**Magnetism and Matter**

**Torque** on a current carrying loop suspended freely in a magnetic field:

(i) When a loop is suspended freely in a magnetic field and a current is passed through it, we find that the resultant force on the loop is zero but the resultant torque is not zero.

(ii) If during the rotation of the loop, the normal to the plane of the loop makes an angle θ with the direction of uniform magnetic field B, then torque acting on the loop is given by:

**τ=IAB sinθ**

where A = *l*b = area of the loop.;If the loop is replaced by a coil consisting of N turns, then **τ=N IAB sinθ**

(iii) In vector form. **τ =** N I **A x B = M x B ;**where M =NIA = magnetic dipole moment of the current carrying coil.

2. Moving coil galvanometer:

The current to be measured is conducted to the coil through the suspension wire. The current deflects the coil in the radial magnetic field between the soft iron cylinder and concave pole pieces. The amount of deflection serves as a measure of current. The deflection is measured with the help of a mirror attached to the phosphor bronze wire using lamp and , scale arrangement.

The current I is directly proportional to deflection θ or I α θ or I = Kθ ; where K is a constant of the galvanometer and is = C/NAB , where C = torsional constant of the suspension wire, N = number of turns in the coil, A = area per turn of the coil and B = magnetic induction of radial magnetic field.

**The current sensitivity, S** = θ/I = 1/K = NAB/C

For higher sensitivity:

(a) Area of the moving coil should be large. In practice length I of the coil is increased as increase in breadth tends to decrease B.

(b) Number of turns in the coil should be increased but this is done up to a certain limit as increase in number of turns leads to increase in the resistance of the galvanometer.

(c) Magnetic induction B should be made large. For this, laminated ferro-cobalt steel permanent magnet is used.

(d) Torsional torque per unit twist C should be made small. As C =πηr4/2*l*), where r is the radius and *l* is the length of suspension wire. Hence, length is made large and radius made small to ensure decrease in C. The suspension wire is made of phosphor bronze, since it is a good conductor and is highly elastic and shows little elastic after effect.

(a) In **dead beat** galvanometer, the frame on which the coil is wound is metallic. Due to strong induced current, the coil is not allowed to oscillate.

(b) In **ballistic** galvanometer, the frame is non-metallic. The coil oscillates for a long time due to absence of induced currents.

**Ammeter:** an ideal ammeter has a zero resistance.

-The resistance of a milliammeter is more than that of an ammeter.

-To convert a galvanometer which gives full scale deflection for a current Ig, so that it may be used to read a current I, the value of the shunt required is given by:

S= [Ig G] / [I- Ig ] where G is the galvanometer resistance.

- If a galvanometer is converted into a multi-range ammeter, then the product of the range of the ammeter and the resistance of the ammeter is constant

**Voltmeter:**

- When a high resistance R is connected in series with a galvanometer of resistance G, it becomes a voltmeter. lf Ig represents the minimum current for full scale deflection of the galvanometer, then the minimum potential difference Vg across the terminals of the galvanometer for full scale deflection is given by:

Vg= [Ig G]

-Now, the potential difference V across the terminals of the series combination of R and G is given by:

V= Ig (R+G) so V/Vg = (R+G)/G

- Here V/Vg is called the **voltage multiplying** power of the series resistor and is denoted by: n =( V/Vg).

So, n= V/Vg = (R+G)/G or R = G(n-1) ; If the total resistance of this series combination which is effectively a voltmeter is denoted by RV,

then RV = R + G = G(n-1) +G =nG

- To measure potential difference across any element of the circuit we use a voltmeter. A voltmeter is connected in parallel with the element to avoid division of voltage, but when placed in parallel with the element it shares current from the element and **decreases** the potential difference across the element before measuring it. Hence, an ideal voltmeter has an infinite resistance so that it may not change the current in the element.

- The resistance of a millivoltmeter is less than that of a voltmeter.

-If a galvanometer is converted into a multi-range voltmeter, then the ratio of the range of the voltmeter and resistance of the voltmeter is constant.

**Magnet and magnetism:**

(i) Magnetism is caused by moving charges or current loops.

(ii) A bar magnet consists. of two equal and opposite magnetic poles separated by a distance. So, a magnet is called as magnetic dipole.

The magnetic moment of a bar magnet M = m x 2*l*. where m is the pole strength and 2*l* is the separation between the poles.

Magnetic moment is a vector quantity, having direction along the axial line of magnet from south to north. The SI unit is Am2

-A magnet can attract small pieces of magnetic substances like iron, steel, cobalt, etc. So, it has attractive property.

-A magnet when suspended freely. aligns itself along geographical north-south line such that the north pole of the magnet is towards the north of the earth. So. it has directive property.

-Unlike poles attract and like poles repel. Repulsion is the sure test for distinguishing between a magnet and a piece of iron.

-Magnetic poles exist in pairs. i.e., an isolated magnetic pole does not exist

- The force between the magnetic poles obeys inverse square law.

-A freely suspended current carrying solenoid behaves just like a bar magnet.

**-Other important points concerning a magnet:**

(i) When a magnet of length *2l* and pole strength m is placed in a magnetic field B. then the couple acting on the bar magnet is given by,

**τ** = **MB** sinθ

-where M = m (2*l* ) - magnetic moment of the magnet and θ is the angle between the bar magnet and direction of magnetic field.

-The work done in deflecting the magnet thru an angle θ from equilibrium position is given by: **W = MB (l - cosθ)**

(a) If the two magnets of moments M1 and M2, are arranged with like poles touching and their axes are inclined making an angle θ the magnetic moment of the system.

M = [M12 + M22 + 2 M1M2 cosθ]1/2

It they touch each other (θ ≈ O), M = M1 + M2

* but if they are arranged ar a position (+). then (θ = 900), M = [M12 + M22]1/2

(b) If the two magnets of moments M1 and M2, are arranged with unlike poles touching and their axes are inclined making an angle θ the magnetic moment of the system.

M = [M12 + M22 - 2 M1M2 cosθ]1/2

- If one magnet is placed over the other with unlike poles touching (θ ≈ O), M = M1 - M2

-but if they are arranged to form a cross like T or L then (θ = 900), M = [M12 + M22]1/2

**Cutting a bar magnet :**

-If a bar magnet of moment M and pole strength m is **cut into two equal halves along its axial line**, then pole strength of each part is m/2 and the magnetic moment of each part is M/2.

- If a bar magnet of magnetic moment M and pole strength m is **cut into two equal halves along its equatorial line**, the pole strength of each part is m and magnetic moment is M/2.

