PHYSICS

BOOKS - U-LIKE PHYSICS (HINGLISH)

MAGNETISM AND MATTER

N C E R T Textbook Exercises

1. A vector needs three quantities for its specification. Name the three independent

quantities conventionally used to specify the earth's magnetic field.

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2. The angle of dip at a location in southern India is about 18°. Would you expect a greater or smaller dip angle in Britain ?

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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 ?

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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?

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5. The earth's field, it is claimed, roughly approximates the field due to a dipole of magnetic moment $8 \times 10^{22} JT^{-1}$ located at its centre. Check the order of magnitude of this number in some way.

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6. 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 ?

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7. The earth's magnetic field varies from point to point in space. Does it also change with time? If so, on what time scale does it change appreciably?

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8. The earth's core is known to contain iron. Yet geologists do not regard this as a source of the earth's magnetism. Why?

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9. The charged currents in the outer conducting regions of the earth's core are thought to be responsible for earth's magnetism. What might be the 'battery' (i.e., the source of energy) to sustain these currents ?

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10. The earth may have even reversed the direction of its field several times during its history of 4 to 5 billion years. How can geologists know about the earth's field in such distant past?

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11. The earth's field departs from its dipole shape substantially at large distances (greater than about 30,000 km). What agencies may be responsible for this distortion ?

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12. Interstellar space has an extremely weak magnetic field of the order of 10^{12} T. Can such a weak field be of any significant consequence ? Explain.

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13. A short bar magnet placed with its axis at 30° 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?

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14. A short bar magnet of magnetic moment $m = 0.32JT^{-1}$ 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 ?

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15. A closely wound solenoid of 800 turns and area of cross-section $2.5 \times 10^{-4} m^2$ carries a current of 3.0 A. Explain the sense in which the

solenoid acts like a bar magnet. What is its associated magnetic moment?

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16. If the solenoid in Exercise 5.5 is free to turn about the vertical direction and a uniform horizontal magnetic field of 0.25 T is applied, what is the magnitude of torque on the solenoid when its axis makes an angle of 30° with the direction of applied field ?

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17. A bar magnet of magnetic moment 1.5JT^{-1} lies aligned with the direction of a uniform magnetic field of 0.22 T.

(a) 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?

(b) What is the torque on the magnet in cases (i) and (ii) ?

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18. A closely wound solenoid of 2000 turns and area of cross-section $1.6 \times 10^{-4} m^2$ carrying a current of 4.0 A, is suspended through its centre allowing it to turn in a horizontal plane.

(a) What is the magnetic moment associated with the solenoid ?

(b) What is the force and torque on the solenoid if a uniform horizontal magnetic field of 7.5×10^{-2} T is set up at an angle of 30° with the axis of the solenoid ?

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19. A circular coil of 16 turns and radius 10 cm carrying a current of 0.75 A rests with its plane normal to an external field of magnitude 5.0×10^{-T}. The coil is free to turn about an axis in its plane perpendicular to the field direction. When the coil is turned slightly and released, it oscillates about its stable equilibrium with a frequency of 2.0 s^{-1}. What is the moment of inertia of the coil about its axis of rotation ?

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20. A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip pointing down at 22° 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.

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21. At a certain location in Africa, a compass points 12° west of the geographic north. The north tip of the magnetic needle of a dip circle placed in the plane of magnetic meridian points 60° above the horizontal. The horizontal component of the earth's field is measured to be 0.16 G. Specify the direction and magnitude of the earth's field at the location.

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22. A short bar magnet has a magnetic moment of $0.48 JT^{-1}$. 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.

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23. A short bar magnet placed in a horizontal plane has its axis aligned along the magnetic north south direction. Null points are found on the axis of the magnet at 14 cm from the centre of the magnet. The earth's magnetic field at the place is 0.36 G and the angle of dip is zero. What is the total magnetic field on the normal bisector of the magnet at the same distance as the null point (i.e., 14 cm) from the centre of the magnet ? (At null points, field due to a magnet is equal and opposite to the

horizontal component of earth's magnetic field.)

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24. If the bar magnet in Exercise 5.13 is turned around by 180° , where will the new null points be located ?

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25. A short bar magnet of magnetic moment $5.25 \times 10^{-2} JT^{-1}$ is placed with its axis perpendicular to the earth's field direction. At what distance from the centre of the magnet, the resultant field is inclined at 45° with earth's field on (a) its normal bisector, and (b) its axis. Magnitude of the earth's field at the place is given to be 0.42 G. Ignore the length of the magnet in comparison to the distances involved.

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Additional Exercises

1. Why does a paramagnetic sample display greater magnetisation (for the same magnetising field) when cooled ?

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2. Why is diamagnetism, in contrast, almost independent of temperature?

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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 ?

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4. Is the permeability of a ferromagnetic material independent of the magnetic field ? If not,is it more for lower or higher fields ?

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5. Magnetic field lines are always nearly normal to the surface of a ferromagnet at every point.Why?

