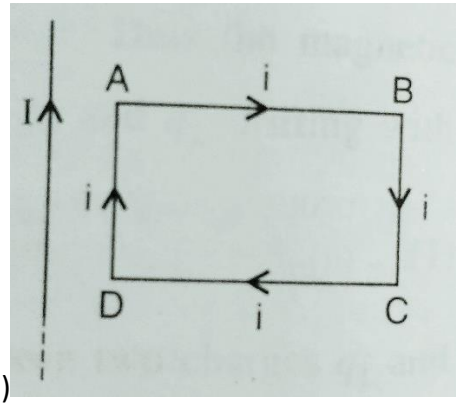
4. Magnetic effect of current

Multiple choice – (Answers of all the multiple type questions given below ; after the multiple type questions)

1. Magnetic induction is measured in:
   (a) weber (b) weber/m (c) weber/m^2 (d) weber/m^3
2. The force acting on a charge q moving with a velocity υ in a magnetic field of induction B is given by:
   (a) $q/(\upsilon \times B)$ (b) $(\upsilon \times B)/q$ (c) $q/(\upsilon \times B)$ (d) $(\upsilon \cdot B)q$
3. Two free parallel wire carrying currents in the opposite directions:
   (a) attract each other
   (b) repel each other
   (c) do not affect each other
   (d) get rotated to be perpendicular to each other
4. Two parallel wires carrying currents in the same direction attract each other because of:
   (a) potential difference between them
   (b) mutual inductance between them
   (c) electric forces between them
   (d) magnetic force between them
5. A free charged particle moves through a magnetic field. The particle may undergo a change in:
   (a) speed (c) direction of motion
   (b) energy (d) none these
6. An electron and a proton travel with equal speeds and in the same direction, at 90° to a uniform magnetic field. They experience forces which are initially:
   (a) in opposite direction and differing by a factor of about 1840
   (b) in the same direction and differing by a factor of about 1840
   (c) equal but in opposite directions
   (d) identical
7. A rectangular loop carrying a current *I* , is situated near a long straight wire such that the wire is parallel to one of the sides of the loop. If a steady current *I* is established in the wire as shown in the figure, the loop will: (figure no:-27.8)



   (a) rotate about an axis parallel to the wire
   (b) move away from the wire
   (c) move towards the wire (d) remain stationary

8. A coil of one turn is made of a wire of certain length and then from the same length a coil of two turns is made. If the same current is passed in both the cases, then the ratio of the magnetic induction at their centres will be:
   (a) 2 : 1 (b) 1 : 4 (c) 4 : 1 (d) 1 : 2

9. A uniform magnetic field acts at right angles to the direction of motion of electrons. As a result, the electron moves in a circular path of radius 2 cm. If the speed of the electrons is doubled, the radius of the circular path will be:
   (a) 2.0 cm (b) 0.5 cm (c) 4.0 cm (d) 1.0 cm
10. If a long copper rod carries a direct current, the magnetic field associated with the current will be:
   (a) only inside the rod
   (b) only outside the rod
   (c) both inside and outside the rod
   (d) neither inside nor outside the rod
11. A proton and an alpha-particle enter a uniform magnetic field with the same velocity. The period of rotation of the alpha-particle will be:
   (a) four times that of the proton
   (b) two times that of the proton
   (c) three times that of the proton
   (d) same as that of the proton
12. If two streams of protons move parallel to each other in the same direction, then these:
   (a) do not exert any force on one another
   (b) repel each other
   (c) attract each other
   (d) get rotated to be perpendicular to each other
13. Two straight long conductors AOB and COD are perpendicular to each other and carrying currents I_1 and I_2. The magnitude of the magnetic induction at a point P at a distance d from the point O in a direction perpendicular to the plane ABCD is:
   (a) $\mu_0/2\pi d(I_1 + I_2)$ (c) $\mu_0/2\pi d(I_1^2 + I_2^2)$
   (b) $\mu_0/4\pi d(I_1 - I_2)$ (d) $\mu_0/2\pi d(I_1 I_2/I_1 + I_2)$
14. The magnetic field *dB* due to a small current element *dl* at a distance r and an element carrying current *I* is:
   (a) $dB = \mu_0 I/4\pi(dl \times r/r)$ (c) $dB = \mu_0 I^2/4\pi(dl \times r/r^2)$
   (b) $dB = \mu_0 I^2/4\pi(dl \times r/r)$ (d) $dB = \mu_0 I/4\pi(dl \times r/r^3)$
15. A circular coil of radius 4 cm and 20 turns carries a current of 3 ampere. It is placed in a magnetic field of 0.5 tesla. The magnetic dipole moment of the coil is:
   (a) 0.3 ampere $\times$ metre^2 (c) 0.60 ampere $\times$ metre^2
   (b) 0.45 ampere $\times$ metre^2 (d) 0.15 ampere $\times$ metre^2
16. 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 masses of X and Y is:
   (a) $(R_1/R_2)^{1/2}$ (b) (R_2/R_1) (c) $(R_1/R_2)^2$ (d) (R_1/R_2)
17. A circular current carrying coil has a radius R. The distance from the centre of the coil on the axis where the magnetic induction will be (1/8)th of its value at the centre of the coil, is:
   (a) $R/\sqrt{3}$ (b) $R\sqrt{3}$ (c) $2R\sqrt{3}$ (d) $(2/\sqrt{3})R$
18. A current of *I* ampere flows in a circular are of wire which subtends an angle of $(3\pi/2)$ radians at its centre, whose radius is R. The magnetic induction B at the centre is:
   (a) $\mu_0 I/R$ (b) $\mu_0 I/2R$ (c) $2\mu_0 I/R$ (d) $3\mu_0 I/8R$
19. An electron and a proton having equal moment enter in a uniform magnetic field normal to the lines of force. If the radii of curvature of circular path be r_e and r_p respectively., then:
   (a) $r_e/r_p = m_e/m_p$ (b) $r_e/r_p = \sqrt{m_e/m_p}$ (c) $r_e/r_p = \sqrt{m_p/m_e}$ (d) $r_e/r_p = 1/1$
20. A proton, a deuteron (nucleus of $_1H^2$) and an α-particle with the same KE enter in a region of uniform magnetic field, moving at right angles to B. What is the ratio of the radii of their circular paths?

