

SUBJECT: PHYSICS

TOPIC: Magnetism

Pre-Content/content Post-Content	Learning outcomes/Objectives	
	General	Specific
PRE-CONTENT: Properties of magnets learnt in previous class, Current loop behaves like a magnetic dipole CONTENT Basic Properties of magnets and some important definitions connected with magnetism, Coulomb's current loop- a magnetic dipole magnetic dipole moment of a revolving electron Introduction, Artificial Magnets, Basic Properties of Magnets, Important terms connected with magnets, Coulomb's law of magnetic force, Magnetic Dipole and magnetic dipole moment ,Magnetic field intensity due to a magnetic dipole along the axis, perpendicular to its axis, torque on a magnetic dipole in magnetic field, PE of a magnetic dipole in magnetic field, Current loop as a magnetic dipole, Bar Magnet as an equivalent Solenoid, Gauss's theorem of magnetism Magnetic Field of Earth,origin of Earth's magnetic field and the simple pictorial representation,Some important terms related to Earth's magnetic field,The 'three elements' used for describing earth's magnetic field,their diagrammatic representation and mathematical relationship	Students will be able to recall that current loop behaves like a magnetic dipole calculate magnetic dipole moment of a revolving electron derive field due to bar magnet Identify the origin and features of magnetic field lines due to a bar magnet and a solenoid recognize features of earth's magnetic field	Students will be able to • find origin of term 'Magnetism' • list the properties of magnets • explain some important terms connected with magnetism • state Coulomb's law of magnetic force. • define unit magnetic pole • identify the magnetic dipole (bar magnet/current loop) to be the basic entity in magnetism • calculate magnetic dipole moment of a revolving electron • correlate with the corresponding expressions for an electric dipole,derive the expressions for the magnetic field intensity due to a magnetic dipole at a point along its axis and on its perpendicular axis • derive an expression for the torque on a magnetic dipole placed in a magnetic field • derive an expression for the potential energy of a dipole placed in magnetic field and find out the positions of stable and unstable equilibrium • interpret the concept and the properties of magnetic field lines. • justify why it is inappropriate to use the term 'lines of force' in place of 'field lines of a magnetic field., • state and interpret Gauss's theorem in magnetism • define the SI unit of magnetic moment through the above expression. • compare the magnetic field lines of the magnetic field of a long current carrying solenoid with bar magnet and conclude that it is an equivalent solenoid. • figure out the origin of Earth's magnetism and represent it diagrammatically depicting magnetic and geographic north and south poles of the earth and the magnetic equator and the geographic equator on it. • explain the 'three elements' for describing the magnetic field of the earth at a point on its surface and represent them diagrammatically and relate them mathematically • solve numerical on angle of dip

Teacher's Activity	Student's Activity	Teacher's observation and Remedial
Teacher will • facilitate students to recall that current loop behaves like a magnetic dipole and make them calculate magnetic dipole moment of a revolving electron. • make students recall electric field due to an electric dipole and ask students to calculate magnetic field due to a magnetic dipole at axial and equatorial points on similar lines • ask students to recall torque and PE of an electric dipole in electric field and will make students derive these parameters for magnetic dipole(bar magnet) in magnetic field • explain why a bar magnet can be regarded as an equivalent solenoid • explain the theories explaining cause of magnetic field of earth and define elements of earth's magnetic field using ICR	Students will • calculate magnetic dipole moment of a revolving electron • derive expression for magnetic field due to a bar magnet at axial and equatorial points on similar lines • derive expression for torque and PE of magnetic dipole(bar magnet) in uniform magnetic field • Draw magnetic field lines for a bar magnet and compare them with the lines due to a solenoid • Grasp and interpret the terms: horizontal component of the earth's magnetic field magnetic declination and 'angle of dip' or 'angle of inclination' and relate angle of dip to the components of the earth's magnetic field.	

