



Student Learning Outcomes

After completing this chapter, students will be able to:

- Describe the forces between magnetic poles and between magnets and magnetic materials [Including the use of the terms north pole (N pole), south pole (S pole), attraction and repulsion, magnetised and unmagnetised]
- Describe induced magnetism
- Differentiate between temporary and permanent magnets.
- Describe magnetic fields [as a region in which a magnetic pole experiences a force]
- State that the direction of the magnetic field at a point is the direction of the force on the N pole of a magnet at that point
- State that the relative strength of a magnetic field is represented by the spacing of the magnetic field lines
- Describe uses of permanent magnets and electromagnets
- Explain qualitatively in terms of the domain theory of magnetism how materials can be magnetised and demagnetise [stroking method, heating, orienting in north-south direction and striking, use of a solenoid]
- Differentiate between ferromagnetic, paramagnetic and diamagnetic materials [by making reference to the domain theory of magnetism and the effects of external magnetic fields on these materials]
- Analyse applications of magnets in recording technology [and illustrate how electronic devices need to be kept safe from strong magnetic fields]
- State that soft magnetic materials (such as soft iron) can be used to provide shielding from magnetic fields.

Subject Questions & Answers

8.1

Magnetic Materials

Q.1. What are magnetism and magnetic materials?

Ans. Magnetism is a force that acts at a distance upon magnetic materials, These materials are attracted to magnets. These materials are called magnetic materials.

Examples: Iron, Nickel and Cobalt.

Q.2. Give some properties of magnet.

Ans. The magnets also exhibit the following properties:

Properties:

1. Magnetic Poles:

Working: If a bar magnet is suspended horizontally through a string and allowed to come to rest, it will point in north-south direction.

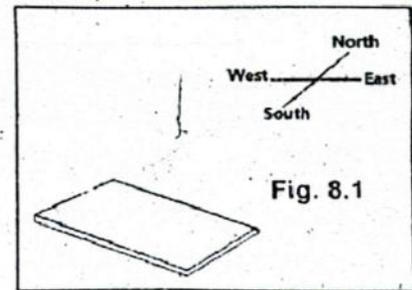


Fig. 8.1

North-Magnetic Pole (N): The end of the magnet that points north is called the north magnetic pole (N).

South Magnetic Pole (S): The end that points south is the

2. Attraction and repulsion of magnetic poles:

Repulsion: When two freely suspended bar magnets are placed close to each other, the two north poles will repel each other, So will the two south poles.

Attraction: If the north pole of one is placed near the south pole of the other, the poles will attract.

Thus, we can say that like poles repel and unlike poles attract.

3. Identification of a magnet:

The repulsion between the like poles is a real test to identify a magnet.

Working purpose for Identification: An object is a magnet or simply a magnetic material, we can bring its one end close to any pole of a suspended. It is attracted, then we can conclude that the end of the object is either of opposite pole to that of the suspended magnet or it is simply a magnetic material. Then we should bring the same end of the object close to the other end of the suspended magnet. If the object is again attracted, it is not a magnet but it is a magnetic material. If it is repelled by the other end of the suspended magnet, then the object is a magnet.

4. Isolated Magnetic Pole:

If we break a bar magnet into two equal pieces, can we get N-pole and S-pole separately? No, it is not possible. Each piece will have its two poles, i.e., N-Pole and S-Pole. Even if a magnet is divided into thousands pieces, each piece will be a complete magnet with its N and S-poles (Fig. 8.6)

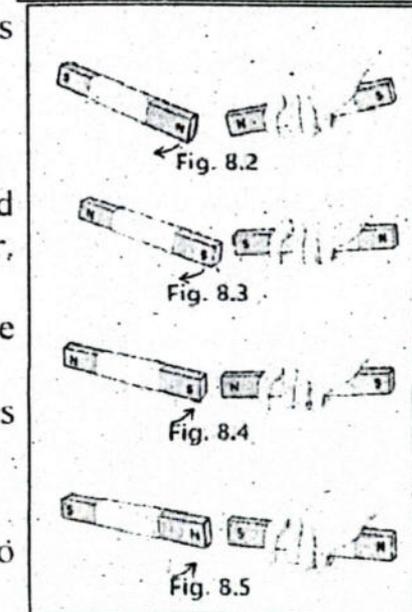


Fig. 8.5

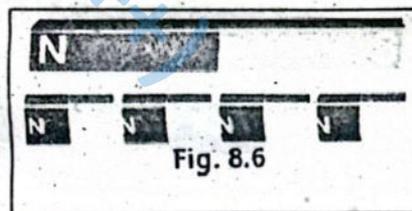


Fig. 8.6

Q.3. Define induced magnetization.

Ans. Induced Magnetism: Magnetic material such as iron or steel can be made a magnet. This is known as magnetization. In other words we can say that magnetism has induced in it.

Q.4. What are temporary and Permanent Magnets?

Ans. Temporary Magnets: Temporary magnets are the magnets that work in the presence of a magnetic field of permanent magnets. Once the magnetic field vanishes, they lose their magnetic properties. Electromagnets are also good examples

Examples: Usually, soft iron is used to make temporary magnets. Paper clips, office pins and iron nails can easily be made temporary magnets.

Permanent Magnets: Permanent magnets retain their magnetic properties forever. These are either found in nature or artificially made by placing objects made of steel and some special alloys in a strong magnetic field for a sufficient time.

Four Main Types: There are many types of permanent magnetic materials. For example cobalt, alnico and ferrite.

Q.5. What is magnetic fields? And how the magnetic lines of force is produce?

Ans. Magnetic field: A magnetic field is the region around a magnet where an other magnetic object experiences a force on it.

Explanation: When a magnet attracts a certain magnetic material, it exerts some force to do so. Similarly, when it attracts or repels a magnetic pole of another magnet, it exerts a force on it. This force can be observed up to a certain distance from the magnet.

Magnetic Field Pattern: The pattern of a magnetic field around a bar magnet can be seen very easily by a simple experiment.

Experiment: If iron filings are sprinkled on a thin glass plate placed over a bar magnet, the filings become tiny magnets through magnetic induction. Now if the glass surface is gently tapped, the filings form a pattern. This is the magnetic field pattern.

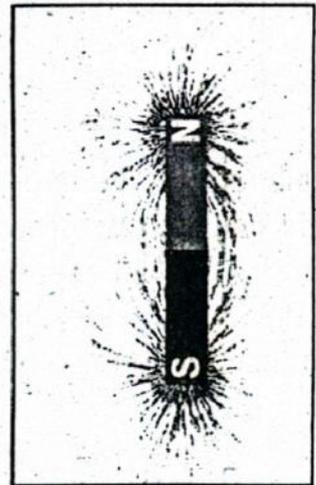


Fig. 8.7

Pattern show better: The pattern can be better shown by lines that correspond to the path of the filings. These lines are called magnetic lines of force.

Magnetic Lines of Force:

Definition: The direction of the magnetic field at any point in space is the direction indicated by the N-pole of a magnetic compass needle placed at that point.

Production: The magnetic lines of force around a bar magnet can be drawn by using a small compass. The needle of the compass will move along the magnetic lines of force.

Fig. 8.8 shows the magnetic lines of force around a bar magnet drawn by this method. The compass needle is symbolized by an arrow being the north pole.