(a) 1 : √2 : 1 (b)1 : √2 : √2 (c) √2 : 1 : 1 (d) √2 : √2 : 1

21. Two identical coils carrying equal currents have a common centre and their planes are at right angles to each other. Find the ratio of the magnitudes of the resultant magnetic at the centre and the field due to one coils alone:
(a) 2 : 1 (b) 1 : 1 (c) 1 : √2 (d) √2 : 1

22. Two long parallel wire P and Q are both perpendicular to the plane of the paper with distance of 5 m between them. If P and Q carry current of 2.5 amp and 5 amp respectively in the same direction, then the magnetic field at a point half-way between the wires is:
(a) $(3\mu_0/2\pi)$ (b) (μ_0/π) (c) $(\sqrt{3}\mu_0/2\pi)$ (d) $(\mu_0/2\pi)$

23. An electron of mass m is accelerated through a potential difference of V and then it enters a magnetic field of induction B normal to the lines. Then, the radius of the circular path is:
(a) $\sqrt{2eV/m}$ (b) $\sqrt{2Vm/eB^2}$ (c) $\sqrt{2Vm/eB}$ (d) $\sqrt{2Vm/e^2B}$

24. A straight wire carrying a current I_1 amp runs along the axis of a circular current I_2 amp. Then, the force of interaction between the two current carrying conductors is:
(a) ∞
(b) zero
(c) $\mu_0/4\pi\ 2I_1I_2$ N/m
(d) $2I_1I_2/r$ N/m

25. An arbitrary shaped closed coil is made of a wire of length L and a current *I* ampere is following in it. If the plane of the coil is perpendicular to magnetic field B, the force on the coil is:
(a) 2*IBL* (b) *IBL* (c) zero (d) 1/2*IBL*

26. Magnetic induction at the centre of a circular coil is given by:
(a) $\mu_0 NI/2r$ (b) $\mu_0 Nir^2/r^2 + x^2)^{3/2}$ (c) $\mu_0 NI/2r^2$ (d) $\mu_0 NI/r$

27. A cell is connected between two points of a uniformly thick circular conductor. I_1 and I_2 are the currents following in the two parts of the circular conductor of radius a; then the magnetic field at the centre of the loop will be:
(a) zero (b) $\mu_0/2a\ (I_1 - I_2)$ (c) $\mu_0/2a\ (I_1 + I_2)$ (d) $\mu_0/a\ (I_1 + I_2)$

28. A proton moving with a velocity υ is acted upon by electric field E and magnetic field B. The proton will move undeflected if:
(a) E is perpendicular to B
(b) E is parallel to υ and perpendicular to B
(c) E and B both are parallel to υ
(d) E, B and υ are mutually perpendicular and υ = E/B

