Ravi Maths Tuition

Moving Charges and Magnetism

12th Standard

Physics

Multiple Choice Question 114 x 1 = 114

1) The magnetic field at a perpendicular distance of 2 cm from an infinite straight current carrying conductor is 2×10^{-6} T. The current in the wire is

(a) 0.1 A (b) 0.2 A (c) 0.4 A (d) 0.8 A

2) A positive charge is moving towards an observer. The direction of magnetic induction lines is

(a) clockwise (b) anticlockwise (c) right (d) left

3) If a copper wire carries a direct current, the magnetic field associated with the current will be

(a) only outside the wire (b) only inside the wire (c) both inside and outside the wire

(d) neither inside nor outside the wire

4) Current carrying wire produces

(a) Only electric field (b) Only magnetic field (c) Both electric and magnetic field (d) None of the above

5) A circular coil of n turns and radius r carries a current I. The magnetic field at the centre is

(a) $\frac{\mu_o nI}{r}$ (b) $\frac{\mu_o nI}{2r}$ (c) $\frac{2\mu_o nI}{r}$ (d) $\frac{\mu_o nI}{4r}$

6) A thin ring of radius R metre 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 field induction in Wb/m^2 at the centre of the ring is

(a) $\frac{\mu_o qf}{2\pi R}$ (b) $\frac{\mu_o q}{2\pi fR}$ (c) $\frac{\mu_o q}{2fR}$ (d) $\frac{\mu_o qf}{2R}$

7) A coil of wire has an area of 600 sq. cm and has 500 turns. If it carries 1.5 A current, its magnetic dipole moment is

(a) 5 Am^2 (b) 15 Am^2 (c) 30 Am^2 (d) 45 Am^2

8) Ampere's circuital law can be derived from

(a) Ohm's law (b) Biot-Savart's law (c) Kirchhoff's law (d) Gauss's law

9) A circular coil carrying current behaves as a

(a) bar magnet (b) horse shoe magnet (c) magnetic shell (d) solenoid

10) A long solenoid has n turns per metre and current I A is flowing through it. The magnetic field induction at the ends of the solenoid is

(a) zero (b) $\mu_o nI/2$ (c) $\mu_o nI$ (d) $2\mu_o NI$

11) Two charged particles traverse identical helical paths in a completely opposite sense in a uniform magnetic field $\vec{B} = B$

(a) They have equal z-components of momenta (b) They must have equal charges

(c) They necessarily represent a particle anti-particle pair. (d) The charge to mass ratio satisfy $\left(\frac{e}{m}\right)_1 + \left(\frac{e}{m}\right)_2 = 0$

12) A current carrying circular loop of radius R is placed in the x-y plane with centre at the origin. Half of the loop with x > 0 is now bent so that it now lies in the y-z plane.

(a) The magnitude of magnetic moment now diminishes (b) The magnetic moment does not change

(c) The magnitude of $\vec{B}$ at (0,0,z), z > > R increases. (d) The magnitude $\vec{B}$ at (0,0,z), z > > R is unchanged.

13) Biot-Savart law indicates that the moving electrons produce a magnetic field $\vec{B}$ such that

(a) $\vec{B} \perp \vec{v}$ (b) $\vec{B} \parallel \vec{v}$ (c) it obeys inverse cube law (d) it is along the line joining the electron and point of observation.

14) An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?

(a) The electron will be accelerated along the axis (b) The electron path will be circular about the axis.

(c) The electron will experience a force at 45° the axis and hence execute a helical path.

(d) The electron will continue to move with uniform velocity along the axis of the solenoid.

15) In a cyclotron a charged particle

(a) undergoes acceleration all the time (b) speeds up between the dees because of the magnetic field.

(c) speeds up in a dee (d) slows down within a dee and speeds up between dees.

16) A circular current loop of magnetic moment M is in arbitrary orientation in an external magnetic field. $\vec{B}$ The work does to rotate the loop by 30° about an axis perpendicular to its plane is

(a) MB (b) $\sqrt{3}\frac{MB}{2}$ (c) $\frac{MB}{2}$ (d) zero

17) An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude

(a) zero (b) $\frac{\mu_0 n^2 e}{r}$ (c) $\frac{\mu_0 ne}{2r}$ (d) $\frac{\mu_0 ne}{2\pi r}$

18) 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 2 I respectively. The resultant magnetic field at the centre will be :

(a) $\frac{\sqrt{5}\mu_0 I}{2R}$ (b) $\frac{3\mu_0 I}{2R}$ (c) $\frac{\mu_0 I}{2R}$ (d) $\frac{\mu_0 I}{R}$

19) Two circular coils 1 and 2 are made from the same wire but the radius of the Ist coil twice that of the 2nd coil. What potential difference ratio should be applied across them so that the magnetic field at their centres is the same?

(a) 2 (b) 3 (c) 4 (d) 6

20) A toroid of n turns, mean radius R and cross-sectional radius carries a current I. It is placed on a horizontal table taken as x-y plane. Its magnetic moment $\vec{M}$

(a) is non-zero and points in the z-direction by symmetry (b) points along the axis of the toroid $(\vec{M} = M\hat{\phi})$

(c) is zero, otherwise, there would be a field falling as $\frac{1}{r^3}$ at large distances outside the toroid

(d) is pointing radially outwards.

21) The magnetic field of earth can be modeled by that of a point dipole placed at the center of the earth. The dipole axis makes an angle of 11.3° with the axis of the earth. At Mumbai, declination is nearly zero. Then,

(a) the declination varies between 11.3° W to 11.3° E (b) the least declination is 0°

(c) the plane defined by dipole axis and earth axis passes through Greenwich.

(d) declination averaged over the earth must be always negative.

22) In a permanent magnet at room temperature

(a) the magnetic moment of each molecule is zero

(b) the individual molecules have a non-zero magnetic moment which is all perfectly aligned

(c) domains are partially aligned (d) domains are all perfectly aligned.

23) Consider the two idealized systems: (i) a parallel plate capacitor with large and small separation and (ii) a long solenoid of length L > > R, radius of the cross-section. In (i) $\vec{E}$ is ideally treated as a constant between plates and zero outside. In (ii) magnetic field is constant inside the solenoid and zero outside. These idealized assumptions, however, contradict fundamental law as below:

(a) case (i) contradicts Gauss's law for electrostatic fields.

(b) case (ii) contradicts Gauss's law for magnetic fields. (c) case (i) agrees with $\oint \vec{E} \cdot d\vec{l} = 0$ (d) case (ii) contradicts $\oint \vec{H} \cdot d\vec{l} =$

24) A paramagnetic sample shows a net magnetization of $8 Am^{-1}$ when placed in an external magnetic field 0.6 T at a temperature of 4K. When the same sample is placed in an external magnetic field of 0.2 T at a temperature of 16 K, the magnetization will be

(a) $\frac{32}{3} Am^{-1}$ (b) $\frac{2}{3} Am^{-1}$ (c) $6 Am^{-1}$ (d) $2.4 Am^{-1}$

25) A long straight wire of radius a carries a steady current i. The current is uniformly distributed across its cross-section. The ratio of the magnetic field at a/2 and 2 a is

(a) 1/2 (b) 1/4 (c) 4 (d) 1

26) The magnetic force acting on a charged particle of charge $-2 \mu C$ in a magnetic field of 2 T acting in y-direction, when the particle velocity is $\left(2\hat{i} + 3\hat{j}\right) \times 10^6 ms^{-1}$ is

(a) 8 N in z-direction (b) 8 N in -z-direction (c) 4 N in z-direction (d) 8 N in y-direction

27) A proton and an α-particle moving with same velocity enter into a uniform magnetic field, acting normal to the plane of their motion. The ratio of radii of the circular paths described by the proton and α-particle is

(a) 1 : 2 (b) 1 : 4 (c) 1 : 16 (d) 4 : 1

28) An electron is travelling along the X-direction. It encounters the magnetic field in the Y-direction. Its subsequent motion will be

(a) straight line along X-direction (b) a circle in the X-Z plane (c) a circle in the YZ plane

(d) a circle in the XY plane

29) A charged particle goes undeflected in a region containing electric and magnetic field. It is possible that

(a) $\vec{E} \parallel \vec{B}$ but $\vec{v}$ is not parallel to $\vec{E}$ (b) $\vec{v} \parallel \vec{E}$ but $\vec{E}$ is not parallel to $\vec{B}$ (c) $\vec{E} \parallel \vec{v} \parallel \vec{B}$ (d) $\vec{E}$ is not parallel to $\vec{B}$ and $\vec{v}$

30) Two particles X and Y having equal charges after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that Y is

(a) $\frac{R_1}{R_2}$ (b) $\frac{R_2}{R_1}$ (c) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (d) $\left(\frac{R_1}{R_2}\right)^2$

31) A proton and an alpha particle both enter a region of uniform magnetic field B, moving at right angles to the field B. If the radius of circular orbits for both the particles is equal and the kinetic energy acquired by proton is 1 MeV, the energy acquired by the alpha particles will be :

(a) 1 MeV (b) 4 MeV (c) 0.5 MeV (d) 1.5 MeV

32) A particle of mass m and charge q is accelerated through a potential difference V to a velocity $\vec{v}$ towards south. The particle enters a region with both a magnetic field $\vec{B}$ (pointing eastwards) and electric field $\vec{E}$ (pointing downwards). The particle travels with a constant velocity through this region. The potential difference V through this region should be equal to

(a) E/B (b) E/qB (c) 2 mE/qB (d) $mE^2/2qB^2$

33) An electric charge + q moves with velocity $\vec{v} = 3\hat{i} + 4\hat{j} + \hat{k}$, in an electromagnetic field give $\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$, $\vec{B} = \hat{i} + \hat{j} - 3\hat{k}$. They y component of the force experienced by + q is

(a) 2 q (b) 11 q (c) 5 q (d) 3 q

34) A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{v}$. Then

(a) $\vec{v} = \vec{B} \times \vec{E}/E^2$ (b) $\vec{v} = \vec{E} \times \vec{B}/B^2$ (c) $\vec{v} = \vec{B} \times \vec{E}/B^2$ (d) $\vec{v} = \vec{E} \times \vec{B}/E^2$

35) Proton, Deuteron and alpha particle of the same kinetic energy are moving in circular trajectories in a constant magnetic field. The radii of proton, deuteron and alpha particle are respectively r_p, r_d and r_α. Which one of the following relations is correct?

(a) $r_\alpha = r_p = r_d$ (b) $r_\alpha = r_p < r_d$ (c) $r_\alpha > r_d > r_p$ (d) $r_\alpha = r_d > r_p$

36) When a proton is released from 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 3 a_0 towards west. The electric and magnetic fields in the room are

(a) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ down (b) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up (c) $\frac{ma_0}{e}$ east, $\frac{2ma_0}{ev_0}$ down (d) $\frac{ma_0}{e}$ west, $\frac{3ma_0}{ev_0}$ up

37) An electron of mass M_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass M_p also initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to

(a) 1 (b) $\sqrt{\frac{M_p}{M_e}}$ (c) $\sqrt{\frac{M_e}{M_p}}$ (d) 1836

38) A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid air by uniform horizontal magnetic field B. The magnitude of B (in Tesla) is : (Take $g = 9.8 m/s^2$)

(a) 2 (b) 1.5 (c) 0.55 (d) 0.65

39) A horizontal wire 0.1 m long carries a current of 5 A. Find the magnitude and direction of the magnetic field, which can support the weight of the wire. Given the mass of the wire is $3 \times 10^{-3} kg/m \quad and \quad g = 10 ms^{-2}$.

(a) $6 \times 10^{-3} T$, acting vertically upwards (b) $6 \times 10^{-3} T$, acting horizontally perpendicular to wire (c) $6 \times 10^{-2} T$, acting vertically downwards (d) $6 \times 10^{-2} T$, acting horizontally perpendicular to wire

40) Two particles each of mass m and charge q are attached to the two ends of a light rigid 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

(a) q/2 m (b) q/m (c) 2 q/m (d) $q/\pi\, m$.

41) A conducting wire of length l is turned in the form of a circular coil and a current I is passed through it. For the torque, due to magnetic field produced at its centre, to be maximum, the number of turns in the coil will be

(a) one (b) two (c) three (d) more than three.

42) A galvanometer having a coil resistance of 100Ω gives a full scale deflection, when a current of 1 mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10 A is

(a) 0.01Ω (b) 2Ω (c) 0.1Ω (d) 3Ω

43) A galvanometer of resistance 25Ω is connected to a battery of 2 volt along with a resistance in series. When the value of this resistance is 3000Ω, a full scale deflection of 30 units is obtained in the galvanometer. In order to reduce this deflection 10 20 units, the resistance in series will be

(a) 4513Ω (b) 5413Ω (c) 2000Ω (d) 6000Ω.

44) A galvanometer has a sensitivity of 60 division/ampere. When a shunt is used its sensitivity becomes 10 division/ampere. What is the value of shunt used if the resistance of the galvanometer is 20Ω

(a) 2Ω (b) 3Ω (c) 4Ω (d) 6Ω

45) In an ammeter 0.5% of main current passes through galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be

(a) G/200 (b) G/199 (c) 199 G (d) 200G.

46) The current sensitivity of a moving coil galvanometer increases by 35%, when its resistance is increased by a factor 3. The voltage sensitivity of galvanometer changes by a factor

(a) 35% (b) 45% (c) 55% (d) none of the above

47) A current of 5 A is flowing through a circular coil of diameter 14 cm having 100 turns. The magnetic dipole moment associated with this coil is :

(a) $0.077 Am^2$ (b) $0.77 Am^2$ (c) $7.7 Am^2$ (d) $77 Am^2$

48) A magnet with moment M is given. If it is bent into a semicircular form, its new magnetic moment will be :

(a) M (b) πM (c) $2M$ (d) $2M/\pi$

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

(a) -0.064 J (b) zero (c) -0.082 J (d) 0.064 J

50) A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60°. The torque required to keep the needle in this position will be

(a) 2 W (b) W (c) $\frac{W}{\sqrt{2}}$ (d) $\frac{W}{\sqrt{3}}$ (e) $\sqrt{3}W$

51) The work done in turning a magnet of magnetic moment M by an angle of 90° from the magnetic meridian is n times the corresponding work done to turn it through an angle of 60°, where n is

(a) 1/2 (b) 2 (c) 1/4 (d) 1.

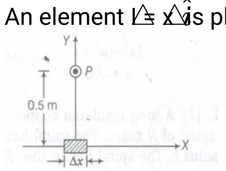
52) A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3}J$ of work to turn it through 60°. The torque needed to maintain the needle in this position will be :

(a) $2\sqrt{3}J$ (b) $3J$ (c) $\sqrt{3}J$ (d) $\frac{3}{2}J$

53) A magnetic field can be produced

(a) only by moving charge (b) only by changing electric field (c) Both (a) and (b) (d) None of the above

54) An element $\Delta l = \Delta x\hat{i}$ is placed at the origin and carries a current I = 10A.



If Δx = 1cm, magnetic field at point P is

(a) $4\times10^{-8}\hat{k}$ T (b) $4\times10^{-8}\hat{i}$ T (c) $-4\times10^{-8}\hat{j}$ T (d) $10^{-8}\hat{j}$ T

55) There is a thin conducting wire carrying current. What is the value of magnetic field induction at any point on the conductor itself ?

(a) 1 (b) Zero (c) - 1 (d) Either (a) or (b

56) A helium nucleus moves in a circle of 0.8 m radius in one second. The magnetic field produced at the centre of circle will be

(a) $\mu_0\times10^{-19}$ (b) $10^{-19}\mu_0$ (c) $2\times10^{-19}\mu_0$ (d) $\frac{2\times10^{-19}}{\mu_0}$

57) For a toroid, magnetic field strength in the region enclosed by wire turns is given by

(a) B = μ_0n I, where n = number of turns. (b) B = μ_0I / n, where n = number of turns per metre

(c) $B=\frac{\mu_0 I}{2r}$ where r = mean radius (d) $B=\frac{\mu_0 NI}{2\pi r}$, where, $N =$ number of turn and $r =$ radius of toroid.

58) The value of force F acting on charge q moving with velocity perpendicular to the magnetic field B will be

(a) F = qvB (b) $F=\frac{qv}{B}$ (c) $F=\frac{qB}{v}$ (d) $F=\frac{Bv}{q}$

59) An electron of charge (e) is moving parallel to uniform magnetic field B with constant velocity v. The force acting on electron is

(a) Bev (b) Be / v (c) B / ev (d) Zero

60) In a uniform magnetic field, an electron (or charge particle) enters perpendicular to the field. The path of electron will be

(a) ellipse (b) circular (c) parabolic (d) linear

61) If the velocity of charged particle is doubled and value of magnetic field is reduced to half, then the radius of path of charged particle will be

(a) 8 times (b) 3 times (c) 4 times (d) 2 times

62) Two parallel wires are placed 1m apart and 1A and 3 A currents are flowing in the wires in opposite direction. The force acting per unit length of both the wires will be

(a) 6×10^{-7} N / m attractive (b) 6×10^{-5} N /m attractive (c) 6×10^{-7} N / m repulsive (d) 6×10^{-5} N / m repulsive

63) A circular loop of area A, carrying current I, is placed in a magnetic field B perpendicular to the plane of the loop. The torque on the loop due to magnetic field is

(a) BIA (b) 2 BIA (c) $\frac{1}{2}BIA$ (d) Zero

64) The area of a circular ring is 1 cm^2 and current of 10 A is passing through it. If a magnetic field of intensity 0.1 T is applied perpendicular to the plane of the ring. The torque due to magnetic field on the ring will be

(a) zero (b) 10^{-4} N-m (c) 10^{-2} N-m (d) 1 N-m

65) The current i is flowing in a coil of area A with the number of turns N, then the magnetic moment of the coil M will be

(a) NiA (b) Ni / A (c) $N^2 Ai$ (d) $\sqrt{N}$ Ai

66) A galvanometer of resistance 25 Ω shows full scale deflection for current of 10 mA. To convert it into 100 V range voltmeter, the required series resistance is

(a) 9975 Ω (b) 10025 Ω (c) 10000 Ω (d) 975 Ω

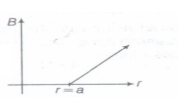
67) Vector form of Biot-Savart's law is

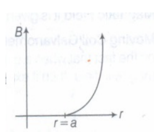
(a) $d\mathbf{B}=\frac{\mu_0}{4\pi}\frac{1\times d\mathbf{l}}{r^2}$ (b) $d\mathbf{B}=\frac{\mu_0}{4\pi}\frac{I d\mathbf{l}\times\mathbf{r}}{r^3}$ (c) $d\mathbf{B}=\frac{\mu_0}{4\pi}\frac{I d\mathbf{l}\times\mathbf{r}}{r^3}$ (d) $d\mathbf{B}=\frac{\mu_0}{4\pi}\frac{I d\mathbf{l}\times\mathbf{r}}{r^2}$

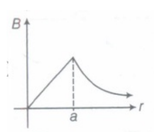
68) A polygon shaped wire is inscribed in a circle of radius R. The magnetic induction at the centre of polygon, when current flows through the wire is

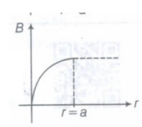
(a) $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n}\right)$ (b) $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n}\right)$ (c) $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n}\right)$ (d) $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n^2}\right)$

69) For a cylindrical conductor of radius a, which of the following graphs shows a correct relationship of B versus r?

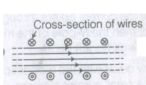
(a) 

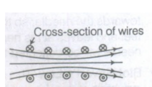
(b) 

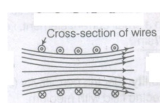
(c) 

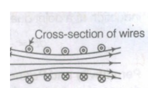
(d) 

70) Which of the following represent a correct figure to display of magnetic field lines due to a solenoid?

(a) 

(b) 

(c) 

(d) 

71) A long solenoid has 20 turns cm^{-1}. The current necessary to produce a magnetic field of 20 mT inside the solenoid is approximately

(a) I A (b) 2 A (c) 4 A (d) 8 A

72) An electron is travelling horizontally towards East. Amagnetic field in vertically downward direction exerts a force on the electron along

(a) East (b) West (c) North (d) South

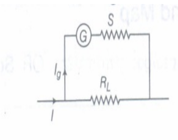
73) An electron is moving in a cyclotron at a speed of 3.2×10^7 ms" in a magnetic field of 5×10^{-4} T perpendicular to it. What is the frequency of this electron? ($q = 1.6 \times 10^{-19}$ C,$m_e = 9.1 \times 10^{-31}$ kg)

(a) 1.4×10^5 Hz (b) 1.4×10^7 Hz (c) 1.4×10^6 Hz (d) 1.4×10^9 Hz

74) The wire which connects the battery of a car to its starter motor carries current of 300 A during starting. Force per unit length between wires (wires are 0.7 m long and 0.015 m distant apart) is

(a) 1.2 Nm^{-1} repulsive (b) 1.2 Nm^{-1} attractive (c) 2.4 Nm^{-1} repulsive (d) 2.4 Nm^{-1}attractive

75) For the voltmeter circuit given,

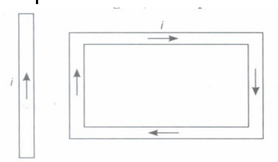


(a) $\frac{I_g}{I}$ (b) $\frac{G}{S}$ $\frac{I}{I_g}$ (c) $\frac{R_L+G}{S}$ $(I - I_g)R_L = I_g(G+S)$ (d) $IR_L = I_gG$

76) The coil of a galvanometer consists of 100 turns and effective area of 1 cm^2. The restoring couple is 10^{-8} Nm rad^{-1}. The magnetic, fieldbetween poles is of 5 T. Current sensitivity of this galvanometer is

(a) 5×10^4 rad / μamp (b) 5×10^6 per amp (c) 2×10^{-7} per amp (d) 5 rad/ μamp

77) A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to the 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.

78) A circular coil of radius 4 cm and of 20 turns carries a current of 3 amperes. It is placed in a magnetic field of intensity 0.5 weber/m^2. The magnetic dipole moment of the coil is

(a) 0.15 ampere-m^2 (b) 0.3 ampere-m^2 (c) 0.45 ampere-m^2 (d) 0.6 ampere-m^2

79) A cubical region of space is filled with some uniform electric and magnetic fields. An electron enters the cube across one of its faces with velocity v and a positron enters via opposite face with velocity -v. At this instant

(a) the electric forces on both the particles cause identical accelerations.

(b) the magnetic forces on both the particles cause equal accelerations.

(c) Only electron gains or looses energy (d) the motion of the centre of mass (CM) is determined by E alone

80) Consider a wire carrying a steady current, I placed in a uniform magnetic field B perpendicular to its length. Consider the charges inside the wire. It is known that magnetic forces do not work. This implies that,

(a) motion of charges inside the conductor is unaffected by B, since they do not absorb energy.

(b) Some charges inside the wire move to the surface as a result of B.

(c) if the wire moves under the influence of B, no work is done by the force.

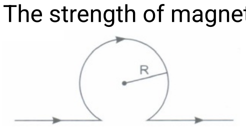
(d) If the wire moves under the influence of B, no work is done by the electric force on the ions, assumed fixed within the wire.

81) Two identical current carrying coaxial loops, carry current I in an opposite sense. A simple amperian loop passes through both of them once. Calling the loop as C,

(a) $\oint_C \boldsymbol{B} \cdot d\boldsymbol{l} = \pm 2\mu_0 I$ (b) the value of $\oint_C \boldsymbol{B} \cdot d\boldsymbol{l}$ is independent of sense of C. (c) there may be a point on C where, B and dl are parallel.

(d) B vanishes everywhere on C.

82) The strength of magnetic field at the centre of circular coil is



(a) $\frac{\mu_0 I}{R}\left(1-\frac{1}{\pi}\right)$ (b) $\frac{\mu_0 I}{\pi R}$ (c) $\frac{\mu_0 I}{2R}\left(1-\frac{1}{\pi}\right)$ (d) $\frac{\mu_0 I}{2R}\left(1+\frac{1}{\pi}\right)$

83) If a charged particle moves through a magnetic field perpendicular to it

(a) both momentum and energy of particle change. (b) momentum as well as energy are constant.

(c) energy is constant but momentum changes. (d) momentum is constant but energy changes

84) A current carrying closed loop of an irregular shape lying in more than one plane when placed in uniform magnetic field, the force acting on it

(a) will be more in the plane where its larger position is covered. (b) is zero. (c) is infinite.

(d) mayor may not be zero.

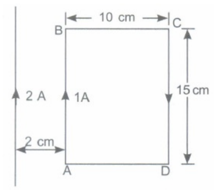
85) The maximum current that can be measured by a galvanometer of resistance 40 Ω is 10 mA. It is converted into voltmeter that can read upto 50 V. The resistance to be connected in the series with the galvanometer is

(a) 2010 Ω (b) 4050 Ω (c) 5040 Ω (d) 4960 Ω

86) A current loop placed in a non-uniform magnetic field experiences

(a) a force of repulsion. (b) a force of attraction. (c) a torque but not force. (d) a force and a torque

87) What is the net force on the rectangular coil?



(a) 25×10^{-7} N towards wire. (b) 25×10^{-7} N away from wire (c) 35×10^{-7} N towards wire

(d) 35×10^{-7} N away from wire.

88) Beams of electrons and protons move parallel to each other in the same direction,they

(a) attract each other (b) repel each other (c) no relation (d) neither attract nor repel

89) A conducting circular loop of radius r carries a constant current i. It is placed in a uniform magnetic field B, such that B is perpendicular to the plane of the loop. The magnetic force acting on the loop is

(a) irB (b) 2πriB (c) zero (d) πrib

90) The gyro-magnetic ratio of an electron in an H-atom, according to Bohr model, is

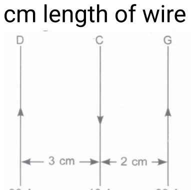
(a) independent of which orbit it is in. (b) neutral (c) positive (d) increases with the quantum number n.

91) An electron is projected along the axis of a circular conductor carrying the same current. Electron will experIence

(a) a force along the axis. (b) a force perpendicular to the axis (c) a force at an angle of 4° with axis

(d) no force experienced.

92) Three long, straight parallel wires, carrying current are arranged as shown in the figure. The force experienced by a 25 cm length of wire C is



(a) 10^{-3} N (b) 2.5×10^{-3} N (c) zero (d) 1.5×10^{3} N

93) In a circular coil of radius r, the magnetic field at the centre is proportional to

(a) r^2 (b) r (c) $\frac{1}{r}$ (d) $\frac{1}{r2}$

94) A positive charge enters in a magnetic field and travels parallel to but opposite the field. If experiences

(a) an upward force (b) a downward force (c) an accelerated force (d) no force

95) A straight wire is kept horizontally along east-west direction. If a steady current flows in wire from east to west, the magnetic field at a point above the wire will point towards

(a) East (b) West (c) North (d) South

96) The magnetic susceptibility for a diamagnetic material is

(a) small and negative (b) small and positive (c) large and negative (d) large and positive

97) A circular loop A of radius R carries a current I. Another circular loop B of radius $r \left(= \frac{R}{20}\right)$ is placed concentrically linked in the plane of A. The magnetic flux linked with loop B is proportional to

(a) R (b) $\sqrt{R}$ (c) $R^{\frac{3}{2}}$ (d) R^2

98) A coil of N turns is placed in a magnetic field B such that B is perpendicular to the plane of the coil. B changes with time as $B = B_0 \cos\left(\frac{2\pi}{T}t\right)$ where T is time period. The magnitude of emf induced in the coil will be maximum at
Here, n = 1, 2, 3, 4, ...

(a) $t = \frac{nT}{8}$ (b) $t = \frac{nT}{4}$ (c) $t = \frac{nT}{2}$ (d) No option is correct.

