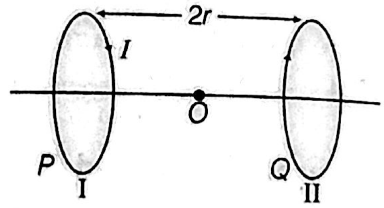
magnetism:CBSE

1 Mark Question

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

2 Marks Questions

2. 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.



3. 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.

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

5. 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.

6. 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?

3 Marks Questions

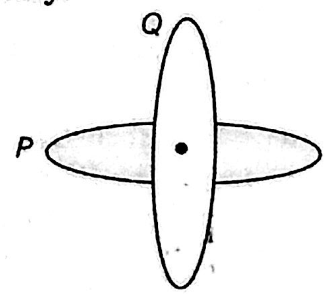
7. (i) Derive with the help of diagram, the expression for the magnetic field inside a very long solenoid having n turns per unit length carrying a current I.
   (ii) How is a toroid different from a solenoid?

8. (i) State Biot Savart law and express it in the vector form.
   (ii) Using Biot Savart law, obtain the expression for the magnetic field due to a circular coil of radius r, carrying a current I at a point on its axis distant x from the centre of the coil.

9. (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 1 A 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.

10. 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.



11. 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.

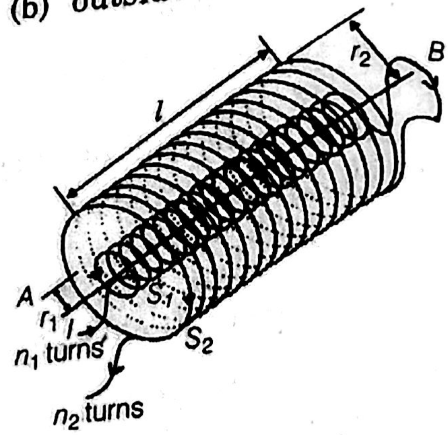
Draw the magnetic field lines due to a circular wire carrying current (I).

12. (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

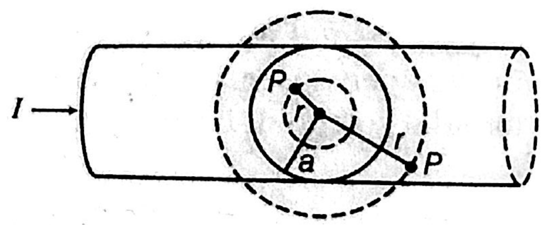
(b) outside the combined system.



13. (i) How is a toroid different from a solenoid?

(ii) Use Ampere's circuital law to obtain the magnetic field inside a toroid.

14. 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. Derive the expressions for the magnetic field in the region (i) $r < a$ and (ii) $r > a$.



15. A long straight wire of a circular cross-section of radius a carries a steady current I. The current is uniformly distributed across the cross-section. Apply Ampere's circuital law to calculate the magnetic field at a point in the region for (i) $r < a$ and (ii) $r > a$.

5 Marks Questions

16. (i) Write using Biot-Savart law, the expression for the magnetic field B due to an element dl carrying current I at a distance **r** from it in a vector form.

Hence, derive the expression for the magnetic field due to a current carrying loop of radius R at a point P and distance x from its centre along the axis of the loop.

(ii) Explain how Biot-Savart law enables one to express the Ampere's circuital law in the integral form, *viz*.

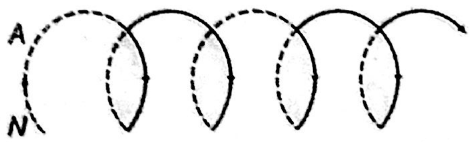
$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I$$

where, I is the total current passing through the surface.

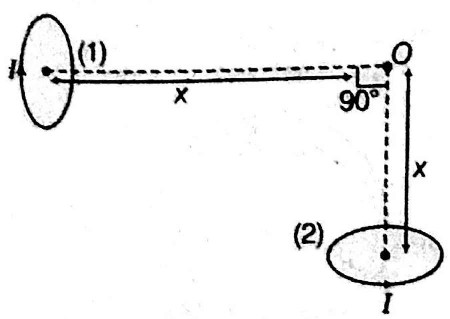
17. (i) State Ampere's circuital law. Use this law to obtain the expression for the magnetic field inside an air cored toroid of average radius r, having n turns per unit length and carrying a steady current I.