Pre-Content/content Post-Content	Learning outcomes/Objectives	
	General	Specific
Magnetic Substances Classification of magnetic materials- some important terms used to describe Magnetic properties of materials- Magnetisation ,Magnetic Intensity, Permeability and susceptibility. Diamagnetism, Paramagnetism, Ferromagnetism(Origin and Properties)	Students will be able to classify magnetic materials	Students will be able to •explain the terms: 'horizontal component of the earth's magnetic field and its magnetic declination and 'angle of dip' or 'angle of inclination' •establish relationship between the elements of the earth's magnetic field. •explain Magnetic Intensity(H),Magnetic Induction(B), Magnetic flux(ϕ), magnetic permeability (μ)and the relative magnetic permeability (μ_r),Intensity of Magnetisation(I),Susceptibility(χ), and list the relations between the magnetic field (B), the magnetic intensity (H) and the magnetization (M) •explain the origin of term 'dia/para/ferromagnetism' and the range/order of magnitude of the values of χ, μ_r and μ for them. •list the basic properties of dia/para/ferromagnetic materials and list some of the common dia/para/ferromagnetics. •explain Curie's law for paramagnetics and list its limitations •explain Curie-Weiss law for ferromagnetic and list its limitations.and define of its curie temperature

Teacher's Activity	Student's Activity	Teacher's observation and Remedial
Teacher will enable students to classify various magnetic materials by introducing them to terms like-Magnetic Intensity(H), Magnetic Induction(B), Magnetic flux(ϕ), magnetic permeability (μ)and the relative magnetic permeability (μ_r), Intensity of Magnetisation(M), Susceptibility(χ). Enable students to observe the behaviour of magnetic materials experimentally. <u>(Annexure5A- attached at the end)</u>	Students will be made to tabulate the features of magnetic materials i.e magnetic susceptibility (χ), the relative magnetic permeability (μ_r) and Intensity of Magnetisation (M),.	

Pre-Content/content Post-Content	Learning outcomes/Objectives	
Hysteresis	General	Specific
	Students would be able to differentiate between permanent and electromagnet decide types of materials to be used for making electro magnets and permanent magnets	Students will be able to •explain the meaning of the terms hysteresis in ferromagnet. •plot the ‘magnetic hysteresis loop’ for a ferromagnetic material and interpret the significance of the area of loop •compare soft ferromagnet and hard ferromagnet. •describe the term ‘Electromagnet and list the factors affecting the strength of an electromagnet. • conclude that the hysteresis curve decides the nature of materials suitable for the core materials of electromagnets.List a few such materials along with their use. •explain the term Permanent Magnets and hysteresis curve of the materials suitable for making permanent magnet and list some such materials. •realize the uses of permanent magnets
Permanent Magnets and Electro Magnets Electromagnets, Factor affecting the strength of Electromagnets, Permanent Magnets		

Teacher's Activity	Student's Activity	Teacher's observation and Remedial
Teacher will • explain hysteresis loop and its role in deciding materials for temporary and permanent magnets • enable students to recall the construction of electromagnet and hence figure out the factors affecting the strength of Electromagnets • prepare assignment consisting of a variety of conceptual, numerical and previous years board problems and guide students to solve it <u>.(Annexure5B&5C- attached at the end)</u>	Students will • learn to interpret hysteresis loop hence decide the material suitable for preparing permanent and temporary magnets • list the factors affecting the strength of Electromagnets • solve the NCERT in text questions and back exercise. They will also solve the assignment consisting of a variety of conceptual ,numerical and previous years board problems.	

TEACHING AIDS: Textbooks, smart board, ICR., various types of magnets from the physics lab

METHODOLOGY/ INNOVATIVE METHODS: Activity based teaching, discussion method ,hands on experience

INTERDISCIPLINARY APPROACH-Geography-composition of earth and it's rotational motion deciding it's magnetic behaviour.Magnetism deflecting the solar winds which may have an adverse effect on the ozone layer

(Annexure5A ACTIVITY - Classification of materials-Dia-, Para-, Ferromagnetism

Subject	PHYSICS
Class	XII
Chapter/Unit	Magnetism
Topic	Classification of materials-Dia-,Para-,Ferromagnetism
Time	20min
Nature of Activity	Individual

What will I learn (Learning Outcome)?

Classification of materials as per their behavior in magnetic field-Dia-,Para-,Ferromagnetism

Skills:

Experimenting, observing, analyzing, interpreting

What I have to do?

To observe the behavior of dia-,para- and ferromagnetic materials in magnetic field

What do I require?

A small disposable glass filled with water and mounted on a piece of thermocol, Aluminum foil circular disc mounted vertically on a piece of thermocol, a small iron nail placed on a piece of thermocol, A small wooden cylindrical piece mounted on a piece of thermocol, A rectangular tray filled with water, a strong magnet,

What do I need to know?

