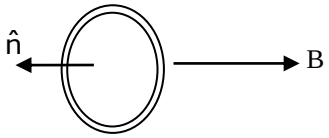
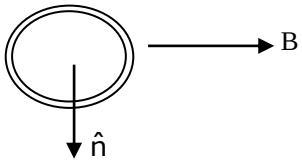
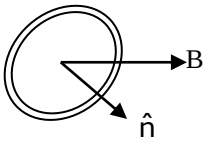
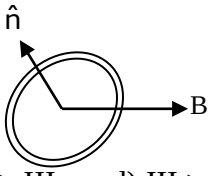
2PUC – CHAPTER 05
MAGNETISM AND MATTER

1. A current carrying loop is placed in a uniform magnetic field in four different orientations, I, II, III and IV arrange them in the decreasing order of potential energy.

I. 

II. 

III. 

IV. 

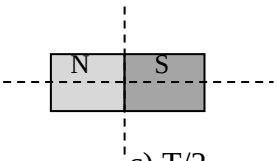
a) I > III > II > IV b) I > II > III > IV c) I > IV > II > III d) III > IV > I > II

2. A neutral point is obtained at the centre of a vertical circular coil carrying current. The angle between the plane of the coil and the magnetic meridian is
a) 0 b) 45° c) 60° d) 90°

3. Rate of change of torque τ with deflection θ is maximum for a magnet suspended freely in a uniform magnetic field of induction B, when
a) $\theta = 0°$ b) $\theta = 45°$ c) $\theta=60°$ d) $\theta=90°$

4. A magnet of magnetic moment $50\,\hat{i}$ A-m^2 is placed along the x-axis in a magnetic field $\vec{B} = (0.5\,\hat{i} + 30\,\hat{j})$ T. The torque acting on the magnet is
a) $175\,\hat{k}$ N-m b) $150\,\hat{k}$ N-m c) $75\,\hat{k}$ N-m d) $25\sqrt{37}\,\hat{k}$ N-m

5. Time period for a magnet is T. If it is divided into four equal parts along its axis and perpendicular to its axis as shown, then time period for each part will be

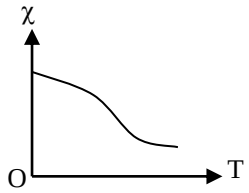


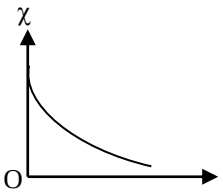
a) 4 T b) T/4 c) T/2 d) T

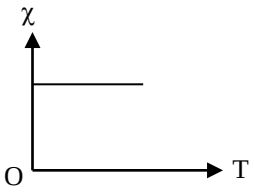
6. Moment of inertia of a magnetic needle is 40 gcm^2 has time period 3s in earth's horizontal field is 3.6×10^{-5} Wb/m^2. Its magnetic moment will be
a) 0.5 A m^2 b) 5 A m^2 c) 0.250 A m^2 d) 5×10^2 A m^2

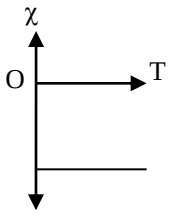
7. A magnet is suspended in such a way that it oscillates in the horizontal plane. It makes 20 oscillations per minute at a place where dip angle is 30° and 15 oscillations per minute at a place where dip angle is 60°. The ratio of total earth's magnetic field at the two places is
a) $3\sqrt{3}:8$ b) $16:9\sqrt{3}$ c) 4:9 d) $2\sqrt{3}:9$

8. The variation of magnetic susceptibility (χ) with absolute temperature T for a ferromagnetic material is

a) 

b) 

c) 

d) 

9. When a material is subjected to a small magnetic field H, the intensity of magnetisation is proportional to

(a) $H^{1/2}$ (b) H (c) H^2 (d) $H^{-1/2}$

10. The magnetic permeability of a paramagnetic substance is

(a) Small and positive (b) Small and negative
(c) Large and positive (d) Large and negative

11. For a paramagnetic material, the dependence of the magnetic susceptibility χ on the absolute temperature T is given by (C is a constant)

(a) $\chi = CT$ (b) $\chi = C/T$ (c) $\chi = CT^2$ (d) $\chi = CT^{-2}$

12. The relative permeability of iron is of the order of

(a) Zero (b) 10^{-4} (c) 1 (d) 10^3

13. At a certain place on earth a magnetic needle is placed along the magnetic meridian at an angle of 60° to the horizontal. If the horizontal component of the earth's field at the place is $0.20\times10^{-4}T$, what is the magnitude of the total earth's field at the place?