(c) -If a bar magnet of moment M and pole strength m is **cut into n equal halves along its axial line**, then pole strength of each part is m/n and the magnetic moment of each part is M/n.

(d) If a bar magnet of pole strength m and magnetic moment M is first cut into n equal parts parallel to its length and then cut into n equal parts parallel to its breadth, then the pole strength of each part is m/n and the magnetic moment of each part is M/n2.

**Expressions for magnetic induction B :**

(a) The magnetic induction on the axial line of a bar magnet is given by **Baxial = (μo/4π) x 2Md/(d2-*l*2)2** along South to north pole.

where B =magnetic induction ; d =distance of the point on axial line from the centre of the magnet ; 2*l* = length of the magnet ; M =magnetic moment of the magnet.

special case : for a short magnet d>>*l* ; **Baxial = (μo/4π) x 2M/d3**

(b)The magnetic induction on the equatorial line of a bar magnet is given by **B**equatorial**= (μo/4π) x M /(d2 + *l*2)3/2** parallel to NS.

where B =magnetic induction ; d =distance of the point on equatorial line from the centre of the magnet ; 2*l* = length of the magnet ; M =magnetic moment of the magnet.

special case : for a short magnet d>>*l* ; **B**equatorial**= (μo/4π) x M / d3**

Therefore for a short magnet **Baxial** / **B**equatorial = 2/1

(c) The magnetic field induction due to a short bar magnet at a point distant d from the centre of the magnet making an angle θ is given by:

**B**θ**= (μo/4π) x M √(1+3cos2θ) /d3**

**Properties of magnetic materials:**

(i) **Magnetising force or intensity of magnetising field H :**

(a) The intensity of magnetising field is defined as the force experienced by a unit north pole placed at a point in the field.

(b) In SI system, the unit of H is a amp-turns/metre.

(c) The direction of **H** is the same as the direction of **B** and is related as **B** = μ**H** where μ is called the magnetic permeability.

(ii) **Intensity of magnetisation (I) :**

(a) When a magnetic material is placed in a magnetic field, it is magnetised and it acquires a magnetic dipole moment M. The intensity of magnetisation is defined as the magnetic dipole moment per unit volume, i.e.,

I= M/V = 2m*l*/A(2*l*) = m/A

where A is the area of cross-section of the material. So, intensity of magnetisation may also be defined as pole strength per unit area of cross-section.

(b) Intensity of magnetisation is also expressed in amp/metre.

(iii) Magnetic susceptibility (**):

(a)Magnetic susceptibility indicates the ease with which a substance can be magnetised.

(b) The susceptibility is defined as the ratio of the intensity of magnetisation to the magnetising field H in which the material is placed. i.e.,

 = I/H

(c) it has no units

(iv) **Magnetic Permeability (μ)** : The permeability is defined as the ratio of magnetic induction **(B)** to the magnetising force **(H**), i.e., μ=(B/H).

(v) **Magnetic induction or flux density** (**B**): The flux density is the total number of lines of force per unit area due to the flux density **Bo** in vacuum produced by that magnetising field and flux density **Bm**, due to magnetisation of the material. Thus

**B = Bo +Bm**

**Diamagnetic materials:**

(i) Materials which are repelled by magnets are known as diamagnetic materials.

Examples: .bismuth, zinc, copper, silver, gold, diamond, NaCl, water, nitrogen, hydrogen, etc.

(ii) These materials get magnetised in a direction opposite to that of the magnetic field.

(iii) A diamagnetic rod suspended in a uniform magnetic field becomes perpendicular to the direction of the field.

(iv) In a non-uniform magnetic field, they move from regions of higher concentration to regions of lower concentration.

(v) Relative permeability of these materials is less than one but positive.

(vi) Magnetic susceptibility of these materials is negative and small. It is independent of temperature.

(vii) All magnetic materials show diamagnetism, i.e., **diamagnetism is a universal property**.

(viii) **In general, atoms with paired electrons exhibit diamagnetism.**

**Paramagnetic materials:**

(i) Materials which are feebly attracted by magnets are known as paramagnetic materials. Examples: aluminium, sodium, platinum, manganese, CuCl2, FeCl3, oxygen, etc.

(ii) These materials get magnetised in the direction of the magnetic field.

(iii) A paramagnetic rod suspended in a uniform magnetic field becomes parallel to the direction of the field.

(iv) In a non-uniform magnetic field, they move towards region of higher field.

(v) Relative permeability of these materials is just greater than one and positive.

(vi) Magnetic susceptibility is small and positive (10-l to 10-3 ).

(vii) The magnetic susceptibility is inversely proportional to absolute temperature. This is called **Curie law**,

X= (C/T), where C is called **Curie's constant**.

(viii) The magnetic susceptibility decreases with increasing magnetising field.

(ix) **In general, atoms with finite magnetic moment are paramagnetic. Such materials have unpaired electrons in their valence orbits.**

**Ferromagnetic materials:**

(i) Substances which are strongly attracted by magnets are known as ferromagnetic substances. Examples: iron, nickel, cobalt, gadolinium.

(ii) A ferromagnetic rod, when suspended in a uniform magnetic field, aligns itself along the direction of the field.

(iii) In a non-uniform magnetic field, a ferromagnetic material moves towards regions of higher magnetic field.

(iv) The relative permeability of these materials is very large (102 to 106).

(v) The magnetic susceptibility of these materials is positive and very high (102 to 106).

(vi) Magnetic susceptibility is very high and constant upto a certain temperature above which it varies with temperature according to the equation

where K and TC are constants. The constant TC is called **Curie temperature.** It is the temperature above which a ferromagnetic material becomes a paramagnetic material.

(vii) Ferromagnetism is due to the existence of magnetic **domains**.

(viii) Ferromagnetic materials exhibit a phenomenon called **hysteresis.**

**Hysteresis loop:**

(i) Hysteresis loop or cycle is a plot of intensity of magnetisation (I) against magnetising field (H) over closed loop ABCDEA.

(ii) Curve OA indicates the variation of 1 with H till the saturation point A is reached.

(iii) Curve AB indicates the variation of 1 as H is decreased to zero.

(iv) Curve BCD indicates the variation of I as H is increased in reverse direction.



(v) Curve DE: indicates the variation of I as H is decreased to zero hut in reverse direction.

(vi) Curve EA indicates the variation of I as H is increased in the original direction.