Classification of materials as per their behavior in magnetic field as dia, para , ferromagnetic materials

➤ **Teacher's Activity**

Teacher will

- Make students recall the behavior of materials in magnetic field and the reason for the same and based on it they are classified as- dia-, para- , ferromagnetic materials.
- facilitate students to perform a simple activity to make them observe the materials (dia-, para- and ferro-) responding differently to the magnetic field as per their nature

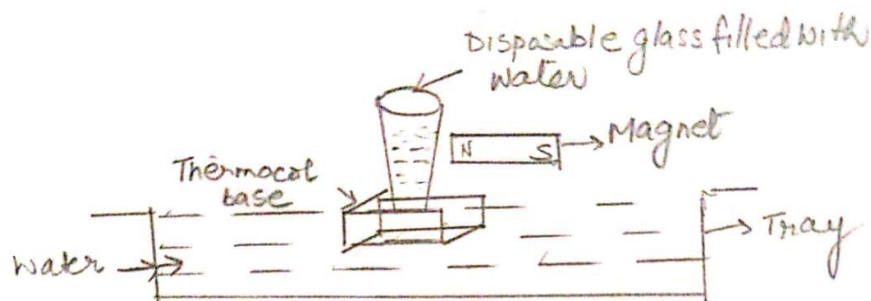
How will I proceed?

➤ Student's Activity

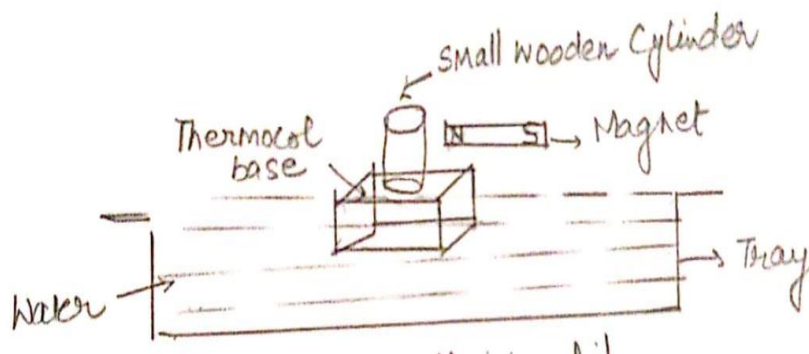
Students will

- Place a tray filled with water on a flat surface and place one after the other (in turn) the following on the surface of water and observe their behavior in the magnetic field by bringing a strong magnet close to them

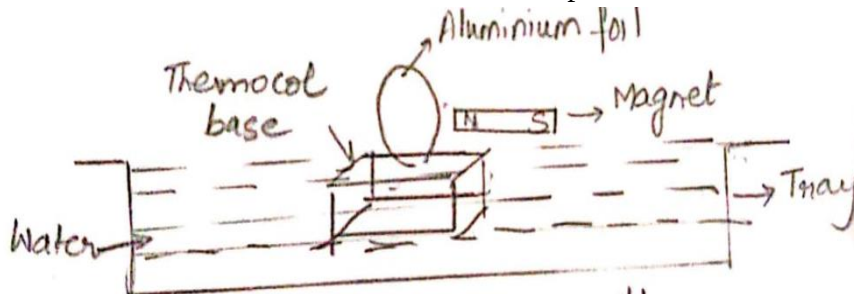
(a) a small disposable glass filled with water and mounted on a piece of thermocol



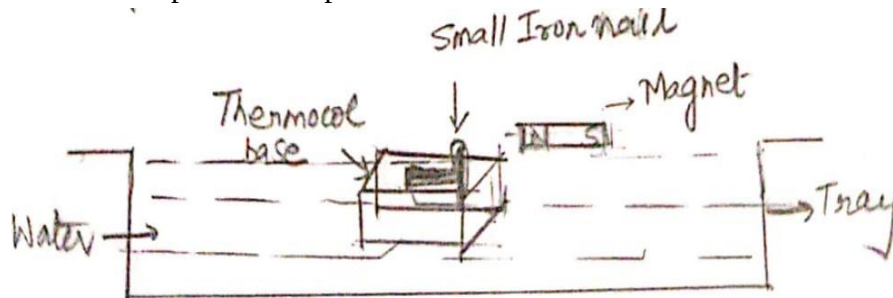
(b) A small wooden cylindrical piece mounted on a piece of thermocol



(c) Aluminum foil circular disc mounted on a piece of thermocol



(d) a small iron nail placed on a piece of thermocol



- enter your observations in the following table

What have I observed?