(a) $0.2\times10^{-4}T$ (b) $0.4\times10^{-4}T$ (c) $0.8\times10^{-4}T$ (d) $1.6\times10^{-4}T$

14. A small piece of a material is repelled by a strong magnet. The material is

(a) Paramagnetic (b) Ferromagnetic (c) Diamagnetic (d) Non-magnetic

15. A bar magnet of pole strength q and magnetic moment m is divided into two equal pieces by cutting it along its length. Then

(a) q is halved and m is doubled (b) q and m both are halved
(c) q is halved but m remains the same (d) q remains the same but m is halved

16. A sample of paramagnetic salt contains 2×10^{24} atomic dipoles, each of dipole moment $1.5\times10^{-23}\,JT^{-1}$. The sample is placed in a magnetic field of 0.6 T and cooled to a temperature of 4K. The degree of magnetic saturation achieved is equal to 15%. What is the total dipole moment of the sample for a magnetic field of 0.9 T and a temperature of 3K?
(a) $3\ JT^{-1}$ (b) $6\ JT^{-1}$ (c) $9\ JT^{-1}$ (d) $12\ JT^{-1}$

17. A short bar magnet of length 4 cm has a magnetic moment of $4\ JT^{-1}$. What is the magnitude of the magnetic field at a distance of 2 m from the centre of the magnet on its equatorial line?
(a) $10^{-7}T$ (b) $5\times10^{-8}T$ (c) $10^{-6}T$ (d) $5\times10^{-5}T$

18. Electromagnets are made of soft iron because, soft iron has
a) low susceptibility and low retentivity b) high susceptibility and low retentivity
c) high susceptibility and high retentivity d) low susceptibility and high retentivity

19. Material of permanent magnet has
a) high retentivity and high coercivity b) low retentivity and high coercivity
c) low retentivity and low coercivity d) high retentivity and low coercivity

20. The magnetic properties of a magnet is lost at it's
a) Melting pointing b) Boiling point c) Curie point d) Triple point

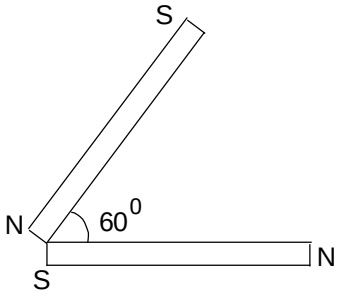
21. The correct definition of Meissner effect is
a) The phenomenon of perfect paramagnetism in super conductors
b) The phenomenon of perfect diamagnetism in superconductors
c) The phenomenon of perfect diamagnetism in semiconductors
d) The phenomenon of ferromagnetism in metals

22. At certain place, the horizontal component of earth's magnetic field is 3.0 G and the angle dip at the place is 30°. The magnetic field of earth at that location
a) 4.5 G b) 5.1 G c) 3.5 G d) 6.0 G

23. At a certain place on earth a magnetic needle is placed along the magnetic meridian at an angle of 60° to the horizontal. If the horizontal component of the earth's field at the place of 0.20×10^{-4} T, what is the magnitude of the total earth's field at that place?
a) 0.2×10^{-4} T b) 0.4×10^{-4} T c) 0.8×10^{-4} T d) 1.6×10^{-4} T

