IMPORTANT QUESTIONS

VERY SHORT ANSWER QUESTIONS

(1 mark)

Previous Years' Questions

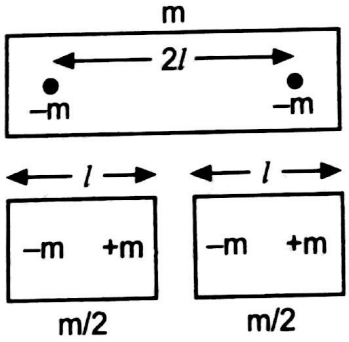
Q. 1. Which physical quantity has the unit Wb/m^2? Is it a scalar or a vector quantity?

[CBSE Delhi 2004]

Ans. Magnetic field induction has the unit Wb/m^2. It is a vector quantity.

Q. 2. How does the (*i*) pole strength and (*ii*) magnetic moment of each part of a bar magnet change if it is cut into two equal pieces transverse to length?

[CBSE Delhi 2003]

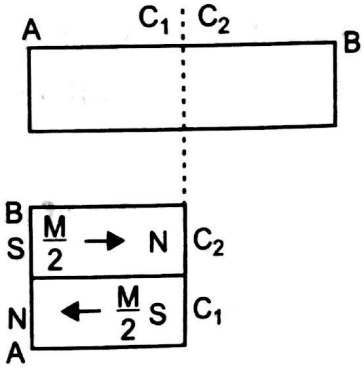


Ans. When a bar magnet of magnetic moment $\left(\vec{M} = m\,2\,\vec{l}\right)$ is cut into two equal pieces transverse to length,

(*i*) The pole strength remains unchanged (since pole strength depends as number of atoms in cross-sectional area).

(*ii*) The magnetic moment is reduced to half (since $M \propto$ length and here length is halved).

Q. 3. A hypothetical bar magnet (*AB*) is cut into two equal parts. One part is now kept over the other, so that the pole C_2 is above C_1. If *M* is the magnetic moment of the original magnet, what would be the magnetic moment of the combination, so formed?



Ans. The magnetic moment of each half bar magnet is $\frac{M}{2}$ but oppositely directed, so net magnetic moment of combination $= \frac{M}{2} - \frac{M}{2} = 0$ (zero).

Q. 4. Where on the earth's surface is the value of angle of dip maximum? *[CBSE Delhi 2003]*

OR

Where on the surface of earth is the angle of dip 90°? *[CBSE (AI) 2011]*

Ans. Angle of dip (90°) is maximum at poles.

Q. 5. 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 Earth's magnetic field and (*ii*) angle of dip at this place? *[CBSE (F) 2012]*

Ans. (*a*) 0° (*b*) 90°

Q. 6. What is the angle of dip at a place where the horizontal and vertical components of the Earth's magnetic field are equal? *[CBSE (F) 2012]*

Ans. We know $\frac{B_V}{B_H} = \tan \delta$

Given $B_V = B_H$ then $\tan \delta = 1$

Angle of dip, $\delta = 45°$

Q. 7. Which of the following substances are diamagnetic?

Bi, Al, Na, Cu, Ca and Ni *[CBSE Delhi 2013]*

Ans. Diamagnetic substances are (*i*) Bi (*ii*) Cu.

Q. 8. Where on the earth's surface is the value of vertical component of earth's magnetic field zero? *[CBSE (F) 2011, 2003]*

Ans. Vertical component of earth's magnetic field is zero at magnetic equator.

Q. 9. What should be the orientation of a magnetic dipole in a uniform magnetic field so that its potential energy is maximum? *[CBSE Delhi 2003]*

Ans. Potential energy of a magnetic dipole in a uniform magnetic field $U = -MB \cos \theta$; clearly the potential energy is maximum when

$$\cos \theta = -1 \quad \text{or} \quad \theta = \pi$$

That is, potential energy is maximum when magnetic dipole with its magnetic moment $\vec{M}$ is oriented opposite to the direction of magnetic field (or angle between $\vec{M}$ and $\vec{B}$ is 180°).

