Grade XII

Chapter 5 – MAGNETISM AND MATTER

Question Bank

1. The magnetic field of Earth can be modelled by that of a point dipole placed at the centre of the Earth. The dipole axis makes an angle of 11.3° with the axis of Earth. At Mumbai, 'declination is nearly zero. Then,

(a) the declination varies between 11.3° W to 11.3° E.
(b) the least declination is 0°.
(c) the plane defined by dipole axis and Earth axis passes through Greenwich.
(d) declination averaged over Earth must be always negative.

HINTS; (a) The axis of the dipole does not coincide with the axis of rotation of the earth and it is tilted at some angle.

2. In a permanent magnet at room temperature
(a) magnetic moment of each molecule is zero.
(b) the individual molecules have non-zero magnetic moment which are all perfectly aligned.
(c) domains are partially aligned.
(d) domains are all perfectly aligned.

HINTS; (c) At room temperature, the permanent magnet retains ferromagnetic property for a long period of time.

3. A long solenoid has 1000 turns per metre and carries a current of 1 A. It has a soft iron core of $\mu_r = 1000$. The core is heated beyond the Curie temperature, T_c.
(a) The H field in the solenoid is (nearly) unchanged but the B field decreases drastically.
(b) The H and B fields in the solenoid are nearly unchanged.
(c) The magnetisation in the core reverses direction.
(d) The magnetisation in the core does not diminishes.

HINTS; (a) At normal temperature, a solenoid behaves as a ferromagnetic substance and at the temperature beyond the Curie temperature, it behaves as a paramagnetic substance.

4. Let the magnetic field on earth be modelled by that of a point magnetic dipole at the centre of earth. The angle of dip at a point on the geographical equator
(a) is always zero. (b) can be zero at specific points.
(c) cannot be positive or negative. (d) is not bounded.

HINTS;(b) As the angle of dip at a point on the geographical equator is bounded in a range from positive to negative value.

5. A magnetic needle is kept in a non-uniform magnetic field. It experiences
(a) a torque but not a force. (b) neither a force nor a torque.
(c) a force and a torque. (d) a force but not a torque.

HINTS;(c) As magnetic needle experiences both torque and force in a non-uniform magnetic field, because unequal and non-linear forces are exerted on its poles.

6. Three needles N_1 N_2 and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet, when brought close to them, will
(a) attract N_1 strongly, but repel N_2 and N_3 weakly.
(b) attract all three of them.
(c) attract N_1 and N_2 strongly but repel N_3.
(d) attract N_1 strongly, N_2 weakly and repel N_3 weakly.

ANS; d

7. Curie temperature is the temperature above which
(a) a ferromagnetic material becomes paramagnetic.
(b) a ferromagnetic material becomes diamagnetic.
(c) a paramagnetic material becomes diamagnetic.
(d) a paramagnetic material becomes ferromagnetic.

HINTS; (a) A ferromagnetic material becomes paramagnetic above the curie temperature.

8. The material suitable for making electromagnets should have
(a) high retentivity and high coercivity. (b) low retentivity and low coercivity.
(c) high retentivity and low coercivity. (d) low retentivity and high coercivity.

Ans; C

9. Lines of force, due to earth's horizontal magnetic field, are
(a) elliptical (b) curved lines (c) concentric circles (d) parallel and straight

Ans; d

10. If the magnetising field on a ferromagnetic material is increased, its permeability.
(a) is decreased (b) is increased (c) is unaffected (d) may be increased or decreased.

HINTS; (a), Since, $\mu=B/H \Rightarrow \mu a 1/H$

11. A magnetic needle suspended parallel to a magnetic field requires /3 J of work to turn it through 60°. The torque needed to maintain the needle in this position will be

