MAGNETISM

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1. **A bar magnet is cut into two equal halves by a plane parallel to the magnetic axis. Of the following physical quantities the one which remains unchanged is**

   a) Pole strength b) Magnetic moment

   c) Intensity of magnetization d) Moment of inertia

2. **Two similar bar magnets P and Q each of magnetic moment M are taken. If P is cut along it axial line and Q is cut along its equatorial line, all the four pieces obtained have each of**

   a) Equal pole strength

   b) Magnetic moment M/4

   c) Magnetic moment M/2

   d) Magnetic moment M

3. **If a bar magnet of moment M is bent as arc its magnetic moment**

   a) decreases b) increases

   c) does not change -d) may change

4. **The earth's magnetic field**

   a) varies in direction but in magnitude

   b) varies in magnitude but not in direction

   c) varies in both magnitude and direction

   d) is centered exactly about the centre of earth

5. **Earth's magnetic field always has a horizontal component except at**

   a) Equator b) Magnetic pole

   c) A latitude of 60^0 d) None of the above

6. **The lines of force due to the earth's horizontal magnetic field are**

   a) parallel and straight b) Concentric circles

   c) elliptical d) curved lines

7. **The magnetic lines of force inside a bar magnet**

   a) Do not exist

   b) Depends on area of cross section of the bar magnet

   c) Are from N-pole to S-pole of the magnet

   d) Are from S-pole to N-pole of the magnet

8. Find out the wrong statement

a) The lines of force may intersect

b) The lines of force never intersect

c) The tangent drawn to the line of induction at any point gives the direction of magnetic induction at that point.

d) None

9. When a bar magnet is suspended freely in a uniform magnetic field, the correct statement is

a) The magnet experiences only couple and undergo only rotatory motion.

b) The direction of Torque is along the suspension wire.

c) The magnitude of Torque is maximum when the magnet is normal to the field direction.

d) All the above.

10. The effect due to uniform magnetic field on a freely suspended magnetic needle is as follows

a) Both torque and net force are present

b) Torque is present but no net force

c) Both torque and net force are absent

d) Net force is present but no torque

11. 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

12. There is no couple acting when two bar magnets are placed coaxially separated by a distance because:

a) There are no forces on the poles

b) The forces are parallel and their lines of action do not coincide

c) The forces are perpendicular to each other

d) The forces act along the same line

13. A bar magnet of magnetic moment is placed in a magnetic field of induction. The torque exerted on it is

a) $\vec{M}.\vec{B}$ **b)** $-\vec{M}.\vec{B}$

c) $\vec{M}\times\vec{B}$ **d)** $\vec{B}\times\vec{M}$

14. **The magnetism of magnet is due to**

a) The spin motion of electron

b) Earth

c) Pressure of big magnet inside the earth

d) Cosmic rays

15. Curie temperature is the temperature above which

a) A ferromagnetic material becomes para magnetic

b) A paramagnetic material becomes diamagnetic

c) A ferromagnetic material becomes diamagnetic

d) A paramagnetic material becomes ferromagnetic

16. 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

17. Match the following

List – I	**List – II**
a) Magnetic flux (Φ)	e) L^2A
b) Magnetic induction (B)	f) $ML^2T^{-2}A^{-1}$
c) Magnetic intensity (H)	g) $MT^{-2}A^{-1}$
d) Magnetic moment (M)	h) $L^{-1}A$

a) a–f, b–g, c–h, d–e b) a–e, b–f, c–g, d–h

c) a–g, b–e, c–f, d–h d) a–h, b–e, c–g, d–f

18. Match the following

List – I	**List – II**
a) Permeability constant	e) N/A.m
b) Magnetic flux	f) Volt.sec
c) Magnetic Field	g) T.m/A
d) Magnetic flux	h) $T.m^2$

a) a–f, b–g, c–e, d–h b) a–g, b–e, c–f, d–h

c) a–f, b–g, c–h, d–e d) a–g, b–h, c–e, d–f

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19. An iron rod of length *L* and magnetic moment *M* is bent in the form of a semicircle. Now its magnetic moment will be

(a) M (b) $\frac{2M}{\pi}$

(c) $\frac{M}{\pi}$ (d) $M\pi$

20. Points *A* and *B* are situated along the extended axis of 2 *cm* long bar magnet at a distance *x* and 2*x cm* respectively. From the pole nearer to the points, the ratio of the magnetic field at A and B will be

(a) 4 : 1 exactly (b) 4 : 1 approx.

(c) 8 : 1 exactly (d) 8 : 1 approx.

