Magnetism and Matter Important Questions With Answers

NEET Physics 2023

1. An iron rod of susceptibility 599 is subjected to a magnetising field of 1200 Am^{-1}. The permeability of the material of the rod is: _____.
   a) 2.4 p x 10^{-7} T mA^{-1} **b) 2.4 p x 10^{-4} T mA^{-1}** c) 8 x 10^{-5} T mA^{-1} d) 2.4 p x 10^{-5} T mA^{-1}

   Solution : -
   $m_r = x_m + 1 = 599 + 1 = 600$
   $m = m_0 m_r = 4p \times 10^{-7} \times 600$
   $= 2.4\pi \times 10^{-4} \frac{Tm}{A}$
2. 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

   Solution : -
   As magnetic field is in vertical direction and needle is free to rotate in horizontal plane only so magnetic force cannot rotate needle in horizontal plane so needle can stay in any position.
3. A short bar magnet of magnetic moment 0.4JT^{-1} is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is _____.
   a) -0.64J b) Zero c) -0.0.82J **d) -0.064J**

   Solution : -
   For stable equilibrium
   U = -MB
   = -(0.4)(0.16)
   = -0.064 J
4. There are four lightweight 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
   (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) B is of a paramagnetic material b) C is of a diamagnetic material c) D is of a ferromagnetic material
   d) A is of a non-magnetic material

   Solution : -
   A = Diamagnetic material
   B = Paramagnetic material
   C = Ferromagnetic material
   D = Non-magnetic material

5. The magnetic moment of a diamagnetic atom is _____.
   a) equal to zero b) much greater than one c) 1 d) between zero and one

   Solution : -
   The magnetic moment of a diamagnetic atom is equal to zero.

6. Electromagnets are made of soft iron because soft iron has _____.
   a) low retentivify ancl high coercive force b) high retentivity and high coercive force
   c) low retentivity and low coercive force **d) high retentivity and low coercive force**

   Solution : -
   Soft iron has high retentivity and low coercive force.

7. 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) 1s b) 2s c) 3s **d) 4s**

   Solution : -
   A vibrations magnetometer time period.
   $T \propto \frac{1}{\sqrt{B}}$
   $\Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{B_2}{B_1}}$
   $\Rightarrow T_2 = T_1\sqrt{\frac{B_1}{B_2}}$
   $= 2\sqrt{\frac{24\times10^{-6}}{6\times10^{-6}}} = 4 \text{ s}$

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

   Solution : -
   External magnetic fields repell diamagnetic substances.

9. A bar magnet having a magnetic moment of 2 x 10^4 JT^{-1} is free to rotate in a horizontal plane. A horizontal magnetic field B = 6 x 10^{-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^o from the field is _____.
   a) 12J **b) 6J** c) 2J d) 0.6J

   Solution : -
   Work done
   = MB (cos θ_1 - cos θ_2)
   = MB (cos 0^o - cos 60^o)
   $= MB\left(1 - \frac{1}{2}\right) = \frac{2\times10^4\times6\times10^{-4}}{2} = 6 \text{ J}$

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

    Solution : -
    Curie temperature is the temperature above which ferromagnetic material becomes paramagnetic material.

11. Nickel shows the ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show _____.
a) antiferromagnetism b) no magnetic property c) diamagnetism **d) paramagnetism**

Solution : -
Beyond Curie temperature, ferromagnetic substances behave like a paramagnetic substances.

12. 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

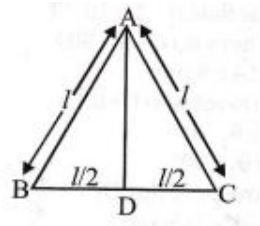
Solution : -
Above Curie temperature, a ferromagnetic substance becomes paramagnetic.

13. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by m_d, m_p and m_f respectively, then _____.
a) $\mu_d = 0 \text{ and } \mu_p \neq 0$ b) $\mu_d \neq 0 \text{ and } \mu_p = 0$ c) $\mu_p = 0 \text{ and } \mu_f \neq 0$ d) $\mu_d \neq 0 \text{ and } \mu_f \neq 0$

Solution : -
As each pair of electrons in a diamagnetic material has opposite spins, the magnetic dipole moment of diamagnetic material is zero i.e. μd= 0.
Paramagnetic substances have dipole moment > 0, i.e. μ_p = 0, because of excess of electrons in its molecules spin in the same direction.
Ferromagnetic substances are very strong magnets and they also have permanent magnetic moment, i.e. $m_f \neq 0$.