Q. 10. What are permanent magnets? Give one example. *[CBSE Delhi 2013]*

Ans. Substances that retain their ferromagnetic property for a long period of time at room temperature are called permanent magnets.

Examples : Steel, alnico, cobalt and ticonal.

Q. 11. Mention two characteristics of a material for making permanent magnets. *[CBSE Delhi 2010]*

Ans. For permanent magnet the material must have high **retentivity** and high **coercivity** (*e.g.*, steel).

Q. 12. How does the value of dip vary from earth's equator to the north pole? *[CBSE Delhi 2004C]*

Ans. The value of dip increases from 0° to 90° as we move from earth's equator to north pole.

Q. 13. The angles of dip at two places located on the earth are 0° and 90° respectively. Where are the places located?

Ans. The angle of dip is 0° at magnetic equator and it is 90° at magnetic poles. That is, the required places are located at magnetic equator and at either pole respectively.

Q. 14. In which direction would a compass needle align if taken to geographic (*i*) north pole and (*ii*) south pole.

Ans. The compass needle aligns along the horizontal component of earth's field (H). At poles $H = 0$, so compass needle will become free and may rest in any direction.

Q. 15. Give two factors by which the voltage sensitivity of a moving coil galvanometer can be increased.

Ans. The voltage sensitivity of a moving coil galvanometer is $S_V = \frac{NBA}{GC}$

Clearly, it may be increased by increasing the number of turns (N) and decreasing the torsional rigidity C of suspension wire.

Q. 16. What is the nature of magnetic field in a moving coil galvanometer?

Ans. The magnetic field in a moving coil galvanometer is **radial.**

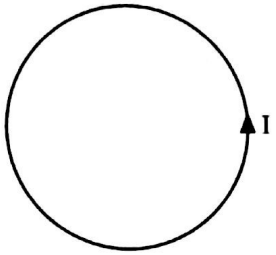
Q. 17. Define the term magnetic moment.

Ans. The magnetic moment of a magnet (or current loop) is defined as the maximum value of **torque** acting on a magnet when it is placed in a magnetic field of 1 T.

Q. 18. The magnetic lines of force prefer to pass through iron than air. Explain why?

Ans. The magnetic lines of force prefer to pass through iron than air because the permeability of iron is much larger than air.

Q. 19. In the diagram below is shown a circular loop carrying current I. Show the direction of the magnetic field with the help of lines of force. *[CBSE Delhi 2004]*

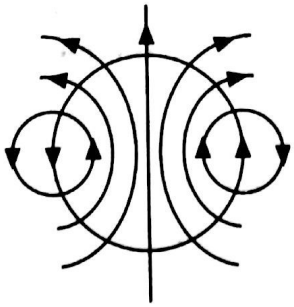


OR

Sketch the magnetic field lines for a current carrying circular loop.

[CBSE Delhi 2007, (AI) 2006]

Ans. The magnetic lines of force is shown in fig.



Q. 20. What is the direction of force acting on a charged particle q moving with a velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$? *[CBSE Delhi 2008]*

Ans. Force, $\vec{F}_m = q\,\vec{v} \times \vec{B}$

Obviously, the force on charged particle is perpendicular to both velocity $\vec{v}$ and magnetic field $\vec{B}$.

Q. 21. When a charged particle moving with velocity $\vec{v}$ is subjected to magnetic field $\vec{B}$, the force acting on it is non-zero. Would the particle gain any energy? *[CBSE (F) 2013]*

Ans. No (i) This is because the charge particle moves on a circular path.

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

and power dissipated $P = \vec{F} \times \vec{v}$

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

Since $\vec{v} \times \vec{v} = 0$

So power $P = 0$ and the particle does not gain any energy.