99) An electron enters a uniform magnetic field with speed v. It describes a semi-circular path and comes out of the field. The final speed of the electron is

(a) zero (b) v (c) $\frac{v}{2}$ (d) 2v

100) Two long straight parallel conductors A and B, kept at a distance r, carry current I in opposite directions. A third identical conductor C, kept at a distance $\left(\frac{r}{3}\right)$ from A carry current I_1, in the same direction as in A. The net magnetic force on unit length of C is

(a) $\frac{3\mu_0 I I_1}{2\pi r}$, towards A (b) $\frac{3\mu_0 I I_1}{2\pi r}$, towards B (c) $\frac{3\mu_0 I I_1}{4\pi r}$, towards A (d) $\frac{3\mu_0 I I_1}{4\pi r}$, towards B

101) Which of the following statements is correct?

(a) Magnetic field lines do not form closed loops.

(b) Magnetic field lines start from north pole and end at south pole of a magnet.

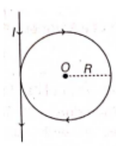
(c) The tangent at a point on a magnetic field line represents the direction of the magnetic field at that point.

(d) Two magnetic field lines may intersect each other.

102) The SI unit of magnetic field intensity is

(a) $A\text{-}mN^{-1}$ (b) $NA^{-1}\,m^{-1}$ (c) $NA^{-2}\,m^{-2}$ (d) $NA^{-1}\,m^{-2}$

103) A current I flows through a long straight conductor which is bent into a circular loop of radius R in the middle as shown in the figure.



The magnitude of the net magnetic field at point O will be

(a) zero (b) $\frac{\mu_0 I}{2R}\left(1 + \frac{1}{\pi}\right)$ (c) $\frac{\mu_0 I}{4\pi R}$ (d) $\frac{\mu_0 I}{2R}\left(1 - \frac{1}{\pi}\right)$

104) The magnetic field at the centre of a current carrying circular loop of radius R is B_1. The magnetic field at a point on its axis at a distance R from the centre of the loop is B_2. Then the ratio of $\frac{B_1}{B_2}$ is

(a) $2\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\sqrt{2}$ (d) 2

105) A proton and an alpha particle move in circular orbits in a uniform magnetic field. Their speeds are in the ratio of 9:4. The ratio of radii of their circular orbits (r_p/r_a) is

(a) 3/4 (b) 4/3 (c) 8/9 (d) 9/8

106) There are uniform electric and magnetic fields in a region pointing along X-axis. An a-particle is projected along Y-axis with a velocity v. The shape of the trajectory will be

(a) circular in XZ-plane (b) circular in YZ-plane (c) helical with its axis parallel to X-axis

(d) helical with its axis parallel to Y-axis

107) A current carrying wire kept in a uniform magnetic field will experience a maximum force, when it is

(a) perpendicular to the magnetic field (b) parallel to the magnetic field

(c) at an angle of 45° to the magnetic field (d) at an angle of 60° to the magnetic field

108) A straight conducting rod of length l and mass m is suspended in a horizontal plane by a pair of flexible strings in a magnetic field of magnitude B. To remove the tension in the supporting strings, the magnitude of the current in the wire is

(a) $\frac{mgB}{l}$ (b) $\frac{mgl}{B}$ (c) $\frac{mg}{lB}$ (d) $\frac{lB}{mg}$

109) A current of 10A is flowing from east to west in a long straight wire kept on a horizontal table. The magnetic field developed at a distance of 10 cm due north on the table is

(a) 2×10^{-5} T, acting downwards (b) 2×10^{-5} T, acting upwards (c) 4×10^{-5} T, acting downwards

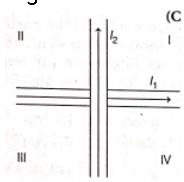
(d) 4×10^{-5} T, acting upwards

110) A current of 5 A is flowing from east to west in a long straight wire kept on a horizontal table. The magnetic field developed at a distance of 10 cm de south on the table is

(a) 1×10^{-5} T, acting downwards (b) 1×10^{-5} T, acting upwards (c) 2×10^{-5} T, acting downwards

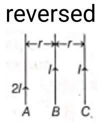
(d) 2×10^{-5} T, acting upwards

111) Two wires carrying currents I_1, and I_2, lie, one slightly above the other, in a horizontal plane as shown in figure. The region of vertically upward strongest magnetic field is



(a) I (b) II (c) III (d) IV

112) Three infinitely long parallel straight current carrying wires A, B and C are kept at equal distance from each other as shown in the figure. The wire C experiences net force F. The net force on wire C, when the current in wire A is reversed will be



(a) zero (b) F/2 (c) F (d) 2F

113) Two wires of the same length are shaped into a square of side a and a circle with radius r. If they carry same current, the ratio of their magnetic moment is

(a) 2: π (b) π:2 (c) π:4 (d) 4:π

114) The current sensitivity of a galvanometer increases by 20%.If its resistance also increases by 25%,then the voltage sensitivity will

(a) decreased by 1% (b) increased by 5% (c) increased by 10% (d) decreased by 4%

Fill up / 1 Marks 13 x 1 = 13

115) What is the approximate distance upto which earth's magnetic field extends ?

116) Verify that the cyclotron frequency $\omega = eB/m$ has the correct dimension of $[T]^{-1}$

117) Describe the motion of a charged particle in a cyclotron if the frequency of the radio frequency (rf) field were doubled.

118) The magnetic field due to a straight current carrying conductor of infinite length at a perpendicular distance a is equal to ________.

119) Relation between S.I. unit and C.G.S unit magnetic field is ________.

120) According to ampere circuital law, the line integral of the magnetic field $\vec{B}$ around any closed path enclosing current I, is equal to ______.

121) Force on a charge q moving in a magnetic field B with velocity v at angle θ is equal to __________.

122) Force on a current carrying conductor in a magnetic field is _______.

123) The magnetic field of a straight solenoid carrying current I and having n turns per unit length is _____.

124) Deflection produced in a galvanometer when a unit current flows through it is known as ________.

125) A moving coil galvanometer can be converted into voltmeter by connecting a large resistance R in _______ with it.

126) Maximum torque acts on a current carrying coil when it is suspended in magnetic field such that its plane is ________ to magnetic field.

127) An ammeter _______ is resistance galvanometer.

Assertion and reason 23 x 1 = 23

128) **Assertion (A) :** Voltmeter is connected in parallel with the circuit.
Reason (R) : Resistance of a voltmeter is very large.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

129) **Assertion (A) :** Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid.
Reason (R) : The magnetic field inside the solenoid is uniform.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

130) **Assertion (A)** : An ammeter is connected in series in the circuit.
Reason (R) : An ammeter is a high resistance galvanometer
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

131) **Assertion (A) :** There is a spark in the switch when the switch is closed
Reason (R) : Current flowing in the conductor produces magnetic field.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

132) **Assertion (A) :** The magnetic field intensity at the centre of a circular coil carrying current changes, if the current through the coil is doubled.
Reason (R) : The magnetic field intensity is dependent on current in conductor.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

133) **Assertion (A) :** When a charged particle moves perpendicular to magnetic field then its kinetic energy and momentum gets affected.

Reason (R) : Force changes velocity of charged particle.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

134) **Assertion (A) :** In electric circuits, wires carrying currents in opposite directions are often twisted together.

Reason (R) : If the wire are not twisted together, the combination of the wires forms a current loop. The magnetic field generated by the loop might affect adjacent circuits or components.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

135) **Assertion (A) :** When two long parallel wires, hanging freely are connected in parallel to a battery, they come closer to each other.

Reason (R) : Wires carrying current in opposite direction repel each other.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

136) **Assertion (A)** : When the observation point lies along the length of the current element, magnetic field is zero.

Reason (R): Magnetic field close to current element is zero.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

137) **Assertion (A) :** A solenoid tends to expand, when a current passes through it.

Reason (R) : Two straight parallel metallic wires carrying current in same direction repel each other.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

138) **Assertion (A) :** In a conductor, free electrons keep on moving but no magnetic force acts on a conductor in a magnetic field.

Reason (R) : Force on free electron due to magnetic field always acts perpendicular to its direction of motion.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

139) **Assertion (A)** : When force is zero, the charged particle follows linear path.
Reason (R) : A charged particle enters in a uniform magnetic field, whose velocity makes an angle θ with magnetic field will cover a linear path.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

140) **Assertion (A) :** When current is represented by a straight line, the magnetic field will be circular.
Reason (R) : According to Fleming's left hand rule, direction of force is parallel to the magnetic field
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

141) **Assertion (A)** : An electron and proton enters a magnetic field with equal velocities, then, the force experienced by proton will be more than electron.
Reason (R) : The mass of proton is 1999 times more than the mass of electron.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

142) **Assertion (A) :** Magnetic field is useful in producing parallel beam of charged particle.
Reason (R) : Magnetic field inhibits the motion of charged particle moving across it
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

143) **Assertion (A) :** When a magnetic dipole is placed in a non uniform magnetic field, only a torque acts on the dipole.
Reason (R) : Force would act on dipole if magnetic field is uniform.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

144) **Assertion (A) :** The kinetic energy of a charged particle moving in a uniform magnetic field does not change.
Reason (R) : In a uniform magnetic field no force acts on the charge particle.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

145) **Assertion (A)** : Magnetic moment is measured in joule/tesla or amp m^2.
Reason (R) : Joule/tesla is equivalent to amp m^2
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

146) **Assertion (A)** : A charged particle moving in a uniform magnetic field penetrates a layer of lead and there by loses half of its kinetic energy. The radius of curvature of its path is now reduced to half of its initial value.
Reason (R) : Kinetic energy is inversely proportional to radius of curvature.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

147) **Assertion (A)** : A charge, whether stationary or in motion produces a magnetic field around it.
Reason (R) : Moving charges produce only electric field in the surrounding space.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

148) Assertion (A): A proton and an electron, with same momenta, enter in a magnetic field in a direction at right angles to the lines ofthe force. The radius of the paths followed by them willbe same.
Reason (R) : Electron has less mass than the proton.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

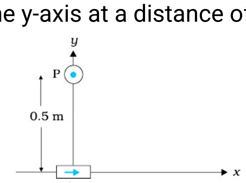
149) Assertion (A) : When radius of a current carrying loop is doubled, its magnetic moment becomes four times.
Reason (R) : The magnetic moment of a current carrying loop is directly proportional to the area of the loop.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

150) Assertion (A) : On increasing the current sensitivity of a galvanometer by increasing the number of turns, may not necessarily increase its voltage sensitivity.
Reason (R) : The resistance of the coil of the galvanometer increases on increasing the number of turns.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

2 Marks 487 x 2 = 974

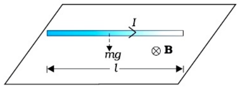
151) (a) A Current carrying circular loop lies on a smooth horizontal plane. Can a uniform magnetic field be set up in such a manner that the loop turns around itself(i.e. turns about the vertical axis)?
(b) A current carrying circular loop is located in a uniform external magnetic field. If the loop is free to turn, what is it orientation of stable equilibrium? Show that in this orientation the flux of the total field (external field + field produced by the loop) is maximum.
(c) A loop of irregular shape carrying current is located in an external magnetic field. If the wire is flexible, why does it change to a circular shape?

152) An element $\Delta l = \Delta x\, \hat{i}$ is placed at the origin and carries a large current I = 10 A (Figure). What is the magnetic field on the y-axis at a distance of 0.5 m. Δ x = 1 cm.



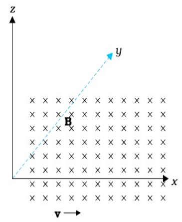
153) A solenoid of length 0.5 m has a radius of 1 cm and is made up of 500 turns. It carries a current of 5 A. What is the magnitude of the magnetic field inside the solenoid ?

154) A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid air by a uniform horizontal magnetic field B . What is the magnitude of the magnetic field?



155) A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil?

156) If the magnetic field is parallel to the positive y-axis and the charged particle is moving along the positive x-axis (Figure), which way would the Lorentz force be for
(a) an electron (negative charge),
(b) a proton (positive charge).



157) What is the radius of the path of an electron (mass 9 x 10^{-31} kg and charge 1.6 x 10^{-19} C) moving at a speed of 3 x 10^7 m/s in a magnetic field of 6 x 10^{-4} T perpendicular to it? What is its frequency? Calculate its energy in keV. (1 eV = 1.6 x 10^{-19} J).

158) Consider a tightly wound 100 turn coil of radius 10 cm, carrying a current of 1 A. What is the magnitude of the magnetic field at the centre of the coil?

159) A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons? If the radius of its 'dees' is 60 cm, what is the kinetic energy of the proton beam produced by the accelerator?
(e = 1.60 $\times 10^{-19}$ C, m_p = 1.67 $\times 10^{-27}$ kg 1 MeV = 1.6 x 10^{-13} J).

160) Answer the following questions:
(a) A magnetic field that varies in magnitude from point to point but has a constant direction (east to west) is set up in a chamber. A charged particle enters the chamber and travels undeflected along a straight path with constant speed. What can you say about the initial velocity of the particle?
(b) A charged particle enters an environment of a strong and non-uniform magnetic field varying strong and non-uniform magnetic field varying from point to point both in magnitude and direction, and comes out of it following a complicated trajectory. Would its final speed equal the initial speed if it suffered no collisions with the environment?
(c) An electron travelling west to east enters a chamber having a uniform electrostatic field in north to south direction. Specify the direction. Specify the direction in which a uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

161) A galvanometer coil has a resistance of 12 Ω and the metre shows full scale deflection for a current of 3 mA. How will you convert the metre into a voltmeter of range 0 to 18 V ?

162) The north pole of a magnet is brought near a stationary negatively charged conductor. Will the pole experience any force?

163) What is the unit of magnetic field strength in cgs system and SI? State the relation between them.

164) An electron moving with a velocity of 10^7 ms^{-1} enters a uniform magnetic field of 1 T, along a direction parallel to the field. What would be its trajectory?

165) Explain, how moving charge is a source of magnetic field.

166) What are the dimensions of $\mu_o/4\pi$

167) Name the physical quantity whose unit is tesla. Hence define a tesla.

168) An electron beam projected along + X-axis, experiences a force due to a magnetic field along the +Y-axis. What is the direction of the magnetic field?

169) If a particle of charge q is moving with velocity v along the y-axis and the magnetic field B is acting along the Z-axis, use the expression $\vec{F}=q\left(\vec{v}\times\vec{B}\right)$ to find the direction of the force $\vec{F}$ acting on it.

170) State the rule that is used to find the direction of magnetic field at a point near a current carrying straight conductor.

171) Where is the magnetic field of a current element (i) minimum and (ii) maximum?

172) What is the nature of the magnetic field associated with the current in a straight conductor?

173) How does a current loop behave like a bar magnet?

174) Where is the magnetic field due to current through circular loop is
(i) uniform and
(ii) non-uniform ?

175) How will the magnetic field strength at the centre of the circular coil carrying current change, if the current through the coil is doubled and the radius of the coil is halved?

176) A current is set up in a long copper pipe. Is there a magnetic field
(a) inside
(b) outside the pipe ?

177) Can the path of integration around which we apply Ampere's law pass through a conductor?

178) Compare Gauss's law and ampere's law.

179) Magnetic field lines can be entirely confined within the toroid, but not within a straight solenoid. Why?

180) How is the magnetic field inside a given solenoid made strong?

181) What is the difference between solenoid and toroid?

182) In a solenoid carrying current, where is the magnetic field
(i) maximum
(ii) minimum and
(iii) half of the maximum value ?

183) Write the relation for the force $\vec{F}$ acting on a charge carrier q moving with a velocity $\vec{v}$ through a magnetic field $\vec{B}$ in vector notation. Using this relation, deduce the conditions under which this force will be (i) maximum (ii) minimum.

184) What is magnetic flux density? Define its units and give its dimensions.

185) In what respect does a wire carrying a current differ from a wire, which carries no current?

186) A current of one ampere is passed through a straight wire of length 2.0 metre. Find the magnetic field at a point in air at a distance 3 metre from one end of wire but lying on the axis of the wire.

187) Write the relation for the magnetic field induction at a point due to a linear conductor carrying current and hence deduce the relation for the magnetic field induction at a point due to a very long linear conductor carrying current.

188) What is the magnetic effect of current? Describe the nature of the magnetic field related with the current in circular coil.

189) Deduce the expression for the magnetic field induction at the centre of a circular electron orbit of radius r, and angular velocity of orbiting electron ω

190) What is magnetic dipole moment of a current loop? Give its direction if any.

191) A wire of length L metre carrying a current of I ampere is bent in the form of a circle. Find its magnetic moment.

192) A wire of length L is bent round in the form of a coil having N turns of same radius. If a steady current I flows through it in a clockwise direction, find the magnitude and direction of the magnetic field produced at its centre.

193) A circular coil of N Turns and diameter d carries a current I. It is unwound and rewound to make another coil of diameter 2d, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

194) What is the value of absolute permeability of free space? Give its units.

195) Is the source of magnetic field analogue to the source of electric current.

196) What is the path of a charged particle moving in a uniform electrostatic field with initial velocity
(i) parallel to the field?
(ii) perpendicular to the field?
(iii) at some angle with the direction of electric field?

197) What is the magnitude and direction of force on an electron moving along the direction of the magnetic field.

198) When a charged particle moving with a velocity $\vec{v}$ is subjected to a magnetic field $\vec{B}$ the force acting on it is non zero. Would the particle gain any energy?

199) An electron is moving vertically downwards. If it passes through a magnetic field which is directed from south to north in a horizontal plane, then in which direction the electron would be deflected?

200) A proton beam is moving horizontally from south to north in a tube. The vertical component of earth's magnetic field is directed downwards. In which direction will the beam be deflected?

201) When a charged particle moves in a magnetic field, does its kinetic energy always remain constant? Explain.

202) Establish analytically that the gain in kinetic energy of the charged particle moving in a magnetic field is zero.

203) A charged particle moving in a uniform magnetic field penetrates a layer of lead and there by loses one-half of its kinetic energy. How does the radius of curvature of its path change?

204) State the principle of working of a cyclotron.

205) An electron moves with velocity $\vec{v} = a\hat{k}$ in a magnetic field, $\vec{B} = b\hat{i} + a\hat{j}$. Find the magnetic force on the electron.

206) A uniform magnetic field and a uniform electric field are produced, pointing in the same direction. An electron is projected with its velocity pointed in the same direction.What will be the effect on electron?

207) What is meant by cyclotron frequency?

208) Looking downward, an electron appears moving anticlock-wise on a horizontal circle under a magnetic field. What is the direction of the magnetic field?

209) Which physical quantity has the unit Wb/m^2? Is it a scalar or a vector quantity?

210) Write expression for the force between two short parallel wires carrying the currents when they are :
(a) much separated
(b) very close

211) What type of force is acting between two parallel wires carrying current in the same direction? What happens if one of the currents is reversed?

212) What is the force that a conductor $\overrightarrow{dl}$ carrying a current I experiences, when placed in a magnetic field, $\vec{B}$ when its length is making an angle of 30^o with the direction of field?

213) If the distance between two parallel current carrying wires is doubled, what is the force between them?

214) In which orientation is the force experienced by a current-carrying conductor placed in a magnetic field (i) minimum (ii) maximum ?

215) Two current elements are placed a certain distance apart but not parallel to each other. Do they exert equal and opposite forces on each other ?

216) . The force exerting between the two parallel current carrying conductors is F. If the current in each conductor is doubled, what is the value of force acting between them ?

217) Wires that carry equal but opposite currents are often twisted together to reduce their magnetic effect at distant points, Why is this effective ?

218) A horizontal wire placed perpendicular to a magnetic field carries a current from left to right. The magnetic field is horizantal, directed towards you. What is the direction of magnetic force on the wire ?

219) A conducting circular loop of radius r carries a constant i. it is placed in a uniform magnetic field B such that B is perpendicular to the plane of loop. What is the magnetic force acting on the loop ?

220) A current carrying wire does not tend to rotate in a magnetic field. What do you conclude from this?

221) What is the magnitude of torque which acts on a coil carrying current placed in a uniform radial magnetic field ?

222) On what interaction is the principle of galvanometer based?

223) What is the value of net force acting on a current carrying (i) rectangular coil and (ii) circular coil of same area placed in a uniform magnetic field? What will be the torque acting in each case?

224) State the principle of moving coil galvanometer.

225) What is a dead beat galvanometer ?

226) Why is the coil wrapped on a conducting frame in a galvanometer ?

227) What is the function of soft iron cylinder between the poles of a galvanometer?

228) Why are pole pieces of galvanometer made concave ?

229) What is the function of the radial magnetic field in the moving coil galvanometer ?

230) Define the term current sensitivity of a moving coil galvanometer.

231) Write two factors by which the current sensitivity of a moving coil galvanometer can be increased ?

232) What is the resistance of ideal ammeter and ideal voltmeter ?

233) What is meant by figure of merit of a galvanometer ?

234) Which has greater resistance
(a) milliammeter or ammeter ?
(b) milli voltmeter or voltmeter ?

235) Why should an ammeter have a high current carrying capacity ?

236) Why should a voltmeter have a low current carrying capacity ?

237) A voltmeter, an ammeter and a resistance are connected in series with a lead accumulator. The voltmeter gives some deflection but the deflection of ammeter is zero. comment

238) A galvanometer of resistance 50 Ω is shunted by a resistance of 5 Ω What fraction of the main current passes through the galvanometer? Through the shunt ?

239) A current of 10^{-7} A produces 50 division deflection in a galvanometer. Find its figure of merit.

240) Can moving coil galvanometer be used to detect an a.c. in a circuit? Give reason.

241) Write the expression for Lorentz magnetic force on a particle of charge q moving with velocity V in a magnetic field B. Show that no work is done by this force on the charged particle.

242) A charged particle is moving on a circular path of radius R in a uniform magnetic field under the Lorentz force F. How much work is done by the force in one round? Is the momentum of the particle changing?

243) Two identical charged particles moving with same speed enter a region of uniform magnetic field. If one of these enters normal to the field direction and the other enters along a direction at 30° with the field, what would be the ratio of their angular frequencies ?

244) An α particle and a proton are moving in the plane of the paper in a region where there is a uniform magnetic field $\vec{B}$ directed normal to the plane of paper. If the two particles have equal linear momenta, what will be the ratio of their trajectories in the field?

245) A hydrogen ion of mass m and charge q travels with a speed v along a circle of radius r in a uniform magnetic field of flux density B. Obtain the expression for the magnetic force on the ion and determine its time period.

246) Show that the frequency of revolution, of a charged particle (in the X-Y plane), in a uniform magnetic field $\vec{B}(= B\hat{k})$ is independent of its speed.
Which practical machine makes use of this fact?
What is the frequency of the alternating electric field used in this machine ?

247) A charged particle moving with a uniform velocity $\vec{v}$ enters a region where uniform electric and magnetic fields $\vec{E}$ and $\vec{B}$ are present. It passes through the region without any change in its velocity. What can we conclude about the
(i) relative directions of $\vec{E}, \vec{v}$ and $\vec{B}$
(ii) magnitude of $\vec{E}$ and $\vec{B}$

248) A cyclotron is not suitable to accelerate electrons. Why ?

249) Explain the main functions of electric and magnetic fields in a cyclotron.

250) What is the basic principle of working of cyclotron? Write two uses of this machine.

251) A body is suspended from the lower end of a vertical spring. What shall be the effect on the position of the body when a current is sent through the spring? Does it depend upon the direction of current in the spring?

252) Two long parallel wires are hanging freely. If they are connected to a battery (i) in series, (ii) in parallel, what would be the effect on their positions?

253) What is the tendency of parallel beam of electron moving uniformly in vaccuum with
(i) normal speed
(ii) with high speed.

254) A straight wire, of length L, carrying a current I, stays suspended horizontally in mid air in a region where there is a uniform magnetic field. The linear mass density of the wire is λ Obtain the magnitude of this magnetic field.

255) A linear conductor carrying current is placed in a magnetic field. In which situation, the force experienced by the conductor is maximum and minimum ?

256) A stream of protons is moving parallel to stream of electrons. Will the two streams tend to come closer or move apart ?

257) A wire of length l metre carries a current I ampere along the Y-axis. A magnetic field, $\vec{B} = B_o\left(\hat{i} + \hat{j} + \hat{k}\right)$ tesla exists in space. Find the magnitude of the force on the wire.

258) A circular loop of radius 0.2 m carrying a current of 1 A is placed in a uniform magnetic field of 0.5 T. The magnetic field is perpendicular to the plane of the loop. What is the force experienced by the loop ?

259) A small coil carrying current is held in a uniform magnetic field. How does the coil tend to orient itself relative to magnetic field ?

260) Does the torque on planar current loop in a magnetic field change when its shape is changed without changing its geometrical area.

261) State the underlying principle of working of a moving coil galvanometer can not be used as such to measure current in a given circuit.

262) A rectangular coil of sides l and b carrying a current I is subjected to a uniform magnetic field $\vec{B}$ acting at an angle θ to its plane. Write the expression for the torque acting on it. In which orientation of the coil in the magnetic field, the torque is (i) minimum and (ii) maximum.

263) State properties of the material of the wire used for suspension of the coil in a moving coil galvanometer.

264) What is a radial magnetic field ? How has it been achieved in moving coil galvanometer ?

265) Why is phosphor bronze alloy preferred for the suspension wire of a moving coil galvanometer ?

266) What is the main function of a soft iron core used in a moving coil galvanometer ?

267) The current sensitivity of a moving coil galvanometer is 10 div/mA and voltage sensitivity is 20 div/V. Find the resistance of the galvanometer.

268) The coils in certain galvanometers, have a fixed core made of a non-magnetic metallic material. Why does the oscillating coil come to rest so quickly in such a core?

269) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Justify this statement.

270) Explain the action of shunt ?

271) What information would you wish to have about the galvanometer before you convert the galvanometer into an ammeter or voltmeter ?

272) Why do we not use galvanometer as an ammeter ?

273) Of the two identical galvanometers one is to be converted into an ammeter and another into a milliammeter. Which of the shunts will be of larger resistance ?

274) Why should an ammeter have a low resistance and a high current carrying capacity ?

275) Why should a voltmeter have a high resistance and a low current carrying capacity ?

276) Explain giving reasons, the basic difference in converting a galvanometer into
(i) an ammeter and
(ii) a voltmeter.

277) What is an ammeter? How is it used in an electric circuit? How it differ from a voltmeter?

278) Which one of the two, an ammeter or a milliammeter, has a higher resistance and why ?

279) (a) What is the importance of a radical magnetic field and how is it produced?
(b) Why is it that while using a moving coil galvanometer as a voltmeter, a high resistance in series is required whereas in an ammeter a shunt is used?
(c) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

280) Compare a voltmeter and an ammeter.

281) What are the SI units of pole strength and magnetic moment ?

282) What is the direction of magnetic dipole moment ?

283) Write the formula for magnetic moment of a current loop.

284) A magnet of length 2 l and pole strength m is divided in two equal parts along its length. What is magnetic moment of each part ?

285) Distinguish between a magnetic dipole and an electric dipole.

286) Name some magnetic and non-magnetic substances.

287) What is a magnetic dipole ?

288) Can we have magnet with a single pole ?

289) Are the two poles of a magnet equally strong ?

290) What is sure test of magnetism ?

291) Magentic lines of force are endless. comment.

292) A magnet of length 2l and pole strength m is equally divided in two parts, perpendicular to its length. What is the magnetic moment of each ?

293) What is the significance of Gauss's Law in magnetism ?

294) Give two examples of magnetic dipole.

295) On what factors does the pole strength of a magnet depend ?

296) What is the basic difference between magnetic and electric lines of force ?

297) Give one important point of distinction between magnetism and electricity.

298) What is meant by strength of magnetic field at any point ?

299) Write an expression for magnetic field intensity at any point an axial line of a bar magnet.

300) On equatorial line of bar magnet, what is the formula for magnetic field strength ?

301) A magnetic dipole is situated in the direction of a magnetic field. What is its potential energy ? If it is rotated by 180^{o} , then what amount of work will be done?

302) What is the strength of earth's magnetic field at the surface of earth ?

303) What is the potential energy of a dipole when it is perpendicular to a magnetic field ?

304) What is the torque acting on a magnet of magnetic moment M held at an angle θ with the direction of magnetic filed B ?

305) What does the torque do ?

306) What is the expression for potential energy of a dipole of moment M held at an angle θ with a magnetic field B ?