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

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

HINTS; (b) Since, $W = -MB(\cos\theta_2 - \cos\theta_1)$

$= -MB(\cos 60° - \cos 0°)$

$= \frac{MB}{2} = \sqrt{3}$ J

Also, $\tau = MB \sin 60° = MB\frac{\sqrt{3}}{2}$

$= \sqrt{3} \times \sqrt{3} = 3$ J

12. The magnetic susceptibility of an ideal diamagneticsubstance is

(a) +1 (b) 0 (c) -1 (d) ∞

HINTS; (c) Since, for diamagnetic $-1 \leq x_m < 0$

13. The best material for the ore of a transformer is

(a) stainless steel (b) mild steel (c) hard steel (d) soft iron

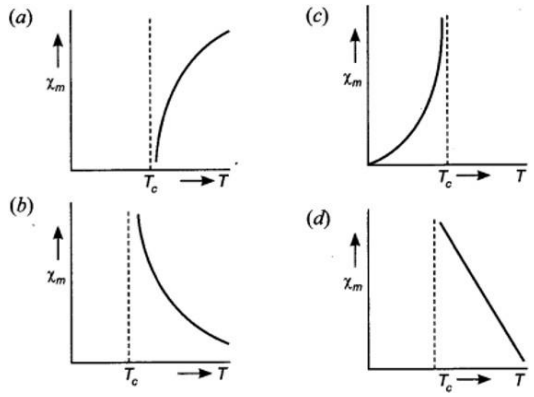
Ans; d

14. Domain formation is the necessary feature of

(a) diamagnetism. (b) Para magnetism. (c) ferromagnetism. (d) all of these.

Ans; c

15. The variation of magnetic susceptibility with the temperature of a ferromagnetic material can be plotted as



HINTS; (b) Since susceptibility (x_m) of ferromagnetic material decreases with increase in temperature and above curie temperature T_c, it becomes paramagnetic.

16. In which type of material the magnetic susceptibility does not depend on temperature?

(a) Diamagnetic (b) Paramagnetic (c) Ferromagnetic (d) Ferrite

Ans; a

17. A diamagnetic material in a magnetic field moves
(a) perpendicular to the field. (b) from weaker to stronger parts.
(c) from stronger to weaker parts. (d) in random direction.

Ans; c

18. The universal property among all substances is
(a) diamagnetism. (b) paramagnetism. (c) ferromagnetism. (d) all of these.

Ans; a

19. A magnet of dipole moment M is aligned in equilibrium position in a magnetic field of intensity B. The work done to rotate it through an angle 0 with the magnetic field is
(a) MB sin θ (b) MB cos θ (c) MB (1 – cos θ) (d) MB(l – sin θ)

HINTS; (c), At equilibrium position θ = 0,
Work done, W = $\int_0^{\theta} \mathrm{MB} \sin \theta \, \mathrm{d}\theta$
= MB (1 – sin θ)

20. A magnet can be completely demagnetized by
(a) breaking the magnet into small pieces. (b) heating it slightly.
(c) dropping it into ice cold water. (d) a reverse field of appropriate strength.

Ans; d

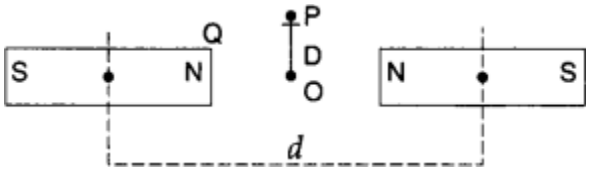
21. Magnetic moment for solenoid and corresponding bar magnet is
(a) equal for both (b) more for solenoid (c) more for bar magnet (d) none of these

Ans; a

22. Which of the following is correct about magnetic monopole?
(a) Magnetic monopole exist.
(b) Magnetic monopole does not exist.
(c) Magnetic monopole have constant value of monopole momentum.
(d) The monopole momentum increases due to increase at its distance from the field

Ans; b

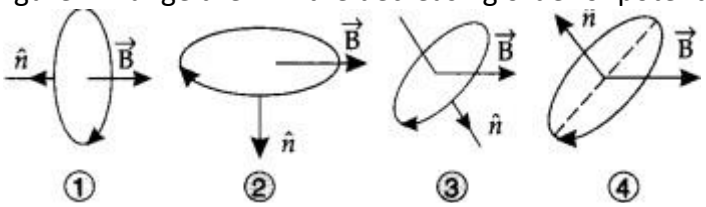
23. Two identical bar magnets are fixed with their centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the figure. The force on the charge Q is



(a) zero (b) directed along OP
(c) directed along PO (d) directed perpendicular to the plane of paper

Ans; a

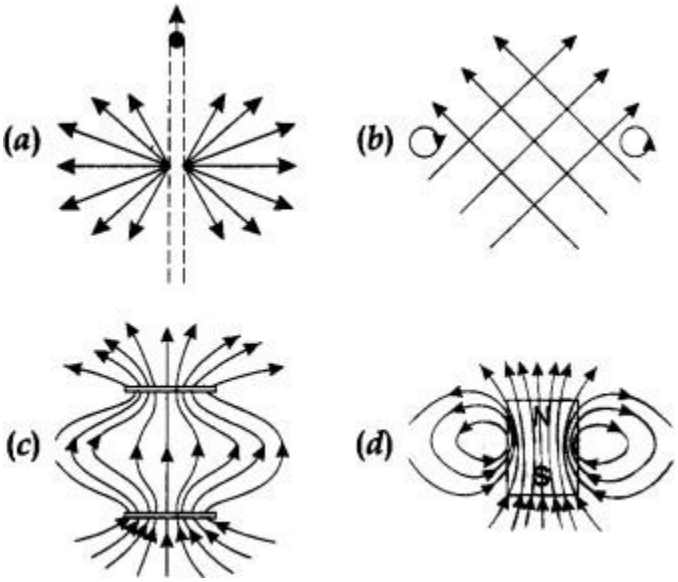
24. A current carrying loop is placed in a uniform magnetic field in four different orientations as shown in figure. Arrange them in the decreasing order of potential energy.