24. Two identical magnetic dipoles of magnetic moment 2 A m^2 are placed at a separation of 2 m with their axis perpendicular to each other in air. The resultant magnetic field at a midpoint between the dipole is
a) $4\sqrt{5}\times10^{-5}$ T b) $2\sqrt{5}\times10^{-5}$ T c) $4\sqrt{5}\times10^{-7}$ T d) $2\sqrt{5}\times10^{-7}$ T

25. Two magnets of equal magnetic moments M each are placed as shown in figure. The resultant magnetic moment is



a) M
b) $\sqrt{3}$ M
c) $\sqrt{2}$ M
d) M/2

26. A circular current loop of magnetic moment M is in an arbitrary orientation in an external magnetic field B. The work done to rotate the loop by 30^o about an axis perpendicular to its plane is

a) MB b) $\sqrt{3}\,\frac{MB}{2}$ c) $\frac{MB}{2}$ d) zero

27. The time period of vibration of two magnets in sum position in 3s. When polarity of weaker magnet is reversed, the combination makes 12 oscillations per minute. The ratio of magnetic moments of two magnets is

a) $\frac{16}{17}$ b) $\frac{17}{8}$ c) $\frac{3}{5}$ d) $\frac{4}{5}$

28. A paramagnetic sample shows a net magnetisation of 8 Am^{-1} when placed in an external magnetic field of 0.6T at a temperature of 4K. When the same sample is placed in an external magnetic field of 0.2 T at a temperature of 16K, the magnetisation will be

a) $\frac{32}{3}$ Am^{-1} b) $\frac{2}{3}$ Am^{-1} c) 6 Am^{-1} d) 2.4 Am^{-1}

29. Two identical magnetic dipoles of magnetic moments 1.0 A-m^2 each, placed at a separation of 2m with their axis perpendicular to each other. The resultant magnetic field at a point midway between the dipoles is

(a) $5\times10^{-7}\,T$ (b) $\sqrt{5}\times10^{-7}\,T$
(c) $10^{-7}\,T$ (d) None of these

30. Two short magnets placed along the same axis with their like poles facing each other repel each other with a force which varies inversely as

(a) Square of the distance
(b) Cube of the distance
(c) Distance
(d) Fourth power of the distance

31. Two identical short bar magnets, each having magnetic moment M, are placed a distance of 2d apart with axes perpendicular to each other in a horizontal plane. The magnetic induction at a point midway between them is

(a) $\frac{\mu_0}{4\pi}(\sqrt{2})\frac{M}{d^3}$ (b) $\frac{\mu_0}{4\pi}(\sqrt{3})\frac{M}{d^3}$
(c) $\left(\frac{2\mu_0}{\pi}\right)\frac{M}{d^3}$ (d) $\frac{\mu_0}{4\pi}(\sqrt{5})\frac{M}{d^3}$

32. If a magnet is suspended at an angle 30° to the magnetic meridian, it makes an angle of 45° with the horizontal. The real dip is

(a) $\tan^{-1}(\sqrt{3}/2)$ (b) $\tan^{-1}(\sqrt{3})$

(c) $\tan^{-1}(\sqrt{3/2})$ (d) $\tan^{-1}(2/\sqrt{3})$

33. 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) 2 B_H

(c) $\frac{\sqrt{5}}{2}B_H$ (d) $\sqrt{5}\,B_H$

34. The true value of angle of dip at a place is 60°, the apparent dip in a plane inclined at an angle of 30° with magnetic meridian is

(a) $\tan^{-1}\frac{1}{2}$ (b) $\tan^{-1}(2)$

(c) $\tan^{-1}\left(\frac{2}{3}\right)$ (d) None of these

35. A vibration magnetometer consists of two identical bar magnets placed one over the other such that they are perpendicular and bisect each other. The time period of oscillation in a horizontal magnetic field is $2^{5/4}$ second. One of the magnets is removed and if the other magnet oscillates in the same field, then the time period in seconds is

(a) $2^{1/4}$ (b) $2^{1/2}$

(c) 2 (d) $2^{3/4}$

36. In a vibration magnetometer, the time period of a bar magnet oscillating in horizontal component of earth's magnetic field is 2s. When a magnet is brought near and parallel to it, the time period reduces to 1s. The ratio H/F of the horizontal component H and the field F due to magnet will be

