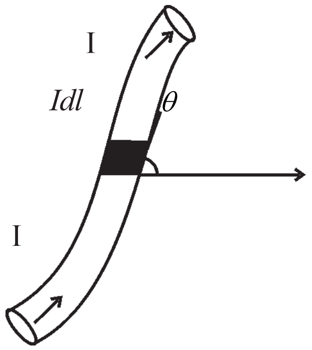
13 Magnetic Effect of Current and Magnetism

(1) Biot-Savart's Law

Biot Savart's Law is used to determine the magnetic field any point due to a current carrying conductor



$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,\vec{dl}\times\hat{r}}{r^2}$$

$$dB = \frac{\mu_0}{}\frac{dl\sin\theta}{r^2}$$

and for entire conducting wire,

$$\vec{B} = \int d\vec{B} = \frac{\mu_0 I}{4\pi}\int\frac{dl\sin\theta}{r^2}\hat{n}$$

$\theta = 0$ or π $\quad$ $\sin\theta = 0$ $\quad$ $\therefore\ \vec{B} = 0$

$\theta = 90°$ $\quad$ $\sin 90° = 1$ $\quad$ $\therefore$ B maximum

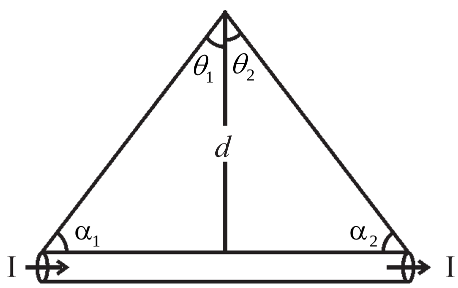
SI unit of B = Wbm^{-2} or Tesla

1 tesla = 10^4 Gauss.

Where μ_0 = Magnetic permeability of vacuum

= $4\pi\times10^{-7}$ T m A^{-1} or Wb $A^{-1}m^{-1}$ or H m^{-1} or N A^{-2}

(2) For conducting wire,



(A) For a wire of finite length

$$B = \frac{\mu_0 I}{4\pi d}[\sin\theta_1 + \sin\theta_2]$$

$$= \frac{\mu_0 I}{4\pi d}[\cos\alpha_1 + \cos\alpha_2]$$

(B) For a wire infinite length $\theta_1 = \theta_2 = 90$

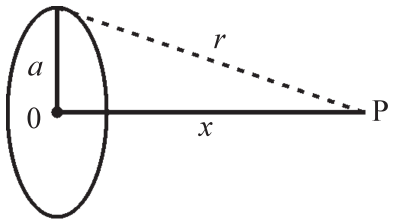
or $\alpha_1 = \alpha_2 = 0°$

$\therefore\ B = \frac{\mu_0 I}{2\pi d}$ $\qquad$ $\therefore\ B \propto \frac{I}{d}$

(C) For a wire half infinite length. $\theta_1 = 0$ and $\theta_2 = 90°$

$$B = \frac{\mu_0}{4\pi}\frac{I}{d}(0+1) = \frac{\mu_0 I}{4\pi d}$$

(3) For Rings



$a \rightarrow$ radius

$x \rightarrow$ distance of given point on axis from center.

$r = \left(a^2 + x^2\right)^{\frac{1}{2}}$

(A) For number of turn $N = 1$; $B = \dfrac{\mu_0 I a^2}{2\left(a^2 + x^2\right)^{\frac{3}{2}}}$

(B) For number of turn $N = N$; $B = \dfrac{\mu_0 N I a^2}{2\left(a^2 + x^2\right)^{\frac{3}{2}}}$

(C) At center of ring $x = 0$; $B = \dfrac{\mu_0 N I}{2a}$

(D) If $x >> a$; $B = \dfrac{\mu_0 N I a^2}{2x^3}$

(E) At a distance on axis equal to radius of ring. $B = \dfrac{\mu_0 N I}{2^{\frac{5}{2}} . a}$

(F) The ratio of magnetic field at center of ring and at any point on axis of ring

$$\frac{B_{\text{Center}}}{B_{\text{Axis}}} = \left(1 + \frac{x^2}{a^2}\right)^{\frac{3}{2}}$$

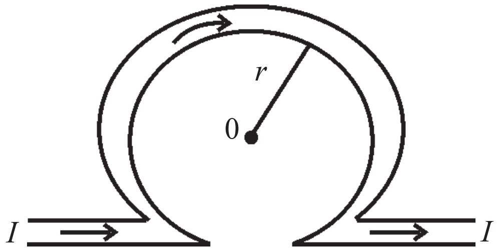
---

(1) A copper rod carries a DC current. The magnetic field associated with the current will be ....

(A) Only inside the rod (B) Only out-side the rod

(C) Both inside and outside the rod (D) Neither inside, nor inside the rod

(2) A wire carrying a current I is bent in to a circle of radius r as shown in figure. The net magnetic field at center O of the circular loop is ....



(A) $\dfrac{\mu_0}{4\pi} \dfrac{2I}{r} (\pi + 1)$ (B) $\dfrac{\mu_0}{4\pi} \dfrac{2I}{r} (\pi - 1)$

(C) Zero (D) Infinite

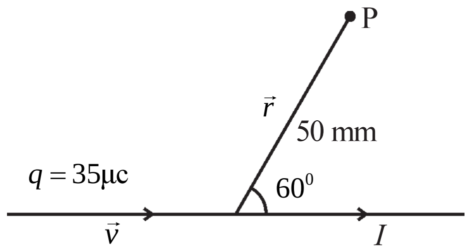
(3) Magnetic field at point P situated at perpendicular distance D from one end of wire of length L and carrying current I is ________

(A) $\frac{\mu_0 I}{4\pi L}$ (B) $\frac{\mu_0 I}{4\pi D}$ (C) $\frac{\mu_0 I}{4\pi D} \frac{L^2}{\sqrt{L^2 + D^2}}$ (D) infinite

(4) An equilateral triangle loop of length 'a' is carrying current I in anticlock wise direction. Magnetic field produced at center of the triangle is ________.

(A) $\frac{9\mu_0 I}{2\pi a}$ (B) $\frac{\mu_0 I}{3\sqrt{3}\pi a}$ (C) $\frac{3\mu_0 I}{2\pi a}$ (D) $\frac{5\sqrt{2}\mu_0 I}{3\pi a}$

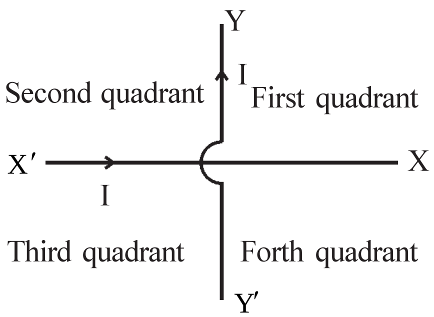
(5) An electric charge of $35 \mu C$ is moving with speed $2 \times 10^6 ms^{-1}$ along a path shown in figure. Then magnetic field produced at point P is ________ μT .



(A) Zero (B) 242.5

(C) 2425 (D) 2524

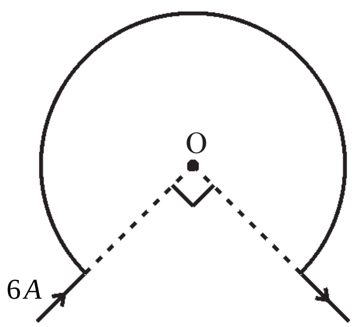
(6) ________ quadrant will behave like North pole.



(A) First (B) Third

(C) Second (D) Forth

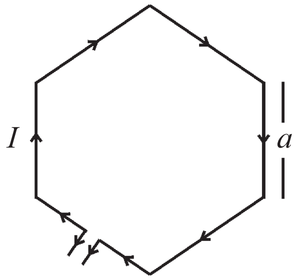
(7) A current of $6 A$ passes through the wire shown in figure. Then magnitude of magnetic field at point O is ________T. The radius of arc is 0.2 m. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}



(A) 1.41×10^{-4} (B) 1.41×10^{-5}

(C) Zero (D) 1.41×10^{-3}

(8) As shown in figure, current I passes through hexagon having side a. Magnetic field at the center of it is ________.



(A) $\dfrac{\mu_0 I}{3\sqrt{3}\pi a}$ (B) $\dfrac{\sqrt{3}\mu_0 I}{\pi a}$

(C) $\dfrac{3\sqrt{3}\mu_0 I}{\pi a}$ (D) $\dfrac{\mu_0 I}{\sqrt{3}\pi a}$

(9) On connecting a battery to the two ends of a diagonal of a square conducter frame of side *a*, the magnitude of the magnetic field at the center will be ________.

(A) zero (B) $\dfrac{\mu_0}{\pi a}$ (C) $\dfrac{2\mu_0}{\pi a}$ (D) $\dfrac{4\mu_0 I}{\pi a}$

(10) 10^{-8}T magnetic field produced at point P situated at 4 cm perpendicular to very long wire carring current *I*. How much magnetic field will be produced at a distance 12 cm. perpendicular to the same wire ?

(A) 1.33×10^{-8} (B) 1.11×10^{-4} (C) 3×10^{-3} (D) 9×10^{-2}

(11) In hydrogen atom, an electron revolving in the orbit of radius $0.53\overset{0}{\text{A}}$ with speed of 6.6×10^{15} revolution per second. Magnetic field at the center B = ________ T.

(A) 0.125 (B) 1.25 (C) 12.5 (D) 125

(12) Two linear conductors AOB and COD are mutually perpendicular. Currents passing through them are I_1 and I_2 respectively. Point P lies at perpendicular distance a from point 0 of ABCD plane. Magnetic field intensity at point P is ________.

