	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**Department: SCIENCE 2026– 27** **SUBJECT: PHYSICS**	**Date: 08/05/2026**
Worksheet No: 5 **WITH ANSWERS**	**CHAPTER / UNIT:** **MAGNETISM AND MATTER**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.:**

OBJECTIE TYPE QUESTIONS

1. The magnetic field due to a small magnetic dipole of dipole moment at a distance from the centre along the axial line is given by:
   A) $\frac{\mu_0}{4\pi} \times \frac{2M}{r^3}$
   B) $\frac{\mu_0}{4\pi} \times \frac{M}{r^3}$
   C) $\frac{\mu_0}{4\pi} \times \frac{M}{2r^3}$
   D) $\frac{\mu_0}{4\pi} \times \frac{2M}{r^2}$
2. A diamagnetic substance like Bismuth is brought near the North pole of a strong bar magnet. The substance will experience:
   A) A strong force of attraction
   B) A weak force of attraction
   C) A weak force of repulsion
   D) No magnetic force at all
3. Which of the following materials is pushed out (repelled) when placed in a non-uniform magnetic field?
   A) Aluminium
   B) Sodium Chloride
   C) Iron
   D) Platinum
4. A bar magnet is initially at right angles to a uniform magnetic field. If the magnet is rotated until the torque acting on it becomes one-half of its initial value, the angle through which it has been rotated from its initial position is:
   A) 30^0
   B) 45^0
   C) 60^0
   D)90^0
5. If a paramagnetic sample like Aluminium is placed in a non-uniform magnetic field, it will tend to move:
   A) From stronger to weaker parts of the field
   B) From weaker to stronger parts of the field

C) In a direction perpendicular to the field
D) It will remain stationary

6. The magnetic susceptibility of a diamagnetic substance is:
A) Small and positive
B) Large and positive
C) Small and negative
D) Large and negative
7. The relative permeability of a material is 0.999. The material is likely to be:
A) Ferromagnetic
B) Paramagnetic
C) Diamagnetic
D) Non-magnetic
8. The magnetic field strength at a point on the equatorial line of a short bar magnet is B. The field strength at the same distance on the axial line will be:
A) B/2
B) B
C) 2B
D) 4B
9. At the Curie temperature, a ferromagnetic material becomes:
A) Diamagnetic
B) Paramagnetic
C) A superconductor
D) Non-magnetic
10. Which of the following is a characteristic property of a ferromagnetic material?
A) It is weakly repelled by magnets
B) It has a small positive susceptibility
C) It can retain magnetism even after the external field is removed
D) Its susceptibility is independent of temperature

ASSERTION - REASON BASED QUESTIONS

Direction: - In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true, but reason is false.
(d) If both assertion and reason are false.

11. Assertion (A): When a ferromagnetic substance is heated to a high temperature, it becomes paramagnetic in nature. CBSE 2025-26
Reason (R): The disappearance of magnetisation of a ferromagnet is abrupt and not gradual.
12. Assertion (A): Diamagnetic substances develop induced magnetism in a direction opposite to the applied magnetic field.
Reason (R): Diamagnetic materials are attracted by the poles of a strong magnet.
13. Assertion (A): The magnetic field lines of a bar magnet form continuous closed loops.
Reason (R): Magnetic monopoles do not exist.
14. Assertion (A): Aluminium is a paramagnetic material.
Reason (R): Paramagnetic materials exhibit weak magnetism only in the presence of an external magnetic field.
15. Assertion (A): The magnetic susceptibility of a diamagnetic substance is independent of temperature.

Reason (R): Diamagnetism is a universal property of all atoms but is often masked by para or ferromagnetism.

CASE STUDY BASED QUESTIONS: -

Magnetisation and Magnetic Intensity

When the atomic dipoles are aligned partially or fully, there is a net magnetic moment in the direction of the field in any small volume of the material. The actual magnetic field inside material placed in magnetic field is the sum of the applied magnetic field and the magnetic field due to magnetisation. This field is called magnetic intensity (H).

$$H = \frac{B}{\mu_0} - M$$

where M is the magnetisation of the material, μ_0 is the permittivity of vacuum and B is the total magnetic field. The measure that tells us how a magnetic material responds to an external field is given by a dimensionless quantity is appropriately called the magnetic susceptibility : for a certain class of magnetic materials, intensity of magnetisation is directly proportional to the magnetic intensity.

16. i. Magnetization of a sample is

(a)volume of sample per unit magnetic moment (b) net magnetic moment per unit volume

(c) ratio of magnetic moment and pole strength (d) ratio of pole strength to magnetic moment

ii. Identify the wrongly matched quantity and unit pair.