14. A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in the plane of the coil. If due to a current i in the triangle a torque t acts on it, the side l of the triangle is _____.
a) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{B \cdot i}\right)^{\frac{1}{2}}$ **b)** $2\left(\frac{\tau}{\sqrt{3}B \cdot i}\right)^{\frac{1}{2}}$ c) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{B \cdot i}\right)$ d) $\frac{1}{\sqrt{3}}\frac{\tau}{B \cdot i}$

Solution : -
$\tau = MB\sin\theta$
$\tau = iAB\sin 90^\circ$



$\therefore A = \frac{\tau}{iB}$
Also, A = 1/2 (BC)(AD)
But, $\frac{1}{2}(BC)(AD) = \frac{1}{2}(l)\sqrt{l^2 - \left(\frac{l}{2}\right)^2}$
$= \frac{\sqrt{3}}{4}l^2$
$\Rightarrow \frac{\sqrt{3}}{4}(l)^2 = \frac{\tau}{Bi}$
$\therefore l = 2\left(\frac{\tau}{\sqrt{3}B \cdot i}\right)^{\frac{1}{2}}$

15. According to Curie's law, the magnetic susceptibility of a substance at an absolute temperature T is proportional to _____.
a) T^2 **b) 1/T** c) T d) $1/T^2$

Solution : -

As per Curie's law, $\chi_m \alpha \frac{1}{T}$

16. Diamagnetic material in a magnetic field moves _____.

a) perpendicular to the field **b) from stronger to the weaker parts of the field**

c) from weaker to the stronger parts of the field d) in none of the above directions

Solution : -

In a magnetic field a diamagnetic material moves from stronger to the weaker parts of the field.

17. Two magnets of magnetic moments M and 2M are placed in a vibration magnetometer, with the identical poles in the same direction. The time period of vibration is T_l. If the magnets are placed with opposite poles together and vibrate with time period T_2, then _____.

a) T_2 is infinite b) $T_2 = T_l$ **c) $T_2 > T_1$** d) $T_2 < T_1$

Solution : -

$T_1 = 2\pi\sqrt{\frac{I_1+I_2}{(M+2M)H}} = 2\pi\sqrt{\frac{I}{3MH}}$

$T_2 = 2\pi\sqrt{\frac{I_1+I_2}{(2M-M)H}} = 2\pi\sqrt{\frac{I}{MH}}$

obviously, $T_2 > T_i$

18. Current I is flowing in a coil of area A and number of turns N, then magnetic moment of the coil, M _____.

a) NiA b) $\frac{Ni}{A}$ c) $\frac{Ni}{\sqrt{A}}$ d) N^2Ai

Solution : -

Magnetic moment linked with one tum = iA Magnetic moment linked with N tums is equal to iNA amp-m^2. Here, A = Area of current loop.

19. A bar magnet of magnetic moment M is placed in a magnetic field of induction B. The torque exerted on it is _____.

a) M.B b) -M.B **c) M x B** d) -M x B

Solution : -

When a bar magnet is palced in an external magnetic field B, a magnetic torque r acts on it, which is given by $\tau = M \times B = |M| \times |B| \sin\theta$. ($\theta$ = angle between M and B).

20. A diamagnetic substance is brought near a strong magnet, then it is _____.

a) attracted by a magnet **b) repelled by a magnet** c) repelled by North pole and attracted by South pole

d) attracted by North pole and attracted by South pole

Solution : -

When diamagnetic substances are placed in magnetic field of a strong magnet, then it is feebly magnetised in the opposite direction of field or it is repelled by strong magnet.

21. For protecting a sensitive equipment from the external magnetic field, it should be _____.

a) placed inside an aluminum can **b) placed inside an iron**

c) require less kinetic energy to reach the equator than the poles d) Surrounded with fine copper sheet

Solution : -

Iron is a ferromagnetic subsatnces. There are no magnetic lines of force inside a ferromagnetic substance. So, equipment may be protected by placing it inside the can made of a ferromagnetic.