(A) $\dfrac{\mu_0}{2\pi a}(I_1+I_2)$ (B) $\dfrac{\mu_0}{4\pi a}(I_1-I_2)$ (C) $\dfrac{\mu_0}{2\pi a}\left(I_1^2+I_2^2\right)^{1/2}$ (D) $\dfrac{\mu_0}{2\pi a}\left(I_1^2-I_2^2\right)^{1/2}$

(13) Electric current of 5 A passes through A current carrying straight wire. A point lying at a distance 10 cm from wire on perpendicular bisector of wire, makes angle 60° with both ends of wire. Then intensity of magnetic field arising at that point is ________ T.

(A) 3 μ_0 (B) 3.98 μ_0 (C) 39.8 μ_0 (D) Zero

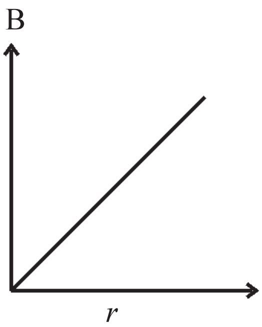
(14) Magnetic field lines associated with a very long straight current carrying wire will be ________.

(A) Along the length of the wire (B) centripetal

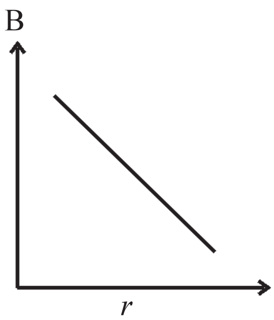
(C) Circular in the plane perpendicular to straight wire (D) Hyperbola

(15) Which of the following graphs shows the variation of magnetic induction $B \rightarrow$ distance (r) from very long straight current carrying wire ?

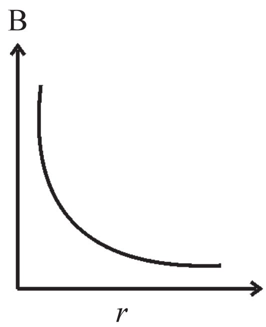
(A)



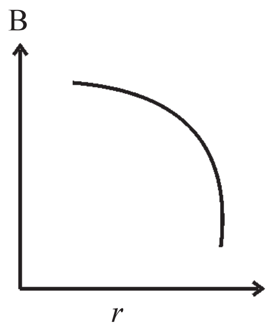
(B)



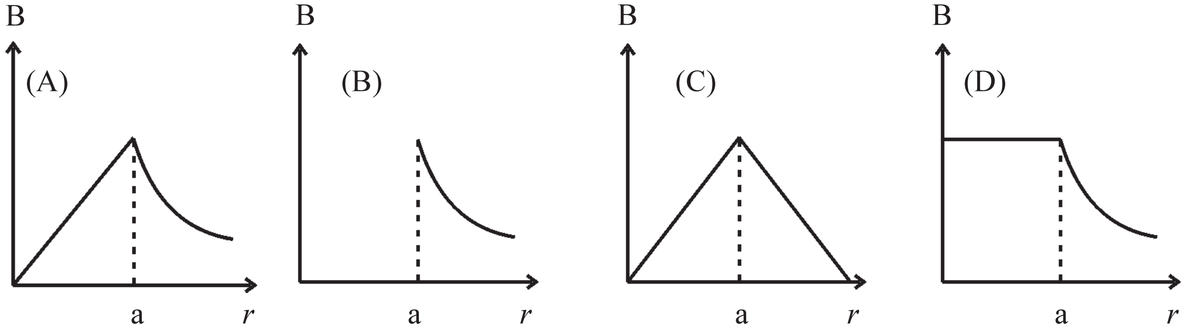
(C)



(D)



(16) The magnetic field due to a straight conductor of unifrom cross section of radius a and carrying steady current is represented by ________ graph.



Ans : 1 (C), 2 (B), 3 (C), 4 (A), 5 (C) 6 (B), 7 (B), 8 (B), 9 (A), 10 (A), 11 (C), 12 (C), 13 (B), 14 (C), 15 (B), 16 (A)

Ampere's Circuital Law

The line integral of magnetic field on a closed curve (loop) in a magnetic field is equal to the product of a algebraic sum of the electric current $\left(\sum I\right)$ enclosed by that closed loop and the permeability (μ_0) of vacuum.

$$\therefore \quad \oint \vec{B} \cdot \vec{dl} = \mu_0 \sum I$$

Magnetic field inside the conductor at a distance r from the axis of wire is $B = \left(\dfrac{\mu_0}{2\pi} \dfrac{I}{a^2}\right) r,\ r < a$

Magnetic field at a point inside a solenoid of infinite length, $B = \mu_0 nI$ where $n = \dfrac{N}{l}$

Magnetic field at a point inside solenoid of finite length, $B = \dfrac{\mu_0 nI}{2}\left(\sin\alpha_1 + \sin\alpha_2\right)$

Magnetic field produced in a toroid, $B = \mu_0 nI = \mu_0\left(\dfrac{N}{2\pi r}\right) I$

---

(17) Two coplaner and concentric coils of 20 turns each having radii of 40 cm and 80 cm are carrying current 0.4 A and 0.8 A in opposite direction respectively. The net magnetic field at the center is ________ T.

(A) $4\ \mu_0$ (B) $2\ \mu_0$ (C) $\dfrac{10}{4}\mu_0$ (D) $\dfrac{5}{4}\mu_0$

(18) When a steady current carrying straight wire turned into one circular loop, the magnetic induction at the center of loop due to current is B. If the same wire is turned into n loops to make a circular coil, the magnetic intensity at the center of this coil for same current will be ________.

(A) nB (B) n^2B (C) $2n$B (D) $2n^2B$

(19) If ratio of magnetic intensities at center and at distance x from center on axis of current carrying circular ring of radius R is 8:1 then $x =$ ________ .

(A) $\sqrt{3}R$ (B) $\frac{R}{\sqrt{3}}$ (C) $2\sqrt{3}R$ (D) $\frac{2R}{\sqrt{3}}$

(20) Magnetice field is B_1 at centre of current carrying coil of radius a and B_2 at a distance a on its axis from centre, then ratio $\frac{B_1}{B_2} =$ ________ .

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

(21) Two concentric rings carry current I_1 and I_2. If the ratio of their radii is $1:2$ and ratio of magnetic field at centre is $1:3$. Then $\frac{I_1}{I_2} =$ ________ .

(A) $\frac{1}{4}$ (B) $\frac{1}{6}$ (C) $\frac{1}{2}$ (D) $\frac{1}{3}$

(22) Current I passes through solenoid having radius a and length L. Magnetic field produced at the end point of solenoid is ________

(A) $\frac{2\mu_0 nIL}{\sqrt{L^2 + a^2}}$ (B) Zero (C) $\frac{\mu_0 nIL}{2\left(L^2 + a^2\right)^{\frac{1}{2}}}$ (D) $\frac{2\mu_0 nIL}{\left(L^2 + a^2\right)}$

(23) Magnetic field at the mid point of axis of solenoid having radius 1.0 m and length 2.0 m is ________.

(A) $\frac{\mu_0 nI}{2\sqrt{2}}$ (B) $\frac{\mu_0 nI}{2}$ (C) $\sqrt{2}\,\mu_0 nI$ (D) $\frac{\mu_0 nI}{\sqrt{2}}$

(24) Two similar coils are kept mutually perpendicular such that their centres coincide. At the centre, what is the ratio of the magnetic field due to one coil and the resulant magnetic field by both coils if the same current flows through them ?

(A) $1:\sqrt{2}$ (B) $1:2$ (C) $2:1$ (D) $\sqrt{3}:1$

(25) A wire is wound on solenoid having 10 A current capacity. If length of solenoid is 80 cm and having cross section radius 3 cm. Then length of required wire is ________ $(\text{Take B} = 2\text{T})$.

(A) 1.2×10^2 (B) 4.8×10^2 (C) 2.4×10^3 (D) 6×10^3

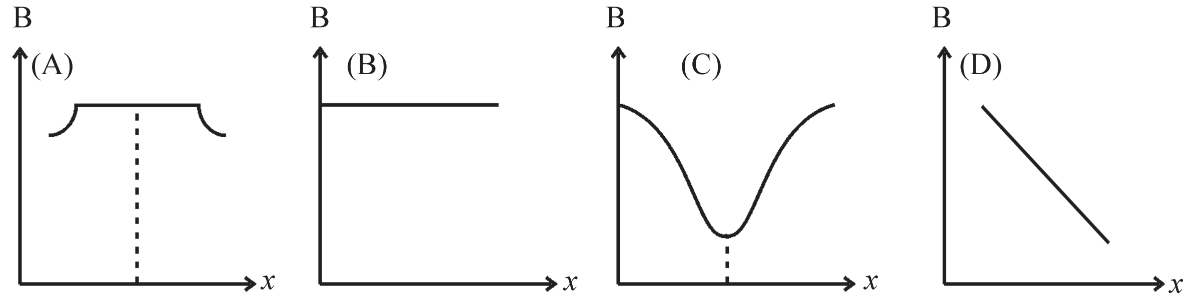
(26) Ampere's circuital law is equivalent to ________.

(A) Bio Savart's law (B) Coulomb's law (C) Faraday's law (D) Kirchoff's law

(27) The dimensional formula of magnetic intensity B is ________ .

(A) $M^1L^{-2}A^{-1}$ (B) $M^1T^{-2}A^{-1}$ (C) M^2TA^{-2} (D) $M^2LT^{-2}A^{-1}$

(28) Which one is the correct graph between the magnetic induction (B) along the axis of current carrying long solenoid and distance x from one end of solenoid ?