307) When is potential energy of a magnetic dipole minimum ?

308) Where is the vertical component of earth's magnetic field zero ?

309) A magnetic needle placed on a piece of cork is floating on the calm surface of a lake in the northern hemisphere. Would the magnetic needle along with the cork move towards north ?

310) What are isogonic, isoclinic and isodynamic lines ?

311) What is the maximum value of angle of dip ? At what place does it occur ?

312) What is the angle of dip at a place where horizontal and vertical components of earth's field are equal ?

313) A compass needle, free to turn in a vertical plane orients itself with its axis vertical at a certain place on the earth. Find out the values of
(i) Horizontal component of earth's magnetic field and
(ii) angle of dip at that place.

314) The angles of dip at two places are respectively 0^{o} and 90^{o} . Where are these values on earth ?

315) In the northern hemisphere, do magnetic lines of force due to earth's field point towards or away from earth ?

316) Name the elements or parameters of earth's magnetic field.

317) What is magnetic inclination at a place ?

318) What is a reduction factor of tangent galvanometer and its unit of measurement ?

319) Before using tangent galvanometer for the measurement of current, why is the plane of coil of tangent galvanometer set in the magnetic meridian ?

320) How is magnetic force between two poles affected when strength of each pole is doubled and distance between them is halved ?

321) No two magnetic lines of force can intersect. Why ?

322) Can ever there be a magnet
(a) with no pole
(b) with two similar poles
(c) with three poles ?

323) Define unit pole from Coulomb's law of magnetism.

324) For a short magnetic dipole, intensity at any point an axial line is same as intensity at same distance on equatorial line. Is it true ?

325) Under what situation a magnet suspended in a uniform magnetic field will be
(a) in stable equilibrium and
(b) in unstable equilibrium ?

326) When will a magnet in an external magnetic field be in unstable equilibrium ?

327) What is the proof of earth's magnetism ?

328) Is there a strong magnet inside the earth responsible for earth's magnetism ? If there is a magnet, what is its inclination w.r.t. to north-south direction ?

329) At what positions, the neutral points will lie for a bar magnet when magnetic axis of magnet is lying in the magnetic meridian
(i) with N- pole of magnet pointing North
(ii) with S-pole of magnet pointing North ?

330) How does a magnetic compass behave at a neutral point ?

331) Write mathematical form of tangent law in magnetism.

332) What is the order of magnetic moment of an atom ?

333) What are the SI units of magnetic field induction or magnetic flux density ?

334) What are the SI units of magnetising force or magnetising intensity ?

335) Name the cgs unit of magnetising intensity. How is it related to SI unit of intensity.

336) What is relative magnetic permeability of superconductors ?

337) What is magnetic susceptibility of super conductors.

338) What is Meissner effect ?

339) What is the SI unit of magnetic field ?

340) Name the SI unit of intensity of magnetisation.

341) What are units of magnetic permeability ?

342) Write the relation between relative permeability and susceptibility.

343) How does the magnetic susceptibility of a paramagnetic magnetic change with temperature ?

344) What are SI units magnetic susceptibility ?

345) Which of the following substances are diamagnetic ?

346) Which of the following substances are paramagnetic?
Al, Bi, Cu, Ca, Pb, Ni.

347) The permeability of Bismuth is 0.9983. To which class of magnetic material Bi belongs.

348) What is curie point ?

349) What is the basic difference between the atom/molecule of a diamagnetic and paramagnetic material ?

350) Why are electromagnets made of soft iron ?

351) What is the net magnetic moment of an atom of a diamagnetic material ?

352) Magnetisation and demagnetization of soft iron is easier/more difficult as compared to steel. Why ?

353) Classify the following into dia and para magnetic substances : aluminium, copper, water, mercury, oxygen,hydrogen.

354) Which materials have negative value of magnetic susceptibility?

355) Write the names of three ferromagnetic substances.

356) Magnetic moment of atoms of certain materials is zero. Name such material.

357) Name any three paramagnetic materials.

358) Which materials have relative magnetic permeability > 1?

359) Can there be a material, which is non magnetic ?

360) An electric of 0.25 A flows in a loop of radius 0.2 cm. What is the magnitude of dipole moment ?

361) Two circular loops of radii r and 2 r have current I and I/2 flowing through them in clockwise and anticlockwise sense respectively. If their equivalent magnetic moments are M_1 and M_2 ,what is the relation between M_1 and M_2 ?

362) State two methods to destroy the magnetism of a magnet.

363) Define the term : magnetic dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed v around an orbit of radius r in hydrogen atom.

364) Identify the materials, which can be classified as paramagnetic and diamagnetic : Al, Bi, Cu, Na.

365) How are wrist watches protected from powerful magnets ?

366) Why does the magnetisation of a paramagnetic salt increase on cooling ?

367) Give two characteristics of a material used for making permanent magnets.

368) What is the susceptbility and permeability of a perfectly diamagnetic substance ?

369) Comment on the state of magnetisation of a substance whose atoms contain odd number of electrons.

370) Which material is used to make electromagnets and why ?

371) Which material is used in making permanent magnets and why ?

372) Why is soft iron preferred for making the core of a transformer ?

373) What is the basic difference between the atom/molecule of a diamagnetic and a paramagnetic material ? Why are elements with even atomic number more likely to be diamagnetic ?

374) In what way is the behaviour of a diamagnetic material different from that of a paramagnetic material, when kept in an external magnetic field ?

375) Out of the two magnetic materials. 'A' has relative permeability slightly greater than unity while 'B' has less than unity. Identify the nature of materials 'A' and 'B' . Will their susceptibilities be positive or negative ?

376) The magnetic field is __________ around a conductor in which its magnetic effect can be felt.

377) Static charge is a source of .... but not of ....

378) A moving charge is a source of .... as well as ....

379) Biot Savart's law deals with the magnetic field induction at a point due to a ....

380) The direction of magnetic field lines due to straight conductor carrying current is given by ....

381) If current through a circular coil flows in clockwise direction, then the direction of magnetic field at the centre of the circular coil is .... to the plane of the coil, directed ....

382) The magnetic dipole moment of a current loop, carrying current I, having n turns, each of radius r is ....

383) The magnetic field induction is .... for a point on the surface of solid cylinder carrying current and is .... for a point on the axis of the cylinder.

384) The magnetic field produced due to current carrying straight solenoid is same as is due to a ....

385) Ampere's law is applicable for .... current distribution whereas the Biot Savart's law is applicable for .... current distribution.

386) Show that a force that does no work must be a velocity dependent force.

387) The magnetic force depends on $\vec{v}$ which depends on the inertial frame of reference. Does then the magnetic force differ from inertial frame to frame? Is it reasonable that the net acceleration has a different value in different frames of reference?

388) A current carrying loop consists of 3 identical quarter circles of radius R, lying in the positive quadrants of the x-y, y-z and z-x planes with their centers at the origin, joined together. Find the direction and magnitude to $\vec{B}$ at the origin.

389) A charged particle of charge e and mass m is moving in an electric field $\vec{E}$ and magnetic field. $\vec{B}$ Construct dimensionless quantities and quantities of dimension $[T]^{-1}$

390) An electron enters with a velocity $\vec{v} = v_0\hat{i}$ into a cubical region in which there are uniform electric and magnetic fields. The orbit of the electron is found to spiral down inside the cube in a plane parallel to the x-y plane. Suggest a configuration of fields $\vec{B}$ and $\vec{E}$ that can lead to it.

391) A proton has spin and magnetic moment just like an electron. Why then its effect is neglected in the magnetism of materials?

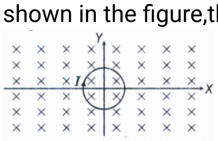
392) A permanent magnet in the shape of a thin cylinder of length 10 cm has $M = 10^6$ A/m. Calculate the magnetization current I_m

393) A ball of superconducting material is dipped in liquid nitrogen and placed near a bar magnet.
(i) In which direction will it move?
(ii) What will be the direction of it's magnetic moment?

394) Write the expression, in vector form, for the Lorentz magnetic force **F** due to a charge moving with velocity V in a magnetic field B**.** What is the direction of the magnetic force?

395) A narrow beam of protons and deuterons, each having the same momentum, enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the circular path described by them?

396) A conducting loop carrying a current I is placed in a uniform magnetic field, pointing into the plane of the paper as shown in the figure,then the loop will have a tendency to expand. Explain.



397) An electron does not suffer any deflection while passing through a region of uniform magnetic field, what is the direction of the magnetic field?

398) A coil of N turns and radius R carries a current I. It is unwound and rewound to make a square coil of side a having same number of turns N.Keeping the currentI same, find the ratio of the magnetic moment of the square coil and the circular coil.

399) Using the concept of force between two infinitely long parallel current carrying conductors, define one ampere of current.

400) Give the magnitude of torque which acts on a coil carrying current placed in a uniform radial magnetic field.

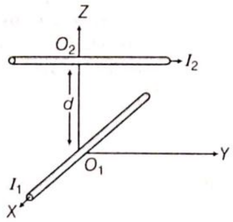
401) Why should the spring / suspension wire in a moving coil galvanometer have low torsional constant?

402) Why is a coil wrapped on a conducting frame in a galvanometer?

403) The coil in certain galvanometers have a fixed core made of non-magnetic metallic materials.Why does the oscillating coil come to rest so, quickly in such a core?

404) Considering the case of a parallel plate capacitor being charged, show how one is required to generalize Ampere's circuital law to include the term due to displacement current.

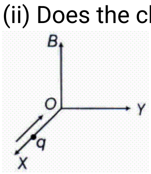
405) Two long wires carrying currents I_1 and I_2 are arranged as shown in the figure. One carrying current I_1 is along the X-axis. The other carrying current I_2 is along a line parallel to Y-axis, given by x = 0 and z = d. Find the force exerted at point O_2 because of the wire along the X-axis.



406) A particle of charge q and mass m is moving with velocity v. It is subjected to a uniform magnetic field B directed perpendicular to its velocity, Show that, it describes a circular path. Write the expression for its radius.

407) A rectangular coil of area $2 \times 10^{-4} m^2$ and 40 turns is pivoted about one of its vertical sides. The coil is in a radial horizontal field of 60 G. What is the torsional constant of the hair springs connected to the coil, if a current of 4.0 mA produces an angular deflection of 16^{o}?

408) A charge q moving along the X-axis with a velocity **v** is subjected to a uniform magnetic field B acting along the Z-axis as it crosses the origin O.
(i) Trace trajectory
(ii) Does the charged particle gain kinetic energy as it enters the magnetic field? Justify your answer.



409) A conductor of length 2 m carrying current of 2 A is held parallel to an infinitely long conductor carrying current of 10 A at a distance of 100 mm. Find the force on a small conductor?

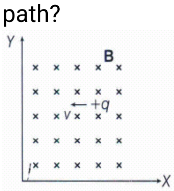
410) Two long parallel wires carrying a current I, separated by a distance r are exerting a force F on each other. If the distance between them is increased to 2r and current in each wire is reduced from I to I / 2, then what will be the force between them?

411) Is the source of magnetic field an analogue to the source of electric field?

412) How can you justify that a current carrying wire produces magnetic field?

413) Name the kind of magnetic field produced by an infinitely long current carrying conductor.

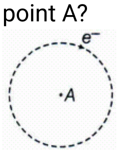
414) A point charge is moving with a constant velocity perpendicular to a uniform magnetic fields as shown in the figure. What should be magnitude and direction of the electric field so that the particle moves undeviated along the same path?



415) Among Biot-Savart's law and Coulomb's law which one is angle dependent?

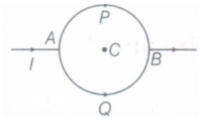
416) Does a current carrying circular coil produce uniform magnetic field?

417) An electron is revolving around a circular loop as shown in the figure. What will be the direction of magnetic field at point A?

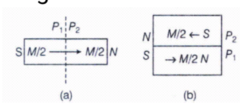


418) A cyclotron when being used to accelerate positive ions? (Mass = 6.7 x 10^{-27}kg, charge = 3.2 x 10^{-19}C) has a magnetic field of $(\frac{\pi}{2})$T. What must be the value of the frequency of the applied alternating electric field to be used in it?

419) There is circuit given below given below, where APB and AQB are semi-circles. What will be the magnetic field at the centre C of the circular loop?

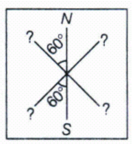


420) A bar magnet is cut into two equal parts as shown in the Fig. (a) One part is now kept over the other such that, the P_2 is above P_1 as shown in the Fig.(b).
If M is the magnetic moment of the original magnet, what would be the magnetic moment of new combination of magnets so formed?



421) How will you identify, whether the magnetic field at a point is due to the earth or due to some current carrying conductor? field at a point is due to the earth or due to some current carrying conductor?

422) Three identical bar magnets are rivetted together at centre in the same plane as shown in the figure. This system is placed at rest in a system is placed at rest in a slowly varying magnetic field. It is found that the system of magnets does not show any motion. The North-South poles of one magnet is shown in the figure. Determine the poles of the remaining two.



423) A current of 5 A is flowing from South to North in a straight wire. Find the magnetic field due to a 1cm piece of wire at a point 1m North-East from the piece of wire.

424) A short magnet oscillates with a time period 0.1 s at a place, where horizontal magnetic field is 24μ
A downward current of 18 A is established in a vertical wire 20cm East of the magnet. What will be the new time period of the oscillator?

425) A short bar magnet has a magnetic moment of 0.48 J/T. Give the direction and magnitude of the magnetic field produced by the magnet at a distance of 10cm from the centre of the magnet on
(i) the axis,
(ii) the equatorial lines (normal bisector) of the magnet.

426) How does a circular loop carrying current behave as a magnet?

427) Where on the surface of the earth is the vertical component of the earth's magnetic field zero?

428) If the horizontal and vertical components of the earth's magnetic field are equal at a certain place, what would be the angle of dip at that place?

429) If two magnets having magnetic moments M and M$\sqrt{3}$ are joined to form a cross (i.e. X). The combination is suspended freely in a uniform magnetic field. In equilibrium position, the magnet having magnetic moment M makes an angle θ with the field. Calculate the value of θ

430) Suppose we want to verify the analogy between electrostatic and magnetic by an explicit experiment. Consider the motion of
(i) electric dipole p in an electrostatic field E and
(ii) magnetic dipole M in a magnetic field B. Write down a set of conditions on E,B,p,M so that the two motions are verified to be identical.(assume idential initial conditions)
E(r) = cB(r), suppose the angle between p and E is θ Torque on electric dipole moment M in magnetic field E, $\tau = pEsi$

431) The horizontal component of the earth's magnetic field at a place is B and angle of dip is 60^0 What is the value of vertical component of earth's magnetic field at equator?

432) A magnetic needle, free to rotate in a vertical plane orients itself vertically at a certain place on the earth. What are the values of (i) horizontal component of the earth's magnetic field (ii) angle of dip at this place?

433) A permanent magnet in the shape of a thin Calculate of length 10 cm has M = 10^6 A/M. Calculate the magnetisation current I_m .

434) In your home TV set, a beam of electronics moves from the back of the picture tube to the screen of the TV where it strikes a fluorescent dot that glows with a specific colour, when hit. The Earth's magnetic field at the location of the TV set is horizontal and towards the North. In which direction, should the TV set be oriented deflection?

435) A short bar magnetic placed in a horizontal plane has its axis aligned along the magnetic North-South direction. Null points are found on the axis of the magnet at 14 cm from the centre of the magnet. The earth's magnetic field at the place is 0.36 gauss and the angle of dip is zero.
What is the total magnetic field on the normal bisector of the magnetic at the same distance as the null point (i.e. 14 cm) from the centre of the magnet? (At null points, field due to a magnet is equal and opposite to the horizontal component of the earth's magnetic field.)

436) A short bar magnet with its axis at 30^0 with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to $4.5 \times 10^{-2}\ J$. What is the magnitude of magnetic moment of the magnet?

437) If the solenoid in Q.6 is free to turn about the vertical direction and a uniform horizontal magnetic field of 0.25 T is applied, what is the magnitude of torque on the solenoid when its axis makes an angle of 30^0 with the direction of applied field?

438) A small compass needle of magnetic moment M and moment of inertia I is free to oscillate in a magnetic field B. It is slightly disturbed from its equilibrium position and then released. Show that it executes simple harmonic motion. Hence, write the expression for its time period.

439) if the bar magnet in Q. 8 is turned around by 180^0, where will the new points be located?

440) The horizontal component of the earth's magnetic field at a place is $\sqrt{3}$ times its vertical component here. Find the value of the angle of dip at that place. What is the ratio of the horizontal component to the total magnetic field of the earth at that place?

441) A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its North tip down at 60^0 with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.4 gauss. Determine the magnitude of the earth's magnetic field at the place.

442) A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its North tip pointing down at 22^0 with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.35 gauss. Determine the magnitude of the earth's magnetic field at the place.

443) A short bar magnet with its North pole facing North forms a neutral point at A in the horizontal plane. If the magnet is rotated by 90^0 in the horizontal plane, what is the net magnetic induction at P?

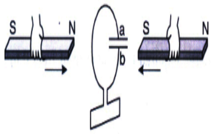
444) From molecular view point, discuss the temperature dependence of susceptibility for diamagnetism, paramagnetism and ferromagnetism.

445) Show diagrammatically the behaviour of magnetic field in the presence of
(i) paramagnetic and
(ii) diamagnetic substances. How does one explain this distinguishing feature?

446) Explain quantitatively the order of magnitude difference between the diamagnetic. susceptibility of (i) N_2 (at STP) (-5×10^{-9}) and (ii) Cu (

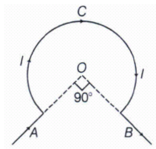
447) Each atom of an iron bar $(4\ cm \times 2\ cm \times 2\ cm)$ has a magnetic moment 13.4×10^{23}
(i) What will be the magnetic moment of an iron bar in the state of magnetic saturation?
(ii) What will be the torque required to keep this magnetised iron bar perpendicular to the magnetic field of 16000 gauss?
(Given, density of iron = $7.8 \times 10^3\ kg\ m^{-3}$
atomic weight if iron = 56d and Avogadro's number = $6.023 \times 10^{23}\ mol^{-1}$

448) Equal currents I = 2A are flowing through the infinitely long wires parallel to Y-axis located at x = +1m, x = +2m, x = +4m and so on, but in opposite directions as shown in figure. Find the magnetic field at the origin O.



449) A circular coil closely wound N turns and radius r carries a current I. Write the expressions for the following. the magnetic moment of this coil.

450) The wire shown in the figure, carries a current of 10 A. determine the magnitude of magnetic field induction at the centre O. Give the radius of bent coil is 3 cm.



451) Write the expression for the magnetic moment($\vec{m}$) due to a planar square loop of side 'l' carrying a steady current I in a vector form.

452) A rectangular coil of sides l and b carrying a current I is subjected to a uniform magnetic field B acting perpendicular to its plane. Obtain the expression for the torque acting on it.

453) A circular coil fo N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius R/2, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

454) Define one Tesla using the expression for the magnetic force acting on a particle of charge q moving with velocity v in a magnetic field B.

455) Write the condition under which an electron will move undeflected in the presences of crossed electric and magnetic fields.

456) Deduce the expression for the magnetic dipole moment of an electron orbiting around the central nucleus.

457) Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity or energy of the particle.

458) Show that cyclotron frequency is independent of energy of the particle. is there an upper limit on the energy of the particle. is there an upper limit on the energy acquired by the particle? Give reason.

459) The permeability of a magnetic material is 0.9983. Name the type of magnetic materials it represents.

460) Where on the surface of the earth is the angle of dip 90^0 ?

461) An ammeter of resistance 0.80Ω can measure current upto1.0 A.
(i) What must be the value of shunt resistance to enable the ammeter to measure current upto 5.0A?
(ii) What is the combined resistance of the ammeter and the shunt?

462) How is an electromagnet different from a permanent magnet?
Write two properties of a material which make it suitable for making electromagnets.

463) Give two points to distinguish between a paramagnetic and a diamagnetic substance.

464) The susceptibility of a magnetic material is -2.6×10^{5}. Identify the type of magnetic material and state its two properties.

465) Write two characteristics of a material used for making permanent magnets. Why is core of an electromagnet made of ferromagnetic material?

466) A flexible wire of irregular shape, abed, as shown in the figure, turns into circular shape when placed in a region of magnetic field which is directed I normal to the plane of the loop away from the reader. Predict the direction of the induced current in the wire.

467) Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C' as shown in the figure. Predict the polarity of the capacitor.

468) A square coil OPQR of side a carrying 'a' current I, is placed in the Y-Z plane as shown here. Find the magnetic moment associated with this coil.

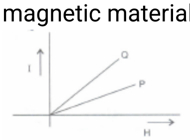
469) (i) State Biot-Savart law in vector form expressing the magnetic field due to an element $\vec{dl}$ carrying current I at a distance $\vec{r}$ from the element
(ii) Write the expression for the magnitude of the magnetic field at the centre of a circular loop of radius r carrying a steady current I. Draw the field lines due to the current loop.

470) A proton and a deuteron, each moving with velocity $\vec{v}$ enter simultaneously in the region of magnetic field $\vec{B}$ acting normal to the direction of velocity. Trace their trajectories establishing the relationship between the two.

471) Two identical circular wires P and Q each of radius, R and carrying current I are kept in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils.

472) A long straight wire AB carries a current I. A proton P travels with a speed v, parallel to the wire, at a distance d from it in a direction opposite to the current as shown in the figure. What is the force experienced by the proton and what is its direction?

473) The given graphs show the variation of intensity of magnetization I with strength of applied magnetic field H for two magnetic materials P and Q.



(i) Identifiy the materials P and Q.
(ii) For material P, plot the variation of intensity of magnetisation with temperature. Justify your answer.

474) Draw magnetic field lines when a (i) diamagnetic, (ii) paramagnetic substance is placed in an external magnetic field. Which magnetic property distinguishes this behaviour of the field lines due to the two substances?

475) Draw the magnetic field lines due to a current passing through a long solenoid. Use Ampere's circuital law, to obtain the expression for the magnetic field due to the current I in a long solenoid having n number of turns per unit length.

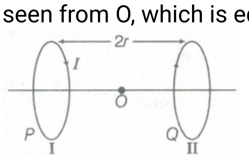
476) In the given figure this loop is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance l as shown. Give reasons to explain that the loop will experience a net force but no torque. Write the expression for this force acting on the loop.

477) Outline the necessary steps to convert a galvanometer of resistance R_g into an ammeter of a given range.

478) State, briefly, an efficient way of making apermanent magnet. Write two properties to select suitable materials for making permanent magnets.

479) A current is induced in coil C_1 due to the motion of current carrying coil C_2
(a) Write any two ways by which a large deflection can be obtained in the galvanometer G.
(b) Suggest an alternative device to demonstrate the induced current in place of a galvanometer.

480) Two identical circular loops P and Q, each of radius r and carrying equal currents are kept in the parallel planes having a common axis passing through O. The direction of current in P is clockwise and in Q is anti-clockwise as seen from O, which is equidistant from the loops P and Q. Find the magnitude of the net magnetic field at O.



481) A long solenoid of length L having N turns carries a current I. Deduce the expression for the magnetic field in the interior of the solenoid.

482) Explain the following
(i) Why do magnetic lines of force form continuous closed loops?
(ii) Why are the field lines repelled (expelled) when a diamagnetic material is placed in an external uniform magnetic field?

483) The relative magnetic permeability of a magnetic material is 800. Identify the nature of magnetic material and state its two properties.

484) (i) How does a diamagnetic material behave when it is cooled at very low temperature?
(ii) Why does a paramagnetic sample display greater magnetisation when cooled? Explain

485) Obtain with the help of a necessary diagram, the expression for the magnetic field in the interior of a toroid carrying current.

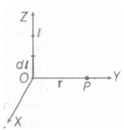
486) A straight wire of length L is bent into a semi-circular loop. Use Biot-Savart's law to deduce an expression for the-magnetic field at its centre due to the current I passing through it.

487) (i) Name the three elements of the Earth's magnetic field.
(ii) Where on the surface of the Barth is the vertical component of the Earth's magnetic field zero?

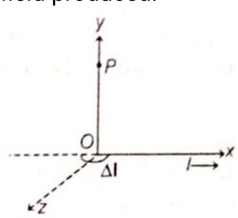
488) Distinguish between diamagnetic and ferromagnetic materials in terms of
(i) susceptibility and
(ii) their behaviour in a non-uniform magnetic field.

489) State Ampere's circuital law. Show through an example, how this law enables an easy evaluation of the magnetic field when there is a symmetry in the system?

490) State Biot-Savart's law. A current I flows in a conductor placed perpendicular to the plane of the paper. Indicate the direction of the magnetic field due to a small element dl at a point P situated at a distance r from the element as shown in the figure.



491) An element $\triangle l = \triangle x \hat{\mathbf{i}}$ is placed at the origin (as shown in figure) and carries a current I = 2 A. Find out the magnetic field at a point P on the Y -axis at a distance of 1.0 m due to the element $\triangle x$ = w cm. Also, give the direction of the field produced.



492) State briefly an efficient way of making a permanent magnet. Write two properties to select suitable materials for making permanent magnets.

493) Out of the following, identify the materials which can be classified as
(i) paramagnetic
(ii) diamagnetic
(a) Aluminium
(b) Bismuth
(c) Copper
(d) Sodium
Write one property to distinguish between paramagnetic and diamagnetic materials.

494) At a place, the horizontal component of earth's magnetic field is B and angle of dip is 60°. What is the value of horizontal component of the earth's magnetic field at equator?

495) A magnetic needle free to rotate in a vertical plane orients itself vertically at a certain place on the earth. What are the values of
(i) horizontal component of the earth's magnetic field and
(ii) angle of dip at this place?

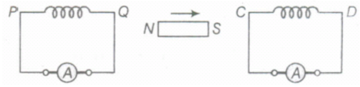
496) The susceptibility of a magnetic material is 1.9×10^{-5} Name the type of magnetic material, it represents.

497) The susceptibility of a magnetic material is 4.2×10^{-6}. Name the type of magnetic material, it represents.

498) What is the characteristic property of a diamagnetic material?

499) Define the term magnetic declination

500) A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of the induced current in each coil.



501) Draw the magnetic field lines due to a current carrying loop.

502) Write the expression in a vector form for the Lorentz magnetic force F due to a charge moving with velocity v in a magnetic field B. What is the direction of the magnetic force?

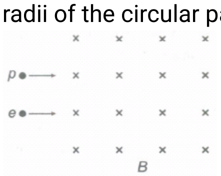
503) Two particles A and B of masses m and 2m have charges q and 2q respectively. They are moving with velocities V_1 and V_2 respectively in the same direction, enters the same magnetic field B acting normally to their direction of motion. If the two forces F_A and FB acting on them are in the ratio of 1 : 2, find the ratio of their velocities.

504) A beam of a-particles projected along + X-axis, experiences a force due to a magnetic field along the + Y-axis. What is the direction of the magnetic field?

505) Find the condition under which the charged particles moving with different speeds in the presence of electric and magnetic field vectors can be used to select charged particles of a particular speed.

506) State the underlying principle of a cyclotron. Write briefly how this machine is used to accelerate charged particles to high energies.

507) An electron and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field. Show the trajectory followed by the two particles in the magnetic field. Find the ratio of the radii of the circular paths which the particles may describe.

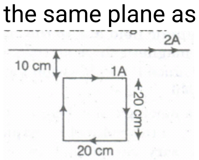


508) A deuteron and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field. Show the trajectories followed by the two particles in the magnetic field. Find the ratio of the radii of the circular paths which the two particles may describe.

509) Write the underlying principle of a moving coil galvanometer.

510) Is the steady electric current the only source of magnetic field? Justify your answer.

511) A square loop of side 20 cm carrying current of lA kept near an infmite long straight wire carrying a current of 2A in the same plane as shown in the figure.



Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor.

512) (i) Two long straight parallel conductors a and b carrying steady currents I_a and I_b respectively, are separated by a distance d. What is the nature and magnitude of the force between the two conductors?
(ii) Show with the help of a diagram, how the force between the two conductors would change when the currents in them flow in the opposite directions.