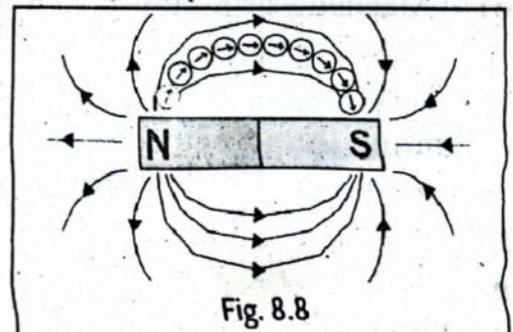
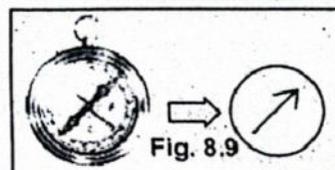


Fig. 8.8

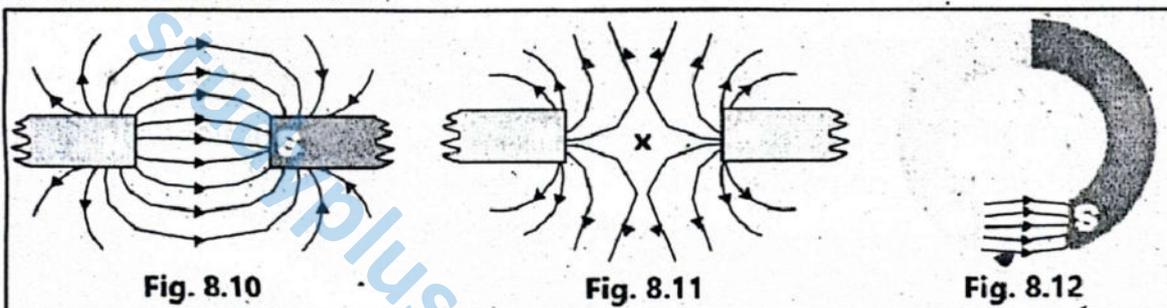
Note: The magnetic field at a point has both a magnitude and a direction. The field lines appear to originate from the north pole and end on the south pole.



Q.6. State and explain strength of magnetic field.

Ans. Strength of magnetic field: The strength of the magnetic field is proportional to the number of magnetic lines of force passing through unit area placed perpendicular to the lines. Thus, the magnetic field is stronger in regions where the field lines are relatively close together and weaker where these are far apart.

Example: The lines are closest together near north and south poles indicating that the strength of the magnetic field is stronger in these regions. Away from the poles, the magnetic field becomes weaker.



Explanation: The two magnets are placed close to each other, their combined magnetic field can also be drawn by using the compass needle. Fig. 8.10 and fig. 8.11 show the patterns of the combined magnetic field of two magnets lying with different orientations. In Fig. 8.11, point x is called a neutral point because the field due to one magnet cancels out that due to the other magnet.

Figure 8.12 represents the field pattern of a horse-shoe magnet. The field is almost uniform between the poles except near the edges.

8.6

Uses of Permanent Magnets

Q.7. Write some uses of permanent magnets.

Ans. Uses: There are many uses of permanent magnet such as:

- They are the essential parts of DC motors, AC and DC electric generators.
- Permanent magnets are used in the moving coil loud-speakers.
- These are very commonly used in door catchers.
- Magnetic strips are fitted to the doors of refrigerators and freezers to keep the door closed tightly.
- They are commonly used to separate iron objects from different mixtures. Flour-mills use permanent magnets to remove iron nails etc. from the grains before grinding.
- In the medical field, they are used to remove iron splinters from the eyes.
- A piece of permanent magnet is used to reset the iron pointer in a maximum and minimum thermometer.

Q.8. Write some applications of permanent magnets.

Ans. 1. A.C generator:

Principle: AC is made to pass through the coil between the poles of permanent magnet, it starts rotating.

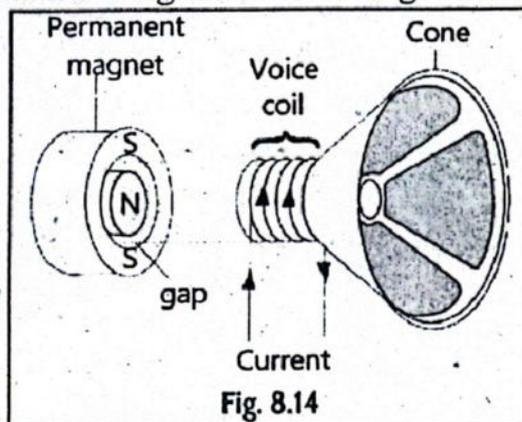
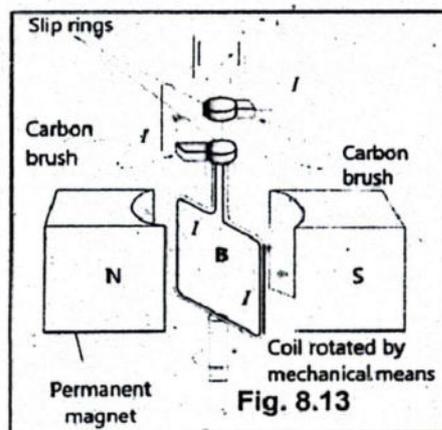
Working: When a coil is rotated between the poles of a permanent magnet, the magnetic field through the coil changes and an emf is induced between the ends of the coil. On connecting these ends to an external circuit, an alternating current (AC) flows through the circuit.

2. Electric motor:

Electric motor is the reverse process of electric generator.

3. Moving Coil Loudspeaker Working: AC interacts with the magnetic field to generate a varying force that pushes and pulls on the voice coil and the attached cone. The cone vibrates back and forth to produce sound in the air.

Explanation: A voice coil attached to the cone of the speaker is slipped over one pole (N) of the radial permanent magnet as shown in fig.8.14. From a microphone or some other sound signals in the form of varying (AC) current passes through the voice coil that is inserted in the gap of permanent magnet.



8.7

Electromagnets

Q.9. What is electromagnets? Give it's some uses.

Ans. Electromagnets are also a kind of temporary magnets.

Electromagnets: An iron nail or a rod becomes a magnet when an electric current passes through a coil of wire around it. It is called an electromagnet.

Explanation: When an electric current passes through the coil of wire, magnetic field is produced inside the coil that magnetizes the iron nail. As we have observed, that the magnetic properties of an electromagnet are temporary, therefore iron object remains a magnet, as long as the electric current passes through the coil. When the current is stopped, it no longer remains a magnet.

Increase the number of cell we observe: If we increase the number of cells in the battery or increase the number of turns of the coil, we will observe that the strength of the magnetic field in each case increases. This will be indicated by the more number of clips held by the nail.

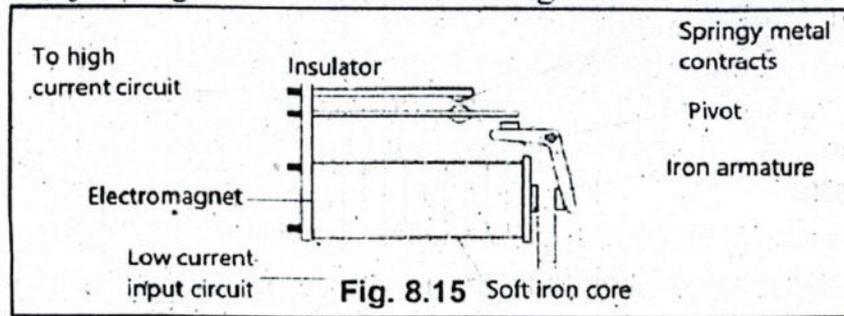
Uses of electromagnets: Electromagnets are used in electric bell, telephone receiver, simple magnetic relay, circuit breaker, reed switch, cranes, tape recorder, maglev trains and many other devices.