(a) Pole strength - Am

(b) Magnetic susceptibility – dimensionless number

(c) Intensity of magnetization – Am^{-1}

(d) Magnetic permeability - Henry m

iii. A bar magnet has length 3cm, cross-sectional area 2cm2 and magnetic moment 3 Am2. The intensity of magnetization of the bar magnet is

(a) 2×10^5 A/m (b) 3×10^5 A/m

(c)4×10^5 A/m (d) 5×10^5 A/m

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

(a) 2.5×10^3 A/m (b) 2.5×10^5 A/m

(c) 2.0×10^3 A/m (d) 2.0×10^5 A/m

v. The relative permeability of iron is 6000. Its magnetic susceptibility is

(a) 5999 (b)6001

(b) 6000×10^{-7} (c) 6000×10^{-7}

17. Diamagnetism is a fundamental property of all matter, though it is often masked by stronger para or ferromagnetic effects. Diamagnetic substances develop induced magnetism in a direction opposite to the applied field, leading to weak repulsion. A spectacular manifestation of diamagnetism is found in superconductors. When certain materials are cooled below a critical temperature, they exhibit zero electrical resistance and become "perfect diamagnets." This phenomenon, known as the Meissner Effect, involves the total expulsion of magnetic flux lines from the interior of the superconductor. This property allows for advanced applications such as magnetic levitation (Maglev) in high-speed trains.

i. A superconductor, when cooled below its critical temperature, behaves as a perfect diamagnet. This means that inside the superconductor:

(A) Magnetic susceptibility $\chi = +1$ and relative permeability $\mu_r = 0$

(B) Magnetic susceptibility $\chi = 0$ and relative permeability $\mu_r = 1$
(C) Magnetic susceptibility $\chi = -1$ and relative permeability $\mu_r = 0$
(D) Magnetic susceptibility $\chi = -1$ and relative permeability $\mu_r = 1$

ii. The expulsion of magnetic flux lines from the interior of a superconductor, as described in the passage, is known as:
(A) Curie's Law
(B) Hysteresis effect
(C) Meissner Effect
(D) Hall Effect

iii. In Maglev trains, magnetic levitation is achieved using the diamagnetic (repulsive) property of superconductors. This levitation occurs because:
(A) The superconductor attracts the magnetic field of the track, pulling the train downward
(B) The superconductor allows magnetic field lines to pass through it freely, creating no net force
(C) The superconductor repels the external magnetic field, and the resulting force balances the weight of the train
(D) The superconductor becomes a permanent magnet and aligns with the Earth's magnetic field

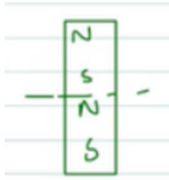
iv. Diamagnetic substances develop induced magnetism in a direction opposite to the applied field. This happens because:
(A) The individual atoms of a diamagnetic material possess a permanent magnetic dipole moment
(B) The magnetic moment induced due to the orbital motion of electrons opposes the applied field
(C) The domains align themselves parallel to the applied field
(D) The material has unpaired electrons whose spins align with the field

SHORT ANSWER TYPE QUESTIONS (2 marks)

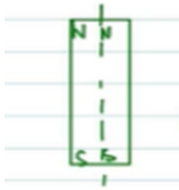
18. Which orientation of a magnetic dipole in a uniform magnetic field will correspond to its stable equilibrium and unstable equilibrium?
19. Magnetic field arises due to charges in motion. Can a system have magnetic moments even though its net charge is zero?
20. If magnetic monopoles existed, how would Gauss's law of magnetism be modified?
21. Does a bar magnet exert a torque on itself due to its own field? Does an element of a current-carrying wire exert a force on another element of the same wire?
22. 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?

SHORT ANSWER TYPE QUESTIONS (3 marks)

23. (a) How does the (i) pole strength and (ii) magnetic moment of each part of a bar magnet change if it is cut into two equal pieces transverse to its length? [HOTS]



(b) How does the (i) pole strength and (ii) magnetic moment of each part of a bar magnet change if it is cut into two equal pieces along its length?



24. (a) What happens if a bar magnet is cut into two pieces: (i) transverse to its length, (ii) along its length?
   (b) Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?
   (c) 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 which one? [Use nothing else but the bars A and B.]
25. (a)Which of the following substances are paramagnetic?
   Bi, Al, Cu, Ca, Pb and Ni
   (b)Which of the following substances are diamagnetic?
   Bi, Al, Na, Cu, Ca and Ni
   (c)The susceptibility of a magnetic material is -4.2 × 10-6. Name the type of magnetic material it represents.
26. A piece of wire bent in the form of a circular loop A carries a current I. The wire is then bent into a circular loop B of two turns and carries the same current. The ratio of magnetic fields at the centre of loop A to that of loop B will be :

LONG ANSWER TYPE QUESTIONS (5 marks)

27. (a) State Gauss's law for magnetism. Explain its significance
   (b)Derive an expression for magnetic field intensity due to a magnetic dipole of a bar magnet at a point on its axial line.
28. (a)Write the four important properties of the magnetic field lines due to a bar magnet.
   (b)Derive an expression for the magnetic field intensity due to a magnetic dipole of a bar magnet at a point that lies on its equatorial line.
29. (a) Write an expression for the magnetic field intensity at a point on the equatorial line of a bar magnet.
   (b) A bar magnet of magnetic moment 1.5 J/T1.5 J/T lies aligned with the direction of a uniform magnetic field of 0.22 T0.22 T. What is the amount of work required by an external torque to turn the magnet to align its magnetic moment opposite to the field direction?

