21. Magnetism – Multiple Choice Questions

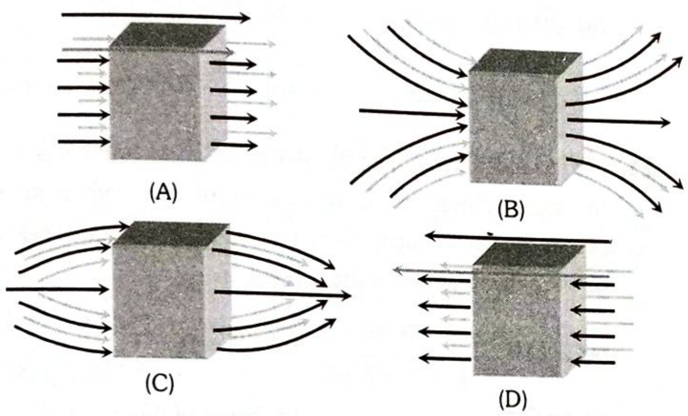
1. Magnet and It's Properties

1. Which of the following is the most suitable material for making permanent magnet

(a) Steel (b) Soft iron

(c) Copper (d) Nickel

2. A uniform magnetic field parallel to the plane of the paper exists in space initially directed from left to right. When a bar of soft iron is placed in the field parallel to it, the lines of force passing through it will be represented by



(a) Figure (A) (b) Figure (B)

(c) Figure (C) (d) Figure (D)

3. Magnetic lines of force

(a) Always intersect

(b) Are always closed

(c) Tend to crowd far away from the poles of magnet

(d) Do not pass through vacuum

4. The mathematical equation for magnetic field lines of force is

(a) $\vec{\nabla}\cdot\vec{B}=0$ (b) $\vec{\nabla}\cdot\vec{B}\neq 0$ 1

(c) $\vec{\nabla}\cdot\vec{B}>0$ (d) $\vec{\nabla}\cdot\vec{B}<0$

5. Two small bar magnets are placed in a line with like poles facing each other at a certain distance *d* apart. If the length of each magnet is negligible as compared to *d*, the force between them will be inversely proportional to

(a) d (b) d^2

(c) $\frac{1}{d^2}$ (d) d^4

6. If a magnet of pole strength *m* is divided into four parts such that the length and width of each part is half that of initial one, then the pole strength of each part will be

(a) $m/4$ (b) $m/2$

(c) $m/8$ (d) $4m$

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

(a) Equal pole strength (b) Magnetic moment $\frac{M}{4}$

(c) Magnetic moment $\frac{M}{2}$ (d) Magnetic moment M

8. A long magnetic needle of length $2L$, magnetic moment M and pole strength m units is broken into two pieces at the middle. The magnetic moment and pole strength of each piece will be

(a) $\frac{M}{2},\frac{m}{2}$ (b) $M,\frac{m}{2}$

(c) $\frac{M}{2},m$ (d) M,m

9. Two identical thin bar magnets each of length l and pole strength m are placed at right angle to each other with north pole of one touching south pole of the other. Magnetic moment of the system is

(a) ml (b) $2ml$

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

10. Two magnets, each of magnetic moment '*M*' are placed so as to form a cross at right angles to each other. The magnetic moment of the system will be

(a) $2\,M$ (b) $\sqrt{2}\,M$

(c) $0.5\,M$ (d) M

11. Each atom of an iron bar ($5cm\times1cm\times1cm$) has a magnetic moment $1.8\times10^{-23}\,Am^2$. Knowing that the density of iron is $7.78\times10^3\,kg\,m^{-3}$, 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) $75.4\,Am^2$

12. 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) $25\,Am^2$

13. A coil carrying current 'I' has radius 'r' and number of turns 'n'. It is rewound so that radius of new coil is $\frac{'r'}{4}$ and it carries current 'I'. The ratio of magnetic moment of new coil to that of original coil is

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

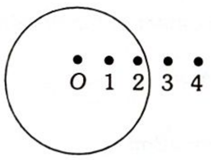
(c) $\frac{1}{4}$ (d) $\frac{1}{8}$

14. 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

15. The adjacent figure shows the cross-section of a long rod with its length perpendicular to the plane of the paper. It carries a constant current flowing along its length. B_1, B_2, B_3 and B_4 respectively represent the magnetic fields due to the current in the rod at point 1, 2, 3 and 4 lying at different separations from the centre O, as shown in the figure. Which of the following shall hold true



(a) $B_1 > B_2 \neq 0$

(b) $B_2 > B_3 \neq 0$

(c) $B_1 = B_2 = B_3 = 0$

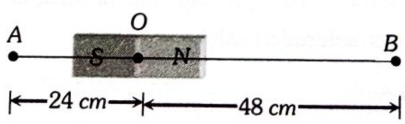
(d) $B_3 > B_4 \neq 0$

16. The magnetic field due to a short magnet at a point on its axis at distance X *cm* from the middle point of the magnet is 200 *gauss*. The magnetic field at a point on the neutral axis at a distance X *cm* from the middle of the magnet is

(a) 100 *gauss* (b) 400 *gauss*

(c) 50 *gauss* (d) 200 *gauss*

17. 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) $1/2\sqrt{2}$

(c) 3 (d) 4

18. The magnetic induction in air at a distance d from an isolated point pole of strength m unit will be

(a) $\frac{m}{d}$ (b) $\frac{m}{d^2}$

(c) md (d) md^2

19. A small bar magnet has a magnetic moment 1.2 $A\text{-}m^2$. The magnetic field at a distance 0.1 m on its axis will be : ($\mu_0 = 4\pi \times 10^{-7}$ $T\text{-}m/A$)