Ans. :	**17 (C), 18 (B), 19 (A), 20 (C), 21 (B), 22 (C), 23 (D), 24 (A), 25 (C), 26 (A), 27 (B) 28 (A)**

- Force on a charged particle in magnetic field.

  If a particle carrying a positive charge q and moving with velocity $\vec{v}$ enters in a magnetic field B then it experiences a force F which is given by the expression.

  $$\vec{F} = q\left(\vec{v} \times \vec{B}\right)$$

  $\therefore$ F = $Bqv\sin\theta$

  If charge is negative

  $$\vec{F} = -q\left(\vec{v} \times \vec{B}\right) = q\left(\vec{B} \times \vec{v}\right)$$

  $\therefore$ F = $Bqv\sin\theta$

  Force on charged particle will be zero

  (1) If $B = 0$

  (2) If particle is neutral then $q = 0$

  (3) If charge particle is static then $v = 0$

  (4) If charge particle moving parallel or anti parallel to magnetic field then $\theta = 0$ or π

- **Lorentz Force :** When the moving charged particle is subjected simultaneously to both electric field $\vec{E}$ and magnetic field $\vec{B}$. So the Lorentz force acting on it

  $$\vec{F} = q\left[\vec{E} + \left(\vec{v} \times \vec{B}\right)\right]$$

- **Cyclotron :** Radius of circular path of charged particle. $r = \dfrac{mv}{Bq} = \dfrac{p}{Bq} = \dfrac{\sqrt{2mK}}{Bq} = \dfrac{1}{B}\sqrt{\dfrac{2mv}{q}}$

  If charged particle accelerated by voltage V and obtain kinetic energy K then

  $p = mv = \sqrt{2mK} = \sqrt{2mqV}$

Angular frequancy of charged particle, $\omega_c = \frac{Bq}{m}$

Periodic time of charged particle, $T = \frac{2\pi m}{Bq}$

---

(29) A particle of mass m has an electric charge q. This particle is accelerated through a potential difference V and then entered normally in a uniform magnetic field B. It performs a circular motion of radius R. The ratio of its charge to the mass $\frac{q}{m}$ is ________ . ($\frac{q}{m}$ is also called specific charge.)

(A) $\frac{2V}{B^2R^2}$ (B) $\frac{V}{2BR}$ (C) $\frac{VB}{2R}$ (D) $\frac{mV}{BR}$

(30) A proton, a deuteron ion and an α - particle of equal kinetic energy perform circular motion normal to a uniform magnetic field B. If the radii of their paths are r_p, r_d and r_α respectively then ________ $\left(\text{Here } q_d = q_p,\ m_d = 2m_p\right)$.

(A) $r_\alpha = r_p < r_d$ (B) $r_\alpha = r_d > r_p$

(C) $r_\alpha > r_d > r_p$ (D) $r_\alpha = r_d = r_p$

(31) Maximum force acting on electron moving in magnetic field of 5×10^{-5} T with velocity $4 \times 10^4 \, ms^{-1}$ is ________ N.

(A) 1.6×10^{-19} (B) 3.2×10^{-19} (C) 1.6×10^{-17} (D) 3.2×10^{-17}

(32) If Lorentz force acting on charged particle is zero and electric field is $5 Vm^{-1}$ then $|\vec{B} \times \vec{v}| =$ ________ .

(A) Zero (B) Infinite (C) 5 (D) 10

(33) Force acting on moving proton having velocity of $10\hat{i}\ ms^{-1}$ in magnetic field of $5\ \hat{j}$ T will be ________ .

(A) $5 \times 10^{-18}\ \hat{k}$ (B) $2 \times 10^{-18}\ \hat{k}$ (C) $8 \times 10^{-18}\ \hat{k}$ (D) $10 \times 10^{-18}\ \hat{k}$

(34) A proton is moving perpendicular to a uniform magnetic field of 5 T with 2 MeV kinetic energy. The magnetic force acting on proton is ________ N.
$(m_p = 1.6 \times 10^{-27} Kg,\ q_p = 1.6 \times 10^{-19} C)$

(A) 8×10^{-11} (B) 16×10^{-11} (C) 8×10^{-12} (D) 16×10^{-12}

(35) A proton having velocity $\vec{v} = 2\hat{i} + 3\hat{j}\ ms^{-1}$ is moving in magnetic field of $\vec{B} = 2\hat{i} + 3\hat{j}$ T. Magnetic force acting on proton is ________ N.

(A) 1.6×10^{-19} (B) 9.1×10^{-31} (C) Zero (D) infinite

(36) A particle having 2 C charge passes through magnetic field of $4\hat{k}$ T and some uniform electric field with velocity $25\hat{j}\ ms^{-1}$. If the Lorentz force acting on it is $400\hat{i}$ N. The electric field in this region is ________ Vm^{-1}.

(A) $200\ \hat{i}$ (B) $200\ \hat{k}$ (C) $100\ \hat{i}$ (D) $10\ \hat{j}$

(37) A proton (mass = 1.67×10^{-27} kg and charge = 1.6×10^{-19} c) enters perpendicular to a magnetic field of intensity 2 T with a velocity $3.4 \times 10^{7}\ ms^{-1}$. The acceleration of the proton is ________ ms^{-2}

(A) 6.5×10^{15} (B) 6.5×10^{13} (C) 6.5×10^{11} (D) 6.5×10^{9}

(38) A deutron of kinetic energy 50 KeV is describing a circular orbit of radius 0.5 meter in a plane perpendicular to magnetic field $\vec{B}$. The kinetic energy of the proton that describes a circular orbit of radius 0.5 meter in the same plane with the same $\vec{B}$ is ________ KeV.

(A) 25 (B) 50 (C) 100 (D) 200

(39) Two electron having same velocities v and moves parallel to each other at distance *r*. The ratio of magnetic force and electric force acting on them is ________ .

(A) $\frac{v}{c}$ (B) $\frac{c}{v}$ (C) $\frac{v^2}{c^2}$ (D) $\frac{c^2}{v^2}$

(40) Path of charged particle entering perpendicular to magnetic field will be ________.

(A) circular (B) linear (C) elliptical (D) parabolic

Ans. : 29 (A), 30 (A), 31 (B), 32 (C), 33 (C), 34 (D), 35 (C), 36 (C), 37 (A), 38 (C), 39 (C), 40 (A)

- Force acting on current carrying wire of length l placed in uniform magnetic field

$$\vec{F} = I\,\vec{l} \times \vec{B}$$

$\therefore$ $F = BIl\sin\theta$ where θ is angle between $\vec{l}$ and $\vec{B}$.

- Force between two parallel current carrying conductors and seperated by a distance y.

$$|\vec{F}| = \frac{\mu_0 I_1 I_2 l}{2\pi y}$$

Force per unit length,

$$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi y}$$

If conductors carry current in same direction, then the force between them will be attractive.

If conductors carry, current in opposite direction, then force between them will be repulsive.

- Torque acting on current carrying loop, suspended in a uniform magnetic field, $\vec{\tau} = \vec{M} \times \vec{B}$

where $\vec{M} = NI\vec{A}$ = Magnetic dipole linked with coil.

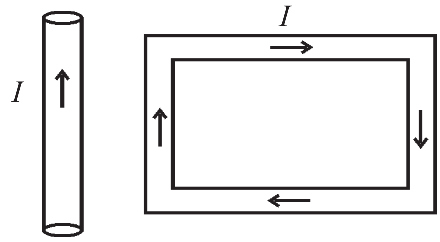
---

(41) The magnetic dipole moment of a current carrying loop is independent of ________.

(A) Magnetic field in which it is lying (B) Number of turns

(C) Area of the loop (D) Current in the loop

(42) A rectangular loop carrying current I is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. If a steady current I is established in wire as shown in figure, the loop will ________ .



(A) Rotate about an axis parallel to the wire (B) Move away from the wire or towards right
(C) Move towards the wire (D) Remain stationary

(43) A conducting circuler loop of radius r carries a constant current I. It is placed in a uniform magnetic field $\vec{B}$ such that $\vec{B}$ is perpendicular to the plane of the loop. The magnetic force acting on the loop is ________.

(A) $Ir\vec{B}$ (B) $2\pi rI\vec{B}$ (C) zero (D) $\pi r^2 I\vec{B}$

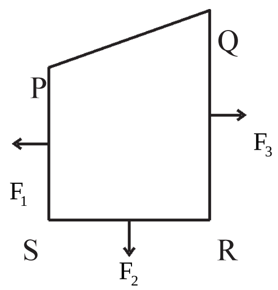
(44) A circular coil of radius 4 cm and of 20 turns carries a current of 3 ampere. It is placed in a magnetic field of intensity of 0.5 T. The magnetic dipole moment of the coil is ________ ampere m^2

(A) 0.15 (B) 0.30 (C) 0.45 (D) 0.60

(45) Two thin long parallel wires seperated by distance b are carrying current I amp each. The magnitude of the force per unit length exerted by one wire on the other is ________.

(A) $\dfrac{\mu_0 I^2}{b^2}$ (B) $\dfrac{\mu_0 I^2}{2\pi b}$ (C) $\dfrac{\mu_0 I}{2\pi b}$ (D) $\dfrac{\mu_0 I}{2\pi b^2}$

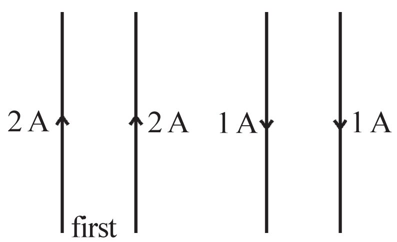
(46) A close loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic force on segment PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is ________.