29. A circular coil of radius R carries an electric current. The magnetic field due to the coil at a point on the axis of the coil located at a distance r from the centre of coil such that r >>R, varies as:
(a) 1/r (b) $1/r^{1/2}$ (c) $1/r^2$ (d) $1/r^3$

30. The radius of the circular path or helical path followed by the test charge q_0 moving in magnetic field B the some velocity υ is:
(a) $m\upsilon \sin\theta/q_0B$ (b) $m\upsilon \cos\theta/q_0B$ (c) $m\upsilon/q_0B$ (d) $m\upsilon \tan\theta/q_0B$

31. A long solenoid carrying a current produces a magnetic field b along its axis. If the current is doubled and the number of turns per cm is halved, then new value of the magnetic field is:
(a) B (b) 2B (c) 4B (d) B/2

32. Energy associated with a moving charge is due to a:
(a) electric field
(b) magnetic field
(c) both electric field and magnetic field
(d) none of the above

33. An are of a circle of radius R subtends an angle $\pi/2$ at the centre. It carries a current *I*. The magnetic field at the centre will be:
(a) $\mu_0 I/2R$ (b) $\mu_0 I/8R$ (c) $\mu_0 I/4R$ (d) $2\mu_0 I/5R$
34. A current i ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any points inside the tube is:
(b) infinite (b) zero (c) $\mu_0 I/4R$ 2i/r tesia (d) 2i/r tesia
35. A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of n turns. The magnetic field at the centre of the coil will be:
(a) nB (b) n^2B (c) 2nB (d) $2n^2B$

36. Two long conductors, separated by a distance d carry currents I_1 and I_2 in the same direction. They exert a force F on each other. Now, the current in on of them is increased to two times and its direction is reversed. The distance is also increased to 3d. The new value of force between them is:
(a) -2F (b) F/3 (c) -2F/3 (d) -F/3
37. A straight wire of mass 200 g and length 1.5 m carries a current of 2A. It is suspended in mid-air by a uniform horizontal magnetic field B. The magnitude of B (in tesla) is: (assume g = 9.8 ms^{-2})
(a) 2 (b) 1.5 (c) 0.55 (d) 0.66
38. Graph of force per unit length between two long parallel current carrying conductors and the distance between them is:
(a) straight line (b) parabola (c) ellipse (d) rectangular hyperbola
39. When a positively charged particle enters in 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) ot (ii) (c) (i) or (iii) (d) any one of (i), (ii) and (iii)
40. Two similar coils are kept mutually perpendicular such that their centre coincide. At the centre, find the ratio of the magnetic field due to coil and the resultant magnetic field through both coils, if the same current flows:
(a) 1 : √2 (b) 1 : 2 (c) 1 : 3 (d) 3 : 1
41. A proton and a deuteron with the same initial kinetic energy enter in a magnetic field in a direction perpendicular to the direction of the field. The ratio of the radii of the circular trajectories described by them is:
(a) 1 : 4 (b) 1 : √2 (c) 1 : 1 (d) 1 : 2
42. Two circular coils of radius R and 2R carry current I and 2I respectively. If magnetic induction at their centres are B_1 and B_2 then B_1/B_2 is:
(a) 1 : 1 (b) 1 : 2 (c) 1 : 4 (d) 2 : 1
43. Magnetic field intensity H at the centre of a circular loop of radius r carrying current *I* emu is:
(a) r/*I* oersted (b) 2 πr/r oersted (c) *I*/2 πr oersted (d) 2 πr/*I* oersted
44. A wire of length 2 m carrying a current of 1 A is bent to from a circle. The magnetic moment of the coil is:
(a) 2π Am^2 (b) $1/\pi$ Am^2 (c) π Am^2 (d) $2/\pi$ Am^2
45. A current loop consists of two identical semi-circular parts each of radius R, one lying in the x , y-plane and the other in x, z-plane. If the current in the loop is i. The resultant magnetic field due two semi-circular parts at their common centre is:
(a) $\mu_0 i/2\sqrt{2}R$ (b) $\mu_0 i/2R$ (c) $\mu_0 i/4R$ (d) $\mu_0 i/\sqrt{2}R$
46. A current *I* flows in an infinitely long wire with cross-section in the from of a semi-circular ring of radius R. The magnitude of the magnetic induction along its axis is:

(a) $\mu_0 I/\pi^2 R$ (b) $\mu_0 I/2\pi^2 R$ (c) $\mu_0 I/2\pi R$ (d) $\mu_0 I/4\pi R$