S. No.	When the following are placed on the surface of water in the tray, in the magnetic field produced by a strong magnet	Observation-The piece of thermocol with the object placed on it	Nature of material placed on the thermocol (Dia/Para/Ferromagnetic)
1	(a) a small disposable glass filled with water and mounted on a piece of thermocol	moves----- (away from/towards) the magnet	
2	(b) A small wooden cylindrical piece mounted on a piece of thermocol	moves----- (away from/towards) the magnet	
3	(c) Aluminum foil circular disc mounted on a piece of thermocol	moves----- (away from /towards) the magnet	
4	(d) a small iron nail placed on a piece of thermocol	moves----- (away from /towards) the magnet	

What have I learnt?

All materials around us are diamagnetic by nature ,however the materials which display para/ferromagnetism,in them the diamagnetic behaviour is dominated by para/ferromagnetism
 ----- (Dia/Para/Ferromagnetic) materials are feebly repelled by the magnet due to the presence of----- (paired/unpaired) valence electrons --
 ----- (Dia/Para/Ferromagnetic) materials are feebly attracted by the magnet due to presence of----- (paired/unpaired) valence electrons in their constituent atoms
 ----- (Dia/Para/Ferromagnetic) materials are strongly attracted by the magnet, due to presence of----- (paired/unpaired) valence electrons in their constituent atoms

What am I curious to learn?

Why is ferromagnetism a rare phenomenon?

Let me evaluate myself

Q1 Why are all pieces of iron not magnet even though iron is a ferromagnetic material

Q2 Distinguish between diamagnetic and ferromagnetic substances in respect of (i) intensity of magnetization (ii) behavior in a non-uniform magnetic field (iii) susceptibility

Q3 Draw diagrams to depict the behavior of magnetic field lines near a 'bar' of (i)copper(ii) aluminum (iii)mercury cooled to a very low temperature (4.2K)

Q4 To which of the two –a polar dielectric or non-polar dielectric –does a paramagnetic material correspond? Justify your answer

Q5 Magnetic field lines show direction at every point which a small magnetized needle takes up at that point? Is it justified to call them lines of force?

.(Annexure5B) Magnetism and Matter(Direct Questions)

1. a) Compare and contrast the following
 - (i) Magnetic field and Electric field
 - (ii) Magnetic field lines and Electric field linesb) State and explain Gauss's Theorem of Magnetism and state its significance
2. a) A current loop behaves as a magnetic dipole obtain its magnetic dipole moment and state the rule to find its direction. Derive the expression for magnetic dipole moment of a revolving electron
3. a) State Coulomb's law of magnetic force and hence define a unit magnetic pole
b) Derive the expression for magnetic field intensity due to a magnetic dipole (bar magnet) (i) along its axis and (ii) perpendicular to its axis. Specify the direction of magnetic field in both the cases
4. Derive the expression for
 - (i) Torque experienced by a magnetic dipole placed in the uniform magnetic field and hence define magnetic dipole moment and its SI unit
 - (ii) Potential energy of a magnetic dipole placed in the uniform magnetic field. Discuss the positions of stable and unstable equilibrium
5. Show that bar magnet is equivalent to a solenoid. Sketch magnetic field lines for both the cases
6. Explain the following terms associated with earth's magnetic field.
 - (i) Magnetic axis (ii) geographic axis (iii) Magnetic meridian (iv) geographic meridian
7. Name and explain the three elements of earth's magnetic field with the help of suitable diagram. Establish the relationship among them.
8. a) Explain the following terms and also mention their units and dimensions
 - (i) Magnetising Field (ii) Magnetic Induction (iii) Intensity of Magnetising Field (iv) Intensity of Magnetisation (v) Permeability (vi) Relative Permeability (vii) Magnetic Susceptibilityb) Establish the relationship between magnetic permeability and magnetic susceptibility
9. Explain why do substances show Ferro, Para and Dia magnetic behaviour. Explain their origin on the basis of electronic theory
10. State and explain Curie's law of Paramagnetism
11. Explain domain theory of Ferromagnetism and State and explain Weiss-Curie's law (modified Curie's law) of Ferromagnetism. Define Curie point
12. State in tabular form the properties of Ferro, Para and Dia magnetic substances
13. Explain Hysteresis curve and hence define the term retentivity and coercivity
14. Out of steel and iron, which material is chosen for making Permanent Magnet and Electromagnet and transformer cores? why?
15. Distinguish between soft and hard ferromagnets.