(A) $\sqrt{(F_3 - F_1)^2 - F_2^2}$ (B) $F_3 + F_1 - F_2$

(C) $F_3 - F_1 + F_2$ (D) $\sqrt{(F_3 - F_1)^2 + F_2^2}$

(47) As shown in the figure, two very long straight wires are kept parallel to each other and 2A current is passed through then in the same direction. In this condition, the force between them is F. Now if the current in both of them is made 1A and direction are reversed in both, then the force between them ________.



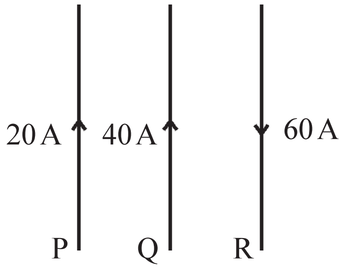
(A) Will be $\dfrac{F}{4}$ and attraction

(B) Will be $\dfrac{F}{2}$ and repulsive

(C) Will be $\dfrac{F}{2}$ and attractive

(D) Will be $\dfrac{F}{4}$ and repulsive

(48) As shown in the figure 20 A, 40 A and 60 A current are passing through very long straight wires P, Q and R respectively in the direction shown by the arrows. In this condition the direction of the resultant force on wire Q is ________.



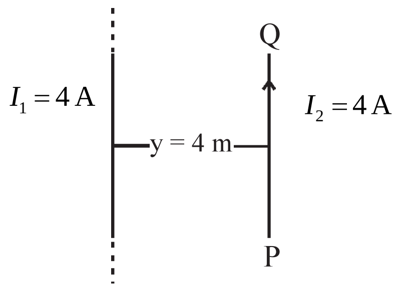
(A) towards left of wire Q

(B) towards right of wire Q

(C) normal to the plane of paper.

(D) in the direction of current passing through Q

(49) As shown in the figure, a straight wire PQ of length 2 m carrying 2 A current is placed parallel to a very long wire at a distance of 2 m. Find the force acting on wire PQ. If the current passing through the long wire is also 2 A.



(A) 6×10^{-7} N (B) 16×10^{-7} N

(C) 16×10^{-8} N (D) Zero

(50) A conducting wire of 4 m length is used to form circular loop. If it carries a current of 1.0 A it's magnetic dipole moment will be = ________ Am^2

(A) 2π (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{4}$ (D) $\frac{4}{\pi}$

(51) Dipole moment of a coil is $2\hat{i} + 3\hat{j} + 5\hat{k}$. If the coil is suspended in the uniform magnetic field having magnitude $5\hat{k}$T torque acting on it will be = ________.

(A) $\sqrt{35}$ (B) $\sqrt{117}$ (C) $\sqrt{25}$ (D) $\sqrt{135}$

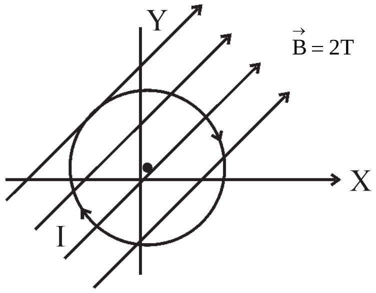
(52) An electron moves with a constant speed v along a circle of radius r. It's magnetic moment will be ________ (e is the charge of electron)

(A) $e\,v\,r$ (B) $\frac{evr}{2}$ (C) $\pi r^2 v$ (D) $2\pi ev$

(53) A circular coil having N turns is made from a wire L meter long. If a current of I is passed through this coil suspended in a uniform magnetic field of B tesla, the maximum torque that can act on this coil = ________ .

(A) $\frac{\text{ILB}}{2\pi N}$ (B) zero (C) $\frac{\text{B}I\text{L}^2}{4\pi N}$ (D) $\frac{\text{B}I\text{L}^2}{8\pi^2 N}$

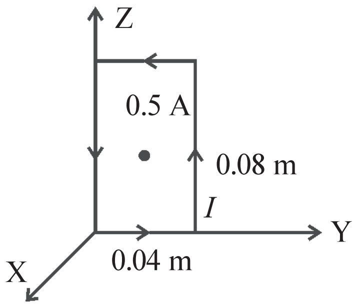
(54) 1 A current carrying circular loop having radius 20 cm is kept in XY plane as shown in the figure Torque acting on loop is ________ Nm.



(A) 0.15 (B) 0.25

(C) 0.35 (D) 0.55

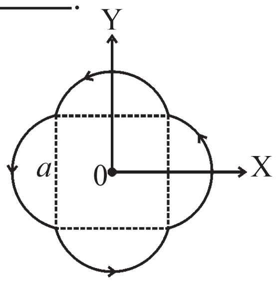
(55) As shown in figure a rectangular coil having one turn is kept in uniform magnetic field of $\frac{0.05}{\sqrt{2}}\hat{j}$ T. Torque acting on it will be ________ Nm.



(A) $11.32 \times 10^{-4}\ \hat{k}$ (B) $22.64 \times 10^{-4}\ \hat{k}$

(C) $5.64 \times 10^{-5}\ \hat{k}$ (D) Zero

(56) A loop carrying current I lies in the XY plane as shown in the fig. The unit vector $\hat{k}$ is out ward and perpendicular to the plane of the paper. The magnetic moment of the current loop is ________.



(A) $I\ a^2\ \hat{k}$ (B) $\left(\frac{\pi}{2}+1\right)a^2\ I\ \hat{k}$

(C) $-\left(\frac{\pi}{2}+1\right)a^2\ I\ \hat{k}$ (D) $(2\pi+1)\ a^2\ I\ \hat{k}$

(57) Straight conducting wire of length 0.5 m and carrying current 1.2 A is placed perpendicular in uniform magnetic field of 2 T. Magnetic force acting on it will be ________ N.

(A) 2.4 (B) 1.2 (C) 3.0 (D) 2.0

(58) Two very long parallel wire seperated by 10 cm and carrying current 10 A in same direction. Force acting on unit length of one wire due to other will be ________ N.

(A) 2×10^{-4} N Attractive (B) 2×10^{-4} N Repulsive

(C) 2×10^{-7} N Attractive (D) 2×10^{-7} N Repulsive

(59) A small coil of N turns has an effective area A and carries a current I. It is suspended in a horizontal magnetic field $\vec{B}$ such that its plane is perpendicular to B. Find the work done in rotating it by $180°$ about the vertical axis ________.

(A) NIAB (B) 2 NIAB (C) $\frac{2NIA}{B}$ (D) 4 NIAB

(60) A square coil 20 cm × 20 cm has 100 turns and carries a current of 1 A. It is placed in a uniform magnetic field B = 0.5 T with the direction of magnetic field parallel to the plane of the coil. The magnitude of the torque required to hold this coil in this poisition is ________ Nm.

(A) zero (B) 2 (C) 10 (D) 40

Ans. :	**41 (A),**	**42 (C),**	**43 (C),**	**44 (B),**	**45 (B),**	**46 (D),**	**47 (A),**	**48 (A),**	**49 (B),**	**50 (D),**
	51 (B),	**52 (B),**	**53 (C),**	**54 (B),**	**55 (C),**	**56 (B),**	**57 (B),**	**58 (A),**	**59 (B),**	**60 (B)**

Galvanometer

Use to detect and measure small electric currents. If the coil becomes steady after a deflection θ,

Deflecting torque = Restoring torque.

$$\mathrm{N}I\mathrm{AB} = K\theta$$

$$\therefore I = \frac{K}{\mathrm{NBA}}\phi \quad (K \rightarrow \text{ effective torsional constant of the spring})$$

$$\therefore I \,\alpha\, \phi$$

Current sensitivity $Si = \frac{\phi}{I} = \frac{\mathrm{NBA}}{K}$

The current sensitivity of a galvanometer is definned as the deflection produced in the galvanometer per unit current flowing through it.

Ammeter

Use to measure electric current

The small resistance joined in parallel to a galvanometer to convert it into an ammeter is called a sShunt.

$$\text{Shunt} = (\mathrm{S}) = \frac{\mathrm{G}I_g}{I - I_g}$$

To convert a galvanometer's rangh by n time $(I = nI_g)$ necessary shunt $\mathrm{S} = \frac{\mathrm{G}}{n-1}$

Current passing through shunt $I_s = I\left(\frac{\mathrm{G}}{\mathrm{G}+\mathrm{S}}\right)$

Current passing through galvanometer $I_g = I\left(\frac{\mathrm{S}}{\mathrm{S}+\mathrm{G}}\right)$ where, $I \rightarrow$ net current

Voltmeter

Use to measure p.d. between two ends of conductor

To convert a galvanometer into a voltmeter, a resistance of high value is joined in series with it.

$$\mathrm{R}_s = \frac{\mathrm{V}}{I_g} - \mathrm{G}$$

To increase voltage capacity by n times, necessary series resistance $R_s = (n-1)\,G$

Voltage sensitivity : S_v

Voltage sensitivity of a galvanometer is defined as the deflection produced in the galvanometer per unit voltage applied to it.

$$S_v = \frac{\phi}{V} = \frac{NBA}{KR}$$

---

(61) Resistance of galvanometer is G.. If shunt required to make its range n times is S, then n = ________.

(A) $\frac{G}{S}$ (B) $1-\frac{G}{S}$ (C) $1+\frac{G}{S}$ (D) $\frac{S}{G}$

(62) Resistance of galvanometer is G.. If series resistance required to make its voltage capacity n times is R_S, than R_S = ________.

(A) Gn (B) (n–1) G (C) (n+1) G (D) $\frac{G}{n-1}$

(63) Resistance of galvanometer is G. What will be resistance of voltmeter after making its voltage capacity n times ?