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6. Would the maximum possible magnetisation of a paramagnetic sample be of the same order of magnitude as the magnetisation of a ferromagnet?

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7. Explain qualitatively on the basis of domain picture the irreversibility in the magnetisation curve of a ferromagnet.

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8. 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 ?

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9. 'A system displaying a hysteresis loop such as a ferromagnet, is a device for storing memory.' Explain the meaning of this statement.

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10. What kind of ferromagnetic material is used for coating magnetic tapes in a cassette

player, or for building 'memory stores' in a modern computer?

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11. A certain region of space is to be shielded from magnetic fields. Suggest a method.

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12. A long straight horizontal cable carries a current of 2.5 A in the direction 10° south of

west to 10° north of east. The magnetic meridian of the place happens to be 10° west of the geographic meridian. The earth's magnetic field at the location is 0.33 G and the angle of dip is zero. Locate the line of neutral points (ignore the thickness of the cable).

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13. A telephone cable at a place has four long straight horizontal wires carrying a current of 1.0 A in the same direction east to west. The

earth's magnetic field at the place is 0.39 G, and the angle of dip is 35°. The magnetic declination is nearly zero. What are the resultant magnetic fields at points 4.0 cm below the cable ?

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14. A compass needle free to turn in a horizontal plane is placed at the centre of circular coil of 30 turns and radius 12 cm. The coil is in a vertical plane making an angle of

45° with the magnetic meridian. When the current in the coil is 0.35 A, the needle points west to east.

(a) Determine the horizontal component of the earth's magnetic field at the location.

(b) The current in the coil is reversed, and the coil is rotated about its vertical axis by an angle of 90° in the anticlockwise sense looking from above. Predict the direction of the needle. Take the magnetic declination at the places to be zero.

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15. A magnetic dipole is under the influence of two magnetic fields. The angle between the field directions is 60°, and one of the fields has a magnitude of 1.2×10^{-2}T. If the dipole comes to stable equilibrium at an angle of 15° with this field, what is the magnitude of the other field?

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16. A monoenergetic (18 KeV) electron beam initially in the horizontal direction is subjected to a horizontal magnetic field of 0.40 G normal to the initial direction. Estimate the up or down deflection of the beam over a distance of 30 cm $\left(m_e = 9.11 \times 10^{-19} C\right)$.

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17. A sample of paramagnetic salt contains 2.0×10^{24} atomic dipoles each of dipole

moment $1.5 \times 10^{-23} JT^{-1}$. The sample is placed under a homogeneous magnetic field of 0.64 , and cooled to a temperature of 4.2 K . The degree of magnetic saturation achieved is equal to 15% . What is the total dipole moment of the sample for a magnetic field of 0.98 T and a temperature of 2.8 K ?

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18. A Rowland ring of mean radius 15 cm has 3500 turns of wire wound on a ferromagnetic

core of relative permeability 800. What is the magnetic field $\vec{B}$ in the core for a magnetising current of 1.2 A ?

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19. The magnetic moment vectors μ_s and μ_l associated with the intrinsic spin angular momentum $\vec{S}$ and orbital angular momentum $\vec{l}$ respectively, of an electron are predicated by quantum theory (and verified experimentally to a hing accuracy) to be given

by :

$$\mu_s = -\left(\frac{e}{m}\right)\vec{S}, \mu_I = -\left(\frac{e}{2m}\right)\vec{I}$$

Which of these relations is in accordance with the result expected classically ? Outline the derivation of the classical result .

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Case Based Source Based Integrated Questions

1. Read the following passage and answer question on the basis of your understanding

of the following passage and the related studied concepts.

Diamagnetic substances are those which have tendency to move from stronger to the weaker part of the external magnetic field and a magnet would repel a diamagnetic substance. When a bar of diamagnetic material is placed in an external magnetic field, the field lines are repelled or expelled and the field inside the material is slightly reduced. Each electron in an atom orbiting around nucleus is equivalent to a current carrying loop and thus possesses orbital angular moment. Diamagnetic

substances are the ones in which resultant magnetic moment of all the electrons in an atom is zero. When a magnetic field is applied, those electrons having orbital magnetic moment in the same direction slow down and those in the opposite direction speed up due to induced current in accordance with lenz's law. Thus, the substance develops a net magnetic moment in a direction opposite to that of applied magnetic field and hence repulsion The most exotic diamagnetic materials are superconductors. These are metals cooled to very low temperatures and

exhibit both perfect conductivity and perfect diamagnetism. This phenomenon was discovered by Meissner. Super conducting magnets can be exploited for running magnetically levitated bullet trains.

Give three examples of diamagnetic substances.

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2. Read the following passage and answer question on the basis of your understanding

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Show modification of field lines when a bar of diamagnetic substance is placed in a magnetic field.

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3. Read the following passage and answer question on the basis of your understanding of the following passage and the related studied concepts.

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What should be the value of magnetic susceptibility and relative magnetic permeability of a superconductor ?

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4. Read the following passage and answer question on the basis of your understanding of the following passage and the related studied concepts.