(a) 3 (b) $1/3$

(c) $\sqrt{3}$ (d) $1/\sqrt{3}$

37. A cylindrical rod magnet has a length of 5 cm and a diameter of 1 cm. It has a uniform magnetisation of 5.30×10^3 Amp/m^3. What its magnetic dipole moment

(a) $1\times10^{-2}\,J/T$ (b) $2.08\times10^{-2}\,J/T$

(c) $3.08\times10^{-2}\,J/T$ (d) $1.52\times10^{-2}\,J/T$

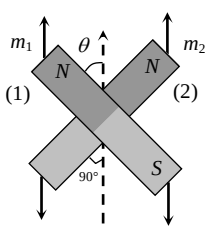
38. Two magnets of equal mass are joined at right angles to each other as shown the magnet 1 has a magnetic moment 3 times that of magnet 2. This arrangement is pivoted so that it is free to rotate in the horizontal plane. In equilibrium what angle will the magnet 1 subtend with the magnetic meridian?

(a) $\tan^{-1}\left(\frac{1}{2}\right)$

(b) $\tan^{-1}\left(\frac{1}{3}\right)$

(c) $\tan^{-1}(1)$

(d) 0°



39. The dipole moment of each molecule of a paramagnetic gas is 1.5×10^{-23} amp $\times$ m^2. The temperature of gas is 27°C and the number of molecules per unit volume in it is 2×10^{26} m^{-3}. The maximum possible intensity of magnetisation in the gas will be

(a) 3×10^3 amp/m (b) 4×10^{-3} amp/m

(c) 5×10^5 amp/m (d) 6×10^{-4} amp/m

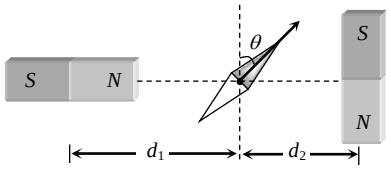
40. Two magnets A and B are identical and these are arranged as shown in the figure. Their length is negligible in comparison to the separation between them. A magnetic needle is placed between the magnets at point P which gets deflected through an angle θ under the influence of magnets. The ratio of distance d_1 and d_2 will be

(a) $(2\tan\theta)^{1/3}$

(b) $(2\tan\theta)^{-1/3}$

(c) $(2\cot\theta)^{1/3}$

(d) $(2\cot\theta)^{-1/3}$



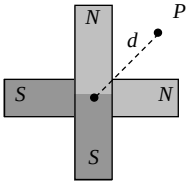
41. Two short magnets of equal dipole moments M are fastened perpendicularly at their centre (figure). The magnitude of the magnetic field at a distance d from the centre on the bisector of the right angle is

(a) $\frac{\mu_0}{4\pi}\frac{M}{d^3}$

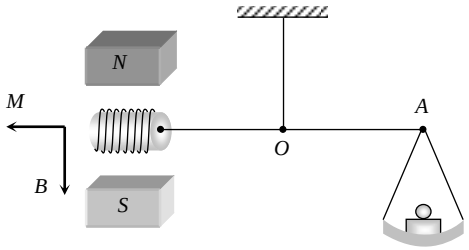
(b) $\frac{\mu_0}{4\pi}\frac{M\sqrt{2}}{d^3}$

(c) $\frac{\mu_0}{4\pi}\frac{2\sqrt{2}M}{d^3}$

(d) $\frac{\mu_0}{4\pi}\frac{2M}{d^3}$



42. A small coil C with N = 200 turns is mounted on one end of a balance beam and introduced between the poles of an electromagnet as shown in figure. The cross sectional area of coil is A= 1.0 cm^2, length of arm OA of the balance beam is $l = 30\ cm$. When there is no current in the coil the balance is in equilibrium. On passing a current I = 22 mA through the coil the equilibrium is restored by putting the additional counter weight of mass $\Delta m = 60\ mg$ on the balance pan. Find the magnetic induction at the spot where coil is located.