47. A proton, a deuteron and an α-particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If rp , rd and rα denote respectively the radii of the trajectories of these particles then:
(a) $r_\alpha = r_d > r_p$
(b) $r_\alpha = r_d = r_p$
(c) $r_\alpha < r_d < r_p$
(d) $r_\alpha = r_p < r_d$
(e) $r_\alpha > r_d > r_p$

48. Two particles A and B having equal charges +6C, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii 2 cm and 3 cm respectively. The ratio of mass of A to that of B is:
(a) 4/9 (b) 9/5 (c) 1/2 (d) 1/3 (e) 9/4

49. A long straight wire of radius a carries a steady current *I*. The current is uniformly distributed over its cross-section. The ratio of magnetic fields B and B' radial distances a/2 and 2a respectively, from the axis of the wire is:
(a) 1/4 (b) 1/2 (c) 1 (d) 4

Ans – 1.- c , 2.- c ,3- b 4- d 5- c

6-c 7- c 8- b 9- c 10- c

11- b 12- b 13- c 14- d 15- a

16- c 17- b 18- d 19- d 20- a

21-d 22- d 23- b 24- b 25- c

26- a 27- a 28- d 29- d 30- a

31- a 32- a 33- c 34- b 35- b

36- c 37- d 38- d 39- d 40- a

41- b 42- a 43- b 44- b 45- a

46- a 47- d 48- a 49- c

Fill in the blanks-

Fill in the blanks-

1. Current sensitivity of a galvanometer can be increased by decreasing_____.

Ans. [Cs = $\frac{NBA}{C}$] Torsional Constant or restoring couple per unit twist.

2. To convert galvanometer in to a voltmeter of given range, a suitable high resistance should be connected in with the galvanometer.

Ans. Series R = $\left(\frac{V}{I_g} - G\right)$

3. When a magnetic dipole of moment $\vec{M}$ rotates freely about its axis from unstable equilibrium to stable equilibrium in a magnetic field $\vec{B}$, the rotational kinetic energy gained by it is___.

Ans. 2 MB [$\Delta K = \Delta U = MB - (-MB)$

]

4. An electron passes undeflected when passes through a region with electric and magnetic fields. When electric field is switched off its path will change to_____.

Ans. Circular

5. The ratio of angular momentum (L) to magnetic moment (M) of an electron revolving in a circular orbit is _.

Ans. M = $\frac{e}{2m}$ L

6. The path of charged particle moving perpendicularly with $\vec{B}$ is_____.

Ans. Path of the charged particle will be circular.

7. There is no change in the_____as a charged particle moving in a magnetic field, although magnetic force is acting on it.

Ans. When a charge particle moves through the magnetic field, its kinetic energy remains constant.

8. Two linear parallel conductors carrying currents in the opposite direction ----------each other.

Ans. (repel)

9. When a coil carrying current is set with its plane perpendicular to the direction of magnetic field, then torque on the coil is----------.

Ans. (zero)

10. A linear conductor carrying current if placed parallel to the direction of magnetic field, then it experiences ---------- force.

Ans. (No) F = I*l*B sinθ and θ = 0°

11. Electric current flows through a thick wire. Magnetic field at a point on its surface is $(B=\mu_o I/2\pi R)$ and is_____on its axis.

Ans. (zero)

12. Torque on a current carrying rectangular coil inside a galvanometer is maximum and constant irrespective of its orientation as it is suspended inside_____magnetic field.

Ans. (radial)

Very short answer type questions (1 marks)-

1- Define one ampere as SI unit of current .

2- What is the work done by a uniform magnetic field on charged particle moving through it?

3- What is the values of angle of dip at (i) magnetic equator (ii) magnetic poles?

4- Why electrons cannot be accelerated by a cyclotron?

5- Why are the pole pieces of a magnet in a moving coil galvanometer made cylindrical?

6- Under what condition an electron moving though a magnetic field experiences (i) no force (ii) maximum force?

7- State two properties of the material of the wire used for suspension of the coil in a moving coil galvanometer?

8- What will be the path of a charged particle moving along the direction of a uniform magnetic field?

9- When a charge particle is moving with velocity v is subjected to magnetic field B , the force experience on it is non zero . would the particle gain any energy?

10- A long straight wire carrying current I in y -axis and a particle of charge +Q is moving with velocity v in positive X-axis in which direction will the particle experience a force ?

11- Under what condition the force experience on the charged particle will be (i) minimum (ii) maximum (iii) zero .