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What is Meissner effect?

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5. Read the following passage and answer question on the basis of your understanding of the following passage and the related studied concepts.

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Does diamagnetism depend on the temperature ?

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6. Read the following passage on the basis of your understanding of the following paragraph and the related studied concepts:

A freely suspended bar magnet capable of rotation in a horizontal plane in its equilibrium state, rests in the direction of earth's magnetic field at the place. If the magnet is slightly rotated from its equilibrium direction and then released, it executes angular oscillations of period T given as per relation

$$T = 2\pi\sqrt{\frac{I}{mB_H}}$$

Here I moment of inertia of bar magnet about its oscillation axis, magnetic moment of bar magnet and B_H horizontal component of earth's magnetic field at the place.

An oscillation magnetometer is designed on this principle and is employed to compare magnetic moments of magnets and for determining earth's magnetic field at a place.

Two bar magnets A and B of same configuration and mass have oscillation periods of 2s and 2.5 s respectively at a given place. The ratio of magnetic moments of A and B is

A. $5:4$

B. $\sqrt{5}:2$

C. $25:16$

D. $16:25$

Answer:

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7. Read the following passage on the basis of your understanding of the following paragraph and the related studied concepts:

A freely suspended bar magnet capable of rotation in a horizontal plane in its equilibrium state, rests in the direction of earth's magnetic field at the place. If the magnet is slightly rotated from its equilibrium direction and then released, it executes angular oscillations of period T given as per relation

$$T = 2\pi\sqrt{\frac{I}{mB_H}}$$

Here I moment of inertia of bar magnet about its oscillation axis, magnetic moment of bar magnet and B_H horizontal component of

earth's magnetic field at the place.

An oscillation magnetometer is designed on this principle and is employed to compare magnetic moments of magnets and for determining earth's magnetic field at a place.

The oscillation period of a given magnetic needle is 5 s at place A and 6 s at place B. The ratio of horizontal components of earth's magnetic field at A and B is

A. $\frac{5}{6}$

B. $\frac{36}{25}$

C. $\frac{12}{5}$

D. $\frac{6}{5}$

Answer:

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8. Read the following passage on the basis of your understanding of the following paragraph and the related studied concepts:

A freely suspended bar magnet capable of rotation in a horizontal plane in its equilibrium state, rests in the direction of

earth's magnetic field at the place. If the magnet is slightly rotated from its equilibrium direction and then released, it executes angular oscillations of period T given as per relation

$$T = 2\pi\sqrt{\frac{I}{mB_H}}$$

Here I moment of inertia of bar magnet about its oscillation axis, magnetic moment of bar magnet and B_H horizontal component of earth's magnetic field at the place.

An oscillation magnetometer is designed on this principle and is employed to compare

magnetic moments of magnets and for determining earth's magnetic field at a place.

Two bar magnets of same dimensions and same mass but different magnetic moments are placed together in an oscillation magnetometer with their like poles together and the combination completes 20 oscillations per minute. Subsequently, the two magnets are placed with their unlike poles together in the oscillation magnetometer. Now the combination completes 10 oscillations per minute only. Compare the ratio of magnetic moments of two given magnets.

A. $\frac{5}{3}$

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

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

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

Answer:

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Multiple Choice Questions

1. If a bar magnet of magnetic moment 'm' is freely suspended in a uniform magnetic field B, the work done in rotating the magnet through an angle $thete$ is

A. $mB(1-\sin\theta)$

B. $mB\sin\theta$

C. $mB\cos B$

D. $mB(1-\cos\theta)$

Answer: D

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2. A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60° . The torque required to maintain the needle in this position will be

A. $\sqrt{3}$ W

B. W

C. $\frac{\sqrt{3}}{2}W$

D. $2W$

Answer: A

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3. At which place earth's magnetism becomes horizontal ?

A. Magnetic pole

B. Geographical pole.

C. Magnetic meridian .

D. Magnetic equation

Answer: D

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4. The angle of dip at the magnetic equator is

A. 0°

B. 45°

C. 30°

D. 90°

Answer: A

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5. The relative magnetic permeability of ferromagnetic materials is of the order of

A. 10

B. 100

C. 1000

D. 10000

Answer: C

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6. A bar magnet has a magnetic moment $5 \times 10^{-5} A - m^2$. It is suspended in a magnetic field of 8×10^{-4} tesla. The magnet vibrates with a period of vibration equal to 15 s. The moment of inertia of the magnet is

A. $22.5 kgm^2$

B. $11.25 kgm^2$

C. $5.62 kgm^2$

D. $7.16 \times 10^{-7} kgm^2$

Answer: D

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7. The materials suitable for making electromagnets should have

A. high retentivity and high coercivity.

B. low retentivity and low coercivity.

C. high retentivity and low coercivity.

D. low retentivity and high coercivity.

Answer: B

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8. In a permanent magnet at room temperature

A. magnetic moment of each molecule is zero.

B. individual molecules have non-zero magnetic moment which are all perfectly

aligned.