Q.10. Write a note on magnetic relay.

Ans. Magnetic Relay: This is a type of switch which works with an electromagnet.

Function: It is an input circuit which works with a low current for safety purpose. When it is turned ON it activates another circuit which works with a high current.

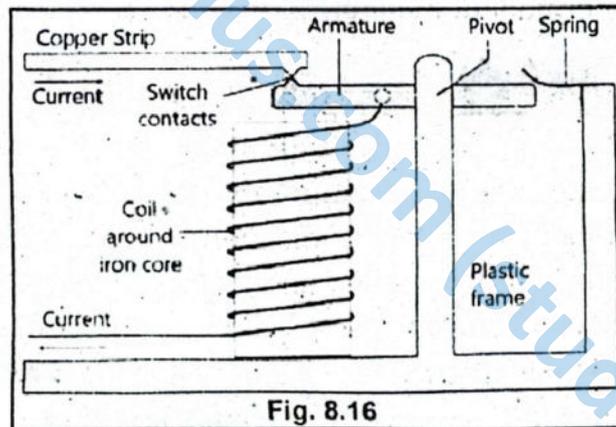
Working Process: The input circuit supplies a small current to electromagnet. It attracts the iron armature which is pivoted. The other end of the armature moves up and pushes the metal contacts to join together which turn the high current-circuit ON. (Fig. 8.15)



Q.11. Briefly explain circuit breaker.

Ans. Circuit Breaker: A circuit breaker is designed to pass a certain maximum current through it safely. If the current becomes excessive, it switches OFF the circuit. Thus, electric appliances are protected from burning.

Explanation: Inside a circuit breaker, the current flows along a copper strip, through the iron armature and coil of electromagnet. The electromagnet attracts the armature. If the current is large enough, the armature is detached from the copper strip and the circuit breaks.



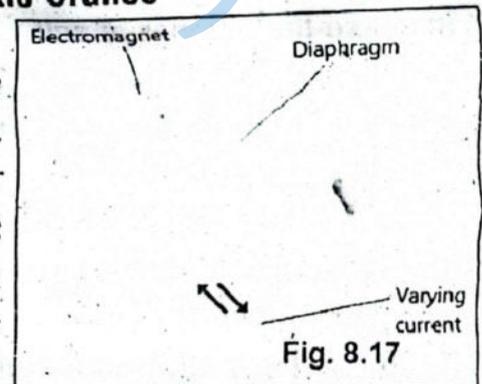
Q.12. Write a note on following:

1. Telephone Receiver

2. Electromagnetic Cranes

Ans. 1. Telephone Receiver

Working Process: There is an iron diaphragm in the receiver under which an electromagnet is placed Fig.8.17. The microphone of the telephone handset on the other side sends varying electric current in accordance with the sound signals. When the varying current passes through the coil of receiver on this side, it causes variation in the force of electromagnet. As a result, the diaphragm over it moves back and forth to produce sound.



2. Electromagnetic Cranes:

Huge Electromagnets: Huge electromagnets are used in cranes at scrapyards, steel works and on ships. These are so powerful that they can lift iron and steel objects such as cars.

Working: After moving the heavy objects to the required position, the objects are released by just switching OFF the current of the electromagnet.

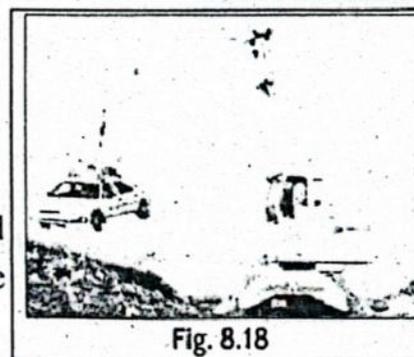


Fig. 8.18

8.8

Domain Theory of Magnetism

Q.13. Define and explain domain theory of magnetism.

Ans. Magnetic Domain: The materials in which large group of atoms of the order of 10^{16} have their electron spin naturally aligned parallel to each other are called ferromagnetic materials. These groups are called magnetic domains.

Explanation: It is observed that the magnetic field of a bar magnet is like the field produced by a solenoid (long coil of wire) carrying current (fig.819 a & b).

Suggest: It suggests that all magnetic effects are due to moving charges. In case of solenoid, charges are moving in the wire. The motion responsible for the magnetism in it is that of electrons within the atoms of the material,

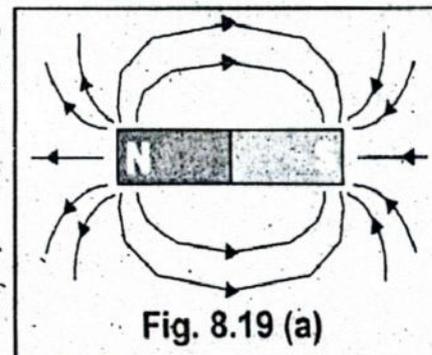


Fig. 8.19 (a)

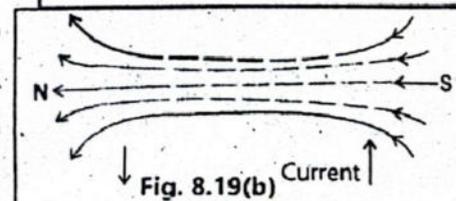


Fig. 8.19(b) Current ↑

Rotation and spin of electron: Electron is a charged particle. Also, each electron in an atom is revolving about the nucleus and at the same time, it is spinning about an axis through it. The rotation and spin both give rise to a magnetic field. Since there are many electrons in an atom, their rotations and spins may be so oriented to strengthen the magnetic effects mutually or to cancel the effects of one another.

magnetic dipole: If an atom has some resultant magnetic field, it behaves, like a tiny magnet. It is called a magnetic dipole.

Q.14. Define following terms.

1. Paramagnetic materials
2. Diamagnetic materials
3. Ferromagnetic materials

Ans. 1. Paramagnetic materials:

If the orbits and spin axes of the electrons in an atom are so oriented that their fields support one another and the atom behaves like a tiny magnet, the materials with such atoms are called paramagnetic materials.

Examples: Aluminium and lithium

2. Diamagnetic Substance Materials:

Magnetic fields produced by both orbital and spin motions of the electrons in an

atom may add up to Zero. In this case, the atom has no resultant field. The materials with such atoms are called diamagnetic materials.

Examples: Copper, Bismuth and Water

3. Ferromagnetic materials: There are some solid substances such as iron, steel, nickel, cobalt etc. in which cancellation of any type does not occur for large groups of neighbouring atoms of the order of 10^{16} because they have electron spins that are naturally aligned parallel to each other. These are known as ferromagnetic materials.

Example: Iron, Steel, Nickel and Cobalt

Q.15. Explain alignment of domain for ferromagnetic materials and non-ferromagnetic materials.

Ans. Alignment of domains:

(i) **Domain's alignment in Ferromagnetic Material:** The domains in a ferromagnetic material are randomly oriented as shown in Fig.8.20 (a). The magnetic fields of the domains cancel each other so the material does not display any magnetism. However, an unmagnetized piece of iron can be magnetized by placing it in an external magnetic field provided by a permanent magnet or an electromagnet.