12- In what condition the path followed by the charge particle In a uniform magnetic field will be (i) circular (ii) helical ?

13- What is the nature of magnetic field in a moving coil galvanometer ?

14- Give two factors by which sensitivity of the galvanometer can be increased?

15- Why should the ammeter have low resistance?

16- Why should the voltmeter have high resistance?

17- What should be the orientation of magnetic dipole in a uniform magnetic field so that its potential energy is (i) maximum (ii) minimum ?

Short answer type questions (2 marks)-

4. Write the expression for the force acting on a charged particle of charge q moving with velocity is in the presence of magnetic field B. Show that in the presence of this force (a) The K.E. of the particle does not change. (b) Its instantaneous power is zero.

7. What is radial magnetic field? How it is obtained in moving coil galvanometer?

1. Two wires of equal lengths are bent in the form of two loops. One of the loop is square shaped whereas the other loop is circular .These are suspended in a uniform magnetic field and the same current is passed through them. Which loop will experience greater torque? Give reasons?

2. A cyclotron is not suitable to accelerate electron. Why? [

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

1- explain the law which is used to find the magnetic field at a point due to small current carrying element. Using this law find the magnetic field at the centre of a circular coil.

2- state Ampere circuital law , use this law to find the magnetic field line due to straight infinite current carrying wire. How are the magnetic field line different from electric field lines?

3-What is meant by crossed electric and magnetic fields? Under what condition a charged particle entering a crossed electric and magnetic fields passes undeflected?

4-Derive the expression for the magnetic energy stored in a solenoid in terms of magnetic field B , area A and length ∫ of the solenoid carrying a steady current I . How does this magnetic energy. per unit volume compare with the electrostatic energy density stored in a parallel plate capacitor.

10-A galvanometer can be converted into a voltmeter to measure upto.

(i) V volts by connecting a resistance R_1 in series with coil.
(ii) V/2 volts by connecting a resistance R_2 in series with coil.

Find the resistance (R) , in terms of R_1 and R_2 required to convert it into a voltmeter that can read upto '2V' volts.

Long answer type questions (3 and 5 marks)-

1- Express Biot- savart law in the vector form . Use it to explain the magnetic field at an axial point, distance d from the centre of a circular coil of radius r carrying current I . also find the ratio of the magnitudes of the magnetic field of this coil at the centre and at an axial pint for which x= r √3 .

2- State and prove Ampere circuital law .How a toroid is different from solenoid ? use Ampere circuital law to obtain the magnetic field inside the solenoid and toroid.

4- With the help of neat and labelled diagram explain the principle and working of a moving coil galvanometer. What is the function of redial magnetic field and how it is produced? Define current and voltage sensitivity of a galvanometer and how it is increased.

5. On what factors the force experience on a moving charge in a uniform magnetic field depend, and how can you explain its direction . Also derive an expression for the force acting on a current carrying conductor placed in a uniform magnetic field Name the rule which gives the direction of the force. Write the condition for which this force will have (1) maximum (2) minimum value?

6. State Ampere's law . A straight thick long wire of uniform crossectional circular area of radius 'a' is carrying a steady current I . The current is uniformly distributed across the cross-section . Use ampere circuital law at obtain a relation showing the variation of the magnetic field B inside and outside the wire with distance r , (r<R) and (r>R) of the field point from the centre of the cross-section . Plot a graph showing the nature of this variation . Also calculate the ratio of magnetic field at a point a/2 above the surface of the wire to that of point a/2 below its surface.

7-Two infinite long parallel wire carrying current i_1 and i_2 in the same direction separated by distance d . obtain the expression for the magnetic field on wire 2 due to wire 1 . hence find out the force per

unit length on wire 2 due to 1 also draw the diagram . how does the nature of force changes if direction of current in 1 and 2 is opposite? Also define one Ampere using this derivation.

8. Find the expression for the torque experience on a current carrying coil placed in uniform magnetic field . what is the conditions when torque is maximum and where torque is minimum . Also states on what factors the torque experience depends.

9. (a) Draw a labelled diagram of a moving coil galvanometer. Prove that in a radial magnetic field, the deflection of the coil is directly proportional to the current flowing in the coil. (b) A galvanometer can be converted into a voltmeter to measure upto (i) V volt by connecting a resistance R_1 series with the coil (ii) 2 v volt by connecting a resistance R_2 in series with coil Find R in terms of R_1 and R_2 required to convert – it into a voltmeter that can read upto '2v' volt.