C. domains are partially aligned.

D. domains are all perfectly aligned.

Answer: C

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9. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material be denoted by μ_d, μ_p and μ respectively, then

A. $\mu_d \neq 0$ and $\mu_f = 0$

B. $\mu_p = 0$ and $\mu_f = 0$

C. $\mu_d = 0$ and $\mu_p \neq 0$

D. $\mu_d \neq 0$ and $\mu_p = 0$

Answer: C

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10. Curie temperature is the temperature above which

A. paramagnetic material becomes diamagnetic material.

B. paramagnetic material becomes ferromagnetic material.

C. ferromagnetic material becomes diamagnetic material.

D. ferromagnetic material becomes paramagnetic material.

Answer: C

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11. 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 force nor a torque

Answer: A

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12. A short bar magnet placed with its axis at 30° with a uniform magnetic field of 0.16 T experiences a torque of magnitude 0.032 J. The magnetic dipole moment of the bar magnet is

A. $0.23JT^{-1}$

B. $0.40JT^{-1}$

C. $0.80JT^{-1}$

D. 0

Answer: B

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13. A magnet of magnetic moment 50 $\hat{i}Am^2$ is placed along the x-axis in a magnetic field $\overrightarrow{B} = \left(0.5\hat{i} + 3.0\hat{j}\right)T$. The torque acting on the magnet is

A. $175\hat{k}N - m$

B. $150\hat{k}N - m$

C. $75\hat{k}N - m$

D. $25\sqrt{37}\hat{k}N - m$

Answer: B

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14. A small bar magnet has a dipole moment 1.2 A m^2. The magnitude of magnetic field at a distance of 0.1 m on its axis will be

A. $1.2 \times 10^{-4} T$

B. $2.4 \times 10^{-4} T$

C. $2.4 \times 10^{4} T$

D. $1.2 \times 10^{4} T$

Answer: B

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15. The angle between the magnetic meridian and geographical meridian is called

A. angle of dip.

B. angle of declination.

C. angle of inclination.

D. bending angle

Answer: B

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16. At a place, horizontal and vertical components of earth's magnetic field are equal. Angle of dip at the given place is

A. 30°

B. 90°

C. 45°

D. 0°

Answer: C

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17. At a certain place the angle of dip is 30° and the horizontal component of earth's magnetic field is $3.2 \times 10^{-5} T$. Earth's total magnetic field at the place is

A. $\frac{3.2}{\sqrt{3}} \times 10^{-5}$

B. $\frac{6.4}{\sqrt{3}} \times 10^{-5} T$

C. $3.2 \times 10^{-5} T$

D. $6.4 \times 10^{-5} T$

Answer: B

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18. At which place direction of earth's magnetic field is horizontal ?

A. Magnetic pole.

B. Geographic pole

C. Magnetic meridian.

D. Magnetic equator.

Answer: D

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19. The time period of oscillations of a freely suspended magnetic needle is given by

A. $T = 2\pi\sqrt{\frac{I}{mB_H}}$

B. $T = 2\pi\sqrt{\frac{mB_H}{I}}$

C. $T = \sqrt{\frac{I}{mB_H}}$

D. $T = 2\pi\sqrt{\frac{B_H}{mI}}$

Answer: A

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20. At a certain place a small bar magnet completes 30 oscillations per minute. At another place, where the magnetic field is double, its time period will be

A. 4 s

B. 2 s

C. $\frac{1}{2}s$

D. $\sqrt{2}$s

Answer: D

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21. Temperature above which a ferromagnetic substance begins to behave as a paramagnetic substance is known as

A. neutral temperature,

B. Debye temperature.

C. Boyle's temperature.

D. Curie's temperature.

Answer: D

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22. Magnetic susceptibility X, magnetic intensity H and magnetisation vector M are correlated as

A. $x = HM$

B. $x = \frac{M}{H}$

C. $x = \frac{H}{M}$

D. $x = M + H$

Answer: B

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23. A superconductor exhibits perfect

A. ferrimagnetism

B. ferromagnetism

C. paramagnetism

D. diamagnetism

Answer: D

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24. In a non-uniform magnetic field a diamagnetic material moves

A. from weaker to stronger part of the field.

B. perpendicular to the field.

C. from stronger to the weaker part of the field.

D. in any random direction.

Answer: C

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25. The magnetic susceptibility (x) of a paramagnetic material changes with absolute temperature (T) as

A. $x \propto T$

B. $x \propto \frac{1}{T}$

C. $x \propto T^2$

D. $x \propto e^{-T}$

Answer: B

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26. Susceptibility of a diamagnetic substance has a value

A. > 1

B. 1

C. < 1

D. < 0

Answer: D

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

A. retentivity

B. coercive force

C. Lorentz force.

D. magnetic saturation

Answer: B

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28. Liquid oxygen remains suspended between two pole faces of a strong horse shoe magnet because it is

A. diamagnetic

B. non-magnetic.

C. paramagnetic

D. ferromagnetic

Answer: C

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29. If μ_r represents relative permeability and x magnetic susceptibility of a material then for a paramagnetic substance

