# PHYSICS

# BOOKS - CHETANA PUBLICATION

# Magnetic Materials

## Examples

**1.** The torque acting on a magnet of magnetic moment 'M' placed in a uniform magnetic field B is

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**2.** Under what condition, will the torque acting on the bar magnet suspended in a uniform magnetic field be maximum?

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**3.** Derive an expression for a torque acting on a bar magnet placed in uniform magnetic field B.

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**4.** A magnet of magnetic dipole moment 2Am2 is deflected through $30°$ from the direction of a magnetic field of induction $2\dfrac{Wb}{m^2}$. Find the magnitude of the torque.

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**5.** Derive an expression for the magnetic potential energy for a bar magnet undergoing rotational motion.

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**6.** State the expression for magnetic potential energy of a bar magnet. Find the potential energy for $\theta = 0°$

**7.** State the expression for magnetic potential energy of a bar magnet. Find the potential energy for $\theta = 90°$

**8.** State the expression for magnetic potential energy of a bar magnet. Find the potential energy for $\theta = 180°$

**9.** Plot the graph of potential energy as a function of $\theta$

**10.** A short bar magnet of magnetic moment m= $0.32\dfrac{A}{m^2}$ is placed in a uniform magnetic field of 0.15T. If the bar is free to rotate in the plane of the field, which orientation would correspond to its stable equilibrium? What is the potential energy in each case?

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**11.** A short bar magnet of magnetic moment m= $0.32\dfrac{A}{m^2}$ is placed in a uniform magnetic field of 0.15T. If the bar is free to rotate in the plane of the field, which orientation would correspond to its stable equilibrium? What is the potential energy in each case?

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**12.** A short bar magnet is placed in an external magnetic field of 700 gauss. When its axis makes an angle of $30°$ with the external magnetic field, it experiences a torque of 0.014Nm. Find the magnetic moment of

the magnet and the work done in moving it from the most stable to most unstable position.

13. The work done for rotating a magnet with magnetic dipole moment m through $90°$ from its magnetic meridian is n times the work done to rotate it through $60°$. Find the value of n.

14. State the differential equation of angular simple harmonic motion.

15. State the expression for angular velocity of the bar magnet oscillating in an uniform magnetic field.

**16.** State the expression for the time period of angular oscillations of the bar magnet.

**17.** State the factors on which the time period of angular oscillations of the bar magnet depends on.

**18.** State the principle of working of Vibration Magnetometer.

**19.** State the uses of Vibration Magnetometer.

**20.** Derive an expression for the time period of a magnet vibrating in a uniform magnetic field.

**21.** Derive the differential equation of angular SHM.

**22.** Find the expression for the time period of the angular oscillations of a bar magnet suspended in uniform magnetic field.

**23.** A bar magnet of moment of inertia of $500 gcm^2$ makes 10 oscillations per minute in a horizontal plane. What is its magnetic moment, if the horizontal component of earth's magnetic field is 0.36 gauss?

**24.** A bar magnet of moment of inertia of $500 gcm^2$ makes 10 oscillations per minute in a horizontal plane. What is its magnetic moment, if the horizontal component of earth's magnetic field is 0.36 gauss?

**25.** A magnetic needle placed in uniform magnetic field has magnetic moment of $2 \times 10^{-2} Am^2$, and moment of inertia of $7.2 \times 10^7 kgm^2$. It performs 10 complete oscillations in 6s. What is the magnitude of the magnetic field?

**26.** A magnet makes 30 vibrations per minute at a place, where horizontal component of earth's field is 0.18G. At another place if it takes 1.6s to complete one vibration. What is the value of horizontal component of

earth s field there? What is the magnetic moment if its moment of inertia is $10^{-5} kgm^2$?

**27.** A magnetic needle is suspended freely so that it can rotate freely in the magnetic meridian. In order to keep it in the horizontal position, a weight of 0.2 g is kept on one end of the needle. If the pole strength of this needle is 20 Am, find the value of the vertical component of the earth s magnetic field, $\left(g = 9.8m/s^{-2}\right)$

**28.** Explain origin of magnetism on the basis of circulating charges.

**29.** What is the magnetic moment of electron due to its orbital motion.

## 30. What is Gyromagnetic Ratio?

## 31. Define Bohr Magneton.

**32.** Calculate the gyromagnetic ratio of electron

$$\left(Givene = 1.6 \times 10T^{-19}C, m_e = 9.1 \times 10^{-31}kg\right)$$

**33.** Calculate the value of Bohr Magneton (Given: Charge on electron =

$1.6 \times 10^{-19}C, h(Planck's)cons\tan t = $ 6.63xx10^-34Js, mass of

electron m_e = 9.1xx10^-31 kg)`

**34.** State the relation between orbital magnetic moment of an electron and its angular momentum. Hence find the expression for Bohr Magneton.