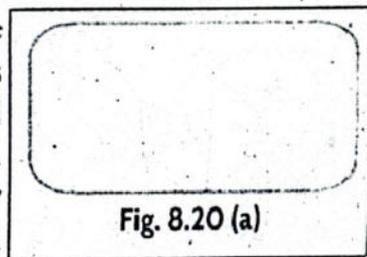


Fig. 8.20 (a)

(ii) **External Magnetic Field:** The external magnetic field penetrates the unmagnetized iron and induces magnetism in it by causing two effects on the domains. Those domains whose magnetism is parallel or nearly parallel to the external magnetic field grow in size at the expense of other domains that are not oriented.

Explanation: The magnetic alignment of the other domains rotates and become oriented in the direction of the external field (Fig.8.20b). As a result, the iron is magnetized and behaves like a magnet having its own north and south poles.

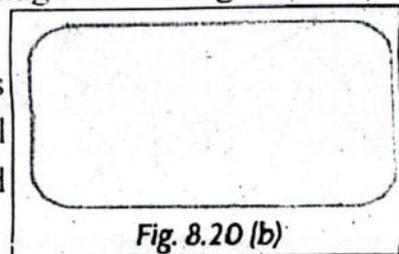


Fig. 8.20 (b)

Domain's alignment in Non-Ferromagnetic Materials: In Non-Ferromagnetic materials, such as aluminium and copper the formation of magnetic domains does not occur, so magnetism cannot be induced into these substances.

Example:

In Soft Iron: In soft iron the domains are easily oriented on applying an external field and return to random position when the field is removed. This is desirable in an electromagnet and also in transformers.

Steel: Steel is not so easily oriented to change order. It requires very strong external field, but once, oriented, retains the alignment. That is why steel is used to make permanent magnets.

8.9

Magnetization and Demagnetization

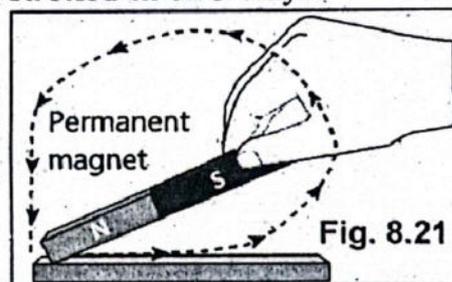
Q.16. What is magnetization and demagnetization? Write the methods of magnetization and demagnetization.

Ans. Magnetization: There are two methods used for magnetizing a steel bar.

1. **Stroking:** In this method, magnetism is induced in a steel bar by using the magnetic field of a permanent magnet. The steel bar can be stroked in two ways.

(a) **Single-Touch Method:**

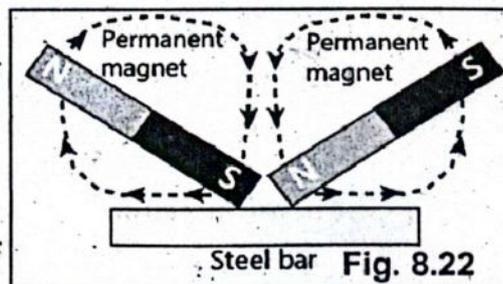
Working: A steel bar is placed on a horizontal surface. It is stroked from one end to the other several times in the same direction using the same pole (say N) of the permanent magnet. Every time the magnet is lifted up sufficiently high on reaching the other end of the bar.



(b) **Double-Touch Method:**

Working: In this method, stroking is done from the centre of the steel bar onwards with the unlike poles of two permanent magnets at the same time. (Fig.8.22). This method is more efficient than the first one.

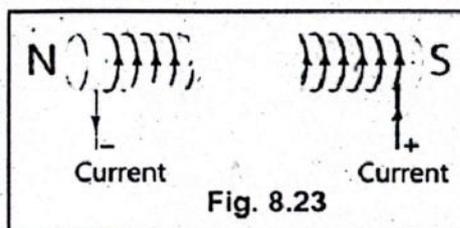
Explanation: In both the cases, the poles produced at the ends of magnetized steel bar after stroking are of the opposite polarity to that of the stroking pole.



2. **Making a magnet using solenoid**

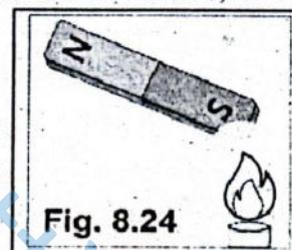
Working: In this method, a steel bar to be magnetized is placed inside a solenoid (long coil of wire) as shown in Fig. 8.23. The solenoid " should have several hundred turns of insulated copper wire. When direct current is passed through the solenoid, the steel bar becomes a magnet. The polarity of magnetized steel bar is found by applying Right hand Grip rule.

Statement: Grip the solenoid with the right hand such that fingers are curled along the direction of current (positive to the negative terminal of the battery) in the solenoid, then the thumb points to the N-pole of the bar end.



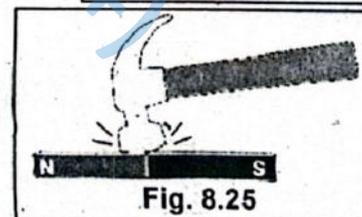
Demagnetization of Magnets:

1. **Heating:** Thermal vibrations tend to disturb the order of the domain. Therefore, if we heat a magnet strongly, the magnet loses its magnetism very quickly.



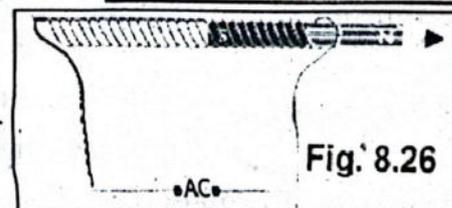
2. **Hammering:**

If we beat a magnet, the domains lose their alignment and the magnet is demagnetized. It is also called hammering.



3. **Alternating Current:**

When an alternating current (AC) is flowing through a long solenoid, a magnet moved out slowly from inside of the solenoid is demagnetized.



Q.17. Give some applications of magnets in recording technology.

Ans. Electromagnets have widely used in recording technology of sound, video and data in the form of electrical signals through magnetization of a magnetic material.

Magnetic Tapes and Disk Recorders: Most common magnetic recording mediums are magnetic tapes and disk recorders, which are used not only to reproduce audio and video signals but also to store computer data coated with iron oxide. Some other recording mediums are magnetic drums ferrite cores and magnetic bubble memory. Now we will discuss the process of magnetic recording on tapes and disks in some detail.

1. Magnetic Tape Recording

Induced magnetism is used in the process of magnetic tape recording. Recording and playing head is a coil of wire wrapped around an iron core.

Horse Shoe Shap Iron Core: The iron core has a horse-shoe shape with a narrow gap in between its two ends. Audio and video tapes are synthetic tapes coated with a layer of ferromagnetic material.

Working: Sound or picture is converted into electrical forms as varying currents. These currents are sent to the head that becomes an electromagnet with a N-pole at one end and a S-pole at the other end. The magnetic field lines pass through the iron core and cross the gap. Some of the field lines in the gap curve outward.

Fringe Field: The curved part of the magnetic field called as **fringe field** penetrates magnetic coating on the moving tape and induces magnetism in the coating.

Explanation: This induced magnetism is retained when the tape leaves the vicinity of the recording head. The reverse process changes the varying induced magnetism into varying current that onward is converted into sound or picture.