(a) $1.2 \times 10^{-4}\ T$ (b) $2.4 \times 10^{-4}\ T$

(c) $2.4 \times 10^{4}\ T$ (d) $1.2 \times 10^{4}\ T$

20. 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*

21. Two identical magnetic dipoles of magnetic moments 1.0 $A\text{-}m^2$ each, placed at a separation of $2m$ with their axes perpendicular to each other. The resultant magnetic field at a point midway between the dipoles is

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

(c) $10^{-7} T$ (d) None of these

22. 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

23. A solenoid has core of a material with relative permeability 500 and its windings carry a current of 1A. The number of turns of the solenoid is 500 per metre. The magnetization of the material is nearly

(a) $2.5 \times 10^3\ Am^{-1}$ (b) $2.5 \times 10^5\ Am^{-1}$

(c) $2.0 \times 10^3\ Am^{-1}$ (d) $2.0 \times 10^5\ Am^{-1}$

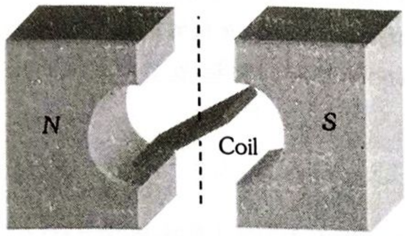
(e) $5 \times 10^5\ Am^{-1}$

24. A magnet of length 0.1 m and pole strength 10^{-4} A.m. is kept in a magnetic field of $30\ Wb/m^2$ at an angle 30°. The couple acting on it is .... $\times 10^{-4} Nm$.

(a) 7.5 (b) 3.0

(c) 1.5 (d) 6.0

25. The figure below shows the north and south poles of a permanent magnet in which n turn coil of area of cross-section A is resting, such that for a current i passed through the coil, the plane of the coil makes an angle θ with respect to the direction of magnetic field B. If the plane of the magnetic field and the coil are horizontal and vertical respectively, the torque on the coil will be



(a) $\tau = niAB\cos\theta$

(b) $\tau = niAB\sin\theta$

(c) $\tau = niAB$

(d) None of the above, since the magnetic field is radial

26. A bar magnet when placed at an angle of 30° to the direction of magnetic field induction of 5×10^{-2} T, experiences a moment of couple 25×10^{-6} N-m. If the length of the magnet is 5 cm its pole strength is

(a) 2×10^{-2} A-m (b) 5×10^{-2} A-m

(c) 2 A-m (d) 5 A-m

27. A planar coil having 12 turns carries 15 A current. The coil is oriented with respect to the uniform magnetic field $\vec{B} = 0.2\hat{i}\,T$ such that its directed area is $\vec{A} = -0.04\hat{i}\,m^2$. The potential energy of the coil in the given orientation is

(a) 0 (b) $+0.72J$

(c) $+1.44J$ (d) $-1.44J$

28. If a bar magnet of magnetic moment M is freely suspended in a uniform magnetic field of strength B, the work done in rotating the magnet through an angle θ is

(a) $MB(1 - \sin\theta)$ (b) $MB\sin\theta$

(c) $MB\cos\theta$ (d) $MB(1 - \cos\theta)$

29. A magnet of magnetic moment M is rotated through 360° in a magnetic field H. The work done will be

(a) MH (b) $2MH$

(c) $2\pi MH$ (d) Zero

2. Earth's Magnetism

1. Magnetic meridian is a

(a) Point (b) Horizontal plane

(c) Vertical plane (d) Line along N-S

2. The magnetic field of earth is due to

(a) Motion and distribution of some material in and outside the earth

(b) Interaction of cosmic rays with the current of earth

(c) A magnetic dipole buried at the centre of the earth

(d) Induction effect of the sun

3. If magnetic lines of force are drawn by keeping magnet vertical, then number of neutral points will be

(a) One (b) Two

(c) Four (d) Five

4. A bar magnet is placed north-south with its north pole due north. The points of zero magnetic field will be in which direction from the centre of the magnet

(a) North and south

(b) East and west

(c) North-east and south-west

(d) North-west and south-east

5. The direction of the null points is on the equatorial line of a bar magnet, when the north pole of the magnet is pointing

(a) North (b) South

(c) East (d) West

6. A very small magnet is placed in the magnetic meridian with its south pole pointing north. The null point is obtained 20 cm away from the centre of the magnet. If the earth's magnetic field (horizontal component) at this point is 0.3 $gauss$, the magnetic moment of the magnet is

(a) 8.0×10^2 $e.m.u.$ (b) 1.2×10^3 $e.m.u.$

(c) 2.4×10^3 $e.m.u.$ (d) 3.6×10^3 $e.m.u.$

7. A bar magnet is 10 cm long, and is kept with its north (N)-pole pointing north. A neutral point is formed at a distance of 15 cm from each pole. Given the horizontal component of earth's field to be 0.4 Gauss, the pole strength of the magnet is

(a) 9 A-m (b) 6.75 A-m

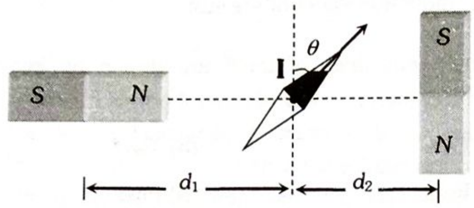
(c) 27 A-m (d) 1.35 A-m

8. Two bar magnets with magnetic moments 2 M and M are fastened together at right angles to each other at their centres to form a crossed system, which can rotate freely about a vertical axis through the centre. The crossed system sets in earth's magnetic field with magnet having magnetic moment 2M making an angle θ with the magnetic meridian such that

(a) $\theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (b) $\theta = \tan^{-1}\left(\sqrt{3}\right)$

