# 19 Magnetism and Matter

## Conceptual MCQs

**1.** A bar magnet of magnetic moment $\vec{M}$, is placed in a magnetic field of induction $\vec{B}$. The torque exerted on it is
(a) $\vec{M}.\vec{B}$ (b) $-\vec{M}.\vec{B}$ (c) $\vec{M}\times\vec{B}$ (d) $\vec{B}\times\vec{M}$

**2.** The torque on a bar magnet due to the earth's magnetic field is maximum when the axis of the magnet is
(a) Perpendicular to the field of the earth
(b) Parallel to the vertical component of the earth's field
(c) At an angle of 33° with respect to the N–S direction
(d) Along the North–South (N–S) direction

**3.** Which of the following is the most suitable material for making permanent magnet ?
(a) Steel (b) Soft iron
(c) Copper (d) Nickel

**4.** A magnet of magnetic moment M is freely suspended in a uniform horizontal magnetic field B. If the magnet is deflected at an angle $\theta$ from the direction of B. The work done is
(a) $MB\sin\theta$ (b) MB
(c) $MB\cos\theta$ (d) $MB(1-\cos\theta)$

**5.** Let V and H be the vertical and horizontal components of earth's magnetic field at any point on earth. Near the north pole
(a) $V>>H$ (b) $V<<H$
(c) $V=H$ (d) $V=H=0$

**6.** The correct relation is
(a) $B=\frac{B_V}{B_H}$ (b) $B=B_V\times B_H$
(c) $|B|=\sqrt{B_H^2+B_V^2}$ (d) $B=B_H+B_V$
[where $B_H$ = Horizontal component of earth's magnetic field; $B_V$ = vertical component of earth's magnetic field and B = total intensity of earth's magnetic field]

**7.** At a certain place, the horizontal component of earth's magnetic field is $\sqrt{3}$ times the vertical component. The angle of dip at that place is
(a) 60° (b) 45° (c) 90° (d) 30°

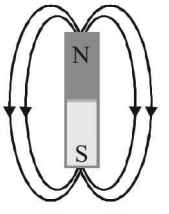
**8.** If a diamagnetic substance is brought near north or south pole of a bar magnet, it is
(a) attracted by the poles
(b) repelled by the poles
(c) repelled by north pole and attracted by the south pole
(d) attracted by the north pole and repelled by the south pole

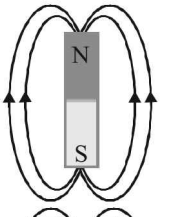
**9.** Above Curie temperature
(a) a paramagnetic substance becomes diamagnetic
(b) a diamagnetic substance becomes paramagnetic
(c) a paramagnetic substance becomes ferromagnetic
(d) a ferromagnetic substance becomes paramagnetic

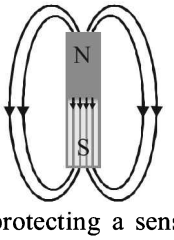
**10.** A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It :
(a) will become rigid showing no movement
(b) will stay in any position
(c) will stay in north-south direction only
(d) will stay in east-west direction only

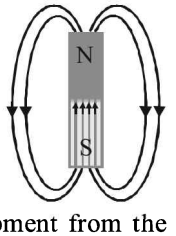
**11.** Demagnetisation of magnets can be done by
(a) rough handling
(b) heating
(c) magnetising in the opposite direction
(d) All the above

**12.** The magnetic field lines due to a bar magnet are correctly shown in

(a) 

(b) 

(c) 

(d) 


**13.** For protecting a sensitive equipment from the external electric arc, it should be
(a) wrapped with insulation around it when a current is passing through it
(b) placed inside an iron can
(c) surrounded with fine copper sheet
(d) placed inside an aluminium can

**14.** A tangent galvanometer is connected directly to an ideal battery. If the number of turns in the coil is doubled, the deflection will
(a) Increase (b) Decrease
(c) Remain unchanged (d) Either increase or decrease

**15.** The materials suitable for making electromagnets should have
(a) high retentivity and low coercivity
(b) low retentivity and low coercivity
(c) high retentivity and high coercivity
(d) low retentivity and high coercivity

# Application Based MCQs

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

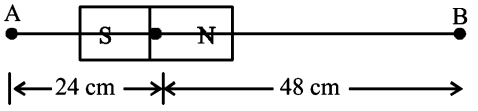
(a) 1/2 (b) 2 (c) 1/4 (d) 1

**17.** A coil in the shape of an equilateral triangle of side 0.02 m is suspended from its vertex such that it is hanging in a vertical plane between the pole pieces of permanent magnet producing a uniform field of $5 \times 10^{-2}$T. If a current of 0.1A is passed through the coil, what is the couple acting?