**35.** Obtain an expression for orbital magnetic moment of an electron rotating about the nucleus in an atom

**36.** An electron in an atom revolves arounnd the nucleusin an orbit of radius

$0.5A°$. $Calculate the \equiv a \le ntmag \ne ticmoment,$ if $the \varepsilon quency of revolu$

10^+10MHz`.

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**37.** In the Bohr model of the H2 atom, linear velocity is $2.190 \times 10^{16} \frac{m}{sec}$.

when it is in the 1st orbit of radius $0.528A°$. Calculate the equivalent

current.

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**38.** In the Bohr model of the $H_2$ atom, linear velocity is $2.190 \times 10^{16} \frac{m}{sec}$.

when it is in the 1st orbit of radius $0.528A°$. Calculate the orbital

magnetic moment.

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**39.** An electron in an atom revolving round the nucleus in a circular orbit of radius $5.3 \times 10^{-11}$ m with a speed of $2 \times 10^6 \frac{cm}{s}$. Find the resultant orbital magnetic moment and angularmomentum of electron. (Charge on electron $e = 1.6 \times 10^{-19} C$, mass of electron $m = 9.1 \times 10 - 31 kg$)

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**40.** Let us see whether the given atom has paired electron or unpaired electrons in the outermost orbit. We will follow three steps

(1) Write electronic configuration

(2) Draw valence orbital

(3) Identify if unpaired electron exist

Given : Chlorine Cl ( it has total 17 electrons )

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**41.** Define magnetization. State its unit and dimensions.

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**42.** Define magnetization. State itsformula and S.I. unit.

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**43.** Define magnetic intensity. State its unit and dimension.

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**44.** Discuss magnetization of a ferromagnetic material with the help of a solenoid?

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**45.** Define the following terms: Magneticsusceptibility

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**46.** Define the following terms: Magnetic permeability

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**47.** Define the following terms: Relative permeability

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**48.** When a plate of magnetic material of size $10cm \times 0.5cm \times 0.2cm$ (length , breadth and thickness respectively) is located in magnetizing field of $0.5 \times 10^4 Am^{-1}$ then a magnetic moment of $5Am^2$ is induced in it. Find out magnetic induction in rod.

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**49.** A domain in ferromagneticiron isin the form of a cube of side 1 pm. Estimate the number of iron atoms in the domain maximum possible

dipole moment and magnetization of the domain. The molecular mass of iron is 55frac(g)(mole) and density is $7.9\dfrac{g}{cm^3}$. Assume that each iron atom has a dipole moment of $9.27 \times 10^{-24} Am^2$.

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**50.** A rod of magnetic material of cross section $0.25cm^2$ is located in $4000Am^{-1}$ magnetizing field. Magnetic flux passing through the rod is $25 \times 10^{-6}$ Wb. Find out relative permeability.

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**51.** A rod of magnetic material of cross section $0.25cm^2$ is located in $4000Am^{-1}$ magnetizing field. Magnetic flux passing through the rod is $25 \times 10^{-6}$ Wb. Find out magnetic susceptibility

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**52.** A rod of magnetic material of cross section $0.25cm^2$ is located in $4000Am^{-}1$ magnetizing field. Magnetic flux passing through the rod is $25 \times 10^{-6}$ Wb. Find out magnetization of the rod.

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**53.** The region inside a current carrying toroid winding is filled with Aluminium having susceptibility $x = 2.3 \times 10^{-5}$. What is the percentage increase in the magnetic field in the presence of Aluminium over that without it?

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**54.** Write a short note on magnetic susceptibility?

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**55.** What are diamagnetic substances? Explain why diamagnetic substances are repelled by external magnetic field ?

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**56.** State the main properties of diamagnetic substances.

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**57.** What are paramagnetic substances? Explain why the net magnetic dipole moment of the material is zero?

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**58.** Draw the diagrams showing the dipole moments in paramagnetic substance when external magnetic field is absent.

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**59.** Draw the diagrams showing the dipole moments in paramagnetic substance when external magnetic field is weak.

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**60.** Draw the diagrams showing the dipole moments in paramagnetic substance when external magnetic field is strong.