Q. 22. If a particle of charge q is moving with velocity v along X-axis and the magnetic field B is acting along Y-axis, use the expression $\vec{F} = q(\vec{v} \times \vec{B})$ to find the direction of force $\vec{F}$ acting on it. *[CBSE (AI) 2008]*

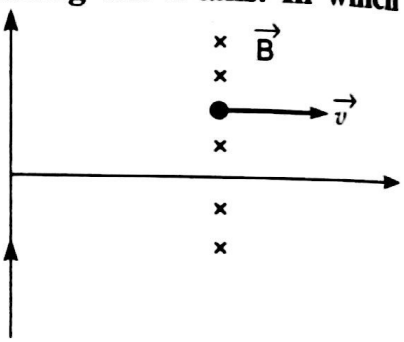
Ans. $\vec{F} = q\,\vec{v} \times \vec{B}$

Given $\vec{v} = v\,\hat{i}$, $\vec{B} = B\,\hat{j}$

$\therefore \quad \vec{F} = q(v\,\hat{i}) \times (B\,\hat{j}) = qvB\,\hat{k}$

That is, force is acting along Z-axis.

Q. 23. 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? *[CBSE (F) 2013]*



Ans. From relation $\vec{F} = qvB[\hat{i} \times (-\hat{k})] = +qvB(\hat{j})$

Magnetic force $\vec{F}$ along + y axis.

OR

From Fleming's left hand rule, thumb points along + y direction, so the direction of magnetic force will be along + y axis (or in the direction of flow of current).

Q. 24. In a certain region of space, electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other. An electron enters in the region perpendicular to the directions of both $\vec{B}$ and $\vec{E}$ and moves undeflected. Find the velocity of the electron. *[CBSE (F) 2013]*

Ans. Net force on electron moving in the combined electric field $\vec{E}$ and magnetic field $\vec{B}$ is

$$\vec{F} = -e[\vec{E} + \vec{v} \times \vec{B}]$$

Since electron moves undeflected then $\vec{F} = 0$.

$$\vec{E} + \vec{v} \times \vec{B} = 0$$

$$\Rightarrow |E| = |v| \times |B|$$

$$\Rightarrow |v| = \frac{|E|}{|B|}$$

Q. 25. What will be the path of a charged particle moving along the direction of a uniform magnetic field?

Ans. The path of particle will remain in straight line (since magnetic force $F_m = qvB \sin\theta = 0$).

Q. 26. Under what condition an electron moving through a magnetic field experiences the maximum force? *(CBSE (AI) 2005)*

Ans. $F_m = qvB \sin\theta$

Force is maximum when $\sin\theta = 1$ or $\theta = 90°$, that is, when electron is moving perpendicular to the direction of magnetic field.

Q. 27. Under what condition is the force acting on a charge moving through a uniform magnetic field is minimum? *[CBSE (AI) 2005]*

Ans. $F_m = qvB \sin\theta$; for minimum force $\sin\theta = 0$.

i.e., force is minimum when charged particle moves parallel or antiparallel to the field.

Q. 28. An electron and a proton moving with the same speed enter the same magnetic field at 90° to the direction of the field. For which of the two particles will the radius of the circular path be smaller?

Ans. Radius of circular path in a uniform magnetic field

$r = \frac{mv}{qB} \propto m$ for same velocity v, charge q and magnetic field B.

As mass of electron is less than mass of proton, radius of electron's path will be smaller.

Q. 29. An α-particle and a proton are moving in the plane of paper in a region where there is a uniform magnetic field $\vec{B}$ directed normal to the plane of the paper. If the particles have equal linear momenta, what would be the ratio of the radii of their trajectories in the field?

Ans. Radius of circular path of a charged particle, $r = \frac{mv}{qB} = \frac{p}{qB}$.

