3) | 8. | (3) | 9. | (1) | 10. | (1) |
| 11. | (2, 3) | 12. | (4) | 13. | (2) | 14. | (3) | 15. | (1) |
| 16. | (2) | 17. | (1) | 18. | (1) | 19. | (1) | 20. | (1) |
| 21. | (1) | 22. | (3) | 23. | (3) | 24. | (3) | 25. | (3) |
| 26. | (3) | 27. | (3) | 28. | (2) | 29. | (3) | 30. | (4) |
| 31. | (1) | 32. | (2) | 33. | (2) | 34. | (2) | 35. | (4) |
| 36. | (2) | 37. | (3) | 38. | (3) | 39. | (3) | 40. | (3) |
| 41. | (2) | 42. | (3) | 43. | (2) | | | | |

### AIIMS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (2) | 2. | (1) | 3. | (2) | 4. | (1) | 5. | (1) |
| 6. | (1) | 7. | (1) | 8. | (1) | 9. | (1) | 10. | (2) |
| 11. | (4) | 12. | (4) | 13. | (2) | 14. | (2) | 15. | (2) |

### SCIENCE OLYMPIAD

| | | | | | |
|---|---|---|---|---|---|
| 1. | (1) | 2. | (3) | 3. | (4) |