A. $\mu_r < 1, x < 0$

B. $\mu_r < 1, x > 0$

C. $\mu_r > 1, x < 0$

D. $\mu_r > 1, x > 0$

Answer: D

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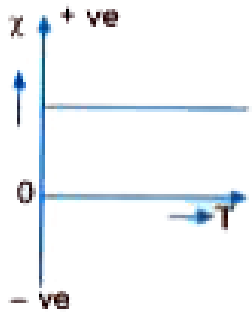
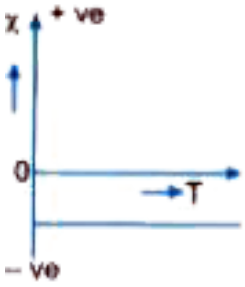
30. The variation of magnetic susceptibility (x) with temperature (T) for a diamagnetic material is best represented by

A.



B.



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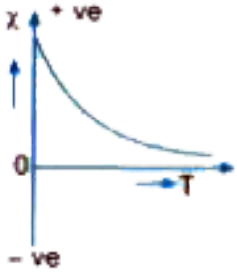
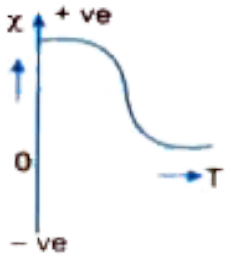


D.



Answer: B

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31. Angle between the magnetic meridian and the geographical meridian at a given place is known as _____ .

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32. The line joining the points on earth's surface where dip needle becomes horizontal

is called as _____ .

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33. Value of dip angle at magnetic equator is and at magnetic poles of earth its value is _____ .

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34. The vertical component of earth's magnetic field exists everywhere except at

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35. The magnetic materials having negative magnetic susceptibility are called ___and those having positive magnetic susceptibility are called _____ .

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36. Electromagents are made of soft iron because soft iron has _____ and _____ .

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37. In a ferromagnetic material typical domain size is _____ and the domain contains about _____atoms.

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38. SI unit of magnetic intensity $\overrightarrow{H}$ as well as magnetisation $\overrightarrow{M}$ is _____ .

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39. The phenomenon of perfect diamagnetism in super conductors is called the _____ .

View Text Solution

40. Alnico and ticonal materials are commonly used for preparing _____ .

View Text Solution

41. Relative permeability μ_r and magnetic susceptibility X_m of a material are related as _____ .

View Text Solution

42. _____ is the intrinsic property of every material and it is generated due to mutual interaction between the applied magnetic field and orbital motion of electrons.

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43. The relation $x = \dfrac{C}{(T - T_C)}$ for a ferromagnetic material above the Curie's temperature T_C is known as _____ .

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44. B-H curve for a ferromagnetic material is called _____ .

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True Or False

1. A magnetised needle in a uniform field experience a force as well as a torque.

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2. Magnetic field lines can be entirely confined within the core of a toroid but not within a straight solenoid.

View Text Solution

3. The strength of earth's magnetic field is of the order of 10^{-3} T.

View Text Solution

4. The angle subtended by magnetic meridian with the geographical meridian at a place is called the angle of inclination.

View Text Solution

5. Bismuth is diamagnetic but copper is paramagnetic.

View Text Solution

6. As per Curie's law the magnetisation of a paramagnetic substance is inversely proportional to the absolute temperature but magnetisation of a diamagnetic substance is directly proportional to the absolute temperature.

View Text Solution

7. Material used for preparing electromagnet should have high retentivity and high coercivity.

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Assertion Reason Type Questions

1. Assertion (A) : The poles of bar magnet cannot be separated by breaking it into two

pieces.

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

A. If both assertion and reason are true and the reason is the correct explanation of the assertion

B. If both assertion and reason are true but reason is not the correct explanation of the assertion

C. if assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

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2. Assertion (A) : The earth's magnetic field is due to the iron present in its core.

Reason (R) A bar magnet experiences a torque when placed at some angle to uniform magnetism field.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion

B. If both assertion and reason are true but reason is not the correct explanation of the assertion

C. if assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: D

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3. Assertion (A) : A compass needle when placed on the magnetic north pole of the earth may lie in any direction.

Reason (R) : The earth has only vertical component of its magnetic field at the north pole.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion

B. If both assertion and reason are true but reason is not the correct explanation of the assertion

C. if assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

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4. Assertion (A) : For a perfectly diamagnetic material the relative permeability has a value of -1.

Reason (R) : The ability of a material to permit the passage of magnetic field lines through it is called magnetic permeability.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion

B. If both assertion and reason are true but reason is not the correct explanation of the assertion

C. if assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

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5. Assertion (A) : A paramagnetic sample displays greater manetisation, for the same magnetising field, when cooled.