(A) nG (B) (n–1) G (C) (n+1) G (D) $\frac{G}{n-1}$

(64) Resistance of DC ammeter is $10\,\Omega$ and its current capacity is 20 mA. Resistance required to convert it in to volt meter measuring 3V p.d. is ________ Ω.

(A) 110 (B) 120 (C) 130 (D) 140

(65) 0.5 % of the total current in ammeter passes through galvanometer. If resistance of galvanometer is G, resistance of ammeter is ________

(A) $\frac{G}{200}$ (B) $\frac{G}{104}$ (C) 119 G (D) 200 G

(66) What will be the shunt required to pass 10 % of the main current through moving coil galvanometer having resistance $99\,\Omega$ ________ Ω.

(A) $10\,\Omega$ (B) $9.9\,\Omega$ (C) $9\,\Omega$ (D) $11\,\Omega$

(67) A galvanometer of resistance $25\,\Omega$ giving full scale deflection for a current of 10 miliampere is to be converted into a voltmeter of range 100 V by connecting a resistance of 'R' in series with galvanometer. Value of resistance R is ________ Ω.

(A) 10,000 (B) 10,025 (C) 975 (D) 9975

(68) An Ideal battery of 100 V is connected in series to a $20\,\Omega$ resistor. A galvanometer of $5\,\Omega$ is used to measure current in the circuit. Error in measurement will be ________.

(A) 0.5 A (B) 1 A (C) 2 A (D) 3 A

(69) A galvanometer of resistance $200\,\Omega$ is connected to a shunt of $20\,\Omega$ to form an ammeter. On connecting this ammeter to a battery of 10 V and a resistor of $4\,\Omega$ in series, ________ A electric current passes through ammeter.

(A) $\frac{55}{122}$ (B) $\frac{77}{55}$ (C) $\frac{122}{55}$ (D) $\frac{177}{22}$

(70) On connecting a shunt of 12Ω in parallel to a galvanometer, its deflection decreases from 50 division to 20 division. Then resistance of galvanometer is ________ Ω.

(A) 18 (B) 26 (C) 30 (D) 36

(71) Resistance of a galvanometer is G. On passing electric current I_g, it shows full scale deflection. A shunt S_1, is required to convert this galvanometer in to an ammeter of range 0 to I. If shunt S_2 is required to convert this galvanometer into an ammeter having range 0 to 2I, then $\frac{S_1}{S_2}$ = ________.

(A) $\frac{2I - I_g}{I - I_g}$ (B) $\frac{1}{2}\left(\frac{I - I_g}{2I - G}\right)$ (C) 2 : 1 (D) 1 : 1

(72) A galvanometer of resistance $50\,\Omega$ shows full scale deflection of 30 division when it is connected in series with 3 V battery and $2950\,\Omega$ resister. To obtain 20 division deflection for same galvanometer, the value of series resistor required is ________ Ω.

(A) 4450 (B) 5050 (C) 5550 (D) 6050

(73) A galvanometer has resistance of $15\,\Omega$ and gives full scale difflection for 4 mA current. To convert it into a ammeter of range 0 to 6 A, ________ .

(A) $10\,m\,\Omega$ resistance connected in parallel with galvanometer

(B) $10\,m\,\Omega$ resistance connected in series with galvanometer

(C) $1\,\Omega$ resistance connected in parallel with galvanometer

(D) $0.1\,\Omega$ resistance connected in series with galvanometer

(74) A voltmeter of resistance $1000\,\Omega$ giving full scale deflecation for a current of 100 mA is to be converted into an ammeter of range 1A. The value of shunt S is ________ Ω.

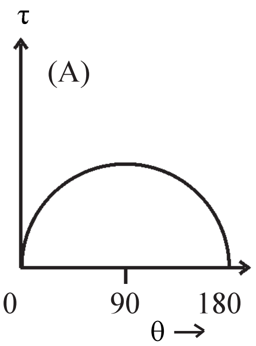
(A) 10000 (B) 9000 (C) 222 (D) 111

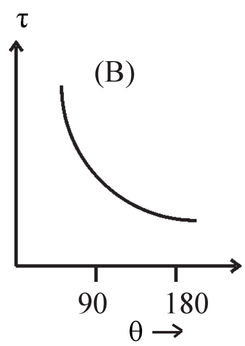
(75) If a galvanometer of resistance $25\,\Omega$ is shunted by $2.5\,\Omega$, then $\frac{Ig}{I}$ = ________

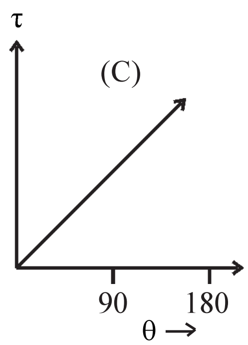
I_g = current passing through galvanometer, I = net current

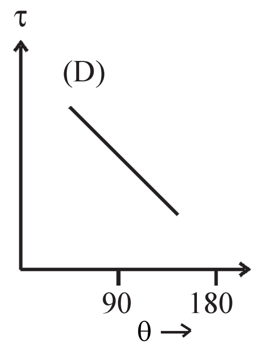
(A) $\frac{1}{11}$ (B) $\frac{1}{10}$ (C) $\frac{3}{11}$ (D) $\frac{4}{11}$

(76) The $(\tau \rightarrow \theta)$ graph for a current carrying coil is ________.









Ans. : 61 (C), 62 (B), 63 (A), 64 (D), 65 (A), 66 (D), 67 (D), 68 (B), 69 (A), 70 (A), 71 (A) 72 (A), 73 (A), 74 (D), 75 (A), 76 (A)

Magnetism and Matter :

Magnetic dipole moment of current carrying loop $\vec{m} = IA$

Pole strength of magnet $p = \frac{F}{B}$ where F = Force, B = magnetic field

Magnetic dipole moment of bar magnet $\vec{m_b} = 2P\vec{l}$ direction of $\vec{m_b}$ is from the south pole to the north pole

The magnitude of force of attraction or repulsion between two magnetic poles $F = \frac{\mu_0}{4\pi}\frac{p_1 p_2}{r^2}$

The force acting between two small bar magnet lying on same axis x distance apart from each other $F = \frac{3\mu_0\, m_1 m_2}{2\pi x^4}$

The magnetic field at a point z on the axis from the center of bar magmet $\vec{B}(z) = \frac{2\mu_0 mz}{4\pi\left(z^2 - l^2\right)^2}\hat{m}$

if $z >>> l$, the value of $\vec{B}\,(z) = \frac{2\mu_0 m}{4\pi z^3}\hat{m}$

The magnetic field on the equaterial point at a distance y from the centre of dipole of a bar magnet

$$\vec{B}\,(y) = \frac{\mu_0\, m}{4\pi\left(y^2 + l^2\right)^{\frac{3}{2}}}\hat{m}$$

if $y >> l$, the value of $\vec{B}(y) = \frac{\mu_0 m}{4\pi y^3}\hat{m}$

The torque acting on a magnetic dipole of magnetic moment m in uniform magnetic field $(\vec{B})$:

$\vec{\tau} = \vec{m} \times \vec{B}$

The periodic time, $T = 2\pi\sqrt{\frac{I}{mB}}$

The potential eneregy, $U = \vec{m} \bullet \vec{B} = mB\cos\theta$

The work done on the magnetic dipole placed in uniform magnetic field $(\vec{B})$ and rotating by (displacing) angle θ

$$\begin{aligned} W &= mB\left(1 - \cos\theta\right) \\ &= mB\left(\cos\theta_1 - \cos\theta_2\right) \\ &= mB\left(\cos\theta_2 - \cos\theta_1\right) \end{aligned}$$

Gauss's law for magnetic field :

The net magnetic flux associated with closed surface, $\oint \vec{B} \cdot d\vec{a} = 0$

---

(77) A bar magnet of length l, pole strength p and magnetic moment $\vec{m}$ is split into two equal pieces each of length $\frac{l}{2}$. The magnetic moment and pole strength of each piece is respectively ________ and ________.

(A) $\vec{m}, \frac{p}{2}$ (B) $\frac{\vec{m}}{2}, p$ (C) $\frac{\vec{m}}{2}, \frac{p}{2}$ (D) $\vec{m}, p$

(78) When a bar magnet is cut into two equal parts parallel to the length which of the following physical quantity does not change ?

(A) pole strength of poles (B) magnetic dipole moment

(C) intensity of magnetic field (D) moment of inertia

(79) A large magnet is broken into two pieces. so that their lengths are in the ratio 2:1, the pole strengths of the two parts will have ratio ________.

(A) 1 : 2 (B) 2 : 1 (C) 4 : 1 (D) 1 : 1

(80) The unit of pole strength of magnet is ________ (where Q is charge and v is velocity)

(A) Qv (B) $\frac{Q}{v}$ (C) $\frac{v}{Q}$ (D) $\frac{1}{Qv}$

(81) Point A and B lie on axis of bar magnet of length 3 cm at a distance 24 cm and 48 cm from center of bar magnet on opposite sides. Ratio of magnetic field at point A and B is ________.

(A) 8:1 (B) 4:1 (C) 3:1 (D) $1:2\sqrt{2}$

(82) If magnetic field at two points lying on equatorial line and axis of small bar magnet are same then ratio of its distance from center of magnet is ________.

(A) 2^{-3} (B) 2^{3} (C) $2^{\frac{1}{3}}$ (D) $2^{-\frac{1}{3}}$

(83) Force acting on north pole of magnet of polestrength 3200 Am. lying 10 cm away from south pole of bar magnet of polestrength 40 Am is ________ N.