10. What is cyclotron? Explain its working principle? Show that cyclotron frequency is independent of velocity of the charged particle also write two limitation of cyclotron.

Numericals-

1. Write the four measures that can be taken to increase the sensitivity of a galvanometer.

2. A proton and an alpha particle of the same enter, in turn, a region of unifor magnetic field acting perpendicular to their direction of motion with same kinetic energy. Deduce the ratio of the radii of the circular paths described the proton and alpha particle.

3. Mention two properties of soft iron due to which it is preferred for making electromagnet.

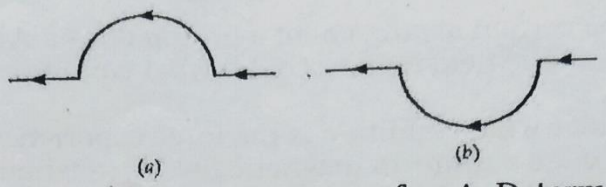
4. A circular coil of n turns and radius R carries a current I. It is unwound an rewound to make another square coil of side 'a' keeping number of turns a current same. Calculate the ratio of magnetic moment of the new coil and t original coil.

5. At a place horizontal component of the earth's magnetic field is B and angl dip at the place is 60°.What is the value of horizontal component of the ea magnetic field,
   (i) at equator and (ii) at a place where dip angle is 30°?

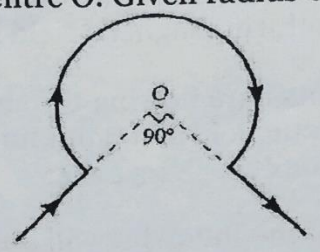
6. A galvanometer of resistance 120Ω gives full scale deflection for a current 5mA. How can it be converted into an ammeter of range 0 to 5A? Also determine the net resistance of the ammeter.

7. A current of 10A flows through a semicircular wire of radius 2 cm as show figure (a). What is direction and magnitude of the magnetic field at the ce

of semicircle? Would your answer change if the wire were bent as shown in figure (b)?



8. The wire shown in diagram carries a current of 10 A. Determine the magnitude of the magnetic field at the centre O. Given radius of the bent coil is 3 cm.



9. A bar magnet of magnetic moment 2.5 Am^2 is free to rotate about a vertical axis through its centre. The magnet is released from rest from the east-west direction. Fin the kinetic energy of the magnet as it aligns itself in the north-south direction. The horizontal component of earth's magnetic field iso.3 G.

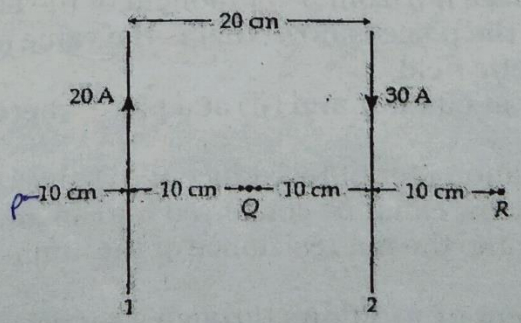
10. A coil of N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius R/2, current remaining the same. Calculate the ratio of the magnetic moment of the new coil and original coil.

11. What will be (i) pole strength (ii) magnetic moment of each of new piece of bar magnet if the magnet is cut into two equal pieces:
    (a) normal to its length
    (b) along its length.

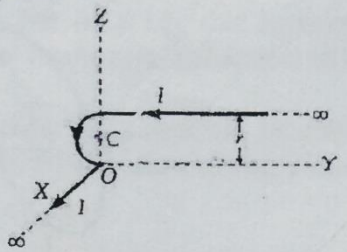
12. A galvanometer coil has a resistance G. 1% of the total current goes through the coil and rest through the shunt. What is the resistance of the shunt?

13. A magnetic dipole of magnetic moment M is kept in a magnetic field B. What is the minimum and maximum potential energy? Also give the most stable position and most unstable position of magnetic dipole.

14. Figure shows two current-carrying wires 1 and 2. Find the magnitudes and directions of the magnetic field at points P, Q and R.



15. Find the magnetic field at point O.

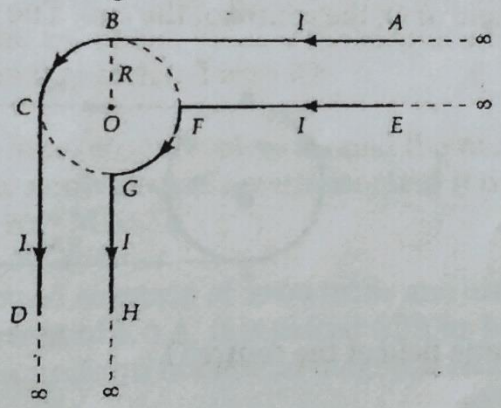


16. A rectangular loop of metallic wires of length a and breadth b and carries current I. Find the magnitude of the magnetic field at the centre O of the loop.