22. Due to the earth's magnetic field, charged cosmic ray particle _____.

a) can never reach the poles b) can never reach the equator

c) require less kinetic energy to reach the equator than the poles

d) require greater kinetic energy to reach the equator than the poles

Solution : -

Earth's magnetic field at poles is vertical (perpendicular to the earth's surface) and horizontal (parallel to the earth's surface) at equator. Cosmic rays are positively charged particles and its velocity is parallel to the earths magnetic field.

23. The work done in turning a magnet of magnetic moment M by an angle of 90^0 from the meridian, is n times the corresponding work done to turn it through an angle of 60^0. The value of n is given by _____ .
a) 2 b) 1 c) 0.5 d) 0.25

Solution : -
Work done in rotating the dipole from $\theta_1 \; to \; \theta_2$
$W = -MB\left(\cos\theta_2 - \cos\theta_1\right)$
M= Magnetic moment
B = Magnetic induction
Case 1:
$W_1 = -MB\left(\cos 90^\circ - \cos 0^\circ\right) = MB$ .....(i)
Case 2:
$W_2 = -MB\left(\cos 60^\circ - \cos 0^\circ\right)$
$= MB\left(\frac{1}{2} - 1\right) = \frac{1}{2}MB$
From Eqn (i) and (ii), $W_2 = \frac{1}{2}W_1$
As $W_1 = nW_2$
n = 2

24. A bar magnet is oscillating in the earth's magnetic field with a period T. What happens to its period of motion, if its mass is quadrupled?
a) Motion remains simple harmonic with new period = T/2
b) Motion remains simple harmonic with new period = 2T
c) Motion remains simple harmonic and the period = 4T
d) Motion remains simple harmonic and the period stays nearly constant

Solution : -
The time period of a bar magnet in a magnetic field is given by $T = 2\sqrt{\left(\frac{I}{MB}\right)}$
Where I is moment of inertia of bar magret, M is magnetic moment and B is magnetic induction. When mass is made 4 times $\left(as I = mr^2, I \propto m\right)$. From the above quation of time period $T \propto \sqrt{I}c$. So, T becomes twice as mass is quadrupole.

25. Two magnets have the same length and the same pole strength. But one of the magnets has a small hole at its centre. Then,
a) both have equal magnetic moment **b) one with hole has small magnetic moment**
c) one with hole has large magnetic moment d) one with hole loses magnetism through the hole

26. A large magnet is broken into two pieces so that their lengths are in the ratio 2 : 1. The pole strengths of the two pieces will have ratio.
a) 2: 1 b) 1: 2 c) 4: 1 **d) 1: 1**

27. The intensity of magnetic field at a point X on the axis of a small magnet is equal to the field intensity at another point Y on equatorial axis. The ratio of distance of X and Y from the centre of the magnet will be
a) $(2)^{-3}$ b) $(2)^{-1/3}$ c) 2^3 **d) $2^{1/3}$**

28. Work done in rotating a bar magnet from 0 to angle 120° is
a) $\frac{1}{2}$ MB **b) $\frac{3}{2}$ MB** c) MB d) $\frac{2}{3}$ MB

29. Gauss's law for magnetism is
a) the net magnetic flux through any closed surface is B. $\triangle$S
b) the net magnetic flux through any closed surface is E. $\triangle$S

c) the net magnetic flux through any closed surface is zero d) Both (a) and (c)