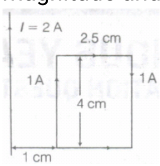
513) A circular coil of closely wound N turns and radius r carries a current I. Write the expressions for the following:
(i) The magnetic field at its centre.
(ii) The magnetic moment of this coil.

514) A steady current I_1 flows through a long straight wire. Another wire carrying steady current I_2 in the same direction is kept close and parallel to the first wire. Show with the help of a diagram, how the magnetic field due to the current I_1 exert a magnetic force on the second wire. Deduce the expression for this force.

515) How is a moving coil galvanometer converted into a voltmeter? Explain giving the necessary circuit diagram and the required mathematical relation used.

516) A metallic rod of length l is rotated with a frequency v with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius r about an axis passing through the centre and perpendicular to the plane of the ring. A constant uniform magnetic field B parallel to the axis is present everywhere. Using Lorentz force, explain how emf is induced between the centre and the metallic ring and hence obtained the expression for it.

517) A rectangular loop of wire of size 2.5 cm x 4 cm carries steady current of 1 A. A straight wire carrying 2 A current is kept near the loop as shown. If the-loop and the wire are coplanar, find the (i) torque acting on the loop and (ii) the magnitude and direction of the force on the loop due to the current carrying wire.



518) Draw a labelled diagram of a moving coil galvanometer and explain its working. What is the function of radial magnetic field inside the coil?

519) Depict the magnetic field lines due to two straight, long, parallel conductors carrying currents I_1 and I_2 in the same direction. Hence, deduce an expression for the force per unit length acting on one of the conductors due to the other. Is this force attractive or repulsive?

520) Find the expression for magnetic dipole moment of a revolving electron. What is Bohr magneton?

521) A moving coil galvanometer of resistance G gives its full scale deflection when a current Ig flows through its coil. It can be converted into a ammeter of range (0 to 1) (I > I g) when a shunt of resistance S is connected is converted into an ammeter of range 0 to 1, find the expression for the shunt required in terms of Ig and G.

522) Derive the expression for force per unit length between two long straight parallel current carrying conductors. Hence, define one ampere.

523) Deduce the expression for the torque experienced by a rectangular loop carrying a steady current I and placed in a uniform magnetic field B. Indicate the direction of the torque acting on the loop.

524) An electron in an atom revolves around the nucleus in an orbit of radius r with frequency v. Write the expression for the magnetic moment of the electron.

525) A rod of length L, along East West direction is dropped from a height H. If B be the magnetic field due to earth at that place and angle of dip is S, then what is the magnitude of induced emf across two ends of the rod when the rod reaches the earth.

526) Where on the surface of Earth is the vertical component of earth's magnetic field zero?

527) A square shaped plane coil of area 100 cm^2 of 200 turns carries a steady current of SA. It is placed in a uniform magnetic field of 0.2T acting perpendicular to the plane of the coil. Calculate the torque on the coil when its plane makes an angle of 60° with the direction of the field. In which orientation will the coil be in stable equilibrium?

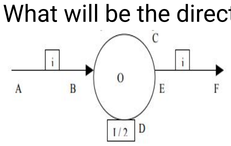
528) Suppose a helical spring is suspended from the roof of a room and very small weight is attached to its lower end what will happen to the spring when a current is passed through it?Give reason to support your answer?

529) Out of Voltmeter and Millivoltmeter, which has the higher resistance?

530) Proton is moving along the axis of a solenoid carrying current of 2 A and 50 number of turns per unit length. What will be the force acting on the particle

531) Out of Ammeter and Milliammeter, which has the higher resistance?

532) What will be the direction of magnetic field at point O



533) One alpha particle and a deuteron entered perpendicularly in a uniform magnetic field with same velocity. Which one follow the greater circle?

534) Can a Moving Coil Galvanometer can be used to detect an A.C. in a circuit .Give reason

535) Two wires of equal length are bent in the form of two loops. One loop is square whereas the other is circular. These are suspended in same magnetic field and same current is passed through them. Explain with reason which will experience greater torque?

536) The pole of a magnet is brought near to a stationary charge. What will be the force experienced by pole?

537) A charge particle moving in a magnetic field penetrates a layer of lead and thereby losses half of its kinetic energy. How does the radius of curvature of its path change?

538) A Current 'I' flows along the length of an infinitely long straight thin walled pipe. What is the magnetic field at any point on the axis of pipe?

539) The Earth's core contains iron but geologists do not regard this as a source of Magnetic Field, Why?

540) Is the Resistance of Voltmeter larger than or smaller than the resistance of Galvanometer from which it is converted.

541) A Magnetic Field dipole placed in a Magnetic Field experiences a net force. What can you say about the Nature of Magnetic Field?

542) Earth's Magnetic Field does not affect working of moving Coil Galvanometer. Why?

543) Which type of Magnetism exists in all substances?

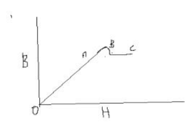
544) For what orientation P.E. of a Magnetic dipole placed in uniform Magnetic Field minimum?

545) How does a ferromagnetic material change its Magnetic properties if it is heated beyond its curie temperature?

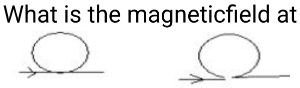
546) A bar magnet is cut into two pieces, along its length. How will its pole strength be affected?

547) What is the work done by a magnetic force, in displacing a charged particle?

548) An unmagnetised ferromagnetic substance is magnetized. Given figure shows the B-H curve. Identify the stage of saturation ,reverse region and irreversible region



549) What is the magneticfield at the centre of the following circular coils carrying current I?

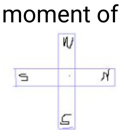


550) Two long straight wires are set parallel to each other. Each carries a current I in the same direction and the separation between them is 2r. What is the intensity of the magnetic field midway between them?

551) A proton is about 1840 times heavier than an electron. What will be its kinetic energy when it is accelerated by a potential difference of 1KV?

552) A circular loop of radius R carrying current I ,lies in X-Y plane with its centre at origin.What is the total magnetic flux through X-Y plane?

553) A hypothetical bar magnet is cut into two equal pieces and placed as shown in the figure. What is the magnetic moment of this arrangement?



554) A circular current carrying coil has a radius R. What is the distance from the centre of the coil on its axis where the magnetic field is 1/8 th of its value at the centre?

555) A magnetic needle suspended freely in a uniform magnetic field experiences torque but no net force. A nail made up of iron kept near a bar magnet experience a force of attraction and torque .Give reason

556) What is the work done by a magnetic field on moving a charge? Give reason

557) A particle with charge q moving with velocity v in the plane of the paper enters a uniform magnetic field B acting perpendicular to the plane of the paper. Deduce an expression for the time period of the charge as it moves in a circular path in the field.
Why does the kinetic energy of the charge not change while moving in the magnetic field.

558) A solenoid of length 0.6m has a radius of 1cm and is made up of 600 turns.It carries a current of 5A.What is the magnetic field inside and at ends of solenoid.?

559) An element dl = dx $\hat{i}$ (where, dx = 1 cm) is placed at the origin and carries a large current I = 10 A. What is the magnetic field on the y-axis at a distance of 0.5 m?

560) You are given a copper wire carrying current I of length L. Now the wire is turned into circular coil. Find the number of turns in the coil so that the torque at the centre of the coil is to maximum

561) What is the magnetic field produced at the centre of curvature of an arc of wire of radius r carrying current I subtends an angle $\pi/2$ radians at its centre

562) If B is the magnetic field produced at the centre of a circular coil of one turn of length L carrying current I then what is the magnetic field at the centre of the same coil which is made into 10 turns?

563) A copper wire is bent into a square of each side 6cm.If a current of 2A is passed through a wire what is the magnetic field at the centre of the square?

564) Find the magnetic moment of a wire of length l carrying current I bent in the form of a circle

565) When current is flowing through two parallel conductors in the same direction they attract while two beams of electrons moving in the same direction repel each other. Why?

566) Draw diagrams to show behavior of magnetic field lines near a bar of (i) Alluminium (ii) copper and (iii) mercury cooled to a very low temperature 4.2 K

567) The hysteresis loss for a sample of 6 kg is 150 J/M^2 /cycle. If the density of iron is 7500 kg/m3 , calculate the energy loss per hour at 40cycle

568) A current carrying solenoid of 100 turns has an area of cross section 10^{-4} m^2 .When suspended freely through its centre, it can turn in a horizontal plane .what is the magnetic moment of the solenoid for a current of 5A.Also calculate the net force and torque on solenoid if a uniform horizontal field of $10x10^{-2}$ T is set up at an angle of 30 degree with axis of solenoid when it is carrying the same current

569) Two concentric circular coils A and B of radii 10 cm and 6 cm respectively, lie in the same vertical plane containing the north to south direction. coil A has 30 turns and carries a current of 10 A. Coil B has 40 turns and carries a current of 15 A .the sense of the current in A is anticlockwise and clockwise in B for an observer looking at the coils facing west. Give the magnitude and direction of net magnetic field.

570) The vertical component of earth's magnetic field at a given place is $\sqrt{3}$ times its horizontal component. If the total intensity of earth's magnetic field at a place is 0.4 G , find the value of horizontal component of earths field and angle of dip.

571) north to south direction.Specify the direction in which the uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

572) A straight wire of mass 200g and the length 1.5m carries a current of 2A. It is suspended in mid air by a uniform horizontal magnetic field B. What is the magnitude of B in tesla?

573) A rigid circular loop of radius r and mass m lies in the x-y plane of a flat table and has a current I flowing in it. At this particular place the earth's magnetic field is B = Bxi +Bzk. What is the value of I, so that loop starts tilting?

574) In an ammeter, 10% of main current is passing through the galvanometer. If the resistance of the galvanometer is G, then what is the shunt resistance in ohms?

575) The two rails of arailway track insulated from each other and the ground is connected to a milli voltmeter. What is the reading g of the millivolmeter when the train passes at aspeed 180km/hr along the track, given that the vertical component of earth"s magnetic field is $0.2x10^{-4}$T and rails are separated by 1m

576) A charged particle moving in a magnetic field penetrates a layer of lead and there by looses half of its kinetic energy.How does the radius of curvature of its path changes? Radius r= mV/qB

577) The velocities of two α particles X and Y entering in an uniform magnetic field are in the ratio 2:1. On entering the field ,they move in different circular paths .Give the ratio of the radii of their paths?

578) Give the dependence of magnetic field produced by a current carrying conductor.

579) State Biot-Savart's law and express this law in the vector form.

580) Two identical circular coils, P and Qeach of radius R, carrying currents 1A and $\sqrt{3}$A respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ-planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.

581) A charged particle enters an environment of a strong and non -uniform magnetic field varying from point to point both in magnitude and direction, and comes out of it following a complicated trajectory. Would its final speed equal to the initial speed, if it suffered no collisions with the environment?

582) A loop of irregular shape carrying current is located in an external magnetic field. If the wire is flexible, why does it change to a circular shape?

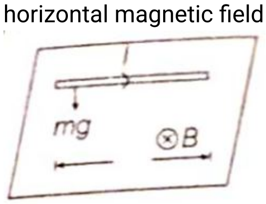
583) A solenoid tends to contract when a current passes through it. Justify the given statement.

584) A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move in a circular path with higher frequency?

585) An iron ring of relative permeability μ has windings of insulated copper wire of n turns per metre. When the current in the windings is I, find the expression for the magnetic field in the ring.

586) The length of a solenoid is 0.2 m and it has 120 turns. Find the magnetic field in its interior, if a current of 2.5 A is flowing through it.

587) A straight wire of mass 200 g and length 1.5 m carries a current of 4 A. It is suspended in mid air by a uniform horizontal magnetic field B. What is the magnitude of the magnetic field?



588) A short conductor of length 5 cm is placed parallel to a long conductor of length 1.5 m near its centre. The conductors carry currents 4 A and 3 A respectively in the same direction. What is the total force experienced by the long conductor when they are 3 cm apart?

589) The full scale deflection current of a galvanometer of resistance 1Ω is 5 mA. How will you convert it into a voltmeter of range 5 V?

590) A galvanometer gives full scale deflection with the current I_g. Can it be converted into an ammeter of range $I< I_g$?

591) What will be the magnetic field at the centre of a circular coil carrying current, when the current through the coil is doubled and the radius of the coil is halved?

592) What is the force on a charge moving along the direction of the magnetic field?

593) Name the force which is experienced by a moving charged particle in electric and magnetic field.

594) Under what condition does an electron moving through a magnetic field experience maximum force?

595) A charged particle moves through a magnetic field. Is the momentum of the particle affected?

596) In a certain arrangement, a proton does not get deflected while passing through a magnetic field region. Under what condition is it possible?

597) Write the expression for the force between parallel current carrying conductors.

598) Two similar coils are placed mutually perpendicular such that their centres coincide. At centre, what will be the ratio of the magnitudes of magnetic fields due to one coil and the resultant magnetic field?

599) Equal currents are flowing through two infinitely long parallel wires-in the same direction. What will be the magnetic field at a point mid-way between the two wires ?

600) Why does a moving charge experience a force when placed in a magnetic field?

601) A long straight wire carries a steady current I along the positive y-axis in a coordinate system. A particle + of charge +Q is moving with a velocity $\vec{v}$ along the x-axis. In which direction will the particle experience a force?

602) In a certain region of space, electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other. directions of both $\vec{B}$ and $\vec{E}$ and moves un deflected. Find the velocity of the electron.

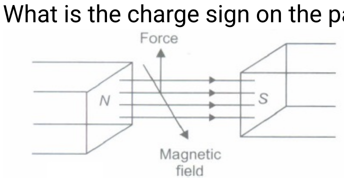
603) An electron and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field. For which of the two particles will the radius of circular path be smaller?

604) Write the expression for the magnetic moment of a circular coil of area A carrying a current I, in a vector form.

605) State the law used to determine the direction of magnetic field at the centre of current carrying circular coil.

606) Write two properties of a material used as a suspension wire in a moving coil galvanometer.

607) A charged particle enters into a uniform magnetic field and experiences an upward force as indicated in the figure. What is the charge sign on the particle?



608) How does the magnetic moment of an electron in a circular orbit of radius r and moving with a speed v change, when the frequency of revolution is doubled?

609) A current carrying loop is free to turn in a uniform magnetic field B. Under what conditions, will the torque acting on it be (i) minimum and (ii) maximum?

610) An ammeter and a milliammeter are converted from the same galvanometer. Out of the two, which current measuring instrument has higher resistance?

611) What is the advantage of using radial magnetic field in a moving coil galvanometer?

612) Why is it necessary for voltmeter to have a high resistance?

613) What is figure of merit of a galvanometer?

614) Define gyro magnetic ratio.

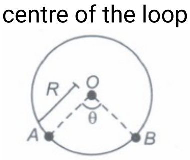
615) Can we decrease the range of an ammeter?

616) Why can a galvanometer not be used as such to measure current in a given circuit? Write two reasons.

617) What is velocity selector? Write its uses.

618) Both, the electric and magnetic fields can deflect a moving electron. What is the difference between these deflections?

619) A wire of uniform cross-section is bent into a circular loop of radius R. Consider two points A and B on the loop, such that ∠AOB = θ as shown. If now a battery is connected between A and B, show that the magnetic field at the centre of the loop will be zero irrespective of angle θ.



620) Define the current sensitivity of a moving coil galvanometer. "Increasing the current sensitivity may not necessarily increase the voltage sensitivity." Justify this statement.

621) A charged particle of mass m and charge q moving at uniform velocity v, enters a uniform magnetic field B acting normal to the plane of the paper. Deduce expression for the
(i) radius of the circular path in which it travels and
(ii) kinetic energy of the particle.

622) A charge q moving in a straight line is accelerated by a potential difference V. It enters into a uniform magnetic field B perpendicular to its path. Deduce, in terms of V, an expression for the radius of the circular path in which it travels.

623) A proton is moving along + ve x-axis in the presence of uniform magnetic field along + ve y-axis. What is the direction of the force acting on it?

624) An electron and a proton, moving parallel to each other in the same direction with equal momenta, enter into a uniform magnetic field which is at right angles to their velocities. Trace their trajectories in the magnetic field.

625) Under what conditions will the force exerted by the magnetic field on a charged particle be (i) maximum and (ii) minimum?

626) Which one of the following will experience maximum force, when projected with the same velocity 'v' perpendicular to the magnetic field 'B': (i) α-particle, and (ii) β-particle?

627) An α-particle and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field. Show the trajectories followed by the two particles in the region of the magnetic field. Find the ratio of the radii of the circular paths which the two particles may describe.

628) Show that the period of a revolution of an ion is independent of its speed and radius of the orbit. Write two important uses of a cyclotron.

629) State Oersted's experiment.

630) State Ampere's circuital law.

631) Using Ampere circuital law, derive the formula for magnetic field due to infinitely long current carrying straight wire.

632) A charged particle moving in a straight line parallel to a uniform magnetic field enters the field. What will be its path n the field? Will there be any change in its speed or direction of motion?

633) Write the relation for the force acting on a charged particle q moving with velocity v in the presence of a magnetic field B.

634) When a charge q is moving in the presence of electric field E and magnetic field B which are perpendicular to each other and also perpendicular to the velocity v of the particle, write the relation expressing v in terms of E and B

635) A proton and α-particle are accelerated through different potentials V_1 and V_2 respectively, so that they have the same de-Broglie wavelengths. Find $\frac{V_1}{V_2}$

636) A wire of length l is in the form ofa circular loop A ofone turn.This loop is reshaped into loop B of three turns. Find the ratio of the magnetíc fields at the centres of loop A and loop B for the same current through them

637) The ratio of de-Broglie wavelengths of a proton and a deuteron accelerated by potential V_p and V_d respectively, $\left(\frac{\lambda_p}{\lambda_d}\right)$ is

3 Marks 294 x 3 = 882

638) (i) A circular coil of 30 turns and radius 8.0 cm carrying a current of 6.0 A is suspended vertically in a uniform horizontal magnetic field of magnitude 1.0 T. The field lines make an angle of 60° with the normal of the coil. Calculate the magnitude of the counter torque that must be applied to prevent the coil from turning.
(ii) Would your answer change, if the circular coil were replaced by a planar coil of some irregular shape that encloses the same area? All other particulars are also unaltered.

639) A short bar magnet placed with its axis at 30° with an external field of 800G experiences a torque of 0.016Nm
(a)What is the magnetic moment of the magnet?
(b)What is the work done in moving it from its most stable to most unstable position?
(c)The bar magnet is replaced by a solenoid of cross-sectional area 210m^2 and 1000 turns, but the same magnetic moment. Determine the current flowing through the solenoid.

640) The earth's magnetic field at the equator is approximately 0.4G.Estimate the earth's dipole moment.

641) Describe qualitatively the path of a charged particle moving in (a) a uniform electrostatic field with initial velocity (i) parallel to the field, (ii) perpendicular to the field,(iii) at an arbitrary angle with the field direction; (b) a uniform magnetic field with initial velocity, (i) parallel to the field, (ii) perpendicular to the field, (iii) at an arbitrary angle with the direction; (c) a region with uniform electrostatic and magnetic field to parallel to each other with initial velocity. (i) Parallel, (ii) perpendicular, (iii) at an arbitrary angle with the common direction of the fields; (d) a region with crossed (i.e. transverse) uniform electrostatic and magnetic field with initial velocity zero.

642) A galvanometer can be converted into a voltmeter to measure up to
(i) V volts by connecting a resistance R_1 in series with coil.
(ii) $\frac{V}{2}$ volts by connecting a resistance R_2 in series with its coil.
Find the resistance R_1 and R_2 required to convert it into a voltmeter that can read up to 2V volts

643) A chamber is maintained at a uniform magnetic field of 5×10^{-3} T. An electron with a speed of 5×10^{7} ms^{-1} enters the chamber in a direction normal to the field. Calculate (i) radius of the path (ii) frequency of revolution of the electron.
Charge of electron = 1.6×10^{-19} C,
Mass of electron = 9.1×10^{-31} kg.

644) A proton is to circulate the earth along the equator with a speed of 1.0×10^{7} ms^{-1} . Find the minimum magnetic field which should be created at the equator for this purpose. The mass of proton = 1.7×10^{-27} kg and radius of earth = 6.37×10^{6} m.

645) A long straight wire carries a current of 2A. An electron travels with a velocity of 4×10^{4} ms^{-1} parallel to the wire 0.1 m from it, and in a direction opposite to the current. What force does the magnetic field of current exert on the moving electron. Charge of electron = 1.6×10^{-19} C.

646) A beam of proton passes undeflected with a horizontal velocity v, through a region of electric and magnetic fields, mutually perpendicular to each other and perpendicular to the direction of the beam. If the magnitudes of the electric and magnetic fields are 100 kV/m, 50 mT respectively, calculate the velocity of the beam v.

647) An electron beam passes through a magnetic field of 2×10^{-3} weber/m^2 and an electric field of 1.0×10^{4} Vm^{-1} both acting simultaneously. The path of electrons remaining undeviated, calculate the speed of the electrons. If the electric field is removed what will be the radius of the electron path ?

648) In a cyclotron, a magnetic field of 2.4 T is used to accelerate protons. How rapidly should the electric field between the dees be reversed? The mass and the charge of protons are 1.67×10^{-27} kg and 1.6×10^{-19} C respectively.

649) What is the magnitude of force on a wire of length 0.04 m placed inside a solenoid near its centre, making an angle of 30° with its axis? The wire carries a current of 12 A and the magnetic field due to the solenoid is of magnitude 0.25 T.

650) A short conductor of length 5.0 cm is placed parallel to a long conductor of length 1.5 m near its centre. The conductors carry currents 4.0 A and 3.0 A respectively in the same direction. What is the total force experienced by the long conductor, when they are 3.0 cm apart?

651) calculate the torque on a 200 turns rectangular coil of length 20 cm and breadth 10 cm carrying a current of 10 A, when placed in a magnetic field. The plane of the coil is making an angle of 60° with a magnetic field of 4 T.

652) A coil in the shape of an equilibrium 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 5×10^{-2} T. Find the couple acting on the coil. When a current of 0.1 ampere is passed through it and the magnetic field is parallel to its plane.

653) Two identical magnets with a length 10 cm and weight 50 gf each are arranged freely with their like poles facing in a vertical glass tube. The upper magnet hangs in air above the lower one so that the distance between the nearest poles of the magnets is 3 mm. Determine the pole strength of the poles of these magnets.

654) A circular coil of 100 turns and having a radius of 0.05 m carriers a current of 0.1 A. Calculate the work required to turn the coil in an external magnetic field of 1.5 T through 180^o about an axis perpendicular to the magnetic field. The plane of the coil is initially at right angles to the magnetic field.

655) A bar magnet of length 10 cm is placed in the magnetic meridian with its north pole pointing towards the geographic north. A neutral point is obtained at a distance of 12 cm from the centre of the magnet. Find the magnetic moment of the magnet, when H = 0.34 gauss.

656) A bar magnet 30 cm long is placed in magnetic meridian with its north pole pointing south. The neutral point is observed at a distance of 30 cm from its centre. calculate the pole strength of the magnet. Given horizontal component of earth's field is 0.34 G.

657) A neutral point is found on the axis of a bar magnet at a distance of 10 cm from its one end. If the length of the magnet be 10 cm, and H= 0.3 G. Find the magnetic moment of the magnet.

658) An electron is revolving in a hydrogen atom in a circular orbit of radius 4A making 10^{15} rps. What is the magnetic moment associated with this electron ?

659) An electron in an atom revolves around the nucleus in an orbit of radius 0.53 A. Calculate the equivalent magnetic moment, if the frequency of revolution of electron is 6.8×10^9 MHz.

660) A magnet of magnetic moment 2.5 Am^2 weighs 66 g. if density of material of the magnet is 7500 kg/m^3, find the intensity of magnetisation.

661) Assume that each iron atom has a permanent magnetic moment = 1.85×10^{-23} Am^2 . The number density of atoms in iron is 8.52×10^{28} m^{-3} Find maximum magnetisation and maximum magnetic induction in the iron bar.

662) If maximum value of permeability of μmetal is 0.126 TmA^{-1} , what will be the maximum relative permeability and susceptibility of the metal ?

663) An iron rod of 0.2 cm^2 area of cross-section is subjected to a magnetising field of 1200 Am^{-1} . If susceptibility of iron is 599, calculate (i) permeability, (ii) magnetic flux produced.

664) The hysterisis loss of a sample of iron is 300 Jm^{-3} $cycle^{-1}$. If density of iron is 7500 kg/m^3 and mass of iron piece is 15 kg, calculate energy lost/ hour when the frequency of magnetisation/ demagnetisation used is 50 c/s.

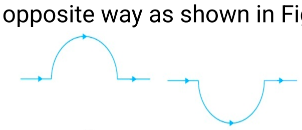
665) The hysterisis loss for a sample of 12 kg is 300 Jm^{-3} $cycle^{-1}$. If density of iron is 7500 kg m^{-3} , calculate energy loss per hour at 50 cycles.

666) An iron rod of volume $10^{-4}m^3$ and relative permeability 1000 is placed inside a long solenoid wound with 5 turns/cm. If a current of 0.5 A is passed through the solenoid, find the magnetic moment of the rod.

667) The horizontal component of the earth's magnetic field at a certain place is 3.0×10^{-5} T and the direction of the field is from geographic south to the geographic north. A very long straight conductor is carrying a steady current of 1 A. What is the force per unit length on it when it is placed on a horizontal table and the direction of current is (a) east to west (b) south to north ?

668) A square coil of side 10 cm consists of 20 turns and carries a current of 12 A. The coil is suspended vertically and the normal to the plane of the coil makes an angle of 30º with the direction of a uniform horizontal magnetic field of magnitude 0.80 T. What is the magnitude of torque experienced by the coil?

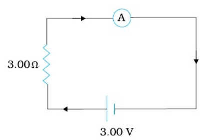
669) A straight wire carrying a current of 12 A is bent into a semi-circular arc of radius 2.0 cm as shown in Fig (a). Consider the magnetic field B at the centre of the arc.
(a) What is the magnetic field due to the straight segments?
(b) In what way the contribution to B from the semicircle differs from that of a circular loop and in what way does it resemble?
(c) Would your answer be different if the wire were bent into a semi-circular arc of the same radius but in the opposite way as shown in Fig.(b)?



(a) (b)

670) A 100 turn closely wound circular coil of radius 10 cm carries a current of 3.2 A.
(a) What is the field at the centre of the coil?
(b) What is the magnetic moment of this coil?
The coil is placed in a vertical plane and is free to rotate about a horizontal axis which coincides with its diameter. A uniform magnetic field of 2T in the horizontal direction exists such that initially the axis of the coil is in the direction of the field. The coil rotates through an angle of 90º under the influence of the magnetic field.
(c) What are the magnitudes of the torques on the coil in the initial and final position?
(d) What is the angular speed acquired by the coil when it has rotated by 90º?. The moment of inertia of the coil is 0.1 kg m^2.

671) In the circuit the current is to be measured. What is the value of the current if the ammeter shown
(a) is a galvanometer with a resistance R_G = 60.00 Ω;
(b) is a galvanometer described in (a) but converted to an ammeter by a shunt resistance r_s = 0.02 Ω;
(c) is an ideal ammeter with zero resistance?



672) A long straight wire carries a current of 35 A. What is the magnitude of the field B at a point 20 cm from the wire?

673) A long straight wire in the horizontal plane carries a current of 50 A in north to south direction. Give the magnitude and direction of B at a point 2.5 m east of the wire.

674) A horizontal overhead power line carries a current of 90 A in east to west direction. What is the magnitude and direction of the magnetic field due to the current 1.5 m below the line?

675) What is the magnitude of magnetic force per unit length on a wire carrying a current of 8 A making an angle of 30º with the direction of a uniform magnetic field of 0.15 T?

676) A 3.0 cm wire carrying a current of 10 A is placed inside a solenoid perpendicular to its axis. The magnetic field inside the solenoid is given to be 0.27 T. What is the magnetic force on the wire?