(c) $\theta = \tan^{-1}\left(\frac{1}{2}\right)$ (d) $\theta = \tan^{-1}\left(\frac{3}{4}\right)$

9. 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) $(2\cot\theta)^{-1/3}$

10. In a vibration magnetometer, the time period of a bar magnet oscillating in horizontal component of earth's magnetic field is 2 *sec*. When a magnet is brought near and parallel to it, the time period reduces to 1 *sec*. 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) $1/\sqrt{3}$

11. The vertical component of earth's magnetic field is zero at or The earth's magnetic field always has a vertical component except at the

(a) Magnetic poles (b) Geographical poles

(c) Every place (d) Magnetic equator

12. 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°

13. The line on the earth's surface joining the points where the field is horizontal is

(a) Magnetic meridian (b) Magnetic axis

(c) Magnetic line (d) Magnetic equator

(e) Isogonic line

14. Isogonic lines on magnetic map will have

(a) Zero angle of dip

(b) Zero angle of declination

(c) Same angle of declination

(d) Same angle of dip

15. At a place, if the earth's horizontal and vertical components of magnetic fields are equal, then the angle of dip will be

(a) 30° (b) 90°

(c) 45° (d) 0°

16. 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) $V = H = 0$

17. A current carrying coil is placed with its axis perpendicular to N-S direction. Let horizontal component of earth's magnetic field be H_o and magnetic field inside the loop be H. If a magnet is suspended inside the loop, it makes angle θ with H. Then $\theta =$

(a) $\tan^{-1}\left(\frac{H_0}{H}\right)$ (b) $\tan^{-1}\left(\frac{H}{H_0}\right)$

(c) $\text{cosec}^{-1}\left(\frac{H}{H_0}\right)$ (d) $\cot^{-1}\left(\frac{H_0}{H}\right)$

18. The angle of dip at a certain place is 30°. If the horizontal component of the earth's magnetic field is H, the intensity of the total magnetic field is

(a) $\frac{H}{2}$ (b) $\frac{2H}{\sqrt{3}}$

(c) $H\sqrt{2}$ (d) $H\sqrt{3}$

19. The angle of dip at a certain place on earth is 60° and the magnitude of earth's horizontal component of magnetic field is 0.26 *G*. The magnetic field at the place on earth is

(a) 0.13*G* (b) 0.26*G*

(c) 0.52*G* (d) 0.65*G*

20. The magnetic field of the 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 the 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 the earth axis passes through Greenwich

(d) Declination averaged over the earth must be always negative

3. Magnetic Equipments

1. Time period of a freely suspended magnet does not depend upon

(a) Length of the magnet

(b) Pole strength of the magnet

(c) Horizontal component of earth's magnetic field

(d) Length of the suspension thread

2. Keeping dissimilar poles of two magnets of equal pole strength and length same side, their time period will be

(a) Zero (b) One second

(c) Infinity (d) Any value

3. At two places A and B using vibration magnetometer, a magnet vibrates in a horizontal plane and its respective periodic time are 2 *sec* and 3 *sec* and at these places the earth's horizontal components are H_A and H_B respectively. Then the ratio between H_A and H_B will be

(a) 9 : 4 (b) 3 : 2

(c) 4 : 9 (d) 2 : 3

4. A bar magnet is oscillating in the earth's magnetic field with time period T. If its mass is increased four times then its time period will be

(a) $4T$ (b) $2T$

(c) T (d) $T/2$

5. 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) $T_0/\sqrt{3}$ (d) $T_0/3$

6. Two magnets of same size and mass make respectively 10 and 15 *oscillations per minute* at certain place. The ratio of their magnetic moments is

(a) 4 : 9 (b) 9 : 4

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

7. Two identical bar magnets are placed one above the other such that they are mutually perpendicular and bisect each other. The time period of this combination in a horizontal magnetic field is T. The time period of each magnet in the same field is

(a) $\sqrt{2}\,T$ (b) $2^{\frac{1}{4}}T$

(c) $2^{-\frac{1}{4}}T$ (d) $2^{-\frac{1}{2}}T$

8. A magnet oscillating in a horizontal plane has a time period of 2 *second* at a place where the angle of dip is 30° and 3 *seconds* at another place where the angle of dip is 60°. The ratio of resultant magnetic fields at the two places is

(a) $\frac{4\sqrt{3}}{7}$ (b) $\frac{4}{9\sqrt{3}}$

(c) $\frac{9}{4\sqrt{3}}$ (d) $\frac{9}{\sqrt{3}}$

9. 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) $2\sqrt{3}:9$

10. A magnet freely suspended in a vibration magnetometer makes 10 oscillations per minute at a place A and 20 oscillations per minute at a place B. If the horizontal component of earth's magnetic field at A is $36\times10^{-6}\,T$, then its value at B is

(a) $36\times10^{-6}\,T$ (b) $72\times10^{-6}\,T$

(c) $144\times10^{-6}\,T$ (d) $288\times10^{-6}\,T$

11. Two bar magnets of the same mass, length and breadth but magnetic moments M and $2M$ respectively, when placed in sum position, have time period 3 *sec*. What will be the time period when they are placed in difference position

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

(c) 3 sec (d) 6 sec

12. Magnets A and B are geometrically similar but the magnetic moment of A is twice that of B. If T_1 and T_2 be the time periods of the oscillation when their like poles and unlike poles are kept together respectively, then $\frac{T_1}{T_2}$ will be

(a) $\frac{1}{3}$ (b) $\frac{1}{2}$

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

13. Two magnets are held together in a vibration magnetometer and are allowed to oscillate in the earth's magnetic field. With like poles together, 12 oscillations per minute are made but for unlike poles together only 4 oscillations per minute are executed. The ratio of their magnetic moments is