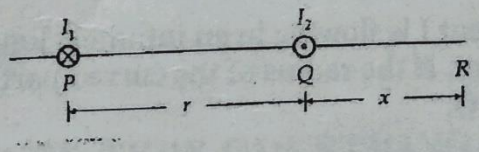
17. In the Bohr model of hydrogen atom, an electron revolves around the nucleus of a circular orbit of radius 5.11×10^{-11} m at a frequency of 6.8×10^{15} Hz. What is the magnetic field set up at the centre of the orbit?

18. A magnetic dipole is placed in the position of stable equilibrium in a uniform magnetic field B (i) How much is the potential energy of the magnet?
(ii) If it is rotated through 180 o,then what will be the amount of work done?

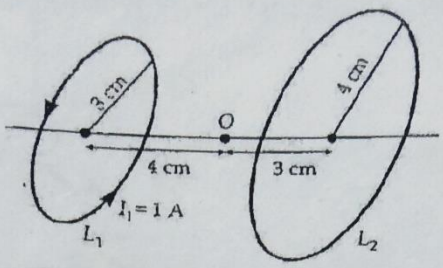
19. Two infinitely long wires carry equal current I. Each wire follows a 90 degree arc along the circumference of the circle of same radius R as shown in fig. below. Find the magnetic field at the centre O.



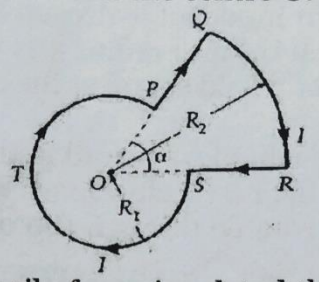
20. Two parallel wires P and Q placed at a separation of r = 6 cm carry electric currents $I_1 = 5$ A and $I_2 = 2$ A in opposite directions as shown in figure. Find the point on the line PQ where the resultant magnetic field is zero.



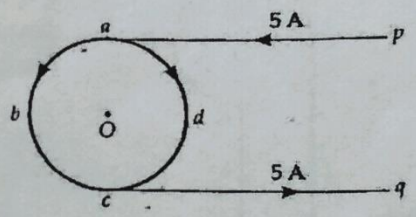
21. Two coaxial circular loops L_1 and L_2 of radii 3 cm and 4 cm are placed as shown. What should be the magnitude and direction of the current in the loop L_2 so that the net magnetic field at the point O be zero?



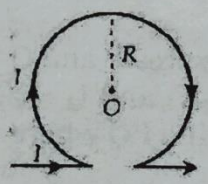
22. Figure shows a current loop having two circular segments and joined by two radial lines. Find the magnetic field at the centre O.



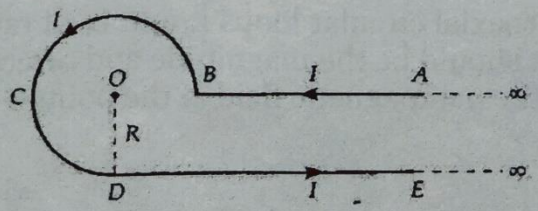
23. In figure, a b c d is a circular coil of non-insulated thin uniform conductor. Conductors pa and qc are very long straight parallel conductors tangential to the coils at the points a and c. If a current of 5 A enters the coil from p to a, find the magnetic field at O, the centre of the coil. The diameter of the coil is 10 cm.



24. Find the magnetic field at the centre O



25. A current I is flowing in an infinitely long conductor bent into the shape shown in figure. If the radius of the curved part is R, find the magnetic field at the centre O.



26. A circular segment of radius 10 cm subtends an angle of 60° at its centre. A current of 9 A is flowing through it. Find the magnitude and direction of the magnetic field produced at the centre.

27. A galvanometer has a current range 15 mA and voltage range 750 mV . How will you convert it into an ammeter of range 25 A ?