(vii) It can be seen that when H is zero. the value of I does not become zero. but has a value of OB. **This lagging of I behind H is called hysteresis.**

(viii)**Retentivity:** The residual magnetism present inside the specimen even when the external magnetising force is made zero is called retentivity; Or **retentivity is the capacity of the material to retain its magnetism when the magnetising force is removed.** The intercept OB is a measure of retentivity.

(ix) Coercivity: Coercivity is the capacity of the material to retain its magnetism in spite of any demagnetising process. The intercept OC is a measure of retentivity.

(x) **The area of the hysteresis loop is a measure of work done or energy dissipation or hysteresis loop.**

(xi) (a) **For soft iron**: Coercivity is less, retentivity is more, hysteresis loss is less. susceptibility is more and permeability is more.

(b) **For steel**: Coercivity is more, retentivity is less, hysteresis loss is more. susceptibility is less and permeability is less.

(xii) Soft iron is used in transformers, moving coil galvanometers, elcctromagnets. etc.. while steel is used for permanent magnets

**Earth's magnetic field:**

(i) At any point on the surface of the earth:

(a) The lines of the earth's magnetic induction lie in a vertical plane coinciding with the magnetic north-south direction of that place. This plane is called the magnetic meridian.

(b) On the magnetic meridian plane the magnetic induction vector of the earth at any point is inclined to the horizontal at an angle θ called the magnetic dip at that place, such that :

**B** = total magnetic induction of the earth at that point.

**BV** = vertical component of B in the magnetic meridian plane = B sinθ

**BH**= Horizontal component of B in the magnetic meridian plane = B cosθ

therefore **BV** / **BH** = tanθ

(ii) An imaginary vertical plane passing through magnetic north and magnetic south of a freely suspended magnet is called the magnetic meridian.

(iii) An imaginary vertical plane passing through the north and south poles of the earth at a place is called as geographical meridian.

**Declination:**

(a) Declination is the angle between magnetic meridian and geographical meridian at a given place.

(b) The value of declination can be determined using **Kew magnetometer**.

(c) The value of declination at equator is l70.

(d) Declination varies from place to place.

(e) The lines joining the places of equal declination are called **isogonal lines**.

(f) The lines joining the places of zero declination are called **agonal lines**.

**(vi) Dip or inclination (θ):**

(a) The angle made by the earth's magnetic field with the horizontal at a place is called dip or inclination at that place.

(b) Dip circle is the instrument used to measure the dip.

(c) It varies between 00 and 9O0. At the magnetic equator it is zero and 900 at poles.

(d) The lines joining the places of equal dip are called **isoclinal** lines.

(e) The lines joining the places of zero dip are called **aclinal** lines.

(vii) **Horizontal component (BH ) :**

(a) The component of the total induction of the earth's magnetic field (B) along the horizontal direction is called the horizontal component.

(b) The horizontal component can be measured with the help of a deflection magnetometer.

(c) If θ is the dip, i.e., the angle between total magnetic induction of the earth's magnetic field B and horizontal component **BH**, then

(I) horizontal component **BH** = B cosθ

(II) vertical component **BV** = B sinθ

(lII) B = √(BH2 +BV2) and **BV** / **BH** = tanθ

(d)BH is zero at magnetic poles and maximum at the magnetic equator.

(e) The lines joining the places of equal horizontal component are called **isodynamical** lines.

**Tangent galvanometer:**

(i) Tangent law: According to this law F = B tan θ, where F and B are two uniform magnetic fields which act at right angles to each other on a magnet and θ is the angle which the magnet makes with the direction of B.

(ii) A tangent galvanometer is an instrument used to measure very small currents and is based on tangent law. It consists of a non-magnetic circular frame mounted on a horizontal turn table. Three c:oils having 2, 50 and 500 turns are mounted on the circular frame. A circular compass box of nonmagnetic material is fitted at the centre of the coil. The compass box has a small magnetic needle pivoted at the centre. This needle is free to rotate over the horizontal circular scale which is divided into four quadrants 00- 900 each. A long aluminium pointer is attached at right angles to the needle.

(iii) If the coil has N turns and radius R, then magnetic field produced at the centre of the coil when a current I is passed through it, is given by: B= (μo/4π) x 2πNI/R ( 1 )

The direction of B is perpendicular to the plane of coil.

(iv) When the coil of a tangent galvanometer is placed in the magnetic meridian, then the horizontal component of the earth's magnetic field (BH ) is along the plane of the coil. So, the magnetic needle will be under the action of two mutually perpendicular magnetic fields. If θ be the deflection of needle. then

B=BH tanθ -(2)

From eqns. ( l) and (2). we get:

**I** = BH 2Rtanθ/Nμo = **K tanθ**

where K is called **reduction factor** of the tangent galvanometer.

**Deflection magnetometer:**

(i) The deflection magnetometer has a magnetic compass. The compass has a small magnetic needle pivoted at its centre. An aluminium pointer is fixed perpendicular to the magnetic needle to read the deflection. This moves over a circular scale. A mirror is provided under the pointer to avoid parallax error in noting the deflection. All these parts are kept in a non-magnetic airtight box. There are two wooden arms with horizontal scale. The zero of the horizontal scale coincides with the centre of circular scale.

(ii) The deflection magnetometer works on the principle of tangent law. When two uniform magnetic fields act at right angles to each other on the magnetic needle, then the needle will be deflected in the direction of resultant field.

tanθ =(B/BH) or B = BH tanθ

**Vibration magnetometer:**

(i) If a magnet of moment M oscillates in a uniform induction field B , then the time period of vibration magnetometer is

T = 2π√(I/MB) -where I is the moment of inertia of the magnet.

(ii) If two magnets of dipole moments M1 and M2 of same dimension and same mass are oscillating in the same field then T1/T2 = √(M2/M1)

(iii)A magnet is oscillating in a magnetic field and it’s time period is T sec. If another identical magnet is placed over that magnet with similar poles together, then the time period remains unchanged because Inew =2I and Mnew =2M.

(iv)A magnet is oscillating in a magnetic field and its it’s time period is T sec. If another identical magnet is placed over that magnet with unlike poles together, then the time period becomes infinity because magnetic moment becomes zero.

(v) The time period of a thin bar magnet is T. It is cut into n equal parts by cutting normal to its length. The time period of each piece when oscillating in the same magnetic field will be T' =T/n

(vi) The time period of a thin bar magnet is T. If it is cut into n equal parts by cutting along its length, the time period of each piece remains unchanged.