(a) 4, 2, 3,1 (b) 1, 4, 2, 3 (c) 4, 3, 2,1 (d) 1, 2, 3, 4

Ans; b

25. Point out the correct direction of magnetic field in the given figures.



Ans; d

26. Which orientation of a magnetic dipole in a uniform magnetic field will correspond to its stable equilibrium?

Answer
In stable equilibrium, the dipole moment vector and the magnetic field vector are in same direction.
Magnetic field arises due to charges in motion. Can a system have magnetic moments even though its net charge is zero?

27. If magnetic monopoles existed, how would the Gauss's law of magnetism be modified?

Answer:
Gauss's law of magnetism states that the flux of B through any closed surface is always zero $\oint B \cdot ds = 0$. If the

monopole existed, then Gauss's law would have been $\oint B.ds = \mu_0 q_m$ where q_m is magnetic charge (monopole) enclosed by the surface.
28. Must every magnetic configuration have a north pole and a south pole? What about the field due to a toroid?

Answer:
Not necessarily. True only if the source of the field has a net non-zero magnetic moment. This is not so for a toroid or even for a straight infinite conductor.

29. Does a bar magnet exert a toque on itself due to its own field? Does on element of a current-carrying wire exert a force on another element of the same wire?

Answer
No. There is no force or torque on a element due to the field produced by that element itself. But there is a force (or torque) on an element of the same wire.

30. A magnetised needle in a uniform magnetic field experiences a torque but no net force. An iron nail near a bar magnet, however, experiences a force of attraction in addition to a torque. Why?

Answer:
No force, if the field is uniform. The iron nail experiences a non-uniform field due to the bar magnet. There is induced magnetic moment in the nail, therefore, it experiences both force and torque. The net force is attractive because the induced south pole (say) in the nail is closer to the north pole of magnet than induced north pole.
31. 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 its length? [HOTS]

Answer:
(i) The pole strength does not change.
(ii) The magnetic moment reduces to half.
32. What happens if a bar magnet is cut into two pieces: (i) transverse to its length, (ii) along its length?

Answer:
In either case, one gets two magnets, each with a north and south pole.
33. 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 along its length?

Answer;
(i) The pole strength becomes half.
(ii) The magnetic magnet becomes half.

34. Magnetic field lines can be entirely confined 'within the core of a toroid, but not within a straight solenoid. Why?

Answer:
According to the Gauss's law, $\oint \vec{B} \cdot d\vec{s} = 0$, which is true for a as has no ends. But, in case of a solenoid, at each end the magnetic flux will not be zero, if the magnetic field lines were entirely confined within the solenoid.

35. Two identical looking iron bars A and B are given, one of which is definitely known to be magnetised. (We do not know which one.) How would one ascertain which one? [Use nothing else but the bars A and B.]

Answer;
Let, two bars are A and B. Now, bring one end of A near to B, and move it slowly (from one end to the middle). If force experienced by bar A reduces as we move towards middle, then bar B is magnetised, and A is not.
If A experiences repulsion, then both the bars are magnetised.

36. 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 placed?
Answer:
(i) Zero (ii) 90°

37. 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?

Answer

Given: $\delta = 60°$

$\because \quad B_H = B_{net} \cos \delta$

$\Rightarrow \quad B_H = B_{net} \cos 60° = B$

$\therefore \quad B_{net} \times \frac{1}{2} = B \quad \Rightarrow \quad B_{net} = 2B$

At equator, dip $(\delta) = 0$,

$\therefore (B_H)_{equator} = B_{net} = 2B$

38. Which of the following substances are paramagnetic?
Bi, Al, Cu, Ca, Pb and Ni
Answer: Al and Ca.

39. Which of the following substances are diamagnetic?
Bi, Al, Na, Cu, Ca and Ni
Answer: Bi and Cu.

40. The susceptibility of a magnetic material is -4.2×10^{-6}. Name the type of magnetic material it represents.
Answer: Diamagnetic.