(A) -1.28 (B) 1.28 (C) 1.28×10^{-7} (D) 1.28×10^{7}

(84) A magnet of magnetic moment $0.1\ \text{Am}^2$ is placed in a uniform magnetic field 0.36×10^{-4} T. The force acting on its each pole is 1.44×10^{-4} N. The distance between two poles would be ________ cm.

(A) 1.25 (B) 2.5 (C) 1.8 (D) 5.0

(85) The magnetic dipole moment of steel wire of length L, is m. It is bent from the middle and arranged as 60^0. So the new magnetic dipole moment will be ________ .

(A) $\frac{m}{\sqrt{2}}$ (B) $\frac{m}{2}$ (C) m (D) $2\,m$

(86) A straight wire of length l and magnetic dipole moment m is bent in form of a semi circle. Hence new magnetic dipole moment is ________.

(A) $\frac{m}{\pi}$ (B) $\frac{2m}{\pi}$ (C) $\frac{3m}{\pi}$ (D) $\frac{4m}{\pi}$

(87) A straight wire of length l and magnetic dipole moment m is bent in the form of a circle. Its two ends makes angles 60^0 at the centre. Hence new magnetic dipole moment is ________.

(A) $\frac{m}{\pi}$ (B) $\frac{2m}{\pi}$ (C) $\frac{3m}{\pi}$ (D) $\frac{4m}{\pi}$

(88) Magnetic field of current carrying coil at a distance 10 cm on axis from centre is 10^{-4}T. If diameter of coil is 1 cm then magnetic dipole moment will be ________ Am^2.

(A) 0.5 (B) 1.0 (C) 1.5 (D) 2.0

(89) A closely would solenoid of 6 cm, having 10 turns cm^{-1} and area of cross-section 3×10^{-4} m^2 carries a current of 1.0 A. The magnetic moment m of the solenoid is ________ Am^2.

(A) 1.8×10^{-2} (B) 0.3×10^{-2} (C) 1.6×10^{-2} (D) 3.6×10^{-2}

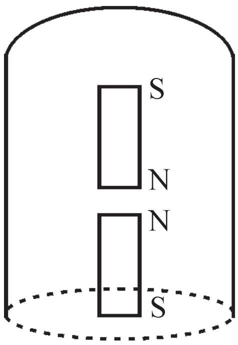
(90) The dimensional formula of magnetic field (B) in MLT and C (Coulomb) is given as ________.

(A) $M^1T^{-1}C^{-1}$ (B) $M^1T^{-2}C^{-1}$ (C) $M^1L^1T^{-1}C^{-1}$ (D) $M^1T^2C^{-2}$

(91) Force between two identical bar magnets whose center are 4 cm apart is 4.5 N when their axis are in the same line. If seperation is increased to 24 cm, the force between them is ________ N.

(A) 0.37×10^{-2} (B) 0.6 (C) 1.2 (D) 2.4

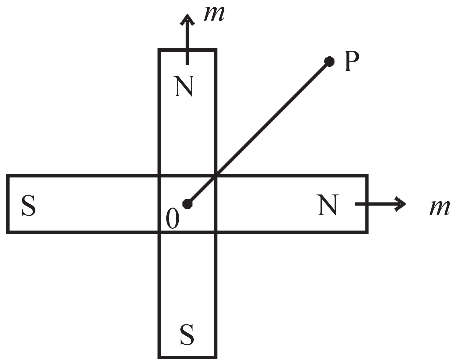
(92) Two idential bar magnets with length 10 cm and mass 50 g. are arranged freely with their like poles facing each other in a inverted vertical glass tube. The upper magnet hangs in the air above the lower one so that the distance between the nearest pole of the magnet is 3 mm. pole strength of the poles of each magnet will be ________ Am.



(A) 6.64 (B) 33.2

(C) 11.1 (D) 99.6

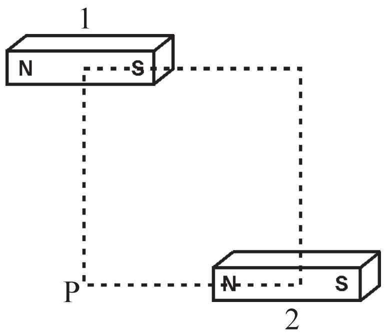
(93) Two short magnets of equal dipole moments M are arranged perpendicularly such that their centres coincide (fig.) The magnitude of the magnetic field at a distance d from the centre on the bisector of the right angle is ________



(A) $\frac{\mu_o m}{4\pi d^3}$ (B) $\frac{\mu_o}{4\pi}\frac{\sqrt{2}m}{d^3}$

(C) $\frac{\mu_o}{4\pi}\frac{2\sqrt{2}m}{d^3}$ (D) $\frac{\mu_o}{4\pi}\frac{2m}{d^3}$

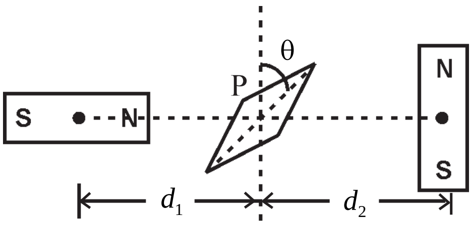
(94) Two short magnets of magnetic moment $1000\ Am^2$ are placed as shown at the corners of a square of side 10 cm. The net magnetic induction at P is ________ T.



(A) 0.1 (B) 0.2

(C) 0.3 (D) 0.4

(95) Two magnets A and B are identical and are arranged as shown in the figure. Their length is negligible in comparison to the separation between them. A magnetic needle is placed between the magnets at point P which gets deflected through an angle θ under the influence of magnets. The ratio of distance d_1 and d_2 will be ________ .



(A) $(2\tan\theta)^{1/3}$ (B) $(2\tan\theta)^{-1/3}$

(C) $(2\cot\theta)^{1/3}$ (D) $(2\cot\theta)^{-1/3}$

(96) A loop of radius 4 cm and 20 turns carries a current 3 A. If it is placed in magnetic field of 0.5 T, the potential energy of dipole in most stable position is ________ J.

(A) –0.15 (B) 0.15 (C) –1500 (D) 1500

(97) A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25 T experience a torque of 4.5×10^{-2} Nm. Magnetic moment of the magnet is ________ JT^{-1}

(A) 0.18 (B) 0.36 (C) 0.54 (D) 0.72

(98) A bar magnet is held perpendicular to a uniform field. How much angle by which it is should be rotated so that the value of torque becomes half of the original value of torque ________ .

(A) 30^0 (B) 45^0 (C) 60^0 (D) 75^0

(99) A bar magnet with magnetic dipole moment m rotates and makes an angle θ with the intensity of magnetic field H, the work done in this process is ________.

(A) $mH \cos \theta$ (B) $mH (1-\cos\theta)$ (C) $mH\sin\theta$ (D) $mH (1-\sin\theta)$

(100) A magnet of magnetic dipole moment $5.0\ Am^2$ is lying in a uniform magnetic field of 7×10^{-4} T such that its dipole moment vector makes an angle of 30^0 with the field. The work done in increasing this angle from 30^0 to 45^0 is about ________ J.

(A) 5.56×10^{-4} (B) 24.74×10^{-4} (C) 30.3×10^{-4} (D) 5.50×10^{-3}

(101) A circular coil having 50 turns and radius 4×10^{-2} m carries a current of 2 A. It is placed in uniform magnetic field of intensity of 0.1 Wbm^{-2}. The work done to rotate the coil from the equillibrium position by $180°$ is ________ J

(A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4

(102) The moment of inertia of magnetic needle is $8 \times 10^{-6}\ Kgm^2$ and its magnetic dipole moment is $10^{-1}\ Am^2$. The value of magnetic field if it performs 10 oscillations in ten second is ________ T.

(A) 3.15×10^{-3} (B) 1.35×10^{-3} (C) 3.15×10^{-5} (D) 1.35×10^{-5}

(103) The period of oscillation of two magnets in the same field are in the ratio of 2:1. If their moment of inertia are equal, the ratio of their magnetic moments is ________.

(A) 1 : 2 (B) 1 : 4 (C) 2 : 1 (D) 4 : 1

(104) The period of oscillation of a magnet is 2 sec. When it is remagnetised so that the pole strength is 4 times, its period will be ________ sec.

(A) 1 (B) 2 (C) 4 (D) 8

(105) Rate of change of torque τ with deflection θ is maximum for a magnet suspended freely in a uniform magnetic field of induction $\vec{B}$ when ________

(A) $\theta = 0$ (B) $\theta = 45^0$ (C) $\theta = 60^0$ (D) $\theta = 90^0$

(106) A magnet freely suspended in a vibration magnetometer is heated so as to reduce it's magnetic moment by 36 % by doing this, its perrodic time ________.

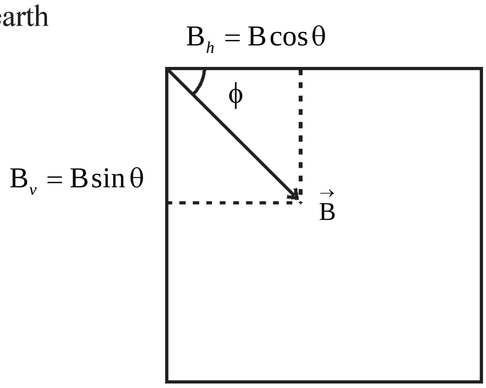
(A) Increase by 36 % (B) Increase by 25 % (C) Decrease by 25 % (D) Decrease by 64 %

(107) Two magnet are held together and allowed to oscillete in earth's magnetic field. With like poles together and unlike poles together periodic time are 4 s and 6 s respectively. The ratio of their magnetic moment is ________.