(ii) An observer to the left of a solenoid of N turns each of cross-section areas A observes that a steady current I 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 $m = NIA$.



18. Two very small identical circular loop (1) and (2) carrying equal current I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point O.



19. State Biot-Savart's law expressing it in the vector form. Use it to obtain the expression for the magnetic field at an axial point distance d from the centre of a circular coil of radius a carrying current I. Also, find the ratio of the magnitudes of the magnetic field of this coil at the centre and at an axial point for which $d = a\sqrt{3}$.

20. State Biot-Savart's law and give the mathematical expression for it.

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?

21. (i) Using Ampere's circuital law, obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis.

(ii) In what respect, is a toroid different from a solenoid? Draw and compare the pattern of the magnetic field lines in the two cases.

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

22. (i) State Ampere's circuital law.

(ii) Use it to derive an expression for magnetic field inside along the axis of an air cored solenoid.

(iii) Sketch the magnetic field lines for a finite solenoid. How are these field lines different from the electric field lines from an electric dipole?

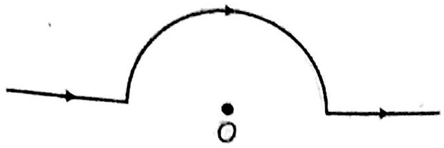
23. (i) Using Biot-Savart's law, deduce an expression for the magnetic field on the axis of a circular current carrying loop.

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

(iii) A straight wire carrying a current of 12 A is bent into a semi-circular arc of radius 2.0 cm as shown in the figure. What is the magnetic field **B** at O due to

(a) straight segments and

(b) the semi-circular arc?



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

(ii) What does a toroid consist of? Show that for an ideal toroid of closely wound turns, the magnetic field

(a) inside the toroid is constant.

(b) in the open space inside and exterior to the toroid is zero.

1 Mark Questions

1. Write the relation for the force acting on a charged particle q moving with velocity $\mathbf{v}$ in the presence of a magnetic field $\mathbf{B}$.

2. When a charge q is moving in the presence of electric (E) and magnetic (B) fields 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.

3. Two protons of equal kinetic energies enter a region of uniform magnetic field. The first proton enters normal to the field direction while the second enters at 30° to the field direction. Name the trajectories followed by them.

4. 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?

5. 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?

6. 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 radii of the circular path described by them?

7. 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 F_B acting on them are in the ratio of 1 : 2, find the ratio of their velocities.

8. A beam of α-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?

9. Use the expression $\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$ to define the SI unit of magnetic field.

2 Marks Questions

10. 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 ?

11. A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30° 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.

12. 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.

13. 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**.

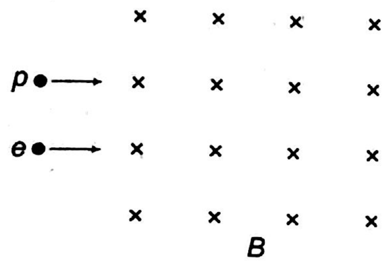
14. State the underlying principle of a cyclotron. Write briefly how this machine is used to accelerate charged particles to high energies.

15. 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.

16. 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.

17. 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.



18. 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

3 Marks Questions

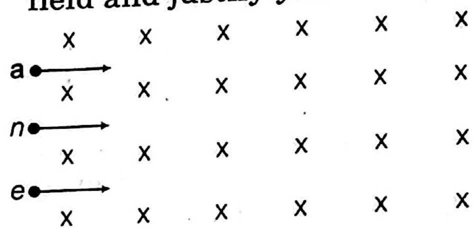
19. Draw a labelled diagram of cyclotron. Explain its working principle. Show that cyclotron frequency is independent of the speed and radius of the orbit.

20. State the underlying principle of a cyclotron. Explain its working with the help of a schematic diagram. Obtain the expression for cyclotron frequency.

21. (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.

22. (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

23. (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.



24. 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.

25. 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.