28. A cyclotron's oscillator frequency is 10MHz what should be the operating magnetic field for accelerating protons? If radius of its Dees is 20cm, what is the K.E .of the proton beam produced by the accelerator?(e = 1.6 ×10-19c , mp = 1.6 ×10-27kg 1Mev = 1.602×10-13J

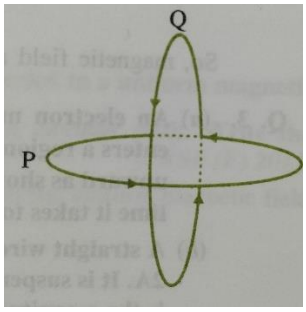
29. A straight wire carries a current of 10A. An electron moving at 107 m/s is 2.0 cm from the wire. Find the force acting on the electron if its velocity is directed towards the wire?

30. An electron of kinetic energy 25KeV moves perpendicular to the direction of a uniform magnetic field of 0.2 mT, calculate the time period of rotation of the electron in the magnetic field?

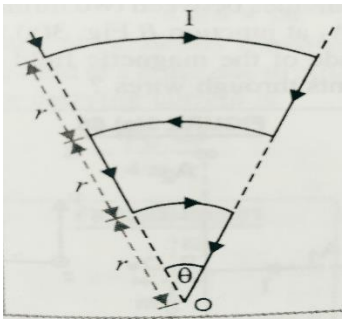
31. It is desired to pass only 10% of the current through a galvanometer of resistance 90Ω. How much shunt resistance be connected across the galvanometer?

32. A uniform magnetic field of 6.5×10^{-4} T is maintained in a chamber . An electron enters into the field with a speed of 4.8×10^{6} m/s normal to the field . Explain why the path of the electron is a circle . Determine its frequency of revolution in the circular orbit. Does the frequency depend on the speed of the electron ? Explain.

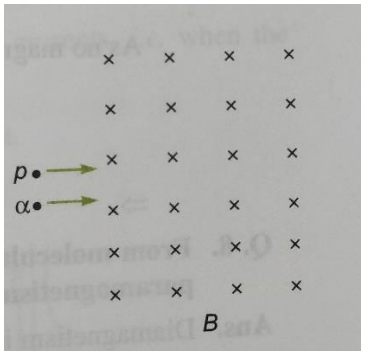
33. If two circular coils of equal radii are placed co-axially such that their planes are perpendicular to each other , if the same current flows through them then find the magnetic field at the common centre . (Take your own direction of current in each coil) .



34.find the magnetic field at the centre ' o ' as shown in fig.



35.An alpha particle and a proton moving with the same speed enters into uniform magnetic field 'B' as shown in fig. Show the trajectory followed by them and also find the ratio of their radii .

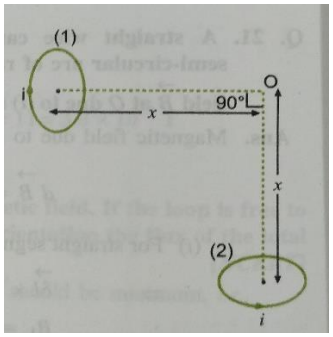


37.

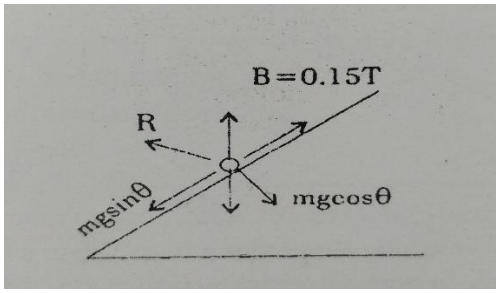
Hots –

1. The magnitude F of the force between two straight parallel current carrying conductors kept at a distance 'd' apart in air given by $F= \mu_0 I_1 I_2 /2\pi d$, where I_1 and I_2 are the current flowing through the wires use this expression and sign convention. Draw the graph showing the variation of force F on (i) $I_1 I_2$ when d is kept constant . (ii) d with the product $I_1 I_2$ kept constant (i) d when $I_1 I_2$ is maintained at constant negative value .

2. Two small identical circular loops carrying equal current , are placed with the geometrical axes perpendicular to each other as shown in fig. find the magnitude and direction of the net magnetic field produced at point O .



3. an electron moving through the uniform magnetic field does not experience any force under what conditions it is possible 4. On a smooth plane inclined at 30^0 with the horizontal , a thin current carrying rod is placed horizontally . The plane is located in a magnetic field of 0.15 T in the vertical direction . for what value of the current can the rod remain stationary ? the mass per unit length of the wire is 0.30 g/m .



5. A neutron , an electron and an alpha particle moving with equal velocities , enter in a uniform magnetic field going into the plane of the paper as shown in fig , trace their path and justify your answer.