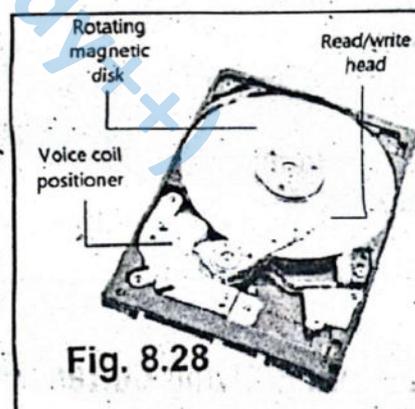
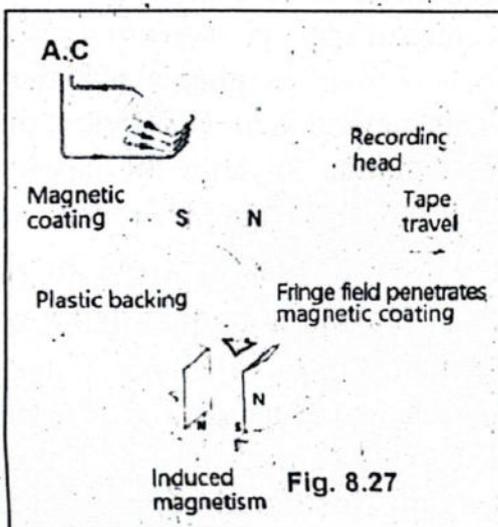
2. Hard Disk Recording:

Hard disks are circular flat plates made of aluminium, glass or plastic and coated on both sides with iron oxide. Hard disks can store terabyte of information.

Uses: The term hard disk is also used to refer to the whole of a computer's internal data storage.

Binary Digit: A magnetic head is a small electromagnet which writes a binary digit (1 or 0) by magnetizing tiny spots on the spinning disk in different directions and reads digit by detecting the magnetization direction of spots.

Advantage of Magnetic Disk: Magnetic disk devices have an advantage over tapes recorders. A disk unit has the ability to read or write a recording instantly while locating a desired information on tape may take many minutes.



Electronic devices can be protected from strong magnetic effects by enclosing them in the boxes made of soft iron.

8.11

Soft Iron as Magnetic Shield

Q.18. What is the purpose of using soft iron in the in electromagnets? Explain how its high magnetic permeability helps in these application.

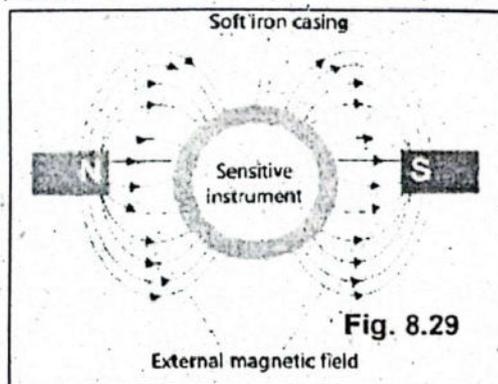
Ans. **Magnetic permeability of soft iron:** Soft iron has high magnetic permeability. The permeability is the ability of a material to allow the magnetic flux or lines of force through it when the material is placed inside a magnetic field.

Explanation: If a sensitive magnetic device is enclosed in a casing of soft iron, the magnetic flux gets established in the soft iron rather than the device. Thus, the device is shielded from external magnetic field.

Working: A soft iron casing (shell) is placed inside a magnetic field produced by opposite poles of two bar magnets. Since the magnetic permeability of the iron shell is higher than that of air, so the magnetic flux is established in the soft iron. As a result, the device is protected from the magnetic field. Usually, the casing is made with rounded corners to facilitate the magnetic field line up easily.

Example: When a piece of soft iron is put into a magnetic field, it generates a magnetic field due to magnetization.

Use of Soft Iron: Soft iron is generally used in the cores of transformers and electromagnets because of its high permeability. In case of an electromagnet, the core of soft iron can be easily magnetized when current is passed around it and quickly lost when current is stopped. That is why electromagnets are widely used in electric bells, loud speakers, picking and releasing iron scraps by the cranes and in many more appliances. The sensitivity of a moving coil galvanometer is also increased by placing a soft iron core inside the coil.



☆ MCQs

Quick Quiz

- In Japan, a bullet train can run up to a speed of:
(a) 100 km per hour (b) 200 km per hour (c) 300 km per hour (d) 400 km per hour
- The magnetism can be surprisingly large in the presence of:
(a) Weak (b) strong internal (c) internal field (d) field

ANSWERS:

1. (d) 2. (b)

☆ Short answer and Question

1. What is lode stone?

Ans. Over 1000 years ago the Greeks discovered a rock called lodestone or magnetite that could attract materials that contained iron. Also, if suspended from a string to rotate freely, it would always settle in north-south direction. This unique property led to form the basis of compass which was later on used for navigation on land and at sea.



2. Write a note on maglev trains.

Ans. A wonderful use of electromagnets seen in the **Maglev trains**. The maglev stands for a magnetically levitated train. A maglev uses forces that arise from induced magnetism to levitate or float a few centimetres above the guideway. That is why, it does not need wheels and faces no friction. In Japan, it is known as a bullet train that can run up to a speed of 400 km per hour.

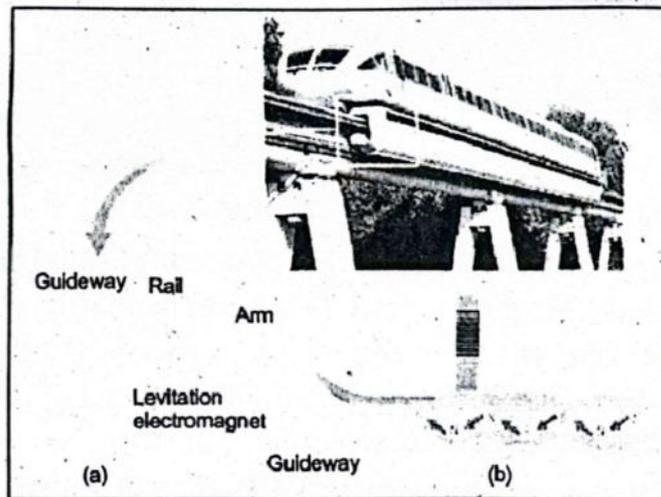
As described above, magnetic levitative only lifts the train and does not move it forward. To push the Train forward propulsion electromagnets are installed along the guideway and train. By push and pull of these magnets the train moves forward.

3. What maglev stands for?

Ans. The maglev stands for a magnetically levitated train.

4. How magnetism induced in a ferromagnetic material?

Ans. The magnetism induced in a ferromagnetic material can be surprisingly large in the presence of weak external field. In some cases, induced field is a thousand times stronger than the external field. That is why high field electromagnets are made by using cores of soft iron of some other ferromagnetic material.



Conceptual Long Questions

1. State that the relative strength of a magnetic field is represented by the spacing of the magnetic field lines.

Ans. Magnetic field lines are used to visualize the magnetic field around a magnet or an electric current. These lines emerge from the north pole and enter the south pole. The direction of the magnetic field is indicated by the direction of the lines. The spacing of the magnetic field lines. Here's

Dense field lines: When the magnetic field lines are closer together it indicates a strong magnetic field. This means that the magnetic force is strong in that region.

Sparse field lines: When the magnetic field lines are apart, it indicates weak magnetic field. This meant that the magnetic force is weak is that region.

The spacing of the magnetic field lines can be used to compare the strength of the magnetic field at different points.

If the field lines are equally spaced around a magnet, it indicates that the magnetic field is uniform.