Reason (R) : At lower temperature the individual atomic dipoles of a paramagnetic material can be easily aligned in the direction of the magnetising field.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion

B. If both assertion and reason are true but reason is not the correct explanation of the assertion

C. if assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: A

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Very Short Answer Questions

1. Compare the magnetic fields due to a straight solenoid and a bar magnet.

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2. What should be the orientation of a magnetic dipole in a uniform magnetic field so that its potential energy is maximum ?

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3. What should be the orientation of a magnetic dipole in a uniform magnetic field so that its potential energy is minimum (or the dipole is in stable equilibrium) ?

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4. What is geomagnetic equator ?

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5. A magnetic needle, free to rotate in a vertical plane, orients itself vertically at a certain place on earth. What is the value of horizontal component of earth's magnetic field at this place ?

View Text Solution

6. Where on the surface of earth is the vertical component of earth's magnetic field zero ?

View Text Solution

7. What is the angle of dip at a place, where the horizontal and vertical components of the earth's magnetic field are equal ?

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8. Where on the surface of earth is the angle of dip 90° ?

View Text Solution

9. Where on the surface of earth is the angle of dip zero?

View Text Solution

10. The horizontal component of the earth's magnetic field at a place is B_H and angle of dip is 60° What is the value of vertical component of earth's magnetic field at equator?

View Text Solution

11. At a place, the horizontal component of earth's magnetic field is B and angle of dip is 60°. What is the value of horizontal component of the earth's magnetic field at equator?

View Text Solution

12. The vertical component of earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component. What is the value of angle of dip at this place?

View Text Solution

13. What does the Gauss theorem in magnetism establish ?

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14. The permeability of a magnetic material is 0.9983. Name the type of magnetic materials it represents.

View Text Solution

15. Which of the following substances are diamagnetic ?

Bi , Al , Na , Cu , Ca and Ni

View Text Solution

16. Which of the following substances are paramagnetic ?

Bi, Al, Cu, Ca, Pb, Ni

View Text Solution

17. What are permanent magnets 2 Give one example.

View Text Solution

18. How does the magnetisation vector of a paramagnetic sample vary with temperature ?

View Text Solution

19. The susceptibility of a magnetic material is 1.9×10^{-5}. Name the type of magnetic materials it represents.

View Text Solution

20. The susceptibility of a magnetic material is -4.2×10^{-6}. Name the type of magnetic materials it represents.

View Text Solution

21. A ball of superconducting material is dipped in liquid nitrogen and placed near a bar magnet. In which direction will it move and why?

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22. Do individual atoms of a paramagnetic material have permanent dipole moment?

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23. Relative permeability of a material $\mu_r = 0.5$. Identify the nature of the magnetic material and write its relation to magnetic susceptibility.

View Text Solution

24. Relative permeability of a material $\mu_r = 400$. Identify the nature of the magnetic material.

View Text Solution

25. What do you mean by hysteresis ?

View Text Solution

26. The susceptibility of a magnetic material is - 0.085. Identify the magnetic type of the material.

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27. Steel is preferred for making permanent magnets whereas soft iron is preferred for making electromagnets. Explain.

View Text Solution

28. Why should the material used for making permanent magnets have high coercivity ?

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Short Answer Questions

1. Define the terms 'magnetic dip' and 'magnetic declination' with the help of relevant diagrams.

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2. Define angle of dip. Deduce the relation connecting angle of dip and horizontal component of earth's magnetic field at a place.

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3. A short bar magnet placed with its axis at 30° to a uniform magnetic field of 0.02 T experiences a torque of 0.060 Nm. (i) Calculate magnetic moment of the magnet, and (ii) find out what orientation of the magnet corresponds to its stable equilibrium in the magnetic field.

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4. A magnetic compass needle of magnetic moment 60 A-m^2 is placed at a place. The needle points towards the geographic north. Using the data given below, find the value of declination at that place. Horizontal component of earth's magnetic field = $40 \times 10^{-6} Wbm^{-2}$ and torque experienced by the needle = 1.2×10^{-3} Nm.

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5. State two characteristic properties distinguishing the behaviour of paramagnetic and diamagnetic materials.

View Text Solution

6. How will you distinguish a diamagnetic substance from a paramagnetic substance in respect of their behaviour in a uniform and non-uniform field ?

View Text Solution

7. State and explain Curie's law in magnetism.

View Text Solution

8. Why does a paramagnetic substance display greater magnetisation for the same magnetising field when cooled ? How does a diamagnetic substance respond to similar temperature changes ?

View Text Solution

9. Show diagrammatically the behaviour of magnetic field lines in the presence of (i) paramagnetic and (ii) diamagnetic substances. How does one explain this distinguishing feature ?

View Text Solution

10. Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and the other having negative

susceptibility. What does negative susceptibility signify ?

View Text Solution

11. Out of the two magnetic materials, 'A' has relative permeability slightly greater than unity while 'B' has less than unity. Identify the nature of the materials 'A' and 'B'. Will their susceptibilities be positive or negative ?

View Text Solution

12. The susceptibility of a magnetic material is -2.6×10^{-5}. Identify the type of magnetic material and state its two properties.