30. At a place angle of dip is 30°. If horizontal component of earth's magnetic field is H, then the total intensity of magnetic field will be
    a) H / 2 **b) 2H / $\sqrt{3}$** c) H $\sqrt{3/2}$ d) 2 H
31. The value of angle of dip is zero at the magnetic equator because on it
    a) V and Hare equal b) the values of V and Hare zero **c) the value of V is zero** d) the value ofH is zero
32. The relative permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then
    a) X is paramagnetic and Y is ferromagnetic b) X is diamagnetic and Y is ferromagnetic
    c) X and Y both are paramagnetic **d) X is diamagnetic and Y is paramagnetic**
33. 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**
34. Cutting a bar magnet in half is like cutting a solenoid, such that we get two smaller solenoids with
    a) weaker magnetic properties b) strong magnetic properties c) constant magnetic properties
    d) Both (a) and (b)
35. A short bar magnet placed with its axis at 30° with an external field of 800 G experiences a torque of 0.016 Nm. The magnetic moment of the magnet is
    a) 4 Am^2 b) 0.5 Am^2 c) 2 Am^2 **d) 0.40 Am^2**
36. The earth's magnetic field at the equator is approximately 0.4 G, the earth's dipole moment is
    a) 1 x 10^{23} Am ^{2} **b) 1.05 x 10^{23} Am ^{2}** c) 8 x 10^{22} Am ^{2} d) 4 x 10^2 Am ^{2}
37. At a certain place, horizontal component is $1/\sqrt{3}$ times the vertical component. The angle of dip at this place is
    a) zero **b)** $\pi/3$ c) $\pi/6$ d) None of these
38. If a diamagnetic substance is brought near the North or the South-pole of a bar magnet, then it is
    a) attracted by the both poles **b) repelled by both 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
39. Ferromagnetism show their properties due to
    a) filled inner subshells b) vacant inner subshells **c) partially filled inner subshells**
    d) all the subshells equally filled
40. The relative permeability of a substance is 0.9999. The nature of substance will be
    a) diamagnetic b) paramagnetic c) magnetic moment d) intensity of magnetic field
41. Hysteresis loss is minimised by using
    a) alloy of steel b) shell type of core c) thick wire which has low resistance **d) metal**
42. To make electromagnet, substance should be of
    a) high permeability and high susceptibility b) low permeability and high susceptibility
    c) high permeability and low susceptibility d) low permeability and low susceptibility
43. A toroid of n turns, mean radius R and cross-sectional radius a carries current I.It is placed on a horizontal table taken as x-y plane. Its magnetic moment m.
    a) is non-zero and points in the z-direction by symmetry. b) points along the axis of the tortoid (m = mΦ).
    c) is zero, otherwise there would be a field falling as $\frac{1}{r^3}$ at large distances outside the toroid.
    d) is pointing radially outwards,
44. The magnetic field of Earth can be modelled by that of a point dipole placed at the centre of the Earth. The dipole axis makes an angle of 11.3° with the axis of Earth. At Mumbai, declination is nearly zero. Then,

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

45. Consider the two idealized systems: (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length L >> R, radius of cross-section. In (i) E is ideally treated as a constant between plates and zero outside. In (ii) magnetic field is constant inside the solenoid and zero outside. These idealised assumptions, however, contradict fundamental laws as below.
a) case (i) contradicts Gauss's law for electrostatic fields.
b) case (ii) contradicts Gauss's law for magnetic fields. c) case (i) agrees with $\int E.\,dl = 0.$
d) case (ii) contradicts $\int \boldsymbol{H}.\,dl = I_{en}$

46. A paramagnetic sample shows a net magnetisation of S Am^{-1} when placed in an external magnetic field of 0.6 T at a temperature of 4 K. 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) $\frac{32}{3}\mathrm{Am}^{-1}$ **b)** $\frac{2}{3}\mathrm{Am}^{-1}$ c) 6 Am^{-1} d) 2.4 Am^{-1}

47. S is the surface of a lump of magnetic material.
a) Lines of B are not necessarily continuous across S. b) Some lines of B must be discontinuous across S.
c) Lines of H are necessarily continuous across S. **d) Lines of H cannot all be continuous across S.**

48. The primary origines) of magnetism lies in
a) Pauli exclusion principle. b) polar nature of molecules **c) intrinsic spin of electron.** d) None of these

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

50. Essential difference between electrostatic shielding by a conducting shell and magnetostatic shielding is due to
a) electrostatic field lines cannot end on charges and conductors do not have free charges.
b) lines of B can also end but conductors cannot end them.
c) lines of B cannot end on any material and perfect shielding is not possible.
d) shells of high permeability materials cannot be used to divert lines of B from the interior region.