677) Two long and parallel straight wires A and B carrying currents of 8.0 A and 5.0 A in the same direction are separated by a distance of 4.0 cm. Estimate the force on a 10 cm section of wire A.

678) Find the force on a wire (of negligible mass) of length 4.0 cm placed inside a solenoid near its centre, making an angle of 60º with its axis. The wire carries a current of 12 A and magnetic field due to solenoid has a magnitude of 0.25 T. Find also the direction of the force experienced by the wire.

679) A voltmeter reads 5.0 V at full scale deflection and is graded according to its resistance per volt at full scale deflection as 2000 Ω/V. How will you convert it into a voltmeter that reads 15V at full scale deflection?

680) In a galvanometer there is a deflection of 10 divisions per mA. The internal resistance of the galvanometer is 78 Ω. If a shunt of 2 Ω is connected to the galvanometer and there are 75 divisions in all on the maximum current which the galvanometer can read.

681) A galvanometer of resistance 80 Ω, shunted by a resistance of 20 Ω is joined in series with a resistance of 200 Ω and a cell of e.m.f. 15 V. What is the sensitivity of the galvanometer if it shows a deflection of 30 division?

682) An electron travels in a circular path of radius 20 cm in a magnetic field of 2×10^{-3} T. Calculate the speed of the electron. What is the potential difference through which the electron must be accelerated to acquire this speed?

683) A circular coil of 20 turns and radius 10 cm is placed in a uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in the coil is 5.0 A, what is the
(a) total torque on the coil,
(b) total force on the coil,
(c) average force on each electron in the coil due to the magnetic field?
(The coil is made of copper wire of cross-sectional area 10^{-5} m^2, and the free electron density in copper is given to be about 10^{29} m^{-3})

684) A straight horizontal conducting rod of length 0.45m and mass 60g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod though the wires.
(a) What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero?
(b) What will be the total tension in the wires if the direction of current is reversed keeping the magnetic field same as before? (Ignore the mass of the wires.) g = 9.8 ms^{-2}.

685) How does the angle of dip vary as one moves from the Equator towards the North Pole? If the horizontal component of earth's magnetic field at a place where the angle of dip is 60^{o} is 0.4 x 10^{-4} testla, calculate the vertical component and the resultant magnetic field of earth at the point.

686) A short bar magnet of magnetic moment M=0.32JT^{-1} is placed in a uniform external magnetic field of 0.15T. If the bar is free to rotate in the plane of the field, Which orientations would correspond to its (i) stable and (ii) unstable equilibrium? What is the potential energy of the magnet in each case?

687) A short bar magnet of magnetic moment 5.25 x $10^{-2}JT^{-1}$ is placed with its axis perpendicular to the earth's field direction. At what distance from the centre of the magnet, the resultant field is inclined at 45^{o} with the earth's field on (a) its normal bisector and (b) its axis. Magnitude of the earth's field at the place is given to be 0.42G. Ignore the length of the magnet in comparison to the distances involved.

688) A long straight horizontal cable carries a current of 2.5A in the direction 10^{o} south of west to 10^{o} north of east. The magnetic meridian of the place happens to be 10^{o} west of the geographic meridian, The earth's magnetic field at the location is 0.33G, and the angle of dip is zero. Locate the line of neutral points(Ignore the thickness of the cable).

689) A compass needle free to turn in a horizontal plane is placed at the centre of circular coil of 30 turns and radius 12cm. The coil is in a vertical plane making an angle of 45^{o} with the magnetic meridian. When the current in the coil is 0.35A, the needle points west to east
(a) Determine the horizontal component of the earth's magnetic field at the location.
(b) The current in the coil is reserved and the coil is rotated about its vertical axis by an angle of 90^{o} in the anticlockwise sense looking from above. Predict the direction of the needle. Take the magnetic declination at the place to be zero.

690) A magnetic compass needle of magnetic moment 60Am^{2} is placed at a place. The needle points towards the geographical north. Using the data given below, find the value of declination at that place. Horizontal component of earth's magnetic field=40X10^{-6} Wb m^{-2} and torque experienced by the needle =1.2X10^{-3}Nm.

691) A coil of 200 turns has a cross-sectional area 900mm^{2} It carries a current of 2 ampere. The plane of the coil is perpendicular to a uniform magnetic field of 0.5T. Calculate (i) the magnetic moment of the coil and (ii) the torque acting on the coil.

692) A bar magnet of magnetic moment 1.5 JT^{-1} lies aligned with the direction of a uniform magnetic field of 0.22T.
(a) What is the amount of work required by an external torque to turn the magnet so as to align its magnetic moment,
(i) normal to the field direction
(ii) opposite to the field direction.
(b) What is the torque on the magnet in cases (i) and (ii)?

693) A closely wound solenoid of 2000 turns and area of cross-section 1.6 x $10^{-4}m^{2}$ carrying a current of 4.0A is suspended through its centre allowing it to turn in a horizontal plane.
(a) What is the magnetic moment associated with the solenoid?
(b) What is the force and torque on the solenoid if a uniform horizontal magnetic field of 7.5 x 10^{-2}T is set up at an angle of 30^{o} with the axis of the solenoid?

694) A closely wound solenoid of 800 turns and area of cross section of carries $2.5 \times 10^{-4} m^2$ a current of 3.0A. Explain the sense in which the solenoid acts like a bar magnet. What is its associated magnetic moment?

695) At a certain location in Africa, a compass point 12° west of the geographical north.The north tip of the magnitude needle of a dip circle placed in the plane of the magnetic meridian points 60° above the horizontal.The horizontal component of the earth's field is measured to be 0.16 G.Specify the direction and magnitude of the earth's field at the location.

696) A short bar magnet placed in a horizontal plane has its axis aligned along the magnetic north-south direction.Null points are found on the axis of the magnet at 14 cm from the centre of the magnet.The earth's magnetic field at the place is 0.36 G and the angle of dip is zero.What is the total magnetic field on the normal bisector of the magnet at the same distance as the null point(i.e. 14 cm from the centre of the magnet)?

697) A sample of paramagnetic salt contains 2.0×10^{24} atomic dipoles each of dipole moment $1.5 \times 10^{-34} JT^{-1}$. The sample is placed under a homogeneous magnetic field of 0.84 Tand cooled to a temperature of 4.2 K.The degree of magnetic saturation achieved is equal to 15.8.What is the total dipole moment of the sample for a magnetic field of 0.98 T and a temperature of 2.8 K?(Assume Curie's law).

698) A Rowland ring of mean radius 15 cm has 3500 turns of wire wound on a ferromagnetic core of relative permeability 800. What is the magnetic field (B) in the core for a magnetising current of 1,2 A?

699) The magnetic moment vector μ_s and μ_l associated with the orbital angular momentum l respectively of an electron are predicted by quantum theory (and verified experimentally to a high accuracy) to be given by
$\mu_s = -(\frac{e}{m})s$
$\mu_l = -(\frac{e}{2m})l$
Which of these relations is in accordance with the result expected 'classically'?Outline the derivation of the classical result.

700) The wires which connect the battery of an automobile to its starring motor carry a current of 300 A (for a short time). What is the force per unit length between the wires if they are 70 cm long 1.5 cm apart? Is the force attractive or repulsive?

701) A galvanometer coil has a resistance of 15 Ω and the metre shows full scale deflection for a current of 4 mA. How will you convert the metre into an ammeter of range 0 to 6 A?

702) A bar magnet of length 0.1 m has a pole strength of 50 Am.Calculate the magnetic field at distance of 0.2 m from its centre on (a) its axial line and (b) its equatorial line.

703) A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.16 T experience a torque of magnitude 0.032J.
(a) Estimate the magnitude moment of the magnet.
(b) If the bar were free to rotate, which orientations would correspond to it's (i)stable, and (ii) unstable equilibrium? What is its potential energy in the field for cases(i) and (ii)?

704) The core of a toroid having 3000 turns has inner and outer radii of 11cm and 12 cm respectively.The magnetic field in the core for a current of 0.70A is 2.5T.What is the relative permeability of the core?

705) A bar magnet 30 cm long is placed in the magnetic meridian with its north towards south of the earth. If the neutral point is obtained 30 cm from the magnet, find magnetic dipole moment and pole strength of the magnet.

706) Work done in turning a magnet of magnetic moment M by an angle 90° from the meridian is n times the corresponding work done to turn it through an angle of 60° Find the value of n.

707) A long horizontal rigidly supported wire carries i_d of 100 A. Directed above it and parallels to it is a fine wire that carries a current i_d of 20A and weighs 0.073N/m. How far above the lower wire should the second wire be kept if we wish to support it by magnetic repulsion?
Given permeability constant $\mu_0 = 4\pi \times 10^{-7}\ Wb\ A^{-1} m^{-1}$

708) A short bar magnet placed with its axis at 30° a uniform magnetic field of 0.2T experiences a torque of 0.06Nm.
(i) Calculate magnetic moment of the magnet and
(ii) Find out what orientation of the magnet corresponds to a stable equilibrium in the magnetic field.

709) An iron sample having mass 8.4 kg is repeatedly taken over cycles of magnetisation and demagnetization at a frequency of 50Hz.It is found that energy of 3.2 J is dissipated as heat in the sample in 30 minutes. If the density of iron is $7200 kg m^{-3}$ Calculate the value of energy dissipated per unit volume per cycle in the iron sample.

710) While watching Discovery channel Sheela was impressed that certain organisms have the ability to sense the field lines of earth's magnetic field. They use this ability to travel from one location to another, Sheela wanted to find the angle of dip at her place. She then mounted the compass on a cardboard and placed it vertically along the magnetic meridian. She was able to measure the angle of dip
(a) What values did Sheela have?
(b) Define the magnetic element of earth.

711) Babita and Sheela class XII students were assigned a project based on magnetism.In their project work, they calculated the value of earth's magnetic field.When they submitted their project work for verification. Mr.Raj, their physics teacher, corrected the mistake.Hew also suggested few books which could be of use to them. What values did Mr.Raj exhibit towards his students? Mention any two.

712) What is te magnitude of the equatorial and axial fields due to a bar magnet of length 5.0 cm at a distance of 50 cm from its mid-point? The magnetic moment of the bar magnet is $0.40 Am^2$

713) In the magnetic meridian of a certain place, the horizontal component of the earth's magnetic field is 0.26 G and the dip angle is 60°. What is magnetic field of the earth at this location?

714) A domain in ferromagnetic iron is in the form of a cube of side length $1\mu m$. Estimate the number of iron atoms in the domain and the maximum possible dipole moment and magnetisation of the domain.The molecular mass of iron is 55g/mole and its density is $7.9 g/cm^3$. Assume that each iron atom has a dipole moment of $9.27 \times 10^{-24} Am^2$

715) A solenoid has a core of a material with relative permeability 400. The windings of the solenoid are insulated from the core and carry a current of 2A. If the number of turns is 1000 per metre, calculate (a) H, (b) M, (c) B and (d) the magnetising current I_m

716) Calculate the magnetic field $\vec{B}$ at a distance 0.1 from a long straight wire carrying a current of 5A.

717) Copper has 8×10^{28} conduction electrons per cubic meter. A copper wire 1 m long area of cross-section $8\times 10^{-6} m^2$ carrying a current and lying at right angle to a magnetic field of strength $5 \times 10^{-3} T$ experiences a force of $8 \times 10^{-2} N$. Calculate the drift velocity of free electrons in the wire.

718) What is the force on wire of length 4.0cm placed inside a solenoid near its centre, making an angle of 60° with its axis? The wire carries a current of 12 A and the magnetic field due to the solenoid has magnitude of 0.25T.

719) Two straight wires A and B of lengths 10 m and 12 m carrying currents of 4.0 A and 6.0 A respectively in opposite directions lie parallel to each other at a distance of 3.0 cm. Estimate the force on a 15 cm section of the wire B near its centre.

720) Two straight wires A and B of the lengths 10 m and 12 m carrying currents of 4.0 A and 6.0 A respectively in opposite directions lie parallel to each other at a distance of 3.0 cm. Estimate the force on a 15 cm section of the wire B near its centre.

721) A solenoid 50 cm long has 4 layers of winding of 350 turns each. The radius of the lowest layer is 1.4 cm. If the current carried is 6.0 A, estimate the magnitude of B
(a) near the centre of the solenoid on its axis, and off its axis.
(b) near its ends on its axis.
(c) outside the solenoid near its centre.

722) A solenoid 50 cm long has 4 layers of winding of 350 turns each. The radius of the lowest layer is 1.4 cm. If the current carried is 6.0 A, estimate the magnitude of B
(a) near the centre of the solenoid on its axis, and off its axis.
(b) near its ends on its axis.
(c) outside the solenoid near its centre.

723) What torque acts on a 40 turns coil of $100 cm^2$ area carrying a current of 10 ampere held with its axis at right angles to a magnetic field of flux density 0.2 tesla?

724) A proton of velocity $10^6 ms^{-1}$ is moving perpendicular to a uniform magnetic field of magnetic induction 1tesla. What is the sideways force acting on the proton of charge ? $1.6 \times 10^{-19} C$

725) A uniform magnetic field of induction B = 5 T acts horizontally, from south to North. A 200 M eV proton moves vertically downwards through it. Find the direction and value of the force action on the proton. It mass = 1.6×10^{-27} kg and charge = $1.6 \times 10^{-19} C$

726) How can a voltmeter resistance 200 ohm and measuring 10 V be used to measure a current of 5A?

727) The frequency of a cyclotron oscillator is 10^7 Hz. What should be the operating magnetic field for accelerating protons? If the radius of the dee's of the cyclotron is $6 \times 10^{-1} m$ calculate the energy of the proton beam produced by it in MeV. Give $1.6 \times$

728) An electron moving at $10^6 ms^{-1}$ in a direction parallel to a current of 5A flowing through infinitely long wire separated by perpendicular distance of 10 cm in air. Calculate the force experienced by the electron.

729) A flat silver strip of width 1.5 cm and thickness 1.5 mm carries a current of 150 A. A magnetic field of 2.0 T is applied circular to the flat face of the strip is measured to be 1.79 μV (Hall effect). Estimate the number density of free electrons in the metal.

730) A magnetic field of 100 G $\left(1 G = 10^{-4} T\right)$ is required which is uniform in a region of linear dimension about 10 cm and area of cross-section about $10^{-3} m^2$. The maximum current carrying capacity of a given coil of wire is 15 A and the number of turns per unit length that can be wound round a core is at most 1000 turns m^{-1}. suggest some appropriate design particulars of a solenoid for the required purpose. assume the core is not ferromagnetic.

731) To increase the current sensitivity of a moving coil galvanometer by 50%, its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

732) A galvanometer having 30 divisions has a current sensitivity of $20 \mu A$ per division. It has a resistance of 25Ω. How will you convert it into an ammeter measuring upto I A? How will you convert in this ammeter into a voltmeter reading upto 1 V?

733) A Ramesh while doing his physics practical in a class, found that if a voltmeter, an ammeter and a resistance are connected in series to a lead accumulator, there is deflection in the voltmeter but the deflection in ammeter is negligible. He discussed his problem with all his class fellows but no one could explain the reason. Harshpreet was also studying in his class. When he discussed the problem with her, she explained the reason and then whole class was informed by both of them.
(a) What was the reason for deflection in voltmeter and negligible deflection in the ammeter?
(b) What value were displayed by Ramesh and Harshpreet?

734) A solenoid length 0.5m has a radius of 1 cm and is made up of 500 turns. It carries of 5A. What is the magnitude of the magnetic field inside the solenoid?

735) A wire placed along north-south direction carries a current of 5 A from south to north. Find the magnetic field due to a 1 cm piece of wire at a point 200 cm north east from the piece.

736) What current must flow in an infinitely long straight wire to produce a magnetic field of 4×10^{-5} T at 8 cm away from the wire?

737) A long straight wire carrying a current of 25 A is placed in an external uniform magnetic field 3.0×10^{-4} T parallel to the current. Find the magnitude of the resultant magnetic field at a point 1.5 cm away from the wire.

738) A straight wire of length $\frac{\pi}{2}$ metre, is bent into a circular shape. If the wire were to carry a current of 5 A, calculate the magnetic field, due to it, before bending, at a point distance 0.01 times the radius of the circle formed from it. Also calculate the magnetic field, at the centre of the circular loop formed, for the same value of current.

739) The electron of hydrogen atom moves along a circular path of radius 0.5×10^{-10} m
(i) with a speed of 4.0×10^{6} ms^{-1}.
(ii) with a frequency 6.8×10^{15} Hz.
Calculate the magnetic field produced at the centre of the cuircular path. ($e = 1.6 \times 10^{-19}$C)

740) Calculate the magnetic field due to a circular coil of 250 turns and diameter 0.1 m, carrying a current of 7 A
(i) at the centre of the coil
(ii) at a point on the axis of the coil at a distance 0.12 m from the centre of the coil.

741) The magnetic field due to a current-carrying circular loop of radius 10 cm at its centre is 0.60×10^{-4} T. Find the magnetic field due to this loop at a point on the axis on the axis at a distance of 4 cm from the centre.

742) An alpha particle moves along a circular path of radius 2A° with a uniform speed of $2x10^6$ ms^{-1} . Calculate the magnetic field set up at the centre of circular path.

743) A long straight solid conductor of radius 6 cm carries a current of 8 A, which uniformly distributed over its circular cross-section. Find the magnetic field
(a) at a distance of 3 cm from the axis of the conductor
(b) at a distance 10 cm from the axis of the conductor.

744) A 0.5 m long solenoid has 500 turns and has strength of magnetic field of 2.52 x 10^{-3} T at its centre. Find the current in the solenoid.

745) A solenoid of length 0.20 m, having 120 turns carries a current of 2.5 A. Find the magnetic field: (a) in the interior of the solenoid, (b) at one end of the solenoid. Given $\mu_o = 4\pi \times 10^{-7}$ S.I. units.

746) A solenoid of length 1.0 m and 3.0 cm diameter has 5 layers of windings of 850 turns each and carries a current of 5 ampere. What is the magnetic field at the centre of the solenoid? Also calculate the magnetic flux for a cross-section of the solenoid at the centre of the solenoid.

747) A copper wire having a resistance of 0.02 Ω per metre is used to wind a 500 turns solenoid of radius 2.0 cm and length 30 cm. What should be the emf of the solenoid would produce a magnetic field of 10^{-2} T, near the centre of the solenoid.

748) A coil wrapped around a toroid has inner radius of 10.0 cm and an outer radius of 20.0 cm. If the wire wrapped makes 600 turns and carries a current of 10.0 A, what are the maximum and minimum values of magnetic field within the toroid?

749) Two straight long conductors AOB and COD are perpendicular to each other and carry currents I_1 and I_2 . Find the magnitude of magnetic field induction at a point P at a distance a from the point O in a direction perpendicular to the plane ABCD.

750) An α particle of mass $6.55x10^{-27}$ kg travels at right angle to a magnetic field of 0.2 T with a speed of $6x10^5$ ms^{-1}. Calculate the acceleration of α particle. Given charge on electron is $1.6x10^{-19}$ C.

751) An electron is moving northwards with a velocity 3.0 x 10^7 ms^{-1} in a uniform magnetic field of 10 T directed eastwards. Find the magnetic and direction of the magnetic force on the electron. (e = 1.6 x 10^{-19} C)

752) A proton projected in a magnetic field of 0.02 T travels along a helical path of radius 6 cm and pitch 24 cm. Find the components of velocity of the proton along and perpendicular to the magnetic field. Take the mass of the proton = 1.6 x 10^{-27} kg.

753) A beam of protons enters a uniform magnetic field of 0.3 T with a velocity of 4 x 10^5 ms^{-1} at an angle of 60° tot he field. Find the radius of the helical path taken by the beam. Also find the pitch of the helix (distance travelled by a proton parallel to the magnetic field during one period of rotation). Mass of proton = 1.67 x 10^{-27} kg.

754) A conductor of length 20 cm is placed (i) parallel (ii) perpendicular (iii) inclined at an angle 30°, to a uniform magnetic field of 2 T. If the charge of 10 C passes through it in 5 s, find the force experienced by the conductor.

755) A horizontal wire 0.1 m long having mass 3 g carries a current of 5A. Find the magnitude of the magnetic field which must act at 30° to the length of the wire inorder to support its weight.

756) A circular coil of 200 turns and radius 10 cm is placed in a uniform magnetic field of 0.5 T, normal to the plane of the coil. If the current in the coil is 3.0 A, calculate the (a) total torque on the coil (b) total force on the coil (c) average force on each electron in the coil, due to the magnetic field. Assume that the area of cross-section of the wire to be 10^{-5} m^2 and the free electron density is 10^{29} m^{-3}

757) A circular coil of 200 turns, radius 5 cm carries a current of 2.5 a. It is suspended vertically in a uniform horizontal magnetic field of 0.25 T, with the plane of the coil making an angle of 60° with the field lines. Calculate the magnitude of the torque that must be applied on it to prevent it from turning.

758) The coil of a galvanometer is 0.02 x 0.8 m^2. It consists of 200 turns of the wire and is in a magnetic field of 0.20 T. The restoring torque constant of suspension fibre is 10^{-5} Nm/degree. Assuming magnetic field to be radial (a) what is the maximum current that can be measured by this galvanometer if scale can be measured by this galvanometer if scale can accommodate 45° deflection? (b) What is the smallest current that can be detected if minimum observed deflection is 0.1 degree?

759) The coil of moving coil galvanometer has an effective area 6 x 10^{-2} m^2. it is suspended in a magnetic field of 3 x 10^{-2} Wb m^{-2} . if the torsional constant of the suspension fibre is 5 x 10^{-9} Nm deg^{-1} , find its current sensitivity in degree per micro-ampere.

760) If the current sensitivity of a moving coil galvanometer is increased by 20%, its resistance also increases by 1.5 times. How will the voltage sensitivity of the galvanometer be affected?

761) To increase the current sensitivity of a moving coil galvanometer by 50% its resistance is increased so that the new resistance becomes twice its initial resistance. by what factor does its voltage sensitivity change ?

762) A moving coil meter has the following particulars : Number of turns, n = 24 ; Area of coil, A = 2.0 x $10^{-3}$$m^2$, magnetic field strength, (a) Indicate a simple way to increase the current sensitivity of the meter by 25%. (It is not easy to change A or B). (b) If in so doing, the resistance of the coil increases by 7 Ω, is the voltage sensitivity of the modified meter greater or lesser than the original meter ?

763) A galvanometer with a coil of resistance 12.0 Ω shows full scale deflection for a current 2.5 mA. How will you convert the meter into
(i) an ammeter of range 0 to 7.5 A
(b) a voltmeter of range 0 to 10 V.

764) A resistance of 900 Ω is connected in series with a galvanometer of resistance 100 Ω A potential difference of 1 volt produces 100 division deflection in the galvanomter. Find the figure of merit of galvanometer.

765) An ammeter gives full scale deflection with a current of 1 ampere. It is converted into an ammeter of range 10 ampere. Find the ratio of the resistance of ammeter of the shunt resistance used.

766) A galvanometer of resistance 50 Ω gives full deflection for a current of 0.05 A. Calculate the length of shunt wire required to convert the galvanometer into an ammeter of range 0 to 5 A. The diameter of the shunt wire is 2 mm and its resistivity is 5 x 10^{-7} Ωm.

767) A galvanometer can be converted into a voltmeter of certain range by connecting a resistance of 880 Ω in series with it. When the resistance of 420 Ω is connected in series, the range becomes half. Find the resistance of galvanometer.

768) In a galvanometer there is a deflection of 10 divisions per mA. The internal resistance of the galvanometer is 60 Ω If a shunt of 2.5 Ω is connected to the galvanometer and there are 50 divisions in all on the scale of galvanometer what maximum current can this galvanometer read ?

769) A bar magnet of magnetic moment 5.0 Am^2 has poles 20 cm apart. Calculate the pole strength.

770) A steel wire of length l has a magnetic moment M. it is bent into a semicircular arc. What is the new magnetic moment ?

771) The force between two magnetic poles in air is 9.604 mN. If one pole is 10 times stronger than the other, calculate the pole strength of each. Given distance between two poles = 10 cm.

772) A bar magnet of length 10 cm has a pole strength of 10 Am. Calculate the magnetic field at a distance of 0.2 m from its centre at a point on its (i) axial line (ii) equatorial line.

773) The earth's field, it is claimed, roughly approximates the field due to a dipole of magnetic moment 8 x10^{22} JT^{-1} located at its centre. Check the order of magnitude of this number in some way.

774) The magnetic moment of assumed dipole at the earth's centre is 8.0 x 10^{22} Am^2. Calculate the magnetic field B at the geomagnetic poles of the earth. Radius of the earth is 6400 km.

775) The magnetic field at a point on the magnetic equator is found to be 3.1 x 10^{-5} T. Taking the earth's radius to be 6400 km, calculate the magnetic moment of the assumed dipole at the earth's centre.

776) calculate the magnetic field due to a bar magnet 2 cm long and having a pole strength of 100 Am at a point 10 cm from each pole.

777) A current of 5 A is flowing through a 10 turn circular coil of radius 7 cm. The coil lies in XY plane. What is the magnitude and direction with it ?

778) A circular coil of 300 turns and diameter 14 cm carries a current of 15 A. What is the magnetic moment of the loop ?

779) A magnetised needle of magnetic moment 4.8 x 10^{-2} JT^{-1} is placed at 30^o with the direction of uniform magnetic field of magnitude 3 x 10^{-2} T. What is the torque acting on the needle?

780) A bar magnet placed in a uniform magnetic field of strength 0.3 T with its axis at 30^o tot he field experiences a torque of 0.06 N-m. What is the magnetic moment of the bar magnet ?

781) Calculate the work done in rotating a magnet of magnetic moment 3.0 JT^{-1} through an angle of 60^o from its position along a magnetic field of strength 0.34x10^{-4} T.

782) A bar magnet is suspended in a region where it is acted upon by two magnetic fields inclined at an angle of 60^o to each other. One of the fields has a magnitude of 1.2x10^{-2} T. The magnet attains stable equilibrium at an angle of 15^o with this field. Calculate the magnitude of other fields. ignore earth's field.

783) Two magnets of magnetic moments M and $M\sqrt{3}$ are joined to form a cross (+). The combination is suspended freely in a uniform magnetic field. In equilibrium position, the magnet of magnetic moment M makes an angle θ with the field. Determine θ

784) A short bar magnet placed with its axis at 30^o with a uniform external magnetic field of 0.16 T experiences a torque of magnitude 0.032 J. Estimate the magnetic moment of the magnet. If the bar were free to rotate, which orientations would correspond to its (i), stable and (ii), unstable equilibrium? What is the potential energy of the magnet in the two cases?

785) If the horizontal component of earth's magnetic field at a place is 0.4 x 10^{-4} T where dip is 60^o, what are the values of vertical component and resultant magnetic field?

786) A dip circle shows an apparent dip of 60^o at a place where true dip is 45^o. if dip circle is rotated through 90^o , what apparent value of dip will it show ?

787) The true dip at a place is 30^o . In what plane is the dip apparently 60^o ?

788) The true value of dip at a place is 45^o. If the vertical plane carrying the needle is turned through 60^o from the magnetic meridian, find the inclination of the needle (i.e. what will be the apparent value of dip)?

789) If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then show that the true angle of dip, θ is given by $cot^2\theta = cot^2\theta_1 + cot^2\theta_2$.

790) A magnetic needle is free to rotate in a vertical plane which makes an angle of 60^o with the magnetic meridian. If the needle stays in a direction making an angle of $tan^{-1}(2/\sqrt{3})$ with the horizontal, what would be the true dip at that place ?

791) A very short bar magnet has magnetic moment 1.4175 JT^{-1} . it is placed (i) with its north pole pointing towards geographic north (ii) with its north pole pointing towards geographic south. If horizontal component of earth's field at the place is 0.42 gauss, calculate the distance of the neutral points from the magnet.

792) A short bar magnet of magnetic moment 0.5 JT^{-1} is placed with its magnetic axis in the magnetic meridian, with its north pole pointing geographic north. A neutral point is obtained at a distance of 0.1 m from the centre of the magnet. Find the horizontal component of earth's magnetic field.