5 Marks Questions

26. (i) 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.
 (ii) Draw a schematic sketch of a cyclotron. Explain the essential details of its construction how it is used to accelerate the charged particles?

27. (i) Draw a schematic sketch of a cyclotron. Explain clearly the role of crossed electric and magnetic field in accelerating the charge. Hence, derive the expression for the kinetic energy acquired by the particles.

(ii) An α-particle and a proton are released from the centre of the cyclotron and made to accelerate.

(a) Can both be accelerated at the same cyclotron frequency? Give reason to justify your answer.

(b) When they are accelerated in turn, which of the two will have higher velocity at the exit slit of the dees?

28. Write the expression for the force **F**, acting on a charged particle of charge q moving with a velocity **v** in the presence of both electric field **E** and magnetic field **B**. Obtain the condition under which the particle moves undeflected through the fields.

29. With the help of a labelled diagram, state the underlying principle of a cyclotron. Explain clearly how it works to accelerate the charged particles?

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

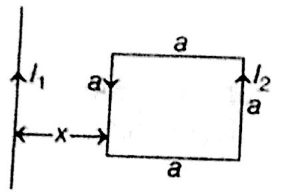
30. Draw a schematic sketch of a cyclotron. State its working principle. Describe briefly, how it is used to accelerate charged particles? Show that the period of a revolution of an ion is independent of its speed or radius of the orbit. Write two important uses of a cyclotron.

1 Mark Questions

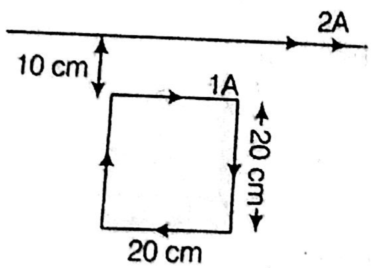
1. Write the underlying principle of a moving coil galvanometer.
2. Using the concept of force between two infinitely long parallel current carrying conductors define one ampere of current.
3. Is the steady electric current the only source of magnetic field? Justify your answer.

2 Marks Questions

4. A square loop of side a carrying a current I_2 is kept at distance x from an infinitely long straight wire carying a current I_1 as shown in the figure. Obtain the expression for the resultant force acting on the loop.



5. A square loop of side 20 cm carrying current of 1A kept near an infinite 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.

6. 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.

7. (i) Two long straight parallel conductors a and b carrying steady currents I_a and I_b respectively are separated by a distance d. Write the magnitude and direction, 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

8. 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 current I same, find the ratio of the magnetic moments of the square coil and the circular coil.

9. 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.

10. A circular 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 I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

11. 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.

12. 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.

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

14. A square coil of side 10 cm has 20 turns and carries a current of 12 A. The coil is suspended vertically and normal to the plane of the coil, makes an angle θ with the direction of a uniform horizontal magnetic field of 0.80 T. If the torque, experienced by the coil equals 0.96 N-m, find the value of θ.

3 Marks Questions

15. Two infinitely long straight wires A_1 and A_2 carrying currents I and $2I$ flowing in the same directions are kept d distance apart. Where should a third straight wire A_3 carrying current 1.5 I be placed between A_1 and A_2, so that it experiences no net force due to A_1 and A_2? Does the net force acting on A_3 depend on the current flowing through it?

16. (i) Derive the expression for the torque acting on a current carrying loop placed in a magnetic field.
(ii) Explain the significance of a radial magnetic field when a currrent carrying coil is kept in it.

17. (i) State the underlying principle of a moving coil galvanometer.
(ii) Give two reasons to explain why a galvanometer cannot as such be used to measure the value of the current in a given circuit.
(iii) Define the terms (i) voltage sensitivity and (ii) current sensitivity of a galvanometer.

18. (i) Define SI unit of current in terms of the force between two parallel current carrying conductors.
(ii) Two long straight parallel conductors carrying steady currents I_a and I_b along the same directions are separated by a distance d. How does one explain the force of attraction between them? If a third conductor carrying a current I_c in the opposite direction is placed just in the middle of these conductors, find the resultant force acting on the third conductor.