(vii)Two magnets of magnetic moments M1 and M2 (M1>M2) are placed one over the other parallely. If T1 is the time period when like poles touch each other and T2 is the time period when unlike poles touch each other, then

**Home assignment – Magnetism and Matter**

1. What do you mean by Coulomb’s law of magnetism ?
2. What do you mean by magnetic field lines ?
3. Write different properties of magnetic field lines?
4. What do you mean by Magnetic dipole moment ?
5. Write expressions for magnetic field strength due to a bar magnet at any point on an axial and equatorial line ?
6. Write Gauss’s Law for magnetism ?
7. Explain different Magnetic elements of earth’s magnetic field?
8. What do you mean by Neutral points?
9. What is Tangent law in Magnetism ?
10. What do you mean by Tangent Galvanometer ?
11. What do you mean by Bohr Magneton ?
12. Define and write expressions for
13. Magnetic field strength
14. Magnetising Intensity (H)
15. Magnetic permeability (µ)
16. Intensity of magnetisation (I)
17. Magnetic susceptibility
18. Write difference between paramagnetic ,ferromagnetic and diamagnetic substances ?
19. What do you mean by “ Curie’s law in Magnetism “ ?
20. What do you mean by (a) Hysterisis curve (b) Retentivity/Remanence

**NCERT Solved**

1. A short bar magnet placed with its axis at 30º with an external field of 800 G experiences a torque of 0.016 Nm. (a) What is the magnetic moment of the magnet?

(b) What is the work done in moving it from its most stable to most unstable position?

(c) The bar magnet is replaced by a solenoid of cross-sectional area 2 × 10–4 m2 and 1000 turns, but of the same magnetic moment. Determine the current flowing through the solenoid ?

1. (a) What happens if a bar magnet is cut into two pieces: (i) transverse to its length, (ii) along its length?

(b) A magnetised needle in a uniform magnetic field experiences a torque but no net force. An iron nail near a bar magnet, however, experiences a force of attraction in addition to a torque. Why?

(c) Must every magnetic configuration have a north pole and a south pole? What about the field due to a toroid?

(d) Two identical looking iron bars A and B are given, one of which is definitely known to be magnetised. (We do not know which one.)

(e)How would one ascertain whether or not both are magnetised? If only one is magnetised, how does one

ascertain which one? [Use nothing else but the bars A and B.]

1. What is the magnitude of the equatorial and axial fields due to a bar magnet of length 5.0 cm at a distance of 50 cm from its mid-point? The magnetic moment of the bar magnet is 0.40 A m2**?**
2. (a) Magnetic field lines show the direction (at every point) along which a small magnetised needle aligns (at the point). Do the magnetic field lines also represent the *lines of force* on a moving charged

particle at every point?

(b) Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?

(c) If magnetic monopoles existed, how would the Gauss’s law of magnetism be modified?

(d) Does a bar magnet exert a torque on itself due to its own field?Does one element of a current-carrying wire exert a force on another element of the *same wire*?

(e) Magnetic field arises due to charges in motion. Can a system have magnetic moments even though its net charge is zero?

1. The earth’s magnetic field at the equator is approximately 0.4 G. Estimate the earth’s dipole moment.
2. In the magnetic meridian of a certain place, the horizontal component of the earth’s magnetic field is 0.26G and the dip angle is 60º. What is the magnetic field of the earth at this location?
3. A solenoid has a core of a material with relative permeability 400. The windings of the solenoid are insulated from the core and carry a current of 2A. If the number of turns is 1000 per metre, calculate (a) *H*, (b) *M*, (c) *B* and (d) the magnetising current *Im*.
4. A domain in ferromagnetic iron is in the form of a cube of side length 1μm. Estimate the number of iron atoms in the domain and the maximum possible dipole moment and magnetisation of the domain. The molecular mass of iron is 55 g/mole and its density is 7.9 g/cm3. Assume that each iron atom has a dipole moment of 9.27×10–24 A m2.

**NCERT (Unsolved)**

1. Answer the following questions regarding earth’s magnetism:
   * 1. A vector needs three quantities for its specification. Name the three independent quantities conventionally used to specify the earth’s magnetic field.
     2. The angle of dip at a location in southern India is about 18º. Would you expect a greater or smaller dip angle in Britain?
     3. If you made a map of magnetic field lines at Melbourne in Australia, would the lines seem to go into the ground or come out of the ground?
     4. In which direction would a compass free to move in the vertical plane point to, if located right on the geomagnetic north or south pole?
     5. The earth’s field, it is claimed, roughly approximates the field due to a dipole of magnetic moment 8 × 1022 J T–1 located at its centre. Check the order of magnitude of this number in some way.

(f ) Geologists claim that besides the main magnetic N-S poles, there are several local poles on the earth’s surface oriented in different directions. How is such a thing possible at all?

1. A short bar magnet placed with its axis at 30º with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to 4.5 × 10–2 J. What is the magnitude of magnetic moment of the magnet?
2. A short bar magnet of magnetic moment m = 0.32 JT–1 is placed in a uniform magnetic field of 0.15 T. If the bar is free to rotate in the plane of the field, which orientation would correspond to its (a) stable, and (b) unstable equilibrium? What is the potential energy of the magnet in each case?
3. A bar magnet of magnetic moment 1.5 J T–1 lies aligned with the direction of a uniform magnetic field of 0.22 T.
   * 1. What is the amount of work required by an external torque to turn the magnet so as to align its magnetic moment: (i) normal to the field direction, (ii) opposite to the field direction?
4. A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip pointing down at 22º with the horizontal. The horizontal component of the earth’s magnetic field

at the place is known to be 0.35 G. Determine the magnitude of the earth’s magnetic field at the place.

1. A short bar magnet has a magnetic moment of 0.48 J T–1. Give the direction and magnitude of the magnetic field produced by the magnet at a distance of 10 cm from the centre of the magnet on (a) the axis, (b) the equatorial lines (normal bisector) of the magnet.
2. Answer the following questions:
   * 1. Why does a paramagnetic sample display greater magnetisation (for the same magnetising field) when cooled?
     2. Why is diamagnetism, in contrast, almost independent of temperature?
     3. If a toroid uses bismuth for its core, will the field in the core be (slightly) greater or (slightly) less than when the core is empty?
     4. Is the permeability of a ferromagnetic material independent of the magnetic field? If not, is it more for lower or higher fields?
     5. Magnetic field lines are always nearly normal to the surface of a ferromagnet at every point. (This fact is analogous to the static electric field lines being normal to the surface of a conductor at every point.) Why?