(a) 0.4 T (b) 0.3 T

(c) 0.2 T (d) 0.1 T

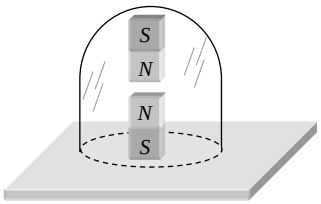
43. Two identical bar magnets with a length 10 cm and weight 50 gm-weight are arranged freely with their like poles facing in a inverted vertical glass tube. The upper magnet hangs in the air above the lower one so that the distance between the nearest pole of the magnet is 3mm. Pole strength of the poles of each magnet will be (g = 9.8 m/s^2)

(a) 6.64 amp $\times$ m

(b) 2 amp $\times$ m

(c) 10.25 amp $\times$ m

(d) None of these



44. If ϕ_1 and ϕ_2 be the angles of dip observed in two vertical planes at right angles to each other and ϕ be the true angle of dip, then

(a) $\cos^2\phi = \cos^2\phi_1 + \cos^2\phi_2$

(b) $\sec^2\phi = \sec^2\phi_1 + \sec^2\phi_2$

(c) $\tan^2\phi = \tan^2\phi_1 + \tan^2\phi_2$

(d) $\cot^2\phi = \cot^2\phi_1 + \cot^2\phi_2$

45. Each atom of an iron bar $(5\,cm \times 1\,cm \times 1\,cm)$ has a magnetic moment $1.8 \times 10^{-23}\ Am^2$. Knowing that the density of iron is $7.78 \times 10^3\ kg^{-3}m$, atomic weight is 56 and Avogadro's number is 6.02×10^{23} the magnetic moment of bar in the state of magnetic saturation will be

(a) $4.75\ Am^2$ (b) $5.74\ Am^2$

(c) $7.54\ Am^2$ (d) $75.4\ Am^2$

46. An iron rod of volume $10^{-4}\,m^3$ and relative permeability 1000 is placed inside a long solenoid wound with 5 turns/cm. If a current of 0.5 A is passed through the solenoid, then the magnetic moment of the rod is

(a) $10\ Am^2$ (b) $15\ Am^2$

(c) $20\ Am^2$ (d) $25\ Am^2$

47. A bar magnet has coercivity $4 \times 10^3\ Am^{-1}$. It is desired to demagnetise it by inserting it inside a solenoid 12 cm long and having 60 turns. The current that should be sent through the solenoid is

(a) 2 A (b) 4 A

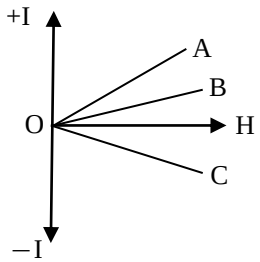
(c) 6 A (d) 8 A

48. A magnet is suspended in the magnetic meridian with an untwisted wire. The upper end of wire is rotated through 180° to deflect the magnet by 30° from magnetic meridian. When this magnet is replaced by another magnet, the upper end of wire is rotated through 270° to deflect the magnet 30° from magnetic meridian. The ratio of magnetic moments of magnets is

(a) 1 : 5 (b) 1 : 8

(c) 5 : 8 (d) 8 : 5

49. The given figure shows the variation of intensity of magnetization (I) versus the applied magnetic field intensity (H) for 3 magnetic materials A, B and C. Name the diamagnetic (D), ferromagnetic (F) and paramagnetic (P) material amongst A, B and C.



a) [A – F, B – D, C – P]

b) [A – F, B – P, C – D]

c) [A – P, B – D, C – F]

d) [A – D, B – F, C – P]

50. Two magnets A and B having the same mass and length are suspended and made to oscillate freely with time periods T_A and T_B. If the moment of inertia of A is one fourth that of B, the ratio of T_B to T_A is

a) 2 : 1 b) 1 : 4 c) 4 : 1 d) 1 : 2