21. Ratio of magnetic intensities for an axial point and a point on broad side-on position at equal distance *d* from the centre of magnet will be or The magnetic field at a distance *d* from a short bar magnet in longitudinal and transverse positions are in the ratio

(a) 1 : 1 (b) 2 : 3

(c) 2 : 1 (d) 3 : 2

22. The magnetism of magnet is due to

(a) The spin motion of electron

(b) Earth

(c) Pressure of big magnet inside the earth

(d) Cosmic rays

23. The pole strength of a bar magnet is 48 *ampere-meter* and the distance between its poles is 25 *cm*. The moment of the couple by which it can be placed at an angle of 30^o with the uniform magnetic intensity of flux density 0.15 *Newton /ampere-meter* will be

(a) 12 *Newton* × *meter* (b) 18 *Newton* × *meter*

(c) 0.9 *Newton* × *meter* (d) None of the above

24. The magnetic field at a point *x* on the axis of a small bar magnet is equal to the field at a point y on the equator of the same magnet. The ratio of the distances of *x* and *y* from the centre of the magnet is

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

(c) 2^{3} (d) $2^{1/3}$

25. In the case of bar magnet, lines of magnetic induction

(a) Start from the North Pole and end at the South Pole

(b) Run continuously through the bar and outside

(c) Emerge in circular paths from the middle of the bar

(d) Are produced only at the North Pole like rays of light from a bulb

26. A long magnet is cut in two parts in such a way that the ratio of their lengths is 2 : 1. The ratio of pole strengths of both the section is

(a) Equal (b) In the ratio of 2: 1

(c) In the ratio of 1: 2 (d) In the ratio of 4: 1

27. A magnetic needle is kept in a non-uniform magnetic field. It experiences

(a) A force and a torque

(b) A force but not a torque

(c) A torque but not a force

(d) Neither a torque nor a force

28. Two short magnets with their axes horizontal and perpendicular to the magnetic meridian are placed with their centres 40 *cm* east and 50 *cm* west of magnetic needle. If the needle remains undeflected, the ratio of their magnetic moments $M_1 : M_2$ is

(a) 4 : 5 (b) 16 : 25

(c) 64: 125 (d) $2 : \sqrt{5}$

29. If a hole is made at the centre of a bar magnet, then its magnetic moment will

(a) Increase (b) Decrease

(c) Not change (d) None of these

30. If the angles of dip at two places are 30^o and 45^o 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) $1 : 2$

31. 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°

32. At a certain place the angle of dip is 30° and the horizontal component of earth's magnetic field is 0.50 *Oersted*. The earth's total magnetic field is

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

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

33. The angle of dip at a place is 60°. At this place the total intensity of earth's magnetic field is 0.64 units. The horizontal intensity of earth's magnetic field at this place is

(a) 1.28 units (b) 0.64 units

(c) 0.16 units (d) 0.32 units

34. The value of the horizontal component of the earth's magnetic field and angle of dip are $1.8 \times 10^{-5} Weber/m^2$ **and 30° respectively at some place. The total intensity of earth's magnetic field at that place will be**

(a) $2.08 \times 10^{-5} Weber/m^2$ (b) $3.67 \times 10^{-5} Weber/m^2$

(c) $3.18 \times 10^{-5} Weber/m^2$ (d) $5.0 \times 10^{-5} Weber/m^2$

35. Magnets cannot be made from which of the following substances

(a) Iron (b) Nickel

(c) Copper (d) All of the above

36. The magnetic moment of atomic neon is

(a) Zero (b) $\mu B/2$

(c) μB (d) $3\mu B/2$

37. Which of the following is most suitable for the core of electromagnets?

(a) Soft iron (b) Steel

(c) Copper-nickel alloy (d) Air

38. Demagnetisation of magnets can be done by

(a) Rough handling

(b) Heating

(c) Magnetising in the opposite direction

(d) All the above

39. A ferromagnetic material is heated above its curie temperature. Which one is a correct statement?

(a) Ferromagnetic domains are perfectly arranged

(b) Ferromagnetic domains becomes random

(c) Ferromagnetic domains are not influenced

(d) Ferromagnetic material changes itself into diamagnetic material

40. 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 the North Pole and attracted by the South Pole

(d) Attracted by the North Pole and repelled by the South Pole

41. The material of permanent magnet has

(a) High retentivity, low coercivity

(b) Low retentivity, high coercivity

(c) Low retentivity, low coercivity

(d) High retentivity, high coercivity

42. The permanent magnet is made from which one of the following substances

(a) Diamagnetic (b) Paramagnetic

(c) Ferromagnetic (d) Electromagnetic

43. Temperature above which a ferromagnetic substance becomes paramagnetic is called

(a) Critical temperature (b) Boyle's temperature

(c) Debye's temperature (d) Curie temperature

44. Two identical magnetic dipoles of magnetic moments 1.0 $A\text{-}m^2$ 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