793) The magnetic needle of a tangent galvanometer is deflected at an angle of 30^o due to a magnet. The horizontal component of earth's magnetic field 0.34x10^{-4} T is along the plane of the coil. What is magnetic intensity ?

794) Two tangent galvanometers differ only in the matter of number of turns in the coil. On passing current through the two joined in series, the first shows a deflection of 35^o and the other shows 45^o deflection. Compute the ratio of their number of turns. Take tan 35^o = 0.7.

795) Two tangent galvanometers have coils of the same radii, differing only in their number of turns. They are connected in series. When a steady current is passed in the circuit, the mean deflections in the galvanometers are θ_1 and θ_2. Deduce an expression for the ratio of number of turns of the galvanometers.

796) A 2 turn coil of radius 10 cm is placed with its plane in magnetic meridian. A small magnetic needle is suspended at the centre of the coil by a torsion free silk thread. On passing a current through the coil, the needle is deflected through 45^o. Calculate the strength of the current if horizontal component of earth's field is 1.6 x 10^{-5} T.

797) A compass needle whose magnetic moment is 60 A m^2 pointing geographic north at a certain place, where the horizontal component of earth's magnetic field is $40 \mu Wb m^{-2}$ experiences a torque 1.2x10^{-3} Nm. What is the declination of the place ?

798) A long straight horizontal cable carries a current of 3.3 A in the direction 10^o south of west to 10^o north of east. The magnetic meridian of the place happens to be 10^o west of the geographic meridian. The earth's magnetic field and location is 0.33 G and the angle of dip is zero degree. Locate the positions of neutral points?

799) A closely wound solenoid of 2000 turns and area of cross section $1.610^{-4} m^2$, carrying a current of 4.0 A is suspended through its centre allowing it to turn in a horizontal plane. What is the magnetic moment associated with the solenoid ? What are the force and torque on the solenoid if a uniform horizontal field of 7.5×10^{-2} T is set up at an angle of 30^o with the axis of the solenoid ?

800) A bar magnet made of steel has a magnetic moment of 2.5 Am^2 and a mass of 6.6 g. If the density of steel is 7.9×10^3 , find the intensity of magnetisation of magnet.

801) A current of 3 A flows through a plane circular coil of radius 4 cm having 20 turns. Calculate dipole moment of the coil.

802) A magnetising field of 1500 A/m produces a flux of 2.4×10^{-5} weber in a bar of iron of cross-sectional area 0.5 cm^2 . Calculate the permeability and susceptibility of the iron bar used.

803) A Rowland ring of mean radius 18 cm has 3500 turns of wire wound on a ferromagnetic core of relative permeability 800. What is the magnetic field in the core for a magnetising current of 1.2 amp.?

804) Calculate the magnetic field intensity at a distance of 20 cm. from a pole of strength 40 Am in air. Find the magnetic induction at the same point.

805) The magnetic field B and the magnetic intensity H in a material are found to be 1.6 T and 1000 A/m respectively. Calculate the relative permeability μ_r and the susceptibility χ_m of material.

806) The maximum value of permeability of μ-metal (77% Ni, 16% Fe, 5% Cu, 2% Cr) is 0.126 T-m/A. Find the maximum relative permeability and susceptbility ?

807) Calculate permeability and susceptibility of a magnetic bar of cross-section 0.1 cm^2 having magnetic flux of 2.41×10^{-5} Wb due to magnetic intensity of 3200 Am^{-1}

808) The magnetic susceptibility of a paramagnetic substance at -73^oC is 0.006. What will be its value at -173^o C ?

809) An iron sample having mass 8.4 kg is repeated taken over cycles of magnetisation and demagnetisation at a frequency of 50 c/s. it is found that 3.2×10^4 J of energy is dissipated as heat in the sample in 30 min. If density of iron is 7200 km/m^3 , what is the hysterisis loss ?

810) A straight wire carries a current of 3 A. Calculate the magnitude of the magnetic field at a point 15cm away from the wire.

811) Find an expression for the magnetic field at the centre of a coil bent in the form of square of side 2a carrying current/as shown in the figure.

812) An electron enters electric field of 10^4 V/m perpendicular to the field with a velocity of 10^6 m/s . Find the vertical displacement of electron after 3 milliseconds. Mass of electron = 9.1×10^{-31} kg ; charge on electron = 1.6×10^{-19} C

813) A current 10 A is flowing East to West in a long wire kept horizontally in the East-West direction. Find the magnitude and direction of magnetic field in a horizontal plane at a distance of 10 cm North.

814) A cyclotron oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating α particle? If the radius of the dees is 50 cm, what is the kinetic energy in MeV of the α particle beam produced by the accelerator?

815) Two identical magnets with a length 100cm are arranged freely with their like like poles facing in a vertical glass tube.The upper magnet hangs in air above the lower one so that the distance between the nearest poles of the magnet is 3mm. If the pole strength of the pole of these magnets is 6.64 A-m, then determine the force between the two magnets.

816) An electric current is flowing in circular coil of radius a. At what distance from the centre on the axis of the coil will the magnetic field be $\frac{1}{8}$ th of its value at the centre?

817) Two poles one of which is 5 times as strong as the other, exert other a force equal to 0.8 x 10^{-3} kg-wt, when placed 10cm apart in air.Find the strength of each pole.

818) What is the magnitude of the axial fields due to a bar magnet of length 5 cm at a distance of 50cm from its mid-point. The magnetic moment of the bar magnet is 0.40 A-m^2 .

819) A bar magnet has poles of strength 48 A-m, which are 25cm apart.
(i) What is the magnetic moment of the magnet?
(ii) What torque is required to hold this magnet at an angle 30^0 with a uniform field of flux density 0.15 T?
(iii) What is the potential energy of the magnet?

820) A circular coil of 100 turns and have an effective radius of 5 cm carries of 0.1A. How much work is required to turn it in an external magnetic field of 1.5 Wb/m^2 through 180^0 about an axis perpendicular to the magnetic field? The plane of the coil is initially perpendicular to the magnetic field.

821) Determine the magnitude of the equatorial fields due to a bar magnet of length 6 cm at a distance of 60 cm from its mid-point. The magnetic moment of the bar magnet is 0.60A-m^2

822) A circular coil of 20 turns and radius 10 cm carries a current of 5 A. It is placed in a uniform magnetic field of 0.10T. Find the torque acting on the coil, when the magnetic field is applied in the plane of the coil.

823) A long straight wire carrying current of 25 A rests on a table shown in the figure. Another wire PQ of length 1m, mass 2.5 g carries the same current but in the opposite direction. The wire PQ is free to slide up and down. To what height will PQ rise?

824) Calculate the torque of 100 turns rectangular coil of length 40 cm and breadth 20 cm, carrying a current 10 A , when placed making an angle of 60^0 with a magnetic field of 5 T.

825) A Straight solenoid of length 50 cm has 1000 turns per metre and a mean cross-sectional area of 2 x 10-4 m^2. It is placed with its axis at 300, with a uniform magnetic field of 0.32 T. Find the torque acting on the solenoid when a current of 2 A is passed through it.

826) A bar magnet when suspended horizontally and perpendicular to the earth's magnetic field experience a torque of 3 x 10^{-4} N-m. What is the magnetic moment of the magnetic moment of the magnetic field at that place is 0.4 x 10^{-4} T.

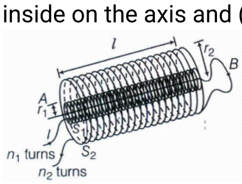
827) State the principle of working of a galvanometer.
A galvanometer of resistance G is converted into a voltmeter to measure up to V volts by connecting a resistance R_1 in series with the coil .If a resistance R_2 is connected in series with it, then it can measure up to V/2 volts. Find the resistance, in terms of R_1 and R_2 required to be connected to convert it into a voltmeter that can read up to 2V. Also, find the resistance G of the galvanometer in terms of R_1 and R_2.

828) Explain how Biot-Savart's law enables one to express the Ampere's circuital law in the integral form, viz
$\oint B.dl = \mu_0 I$ Where, I is the total current passing through the surface.

829) A uniform magnetic field with magnitude 1.4mT, is directed vertically upward throughout the volume of a laboratory chamber. A proton enters the chamber with kinetic energy 5.3 Mev, moving horizontally from south to North. What magnetic force acts on the proton as it enters the chamber?
[Given, $m_p = 1.67 \times 10^{-27} kg$
Since, the proton is charged and moving through a magnetic field, a magnetic force F_m can act on it. Also, since the initial direction of velocity of proton is not along a magnetic field line, F_m is not simply zero.

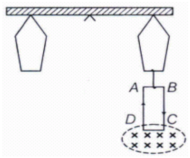
830) In order to increase the current sensitivity of a moving coil galvanometer by 50%, its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

831) Two long coaxial insulated solenoids, S_1 and S_2 of equal lengths are wound one over the other as shown in the figure. A steady current I flows through the inner solenoid S_1 to the other end B, which is connected to the outer solenoid S_2 through which the same current I flows in the opposite direction, so as to come out at end A. If $n_1$and n_2 are the number of turns per unit length, find the magnitude and direction of the net magnetic field at s point (a) inside on the axis and (b) outside the combined system.



832) An observation to the left of a solenoid of N turns each of cross-section area A observes that a steady current I in it flows in the clockwise direction. Depict the magnetic field lines due to the solenoid specifying its polarity and show that it acts as a bar magnet of magnetic moment m = NIA.

833) A 100 turns rectangular coil ABCD (in XY-plane) is hung from one arm of a balance figure. A mass 500 g is added to the other arm to balance the weight of the coil. A current 4.9 A passes through the coil and a constant magnetic field of 0.2 T acting inward (in XZ plane) is switched ON such that only arm CD of length 1 cm lies in the field. How much additional mass m must be added to regain the balance?



The magnetic force applied on CD by magnetic field must balance the weight.

834) A compass needle-free to turn in a horizontal plane is placed at the center of the circular coil of 30 turns and radius 12cm. The coil is in a vertical plane making an angle of 45^0 with magnetic meridian. When the current in the coil is 0.35 A, the needle points West to East.

i) Determine the horizontal component of the earth's magnetic field at the location.

ii) The current in the coil is reversed and the coil is rotated about its vertical axis by an angle of 90^0 in the anti-clockwise sense looking from above. Predict the direction at the places to be zero.

835) An electron with a kinetic energy of 22 eVmoves into a region of a uniform magnetic field of magnitude $4.6 \times 10^{-14} T$. The angle between the directions of magnetic field and electron's velocity is 65.5^0. Calculate the pitch of the helical path taken by the the electron.

836) A magnetic dipole is under the influence of two magnetic fields. The angle between the field directions is 60° and one of the fields has a magnitude of $1.2 \times 10^{-2} T$. If the dipole comes to stable equilibrium at an angle of 15° with this field, what is the magnitude of the other field?

837) A uniform conducting wire of length 12 a and resistance R is wound up as a current carrying coil in the shape of

(i) an equilateral triangle of side a,

(ii) a square of sides a and

(iii) a regular hexagon of side a. The coil is connected to a voltage source V_0. Find the magnetic moment of the coils in each case.

The different shapes form figures of different area and hence, their magnetic moments vary.

838) Verify the Gauss' law for magnetic field of a point dipole moment M at the origin for the surface which is a sphere of radius R.

839) A uniform magnetic field B is set up along the positive X-axis. A particle of charge q and mass m moving with a velocity v enters the field at the origin in XY-plane such that it has velocity components both along and perpendicular to the magnetic field B. Trace, giving reason, the trajectory followed by the particle. Find out the expression for the distance moved by the particle along the magnetic field in one rotation.

840) The vertical component of the earth's magnetic field at a place is $0.24\sqrt{3} \times 10^{-4} T$. Find out the value of horizontal component of the earth's magnetic field, if angle of dip at that place is 30°

841) A solenoid of 600 turns per meter is carrying a current of 4A. Its core is made of iron with relative permeability of 5000. Calculate the magnitudes of magnetic intensity, intensity of magnetisation and magnetifield inside the core.

842) Answer the following questions:
i) Why does a paramagnetic sample display greater magnetization (for the same magnetizing field) when cooled?
ii) If a toroid uses bismuth for its core, then will the field in the core be (slightly) greater or (slightly) less than when the core is empty?
iii) Is the permeability of a ferromagnetic material independent of the magnetic field? if not, is it more for lower or higher fields?
iv) Magnetic field lines are always nearly normal to the surface of a ferromagnet at every point. (This fact is analogous to the static electric field lines being normal to the surface of a conductor at every point) why?
v) Would the maximum possible magnetization of a magnitude as the magnetization of a ferromagnet?

843) Answer the following questions:
i) Explain qualitatively on the basis of domain picture the irreversibility in the magnetisation curve of a ferromagnet
ii) The hysteresis loop of a soft iron piece has a much smaller area than that of a carbon steel piece. If the material is to go through repeated cycles of magnetisation, which piece will dissipate greater heat energy?
iii) A system displaying a hysteresis loop such as a ferromagnet, is a device device for storing memory. Explain the meaning of this statement.
iv) What kind of ferromagnetic material is used for coating magnetic tapes in a cassette player or for building 'memory stores' in a modern computer?
v) A certain region of space is to be shislded from magnetic fields, Suggest a method.

844) A long straight horizontal cable carries a current of 2.5 in the direction 10^0 North of east. The magnetic meridian of the place happens to be 10^0 west of the geographic meridian. The earth's magnetic fieldat the location is 0.33 gauss and the angle of dip is zero. locate the line of neutral points(ignore the thickness of the cable). (At neutral points, magnetic field due to acurrent-carrying cable is equal and opposite to the horizontal component of Earth's magnetic field)

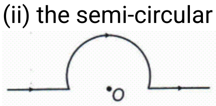
845) The magnetic moment vectors μ_s and μ_l associated with the intrinsic spin angular momentum s and orbital angular momentum l respectively, of an electron are predicted by quantum theory (and verified experimentally to a high accuracy) to be given by $\mu_s = -(e/m)s$, $\mu_l = -(e/2m)l$ Wich of these relation is in accordance with the resukt expected classically? Outline the derivation of the classical result.

846) A telephone cable at aplace has four long staight horizontal wires carrying current of 1.0 A in the same direction east to west. The earth's magnetic field at the place is 0.39 gauss and the angle of dip is 35^0. The magnetic declination is nearly zero.What are the resultant magnetic fields at points 4.0 cm above and below the cable?

847) A Hindu ruler once suggested that he should be buried in a magnetic coffin with the polarity arranged, such that he could forever be suspended between heaven and the earth. Discuss whether such magnetic levitation possible.

848) A sample of paramagnetic salt contains atomic dipoles 2×10^{24}, each of dipole moment 1.5×10^{-23} J/T. The sample is placed under a homogenous magnetic field of 0.84 T and cooled to a temperature of 4.2 k. The degree of magnetic saturation achieved is equal to 15%. What will be the total dipole moment of the sample for a magnetic field of 0.98 T and at a temperature of 2.8k?

849) A bar magnet of magnetic moment m and moment of inertia I (about a center, perpendicular to the length) is cut into two equal pieces, perpendicular to the length. Let T be the period of oscillations of the original magnet about an axis through the midpoint, perpendicular to the length, in a magnetic field B, what would be the similar period T' for each piece?

850) A straight wire carrying a current of 10 A is bent into a semi-circular are of radius 2.0 cm as shown in the figure. What is the magnetic field at O due to
(i) straight segments and
(ii) the semi-circular arc?


851) Derive an expression for the magnetic moment ($\vec{\mu}$) of an electron revolving around the nucleus in terms of its angular momentum ($\vec{l}$). What is the direction of the magnetic moment of the electron with respect to its angular momentum?

852) Relative permeability of a material, μ_r = 0.5. Identify the nature of the magnetic material and write its relation to magnetic susceptibility.

853) What are permanent magnets? Give one example.

854) Consider the motion of a charged particle of mass 'm' and charge 'q' moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$
(a) If $\vec{v}$ is perpendicular $\vec{B}$ to, show that its describes a circular path having angular frequency ω = qB/m.
(b) If the velocity $\vec{v}$ has a component parallel to the magnetic field $\vec{B}$ trace the path described by the particle. Justify your answer.

855) Use the expression $\vec{F} = q(\vec{v} \times \vec{B})$ to define the S.I. unit of magnetic field.

856) (a) How is a toroid different from a solenoid?
(b) Use Ampere's circuital law to obtain the magnetic field inside a toroid.
(c) Show that in an ideal toroid, the magnetic field
(i) inside the toroid and
(ii) outside the toroid at any point in the open space is zero.

857) (a) A capacitor is connected in series to an ammeter across a d.c, source. Why does the ammeter show a momentary deflection during the charging of the capacitor? What would be the deflection when it is fully charged?
(b) How is the generalized form of Ampere's circuital law obtained to include the term due to displacement current?

858) Draw a schematic sketch of a cyclotron. Explain, giving the essential details of its construction, how it is used to accelerate the charged particles.

859) The magnitude F of the force between two straight parallel current carrying conductors kept at a distance d apart in air is given by $F = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{d}$ Where I_1 and I_2 are the currents flowing through the two wires Use this expression, and the sign convention that the: "Force of attraction is assigned a negative sign and force of repulsion assigned a positive sign". Draw graphs showing dependence of F on :
(i) I_1I_2 when d kept constant
(ii) when the product I_1I_2 is maintained at a constant positive value.
(iii) when the product I_1I_2 is maintained at a constant negative value.

860) (a) Two long straight parallel conductors 'a' and 'b', carrying steady currents Ia and Ib are separated by a distance d. Write the magnitude and direction of the magnetic field produced by the conductor 'a' at the points along the conductor 'b'. If the currents are flowing in the same direction, what is the nature and magnitude of the force between the two conductors?
(b) Show with the help of a diagram how the force between the two conductors would change the currents in them, flow in the opposite directions.

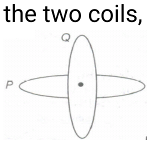
861) (i) State Biot - Savart's law and express this law in the vector form.
(ii) Two identical circular coils, P and Q each of radius R, carrying currents 1A and A respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.

862) A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the earth's magnetic field. The earth's magnetic field at the place is 0.4 G and the angle of dip is 60°. Calculate the emf induced between the axle and the rim of wheel. How will the value of emf be affected, if the number of spokes were increased?

863) Three identical specimens of a magnetic materials nickel, antimony and aluminium are kept in a non-uniform magnetic field. Draw the modification in the field lines in each case. Justify your answer.

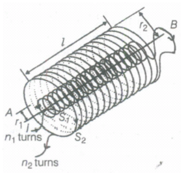
864) (i) What happens when a diamagnetic substance is placed in a varying magnetic field?
(ii) Name the properties of a magnetic material that makes it suitable for making (a) a permanent magnet and (b) a core of an electromagnet.

865) Two identical loops P and Q each of radius 5 cm are lying in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils, if they carry currents equal to 3A and 4A, respectively.



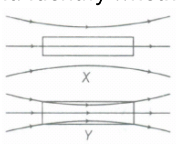
866) Use Biot-Savart's law to derive the expression for the magnetic field on the axis of a current carrying circular loop of radius R. Draw the magnetic field lines due to a circular wire carrying current (I).

867) (i) State Ampere's circuital law expressing it in the integral form.
(ii) Two long co-axial insulated solenoids S_1 and S_2 of equal length are wound one over the other as shown in the figure. A steady current I flows through the inner solenoid S_1 to the other end B which is connected to the outer solenoid S_2 through which the some current I flows in the opposite direction so, as to come out at end A. If n_1 and n_2 are the number of turns per unit length, find the magnitude and direction of the net magnetic field at a point
(a) inside on the axis and
(b) outside the combined system.

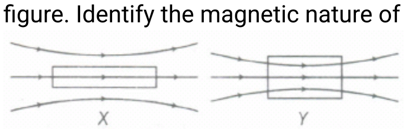


868) (i) How is a toroid different from a solenoid?
(ii) Use Ampere's circuital law to obtain the magnetic field inside a toroid.

869) (i) How does angle of dip change as line goes from magnetic pole to magnetic equator of the earth?
(ii) A uniform magnetic field gets modified as shown in the figure below, when two specimens X and Y are placed in it. Identify whether specimens X and Yare diamagnetic, paramagnetic or ferromagnetic.

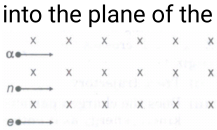


870) When two materials are placed in an external magnetic field, the behaviour of magnetic field lines is as shown in the figure. Identify the magnetic nature of each of these two materials.



871) (i) Write the expression for the force F acting on a particle of mass m and charge q moving with velocity v in a magnetic field B. Under what conditions will it move in
(a) a circular path and
(b) a helical path?
(ii) Show that the kinetic energy of the particle moving in magnetic field remains constant.

872) (i) Write the expression for the magnetic force acting on a charged particle moving with velocity v in the presence of magnetic field B.
(ii) A neutron, an electron and an alpha particle moving with equal velocities, enter a uniform magnetic field going into the plane of the paper as shown in the figure. Trace their paths in the field and justify your answer.



873) Draw a schematic sketch of the cyclotron. State its working principle. Show that the cyclotron frequency is independent of the velocity of the charged particle.

874) Explain the principle and working of a cyclotron with the help of a schematic diagram. Write the expression for cyclotron frequency.

875) (i) Write an expression for the force experienced by a charge q moving with a velocity v in a magnetic field B. Use this expression to define the unit of magnetic field.
(ii) Obtain an expression for the force experienced by a current carrying wire in a magnetic field.

876) An electron of mass me revolves around a nucleus of charge +Ze. Show that it behaves like a tiny magnetic dipole. Hence, prove that the magnetic moment
associated with it is expressed as $\mu = -\frac{e}{2m_e}L$, where L is the orbital angular momentum of the electron. Give the significance of negative sign.

877) (i) Obtain the expression for the cyclotron frequency.
(ii) A deuteron and a proton are accelerated by the cyclotron. Can both be accelerated with the same oscillator frequency? Give reason to justify your answer.

878) A metallic ring of mass m and radius l is falling under gravity in a region having a magnetic field. If z is the vertical direction, the z-component of magnetic field is Bz = B˚ $(1+\lambda z)$. If R is the resistance of the ring and if the ring falls with a velocity v, find the energy lost in the resistance. If the ring has reached a constant velocity, use the conservation of energy to determine v in terms of m, B, λ and acceleration to gravity g.

879) Derive the expression for the torque τ acting on a rectangular current loop of area A placed in a uniform magnetic field B. Show that $\vec{\tau} = \vec{m} \times \vec{B}$ where $\vec{m}$ is the magnetic moment of the current loop given by $\vec{m} = I\vec{A}$

880) Describe the concept used for the selection of velocity of a charged particle. Explain the principle of the device with the help of a diagram where the same concept is used. What is the resonating condition for the said device?

881) Define the following using suitable diagrams : (i) ma ic declination and (ii) angle of dip. In what direction will a compass needle point when kept at the (i) poles and (ii) equator?

882) A long straight wire, of circular cross-section (radius = (I) carries a current I which is uniformly distributed across the cross-section of the wire.
Use Ampere's circuital low to calculate magnetic field B (r), due to this wire, at a point distance r < a and r > a from its axis. Draw a graph Showing the dependence of B (r) on r.

883) (i) Name the machine which uses crossed electric and magnetic fields to accelerate the ions to high energies. With the help of a diagram, explain the resonance condition.
(ii) What will happen to the motion of charged particle if the frequency of the alternating voltage is doubled?

884) (i) Why is the magnetic field radial in a moving coil galvanometer? Explain how it is achieved?
(ii) A galvanometer of resistance 'G' can be converted into a voltmeter of range (0-V) volts by connecting a resistance 'R' in series with it. How much resistance will be required to change its range from 0 to V/2?

885) Write the expression for the magnetic force $\vec{F}$ acting on a charged particle q moving with velocity $\vec{V}$ in the presence of the magnetic field $\vec{B}$ in a vector form. Show that no work is done and no change in the magnitude of the velocity of the particle is produced by this force. Hence define the unit of magnetic field.

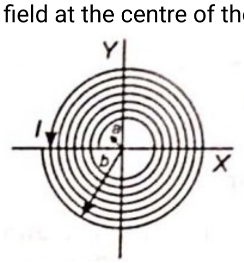
886) A circular coil, having 100 turns of wire, of radius (nearly) 20 cm each, lies in the XY plane with its centre at the origin of co-ordinates. Find the magnetic field at the point $(0, 0, 20\sqrt{3}\,cm)$ when this coil carries a current of $\left(\frac{2}{\pi}\right) A.$

887) Two long straight parallel conductors carrying steady currents I_1 and I_2 are separated by a distance 'd', Explain brifely, with the help of a suitable diagram, how the magnetic field due to one conductor acts on the other. Hence deduce the expression for the force acting between the two conductors. Mention the nature of this force.

888) Two wires A and B have the same length equal to 44 cm and carry a current of 10 A each. Wire A is bent into a circle and wire B is bent into a square.
(i) Obtain the magnitudes of the fields at the centres of the two wires.
(ii) Which wire produces a greater magnetic field at its centre?

889) The magnetic field B due to a current carrying circular loop of radius 12 cm at its centre is 0.5 x 10^{-4}T. Find the magnetic field due to this loop at a point on the axis at a distance of 5.0 cm from the centre.

890) A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the XY-plane and a steady current I flows through the wire. Find the Z-component of the magnetic field at the centre of the spiral.



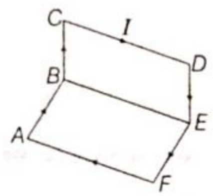
891) A long straight solid metal wire of radius R carries a current I uniformly distributed over its circular cross-section. Find the magnetic field at a distance r from the axis of wire
(i) inside
(ii) outside the wire.

892) A proton and an α particle, accelerated through same potential difference, enter in a region of uniform magnetic field, with their velocities perpendicular to the field. Compare the radii of circular paths followed by them.

893) A beam of protons with a velocity of 4×10^5 ms^{-1} enters in a region of uniform magnetic field of 0.3 T. The velocity makes an angle of 60° with the magnetic field. Find the radius of the helical path taken by the proton beam and the pitch of the helix.

894) A proton beam passes without deviation through a region of space, where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 220 kV / m and B = 50 mT. Then, the beam strikes a grounded target. Find the force imparted by the beam on the target, if the beam current is equal to 1 = 0.80 mA.

895) Find the magnitude of magnetic moment of the current carrying loop ABCDEFA. Each side of the loop is 10 cm long and current in the loop is I = 2.0 A.



896) A galvanometer of resistance 15 Ω gives full scale deflection for a current of 2 mA. Calculate the shunt resistance needed to convert it to an ammeter of range 0 to 5 A.

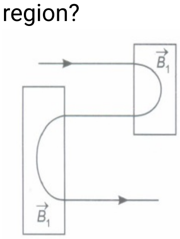
897) Answers the following questions .
(i) Write two reasons why a galvanometer cannot be used as such to measure the current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends
(ii) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer?

898) An electron being accelerated through a potential difference of Venters a uniform magnetic field of B perpendicular to the direction of motion. Find the radius of path described by the electron.

899) The coil of galvanometer consists of 100 turns and effective area of 1cm^2. The restoring couple is 10^{-8} N-m / rad. The magnetic field between poles is of 5T. What will be the current sensitivity of galvanometer?

900) Describe the working principle of a moving coil galvanometer. Why is it necessary to use (i) a radial magnetic field and (ii) a cylindrical soft iron core in a galvanometer? Write the expression for current sensitivity of the galvanometer.
Can a galvanometer as such be used for measuring the current? Explain.

901) Figure shows the path of an electron that passes through two regions containing uniform magnetic fields of magnitude B_1 and B_2 Its path in each region is a half circle.
(a) Which field is stronger?
(b) What are the directions of two fields?
(c) Is the time spend by the electron in the B_1, region greater than, less than, or the same as the time spent in B_2 region?



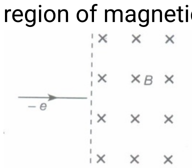
902) Assuming that the MRI scan test involved a magnetic field of 0.1 T, find the maximum and minimum values of the force that this field could exert on a proton moving with a speed Of 10^4 ms^{-1} State the condition under which the force can be minimum.