(f ) Would the maximum possible magnetisation of a paramagnetic sample be of the same order of magnitude as the magnetisation of a ferromagnet?

1. Answer the following questions:
   * 1. Explain qualitatively on the basis of domain picture the irreversibility in the magnetisation curve of a ferromagnet.
     2. The hysteresis loop of a soft iron piece has a much smaller area than that of a carbon steel piece. If the material is to go through repeated cycles of magnetisation, which piece will dissipate greater heat energy?
     3. ‘A system displaying a hysteresis loop such as a ferromagnet, is a device for storing memory?’ Explain the meaning of this statement.
     4. What kind of ferromagnetic material is used for coating magnetic tapes in a cassette player, or for building ‘memory stores’ in a modern computer?
     5. A certain region of space is to be shielded from magnetic fields. Suggest a method.

**Exemplar**

1. A proton has spin and magnetic moment just like an electron. Why then its effect is neglected in magnetism of materials?
2. From molecular view point, discuss the temperature dependence of susceptibility for diamagnetism, paramagnetism and ferromagnetism.
3. A ball of superconducting material is dipped in liquid nitrogen and placed near a bar magnet. (i) In which direction will it move? (ii) What will be the direction of it’s magnetic moment?

**Objective Questions**

1 An ammeter can be converted into a voltmeter by connecting (a) a high resistance in series

(b) a low resistance in parallel (c) a low resistance in series (d) a high resistance in parallel

2. A candidate connects a moving coil ammeter A. a moving coil voltmeter V and a resistance R as shown(fig 34.2). If the voltmeter reads 20 volt and ammeter reads 4 ampere, then R is

(a) equal to 5 ohm (b) greater than 5 ohm (c) less than 5 ohm

(d) greater or less than 5 ohm depending upon its material

3.A candidate connects a moving coil voltmeter V and a moving coil ammeter A and a resistor R as shown Fig.34.3’ If the voltmeter reads 20 volt and ammeter reads 4 ampere, then R is

(a) equal to 5 ohm (b) greater than 5 ohm (c) less than 5 ohm

(d) greater or less than 5 ohm depending upon its material

4. To convert a moving coil galvanometer into an ammeter one has to connect:

(a) a small resistance in series (b) a small resistance in parallel

(c) a high resistance in series (d) a high resistance in parallel

5. If a shunt of (l/10)th of the coil resistance is applied to a moving coil galvanometer, its sensitivity becomes:

(a) 10 times (b) 11 times (c) 1/10 times (d) 1/11 times

6. In the adjoining fig(34.4) , when an ideal voltmeter is connected across 4000 ohm resistance, it reads 30V.If the voltmeter is connected across 3000 ohm resistance , it will read

(a) 20 V (b) 22.5 V (c) 35V (d) 40V



7.In the given circuit (fig 34.5). A & V are ideal ammeter and ideal voltmeter. The voltmeter reading will be (a) 2 V (b) 3 V (c) 5V (d) 0 V

8. A voltmeter has a resistance of G ohm and range V volt. The value of a resistance used in series to convert it into voltmeter of range nV volts is :(a) nG (b) (n-1)G (c) G/n (d) G/(n-1)

9. An ammeter has a resistance of G ohm and a range of I amp. The value of resistance used in parallel to convert it into an ammeter of range nI amp is:(a) nG (b) (n-1)G (c) G/n (d) G/(n-1)

10.To decrease the range of an ammeter, its resistance need to be increased. An ammeter has resistance Ro and range I. Which of the following resistances can be connected in series with it to decrease its range to I/n :

:(a) Ro / n (b) Ro /(n-1) (c) Ro /(n+1) (d) none of these



11. Which of the following conclusion can be drawn from the result :

(a) magnetic field is zero everywhere (b) magnetic monopole cannot exist

(c) magnetic lines of force do not intersect each other (d) a current produces magnetic field

12. A galvanometer has a resistance of 3663 ohm. A shunt S is connected across it such that (l/34) of the total current passes through the galvanometer. Then, the value of the shunt is:

(a) 3663 ohm (b) 111 ohm (c) 107.7 ohm (d) 3555.3 ohm

13. A galvanometer has a resistance of 3663 ohm. A shunt S(111 ohm) is connected across it such that (l/34) of the total current passes through the galvanometer. Then, the combined resistance of the shunt and the galvanometer is: (a) 3663 ohm (b) 111 ohm (c) 107.7 ohm (d) 3555.3 ohm

14. A galvanometer has a resistance of 3663 ohm. A shunt S(111 ohm) is connected across it such that (l/34) of the total current passes through the galvanometer. How much the external resistance must be connected in series with the main circuit so that the total current in the main circuit remains unaltered even when the galvanometer is shunted. is: (a) 3663 ohm (b) 111 ohm (c) 107.7 ohm (d) 3555.3 ohm

15. A galvanometer has a resistance of 3663 ohm. A shunt S(111 ohm) is connected across it such that (l/34) of the total current passes through the galvanometer. The multiplying power of the shunt is:

(a) 1 (b) 33 (c) 34 (d) 35

16. A soft iron cylinder is used in a moving coil galvanometer because without it in galvanometer:

(a) magnetic field will not be radial and strong (b) magnetic field will be radial but weak

(c) magnetic field will be radial and strong (d) magnetic field will not he radial and weak

17.The cylindrical pole pieces used in the moving coil galvanometer provide a magnetic field which is:

(a) radial throughout the space (b) radial in the gap between the pole pieces and soft iron cylinder

(c) uniform throughout the space (d) uniform near the poles

18. The resistance of an ammeter is 13 ohm and its scale is graduated for a current of 100 A. After an additional shunt has been connected it becomes possible to measure the current up to 750 A by this instrument. Find the resistance of the shunt : (a) 8 ohm (b) 6 ohm (c) 4 ohm (d) 2 ohm

19.When an additional resistance of 1980 ohm is connected in series with a voltmeter, the scale division has 100 times larger value. Resistance of the voltmeter RV ( In ohm) is :

(a) 10 (b) 20 (c) 30 (d) 40

20. Two moving coil galvanometers 1 and 2 are with identical field magnets and suspension torque constants but with coils of different number of turns N1 and N2, area per turn A1 and A2 and resistances R1 and R2. When they are connected in series in the same circuit they show deflections θ1 and θ2. Then, (θ1/θ2) is:

(a) (A1N1/A2N2) (b) (A1N2/A2N1) (c) (A1N1R2/A2N2 R1) (a) (A1N1R1/A2N2 R2)