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

(c) 3 : 5 (d) 5 : 4

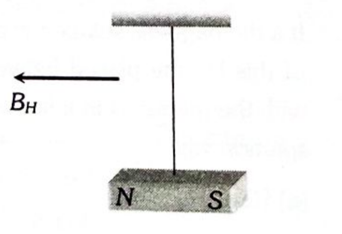
14. A magnet is suspended horizontally in the earth's magnetic field. When it is displaced and then released it oscillates in a horizontal plane with a period T. If a piece of wood of the same moment of inertia (about the axis of rotation as the magnet) is attached to the magnet, what would be the new period of oscillation of the system

(a) $\frac{T}{3}$

(b) $\frac{T}{2}$

(c) $\frac{T}{\sqrt{2}}$

(d) $T\sqrt{2}$

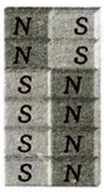


15. A vibration magnetometer consists of two identical bar magnets placed one over the other such that they are perpendicular and bisect each other. The time period of oscillation in a horizontal magnetic field is $2^{5/4}$ *seconds*. One of the magnets is removed and if the other magnet oscillates in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

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

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

16. The length of a magnet is large compared to it's width and breadth. The time period of its oscillation in a vibration magnetometer is *T*. The magnet is cut along it's length into six parts and these parts are then placed together as shown in the figure. The time period of this combination will be



(a) T

(b) $\frac{T}{\sqrt{3}}$

(c) $\frac{T}{2\sqrt{3}}$

(d) Zero

17. The magnet of a vibration magnetometer is heated so as to reduce its magnetic moment by 19%. By doing this the periodic time of the magnetometer will

(a) Increase by 19% (b) Decrease by 19%

(c) Increase by 11% (d) Decrease by 21%

18. Two short magnets having magnetic moments in the ratio 27: 8, when placed on opposite sides of a deflection magnetometer, produce no deflection. If the distance of the weaker magnet is 0.12 *m* from the centre of deflection magnetometer, the distance of the stronger magnet from the centre is

(a) 0.06 *m* (b) 0.08 *m*

(c) 0.12 *m* (d) 0.18 *m*

4. Magnetic Materials

1. Diamagnetic substances are

(a) Feebly attracted by magnets

(b) Strongly attracted by magnets

(c) Feebly repelled by magnets

(d) Strongly repelled by magnets

2. If a diamagnetic solution is poured into a *U*-tube and one arm of this *U*-tube placed between the poles of a strong magnet with the meniscus in a line with the field, then the level of the solution will

(a) Rise (b) Fall

(c) Oscillate slowly (d) Remain as such

3. If a magnetic substance is kept in a magnetic field, then which of the following is thrown out

(a) Paramagnetic (b) Ferromagnetic

(c) Diamagnetic (d) Antiferromagnetic

4. The universal property of all substances is

(a) Diamagnetism (b) Ferromagnetism

(c) Paramagnetism (d) All of these

5. A small rod of bismuth is suspended freely between the poles of a strong electromagnet. It is found to arrange itself at right angles to the magnetic field. This observation establishes that bismuth is

(a) Diamagnetic (b) Paramagnetic

(c) Ferri-magnetic (d) Antiferro-magnetic

6. Among the following properties describing diamagnetism identify the property that is wrongly stated

(a) Diamagnetic materials do not have permanent magnetic moment

(b) Diamagnetism is explained in terms of electromagnetic induction

(c) Diamagnetic materials have a small positive susceptibility

(d) The magnetic moment of individual electrons neutralize each other

7. Which one of the following is not a characteristic of diamagnetism?

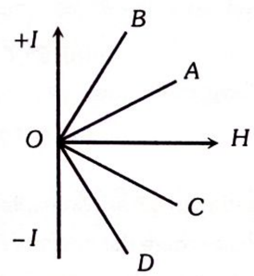
(a) The diamagnetic materials are repelled by a bar magnet

(b) The magnetic susceptibility of the materials is small and negative

(c) The origin of dia magnetism is the spin of electrons

(d) The material move from a region of strong magnetic field to weak magnetic field

8. The variation of the intensity of magnetisation *(I)* with respect to the magnetising field *(H)* in a diamagnetic substance is described by the graph



(a) *OD* (b) *OC*

(c) *OB* (d) *OA*

9. The magnetic susceptibility of paramagnetic materials is

(a) Positive, but very high (b) Negative

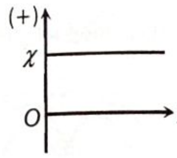
(c) Negative and very high (d) Positive, but small

10. The relative permeability is represented by μ_r and the susceptibility is denoted by χ for a magnetic substance. Then for a paramagnetic substance

(a) $\mu_r < 1, \chi < 0$ (b) $\mu_r < 1, \chi > 0$

(c) $\mu_r > 1, \chi < 0$ (d) $\mu_r > 1, \chi > 0$

11. The variation of magnetic susceptibility (χ) with magnetising field for a paramagnetic substance is

(a)


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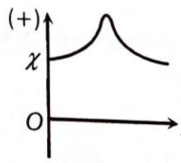

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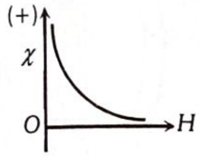

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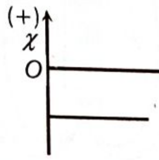


12. Which of the following statements is true for the three types of magnetism – para, dia and ferro

(a) Paramagnetism is associated with negative susceptibility and dia and ferromagnetism with positive susceptibility

(b) Diamagnetism is generally weakest of the three, and is associated with negative susceptibility

(c) Ferromagnetism is the strongest of the three and is associated with negative susceptibility

(d) All three are associated with positive susceptibility, diamagnetism is the weakest form of magnetism, and ferromagnetism is the strongest form