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**61.** State the properties of a paramagnetic substances

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**62.** Discuss the Curie law for paramagnetic material.

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**63.** The susceptibility of a paramagnetic material is X at $27°C$. At what temperature itssusceptibility be frac(x)(3)?

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**64.** A paramagnetic gas has $2.0 \times 10^{26} \dfrac{a \to ms}{m^3}$ with atomic magnetic dipole moment of $1.5 \times 10^{-23} Am^2$ each. The gas is at 27^@C`. (Find the maximum magnetization intensity of this sample.

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**65.** A paramagnetic gas has $2.0 \times 10^{26} \dfrac{a \to ms}{m^3}$ with atomic magnetic dipole moment of $1.5 \times 10^{-23} Am^2$ each. The gas is at 27^@C`. (If the gas in this problem is kept in a uniform magnetic field of 3T, is it possible to achieve saturation magnetization? Why?

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**66.** What are ferromagnetic substances? Give examples.

**67.** State the propertiesof ferromagneticsubstances

**68.** Explain ferromagnetism on the basis of domain theory.

**69.** What is Curie temperature? What happens above Curie temperature?

**70.** What do a ferromagnetic material when its temperature increases aboveCurie temperature?

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**71.** What is the effect of heat on ferromagnetic substance?

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**72.** What does hysteresisloop represent?

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**73.** Define: Hysteresis

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**74.** Define:Retentivity

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**75.** Define:Coerdvity.

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**76.** What does the area inside the hysteresis curve indicate?

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**77.** Explain hysteresis loop

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**78.** How does hysteresis loop differ in hard and soft ferromagnetic substances?

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**79.** What would be retentivity and coercivity of permanent magnet? Why?

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**80.** Which property of soft iron makes it useful for preparing electromagnet?

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**81.** Write a short note on electromagnets.

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**82.** Write a short note on magnetic shielding.

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**83.** Distinguish between: Diamagnetism and Paramagnetism

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**84.** Distinguish between paramagnetic and ferro-magnetic substance.

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**85.** Distinguish between ferromagnetic and diama-gnetic.

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Exercise

**1.** The susceptibility magnesium is $1.5 \times 10^{-5}$ at 300 K. What will be its susceptibility at 200 K?

**2.** The magnetic susceptibility of bismuth is $2.1 \times 10^{-6}$. Calculate relative permeability.

**3.** The magneticmoment of a magnet of dimensions $5cm \times 2.5cm \times 1.25cm$ is $3Am^2$. Calculate the intensity of magnetization

**4.** Magnetic susceptibility of a paramagnetic substance is $5 \times 10^{-4}$. The uniform magnetic induction within a paramagnetic crystal is 0.2 T. Find

the magnetic intensity

**5.** Magnetic susceptibility of a paramagnetic substance is $5 \times 10^{-4}$ The uniform magnetic induction within a paramagnetic crystal is 0.2 T. Find the magnetization with the crystal

**6.** Magnetic susceptibility of a paramagnetic substance is $5 \times 10^{-4}$. The uniform magnetic induction within a paramagnetic crystal is 0.2 T. Find the magnetic moment of $1mm^3$ of the crystal.

**7.** Find the percent increase in magnetic field B when the space within a current-carrying toroid is filled with aluminium. The susceptibility of

aluminium is $2.1 \times 10^{-5}$.

**8.** Solenoid core made of iron having relative permeability 5000. It is carrying current 1.5 A having 1000 turns per metre. Determine the magnitude of magnetic intensity, magnetization and magnetic field inside the core.

**9.** The magnetic field Band themagneticintensity H in a material are found to be 1.6 T and $1000\dfrac{A}{m}$, respectively. Calculate the relative permeability 'mu_r' and the susceptibility $x$ of the material.

**10.** A bar magnet of moment $7.5Am^2$ experiences a torque of $1.5 \times 10^{-4}Nm$, when placed inclined at $30°$ in a uniform magnetic field. Find the magnetic induction of the field.

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**11.** A magnet makes 55 vibrations in one minute where horizontal component of earth's field is 0.36G. If the moment of inertia of the bar magnet is $10^{-5}Kgm^2$, find the magnetic moment of the bar magnet.

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**12.** Two bar magnets having their moment of inertia in the ratio $1:1.5$ oscillate in a horizontal plane with time periods 2.5s and 4.5s respectively. Compare their magnetic moments.

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**13.** Intensity of magnetic field of the earth at a point inside a hollow iron box is _____.