View Text Solution

13. (a) Define the term magnetic susceptibility and write its relation in terms of relative magnetic permeability.

(b) Two magnetic materials A and B have relative magnetic permeabilities of 0.96 and 500. Identify the magnetic materials A and B.

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14. The susceptibility of a magnetic material is 0.9853. Identify the type of magnetic material. Draw the modification of the field pattern on keeping a piece of this material in a uniform magnetic field.

View Text Solution

15. The susceptibility of a magnetic material is -1.6×10^{-5}. Identify the type of the magnetic material and write its two properties.

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16. (a) How is an electromagnet different from a permanent magnet?

(b) Write two properties of a material which make it suitable for making electromagnets.

View Text Solution

17. Write two properties of a material suitable for making (a) a permanent magnet, and (b) an electromagnet.

View Text Solution

18. The horizontal component of the earth's magnetic field at a place is $\frac{1}{\sqrt{3}}$ times its vertical component there. Find the value of the angle of dip at that place. What is the

ratio of the horizontal component to the total magnetic field of the earth at that place?

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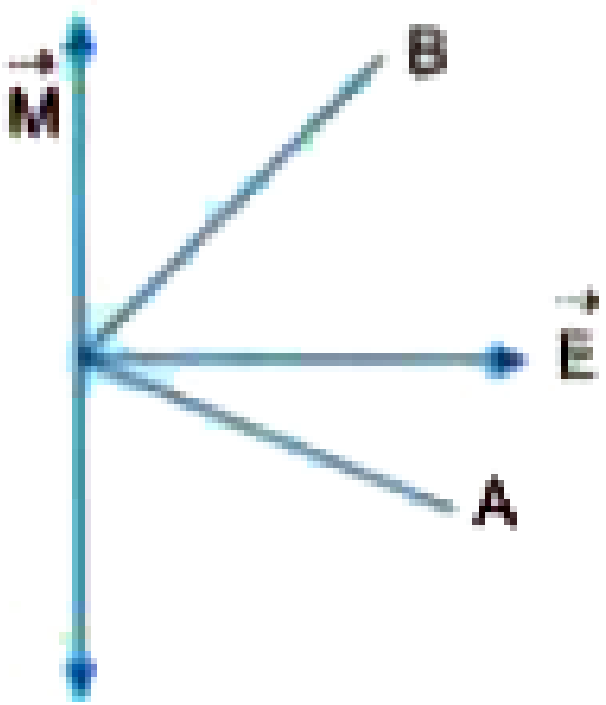
19. Figure shows the variation of intensity of magnetisation $\vec{M}$ versus the applied magnetic field intensity $\vec{H}$ for two materials A and B:

(a) Identify the materials A and B.

(b) Why does the material B, have a larger susceptibility than A for a given field at

constant temperature ?



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20. A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip down at 60° with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.4 G. Determine the magnitude of the earth's magnetic field at the place.

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21. (i) Write two characteristics of a material used for making permanent magnets.

(i) Why is core of an electromagnet made of ferromagnetic materials ?

View Text Solution

22. 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 its magnetic moment?

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Long Answer Questions I

1. A small compass needle of magnetic moment 'm' and moment of inertia 'I' is free to oscillate in a magnetic field 'B'. It is slightly disturbed from its equilibrium position and then released. Show that it executes simple

harmonic motion. Hence, write the expression for its time period.

View Text Solution

2. Show that the time period (T) of oscillations of a freely suspended magnetic dipole of magnetic moment (m) in a uniform magnetic field (B) is given by $T = 2\pi\sqrt{\frac{I}{mB}}$, where I is moment of inertia of the magnetic dipole.

View Text Solution

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

View Text Solution

4. What happens if an iron bar magnet is melted ? Does it retain its magnetism?

View Text Solution

5. 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?

View Text Solution

6. Must every magnetic field configuration have a north pole and a south pole ? What about the field due to a toroid ?

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7. Can you think of a magnetic field configuration with three poles ?

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8. 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). 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 two bars A and B]

View Text Solution

9. Name three elements required to specify the earth's magnetic field at a given place. Draw a labelled diagram to define these elements. Explain briefly how these elements are determined to find out the magnetic field at a given place on the surface of earth.

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10. Define the following using suitable diagrams :

(i) Magnetic declination, and (ii) angle of dip.

In what direction will a compass needle point when kept at the (i) poles , and (ii) equator ?

View Text Solution

11. (a) State Gauss's law for magnetism. Explain its significance.

(b) Write the four important properties of the magnetic field lines due to a bar magnet.

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12. A short bar magnet placed with its axis inclined at 30° to the external magnetic field of 800 G acting horizontally experiences torque of 0.016 Nm. Calculate :

(i) the magnetic moment of the magnet.

(ii) the work done by an external force in moving it from most stable to most unstable

position.

(iii) what is the work done by the force due to the external magnetic field in the process mentioned in (ii)?