21. An ammeter is obtained by shunting a 30 ohm galvanometer with a 30 ohm resistance. What additional shunt should be connected across it to double the range :

(a) 15 ohm (b) 10ohm (c) 5 ohm (d) none of these

22. A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with a resistance of 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions the resistance in series should be :

(a) 4450 Ω (b) 5050 Ω (c) 5550 Ω (d) 6050 Ω

23. What is the relation between voltage sensitivity SV and current sensitivity SI of a moving coil galvanometer? Given that the resistance of the galvanometer is G:

(a) SV = G SI (b) SV = SI / G (c) SV SI = G (d) none of these

24. The coil of a moving coil galvanometer is wound over a metal frame in order to:

(a) reduce hysteresis (b) provide electromagnetic damping

(c) increase the moment of inertia (d) increase the sensitivity

25. When 0.005 A current flows thru a moving coil galvanometer it gives full scale deflection. It is converted into a voltmeter to read 5 volt using an external resistance of 975 Ω. The resistance of the galvanometer, in ohms, is:(a) 5 Ω (b) 10 Ω (c) 15 Ω (d) 25 Ω

26.The magnetic needle of a tangent galvanometer is deflected at an angle 300 due to a magnet. The horizontal component of the earth's magnetic field is 0.34 x 10-4 T which is along the plane of the coil. The magnetic intensity is:

(a) 1.96 x 10-4 T (b) 1.96 x 10-5 T (c) 1.96 x 104 T (d) 1.96 x 105 T

27. If an ammeter is connected in parallel to a circuit, it is likely to be damaged due to excess:

(a) current (b) voltage (c) resistance (d) all of these

28. A thin bar magnet of length 2L is bent at the mid-point so that the angle between them is 600. The new length of the magnet is: (a) L√2 (b) L√3 (c) 2L (d) L

29. A magnetised wire of moment M is bent into an arc of a circle subtending an angle of 600 at the centre; then the new magnetic moment is: (a) 2M/π (b) M/π (c) 3√3M/π (d) 3M/π

30. A dip needle in a plane perpendicular to the magnetic meridian will remain:

(a) vertical (b) horizontal (c) in any direction (d) at an angle of dip to the horizontal

31. The magnetic force required to demagnetize the material is :

(a) retentivity (b) coercivity (c) energy loss (d) hysteresis

32. Two points A and B are situated along the extended axis of a 2 cm long bar magnet at distances *x* and 2*x* cm respectively from the pole nearer to the points. The ratio of the magnetic fields at A and B will be:

(a) 4: 1 exactly (b)4:1 approximately (c)8:l exactly (d)8:l approximately

33. Two bar magnets of the same mass, same length and breadth but having magnetic moments M and 2M are joined together pole for pole and suspended by a string. The time period of assembly in a magnetic field of strength H is 3 second. If now the polarity of one of the magnets is reversed and the combination is again made to oscillate in the same field, the time of oscillation is: (a) √3 s (b) 3√3 s (c) 3s (d) 6s

34. A magnetic needle suspended by a silk thread is vibrating in the earth's magnetic field. If the temperature of the needle is increased by 10000 C, then:

(a) the needle stops vibrating (b) the time period decreases

(c) the time period increases (d) the time period remains unchanged

35. At the magnetic poles of the earth, a dip needle will be:

(a) bent slightly vertical (b) vertical (c) horizontal (d) inclined at 450 to the horizontal

36. The area enclosed by a hysteresis loop is a measure of:

(a) retentivity (b) susceptibility (c) permeability (d) energy loss per cycle

37. An iron rod of cross-sectional area 4 sq cm is placed with its length parallel to a magnetic field of intensity 1600 amp/m. The flux through the rod is 4 x 10-4 weber. What is the permeability (In weber/amp-m) of the material of the rod?

(a) 0.625 (b) 6.25 (c) 0.625 x l0-3 (d) None of these

38. A magnet is parallel to a uniform magnetic field. If it is rotated by 600, the work done is 0.8 J. How much work is done in moving it 300 further (a) 0.8 x 107 erg (b) 0.4 J (c) 8 J (d) 0.8 erg

39. The temperature at and above which a ferromagnetic material becomes paramagnetic is called:

(a) critical temperature (b) inversion temperature (c) Curie temperature (d) Debye temperature

40.An atom is paramagnetic if it has: (a) a magnetic moment (b) an electric dipole moment

(c) no electric dipole moment (d) no magnetic moment

41. A sample of diamagnetic substance when placed near a permanent bar magnet is: (a) repelled away

(b) attracted towards (c) unaffected (d) attracted or repelled dependent on the size of the sample

42. The magnetic moment of a diamagnetic atom is:

(a) much greater than one (b) one (c) between zero and one (d) equal to zero

43. Alnico is used for making permanent magnets because it has:

(a) high coercivity and high retentivity (b) high coercivity and low retentivity

(c) low coercivity and low retentivity (d) low coercivity and high retentivity

44.A magnetic north pole is a : (a) source of B –vector (b) source of H -vector

(c) sink of B –vector (d) sink of H -vector

45.A magnetic field is present, the direction of which is perpendicular to the plane of paper from top to bottom. An electron is projected into the field in the plane of paper with a constant velocity. The electron, as it enters the magnetic field, would: (a) move straight

(b) move in the plane of paper towards right with respect to its initial direction following a circular path

(c) move in the plane of paper towards left with respect to its initial direction following a circular path

(d) move perpendicular to the plane of paper following a circular path

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

(a) a force and a torque (b) a force but not a torque

(c) a torque but not a force (d) neither a torque nor a force

47. If a magnet is suspended at an angle of 300 to the magnetic meridian, the dip needle makes an angle of 450 with the horizontal. The real dip is:

(a) tan-1(√3/2) (b) tan-1(√3) (c) tan-1(√3/√2) (d) tan-1(2/√3)

48. A copper rod is suspended in a non-homogeneous magnetic field region. The rod when in equilibrium will align itself: (a) in the region where the magnetic field is strongest

(b) in the region where the magnetic field is weakest and parallel to the direction of the magnetic field there

(c) in the direction in which ir was originally suspended

(d) in the region where the magnetic field is weakest and perpendicular to the direction of magnetic field there

49.The magnetism of a magnet is due to:(a) the earth (b) cosmic rays

(c) the spin motion of electrons (d) pressure of big magnet inside the earth

50. The magnetic field of the 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 the earth

(c) a magnetic dipole buried at the centre of the earth (d) induction effect of the sun