In overall summary: In summary, the spacing of the magnetic field lines provides a visual representation of the strength of the magnetic field. Dense field lines indicate a strong magnetic field, while sparse field lines indicate a weak magnetic field.

2. **Analyse applications of magnet in recording technology and illustrate electronic devices need to be kept safe from the strong magnetic fields.**

Ans. Magnets play a crucial role in recording technology. Here are some applications.

Magnetic tapes: Magnetic tapes are used to record audio and video signals. The tape is coated with a magnetic material that can be magnetized to represent the recorded signal.

Hard disk drivers: Hard disk drivers use magnetic disks to store data. The disks are coated with a magnetic material and the data is recorded by magnetizing the material.

Magnetic Resonance Imaging: MRI machines use strong magnetic fields to create images of the body.

Electronic devices that need to be kept them safe from strong magnetic fields:

Credit cards: Credit cards have a magnetic strip that can be damaged by strong magnetic fields.

Smart phones: Smart phones have magnetic sensors that can be affected by strong magnetic fields.

Laptops have hard disk drivers that can be damaged

Keep devices them safe: Keep them away from strong magnetic fields, such as those produced by MRI machines or strong magnets.

Avoid placing devices near magnetic fields for extended periods.

3. **State the soft magnetic material such as a soft iron can be used to provide shielding form magnetic field.**

Ans. Soft magnetic materials, such as soft iron, can be used to provide shielding from magnetic fields.

Characteristics:

High permeability: Soft magnetic materials have high permeability which means they can easily conduct magnetic materials.

Low Retentivity: Soft magnetic materials have low retentivity, which means they do not retain any significant magnetic field when the external field is removed.

Soft magnetic materials provide shielding

i. **Redirecting magnetic field lines:** When a soft materials are placed near a magnetic field, it redirects the magnetic field lines around itself, reducing the magnetic field strength in the surrounding area.

ii. **Absorbing magnetic field:** The soft magnetic materials absorb the magnetic field, preventing it from passing through to the surrounding area.

Examples:

Soft Iron: Soft iron is a common soft magnetic material used for shielding.

Mu-Metal: Mu-Metal is a nickel-iron alloy that is highly effective at shielding magnetic fields.

Applications: Magnetic Resonance Imaging

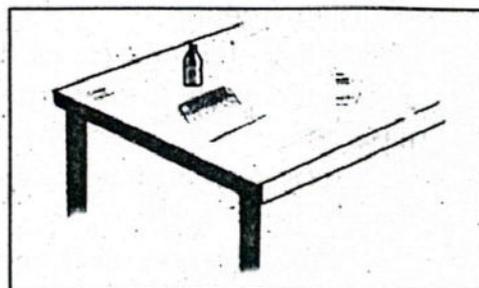
Machines: Soft magnetic materials are used to shield the strong magnetic field produced by MRI machines.

Electric Devices: Soft magnetic materials are used to shield electronic devices from external magnetic fields. Electrical transformers soft magnetic materials are used to shield the magnetic fields produced by electrical transformer.

Activity 8.1

Teacher should divide the students into groups and provide them permanent magnets to perform this activity.

Each group should collect some items made of different materials such as copper wire, nickel ring, glass bottle, paper clips, Iron nail, eraser, wooden ruler, plastic comb etc. Place them on a table as shown in figure.



Bring the permanent magnet close to each item one by one and observe which item of them are attracted by the magnet and which are not. Make lists of magnetic and non magnetic materials.

Aim: To identify and classify materials as magnetic and non-magnetic

Materials:

- Permanent Magnets
- Glass bottle
- Eraser
- Brass
- Copper Wire
- Paper clips
- Wooden ruler
- Cobalt
- Nickle ring
- Iron nail
- Plastic comb

Procedure:

- i. Divide students into groups
- ii. Provide each group with a permanent magnet and various materials.
- iii. Instruct students to bring the magnet close to each material one by one.
- iv. Observe and record which materials are attracted to the magnet.

Observations and Results:

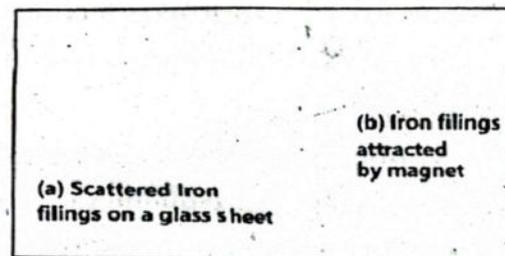
- i. List of magnetic material.
- ii. List of non-magnetic materials.

Conclusion: Material that are attached to the magnet are magnetic (e.g. iron, nickel, cobalt). Materials that are not attracted to the magnet are non-magnetic e.g., brass, copper, wood, glass, plastic.

Activity 8.2

The teacher should facilitate each group to perform this activity as per instructions.

- i. Place some iron filings scattered on the top of a card paper or a sheet of glass.
- ii. Move a magnet beneath the paper card, glass or plastic sheets as shown in the figure.



iii. What do you observe? Describe briefly.

Aim: To observe the magnetic field of a magnet using iron filings.

Materials:

- Iron Filings
- Magnet
- Card paper or glass sheet
- Plastic sheet (Optional)

Procedure:

- Place iron filings scattered on the top of a card paper or glass sheet.
- Move a magnet beneath the paper, card, glass or plastic sheet.
- Observe the pattern formed by the iron filings.

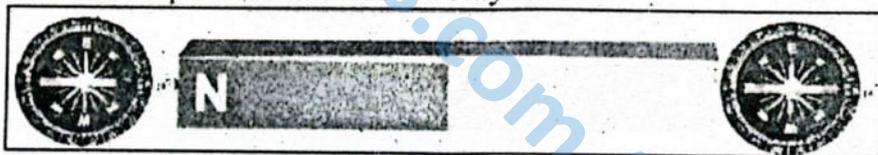
Observation and Results: When the magnet is moved beneath the paper, card, glass or plastic sheet, the iron filings align themselves in a pattern, forming lines that emerge from the north pole and enter the south pole of the magnet.

Conclusion: The pattern formed by the iron filings represents the magnetic field lines of the magnet. The magnetic field is strongest near the poles of the magnet and weakest near the center.

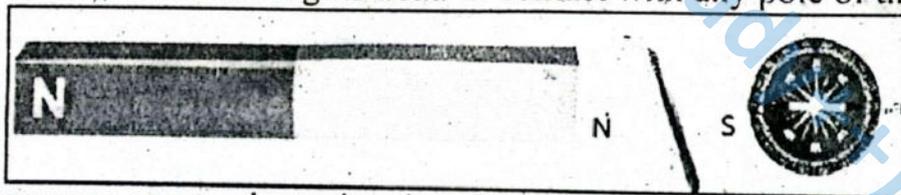
Activity 8.3

The teacher should facilitate each group to perform this activity as per instructions.

- Take a magnetic compass. Put it on a table and see which end of its needle points north. The N-pole of the needle is usually coloured red.
- Place a bar magnet on the table. Bring the compass near to its N-pole. In which direction does the N-pole of the needle stay?



- Put the compass near to the S-pole of the bar magnet. In which direction does the N-pole of the needle stay this time?
- Now place an iron nail having its head in contact with any pole of the bar magnet.



- Put the compass near to the pointed end of an iron nail. Observe the direction in which N-pole of the needle settles. Has the nail become a magnet? Has magnetism been induced in it?
- Take the bar magnet away from the nail. Again check the behaviour of the nail by bringing compass near to its ends. Does the magnetism vanish?