A. less than that outside

B. more than that outside

C. same as that outside

D. zero

**Answer:**

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**14.** Soft iron is used to make the core of transformer because of it's _____.

A. low coercivity and low retentivity

B. low coercivity and high retentivity

C. high coercivity and low retentivity

D. high coercivity and high retentivity

**Answer:**

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**15.** An iron rod of $0.2cm^2$ cross-sectional area is subjected to a magnetizing field of $1200A/m$. If the susceptibility of iron is 599, then magnetic flux produced in the rod is

A. `1.8xx10^-5Wb1

B. $0.9 \times 10^{-5}Wb$

C. $2.4 \times 10^{-5}Wb$

D. $5.4 \times 10^{-5}Wb$

**Answer:**

**16.** The susceptibility of the rod of a magnetic material is -0.04. What will happen if the rod is suspended in a magnetic field?

    A. it will perform angular S.H.M

    B. it willset itself parallel to the magnetic field.

    C. itwillsetitself perpendiculartothe magnetic field.

    D. it will set itself in a position, making a small angle with the field.

**Answer:**

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**17.** The Gyromagnetic Ratio is given by

A. $\dfrac{e}{2m_e}$

B. $\dfrac{e}{m_e}$

C. $e.2m_e$

D. $\dfrac{2m_e}{e}$

**Answer:**

**18.** An electron in an atom revolves around the nucleus in an orbit of radius 0.5 A and the frequency of revolution of electron is 1010 MHz. Then current is_____.

A. $1.6 \times 10^{-2} A$

B. `1.6xx10^(-35) A

C. $1.6 \times 10^{-3} A$

D. $0.16 A$

**Answer:**

**19.** The root cause of magnetic properties in a substance is_____.

A. orbital motion of an electron

B. spin motion of proton

C. orbital and spin motion of proton

D. orbital and spin motion of an electron

Answer:

20. According to Curie's law, magnetization is proportional _____.

A. directly to $B_ext$ only

B. directly to absolute temperature only

C. directly to $B_ext$ and absolute temperature.

D. directly to $B_ext$ and inversely to absolute temperature

Answer:

**21.** If a paramagneticmaterial is placed in a magnetic field, the flux density inside the material compared to that outside will be

A. slightly less

B. slightly more

C. much more

D. not changed

**Answer:**

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**22.** S.I. unit of magnetic dipole moment is _____.

A. $\dfrac{A}{m^3}$

B. $Am^{-2}$

C. $Am^2$

D. $A - m$

**Answer:**

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23. Unique property associated with ferromagnetic material is_____.

    A. superconductivity

    B. attracting magnetic substances

    C. directional property

    D. hysteresis

**Answer:**

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24. (12)The magnetic moment is not associated with _____.

A. stationary charges

B. accelerated charges

C. retarded charges

D. Change moving with constant speed

**Answer:**

25. The correct relation between p and % is _____.

A. $\mu_0 = \mu(1 + x)$

B. $\mu = \mu_0(1 + x)$

C. $\mu = \dfrac{\mu}{1 + X}$

D. $\mu = \mu_0 - \mu_0 x$

**Answer:**

**26.** In which type of material the magnetic susceptibility does not depend upon the temperature?

A. Ferromagnetic

B. Diamagnetic

C. Superconductors

D. Paramagnetic

**Answer:**

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**27.** The magnetic susceptibility of magnesium is `10xx10^(-5). Its permeability is _____.

A. $1.0001\mu_0$

B. $0.9999\mu_0$

C. $11 \times 10^{-5}$

D. $9 \times 10^{-5}$

**Answer:**

28. Magnetic susceptibility is positive and large for

A. iron

B. silver

C. air

D. aluminium

**Answer:**

**29.** The magnetic dipole moment of a bar magnet is $20A - m^2$. It is 20 cm long and its cross-sectional area is $2cm^2$. The magnetization of this material, assumed to be uniform is

A. $5 \times 10^5 \frac{A}{m}$

B. $2 \times 10^5 \frac{A}{m}$

C. $0.5 \times 10^5 \frac{A}{m}$

D. $5 \times 10^4 \frac{A}{m}$

**Answer:**

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**30.** If the relative permeability of iron is 3000, its absolute permeability in S.I. unit is_____.

A. $\frac{12}{\pi} \times 10^{-4}$)

B. $12\pi \times 10^{-4} H - m^{-1}$

C. $\dfrac{3}{\pi} \times 10^{-4}\Big) H - m$

D. $12\pi \times 10^{-4} H - m$

**Answer:**

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**31.** A circular coil of 500 turns and area of $0.5 cm^2$ carries a current of 10 A.