(a) $5\sqrt{3}\times10^{-7}$ N – m (b) $5\sqrt{3}\times10^{-10}$ N – m

(c) $\frac{\sqrt{3}}{5}\times10^{-7}$ N – m (d) None of these

**18.** A bar magnet of length 3 cm has points A and B along its axis at distances of 24 cm and 48 cm on the opposite sides. Ratio of magnetic fields at these points will be




(a) 8 (b) $\frac{1}{2\sqrt{2}}$

(c) 3 (d) 4

**19.** A short bar magnet, placed with its axis at 30° with an external magnetic field of 0.16 T, experiences a torque of magnitude 0.032 J. The magnetic moment of the bar magnet is (in units of J/T)

(a) 4 (b) 0.2 (c) 0.5 (d) 0.4

**20.** If the angles of dip at two places are 30° and 45° respectively, then the ratio of horizontal components of earth's magnetic field at the two places will be

(a) $\sqrt{3}:\sqrt{2}$ (b) $1:\sqrt{2}$

(c) $1:\sqrt{3}$ (d) 1 : 2

**21.** A dip needle lies initially in the magnetic meridian when it shows an angle of dip θ at a place. The dip circle is rotated through an angle x in the horizontal plane and then it shows an angle of dip θ′. Then $\frac{\tan\theta'}{\tan\theta}$ is

(a) $\frac{1}{\cos x}$ (b) $\frac{1}{\sin x}$ (c) $\frac{1}{\tan x}$ (d) cos x

**22.** The horizontal component of the earth's magnetic field is $3.6\times10^{-5}$ tesla where the dip angle is 60°. The magnitude of the earth's magnetic field is

(a) $2.8\times10^{-4}$ tesla (b) $2.1\times10^{-4}$ tesla

(c) $7.2\times10^{-5}$ tesla (d) $3.6\times10^{-5}$ tesla

**23.** A torque of $10^{-5}$ Nm is required to hold a magnet at 90° with the horizontal component H of the earth's magnetic field. The torque to hold it at 30° will be

(a) $5\times10^{-6}$ Nm (b) data is insufficient

(c) $\frac{1}{3}\times10^{-5}$ Nm (d) $5\sqrt{3}\times10^{-6}$ Nm

**24.** A compass needle whose magnetic moment is 60 $Am^2$, is directed towards geographical north at any place experiencing moment of force of $1.2\times10^{-3}$ Nm. At that place the horizontal component of earth field is 40 micro $W/m^2$. What is the value of dip angle at that place?

(a) 30° (b) 60° (c) 45° (d) 15°

**25.** When a piece of a ferromagnetic substance is put in a uniform magnetic field, the flux density inside it is four times the flux density away from the piece. The magnetic permeability of the material is

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

**26.** A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60°. The torque needed to maintain the needle in the position will be

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

**27.** The time period of a vibration magnetometer is $T_0$. Its magnet is replaced by another magnet whose moment of inertia is 3 times and magnetic moment is 1/3 of the initial magnet. The time period now will be

(a) $3T_0$ (b) $T_0$ (c) $\frac{T_0}{\sqrt{3}}$ (d) $\frac{T_0}{3}$

**28.** A certain amount of current when flowing in a properly set tangent galvanometer, produces a deflection of 45°. If the current be reduced by a factor of $\sqrt{3}$, the deflection would

(a) Decrease by 30° (b) Decrease by 15°

(c) Increase by 15° (d) Increase by 30°

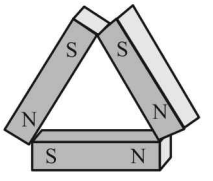
**29.** Three identical bar magnets each of magnetic moment M are placed in the form of an equilateral triangle as shown. The net magnetic moment of the system is

(a) Zero

(b) 2M

(c) $M\sqrt{3}$

(d) $\frac{3M}{2}$

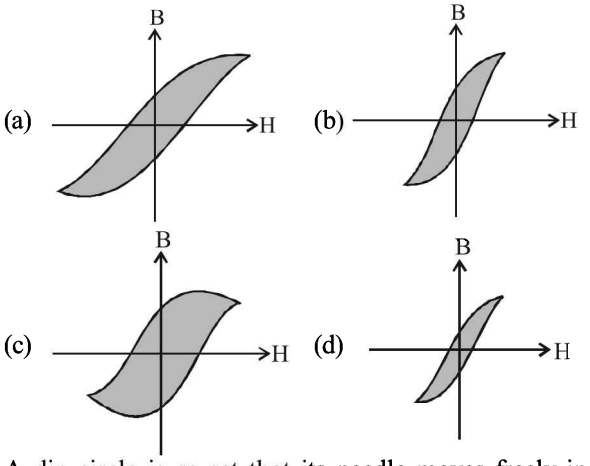



**30.** A bar magnet of length 10 cm and having the pole strength equal to $10^{-3}$ weber is kept in a magnetic field having magnetic induction (B) equal to $4\pi\times10^{-3}$ tesla. It makes an angle of 30° with the direction of magnetic induction. The value of the torque acting on the magnet is ($\mu = 4\pi\times10^{-7}$ weber / amp × m)

(a) $2\pi\times10^{-7}$ Nm (b) $2\pi\times10^{-5}$ Nm

(c) 0.5 Nm (d) $0.5\times10^{2}$ Nm

**31.** For substances hysteresis (B - H) curves are given as shown in figure. For making temporary magnet which of the following is the best?