13. Which one of the following characteristics is not associated with a ferromagnetic material

(a) It is strongly attracted by a magnet

(b) It tends to move from a region of strong magnetic field to a region of weak magnetic field

(c) Its origin is the spin of electrons

(d) Above the Curie temperature, it exhibits paramagnetic properties

(e) Its magnetic susceptibility is large and positive

14. The only property possessed by ferromagnetic substance is

(a) Hysteresis

(b) Susceptibility

(c) Directional property

(d) Attracting magnetic substances

15. Domain formation is the necessary feature of

(a) Ferromagnetism (b) Paramagnetism

(c) Diamagnetism (d) All of these

16. Iron would become paramagnetic at about

(a) 200°C (b) 400°C

(c) 600°C (d) 800°C

17. 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

18. A paramagnetic substance of susceptibility 3×10^{-4} is placed in a magnetic field of $4\times10^{-4}\,Am^{-1}$. Then the intensity of magnetization in the units of Am^{-1} is

(a) 1.33×10^{8} (b) 0.75×10^{-8}

(c) 12×10^{-8} (d) 14×10^{-8}

19. Relative permeability of iron is 5500, then its magnetic susceptibility will be

(a) 5500×10^{7} (b) 5500×10^{-7}

(c) 5501 (d) 5499

20. For an isotropic medium B, μ, H and M are related as (where B, μ_0, H and M have their usual meanings in the context of magnetic material)

(a) $(B-M)=\mu_0 H$ (b) $M=\mu_0(H+M)$

(c) $H=\mu_0(H+M)$ (d) $B=\mu_0(H+M)$

21. 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

22. The magnetic susceptibility of any paramagnetic material changes with absolute temperature T as

(a) Directly proportional to T

(b) Remains constant

(c) Inversely proportional to T

(d) Exponentially decaying with T

23. A domain in a ferromagnetic substance is in the form of a cube of side length $1\mu m$. If it contains 8×10^{10} atoms and each atomic dipole has a dipole moment of $9\times10^{-24}\,A\,m^2$, then magnetization of the domain is

(a) $7.2\times10^{5}\,A\,m^{-1}$ (b) $7.2\times10^{3}\,A\,m^{-1}$

(c) $7.2\times10^{9}\,A\,m^{-1}$ (d) $7.2\times10^{12}\,A\,m^{-1}$

(e) $7.2\times10^{18}\,A\,m^{-1}$

24. Susceptibility of Mg at 300 K is 1.2×10^{-5}. The temperature at which susceptibility will be 1.8×10^{-5} is

(a) 450 K (b) 200 K

(c) 375 K (d) None of these

25. The material of permanent magnet has

(a) High retentivity, low coercivity

(b) Low retentivity, high coercivity

(c) Low retentivity, low coercivity

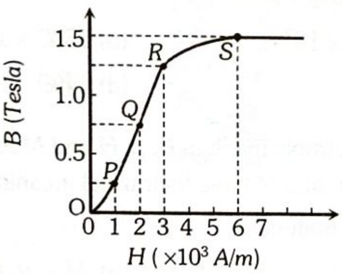
(d) High retentivity, high coercivity

26. In the hysteresis cycle, the value of H needed to make the intensity of magnetisation zero is called

(a) Retentivity (b) Coercive force

(c) Lorentz force (d) None of the above

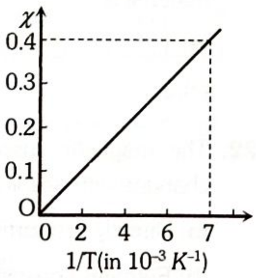
27. The basic magnetization curve for a ferromagnetic material is shown in figure. Then, the value of relative permeability is highest for the point



(a) P (b) Q

(c) R (d) S

28. The $\chi - 1/T$ graph for an alloy of paramagnetic nature is shown in fig. The curie constant is



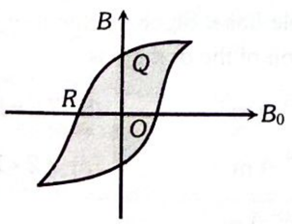
(a) $57\,K$

(b) $2.8\times10^{-3}K$

(c) $570\,K$

(d) $17.5\times10^{-3}K$

29. The figure illustrates how B, the flux density inside a sample of unmagnetised ferromagnetic material, varies with B_0, the magnetic flux density in which the sample is kept. For the sample to be suitable for making a permanent magnet



(a) OQ should be large, OR should be small

(b) OQ and OR should both be large

(c) OQ should be small and OR should be large

(d) OQ and OR should both be small

5. IIT-JEE/AIEEE

1. The magnetic lines of force inside a bar magnet **[2003]**

(a) Are from south-pole to north-pole of the magnet

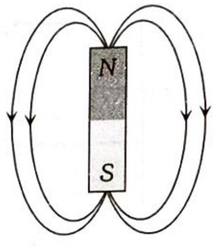
(b) Are from north-pole to south-pole of the magnet

(c) Do not exist

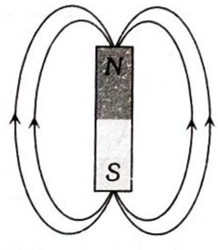
(d) Depend upon the area of cross-section of the bar magnet

2. The magnetic field lines due to a bar magnet are correctly shown in **[2002]**

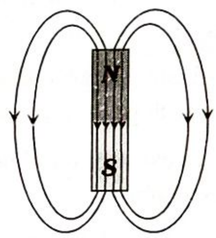
(a)



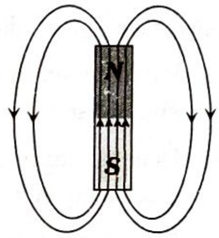
(b)



(c)



(d)