For same linear momentum and magnetic field B,

$$r \propto \frac{1}{q} \qquad \therefore \quad \frac{r_\alpha}{r_p} = \frac{q_p}{q_\alpha} = \frac{+e}{+2e} = \frac{1}{2}$$

Q. 30. 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 paths described by them? *[CBSE (F) 2011]*

Ans. Charge on deutron (q_d) = charge on proton (q_p)

$$q_d = q_p$$

Radius of circular path $(r) = \frac{p}{Bq} \qquad \left(\because\ qvB = \frac{mv^2}{r}\right)$

$$r \propto \frac{1}{q} \quad \text{[for constant momentum (P)]}$$

So, $$\frac{r_p}{r_d} = \frac{q_d}{q_p} = \frac{q_p}{q_p} = 1$$

Hence, $$r_p : r_d = 1:1$$

Q. 31. Equal currents are flowing through two infinitely long parallel wires. What will be the magnetic field at a point midway when the currents are flowing in the same direction?

Ans. Magnetic field at mid point due to two wires will be equal and opposite, hence the net magnetic field at this point will be zero.

Q. 32. How will be magnetic field intensity at the centre of a circular coil carrying current change if the current through the coil is doubled and the radius of the coil is halved?

Ans. Magnetic field due to a circular coil, $B = \frac{\mu_0 Ni}{2a}$

when current i is doubled and radius a is halved, new magnetic field

$$B' = \frac{\mu_0 N(2i)}{2(a/2)} = 4\frac{\mu_0 Ni}{2a} = 4B$$

That is magnetic field will become four times.

Q. 33. Which one of the following will experience maximum force when projected with the same velocity $\vec{v}$, perpendicular to the magnetic field $\vec{B}$

(*i*) α-particle and (*ii*) β-particle. *[CBSE Delhi 2002 (C)]*

Ans. $F_m = qvB \sin 90° = qvB$

For same v and B, $F_m \propto q$

Charge on α-particle is $2e$ and charge as β-particle is e; so α-particle will experience the maximum force.

Q. 34. Which of the following will describe the smallest circle when projected with the same velocity v perpendicular to the magnetic field B (*i*) α-particle and (*ii*) β-particle? *[CBSE Delhi 2002 (C)]*

Ans. Radius of circular path in transverse magnetic field

$$r = \frac{mv}{qB} \propto \frac{m}{q} \quad \text{for same } v \text{ and } B$$

For α-particle $\left(\frac{m}{q}\right)_\alpha = \frac{4m_p}{2e} = \frac{2m_p}{e}$ where m_p is mass of proton.

For β-particle $\left(\frac{m}{q}\right)_\beta = \frac{\frac{1}{1840}m_p}{e} = \frac{1}{1840}\left(\frac{m_p}{e}\right)$

Clearly β-particle has smallest value of $\frac{m}{q}$; so β-particle will describe the smallest circle.

Q. 35. Which one of the following will have the minimum frequency of revolution, when projected with the same velocity (v) perpendicular to the magnetic field (B) (*i*) α-particle and (*ii*) β-particle. *[CBSE Delhi 2002 (C)]*

Ans. Frequency of revolution of charged particle

$$f = \frac{qBm}{2\pi m} \propto \frac{q}{m} \quad \text{for same } B$$

The value of $\frac{q}{m}$ is maximum for electron, so frequency of **revolution of electron will be maximum.**

Q. 36. Why is the core of an electromagnet made of ferromagnetic materials? *[CBSE Delhi 2010]*

Ans. Ferromagnetic material has a high retentivity. So on passing current through windings it gains sufficient magnetism immediately.

Q. 37. An ammeter and a milliammeter are converted from the same galvanometer. Out of the two, which current measuring instrument has a higher resistance ? *[CBSE (AI) 2006, 2002]*

Ans. Shunt resistance, $S = \frac{I_g}{I - I_g} G \approx \frac{I_g}{I} G$

Clearly, smaller the value of range, larger is the shunt resistance. Obviously, milliammeter will have a larger shunt resistance and hence it will have a higher resistance.

$$\frac{1}{R_A} = \frac{1}{G} + \frac{1}{S}$$

Higher the S, higher the R_A for given G.

Q. 38. State two properties of the material of wire used for suspension of coil in a moving coil galvanometer.

Ans. For suspension wire of a galvanometer, the torsional rigidity $C = \frac{\pi \eta r^4}{2l}$ should be small, so wire should have low value of elasticity η, smaller radius and larger length.