45. 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

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46. Two identical short bar magnets, each having magnetic moment *M*, are placed a distance of 2*d* 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) $\frac{\mu_0}{4\pi}(\sqrt{5})\frac{M}{d^3}$

47. If a magnet is suspended at an angle 30^o to the magnetic meridian, it makes an angle of 45^o 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) $\tan^{-1}(2/\sqrt{3})$

48. 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^o 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) $\sqrt{5}\,B_H$

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

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

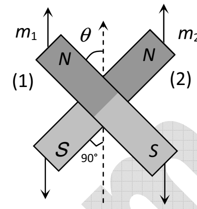
(c) $\tan^{-1}\left(\frac{2}{3}\right)$ (d) None of these

50. A cylindrical rod magnet has a length of 5 cm and a diameter of 1 cm. It has a uniform magnetization 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) $1.52\times10^{-2}\,J/T$

51. 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) $\tan^{-1}(1)$

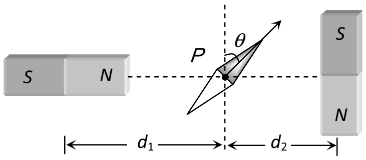
(d) $0°$

52. The dipole moment of each molecule of a paramagnetic gas is 1.5×10^{-23} *amp* × m^2. The temperature of gas is $27^{o}C$ and the number of molecules per unit volume in it is 2×10^{26} m^{-3}. The maximum possible intensity of magnetization 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*

53. 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



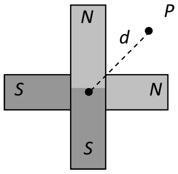
(a) $(2\tan\theta)^{1/3}$

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

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

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

54. **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) $\frac{\mu_0}{4\pi}\frac{2M}{d^3}$

KEY

1) c	2) c	3) a	4) c	5) b	6) a	7) d	8) a	9) d	10) b
11) c	12) d	13) c	14) a	15) a	16) b	17) a	18) d	19) b	20) d
21)	22) a	23) c	24) d	25) b	26) a	27) a	28) c	29) c	30) a
31) d	32) c	33) d	34) a	35) c	36) a	37) a	38) d	39) d	
40) b	41) d	42) c	43) d	44) b					
45)d	46)d	47)a	48)d	49)b					
50)c	51)b	52)a							
53)c	54)c								

HINTS

19. $M' = m(2R) = m\left(\frac{2L}{\pi}\right) = \frac{2M}{\pi}$

20. For a magnet $B = \frac{\mu_0}{4\pi}.\frac{2M}{x^3}$ (Nearly)

$\Rightarrow \frac{B_1}{B_2} = \left(\frac{x_1}{x_2}\right)^3 = \left(\frac{x}{2x}\right)^3 = \frac{1}{8}$ (Approx)

21. $B_1 = \frac{2M}{d^3}.B_2 = \frac{M}{d^3}; \ \therefore \frac{B_1}{B_2} = 2:1$

23. $\tau = MB\sin\theta = 48\times 25\times 10^{-2}\times 0.15\times\frac{1}{2} = 0.9\ N\times m$

24. $B_1 = \frac{2M}{x^3}\ and\ B_2 = \frac{M}{y^3}$

As $B_1 = B_2$

$\frac{2M}{x^3} = \frac{M}{y^3}$ or $\frac{x^3}{y^3} = 2$ or $\frac{x}{y} = 2^{1/3}$

28. $M_{net} = \sqrt{2}M = \sqrt{2}ml.$

30. $(B_H)_1 = B\cos\phi_1$ and $(B_H)_2 = B\cos\phi_2$

$\therefore \frac{(B_H)_1}{(B_H)_2} = \frac{\cos\phi_1}{\cos\phi_2} = \frac{\cos 30^o}{\cos 45^o} = \frac{\sqrt{3}}{2}\times\sqrt{2} = \frac{\sqrt{3}}{\sqrt{2}}$

31. $B_H = \sqrt{3}\,B_V$, also $\tan\theta = \frac{B_V}{B_H} = \frac{1}{\sqrt{3}} \Rightarrow \theta = 30^o$

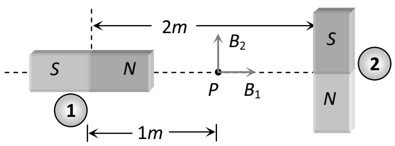
32. $B_H = B\cos\phi; \therefore B = \frac{B_H}{\cos\phi} = \frac{0.5}{\cos 30^o} = \frac{0.5}{\sqrt{3}/2} = \frac{1}{\sqrt{3}}$