3. 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 **[2000]**

(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) $\frac{\mu_0}{4\pi}(\sqrt{5})\frac{M}{d^3}$

4. A magnetic needle is kept in a non-uniform magnetic field. It experiences **[1982]**

(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

5. The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is B_1. When the dipole moment is double by keeping the current constant, the magnetic field at the centre of loop is B_2. The ratio $\frac{B_1}{B_2}$ is **[2018]**

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

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

6. Two short bar magnet of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0cm. The value of the resultant horizontal magnetic induction at the mid – point O of the line joining their centres is close to (Horizontal component of earth's magnetic induction is $3.6\times10^{-5}Wb/m^2$) **[2013]**

(a) $3.6\times10^{-5}Wb/m^2$ (b) $2.56\times10^{-4}Wb/m^2$

(c) $3.50\times10^{-4}Wb/m^2$ (d) $5.80\times10^{-4}Wb/m^2$

7. 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 **[2002]**

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

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

8. The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is 2 s. The magnet is cut along its length into three equal parts and three parts are then placed on each other with their like poles together. The time period of this combination will be **[2004]**

(a) 2 s (b) 2/3 s

(c) $2\sqrt{3}$ s (d) $2/\sqrt{3}$ s

9. 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', then ratio T'/T is **[2003]**

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

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

10. A magnetic needle of magnetic moment $6.7\times10^{-2}Am^2$ and moment of inertia $7.5\times10^{-6}kgm^2$ is performing simple harmonic oscillations in a magnetic field of $0.01T$. Time taken for 10 complete oscillations is **[2017]**

(a) 8.76 s (b) 6.65 s

(c) 8.89 s (d) 6.98 s

11. Relative permittivity and permeability of a material are ε_r and μ_r, respectively. Which of the following values of these quantities are allowed for a diamagnetic material **[2008]**

(a) $\varepsilon_r=1.5, \mu_r=0.5$ (b) $\varepsilon_r=0.5, \mu_r=0.5$

(c) $\varepsilon_r=1.5, \mu_r=1.5$ (d) $\varepsilon_r=0.5, \mu_r=1.5$

12. The magnetic susceptibility is negative for **[2002]**

(a) Diamagnetic material only

(b) Paramagnetic material only

(c) Ferromagnetic material only

(d) Paramagnetic and ferromagnetic materials

13. 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 **[2006]**

(a) Attract N_1 strongly, N_2 weakly and repel N_3 weakly

(b) Attract N_1 strongly, but repel N_2 and N_3 weakly

(c) Attract all three of them

(d) Attract N_1 and N_2 strongly but repel N_3

14. Curie temperature is the temperature above which **[2003]**

(a) A paramagnetic material becomes ferromagnetic

(b) A ferromagnetic material becomes paramagnetic

(c) A paramagnetic material becomes diamagnetic

(d) A ferromagnetic material becomes diamagnetic

15. The materials suitable for making electromagnets should have **[2004]**

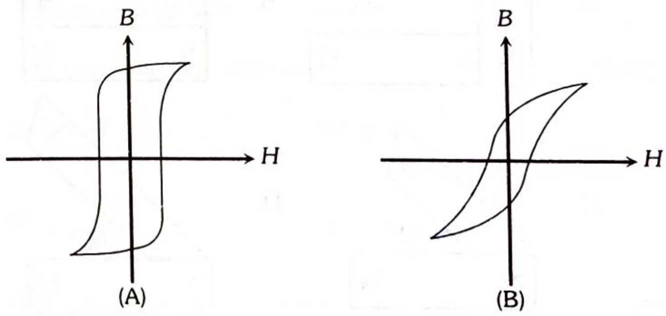
(a) High retentivity and high coercivity

(b) Low retentivity and low coercivity

(c) High retentivity and low coercivity

(d) Low retentivity and high coercivity

16. Hysteresis loops for two magnetic materials A and B are given below **[2005]**



These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use

(a) A for electromagnets and B for electric generators

(b) A for transformers and B for electric generators

(c) B for electromagnets and transformers

(d) A for electric generators and transformers

6. NEET/AIPMT

1. For protecting a sensitive equipment from the external magnetic field, it should be **[1998]**

(a) Placed inside an aluminium case

(b) Placed inside an iron case

(c) Wrapped with insulation around it when passing current through it

(d) Surrounded with fine copper sheet

2. In the case of bar magnet, lines of magnetic induction **[1990]**

(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

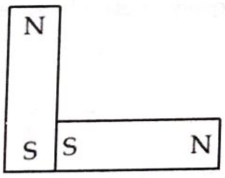
3. An iron rod of length L and magnetic moment M is bent in the form of a semicircle. Now its magnetic moment will be **[2013]**

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

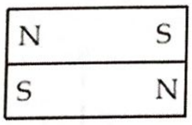
(c) $\frac{M}{\pi}$ (d) $M\pi$

4. Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment $\vec{m}$. Which configuration has highest net magnetic dipole moment **[2014]**

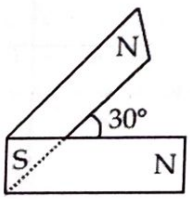
A.



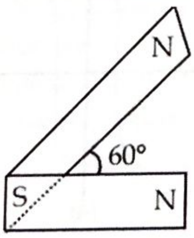
B.



C.



D.