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13. A bar magnet of magnetic moment 6 J/T is aligned at 60° with a uniform external magnetic field of 0.44 T. Calculate (a) the work done in turning the magnet to align its magnetic moment (i) normal to the magnetic

field, (ii) opposite to the magnetic field, and (b) the torque on the magnet in the final orientation in case (ii).

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14. A uniform magnetic field gets modified as shown in Fig. when two specimens X and Y are placed in it.

(i) Identify the two specimens X and Y.

(ii) State the reason for the behaviour of the

field lines in X and Y.

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15. Name the three types of magnetic materials which behave differently when placed in a non uniform magnetic field. Give two properties for each of them.

View Text Solution

16. If X stands for the magnetic susceptibility of a given material, identify the class of materials for which

(i) $-1 \leq X < 0$, (ii) $0 < X < \varepsilon$ (ε stands for a small positive number).

(a) Write the range of relative magnetic permeability of these materials.

(b) Draw the pattern of the magnetic field lines when these materials are placed in an external magnetic field.

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17. Three identical specimens of magnetic maerials , uniform magnetic field. Draw the modification in the field lines in each case. Justify your answer.

View Text Solution

18. Explain the phenomenon of hysteresis in magnetic materials.

View Text Solution

19. What are permanent magnets ? What is an efficient way of preparing a permanent magnet ? Write two characteristic properties of materials which are required to select them for permanent magnets.

View Text Solution

20. What is the difference between an electromagnet and a permanent magnet ? How is an electromagnet designed ? State any

two factors on which the strength of an electromagnet depends.

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Long Answer Questions Ii

1. (a) A small compass needle of magnetic moment 'm' is free to turn about an axis perpendicular to the direction of uniform magnetic field 'B'. The moment of inertia of the needle about the axis is 'I'. The needle is

slightly disturbed from its stable position and then released. Prove that it executes simple harmonic motion. Hence, deduce the expression for its time period .

(b) A compass needle , free to turn in a vertical orients itself with its axis vertical at a certain place on the earth . Find out the values of (i) horizontal component of earth's magnetic field and (ii) angle of dip at the place.

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2. Distinguish the magnetic properties of dis-para and ferro-magnetic substance in terms (i) susceptibility, (ii) magnetic permeability , and (iii) coercicity. Give one example of each these materials.

Draw the field lines due to an external magnetic field near a (i) diamagnetic , (ii) paramagnetic substance.

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Self Assessment Test Section A Multiple Choice Questions

1. Which of the following is weakly repelled by a magnetic field ?

A. Iron

B. Cobalt

C. Copper

D. Nickel

Answer: C

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2. A bar magent AB with magnetic moments $\vec{m}$ is cut into two equal parts perpendicular to its axis. One part is kept over the other so the end B is exactly over A. The magnetic moment of the combination formed in this manner is

A. zero

B. $\frac{\vec{m}}{2}$

C. $\vec{m}$

D. $2\vec{m}$

Answer: A

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3. The value of the magnetic suseptibility for a superconductor is

A. zero

B. infintiy

C. $+1$

D. -1

Answer: D

View Text Solution

4. Magnetic susceptibility of a paramagnetic material is x at a termperature of 27° C . At what temperature will its susceptibility be 1.5 x ?

A. $13.5^\circ C$

B. $200^\circ C$

C. $-73^\circ C$

D. $+73^{\circ}C$

Answer: C

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5. The dipole moment of a short bar magnet is 1.25 A m^2 . The magnetic field $\vec{B}$ on its axis at a distance of 0.5 m from the centre of magnet has a magnitude.

A. $1.0 \times 10^{-4} T$

B. $4 \times 10^{-2} T$

C. $2 \times 10^{-6} T$

D. $6.64 \times 10^{-8} T$

Answer: C

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Self Assessment Test Section A Fill In The Blanks

1. The ability of a material to retain magnetism even after removal of the magnetising field is

known as _____ ,

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2. Potential energy of a magnetic dipole of dipole strength $\vec{m}$ placed in a uniform magnetic field $\vec{B}$ is given as _____

View Text Solution

Self Assessment Test Section B

1. A magnetic dipole is under the influence of two magnetic fields. The angle between the field directions is 60° , and one of the fields has a magnitude of 1.2×10^{-2} T. If the dipole comes to stable equilibrium at an angle of 15° with this field, what is the magnitude of the other field ?

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Self Assessment Test Section C

1. A closely wound solenoidof 2000 turns and area of cross- section $1.6 \times 10^{-4} m^2$, carrrying a current 4.0 A, is suspended through its centre allowing it to turn in a horizontal plane.

(a) What is the magnetic moment associated with the solenoid ?

(b) What is the force and torque on teh solenoid if a uniform horizontal magnetic field . 7.5×10^{-2} T is set up at an angle of 30° with the axis of solenoid ?

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Self Assessment Test Section D

1. (a) Name three elements required to specify the earth's magnetic field at a given place. Draw a labelled diagram to define these elements . Explain briefly how these elements are determined to find out the magnetic field at a given place on the surface of earth.

(b) A short bar magnet of magnetic moment m = $0.32JT^{-1}$ 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 ?

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