	ANSWER KEY
1	**A)** $\frac{\mu_0}{4\pi} \times \frac{2M}{r^3}$
2	C) A weak force of repulsion
3	B) Sodium Chloride
4	C) 60^0
5	B) From weaker to stronger parts of the field
6	C) Small and negative
7	C) Diamagnetic
8	C) 2B
9	B) Paramagnetic
10	C) It can retain magnetism even after the external field is removed
11	B) Both A and R are true, but R is not the correct explanation. (The explanation is thermal agitation disrupting domain alignment).

12	C) Assertion is true, but Reason is false (Diamagnetic materials are repelled).
13	A) Both A and R are true, and R is the correct explanation (Monopoles don't exist, so lines must return to the source).
14	A) Both A and R are true, and R is the correct explanation.
15	B) Both A and R are true, but R is not the explanation for temperature independence (which is due to paired electrons).
16	**(i) (b)** **(ii) (d):** Magnetic permeability - Henry m^{-1}. **(iii) (d):** Given, $l = 3$ cm, $A = 2$ cm^2, $M = 3$ A m^2 Intensity of magnetisation $= \frac{M}{lA} = \frac{3}{3\times10^{-2}\times2\times10^{-4}}$ $= \frac{1}{2\times10^{-6}} = 0.5\times10^6 = 5\times10^5$ A/m **(iv) (b):** Here, $n = 500$ turns/m $I = 1$ A, $\mu_r = 500$ Magnetic intensity, $H = nI = 500\ m^{-1}\times 1\ A = 500\ A\ m^{-1}$ As $\mu_r = 1 + \chi$ or $\chi = (\mu_r - 1)$ Magnetisation, $M = \chi H$ $= (\mu_r - 1)H = (500 - 1)\times 500\ A\ m^{-1}$ $= 2.495\times10^5\ A\ m^{-1} \approx 2.5\times10^5\ A\ m^{-1}$ **(v) (a):** Relative permeability of iron, $\mu_r = 6000$ Magnetic susceptibility $\chi_m = \mu_r - 1 = 5999$.
17	i. (C) Magnetic susceptibility $\chi = -1$ and relative permeability $\mu_r = 0$ ii. (C) Meissner Effect iii. (C) The superconductor repels the external magnetic field, and the resulting force balances the weight of the train iv. (B) The magnetic moment induced due to the orbital motion of electrons opposes the applied field
18	In stable equilibrium, the dipole moment vector and the magnetic field vector are in the same direction. In unstable equilibrium, the dipole moment vector and the magnetic field vector are in the opposite direction.
19	A system can have a magnetic moment even though its net charge is zero. It is because the average charge of a system may be zero, but it is not necessary that magnetic moments due to various current loops will also be zero. For example, a neutron has zero charge, but possesses a non-zero magnetic moment.
20	Gauss's law of magnetism states that the flux of B through any closed surface is always zero $\oint B \cdot ds = 0$. If the monopole existed, then Gauss's law would have been $\oint B.ds = \mu 0 qm$ where qm is magnetic charge (monopole) enclosed by the surface.
21	No. There is no force or torque on an element due to the field produced by that element itself. But there is a force (or torque) on another element of the same wire.
22	No force, if the field is uniform. The iron nail experiences a non-uniform field due to the bar magnet. There is an induced magnetic moment in the nail; therefore, it experiences both force and torque. The net force is attractive because the induced south pole (say) in the nail is closer to the north pole of the magnet than the induced north pole.
23	a. (i) The pole strength does not change. (ii) The magnetic moment reduces to half as the magnetic moment is proportional to

	length. (Here the length becomes half) b. (i) The pole strength becomes half. (ii) The magnetic moment becomes half as pole strength becomes half.
24	(a)In either case, one gets two magnets, each with a north and south pole. (b) According to Gauss's law, $\oint \vec{B} \cdot \vec{ds} = 0$, which is true for a as it has no ends. But, in the case of a solenoid, at each end the magnetic flux will not be zero if the magnetic field lines are entirely confined within the solenoid. (c) Let two bars be A and B. Now, bring one end of A near to B, and move it slowly (from one end to the middle). If the force experienced by bar A reduces as we move towards the middle, then bar B is magnetised, and A is not. If A experiences repulsion, then both the bars are magnetised.
25	(a) Al and Ca (b) Bi and Cu Diamagnetic.
26	The magnetic field at the centre of a coil is given by $B = \frac{\mu_0 n i}{2a} \Rightarrow B = \frac{\mu_0 i}{2a}$ For n=1 (turn) For n=2, a becomes $\frac{a}{2}$ $\therefore B. = \frac{\mu_0 \times 2 \times i}{2 \cdot a/2} = \frac{\mu_0 i}{2a} \cdot 4 = 4B.$
27	Refer notes
28	Refer notes
29	(a) $B_{eq} = \frac{\mu_0}{4\pi} \cdot \frac{M}{r^3}$ (b) $W = MB(\cos\theta_1 - \cos\theta_2) = 1.5 \times 0.22 \times (1 - (-1)) = 0.66 \text{ J}.$

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