(a) C (b) D

(c) A (d) B

5. A bar magnet is held perpendicular to a uniform magnetic field. If the couple acting on the magnet is to be halved by rotating it, then the angle by which it is to be rotated is **[2000]**

(a) 30° (b) 45°

(c) 60° (d) 90°

6. A bar magnet having a magnetic moment of $2\times10^4\ JT^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6\times10^{-4}\ T$ exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is **[2009]**

(a) 0.6 J (b) 12 J

(c) 6 J (d) 2 J

7. A short bar magnet of magnetic moment $0.4\,JT^{-1}$ is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is **[2011]**

(a) $-0.082J$ (b) $0.064J$

(c) $-0.064J$ (d) Zero

8. 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 **[1995]**

(a) 1/2 (b) 2

(c) 1/4 (d) 1

9. A 250 turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of $82\,\mu A$ are subjected to a magnetic field of strength $0.85T$. Work done for rotating the coil by 180° against the torque is **[2017]**

(a) $9.1\,\mu J$ (b) $4.55\,\mu J$

(c) $2.3\,\mu J$ (d) $1.15\,\mu J$

10. A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W. Now the torque required to keep the magnet in this new position is **[2016]**

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

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

11. A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It **[2012]**

(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

12. Due to the earth's magnetic field, charged cosmic ray particles **[1997]**

(a) Require greater kinetic energy to reach the equator than the poles

(b) Require less kinetic energy to reach the equator than the poles

(c) Can never reach the equator

(d) Can never reach the poles

13. If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angles of dip θ is given by **[2017]**

(a) $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

(b) $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$

(c) $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$

(d) $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$

14. A bar magnet is oscillating in the Earth's magnetic field with a period T. What happens to its period and motion if its mass is quadrupled **[2003]**

(a) Motion remains S.H.M. with time period $= 2T$

(b) Motion remains S.H.M. with time period $= 4T$

(c) Motion remains S.H.M. and period remains nearly constant

(d) Motion remains S.H.M. with time period $= \frac{T}{2}$

15. A bar magnet has a magnetic moment equal to 5×10^{-5} *weber* $\times$ *m*. It is suspended in a magnetic field which has a magnetic induction (B) equal to $8\pi\times10^{-4}$ *tesla*. The magnet vibrates with a period of vibration equal to 15 *sec*. The moment of inertia of the magnet is **[2001]**

(a) $22.5 kg\times m^2$ (b) $11.25\times kg\times m^2$

(c) $5.62 kg\times m^2$ (d) $7.16\times10^{-7} kg-m^2$

16. 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: **[2010]**

(a) 4s (b) 1s

(c) 2s (d) 3s

17. If a diamagnetic substance is brought near north or south pole of a bar magnet, it is **[2009]**

(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

18. Demagnetisation of magnets can be done by **[1988]**

(a) Rough handling

(b) Heating

(c) Magnetising in the opposite direction

(d) All the above

19. The magnetic moment of a diamagnetic atom is **[2010]**

(a) Much greater than one (b) 1

(c) Between zero and one (d) Equal to zero

20. A diamagnetic material in a magnetic field moves **[2003]**

(a) From weaker to the stronger parts of the field

(b) Perpendicular to the field

(c) From stronger to the weaker parts of the field

(d) In none of the above directions

21. The magnetic susceptibility does not depend upon the temperature in **[2001]**

(a) Ferrite substances (b) Ferromagnetic substances

(c) Diamagnetic substances (d) Paramagnetic substances

22. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material is denoted by μ_d, μ_p, μ_f respectively then **[2005]**

(a) $\mu_d \neq 0$ and $\mu_f \neq 0$ (b) $\mu_p = 0$ and $\mu_f \neq 0$

(c) $\mu_d = 0$ and $\mu_p \neq 0$ (d) $\mu_d \neq 0$ and $\mu_p = 0$

23. There are four light-weight-rod samples, A, B, C, D separately suspended by threads. A bar magnet is slowly brought near each sample and the following observations are noted **[2011]**

(i) A is feebly repelled (ii) B is feebly attracted

(iii) C is strongly attracted (iv) D remains unaffected

Which one of the following is true?

(a) A is of a non-magnetic material

(b) B is of a paramagnetic material

(c) C is of a diamagnetic material

(d) D is of a ferromagnetic material

24. Which of the following is most suitable for the core of electromagnets **[1990]**

(a) Soft iron (b) Steel

(c) Copper-nickel alloy (d) Air

25. Curie's law can be written as **[2003]**

(a) $\chi \propto (T - T_c)$ (b) $\chi \propto \frac{1}{T - T_c}$

(c) $\chi \propto \frac{1}{T}$ (d) $\chi \propto T$

26. When a ferromagnetic material is heated to temperature above its Curie temperature, the material **[2006]**

(a) Is permanently magnetized

(b) Remains ferromagnetic

(c) Behaves like a diamagnetic material

(d) Behaves like a paramagnetic material

27. For diamagnetic materials, magnetic susceptibility is **[2016]**

(a) Small and negative (b) Small and positive

(c) Large and negative (d) Large and positive

28. A thin diamagnetic rod is placed vertically between the poles of an electromagnetic. When the current in the electromagnet is switched on, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence the rod gains gravitational potential energy. The work required to do this comes from **[2018]**

(a) The current source

(b) The magnetic field

(c) The lattice structure of the material of the rod

(d) The induced electric field due to the changing magnetic field

7. AIIMS

1. Force between two identical bar magnets whose centres are *r metre* apart is 4.8 *N*, when their axes are in the same line. If separation is increased to 2*r*, the force between them is reduced to **[1995]**

(a) 2.4*N* (b) 1.2*N*

(c) 0.6*N* (d) 0.3*N*

2. 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 $5\times10^{-2}T$. If a current of 0.1 *A* is passed through the coil, what is the couple acting **[2010]**

(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

3. The lines of force due to earth's horizontal component of magnetic field are **[1998]**

(a) Parallel straight lines (b) Concentric circles

(c) Elliptical (d) Parabolic

4. At magnetic poles of earth, angle of dip is **[1999]**

(a) Zero (b) 45°

(c) 90° (d) 180°

5. A magnet makes 40 oscillations per minute at a place having magnetic field intensity of 0.1×10^{-5} *T*. At another place, it takes 2.5 *sec* to complete one vibration. The value of earth's horizontal field at that place is **[2000]**