**32.** A dip circle is so set that its needle moves freely in the magnetic meridian. In this position, the angle of dip is 40°. Now the dip circle is rotated so that the plane in which the needle moves makes an angle of 30° with the magnetic meridian. In this position, the needle will dip by an angle

(a) 40° (b) 30°

(c) more than 40° (d) less than 40°

**33.** The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is 2s. The magnet is cut perpendicular to its length into three equal parts and these parts are then placed on each other with their like poles together. The time period of this combination will be

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

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

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

**35.** 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

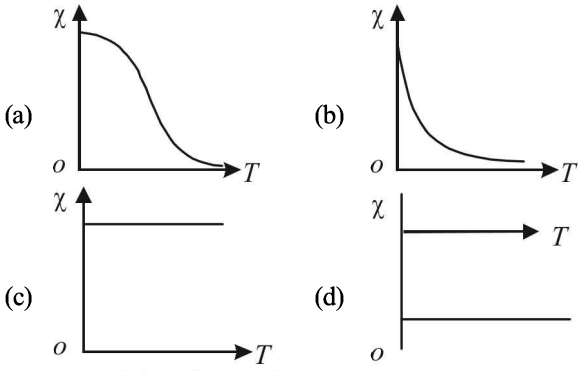
(a) attract $N_1$ and $N_2$ strongly but repel $N_3$

(b) attract $N_1$ strongly, $N_2$ weakly and repel $N_3$ weakly

(c) attract $N_1$ strongly, but repel $N_2$ and $N_3$ weakly

(d) attract all three of them

**36.** The variation of magnetic susceptibility ($\chi$) with absolute temperature T for a ferromagnetic material is




**37.** The coercivity of a small magnet where the ferromagnet gets demagnetized is $3 \times 10^3$ $Am^{-1}$. The current required to be passed in a solenoid of length 10 cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is:

(a) 30 mA (b) 60 mA (c) 3 A (d) 6 A

**38.** Two identical short bar magnets, each having magnetic moment of 10 $Am^2$, are arranged such that their axial lines are perpendicular to each other and their centres be along the same straight line in a horizontal plane. If the distance between their centres is 0.2 m, the resultant magnetic induction at a point midway between them is ($\mu_0 = 4\pi \times 10^{-7}$ $Hm^{-1}$)

(a) $\sqrt{2} \times 10^{-7}$ tesla (b) $\sqrt{5} \times 10^{-7}$ tesla

(c) $\sqrt{2} \times 10^{-3}$ tesla (d) $\sqrt{5} \times 10^{-3}$ tesla

**39.** The period of oscillation of a magnet in a vibration magnetometer is 2 sec. The period of oscillation of a magnet whose magnetic moment is four times that of the first magnet is

(a) 1 sec (b) 5 sec (c) 8 sec (d) 0.5 sec

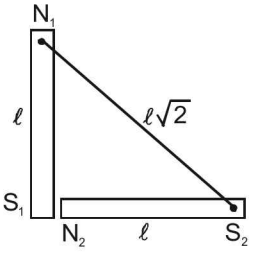
**40.** Two identical thin bar magnets each of length $\ell$ and pole strength m are placed at right angles to each other, with north pole of one touching south pole of the other, then the magnetic moment of the system is

(a) 1 m$\ell$

(b) 2 m$\ell$

(c) $\sqrt{2}$ m$\ell$

(d) m$\ell$/2




## Skill Based MCQs

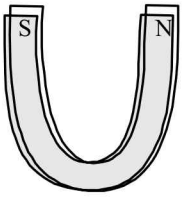
**41.** The distance between the poles of a horse shoe magnet is 0.1 m and its pole strength is 0.01 amp–m. The induction of magnetic field at a point midway between the poles will be

(a) $2 \times 10^{-5}$ T

(b) $4 \times 10^{-6}$ T

(c) $8 \times 10^{-7}$ T

(d) Zero



**42.** A thin rectangular magnet suspended freely has a period of oscillation equal to $T$. Now it is broken into two equal halves (each having half of the original length) and one piece is made to oscillate freely in the same field. If its period of oscillation is $T'$, the ratio $\frac{T'}{T}$ is