From the above activity, we conclude that the S-pole of the true magnet induces N-pole in the near end of the piece of iron (nail) while the far end of the iron piece becomes S-pole.

It should be noted that the induced magnetism vanishes as the true magnet is removed.

Aim: To demonstrate the phenomenon of induced magnetism in a piece of iron.

Materials:

- Magnetic Compass
- Bar magnet
- Iron nail

Procedure:

- Place the compass on the table and observe the direction of its needle.
- Bring the compass near the S-pole of the bar magnet and observe the direction of the needle.
- Place the iron nail in contact with the pole of bar magnet.
- Bring the compass near the potential end of the iron nail and observe the direction of the needle.
- Remove the bar magnet from the iron nail and again check the behaviour of nail using

Observations and Results:

- The N-pole of the compass needle point toward the N-pole of the Earth-magnetic field.
- When the compass is brought near the S-pole of the bar magnet, the N-pole of the needle is attracted towards it.
- When the iron nail is placed in contact with the pole of the bar magnet, it became a magnet.
- The compass needle shows deflection when brought near to the potential end of the iron nail indicating induced magnetism.
- When the bar magnet is removed the induced magnetisms in the iron nail vanishes.

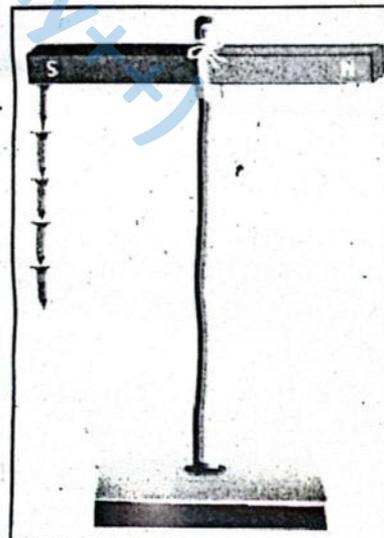
Conclusion: Induced magnetism is a phenomenon where a magnet induces magnetism's is a piece of iron. The N-pole of the true magnet induces an S-pole in the near end of the iron piece and an N-pole in the far end, similarly, the S-pole of the true magnet induces an N-pole in the near end and an S-pole in the for magnet. The induced magnetisms vanishes when the true magnet is removed.

Activity 8.4

The teacher should facilitate the groups to provide each a bar magnet, a stand with clamp, some- small nails made of iron and also some nail of steel. He should further supervise them to perform the activity as perinstructions.

- Clamp the bar magnet horizontally on the stand.
- Touch the head of an iron nail to any one end of the magnet. It will be attracted and stick to the magnet.
Touch another iron nail to the lower end of the first one does it stick to it?

Yes, it will, because the upper nail has become a magnet itself. Go on hanging iron nail one by one to make a chain until no more nails stay attached to the chain.



- iii. Try to hang steel nails at the other end of the bar magnet to form a similar chain.
 - iv. Remove the chain of iron nails by pulling the topmost nail. Does the similar chain collapse?
 - v. Remove the chain of steel nails in the same way. Does this collapse?
- You will observe that the chain of iron nails immediately collapse but the steel nails remain attached to each other for some time. This shows that the magnetism induced in the iron nails is temporary while that in the steel nails is permanent.

Aim: To compare the temporary and the permanent magnetization of iron and steel nails.

Materials:

- Bar magnet
- Stand with clamp
- Iron nails
- Steel nails

Procedure:

- i. Clamp the bar magnet horizontally on the stand.
- ii. Touch the head of an iron nail to one end of the magnet and observe.
- iii. Continue adding iron nails to form a chain.
- iv. Attempt to form a similar chain using steel nails.
- v. Remove the chain of the iron nails by pulling the topmost nail and observe.
- vi. Remove the chain of the steel nails in the same way and observe.

Observations and Results:

- i. The iron nails form a chain due to temporary magnetization.
- ii. The steel nails also form a chain, but it remains attached for some time due to permanent magnetization.
- iii. When the chain of the iron nail is removed, it immediately collapses.
- iv. When the chain of steel nails is removed, it remains attached for some time before collapsing.

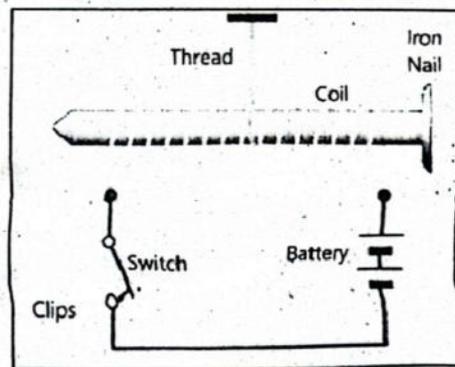
Conclusion: The magnetism induced in iron nail temporary, whereas the magnetism induced in steel nails is permanent. This is because iron is a soft ferromagnetic material that loses its magnetization when the external magnetic field is removed, whereas steel is a hard ferromagnetic material that retains its magnetization even after the external magnetic field is removed.

Activity 8.5

The teacher should divide the students into groups and facilitate them to perform this activity.

Take a battery of two cells, a switch, an iron nail, cotton (or plastic) covered copper wire, thread and a few paper clips.

Wind the wire over the iron nail to form a coil. Suspend the coil by means of thread tied to its centre. Connect ends of the wire to the battery



through the switch as shown in figure.

Keeping the switch OFF, bring some paperclips near to one end of the nail. Do they stick to the nail? Now turn the switch ON and again bring the paper clips near to the end of the nail. Do they stick this time? Does the nail behave like a magnet? Yes, the nail has become a magnet. Turn the switch OFF and see what happens to the clips. Do they fall down? What do you conclude from this activity.

Aim: To demonstrate the principle of electromagnetism by converting an iron nail into a magnet using an electric current.

Materials:

- Battery (2 Cells)
- Iron nails
- Cotton or plastic - covered copper wire
- Switch
- Thread
- Paper clips

Procedure:

- i. Wind the wire over the iron nail to form a coil.
- ii. Suspended the coil by means of thread tied to its center.
- iii. Connects the ends of the wire to the battery through a switch.
- iv. Keeping the switch OFF, bring some paper clips near to one end of the nail.
- v. Turn the switch ON and again bring the paper clips near to the end of the nail.
- vi. Observe what happens.

Observations and Results: When the switch is OFF, the paper clips do not stick the nail. When the switch is turned ON the paper clips stick to the nail, indicating that the nail has become a magnet. When the switch is turned OFF again, the paper clips fall down.

Conclusion: The nail behaves like a magnet when an electric currents flow through the coil wound around it. This demonstrates the principal of electromagnetism where an electric current produce a magnetic field.