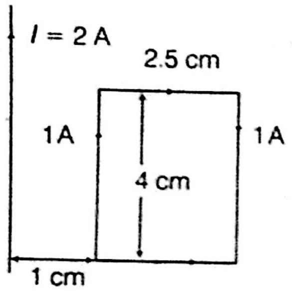
19. An electron of mass m_e revolves around a nucleus of charge $+Ze$. Show that it behaves like a tiny magnetic dipole. Hence, prove that the magnetic moment associated with it is expressed as $\mu = -\frac{e}{2m_e}\mathbf{L}$, where **L** is the orbital angular momentum of the electron. Give the significance of negative sign.

20. Two long straight parallel conductor carry steady current I_1 and I_2 separated by a distance d. If the currents are flowing in the same direction, show how the magnetic field set up in one produces an attractive force on the other. Obtain the expression for this force. Hence, define one ampere.

21. State the principle of working of a galvanometer. A galvanometer of resistance G is converted into a voltmeter to measure upto 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 upto $V/2$ 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 upto 2V. Also, find the resistance G of the galvanometer in terms of R_1 and R_2.

22. A wire AB is carrying a steady current of 12A and is lying on the table. Another wire CD carrying 5A is held directly above AB at a height of 1 mm. Find the mass per unit length of the wire CD, so that it remains suspended at its position when left free. Give the direction of the current flowing in CD with respect to that in AB. [Take, the value of $g = 10\ \text{ms}^{-2}$]

23. A rectangular loop of wire of size 2.5 cm × 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.



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

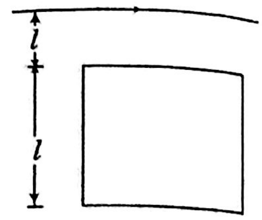
25. Depict the magnetic field lines due to two straight, long, parallel conductors carrying currents I_1 and I_2 in the same direction. Hence, deduce an expression for the force per unit length acting on one of the conductors due to the other. Is this force attractive or repulsive?

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

27. State the underlying principle of working of a moving coil galvanometer. 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.

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

29. Write the expression for the magnetic moment (m) due to a planar square loop of side l carrying a steady current I in a vector form. 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.

5 Marks Questions

30. 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? Define the terms (i) current sensitivity and (ii) voltage sensitivity of a galvanometer.

Why does increasing the current sensitivity not necessarily increase voltage sensitivity?

31. (i) Draw a labelled diagram of a moving coil galvanometer. Describe briefly its principle and working.

(ii) Answers the following questions.

(a) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer?

(b) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Explain with giving reasons.

32. (i) State using a suitable diagram, the working principle of a moving coil galvanometer. What is the function of a radial magnetic field and the soft iron core used in it?

(ii) For converting a galvanometer into an ammeter, a shunt resistance of small value is used in parallel, whereas in the case of a voltmeter a resistance of large value is used in series. Explain, why?

33. (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.

34. A rectangular loop of size $l \times b$ carrying a steady current I is placed in a uniform magnetic field **B**. Prove that the torque τ acting on the loop is given by $\tau = \mathbf{m} \times \mathbf{B}$, where, **m** is the magnetic moment of the loop.

35. (i) Draw a schematic sketch of a cyclotron, explain its working principle and deduce the expression for the kinetic energy of the ions accelerated.

(ii) Two long and parallel straight wires carrying currents of 2A and 5 A in the opposite directions are separated by a distance of 1 cm. Find the nature and magnitude of the magnetic force between them.

36. (i) Show that a planer loop carrying a current I, having N closely wound turns and area of cross-section A, possesses a magnetic moment $\mathbf{m} = NI\mathbf{A}$.

(ii) When this loop is placed in a magnetic field **B**, find out the expression for the torque acting on it.

(iii) A galvanometer coil of 50 Ω resistance shows full scale deflection for a current of 5 mA. How will you convert this galvanometer into a voltmeter of range 0 to 15 V?

37. (i) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

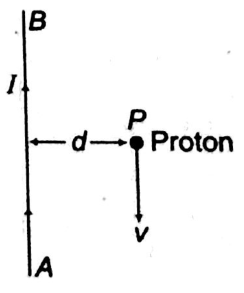
(ii) What is the importance of radial magnetic field and how is it produced?

(iii) 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?

38. (i) Derive an expression for the force between two long parallel current carrying conductors.