51. At a place the angle of dip is 300. If the horizontal component of the earth's magnetic field is H, then the total field intensity will be given by: (a) H/2 (b) 2H/√3 (c) H√2 (d) H√3

52.A magnetic needle lying parallel to a magnetic field required W units of work to turn it through 600. The torque required to maintain the needle in this position will be:

(a) W√3 (b) W (c) W√3/2 (d) 2W

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

(a) rise (b) fall (c) oscillate slowly (d) remain unchanged

54.A dip circle is so set that the dip needle moves freely in the magnetic meridian. In this position the angle of dip is 390.Now, the dip circle is rotated so that the plane in which the needle moves makes an angle of 300 with the magnetic meridian. In this position, the needle will dip by an angle:

(a) exactly 390  (b) 300  (c) more than 390 (d) less than 390

55. If a magnet is suspended at an angle 300 to the magnetic meridian, the dip needle makes an angle of 600 with the horizontal. The true value of dip is:

(a) tan-1(2/3) (b) tan-1(3/2) (c) tan-1(3) (d) tan-1(2)

56. lsoclinic lines are: (a) the lines joining places of zero dip (b) the lines joining places of equal dip

(c) the lines joining places of zero declination (d) the lines joining places of equal declination

57. Aclinic lines are : (a) the lines joining places of zero dip (b) the lines joining places of equal dip

(c) the lines joining places of zero declination (d) the lines joining places of equal declination

58. Which of the following substances is diamagnetic?

(a) Iron (b) Wood (c) Nickel (d) None of these

59. When a paramagnetic substance is placed in a magnetic field, the magnetic induction inside the substance(a) remains constant (b) decreases (c) increases (d) reduces to zero

60. The period of oscillation of a magnetic needle in a magnetic field is 1.0 s. If the length of the needle is halved by cutting it, then the time period will be:

(a) 1.0 sec (b) 0.5 sec (c) 0.25 sec (d) 2.0 sec

61.A dip needle arranged to move freely in the magnetic meridian dips by an angle θ. If the vertical plane in which the needle moves is rotated through an angle α to the magnetic meridian, then the needle will dip by an angle:(a)θ (b) α (c) more than θ (d) less than θ

62.A current of 3 amp is flowing in a plane circular coil of radius 4 cm and number of turns 20. The coil is placed in a uniform magnetic field of magnetic induction 0.5 tesla. Then, the dipole moment of the coil is

(a) 3000 A-m2 (b) 0.3 A-m2 (c) 75 A-m2 (d) 300 A-m2

63.A current of 3 amp is flowing in a plane circular coil of radius 4 cm and number of turns 20. The coil is placed in a uniform magnetic field of magnetic induction 0.5 tesla. Then, the potential energy of the magnetic dipole in the position of stable equilibrium is:

(a) -1500 J (b) – 0.15 J (c) +0.15 J (d) +1500 J

64. The hysteresis cycle for the material of a permanent magnet is:

(a) short and wide (b) tall and narrow (c) tall and wide (d) short and narrow

65. The hysteresis cycle for the material of transformer core is:

(a) short and wide (b) tall and narrow (c) tall and wide (d) short and narrow

66. A hydrogen atom is paramagnetic. A hydrogen molecule is:

(a) diamagnetic (b) paramagnetic (c) ferromagnetic (d) anti-ferromagnetic

67. At a place of latitude 50, the angle of dip is nearly (a)50 (b) 100 (c) 2.50 (d) 7.50

68. The isoclinic lines are loci of equal:

(a) dip angle (b) declination angle (c) BH (d) BV

69. The isodynamic lines are loci of equal:

(a) dip angle (b) declination angle (c) BH (d) BV

70. The agonic lines are loci of zero:(a) dip angle (b) declination angle (c) BH (d) BV

71. A compass needle is placed at the magnetic pole. The compass needle:

(a) points south-north (b) points east-west (c) becomes vertical (d) may stay in any direction

72. In a moving coil galvanometer, to make the field radial

(a) coil is wound on wooden frame (b) magnetic poles are cylindrically cut

(c) a horse shoe magnet is used (d) the number of windings in the coil is decreased

73. The relation connecting magnetic susceptibility and relative permeability is:



74. lf the total magnetic field due to the earth is 28 ampere per metre, then the total magnetic induction due to the earth is: (a) 28 tesla (b) 280 ab-amp/cm (c) 0.352 gauss (d) 0.352 tesla

75. lf 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

76. The ratio of magnetic fields due to a small bar magnet in the end on position to that in broadside on position for the same distance from it is: (a)l:4 (b)l:2 (c)1:l (d)2:1

77. The ratio of magnetic potentials due to magnetic dipole in the end on position to that in the broadside on position for the same distance from it is: (a) zero (b) I (c) 2 (d) ∞

78. The magnetic potential at a point distant 10 cm from the middle point of a magnetic dipole on a line inclined at an angle of 600 with the axis is 3 CGS emu. Then, the magnetic dipole moment of the magnet is:

(a) 300 ab-amp x cm2 (b) 600 ab-amp x cm2 (c) 30 ab-amp x cm2 (d) 60 ab-amp x cm2

79. Two short bar magnets with magnetic moment 400 ab-amp x cm2 and 800 ab-amp x cm2 are placed with their axes in the same straight line with similar poles facing each other and with centres at a distance of 20 cm from each other. Then, the force of repulsion is:

(a) 6 dyne (b) 12 dyne (c) 800 dyne (d) 400 dyne

80.A bar magnet 8 cm long is placed in the magnetic meridian with the N-pole pointing towards geographical north. Two neutral points separated by a distance of 6 cm are obtained on the equatorial axis of the magnet. If BH =3.2 x 10-5 tesla, then the pole strength of the magnet is :

(a) 5 ab-amp x cm (b) 10 ab-amp x cm (c) 2.5 ab-amp x cm (d) 20 ab-amp x cm

81. A superconductor exhibits perfect:

(a) ferrimagnetism (b) ferromagnetism (c) Paramagnetism (d) Diamagnetism

82. Which of the following is true?

(a) Diamagnetism is temperature dependent (b) Paramagnetism is temperature dependent

(c) Paramagnetism is temperature independent (d) None of the above

83. Curie law relating magnetic susceptibility and absolute temperature is obeyed by

(a) all magnetic substances (b) paramagnetic substances

(c) diamagnetic substances (d) none of these

84. A-magnet oscillating in a horizontal plane has a time period of 2s at a place where the angle of dip is 300 and 3 seconds at another place where the angle of dip is 600. The ratio of resultant magnetic fields at the two places is:(a) 9/√3 (b) 9/4√3 (c) 4/9√3 (d) 4√3/7