Q. 39. Horizontal component of earth's magnetic field at a place is $\sqrt{3}$ times its vertical component. What is the value of angle of dip at that place?

Ans. Given $H = \sqrt{3}V \Rightarrow \tan\theta = \frac{V}{H} = \frac{1}{\sqrt{3}}$

$\Rightarrow$ Angle of dip $\theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = 30°$

Q. 40. The vertical component of Earth's magnetic field at a place is $\sqrt{3}$-times the horizontal component. What is the angle of dip at this place? *[CBSE Delhi 2006]*

Ans. If θ is angle of dip, then

$$\tan\theta = \frac{V}{H}$$

Given $V = \sqrt{3}H \Rightarrow \frac{V}{H} = \sqrt{3}$

$\therefore$ $\tan\theta = \sqrt{3} \Rightarrow \theta = 60°$

Q. 41. 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 earth's magnetic field at equator? *[CBSE Delhi 2012]*

Ans. Zero

Q. 42. Two wires of equal length are bent in the form of two loops. One of the loops 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. *[CBSE Delhi 2005]*

Ans. Torque $\tau = IAB \sin\theta \propto A$. For given perimeter the area of circular loop is maximum, so a circular loop will experience greater torque.

Q. 43. The permeability of a magnetic material is 0.9983. Name the type of magnetic materials it represents. *[CBSE Delhi 2011]*

Ans. $\mu_r < 1$, so magnetic material is diamagnetic.

Q. 44. The susceptibility of a magnetic material is 1.9×10^{-5}. Name the type of magnetic materials it represents. *[CBSE Delhi 2011]*

Ans. Susceptibility is small positive, so material is paramagnetic.

Q. 45. The susceptibility of a magnetic materials is -4.2×10^{-6}. Name the type of magnetic materials it represents. *[CBSE Delhi 2011]*

Ans. Susceptibility of material is negative, so given material is diamagnetic.

Other Important Questions

Q. 46. Why should an ammeter have a low resistance?

Ans. An ammeter is connected in series with the circuit to read the current. If it had large resistance, it will reduce the current in circuit; hence ammeter reading will have significant error; so for correct reading an ammeter should have a very low resistance.

Q. 47. A small magnet is pivoted to move freely in the magnetic meridian. At what place on earth's surface will the magnet be vertical?

Ans. Magnet will be vertical at the either magnetic pole of earth.

Q. 48. In what condition does a charged particle moving through a magnetic field follow a circular path?

Ans. The charged particle follows a circular path, when it moves perpendicular to the direction of magnetic field.

Q. 49. When is a magnet said to be in stable equilibrium in a magnetic field?

Ans. The magnet is said to be in stable equilibrium when the magnetic dipole moment of magnet is aligned along the direction of magnetic field.

Q. 50. What is Bohr magneton?

Ans. Bohr magenton is a unit of atomic dipole moment. Its value is $\frac{eh}{4\pi m} = 9{\cdot}27 \times 10^{-24}$ Am^2.

Q. 51. A charged particle enters along the axis of a current carrying a long solenoid. How is its velocity affected? Will the particle be accelerated or decelerated?

Ans. The magnetic field due to a current in solenoid is along the axis, so when a charged particle enters along the axis ($\theta = 0$), the magnetic force on particle is $qvB \sin 0° = 0$; so the particle's velocity remains unchanged *i.e.*, the particle remains unaccelerated.

Q. 52. Which has larger susceptibility: Iron or copper?

Ans. Iron is a ferromagnetic substance while and copper is diamagnetic, the susceptibility of iron is much larger.

Q. 53. Which types of fields are produced by a moving electron? If electron is at rest, then what type of field is produced?

Ans. A ***moving electron*** produces electric and magnetic fields both. A stationary electron produces electric field only.

Q. 54. A charged particle moving with a uniform velocity enters a magnetic field directed perpendicular to it, what will be the path of electron? How will its speed be affected?