(ii) Use this expression to define SI unit of current.

(iii) 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?



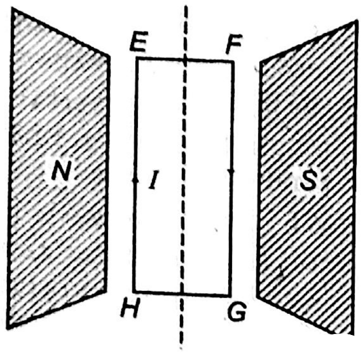
39. (i) Two straight long parallel conductors carry currents I_1 and I_2 in the same direction.

Deduce the expression for the force per unit length between them. Depict the pattern of magnetic field lines around them.

(ii) A rectangular current carrying loop *EFGH* is kept in a uniform magnetic field as shown in the figure.

(a) What is the direction of the magnetic moment of the current loop?

(b) When is the torque acting on the loop maximum and zero?



2 Marks Question

1. 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.

3 Marks Questions

2. Prove that the magnetic moment of the electron revolving around a nucleus in an orbit of radius r with orbital speed v is equal to $evr/2$. Hence using Bohr's postulate of quantisation of angular momentum, deduce the expression for the magnetic moment of hydrogen atom in the ground state.

3. (a) State Gauss's law for magnetism. Explain its significance.

   (b) Write the four important properties of the magnetic field lines due to a bar magnet.

4. A bar magnet of magnetic moment 6 J/T is aligned at 60° with a uniform external magnetic field of 0.44 T. Calculate (a) the work done in turning the magnet to align its magnetic moment (i) normal to the magnetic field, (ii) opposite to the magnetic field and (b) the torque on the magnet in the final orientation in case (ii).

1 Mark Questions

1. The magnetic susceptibility of magnesium at 300K is 1.2×10^5. At what temperature will its magnetic susceptibility become 1.44×10^5?

2. The magnetic susceptibility of χ of a given material is -0.5. Identify the magnetic material.

3. 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?

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

5. Relative permeability of a material $\mu_r = 0.5$. Identify the nature of the magnetic material and write its relation of magnetic susceptibility.

6. What are permanent magnets? Give one example.

7. Where on the surface of earth is the vertical component of earth's magnetic field zero?

8. The horizontal component of the earth's magnetic field at a place is B and angle of dip is 60°. What is the value of vertical component of the earth's magnetic field?

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

10. 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?

11. Where on the surface of earth is the angle of dip 90°?

12. The permeability of a magnetic material is 0.9983. Name the type of magnetic material, it represents

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

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

15. What is the characteristic property of a diamagnetic material?

2 Marks Questions

16. (i) Define the term magnetic susceptibility and write its relation in terms of relative magnetic permeability.
   (ii) Two magnetic materials *A* and *B* have relative magnetic permeabilities of 0.96 and 500. Identify the magnetic materials *A* and *B*.

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

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

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

20. (i) How is an electromagnet different from a permanent magnet?
   (ii) Write two properties of a material which makes it suitable for making electromagnet.

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

22. (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.

23. 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?

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

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

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

27. (i) Write two characteristics of a material used for making permanent magnets?
(ii) Why is core of an electromagnet made of ferromagnetic materials?

28. The horizontal component of the earth's magnetic field at a place is $\sqrt{3}$ times its vertical component there. 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?

29. The horizontal component of the earth's magnetic field at a place equals to its vertical component there. 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?

30. 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?

3 Marks Questions

31. Write three points of differences between para-, dia- and ferro- magnetic materials, giving one example for each.

32. The susceptibility of a magnetic material is 0.9853. Identify the type of magnetic material. Draw the modification of the field pattern on keeping a piece of this material in a uniform magnetic field.

33. 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?

34. 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.

5 Marks Question

35. (i) A small compass needle of magnetic moment M is free to turn about an axis perpendicular to the direction of uniform magnetic field B. The moment of inertia of the needle about the axis is I. The needle is slightly disturbed from its stable position and then released. Prove that it executes simple harmonic motion. Hence, deduce the expression for its time period.
(ii) 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
(a) horizontal component of the earth's magnetic field and
(b) angle of dip at the place.