85. A point near equator has (a) V>>H (b) H>>V (c) V=H ≠ 0 (d) V=H

86.A magnet makes 40 oscillation per minute at a place having magnetic field intensity of 0.1 x 10-5 T. At another place, it takes 2.5 sec to complete one vibration. The value of the earth's horizontal field at that place is(a) 0.25 x 10-6 T (b) 0.36 x 10-6 T (c) 0.66 x 10-6 T (d) 1.2 x 10-6 T

87. 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. The observation establishes that bismuth is :

(a) diamagnetic (b) paramagnetic (c) ferromagnetic (d) anti-ferromagnetic (e) ferrimagnetic

88. The time period of oscillation of magnet in a vibration magnetometer is 1.5 sec, The time period of oscillation of another magnet similar in size, shape and mass but having one-fourth magnetic moment than that of the first magnet oscillating at the same place will be: (a) 0.75 s (b) 1.5s (c) 3 s (d) 6 s

89. The magnetic dipole moment of a current loop is independent of:

(a) magnetic field in which it is lying (b) number of turns (c) area of the loop (d) current in the loop

90. A magnetising field of 1600 A-m-l produces a magnetic flux of 2.4 x 10-5 Wb in an iron bar of cross sectional area 0.2 cm2.The susceptibility of the iron bar is:

(a) 298 (b) 596 (c) 1192 (d) 1788

91. In which type of materials the magnetic susceptibility does not depend on temperature?

(a) Diamagnetic (b) paramagnetic (c) Ferromagnetic (d) ferrite

92.A bar magnet of magnetic moment 3.0 A-m2 is placed in a uniform magnetic induction field of 2 x l0-5 T. If each pole of the magnet experiences a force of 6 x 10-4 N, the length of magnet is

(a) 0.5 m (b) 0.3 m (c) 0.2 m (d) 0.1 m

93. A diamagnetic material in a magnetic field moves:

(a) perpendicular to the field (b) from weaker to stronger Parts

(c) from stronger to weaker Parts (d) in none of the above directions

94. A bar magnet is oscillating in the earth's magnetic field with a time period T. lf the mass is quadrupled, then its time period will be: (a) T/2 (b) T (c) 2T (d) 4T

95. The period of oscillation of a magnet at a place is 4 seconds. When it is remagnetised, so that the pole strength becomes 4 times the initial value, the period of oscillation (in second) is:

(a) 1/2 (b)1 (c) 2 (d) 4

96. Two short bar magnets of magnetic moments M each are arranged at the opposite corners of a square of side *d* such that their centres coincide with the corners and their axes are parallel. If the like poles are in the same direction, the magnetic induction at any of the other corners of the square is :

(a) μoM/4πd3 (b) μo2M/4πd3 (c) μoM/4π 2d3  (d) μoM2/4π 2d3

97. A sphere of gold is brought close to a powerful magnet. The sphere will experience:

(a) zero force (b) a repulsive force (c) an attractive force (d) an oscillating force

98. A current flows in a conducting wire of length L. If we bend it in a circular form, its magnetic dipole moment would be: (a) IL2/4π (b) IL/4π (c) I2L/4π  (d) I2L2/4π

99. A hydrogen atom is paramagnetic. A hydrogen molecule is

(a) Diamagnetic (b) Paramagnetic (c) Ferromagnetic (d) none of these

100. 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 25/4 sec. One of the magnets is removed and if the other magnet oscillates in the same field, then the time period in seconds is:(a) 21/4 (b) 21/2 (c) 2 (d) 25/4

101. The magnetic susceptibility of a material of a rod is 499.Permeability of vacuum is 4π x l0-7 henry/m. Absolute permeability of the material of the rod in henry per meter is:

(a) π x 10-4 (b) 2π x 10-4 (c) 3π x 10-4  (d) 4π x 10-4

102. The magnetic lines of force inside a bar magnet:

(a) do not exist (b) are from N-pole to S-pole of the magnet

(c) are from S-pole to N-pole of the magnet (d) depend upon the area of cross-section of the bar magnet

103. Curie temperature is the temperature above which:

(a) a paramagnetic material becomes diamagnetic (b) a ferromagnetic material becomes diamagnetic

(c) a paramagnetic material becomes ferromagnetic (d) a ferromagnetic material becomes paramagnetic

104. The Curie-Weiss law is obeyed by iron:

(a) at all temperatures (b) above the Curie temperature

(c) below the Curie temperature (d) at the Curie temperature only

105.A vertical circular coil of radius 0.1 m and having 10 turns carries a steady current. When the plane of the coil is normal to magnetic meridian, a neutral point is observed at the centre of the coil. If BH = 0.314 x 10-4 T, then current in the coil is : (a) 0.25 A (b) 0.5 A (c) l A (d)2A

**Answers Explanations Objective Questions- Magnetism & Matter**

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| --- | --- | --- | --- |
| 1. A | 1. C | 1. B | 1. B |
| 1. D | 1. B | 1. D | 1. B |
| 1. D | 1. D | 1. B | 1. B |
| 1. C | 1. D | 1. C | 1. A |
| 1. B | 1. D | 1. B | 1. A |
| 1. A | 1. A | 1. B | 1. D |
| 1. D | 1. B | 1. A | 1. D |
| 1. D | 1. A | 1. B | 1. D |
| 1. B | 1. A | 1. B | 1. D |
| 1. C | 1. A | 1. C | 1. A |
| 1. A | 1. D | 1. A | 1. B |
| 1. B | 1. A | 1. A | 1. D |
| 1. C | 1. A | 1. B | 1. A |
| 1. A | 1. C | 1. B | 1. B |
| 1. A | 1. D | 1. C | 1. B |
| 1. C | 1. B | 1. B | 1. C |
| 1. B | 1. A | 1. B | 1. A |
| 1. C | 1. B | 1. D | 1. B |
| 1. B | 1. C | 1. D | 1. D |
| 1. D | 1. B | 1. B | 1. A |
| 1. D | 1. B | 1. B | 1. B |
| 1. B | 1. B | 1. A | 1. C |
| 1. A | 1. B | 1. A | 1. D |
| 1. C | 1. C | 1. C | 1. A |
| 1. B | 1. A | 1. A | 1. C |
| 1. B | 1. C | 1. D | 1. B |
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