(A) 6 : 4 (B) 30 : 16 (C) 2.6 : 1 (D) 1.5 : 1

Ans. : 77 (B), 78 (C), 79 (D), 80 (A), 81 (A), 82 (D), 83 (B), 84 (B), 85 (B), 86 (B), 87 (C), 88 (A), 89 (A), 90 (A), 91 (A), 92 (A), 93 (C), 94 (A), 95 (C), 96 (A), 97 (B), 98 (C), 99 (B), 100 (A), 101 (A), 102 (A), 103 (B), 104 (A), 105 (A), 106 (B), 107 (C)

- If B is the magnetic field at any place on the earth



Its horizontal component $B_h = B\cos\theta$

Its vertical component $B_v = B\sin\theta$

Where $\phi \rightarrow$ Angle of dip.

Here $B = \sqrt{B_h^{\,2} + B_v^{\,2}}$

$$\tan\theta = \frac{B_v}{B_h}$$

- **Magnetic susceptibility :**

$\chi_m = \dfrac{M}{H}$ Where $M \rightarrow$ Intensity of magnetization

$H \rightarrow$ Magnetic intensity

- **Permeability**

$$\mu = \mu_0 (1 + \chi_m)$$

$\therefore \ \mu_r = \dfrac{\mu}{\mu_0} = 1 + \chi_m$ Where $\mu_r \rightarrow$ Relative permoability

According to Curie's Law

$\chi_m = \dfrac{M}{H} = \dfrac{c\mu_0}{T}$ $\therefore \ \chi_m \ \alpha \ \dfrac{1}{T}$

---

(108) The magnetic dip angle at a certain place where the horizental and vertical components of earth's magnetic field are equal is ________ .

(A) 0° (B) 30° (C) 45° (D) 90°

(109) At a place on Earth, the horizontal component of Earth's magnetic field is $\sqrt{3}$ times its vertical component. The angle of dip at this place is ________.

(A) 0° (B) 30° (C) 45° (D) 90°

(110) The angle of dip at a given place in magnetic merridian is 30°, then the angle of dip in the plane perpendicular to the magnetic meridian is ________ rad.

(A) 0 (B) $\dfrac{\pi}{3}$ (C) $\dfrac{\pi}{6}$ (D) $\dfrac{\pi}{2}$

(111) At a certain place on the earth, the horizontal component of magnetic field is 73.2 % more than the vertical component. The angle of dip at this place would be ________ .

(A) 30° (B) 45° (C) 60° (D) 90°

(112) The magnetic dip angle at two places are 30^{o} and 45^{o}. Calculate ratio of horizontal components of earth's magnetic field at the two places.

(A) $\sqrt{3}:\sqrt{2}$ (B) $1:\sqrt{2}$ (C) $1:2$ (D) $1:\sqrt{3}$

(113) A small bar magnet of magnetic dipole moment $1.6\ Am^2$ is placed in a magnetic meridian in such a way that its north pole remains in north direction. At this time, if neutral point is obtained at distance 20 cm, then horizental component of earth magnetic field $B_h =$ ________ T.

(A) 1×10^{-5} (B) 2×10^{-5} (C) 3×10^{-5} (D) 4×10^{-5}

(114) The Earth's magnetic field at some place on magnetic equator of Earth is $0.4\times10^{-4}T$. Estimate the magnetic dipole moment of the Earth. Consider the radius of earth at that place to be 6400 Km.

(A) $1.05\times10^{20}\ Am^2$ (B) $1.05\times10^{21}\ Am^2$ (C) $1.05\times10^{22}\ Am^2$ (D) $1.05\times10^{23}\ Am^2$

(115) A bar magnet is placed with its south pole towards geographic north. The neutral point is situated at distance of 40 cm from the center of the magnet. The length of the magnet is 20 cm. The horizontal component of the earth's magnetic field is $3.2\times10^{-5}\ T$. The pole strength of the magnet is ________ Am.

(A) 5 (B) 10 (C) 25 (D) 45

(116) Two short bar magnets of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the south. They have a common magnetic equator and are seperated by a distance of 20 cm. The value of the resultant horizontal magnetic induction at the mid-point of the line joining their centers is ________ T. $B_h = 3.6\times10^{-5}\ T$.

(A) 3.5×10^{-4} (B) 5.8×10^{-4} (C) 3.6×10^{-5} (D) 2.56×10^{-4}

(117) Relative permeability of substance is 0.075. Its magnetic susceptibillity is ________.

(A) 0.925 (B) – 0.925 (C) 1.075 (D) –1.075

(118) A toroid wound with 100 turns/m of wire carries a current of 3A. The core of toroid is made of iron having relative magnetic permeability $\mu_r = 5000$ under given conditions. The magnetic field inside the iron is ________ T. $\left(\text{Take } \mu_0 = 4\pi\times10^{-7}\ Tm A^{-1}\right)$

(A) 0.15 (B) 0.47 (C) 1.5×10^{-2} (D) 1.88

(119) A magnet of $1.2\ Am^2$ magnetic dipole moment having dimension of $0.15\ m\times0.02\ m\times0.01\ m$. Then intensity of magnetization M is ________ Am^{-1}.

(A) 10^4 (B) 2×10^4 (C) 4×10^4 (D) 8×10^4

(120) A magnet has coercivity of $3\times10^3\ Am^{-1}$. It is kept in a 10 cm long solenoid with a total of 50 turns. How much current has to be passed through the solenoid to demagnetize it ?

(A) 0.1 A (B) 0.6 A (C) 6 A (D) 10 A

(121) A magnetic field of $1600\ Am^{-1}$ produces a magnetic flux 2.4×10^{-5} Wb parallel to length of an iron bar of cross sectional area $0.2\ cm^2$. The susceptibillity of iron bar will be ________.

(A) 298 (B) 596 (C) 1192 (D) 1788

(122) The susceptibillity of a paramagnetic substance at -73° C temperature is 6×10^{-3} then the suseptibillity at -173° C temprature will be ________.

(A) 1.2×10^{-2} (B) 1.8×10^{-3} (C) 3×10^{-3} (D) 4.5×10^{-3}

(123) A magnet in the form of a cylindrical rod has a length of 5 cm and a diameter of 2 cm. It has a uniform magnetization of $5 \times 10^{3}\ Am^{-1}$. Its net magnetic dipole moment is ________ JT^{-1}.

(A) 7.85×10^{-2} (B) 8.75×10^{-2} (C) 5.78×10^{-2} (D) 7.58×10^{-2}

(124) A magnetic needle vibrates in the vertical plane perpendicular to the magnetic meridian. The time period of vibration is found to be 2 sec. The same needle is then allowed to vibrate in the horizontal plane and the time period is again found to be 2 sec. Then the angle of dip is ________.

(A) 0° (B) 30° (C) 45° (D) 90°

(125) A bar magnet suspended in earth magnetic field and oscillating in horizontal plane with periodic time T. If a wooden bar having moment of inertia equal to bar magnet is tied with bar magnet then periodic time of system will be ________.

(A) $\frac{T}{2}$ (B) $\frac{T}{3}$ (C) $\sqrt{2}\,T$ (D) $\frac{T}{\sqrt{2}}$

(126) A bar of iron has size of $5cm \times 1cm \times 1cm$ and density of $7.78 \times 10^{3}\ kgm^{-3}$. If each atom of iron has atomic dipole moment of $1.8 \times 10^{-23}\ Am^2$. Then magnetic dipole moment of iron in saturation magnetization state will be ________ Am^2.

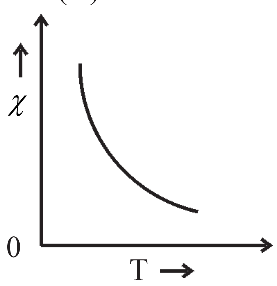
(A) 4.75 (B) 5.74 (C) 7.54 (D) 17.54

(127) Two magnet of equal dipole moment are arranged perpendicularly at their center. The periodic time of oscillation of system at anywhere on earth is T. Periodic time of each magnet will be ________.

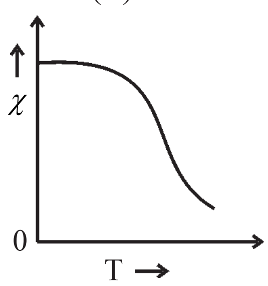
(A) $\sqrt{2}\,T$ (B) $2^{\frac{1}{4}}\,T$ (C) $2^{-\frac{1}{4}}\,T$ (D) $2^{\frac{-1}{3}}\,T$

(128) The graph of susceptibility $\rightarrow$ temperature for a diamagnetic substance is ________.

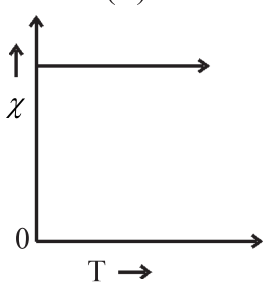
(A)



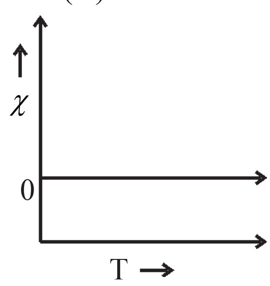
(B)



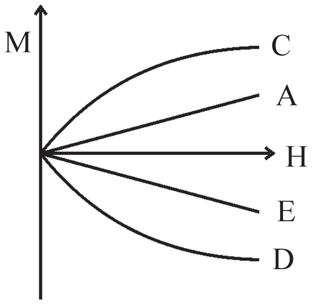
(C)



(D)



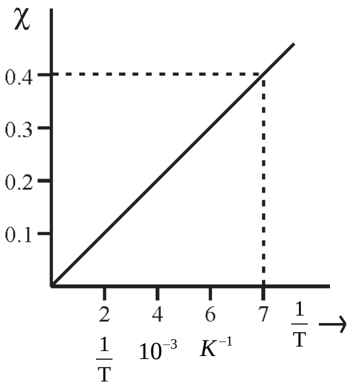
(129) The most appropriate magnetization M versus magnetising field H curve for a paramagnetic substance is ________.