The magnetic moment associated with it_____.

A. $0.25 \dfrac{A}{m^2}$

B. $250 \dfrac{A}{m^2}$

C. $2500 \dfrac{A}{m^2}$

D. $2.5 \dfrac{A}{m^2}$

**Answer:**

**32.** Magnetic susceptibility does not depend upon temperature then the material must be_____.

A. paramagnetic

B. ferromagnetic

C. diamagnetic

D. ferrite

**Answer:**

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**33.** The magnetic moment per unit volume of a material is_____.

A. magnetism

B. magnetic intensity

C. magnetization

D. magnetic flux

**Answer:**

**34.** Which of the following statements is correct for diamagnetic materials?

A. $\mu_r < 1$

B. x is negative and low

C. x does not depend on temperature

D. All of the above

**Answer:**

**35.** Diamagnetic substances are_____.

A. feebly attracted by magnets

B. strongly attracted by magnets

C. feebly repelled by magnets

D. strongly repelled by magnets

**Answer:**

**36.** After removal of strong magnetic field, the substance that remains magnetic are_____.

A. Non magnetic substance

B. Diamagnetic substance

C. Paramagnetic substance

D. Ferromagnetic substance

**Answer:**

**37.** Copper is $a/an$_____.

A. non-magnetic substance

B. diamagnetic substance

C. paramagnetic substance

D. ferromagnetic substance

**Answer:**

**38.** The atom of a paramagnetic substance is_____.

A. very small magnetic moment

B. no magnetic moment

C. large magnetic moment

D. very large magnetic moment

**Answer:**

**39.** When a paramagnetic substance is placed in a uniform magnetic field_____.

A. its atoms acquire a magnetic moment opposite to magnetic field

B. atoms acquire a magnetic moment along the magnetic field

C. atoms acquire a magnetic moment perpendicular to the magnetic field

D. atoms acquire a magneticmomentrandomly

**Answer:**

**40.** A magnetizing field of $360A/m$ produces a magnetic flux density B = 0.6T in a ferromagnetic material. What is its permeability in $TmA^{-1}$?

A. $\dfrac{1}{100}$

B. 300

C. $\dfrac{1}{600}$

D. 600

**Answer:**

**41.** In a uniform magnetic field, freely suspended diamagnetic rodslength will be_____.

A. parallel to the field

B. perpendicular to the field

C. inclined to the field

D. none of these

**Answer:**

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**42.** Domains are characteristics of_____.

A. non-magnetic substances

B. paramagnetic substances

C. diamagnetic substances

D. ferromagnetic substances

**Answer:**

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**43.** If oxygen gas is introduced between the pole pieces of a magnet _____.

A. spreads in the direction of magnetic field

B. spreads in the direction perpendicular to the magnetic field

C. spreads in the direction inclined to the magnetic field

D. none of the above

**Answer:**

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**44.** Which of the following is a diamagnetic group?

A. Iron, Nickel, Cobalt and gadolinium

B. Manganese, aluminum, oxygen

C. Copper, gold, water, hydrogen

D. Iron, Manganese, Nickel

**Answer:**

**45.** Relative permeability of diamagnetic materials are_____.

A. zero

B. equal to unity

C. less than unity

D. greater than unity

**Answer:**

**46.** The diamagnetic material has susceptibility_____.

A. x = 0

B. x gt1

C. x lt1

D. xlt0

**Answer:**

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**47.** The universal property among all substances, is_____.

A. diamagnetism

B. ferromagnetism

C. paramagnetism

D. non-magnetism

**Answer:**

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**48.** A 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. Its period of oscillation is T.The ratio of

A. $\frac{1}{2}\sqrt{2}$

B. $\frac{1}{2}$

C. 2

D. $\frac{1}{4}$

**Answer:**

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**49.** The torque acting on a magnetie dipole of moment $5Am^2$ when placed in an external uniform magnetic induction $1.5 \times 10^{-4}$ $Wb/m^2$ at right angle to magnetic induction is

A. $7.5 \times 10^{-4} Nm$

B. $75 \times 10^{-4} Nm$

C. $1.25 \times 10^{-5} Nm$

D. $1.5 \times 10^{-4} Nm$

**Answer:**

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50. A magnetizing field of intensity $1600A/m$ produces a magnetic flux of $2.5 \times 10^{-5}$ Wb in a bar of iron of cross-section $0.2cm^2$. The permeability of the bar is

A. $7.5 \times 10^{-4} TA^{-1}m$

B. $7.813 \times 10^{-4} TA^{-1}m$

C. $7.5 \times 10^{-3} TA^{+}1m^{-1}$

D. $7.813 \times 10^{3} TAm^{-1}$

**Answer:**

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51. In order to have a strong electromagnet it must have

    A. high value of saturation magnetization

    B. low retentivity

    C. low hysteresisloop

    D. all of these

**Answer:**

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**52.** A bar magnet is demagnetized by inserting the inside a solenoid of length 0.2 m, 100 turns and carrying a current of 5.2 A. The corecivity of the bar magnet is.