903) (a) State the condition under which a charged particle moving with velocity v goes undeflected in a magnetic field B.
(b) An electron, after being accelerated through a potential difference of 10^4 V, enters a uniform magnetic field 0.04 T, perpendicular to its direction of motion. Calculate the radius of curvature of its trajectory.

904) An electron of kinetic energy 25 keV moves perpendicular to the direction of a uniform magnetic field of 0.2 millitesla. Calculate the time period of rotation of the electron in the magnetic field.

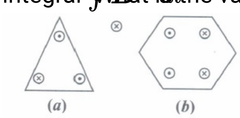
905) A proton and an a-particle move perpendicular to a magnetic field. Find the ratio of radii of the circular paths described by them when both
(i) have equal momenta, and
(ii) were accelerated through the same potential difference.

906) (a) An electron moving horizontally with a velocity of 4 x 10^4 mls enters a region of uniform magnetic field of 10^{-5} T acting vertically upward as shown in the figure; Draw its trajectory and find out the time it takes to come out of the region of magnetic field.



(b) A straight wire 0 mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid air by a uniform magnetic field B. What is the magnitude of the magnetic field?

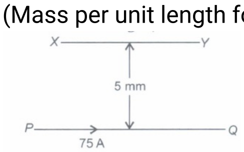
907) Each of eight conductors in figure carries 2A of current into or out of page. Two path are indicated for the line integral $\oint \vec{B} \cdot \vec{dl}$ What is the value of the integral for the path (a) and (b)?



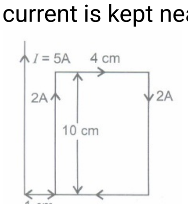
908) A proton and an a-particle move perpendicular to a magnetic field. Find the ratio of radii of circular paths described by them when both have (i) equal velocities, and (ii) equal kinetic energy.

909) A long straight wire carries a current of 2 A. An electron travels with a speed of 4 x 10^4 ms^{-1} parallel to the wire at a distance of 0.1 m from it in a direction opposite to the electric current. What force does the magnetic field of the current exert on the moving electron?

910) A long straight conductor PQ, carrying a current of 75 A, is fixed horizontally. Another long conductor XY is kept parallel to PQ at a distance of 5 mm, in air. Conductor XY is free to move and carries a current I. Calculate the magnitude and direction of current 1for which the magnetic repulsion just balances the weight of conductor XY (Mass per unit length for conductor XY is 10^{-2} kg/m).



911) A rectangular loop of wire of size 4 cm x 10 cm carries a steady current of 2 A. A straight long wire carrying 5 A current is kept near the loop as shown. If the loop and the wire are coplanar, find



(i) the torque acting on the loop and
(ii) the magnitude and direction of the force on the loop due to the current carrying wire.

912) An electron in an atom revolves around the nucleus in an orbit of radius 0.53 Å. Calculate the equivalent magnetic moment if the frequency of revolution of electron is 6.8 x 10^9 MHz.

913) A circular coil of 100 turns, radius 10 cm carries a current of 5A. It is suspended vertically in a uniform horizontal magnetic field of 0.5 T, the field lines making an angle of 60° with the plane of the coil. Calculate the magnitude of the torque that must be applied on it to prevent it from turning.

914) An electron revolves around a proton in a H-atom at a speed of 2.18×10^{-6} ms^{-1} in an orbit of radius 0.53 Å. What magnetic field does it produce at the centre of its circular orbit?

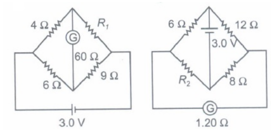
915) In an ammeter (consisting of a galvanometer and a shunt), 0.5% of the main current passes through the galvanometer. The resistance of the galvanometer coil is G. Calculate the resistance of the shunt in terms of galvanometer resistance, G.

916) A galvanometer having a coil resistance of 100 Ω gives full scale deflection when a current of 1mA passes through it. Calculate the value of resistance required to convert it into an ammeter of range 0-1 A.

917) How can a moving coil galvanometer be converted into an ammeter? To increase the current sensitivity of a moving coil galvanometer by 50%, its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

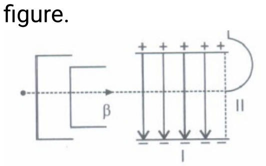
918) What is the direction of the force acting on a charged particle q, moving with a velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$

919) (a) Define the current sensitivity of a galvanometer. Write its SI unit.
(b) Figure shows two circuits each having a galvanometer and a battery of 3 V.



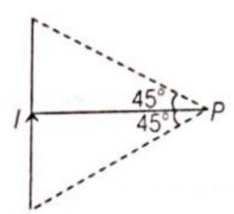
When the galvanometers in each arrangement do not show any deflection, obtain the ratio R_1/R_2.

920) A fine pencil of β-particles, moving with a speed v, enters a region (reigon I), where a uniform electric field and a uniform magnetic field both are present. These β-particles then move into region II, where only the magnetic field, (out of the two fields present in region I) exists. The path of the β-particles, in the two regions is as shown in the figure.



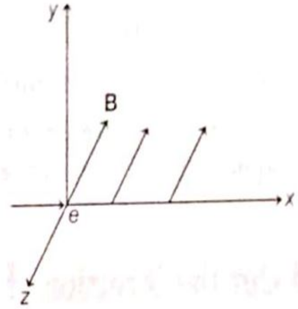
(i) State the direction of the magnetic field.
(ii) State the relation between E and B in region I.
(iii) Derive the expression for the radius ofthe circular path of the β-particle in region II.
(iv) If the magnitude of magnetic field, in region II is changed to n times its earlier value, (without changing the magnetic field in region I) find the factor by which the radius of this circular path would change.

921) Find the magnetic field at point P due to the current carrying conductor of current I as shown in the figure.

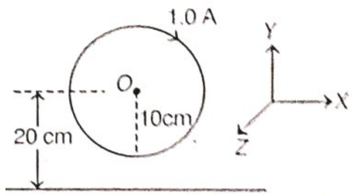


922) A proton is accelerated through a potential difference V, subjected to a uniform magnetic field acting normal to the velocity of the proton. If the potential difference is doubled, how will the radius of the circular path described by the proton in the magnetic field change?

923) An electron moves along + x - direction. It enters into a region of uniform magnetic field B directed along - z - direction as shown in figure. Draw the shape of trajectory followed by the electron after entering the field.



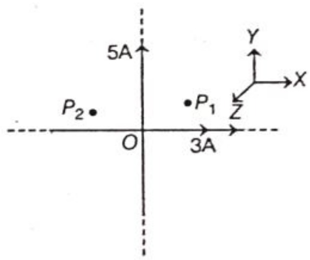
924) A circular loop of radius 10 cm carrying current of 1.0 A lies in X-Y plane. A long straight wire lies in the same plane parallel to X-axis at a distance of 20 cm as shown in figure.



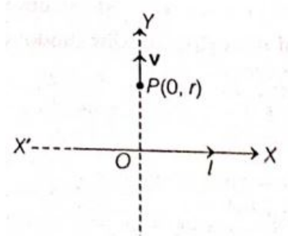
Find the direction and value of current that has to be maintained in the wire so that the net magnetic field at O is zero.

925) What are ferromagnetic materials? Explain ferromagnetism with the help of suitable diagrams, using the concept of magnetic domain.

926) Two long insulated straight wires carrying currents of 3 A and 5 A are arranged in XY-plane as shown in figure. Find the magnitude and direction of the net magnetic field at points P_1(2 m, 2 m) and P_2(-1m, 1m).



927) An infinite straight conductor is kept along X'X-axis and carries a current I. A charge q at point P(0, r) starts moving with velocity v = $V_0\hat{j}$ as shown in figure. Find the direction and magnitude of force initially experienced by the charge.



928) A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30^o with the direction of the motion of the particle. Draw the trajectory followed by the particle in the presence of the field and explain how the particle describes this path.

929) an α - particle and a proton of the same kinetic energy are in turn allowed to pass through a magnetic field b, acting normal to the direction of motion of the particles. calculate the ratio of radii of the circular paths described by them.

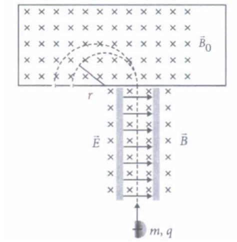
930) A deuteron and an alpha particle having same momentum are in turn allowed to pass through a magnetic field B, acting normal to the direction of motion of the particles. Calculate the ratio of the radii of the circular paths described by them.

931) Briefly explain why and how a galvanometer is converted into an ammeter.

Case Study Questions 17 x 4 = 68

932) Various methods can be used to measure the mass of an atom. One possibility is through the use of a mass spectrometer. The basic feature of a Banbridge mass spectrometer is illustrated in figure. A particle carrying a charge +q is first sent through a velocity selector and comes out with velocity v = E/B.

The applied electric and magnetic fields satisfy the relation E = vB so that the trajectory of the particle is a straight line. Upon entering a region where a second magnetic field $\vec{B}_0$ pointing into the page has been applied, the particle will move in a circular path with radius r and eventually strike the photographic plate.



(i) In mass spectrometer, the ions are sorted out in which of the following ways?

(a) By accelerating them through electric field

(b) By accelerating them through magnetic field

(c) By accelerating them through electric and magnetic field

(d) By applying a high voltage

(ii) Radius of particle in second magnetic field B_o is

(a) $\frac{2mv}{qE_0}$ (b) $\frac{mv}{qE_0}$ (c) $\frac{mv}{qB_0}$ (d) $\frac{2mE_0v}{qB_0}$

(iii) Which of the following will trace a circular trajectory wit largest radius?

(a) Proton **(b) -α particle** **(c) Electron** **(d) A particle with charge twice and mass thrice that of electron**

(iv) Mass of the particle in terms q, $B_{o,}$ B,r and E is

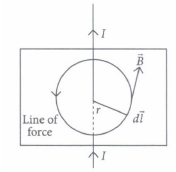
(b) (c) (d) $\frac{qB_0Br}{E}$ $\frac{qBr}{EB_0}$ $\frac{qBrE}{B_0}$

(v) The particle comes out of velocity selector along a straight line, because

(a) electric force is less than magnetic force **(b) electric force is greater than magnetic force**

(c) electric and magnetic force balance each other **(d) can't say.**

933) Ampere's law gives a method to calculate the magnetic field due to given current distribution. According to it, the circulation $\oint \vec{B}\cdot d\vec{l}$ of the resultant magnetic field along a closed plane curve is equal to μ_0 times the total current crossing the area bounded by the closed curve provided the electric field inside the loop remains constant. Ampere's law is more useful under certain symmetrical conditions. Consider one such case of a long Straight wire with circular cross-section (radius R) carrying current I uniformly distributed across this cross-section.



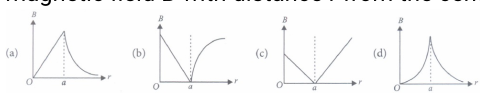
(i) The magnetic field at a radial distance r from the centre of the wire in the region r > R, is

(a) $\frac{\mu_0 I}{2\pi r}$ (b) $\frac{\mu_0 I}{2\pi R}$ (c) $\frac{\mu_0 I R^2}{2\pi r}$ (d) $\frac{\mu_0 I r^2}{2\pi R}$

(ii) The magnetic field at a distance r in the region r < R is

(a) $\frac{\mu_0 I}{2r}$ (b) $\frac{\mu_0 I r^2}{2\pi R^2}$ (c) $\frac{\mu_0 I}{2\pi r}$ (d) $\frac{\mu_0 I r}{2\pi R^2}$

(iii) 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?



(iv) A long straight wire of radius R carries a steady current I. The current is uniformly distributed across its cross-section. The ratio of magnetic field at R/2 and 2R is

(a) 2 (b) $\frac{1}{2}$ (c) 1 (d) $\frac{1}{4}$

(v) A direct current I flows along the length of an infinitely long straight thin walled pipe, then the magnetic field is

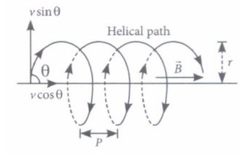
(a) uniform throughout the pipe but not zero

(b) zero only along the axis of the pipe

(c) zero at any point inside the pipe

(d) maximum at the centre and minimum at the edges.

934) The path of a charged particle in magnetic field depends upon angle between velocity and magnetic field.If velocity $\vec{v}$ is at angle θ to $\vec{B}$ component of velocity parallel to magnetic field $(v\cos\theta)$ remains constant and component of velocity perpendicular to magnetic field $(v\sin\theta)$ is responsible for circular motion, thus the charge particle moves in a helical path.



The plane of the circle is perpendicular to the magnetic field and the axis of the helix is parallel to the magnetic field. The charged particle. moves along helical path touching the line parallel to the magnetic field passing through the starting point after each rotation.

Radius of circular path is $r = \frac{mv\sin\theta}{1v_q B}$

Hence the resultant path of the charged particle will be a helix, with its axis along the direction of $\vec{B}$ as shown in figure.

(i) When a positively charged particle enters into a uniform magnetic field with uniform velocity, its trajectory can be (i) a straight line (ii) a circle (iii) a helix.

(a) (i) only **(b) (i) or (ii)**

(c) (i) or (iii) **(d) anyone of (i), (ii) and (iii)**

(ii) Two charged particles A and B having the same charge, mass and speed enter into a magnetic field in such a way that the initial path of A makes an angle of 30° and that of B makes an angle of 90° with the field. Then the trajectory of

(a) B will have smaller radius of curvature than that of A

(b) both will have the same curvature

(c) A will have smaller radius of curvature than that of B

(d) both will move along the direction of their original velocities.

(iii) An electron having momentum 2.4 x 10^{-23}kg m/ s enters a region of uniform magnetic field of 0.15 T. The field vector makes an angle of 30° with the initial velocity vector of the electron. The radius of the helical path of the electron in the field shall be

(a) 2 mm **(b) 1 mm** (c) $\frac{\sqrt{3}}{2}$ mm **(d) 0.5 mm**

(iv) The magnetic field in a certain region of space is given by $\vec{B} = 8.35 \times 10^{-2}\hat{i}$ T. A proton is shot into the field with velocity $\vec{v} = \left(2 \times 1\right.$ The proton follows a helical path in the field. The distance moved by proton in the x-direction during the period of one revolution in the yz-plane will be

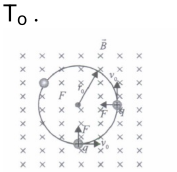
(Mass of proton = 1.67 x 10^{-27}kg)

(a) 0.053 m **(b) 0.136 m** **(c) 0.157 m** **(d) 0.236 m**

(v) The frequency of revolution of the particle is

(a) $\frac{m}{qB}$ (b) $\cdot\frac{qB}{2\pi m}$ (c) $\frac{2\pi R}{v\cos\theta}$ (d) $\frac{2\pi R}{v\sin\theta}$

935) An electron with speed $V_o << c$ moves in a circle of radius r_o in a uniform magnetic field. This electron is able to traverse a circular path as magnetic field is perpendicular to the velocity of the electron. A force acts on the particle perpendicular to both $\vec{v}_0$ and $\vec{B}$. This force continuously deflects the particle sideways without changing its speed and the particle will move along a circle perpendicular to the field. The time required for one revolution of the electron is T_o.



(i) If the speed of the electron is now doubled to $2v_o$. The radius of the circle will change to

(a) $4r_0$ (b) $2r_0$ (c) r_0 (d) $r_0/2$

(ii) If $v_o = 2v_o$ then the time required for one revolution of the electron will change to

(a) $4T_0$ (b) $2T_0$ (c) T_0 (d) $T_0/2$

(iii) A charged particles is projected in a magnetic field $\vec{B} = (2\hat{i} + 4\hat{j}) \times 10^2$ T. The acceleration of the particle is found to be $\vec{a} = (x\hat{i} + 2\hat{j})$ m s^{-2}. Find the value of x.

(a) 4 m S^{-2} (b) -4 m s^{-2} (c) -2 m s^{-2} (d) 2 m s^{-2}

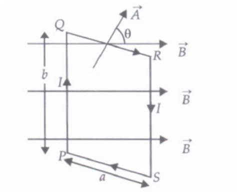
(iv) If the given electron has a velocity not perpendicular to B, then trajectory of the electron is

(a) straight line (b) circular (c) helical (d) zig-zag

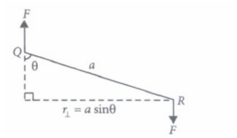
(v) If this electron of charge (e) is moving parallel to uniform magnetic field with constant velocity v, the force acting on the electron is

(a) Bev (b) zero (d) $\frac{Be}{ev}$

936) When a rectangular loop PQRS of sides 'a' and 'b' carrying current I is placed in uniform magnetic field $\vec{B}$ such that area vector $\vec{A}$ makes an angle θ with direction of magnetic field, then forces on the arms QR and SP of loop are equal, opposite and collinear, thereby perfectly cancel each other, whereas forces on the arms PQ and RS of loop are equal and opposite but not collinear, so they give rise to torque on the loop.



Force on side PQ or RS ofloop is F = IbB sin 90° = Ib B and perpendicular distance between two non-collinear forces is $r_\perp$ = a sin θ



So, torque on the loop, $\tau = IAB\sin\theta$

In vector form torque $\vec{\tau} = \vec{M} \times \vec{B}$

where $\vec{M} = NI\vec{A}$ is called magnetic dipole moment of current loop and is directed in direction of area vector $\vec{A}$ i.e., normal to the plane ofloop.

(i) A circular loop of area 1 cm^2, carrying a current of 10 A is placed in a magnetic field of 0.1T perpendicular to the plane of the loop. The torque on the loop due to the magnetic field is

(a) zero (b) 10^{-4} N m (c) 10^{-2} N m (d) 1N m

(ii) Relation between magnetic moment and angular velocity is

(b) $M \propto \sqrt{\omega}$ (d) none of these

(ill) A current loop in a magnetic field

(a) can be in equilibrium in two orientations, both the equilibrium states are unstable

(b) can be in equilibrium in two orientations, one stable while the other is unstable

(c) experiences a torque whether the field is uniform or non uniform in all orientations

(d) can be in equilibrium in one orientation

(iv) The magnetic moment of a current I carrying circular coil of radius r and number of turns N varies as

(b) $\frac{1}{r^2}$ (d) r^2

(v) A rectangular coil carrying current is placed in a non-uniform magnetic field. On that coil the total

(a) force is non-zero (b) force is zero (c) torque is zero (d) none of these

(i) (c): In mass spectrometer, the ions are sorted out by accelerating them through electric and magnetic field.

937) A magnetic field can be produced by moving, charges or electric currents. The basic equation governing the magnetic field due to a current distribution is the Biot-Savart law.

Finding the magnetic field resulting from a current distribution involves the vector product, and is inherently a calculas problem when the distance from the current to the field point is continuously changing.

According to this law, the magnetic field at a point due to a current element oflength $d\vec{l}$ carrying current I, at a distance r from the element is $dB = \frac{\mu_0}{4\pi}\frac{I(d\vec{l}\times\vec{r})}{r^3}$

Biot -Savart law has certain similarities as well as difference with Coloumbs law for electrostatic field e.g., there is an angle dependence in Biot-Savart law which is not present in electrostatic case.

(i) The direction of magnetic field $d\vec{B}$ due to a current element $Id\vec{l}$ at a point of distance $\vec{r}$ from it, when a current I passes through a long conductor is in the direction

(a) of position vector $\vec{r}$ of the point (b) of current element $d\vec{l}$

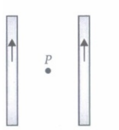
(c) perpendicular to both $d\vec{l}$ and $\vec{r}$ (d) perpendicular to $d\vec{l}$ only

(ii) The magnetic field due to a current in a straight wire segment of length L at a point on its perpendicular bisector at a distance r (r > > L)

(a) decreases as $\frac{1}{r}$. (b) decreases as $\frac{1}{r^2}$.

(c) decreases as $\frac{1}{r^3}$. (d) approaches a finite limit as $r \rightarrow \infty$

(iii) Two long straight wires are set parallel to each other. Each carries a current i in the same direction and the separation between them is 2r. The intensity of the magnetic field midway t between them is



(a) $\mu_0 i/r$ (b) $4\mu_0 i/r$

(c) zero (d) $\mu_0 i/4r$

(iv) A long straight wire carries a current along the z-axis for any two points in the x - y plane. Which of the following is always false?

(a) The magnetic fields are equal

(b) The directions of the magnetic fields are the same

(c) The magnitudes ofthe magnetic fields are equal

(d) The field at one point is opposite to that at the other point

(v) Biot-Savart law can be expressed alternatively as

(a) Coulomb's Law **(b) Ampere's circuital law**

(c) Ohm's Law **(d) Gauss's Law**

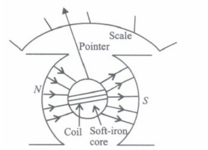
938) Moving coil galvanometer operates on Permanent Magnet Moving Coil (PMMC) mechanism and was designed by the scientist D'arsonval.

Moving coil galvanometers are of two types

(i) Suspended coil

(ii) Pivoted coil type or tangent galvanometer.

Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum.



(i) A moving coil galvanometer is an instrument which

(a) is used to measure emf

(b) is used to measure potential difference

(c) is used to measure resistance

(d) is a deflection instrument which gives a deflection when a current flows through its coil

(ii) To make the field radial in a moving coil galvanometer

(a) number of turns of coil is kept small	**(b) magnet is taken in the form of horse-shoe**
(c) poles are of very strong magnets	**(d) poles are cylindrically cut**

(iii) The deflection in a moving coil galvanometer is

(a) directly proportional to torsional constant of spring

(b) directly proportional to the number of turns in the coil

(c) inversely proportional to the area of the coil

(d) inversely proportional to the current in the coil

(iv) In a moving coil galvanometer, having a coil of N-turns of area A and carrying current I is placed in a radial field of strength B.

The torque acting on the coil is

[illegible]

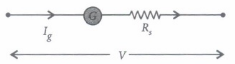
(v) To increase the current sensitivity of a moving coil galvanometer, we should decrease

(a) strength of magnet	**(b) torsional constant of spring**
(c) number ofturns in coil	**(d) area of coil**

939) A galvanometer can be converted into voltmeter of given range by connecting a suitable resistance R_s in series with the galvanometer, whose value is given by

$$R_s = \frac{V}{I_g} - G$$

where V is the voltage to be measured, I_g is the current for full scale deflection of galvanometer and G is the resistance of galvanometer



Series resistort (R_S) increases range of voltmeter and the effective resistance of galvanometer. It also protects the galvanometer from damage due to large current.

Voltmeter is a high resistance instrument and it is always connected in parallel with the circuit element across which potential difference is to be measured. An ideal voltmeter has infinite resistance

In order to increase the range of voltmeter n times the value of resistance to be connected in series with galvanometer is R_s = (n - I)G.

(I) 10 mA current can pass through a galvanometer of resistance 25Ω. What resistance in series should be connected through it, so that it is converted into a voltmeter of 100 V?

(a) 0.975Ω (b) 99.75Ω (c) 975Ω (d) 9975Ω .

(ii) There are 3 voltmeter A, B, C having the same range but their resistance are $15,000\Omega$, $5,000\Omega$ and $10,000\Omega$ respectively. The best voltmeter amongst them is the one whose resistance is

$10,000\Omega$ (d) all are equally good

(iii) A milliammeter of range 0 to 25 mA and resistance of 10Ω is to be converted into a voltmeter with a range of 0 to 25 V. The resistance that should be connected in series will be

(a) 930Ω 960Ω

(iv) To convert a moving coil galvanometer (MCG) into a voltmeter

(a) a high resistance R is connected in parallel with MCG

(b) a low resistance R is connected in parallel with MCG

(c) a low resistance R is connected in series with MCG

(d) a high resistance R is connected in series with MCG

(v) The resistance of an ideal voltmeter is

(a) zero (b) low (c) high (d) infinity

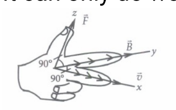
940) A charged particle moving in a magnetic field experiences a force that is proportional to the strength of the magnetic field, the component of the velocity that is perpendicular to the magnetic field and the charge of the particle.

This force is given by $\vec{F} = q(\vec{v} \times \vec{B})$ where q is the electric charge of the particle, v is the instantaneous velocity of the particle, and B is the magnetic field (in tesla).

The direction of force is determined by the rules of cross product of two vectors

Force is perpendicular to both velocity and magnetic field. Its direction is same as $\vec{v} \times \vec{B}$ if q is positive and opposite of $\vec{v} \times \vec{B}$ if q is negative

The force is always perpendicular to both the velocity of the particle and the magnetic field that created it. Because the magnetic force is always perpendicular to the motion, the magnetic field can do no work on an isolated charge. It can only do work indirectly, via the electric field generated by a changing magnetic field.



(I) When a magnetic field is applied on a stationary electron, it

(a) remains stationary

(b) spins about its own axis

(c) moves in the direction of the field

(d) moves perpendicular to the direction of the field.

(ii) A proton is projected with a uniform velocity v along the axis of a current carrying solenoid, then

(a) the proton will be accelerated along the axis

(b) the proton path will be circular about the axis

(c) the proton moves along helical path

(d) the proton will continue to move with velocity v along the axis.

(iii) A charged particle experiences magnetic force in the presence of magnetic field. Which of the following statement is correct?

(a) The particle is stationary and magnetic field is perpendicular.

(b) The particle is moving and magnetic field is perpendicular to the velocity

(c) The particle is stationary and magnetic field is parallel

(d) The particle is moving and magnetic field is parallel to velocity

(iv) A charge q moves with a velocity 2 ms^{-1} along x-axis in a uniform magnetic field $\vec{B} = (\hat{i} + 2\hat{j} + 3\hat{k})$ T. Then charge will experience a force

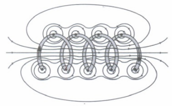
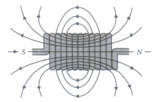
(a) in z-y plane	(b) along -yaxis	(c) along +z axis	(d) along -z axis

(v) Moving charge will produce

(a) electric field only	(b) magnetic field only
(c) both electric and magnetic field	**(d) none ofthese.**

941) A solenoid is a long coil of wire tightly wound in the helical form. Solenoid consists of closely stacked rings electrically insulated from each other wrapped around a non-conducting cylinder.

Figure below shows the magnetic field lines of a solenoid carrying a steady current 1.We see that if the turns are closely spaced, the resulting magnetic field inside the solenoid becomes fairly uniform, provided that the length of the solenoid is much greater than its diameter, For an "ideal" solenoid, which is infinitely long with turns tightly packed, the magnetic field inside the solenoid is uniform and parallel to the axis, and vanishes outside the solenoid.

(i) Along solenoid has 800 turns per metre length of solenoid. A current of 1.6A flows through it. The magnetic induction at the end of the solenoid on its axis is

(a) 16 x 10^{-4} T (b) 8 x 10^{-4} T (c) 32 X 10^{-4} T (d) 4 x 10^{-4} T

(ii) Choose the correct statement in the following

(a) The magnetic field inside the solenoid is less than that of outside

(b) The magnetic field inside an ideal solenoid is not at all uniform

(c) The magnetic field at the centre, inside an ideal solenoid is atmost twice that at the ends

(d) The magnetic field at the centre, inside an ideal solenoid is almost half of that at the ends

(iii) The magnetic field (B) inside a long solenoid having n turns per unit length and carrying current I when iron core is kept in it is $(\mu_0 = \text{ permeability of vacuum}, \chi = \text{ magnetic susceptibility})$

(a) $\mu_0 nI(1-\chi)$ (b) $\mu_0 nI\chi$ (c) $\mu_0 nI^2(1+\chi)$ (d) $\mu_0 nI(1+\chi)$

(iv) A solenoid oflength I and having n turns carries a current I is in anticlockwise direction. The magnetic field is

(a) $\mu_0 nI$ (b) $\mu_0 \frac{nI}{l^2}$

(c) along the axis of solenoid **(d) perpendicular to the axis of coil**

(v) The magnitude of the magnetic field inside a long solenoid is increased by

(a) decreasing its radius **(b) decreasing the current through it**

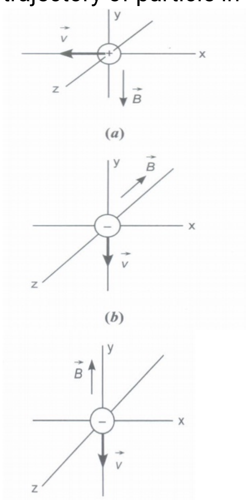
(c) increasing its area of cross-section **(d) introducing a medium of higher permeability**

942) Electric fields interact with both stationary and moving charges while magnetic fields affect only moving charges. Therefore, when a charged particle of charge q and mass m moving with velocity 'v' enters a region where both eletric ($\vec{E}$) and magnetic ($\vec{B}$) fields are simultaneously applied, then this charge particle will experience a force called Lorentz force given by

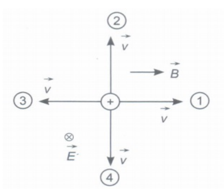
$$\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$$

and the motion of the charged particle is quite complicated. But by adjusting the value of ($\vec{E}$) and ($\vec{B}$) the velocity of.charge particle can be controlled.