(a) 0.25×10^{-6} *T* (b) 0.36×10^{-6} *T*

(c) 0.66×10^{-8} *T* (d) 1.2×10^{-6} *T*

6. The time period of a freely suspended magnet is 4 *seconds*. If it is broken in length into two equal parts and one part is suspended in the same way, then its time period will be **[2010]**

(a) 4 *sec* (b) 2 *sec*

(c) 0.5 *sec* (d) 0.25 *sec*

7. When a magnetic substance is heated, then it **[1999]**

(a) Becomes a strong magnet

(b) Losses its magnetism

(c) Does not effect the magnetism

(d) Either (a) or (c)

8. A frog can be deviated in a magnetic field produced by a current in a vertical solenoid placed below the frog. This is possible because the body of the frog behaves as **[2003]**

(a) Paramagnetic (b) Diamagnetic

(c) Ferromagnetic (d) Antiferromagnetic

9. Liquid oxygen remains suspended between two pole faces of a magnet because it is **[2004]**

(a) Diamagnetic (b) Paramagnetic

(c) Ferromagnetic (d) Antiferromagnetic

10. Magnetic permeability is maximum for **[2000]**

(a) Diamagnetic substance (b) Paramagnetic substance

(c) Ferromagnetic substance (d) All of these

8. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : We cannot think of magnetic field configuration with three poles.

Reason : A bar magnet does exert a torque on itself due to its own field.

2. Assertion : The poles of magnet cannot be separated by breaking into two pieces.

Reason : The magnetic moment will be reduced to half when a magnet is broken into two equal pieces.

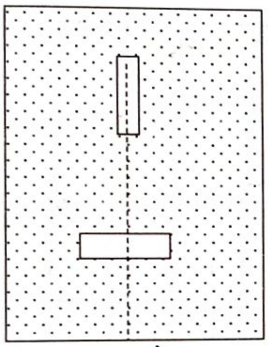
3. Assertion : Magnetic moment of an atom is due to both the orbital motion and spin motion of every electron.

Reason : A charged particle produces a magnetic field.

4. Assertion : If a compass needle be kept at magnetic north pole of the earth, the compass needle may stay in any direction.

Reason : Dip needle will stay vertical at the north pole of earth.

5. Assertion : Two short magnets are placed on a cork which floats on water. The magnets are placed such that the axis of one produced bisects the axis of other at right angles. Then the cork has neither translational nor rotational motion.



Reason : Net force on the cork is zero.

6. Assertion : The properties of paramagnetic and ferromagnetic substances are not affected by heating.

Reason : As temperature rises, the alignment of molecular magnets gradually decreases.

7. Assertion : Soft iron is used as transformer core.

Reason : Soft iron has narrow hysteresis loop.

8. Assertion : Magnetism is relativistic.

Reason : When we move along with the charge so that there is no motion relative to us, we find no magnetic field associated with the charge.

9. Assertion : Diamagnetic materials can exhibit magnetism.

Reason : Diamagnetic materials have permanent magnetic dipole moment.

10. Assertion : When a magnet is brought near iron nails, only translatory force acts on it.

Reason : The field due to a magnet is generally uniform.

11. Assertion : When a magnetic dipole is placed in a non uniform magnetic field, only a torque acts on the dipole.

Reason : Force would also act on dipole if magnetic field were uniform.

12. Assertion : The permeability of a ferromagnetic material is independent of the magnetic field.

Reason : Permeability of a material is a constant quantity.

13. Assertion : A paramagnetic sample displays greater magnetisation (for the same magnetising field) when cooled.

Reason : The magnetisation does not depend on temperature.

21. Magnetism – Answers Keys

1. Magnet and It's Properties

1	a	2	b	3	b	4	a	5	d
6	b	7	c	8	c	9	c	10	b
11	c	12	d	13	c	14	c	15	d
16	a	17	a	18	b	19	b	20	d
21	b	22	d	23	b	24	c	25	a
26	a	27	c	28	d	29	d		

2. Earth's Magnetism

1	c	2	a	3	a	4	b	5	a
6	b	7	d	8	c	9	c	10	b
11	d	12	d	13	d	14	c	15	c
16	a	17	b	18	b	19	c	20	a

3. Magnetic Equipments

1	d	2	c	3	a	4	b	5	a
6	a	7	c	8	c	9	b	10	c
11	b	12	c	13	d	14	d	15	c
16	c	17	c	18	d				

4. Magnetic Materials

1	c	2	b	3	c	4	a	5	a
6	c	7	c	8	a	9	d	10	d
11	a	12	b	13	b	14	a	15	a
16	d	17	d	18	c	19	d	20	d
21	d	22	c	23	a	24	b	25	d
26	b	27	b	28	a	29	b		

5. IIT-JEE/AIEEE

1	a	2	d	3	d	4	a	5	a
6	b	7	b	8	b	9	c	10	b
11	a	12	a	13	a	14	b	15	b
16	c								

6. NEET/AIPMT

1	b	2	b	3	b	4	a	5	c
6	c	7	c	8	b	9	a	10	d
11	b	12	c	13	a	14	a	15	d
16	a	17	b	18	d	19	d	20	c
21	c	22	c	23	b	24	a	25	c
26	d	27	a	28	a				

7. AIIMS

1	d	2	a	3	a	4	c	5	b
6	b	7	b	8	b	9	b	10	c

8. Assertion and Reason

1	d	2	b	3	c	4	b	5	a
6	e	7	a	8	a	9	c	10	d
11	d	12	d	13	c				