33. $B_H = B\cos\phi = 0.64 \times \cos 60^o = 0.64 \times \frac{1}{2} = 0.32$ Units

34. $B_H = B\cos\phi$

$B = \frac{B_H}{\cos\phi} = \frac{1.8\times10^{5}}{\cos 30^o} = \frac{1.8\times10^{-5}}{\sqrt{3}/2} = 2.08\times10^{-5}\,Wb/m^2$

44. $\therefore B_1 = \frac{\mu_0}{4\pi}\left(\frac{2M}{d^3}\right)$ (RHS)

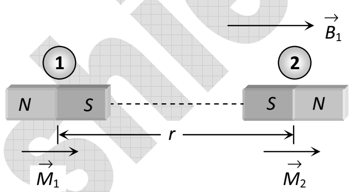


$\therefore B_2 = \frac{\mu_0}{4\pi}\left(\frac{M}{d^3}\right)$ (Upward)

$B_1 = 10^{-7}\times\frac{2\times1}{1} = 2\times10^{-7}\,T,\ B_2 = \frac{B_1}{2} = 10^{-7}\,T$

$B_R = \sqrt{B_1^2 + B_2^2} = \sqrt{(2\times10^{-7})^2 + (10^{-7})^2} = \sqrt{5}\times10^{-7}\,T$

45.



$U_2 = -M_2B_1\cos0 = -M_2B_1 = M_2\times\frac{\mu_0}{4\pi}.\frac{2M_1}{r^3}$

But, $F = -\frac{dU}{dr}$,

$F_2 = -\frac{dU_2}{dr} = -\frac{d}{dr}\left(\frac{\mu_0}{4\pi}.\frac{2M_1M_2}{r^3}\right) = -\frac{\mu_0}{4\pi}.6\frac{M_1M_2}{r^4}$

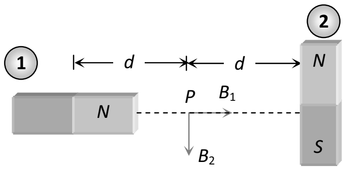
$|F_1| = |F_2| = F = \frac{\mu_0}{4\pi}.\frac{6M_1M_2}{r^4}$

$\Rightarrow F \propto \frac{1}{r^4}$

46. $B_{net} = \sqrt{B_1^2 + B_2^2}$

$B_1 = \frac{\mu_0}{4\pi}.\frac{2M}{d^3}$ and $B_2 = \frac{\mu_0}{4\pi}.\frac{M}{d^3}$

$\Rightarrow B_{net} = \frac{\mu_0}{4\pi}.\frac{\sqrt{5}M}{d^3}$



47. $\tan\phi = \frac{B_V}{B_H}$

$\tan\phi' = \frac{B_V}{B_H\cos\beta} = \frac{B_V}{B_H\cos 30^o} = \frac{2B_V}{\sqrt{3}B_H}$

or $\tan 45^o = \frac{2}{\sqrt{3}}.\tan\phi$ or $\phi = \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

49. $\Rightarrow \tan\phi' = \frac{\tan 60^o}{\cos 30^o} = 2 \Rightarrow \phi' = \tan^{-1}(2)$

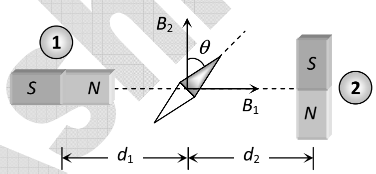
50. $M = I\pi r^2 l = (5.30\times10^3)\times\frac{22}{7}\times(0.5\times10^{-2})^2(5\times10^{-2})$

$= 2.08\times10^{-2}\ J/T$

51. $\tan\theta = \frac{M_2}{M_1} = \frac{M}{3M} = \frac{1}{3} \Rightarrow \theta = \tan^{-1}\left(\frac{1}{3}\right)$

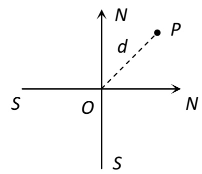
52. $I = \frac{M}{V} = \frac{\mu N}{V} = \frac{1.5\times10^{-23}\ \times 2\times10^{26}}{1} = 3\times10^3\ Amp\ /m$

53. $B_1 = B_2\tan\theta$



$\Rightarrow \frac{\mu_0}{4\pi}.\frac{2M}{d_1^3} = \frac{\mu_0}{4\pi}.\frac{M}{d_2^3}\tan\theta \Rightarrow \frac{d_1}{d_2} = (2\cot\theta)^{1/3}$

54. $M_{net} = \sqrt{M^2 + M^2} = \sqrt{2}M$



$B = \frac{\mu_0}{4\pi}.\frac{2\sqrt{2}M}{d^3}$