(i) The figure below shows three situation in which a charged particle with velocity $\vec{v}$ travels through a uniform magnetic field $\vec{B}$ In each situation, what is the direction of the magnetic force $\overrightarrow{F_B}$ on the particle? Also, draw the trajectory of particle in each case.



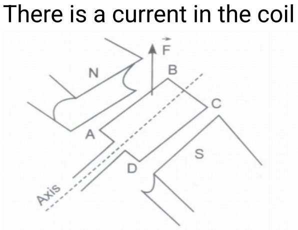
(ii) In the adjoining figure four directions for the velocity vector $\vec{v}$ of a positively charged particle moving through a uniform electric field $\vec{E}$ (directed into the page and represent by ⊗) and a unform magnetic field $\vec{B}$



(a) Rank directions 1, 2 and 3 according to the magnitude of the net force on the particle, greatest first.

(b) Among all four directions, which might result in a net force of zero?

943) Figure shows a rectangular coil ABCD placed between magnetic N-pole and S-pole.
There is a current in the coil



An upward force F = 9.6×10^{-3} N is acting on the side AB of the coil.

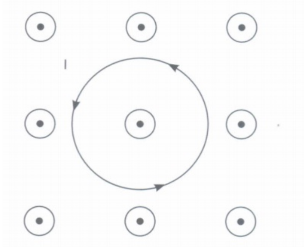
(i) (a) Explain why there is a force on side AB.

(b) Determine the direction of current in AB and state how the direction is deduced.

(ii) Both sides AB and CD of the coil are at a distance 2 cm from the axis. Determine the moment acting on the coil ABCD.

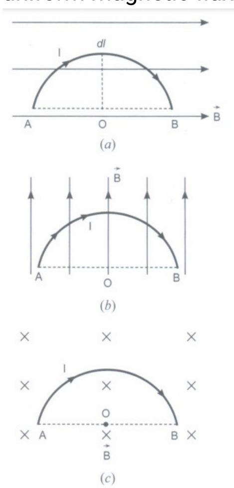
(iii) For which purpose above arrangement can be used?
In which device above arrangement is used?

944) A loop of flexible conducting wire of length 31.4 cm carrying current of 1.5 A is placed in a magnetic field as shown. If current flowing through the wire in anticlockwise direction is switched on then what will be

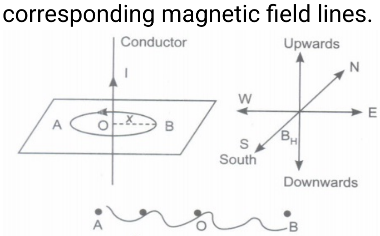


(i) the shape of the loop?
(ii) determine net magnetic field at the centre of the loop. If it is given that current carrying loop is placed in a region having external magnetic field of 3.6 G.

945) What is the force experienced by a semi-circular wire of radius R carrying current 'I' and is placed in a region where uniform magnetic flux density (B) is as shown in the figures (a), (b) and (c) respectively?

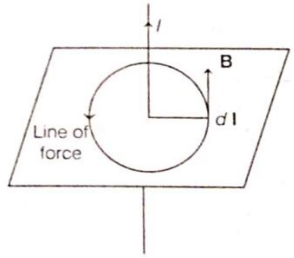


946) If a straight current carrying conductor is placed as shown. Points A and B lies on west and east side of a conductor at a distance x each from the conductor. Then relate the magnetic field at A to that at B. Also draw the corresponding magnetic field lines.



947) A magnetic field can be produced by moving charges or electric current. The basic equation of magnetic field due to a current distribution is governed by Biot-Savart law. According to this law, the magnetic field at a point due to a current element of length d l carrying current I, at a distance r from the element d l is,
$d\mathbf{B} = \frac{\mu_0}{4\pi}\frac{I d\mathbf{l}\times\mathbf{r}}{r^3}$ This law has certain similarities as well as differences with coulomb's law of electrostatic. e.g. There is an angle dependence in Biot-Savart law which is absent in electrostatic case.
(i) Write the alternative way to express Biot-Savart law.
(ii) What is the difference between Biot-Savart law and Coulomb's law in electrostatic.
(iii) How magnetic field due to an infinitely long current carrying wire at a distance r on its perpendicular bisector is related with current?
(vi) What is the magnetic field at a point on a long current carrying wire?

948) Ampere's law gives a method to calculate the magnetic field due to a given current distribution. According to this law, the line integral $\oint B . d1$ of the resultant magnetic field B along any closed path in vacuum is μ_0 times the net current I_{net} crossing the area bounded by the closed curve provided the electric field inside the loop remains constant. It is more useful under certain symmetrical conditions. Consider a long straight wire with circular cross-section (radius R) carrying a current I uniformly distributed across this cross-section.

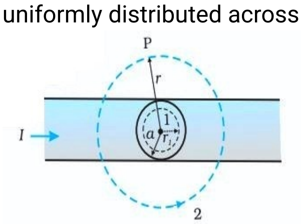


(i) What is the magnetic field at a radial distance r from the centre of the wire in the region r > R?
(ii) Write the expression for magnetic field at a distance r is the region r < R.
(iii) Draw the variation of magnetic field B with distance r from the centre of the wire.
(iv) A long straight wire of radius R carries a steady current I. The current is uniformly distributed across its cross-section. What will be the ratio of magnetic field at R/2 and 2R?

5 Marks 116 x 5 = 580

949) In a chamber, a uniform magnetic field of 6.5 G (1 G = 10^{-4} T) is maintained. An electron is shot into the field with a speed of 4.8 x 10^6 m s^{-1} normal to the field. Explain why the path of the electron is a circle. Determine the radius of the circular orbit. (e = 1.5 x 10^{-19} C, m_e = 9.1 x 10^{-31} kg)

950) Figure shows a long straight wire of a circular cross-section of (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region r < a and r > a.



951) A closely wound solenoid 80 cm long has 5 layers of windings of 400 turns each. The diameter of the solenoid is 1.8 cm. If the current carried is 8.0 A, estimate the magnitude of B inside the solenoid near its centre.

952) Two moving coil meters, M_1 and M_2 have the following particulars:
R_1 = 10 Ω, N_1 = 30, A_1 = 3.6 x 10^{-3} m^2, B_1 = 0.25 T
R_2 = 14 Ω, N_2 = 42, A_2 = 1.8 x 10^{-3} m^2, B_2 = 0.50 T
(The spring constants are identical for the two meters). Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of M_2 and M_1.

953) Obtain the frequency of revolution of the electron in its circular orbit. Does the answer depend on the speed of the electron? Explain.

954) An electron emitted by a heated cathode and accelerated through a potential difference of 2.0 kV, enters a region with uniform magnetic field of 0.15 T. Determine the trajectory of the electron if the field
(a) is transverse to its initial velocity,
(b) makes an angle of 30^o with the initial velocity.

955) A uniform magnetic field of 1.5 T exists in a cylindrical region of radius 10.0 cm, its direction is parallel to the axis along east to west. A wire carrying current of 7.0 A in the north to south direction passes through this region. What is the magnitude and direction of the force on the wire if,
(a) the wire intersects the axis,
(b) the wire is turned from N-S to northeast-southwest direction,
(c) the wire in the N-S direction is lowered from the axis by a distance of 6.0 cm?

956) Assume the dipole model for earth's magnetic field B which by B_V = vertical component of magnetic field = $\frac{\mu_0}{4\pi}\frac{2M\cos\theta}{r^3}$ B_H = Horizontal component of magnetic field = $\frac{\mu_0}{4\pi}\frac{2M\sin\theta M}{r^3}$, $\theta = 90^\circ$ latitude as measured from magnetic equator. Find loci of points for which

(i) $|B|$ is minimum

(ii) dip angle is zero and

(iii) dip angle is $\pm 45^\circ$

957) Two concentric circular coils X and Y of radii 16 cm and 10 cm respectively lie in the same vertical plane containing the north-south direction. Coil X has 20 turns and carries a current of 16 A ; coil Y has 25 turns and carries a current of 18 A. The sense of the current in X is anticlockwise and in Y is clockwise, for an observer looking at the coil facing west. Give the magnitude and direction of the coils at their centre.

958) A toroid has a core(non-ferromagnetic) of inner radius 25 cm and outer radius 26 cm, around which 3500 turns of wire are wound. If the current in the wire is 11A, that is the magnetic field

(a) outside the toroid,

(b) Inside the core of the toroid,

(c) in the empty space surrounded by the toroid?

959) A magnetic field set up using Helmholts coils(described in Exercise) is uniform in a small region and has a magnitude of 0.75 T. In the same region, a uniform electrostatic field is maintained in a direction normal to the common axis of the coils. A narrow beam of(single-species) charged particles all accelerated through 15 kV enters this region in a direction perpendicular to both the axis of the coils and the electrostatic field. If the beam remains undeflected when the electrostatic field is $9.0\times10^{-5}Vm^{-1}$, make a simple guess as to what the beam contains. Why is the answer not unique?

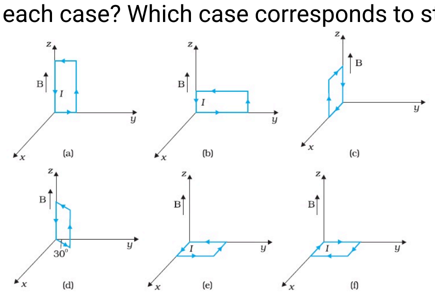
960) How are materials classified according to their behaviour in magnetic field?

961) Discuss relative strengths of electrical and magnetic forces.

962) Discuss the sensitivity of a moving coil galvanometer.

963) Find the expression for maximum energy of a charged particle accelerated by a cyclotron.

964) A uniform magnetic field of 3000 G is established along the positive Z direction. A rectangular loop sides 10 cm and 5 cm carries a current of 12 A. What is the torque on the loop in the different cases shown in Fig. What is the force on each case? Which case corresponds to stable equilibrium?



965) A current element 3 dl is at (0,0,0) along y-axis. if dl =1 cm, find the magnetic field at a distance 20 cm on the x-axis.

966) Same current I is flowing in three infintely long wires along x, y and z directions. What is the magnetic field at point (0, 0, -a) ?

967) A long straight wire carrying a current of 20 A is placed in an external uniform magnetic field of 3 x 10^{-4} T parallel to the current. Find the magnitude of the resultant field at a point 2.0 cm away from the wire.

968) An alpha particle is completing one circular round of radius 0.8 m in 2 seconds. Find the magnetic field at the centre of the circle. Electronic charge = 1.6 x 10^{-19} C.

969) The electron in a hydrogen atom circles around the proton with a speed of 2.18 x 10^{6} ms^{-1} in an orbit of radius 5.3 x 10^{-11} m. Calculate (a) the equivalent current (b) magnetic field produced at the proton. Give charge on electron is 1.6 x 10^{-19} C and $\mu_o = 4\pi\times10^{-7}TmA^{-1}$.

970) A circular loop of 2 turns carries a current of 5.0 A. If the magnetic field at the centre of loop is 0.40 mT, find the radius of the loop.

971) A circular coil of 120 turns has a radius of 18 cm and carries a current of 3 A. What is the magnitude of the magnetic field at a point on the axis of the coil at a distance from the centre equal to the radius of the circular coil?

972) A wire of radius 0.8 cm carries a current of 100 A which is uniformly distributed over its cross-section. Find the magnetic field (a) at 0.2 cm from the axis of the wire (b) at the surface of the wire and (c) at a point outside the wire 0.4 cm from the surface of the wire. Neglect the permeability of the material of wire.

973) A solenoid coil of 300 turns/m is carrying a current of 5 A. The length of the solenoid is 0.5 m and has a radius of 1 cm. Find the magnitude of the magnetic field well inside the solenoid.

974) A solenoid of length 50 cm, having 100 turns carries a current of 2.5 A. Find the magnetic field,
(a) in the interior of the solenoid,
(b) at one end of the solenoid.

975) A toroid has a core of inner radius 20 cm and outer radius 22 cm around which 4200 turns of a wire are wound. If the current in the wire is 10 A, what is the magnetic field
(a) inside the core of toroid
(b) outside the toroid
(c) in the empty space surrounded by toroid ?

976) A coil wrapped around a toroid has inner radius of 15 cm and outer radius of 20 cm. If the toroid has 1000 turns of wire and carries a current of 12 A, find the maximum and minimum values of magnetic field within the toroid.

977) A proton enters a magnetic field of flux density 2.5 T with a speed of 1.5 x 10^7 ms^{-1} at an angle of 30^o with the field. Find the force on the proton.

978) An electron of energy 2000 eV describes a circular path in magnetic field of flux density 0.2 T. What is the radius of the path ? take e = 1.6 x 10^{-19} C, m = 9 x 10^{-31} kg.

979) A proton, a deutron and αparticle, whose kinetic energies are same, enter perpendicularly a uniform magnetic field. Compare the radii of their circular paths.

980) An electron beam passes through a magnetic field of 4 x 10^{-3} weber/m^2 and an electric field of 2 x 10^4 Vm^{-1}, both acting simultaneously. The path of electron remaining undeviated, calculate the speed of the electrons. If the electric field is removed, what will be the radius of the electron path ?

981) If the maximum value of accelerating potential provided by a radio frequency oscillator be 25 kV, find the number of revolutions made by a proton in a cyclotron to achieve one sixth of the speed of light. Mass of proton = 1.67 x 10^{-27} kg.

982) A straight wire 50 cm long carries a current of 5 A. It is placed at right angle to a uniform magnetic field of 1 T. Find the mechanical force on the wire and the power required to move it at 10 ms^{-1} in a plane at right angles to the magnetic field.

983) A long straight conductor C carrying a current of 3 A is placed parallel to a short conductor D of length 5 cm, carrying a current 4 A. The two conductors are 10 cm apart. Find
(i) the magnetic field due to C at D.
(ii) The approximate force on D.

984) A horizontal wire 0.2 m long carries a current of 4 A. Find the magnitude and direction of the magnetic field, which can support the weight of the wire. Given the mass of the wire is 3 x 10^{-3} kg/m, g = 10 ms^{-2}

985) A straight horizontal conducting rod of length 0.60 m and mass 60 g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod through the wire.
(a) What magnetic field should be set up normal to the conductor in order that the tension in the wire is zero ?
(b) What will be total tension in the wires if the direction of current is reversed, keeping the magnetic field same as before (Ignore mass of the wire), g = 10 ms^{-2} .

986) Calculate the force per unit length on a long straight wire carrying current 4 A due to parallel wire carrying 6 A current. if the distance between the wires is 3 cm.

987) A wire AB is carrying a steady current of 12 A and is lying on the table. Another wire CD carrying current 5 A is held vertically above AB at a height of 1 mm.
Find the mass per unit length of the wire CD so that it remains suspended at the position when left free. Give the direction of the current flowing in CD with respect to that in AB.(g = 10 ms^{-2})

988) A rectangular coil of area 5.0 x 10^{-4} m^2 and 60 turns is pivoted about one of its vertical sides. The coil is in a radial horizontal field of 90 G (radial here means the field lines are in the plane of the coil for any rotation). What is the torsional constant of the hair springs connected to the coil, if a current of 2.0 mA produces an angular deflection of 18^o?

989) The current sensitivity of a moving coil galvanometer increases by 20% when its resistance is increased by a factor does the voltage sensitivity change ?

990) A current of 500 μA deflects the coil of a moving coil galvanometer through 60^o . What should be the current to cause the rotation through $\pi/5$ radian ? What is the sensitivity of galvanometer ?

991) When a galvanometer having 30 divisions scale and 100 Ω resistance is connected in series with the battery of e.m.f. 3 volt through a resistance of 200 Ω it shows full scale deflection. Find the fogure of merit of the galvanometer in microampere.

992) A resistance of 1980 Ω is connected in series with a voltmeter, after which the scale division becomes 100 times larger. Find the resistance of voltmeter.

993) Two linear parallel conductors carrying currents in the same direction attract each other and two linear parallel conductors carrying in opposite directions repel each other. The force acting per unit length due to currents $I_1 and I_2$ in two linear parallel conductors held distance r apart in vacuum in SI unit is $F = \frac{\mu_0}{2\pi}\frac{2I_1I_2}{r}$
Read the above passage and answer the following questions:
(i) What is the basic reason for the force between two linear parallel conductors currents?
(ii) Two straight wires A and B of lengths 2 cm and 20 cm, carrying currents 2.0 A and 5.0 A respectively in opposite directions are lying parallel to each other 4.0 cm apart. The wire A is held near the middle of wire B. What is the force on 20 cm long wire B?
(iii) What does this study imply in day to day life?

994) When a galvanometer of resistance G is shunted with a low resistance S, then the effective resistance of Re_{ff} galvanometer becomes
$Re_{ff} = \frac{GS}{G+S}$
If the current is passed through such a galvanometer, then the major amount of current flows through the shunt and the rest through the galvanometer, then the major amount of current flows through the shunt and the rest through galvanometer., the current divides itself in the inverse ratio of resistances.
Read the above passage and answer the following questions:
(i) Why is the resistance of shunted galvanometer lower than that of a shunt?
(ii) A galvanometer of resistance. 30Ω What the fraction of the main current passes (i) through the galvanometer and (ii) through the galvanometer and (ii) through the shunt?
(iii) What are the basic values you learn from the above study?

995) Saniya and Priya are friends. Both of them know that a small compass needle point always along north-south direction. One day Saniya is plotting field due to a bar magnet in the laboratory. She discovers a point where compass needle does not point along N-S. Rather, it sets itself in any arbitrary direction. Saniya thinks first that compass needle has become faulty. Priya then explains to her the real situation.
Read the above passage and answer the following questions:
(i) How did Priya justify the situation?
(ii) If a bar magnet is placed along the N-S direction with its north pole pointing north, what is the position of neutral points?
(iii) If a bar magnet is placed along N-S direction with its north pole pointing South, What is the position of neutral points?
(iv) What values of life do you learn from this piece of knowledge?

996) Explain using a labelled diagram, the principle and working of a moving coil galvanometer. What is the function of
(i) uniform radial magnetic field
(ii) soft iron core?
Also, define the terms
(iii) current sensitivity and
(iv) voltage sensitivity of a galvanometer.
Why does increasing the current sensitivity not necessarily increase voltage sensitivity?

997) A proton is traveling with horizontal velocity $v_x = 2.5 \times 10^8 cm/s$. Calculate the transverse deflection in traveling horizontal distance, x = 5 cm in electric field of, $E_y = 400V/cm$, mass of proton, $m = 1.6 \times 10^{-24} g$, charge on proton, $q = 1.6 \times 10^{-19} c$

998) (i) Explain giving reasons, the basic difference in converting a galvanometer into
(a) a voltmeter and
(b) an ammeter
(ii) Two long straight parallel conductors carrying steady currents I_1 and I_2 are separated by a distance d. Explain briefly, with the help of a suitable diagram, how the magnetic field due to one conductor acts on the other. Hence, deduce the expression for the force acting between the two conductors. Mention the nature of this force.

999) Ms. Kanchan, a student of PG course in nanotechnology lab in IIT Kanpur on her first day in the lab met Mr. Cobra, the lab assistant
He advised her not to touch the wires, which were suspended from the roof at every part of the lab as they were from high voltage lines.
He also told her not to bring any of the two wires closer to each other during any experimental applications. Read the above passage and answer the following questions:
(i) What values did Mr. Cobra exhibit? Give two reasons.
(ii) Why should not the the two high voltage wires be brought close to each other?

1000) (i) Using Ampere's circuital law, derive the expression for the magnetic field in the vector from at a point on the axis of solenoid.
(ii) What does a toroid consist of? Find out the expression for the magnetic field inside a toroid for N turns of the coil having the average radius r and carrying a current I.Show that the magnetic field in the open space interior and exterior to the toroid is zero.

1001) Alka and her sister were watching a movie in which the phenomena of Aurora Borealis was shown. Alka could not believe her eyes that, such a colourful display like the one during common wealth games could be created by the nature. She went to the library, but could not find the right book. So, she consulted her teacher who guided her. Hence, Alka understood that during a solar flare, a large number of electrons and protons are ejected from the sun. some of these get trapped in the earth's magnetic field and move in a helical path along the field lines. As the density of the field lines increases near the poles, these particles collide with atoms and molecules of the atmosphere emitting green and pink lights. Alka shared this knowledge with her class when they studied the chapter of moving charges in magnetic field.
Read the above passage and answer the following questions:
(i) What values did Alka have?
(ii) What is the radius of the path of an electron moving at a speed of $3 \times 10^7 m/s$ in a magnetic field of 6 gauss perpendicular to it?
What is its frequency? Calculate its energy in kilo electron volt.

1002) In the birthday party of Kamal, his parents gave big slinkies to all his friends as a return gift. The very next day, during the physics class Mr. Mohan, the teacher explained them about the production of magnetic field using current carrying coil and also said that they can make permanent magnet, using such coils by passing high currents through them. That night Priyanshu, a friend of Kamal, asked his father about the coils, and their shape. His father asked him to bring the slinky, that his friend gave and explained the use of toroid and solenoid.
Read the above passage and answer the following questions:
(i) What value did Priyanshu's father have?
(ii) What is the difference between solenoid and toroid?
(iii) Give the value or magnitude of magnetic field in solenoid.

1003) Niyaz was using galvanometer in the practical class. Unfortunately, it fell from his hand and broke. He was upset, some of his friends advised him not to tell the teacher but Niyaz decided to tell his teacher. Teacher listened to him patiently and on knowing that the act was not intentional, but just an accident, did not scold him and used the opportunity to show the internal structure of galvanometer.
(i) What are the values displayed by Niyaz?
(ii) Give the principle of moving coil galvanometer.
(iii) How can you increase the sensitivity of a galvanometer?

1004) (i) Derive the expression for the torque on a rectangular current carrying loop suspended in a uniform magnetic field
(ii) A proton and a deuteron having equal momentum enter in a region of a uniform magnetic field at right angle to the direction of the field.Depict their trajectories in the field

1005) (i) Derive an expression for torque acting on a bar magnet held at an angle θ with the direction of magnetic field.
(ii) A bar magnet of magnetic moment 5A-m^2 has poles 0.20 m apart. Calculate the pole strength.

1006) i) Discuss briefly electron theory of magnetism for diamagnetic and paramagnetic materials.
ii) Give two methods to destroy the magnetism of a magnet.

1007) Mandeep's mother had put lot of clothes for washing in the washing machine, but the machine did not start and an indicator was showing that the lid of the machine did not close. Mandeep seeing his mother disturbed thought that, he would close the lid by applying some force but would close the lid by applying some force but realised that the mechanism was different. It was a magnetic system. He went to the shop and got a small magnetic door closer and put it on the lid of the machine. The machine started working. His mother was happy that Mandeep helped her to save 500 rs also.
i) What were the values developed by Mandeep?
ii) What values did his mother impart to Mandeep?
iii) Every magnetic configuration has a North pole and a South pole, What about the field due to toroid?

1008) Bala and rama (Class X students), were assigned a project based on magnetism.In their project work, they had calculated the value of the earth's magnetic field.When they submitted their project for verification.Mr.Santosh, their Physics techer, corrected the mistakes. He also suggested few books which could be useful for them.
i) What values did Mr.Santosh exhibit towards his students? Mention any two.
ii) Mention the three magnetic elements required to calculate the value of the earth's magnetic field.
iii) What is the strength of the earth's magnetic fields at the surface of the earth?

1009) Mr. Sairam, the chief development officer in southern railway went on an official went on an official tour to attend a seminar on fast moving trains. He met his friend Ontosaki in Tokyo after he finished his seminar there. His friend explained to sairam, how Japanese people are concentrating on energy conservation and saving of fossil fuels using Maglev trains.
Mr. Sairam traveled from Tokyo to Osaka in Maglev train and found that noise is less, travelling is smooth and understood in what way we are lagging behind Japnese in mass transporting systems. This works on the principle of Meissner's effect.
i) What values did Mr.sairam found from Ontosaki? Mention any two.
ii) What are superconductors?
iii) What is Meissner's effect?

1010) A monoenergetic(18kev) electron beam initially in the horizontal direction is subjected to a horizontal magnetic field of 0.4 passes normal to the initial direction.Estimate the up or down deflection of the beam over a distance of 30 cm.
$(mc = 9.11 \times 10 - 19C)$.

1011) Two concentric circular coils x and y of radii 16 cm and 10 cm respectively lie in the same vertical plane containing the North to South direction. Coil x has 20 turns and carries a current of 16 A, coil y has 25 turns and carries a current of 18 A. The sense of the current in x is anti-clockwise and clockwise in y, for an observer looking at the coils facing West. Find the magnitude and direcion of the net magnetic field due to the coils at their centre.
Here, we have to find the magnetic field due to two coils. So, first of all find the magnetic fields due to individual coil and find the net field using the law of vector addition, as magnetic field is a vector quantitiy.

1012) State Biot-Savart law giving the mathematical expression for it. Use this law to derive the expression. Use this law to derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis. How does a circular loop carrying current behave as a magnet?

1013) Dimpi's class was shown a video on effects of magnetic field on a current carrying straight conductor. She noticed that the force on the straight current carrying conductor becomes zero when it is oriented parallel to the magnetic field and this force becomes maximum when it is perpendicular to the field. She shared this interesting information with her grandfather in the evening. The grandfather could immediately relate it to something similar in real life situations. He explained it to Dimpi that similar things happen in real life too. When we align and orient our thinking and actions in an adaptive and accommodating way our lives become more peaceful and happy. However, when we adopt an unaccommodating and stubborn attitude, life becomes troubled and miserable. We should therefore always be careful in our response to different situations in life and avoid unnecessary conflicts.

Answer the following based on above information:

(a) Express the force acting on a straight current carrying conductor kept in a magnetic field in vector form. State the rule used to find the direction of this force.

(b) Which one value is displayed and conveyed by the grandfather as well as Dimpi?

(c) Mention one specific situation from your own life which reflects similar values shown by you towards your elders.

1014) Ms. Sumathy wife of Mr. Varadan complained about the non-availability of gas cylinders and explained to him to look out for alternate methods for cooking.

Mr. Varadan bought an induction stove to overcome the fuel problem. The next day Sumathy used her copper bottom cooker and kept it on the induction stove. But even after using it for half an hour she found that the cooker was not hot and food not cooked. As she was not aware of the method to use the induction stove, she asked her elder daughter Dhanya, studying first year engineering about it. She told her, that some vessels can not be used on this stove. She took the instruction manual and explained to her mother, that the stove works on magnetic material, will not respond to it.

(a) What value dis Mr.Varadan and Dhanya exhibit towards Ms. Sumathy?

(b) Give few examples of diamagnetic materials and explain how their susceptiblity varies with temperature?

1015) A magnetic dipole is placed in a uniform magnetic field with its axis tilted with respect to its position of stable equilibrium. Deduce an expression for the time period of (small amplitude) oscillation of this magnetic dipole about an axis, passing through its centre and perpendicular to its plane. If this bar magnet is replaced by a combination of two similar bar magnets, placed over each other, how will the time period vary?