A. 1200 frac(A)(m)

B. 1285 frac(A)(m)

C. 2600frac(A)(m)

D. 5200 frac(A)(m)

**Answer:**

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**53.** A paramagnetic material has $10^{28} a \rightarrow m/m^3$.Its magnetic susceptibility at temperature 350K is `2.8 xx 10^-4. Its susceptibility at temperature 350K is

A. $2.672 \times 10^{-4}$

B. $3.267 \times 10(-4)$

C. $3.672 \times 10^{-4}$

D. $3.762 \times 10^{-4}$

**Answer:**

54. The number of electrons flowing in a current carrying circular coil per second having area of $2m^2$ and magnetic moment of 8  A m$^2$ is

A. $2.5 \times 10^{18}$

B. $5 \times 10^{18}$

C. $6.25 \times 10^{18}$

D. $25 \times 10^{18}$

**Answer:**

55. The correct relation between `mu,mu_0, x is

A. $\mu_0 = \mu(1 + x)$

B. $\mu = \mu_0(1 + x)$

C. $\mu = \dfrac{\mu_0}{1 + x}$

D. $\mu = \mu_0 - \mu_0 x$

**Answer:**

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56. The net magnetic dipole moment per unit volume is known as

A. magnetization

B. magnetic induction

C. magnetic intensity

D. susceptibility

**Answer:**

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**57.** SI unit of intensity is

A. $\dfrac{Wb}{Am}$

B. $\dfrac{Wb}{m^2}$

C. Am

D. $\dfrac{A}{m}$

**Answer:**

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**58.** The Gyromagnetic Ratio is given by

A. $\dfrac{e}{m_e}$

B. $\dfrac{m_e}{e}$

C. $\dfrac{e}{2m_e}$

D. $\dfrac{2m_e}{e}$

**Answer:**

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**59.** Two substances A and B have their relative permeabilities slightly greater and less than unity respectively. What do you conclude about A and B?

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**60.** What isCurie temperature?

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**61.** What is the effect of temperature on magnetization of paramagnetic material?

**62.** Write a short note on electromagnets.

**63.** Define: Hysteresis

**64.** Define Retentivity

**65.** Find the value of Bohr magneton, given that $e = 1.6 \times 10^{-19}C$, $H = 6.63 \times 10(-34)$, $\pi = 3.142$ and $m_e = 9.1 \times 10^{-28}g$

**66.** A short bar magnet placed with its axis at $30°$ with a uniform external uniform magnetic field of 025T experiencesa torqueof magnitude $4.5 \times 10^{-2} J.$ What is themagnitudeof magnetic dipole moment?

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**67.** State the factors on which time period of angular oscillations depend on

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**68.** Explain the origin of diamagnetism.

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**69.** Explain hysteresis loop

**70.** A short bar magnet of magnetic moment m= $0.32\dfrac{A}{m^2}$ is placed in a uniform magnetic field of 0.15T. If the bar is free to rotate in the plane of the field, which orientation would correspond to its stable equilibrium? What is the potential energy in each case?

**71.** A short bar magnet of magnetic moment m= $0.32\dfrac{A}{m^2}$ is placed in a uniform magnetic field of 0.15T. If the bar is free to rotate in the plane of the field, which orientation would correspond to its unstable equilibrium? What is the potential energy in each case?

**72.** A certain region of space isto be shielded from magnetic fields. Suggest a method.

**73.** Distinguish between: Diamagnetism and Paramagnetism

**74.** A domain in ferromagnetic iron is in the form of a cube of side length $1 \times 10^{-6} m$. Estimate the number of iron atoms in the domain, the maximum possible dipole moment and magnetization of the domain. Given: density $7.9 \dfrac{g}{cm^3}$, molecular mass of iron = 55 g/ mole. Assume each atom has a dipole moment of $9.27 \times 10^{-24} Am^2$.