Ans. In a perpendicular magnetic field a charged particle traverses a ***circular path.*** There will be no change in speed of particle.

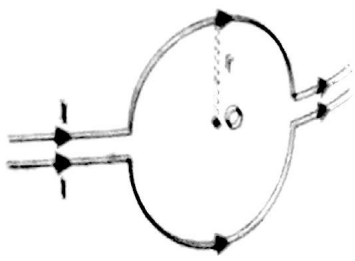
Q. 55. Is any work done on a moving charge by a magnetic field?

Ans. No, because magnetic force is always perpendicular to the path of the moving charge and so $W = FS \cos 90° = 0$.

Q. 56. When a charged particle moves in a magnetic field normally; what quantity changes — the particle's speed, particle's energy, path of motion of the particle.

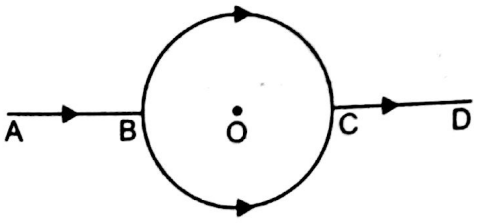
Ans. Path of motion changes.

Q. 57. What is the value of magnetic field at point *O* due to current flowing in the wires?



Ans. Zero, because the upper and lower current carrying conductors are identical and so the magnetic fields caused by them at the centre *O* will be equal and opposite.

Q. 58. What is the magnetic field at point O due to current carrying wires shown in figure?



Ans. The magnetic field due to straight wires AB and CD is zero since either $\theta = 0°$ or $180°$ and that due to a semi-circular arcs are equal and opposite; hence net field at O = **zero.**

Q. 59. An electron, passing through a region is not deflected. Are you sure that there is no magnetic field in that region?

Ans. No, if an electron enters parallel to a magnetic field, no force acts and the electron remains undeflected.

Q. 60. Why should a voltmeter have high resistance?

Ans. A voltmeter is connected in parallel. When connected in parallel, it should not affect the resistance of a circuit. In parallel, effective resistance (R_{eff}) will be

$$\frac{1}{R_{eff}} = \frac{1}{R_V} + \frac{1}{R}$$

Clearly $R_{eff} \to R$ if $R_V \to \infty$; hence a voltmeter should have high resistance.

Q. 61. What pre-information would you require to convert a galvanometer into ammeter or voltmeter?

Ans. Two informations are required (*i*) resistance of galvanometer and (*ii*) current in galvanometer for full scale deflection.

Q. 62. A bar magnet has magnetic moment M. It is divided into n–equal parts. Will each part be a magnetic dipole? What will be the magnetic moment of each part?

Ans. Yes, each part will be a magnetic dipole. The dipole moment of each part will be equal to $\frac{M}{n}$.

Q. 63. An iron bar magnet is heated to 1000°C and then cooled in a magnetic field free space. Will it retain magnetism?

Ans. Curie temperature of iron is 770°C. 1000°C is above the Curie temperature, therefore at 1000°C iron bar will lose its magnetism. Again when cooled in field free space it will not retain magnetism.

Q. 64. State with reason, whether the following statement is true or false? "The product of magnetic susceptibility and absolute temperature χT is constant for a paramagnetic material".

Ans. According to Curie law, $\chi \propto \frac{1}{T}$. χT = constant is true for paramagnetic substances.

Q. 65. What are the factors which are considered for a permanent magnet? Give an example.

Ans. For a permanent magnet, the substance should have high retentivity and high coercivity. Steel is such a substance.

Q. 66. What are the factors which are considered for an electromagnet? Give an example.

Ans. For an electromagnet, the substance should have high retentivity but low coercivity. Soft iron is such a substance.

Q. 67. A small magnetic needle, placed on a piece of cork, is floating on a still lake in northern hemisphere. Will the needle together with cork, move along north?

Ans. No, they won't because earth's magnetic field exerts a torque on the magnetic needle, therefore the needle will rotate and stay in north-south direction.