(a) $\frac{1}{2\sqrt{2}}$ (b) $\frac{1}{2}$ (c) 2 (d) $\frac{1}{4}$

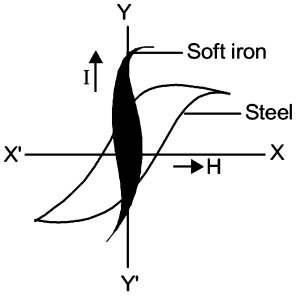
**43.** The mass of a specimen of a ferromagnetic material is 0.6 kg. and its density is $7.8 \times 10^3$ kg/m$^3$. If the area of hysteresis loop of alternating magnetising field of frequency 50Hz is 0.722 MKS units then the hysteresis loss per second will be

(a) $277.7 \times 10^{-5}$ joule

(b) $277.7 \times 10^{-6}$ joule

(c) $277.7 \times 10^{-4}$ joule

(d) $27.77 \times 10^{-4}$ joule




**44.** A short magnet of length 4 cm is kept at a distance of 20 cm to the east of a compass box such that is axis is perpendicular to the magnetic meridian. If the deflection produced is 45°, find the pole strength (H = 30 Am$^{-1}$)

(a) 17.7Am (b) 44.2Am

(c) 27.7Am (d) 37.7Am

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

(a) 1.5 cm (b) 2.5 cm

(c) 3.5 cm (d) 2.0 cm

**46.** A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be

(a) 1 $s$ (b) 2 $s$ (c) 3 $s$ (d) 4 $s$

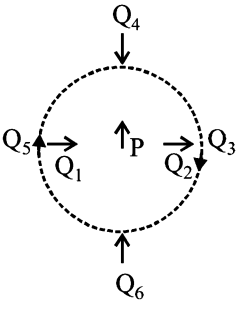
**47.** The figure shows the various positions (labelled by subscripts) of small magnetised needles P and Q. The arrows show the direction of their magnetic moment. Which configuration corresponds to the lowest potential energy among all the configurations shown ?

(a) $PQ_3$

(b) $PQ_4$

(c) $PQ_5$

(d) $PQ_6$




**48.** Two tangent galvanometers A and B have coils of radii 8 cm and 16 cm respectively and resistance 8 Ω each. They are connected in parallel with a cell of emf 4 V and negligible internal resistance. The deflections produced in the tangent galvanometers A and B are 30° and 60° respectively. If A has 2 turns, then B must have

(a) 18 turns (b) 12 turns

(c) 6 turns (d) 2 turns

**49.** A magnetic dipole is under the influence of two magnetic fields The angle between the field directions is 60° and one of the fields has a magnitude of $1.2 \times 10^{-2}$ T. If the dipole comes to stable equilibrium at an angle of 15° with this field, what is the magnitude of other field ?

(a) $4.4 \times 10^{-3}$ tesla (b) $5.2 \times 10^{-3}$ tesla

(c) $3.4 \times 10^{-3}$ tesla (d) $7.8 \times 10^{-3}$ tesla

**50.** A short bar magnet with its north pole facing north forms a neutral point at P in the horizontal plane. If the magnet is rotated by 90° in the horizontal plane, the net magnetic induction at P is (Horizontal component of earth's magnetic field = $B_H$)

(a) 0 (b) $2B_H$ (c) $\frac{\sqrt{5}}{2}B_H$ (d) $\sqrt{5}B_H$

**ANSWER KEY**

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conceptual MCQs** | | | | | | | | | | | | | | | | | | |
| **1** | (c) | **3** | (a) | **5** | (a) | **7** | (d) | **9** | (d) | **11** | (d) | **13** | (b) | **15** | (b) | | | |
| **2** | (a) | **4** | (d) | **6** | (c) | **8** | (b) | **10** | (b) | **12** | (d) | **14** | (c) | | | | | |
| **Application Based MCQs** | | | | | | | | | | | | | | | | | | |
| **16** | (b) | **19** | (d) | **22** | (c) | **25** | (d) | **28** | (b) | **31** | (d) | **34** | (a) | **37** | (c) | **40** | (c) | |
| **17** | (a) | **20** | (a) | **23** | (a) | **26** | (b) | **29** | (b) | **32** | (d) | **35** | (b) | **38** | (d) | | | |
| **18** | (a) | **21** | (a) | **24** | (a) | **27** | (a) | **30** | (a) | **33** | (b) | **36** | (a) | **39** | (a) | | | |
| **Skill Based MCQs** | | | | | | | | | | | | | | | | | | |
| **41** | (c) | **42** | (b) | **43** | (a) | **44** | (d) | **45** | (a) | **46** | (d) | **47** | (d) | **48** | (b) | **49** | (a) | **50** | (d) |