(A) A (B) B

(C) C (D) D

(130) The $\chi \rightarrow \frac{1}{T}$ graph for an alloy of paramagnetic nature is shown in fig. The Curie constant is ______K.



(A) 57 (B) 67

(C) 77 (D) 97

Ans. : 108 (C), 109 (D), 110 (D), 111 (A), 112 (A), 113 (B), 114 (D), 115 (D), 116 (D), 117 (B), 118 (D), 119 (C), 120 (B), 121 (B), 122 (A), 123 (A), 124 (C), 125 (C), 126 (C), 127 (C), 128 (D), 129 (A), 130 (A)

Assertion - Reason type Question :

Instruction : Read assertion and reason carefully, select proper option from given below.

(a) Both assertion and reason are true and reason explains the assertion.

(b) Both assertion and reason are true but reason does not explain the assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false and reason is true.

---

(131) Assertion : Cyclotrom does not accelerate electron

Reason : Mass of the electron is very small.

(A) a (B) b (C) c (D) d

(132) Assertion : The magnetic field produced by a current carrying solenoid is independent of its length and cross sectional area.

Reason : The magnetic field inside the solenoid is uniform.

(A) a (B) b (C) c (D) d

(133) Assertion : A circular loop carrying current lies in *xy* plane with its center at origin has a magnetic flux in negative Z-axis

Reason : Magnetic flux direction is independent of the direction of current in the conductor.

(A) a (B) b (C) c (D) d

(134) Assertion : A direct current flowing through a metalic rod produces magnetic field only outside the rod.

Reason : There is no flow of charge carriers inside the rod.

(A) a (B) b (C) c (D) d

(135) Assertion : The poles of a magnet can never be seperated.

Reason : Atoms themselves are magnets.

(A) a (B) b (C) c (D) d

(136) Assertion : When the radius of a circular wire carrying current is doubled, its magnetic moment becomes four times.

Reason : The magnetic moment of the loop depend on the area of loop.

(A) a (B) b (C) c (D) d

(137) Assertion : Steel is not attracted by a magnet

Reason : Steel is not a magnetic substance.

(A) a (B) b (C) c (D) d

(138) Assertion : The force between two small bar magnets lying on the same axis is inversely proportional to square of distance between them.

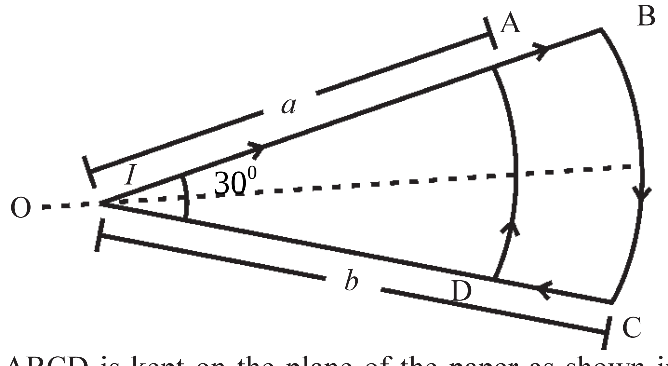
Reason : The force between two poles of a magnet is inversely proportional to the square of the distance between them.

(A) a (B) b (C) c (D) d

Asn. : 131 (A), 132 (B), 133 (C), 134 (D), 135 (A), 136 (B), 137 (C), 138 (D)

Comprehension Type Questions :

Paragraph -I Read the following paragraph and give the answers to the questions



A current loop ABCD is kept on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius = a) of the loop are joined by two straight wire AB and CD.

A steady current I is flowing in the loop. Angle made by AB and CD at the origin O is 30°. Another straight thin wire with steady current I, flowing out of the plane of the paper, is kept at the origin.

(139) The magnitude of the magnetic field (B) due to arc AD at the origin 'O' is ________.

(A) zero (B) $\frac{\mu_0 I}{24a}$ (C) $\frac{\mu_0 I}{4\pi a}$ (D) $\frac{\mu_0 I}{12\pi a}$

(140) The magnitude of the magnetic field (B) due to the arc BC at the origin 'O' is ________.

(A) zero (B) $\frac{\mu_0 I}{24b}$ (C) $\frac{\mu_0 I}{4\pi b}$ (D) $\frac{\mu_0 I}{12\pi b}$

(141) The magnitude of the magnetic field (B) due to the loop ABCD at the origin O is ________.

(A) $\frac{\mu_0 I}{2\pi}\left(\frac{b-a}{ab}\right)$ (B) $\frac{\mu_0 I}{24}\left(\frac{b-a}{ab}\right)$ (C) $\frac{\mu_0 I}{4\pi}\left(\frac{b-a}{ab}\right)$ (D) zero

(142) Due to the presence of the current I at the origin, ________.

(A) the forces on AB and DC are zero

(B) the forces on AD and BC are zero

(C) the magnitude of the net force on the loop is given by $\frac{I_1 I}{4\pi}\left[2(b-a)+\frac{\pi}{3}(a+b)\right]$

(D) the magnitude of the net force on the loop is given by $\frac{\mu_0 I I_1}{24ab}(b-a)$

Paragraph -II

Advanced countries are making use of powerful electromagnets to move trains at very high speed. These trains are called Maglev trains (abbreviated from magnetic levitation.) These trains float on a guideway and do not run on steel rail tracks.

Insteand of using an engine based on conventional fuels like LPG, CNG, Deisel they make use of magnetic field forces. The magnetized coils are arranged on the guideway which repel the strong magnet placed under train's carriage. This helps train move over the guideway, a technique called Electrodynamic suspension. When current passes in the coils of guideway, a typical magnetic field is set up between the under carriage of train and guideway which pushes and pulls the train along the guideway depending on the requirement.

The lack of friction and its aerodynamic style allows the train to move at very high speed.

(143) The force which makes maglev move is ________.

(A) Gravitational (B) Magnetic (C) Nuclear forces (D) Air drag

(144) The advantage of maglev train is ________ .

(A) More friction (B) More pollution (C) Less pollution (D) Less friction

(145) The levitation of the train is due to ________.

(A) Mechanical force (B) Electrostatic attraction

(C) Electrostatic repulsion (D) Magnetic repulsion

Ans. :139 (B), 140 (B), 141 (B), 142 (B), 143 (B), 144 (D), 145 (D)

Match the columns :

(146)

Column-1		Column-2	
(a)	Biot-Savart's law	(p)	gives direction of induced magnetic field
(b)	Law of right hand thumb	(q)	gives intensity of induced magnetic field
(c)	Fleming's left hand rule	(r)	gives direction of induced current
(d)	Fleming's right hand rule	(s)	gives direction of force due to magnetic field.

(A) a – s, b – r, c – q d – p

(B) a – p, b – q, c – r d – s

(C) a – q, b – s, c – r d – p

(D) a – q, b – r, c – s d – p

(147)

Column-1		Column-2	
(a)	Magnetic field due to a straight very long wire and carrying current I at a point at perpendicular distance r from the wire	(p)	$\frac{\mu_0 I}{2r}$
(b)	Magnetic field due to a circular coil carrying current I and radius (r), at its center.	(q)	$\frac{\mu_0 I}{4\pi r}$
(c)	Magnetic field due to a circular coil of radius r and carrying current I at a point on its axis at a distance r from it's centre.	(r)	$\frac{2\,\mu_0 I}{4\pi r}$
(d)	Magnetic field at a centre of current carrying ring having are length r and having radius r.	(s)	$\frac{\mu_0 I}{4\sqrt{2}\,r}$

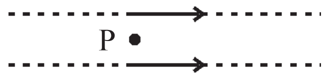
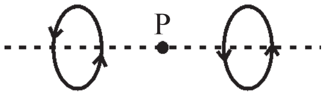
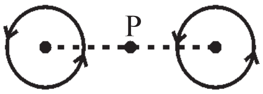
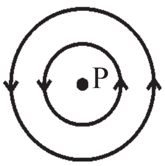
(A) a – r, b – s, c – p, d – q

(B) a – r, b – p, c – s, d – q

(C) a – p, b – q, c – s, d – r

(D) a – s, b – p, c – r, d – q

(148) Two wires each carrying a steady current I are shown in four configurations in column I. Some of the resulting effects are described in column II. Match the statments in column I with the statements in column II.

Column - I		Column - II	
(a)		(p)	The magnetic fields (B) at P due to the currents in the wires are in the same direction.
(b)		(q)	The magnetic fields (B) at P due to the currents in the wires are in opposite direction.
(c)		(r)	There is no magnetic field at P.
(d)		(s)	The wires repel each other.

(A) a – p, b – r, c – q, d – s

(B) a – q, b – p, c – r, d – p

(C) a – p, b – p, c – r, d – q

(D) a – s, b – p, c – s, d – q

(149)

Column - I		Column - II	
(a)	Moving coil galvanometer	(p)	having very small resistance.
(b)	Ammeter	(q)	having medium resistance.
(c)	Voltmeter	(r)	having very high, medium or very small resistance.
(d)	Avometer	(s)	having very high resistance.

(A) a – p, b – q, c – r, d – s

(B) a – p, b – q, c – s, d – r

(C) a – q, b – p, c – r, d – s

(D) a – q, b – p, c – s, d – r

Ans. : 146 (D), 147 (B), 148 (B), 149 (D)