Additional MCQs

1. Magnetism is a _____ that acts at a distance upon magnetic materials.
(a) Energy (b) Force (c) Mass (d) Material
2. Those materials which used in magnetic materials are attracted to the:
(a) Magnets (b) Forces (c) Poles (d) Strings
3. Magnets has _____ properties.
(a) Nine (b) Two (c) Four (d) None of these

4. **The end of the magnet that points north is known as:**
 (a) North magnetic pole (b) South magnetic pole
 (c) Identification of Magnet (d) Magnetic End
5. **If the north pole of one is placed near the south pole of other, the poles will attract, we can say that:**
 (a) Like poles repel and unlike pole attract
 (b) Unlike pole repel and like pole attract (c) both a and b (d) none of these
6. **Which material can be made a magnet:**
 (a) Like poles (b) Unlike poles (c) Magnetic poles (d) Steel and iron
7. **How many main types of permanent magnet's?**
 (a) Three (b) Seven (c) Six (d) Four
8. **Electromagnets are also good examples of:**
 (a) Temporary magnets (b) Permenent magnets
 (c) Megnatic field (d) Eelctromagnets
9. **The pattern of a magnetic field around a bar magnet can be seen _____ by a simple experiment.**
 (a) with very difficulty (b) with very hard
 (c) with very easy (d) with very normal
10. **The lines that correspond to the path of the fillings these lines are:**
 (a) Poles lines of force (b) Parallel lines
 (c) Distance lines of force (d) Magnetic lines of force
11. **Electric motor is the _____ process of electric generator.**
 (a) Forward (b) Reverse (c) Previous (d) Both a and c
12. **Electromagnets are also kind of:**
 (a) Temperory magnets (b) Permanents Magnets
 (c) Both a and b (d) none of these
13. **If we increase the number of cells in the battery of increase the number of the coil, we will observe:**
 (a) No change in magnetic field (b) Magnetic field increase
 (c) Magnetic field decrease (d) 0.9% magnetic field increase
14. **Magnetic relay is a type of _____ which work on electromagnet.**
 (a) Current (b) Current-circuit (c) Magnet (d) Switch
15. **Circuit breaker protected appliances from:**
 (a) Burning (b) Current (c) Electricity (d) Power surges
16. **A wonderful use of electromagnets seen in:**
 (a) First law of motion (b) Second law of motion
 (c) Third law of motion (d) Momentum
17. **Theory of magnetism is suggest by:**
 (a) Bohar (b) Mendeleve (c) Domain (d) Maglev's
18. **Each domin behaves as a _____ magnet with its own North and South poles.**
 (a) Parallel (b) Small (c) Maximum (d) Big

19. What is the size of magnetic domain?
 (a) 1cm (b) 0.1mm (c) 1mm (d) 1m
20. What is magnetic domain?
 (a) A single atom with magnetic properties
 (b) A group of atoms (c) A type of magnetic fields
 (d) A ferromagnetic material
21. Which material exhibit magnetic domains?
 (a) Only paramagnetic material (b) Only diamagnetic material
 (c) Ferromagnetic material (d) All magnetic materials
22. To determine the polarity of solenoid which hand rule is used?
 (a) Left hand rule (b) Right hand rule (c) Both a and b (d) None of these
23. How many methods used for magnetizing a steel bar?
 (a) Two (b) Four (c) One (d) Ten
24. The steel bar can be stroked in way:
 (a) Four (b) Five (c) Two (d) Three
25. Soft iron is generally used in
 (a) the iron is generally used in (b) the cores of transformers
 (c) Electromagnets (d) Both a and b
26. Electromagnets is widely used in
 (a) Electric bells (b) Loud speakers
 (c) Picking and releasing iron scraps (d) All of these
27. Soft iron has _____ magnetic permeability
 (a) low (b) high (c) extreme low (d) extreme high
28. The magnetism induced in a ferromagnetic material can be surprisingly large in the presence of
 (a) weak external field (b) strong external field
 (c) weak internal field (d) strong internal field
29. In Japan, a bullet train can run upto a speed of
 (a) 200kmh^{-1} (b) 400kmh^{-1} (c) 420kmh^{-1} (d) 500kmh^{-1}
30. Soft iron is used to make.
 (a) Temporary magnets (b) Paper clips
 (c) Office pins (d) All of these

ANSWERS:

1. (b) 2. (a) 3. (c) 4. (a) 5. (a) 6. (d) 7. (d)
 8. (a) 9. (c) 10. (d) 11. (b) 12. (a) 13. (b) 14. (d)
 15. (a) 16. (c) 17. (c) 18. (b) 19. (b) 20. (b) 21. (c)
 22. (b) 23. (a) 24. (c) 25. (d) 26. (d) 27. (b) 28. (a)
 29. (b) 30. (d)

Conceptual MCQs

- Which force act between two magnetic poles?**
(a) Electric Force (b) Magnetic Force
(c) Gravitational Force (d) Fractional Force
- Which of the following material is a natural magnet?**
(a) Iron (b) Copper (c) Lode stone (d) Aluminium
- What is the direction of the magnetic field lines around a bar magnet?**
(a) From north pole to south pole (b) From south to north pole
(c) Clokwise (d) Counterclockwise
- What is the term for the region around a magnet where the magnetic force can be detected?**
(a) Magnet Field (b) Electric Field
(c) Gravitational Field (d) Frictional Field
- Which of the following is the characteristics of a magnetic field?**
(a) It is a scaler quantity (b) It is a vector quantity
(c) It is constant quantity (d) It is a variable quantity
- What is the unit of measurement of magnetic field strength?**
(a) Tesla (b) Ampere (c) Volt (d) Ohm
- Which of the following material is ferromagnetic?**
(a) Copper (b) Aluminum (c) Iron (d) Glass
- What is the term for the process of a magnetizing a material?**
(a) Electrification (b) Magnetization (c) Ionization (d) Polarization
- Which of the following is a type of magnet?**
(a) Temporary magnet (b) Permanent magnet
(c) Electromagnet (d) All of the above
- What is the term for the force that opposes the motion of a magnet?**
(a) Magnetic Friction (b) Electric Resistance
(c) Gravitational Force (d) Normal Force
- Which of the following is a charactertistic of a permanent magnet?**
(a) It loses its magnetism over time (b) It retains its magnetism forever
(c) It is affected by temperature changes
(d) It is not affected by temperature changes
- What is the term for the process of demagnetizing a material?**
(a) Magnetization (b) Demagnetization (c) Electrification (d) Ionization
- Which of following is a type of magnetic material?**
(a) Feramagnetic (b) Paramagnatic (c) dimagnetic (d) All of the above
- What is the term of magnetic field that surrounds a current - carrying wire?**
(a) Electric Field (b) Magnetic Field
(c) Gravitational Field (d) Fractional Field

1. (b) 2. (c) 3. (a) 4. (a) 5. (b) 6. (a) 7. (c)
8. (b) 9. (d) 10. (a) 11. (b) 12. (b) 13. (d) 14. (b)

Additional Short Questions

1. Give the name of magnetic poles.

Ans. If a bar magnet is suspended horizontally through a string allowed to come to rest, it will point in north-south direction. The end of the magnet that points north is called the north magnetic pole (N). The end that points south is the south magnetic pole (S).

2. How the attraction and repulsion of magnetic poles is formed?

Ans. When two freely suspended bar magnets are placed close to each other, the two north poles will repel each other. So will the two south poles. However, if the north pole of one is placed near the south pole of the other, the poles will attract. We can say that like poles repel and unlike poles attract.

3. An object is a magnet or simply a magnetic material, we can bring its one end close to any pole of a suspended bar magnet. If it is attracted then what we conclude?

Ans. Working purpose for identification an object is a magnet or simply a magnetic material, we can bring its one end close to any pole of a suspended bar magnet. If it is attracted, then what we can conclude that the end of the object is either of opposite pole to that of the suspended magnet or it is simply a magnetic material. Then we should bring the same end of the object close to the other end of the suspended magnet. If the object is again attracted, it is not a magnet but it is a magnetic material.

4. If we break a bar magnet into two equal pieces, can we get N-pole and S-pole separately?

Ans. No, it is not possible. Each piece will have its two poles, i.e. N-pole and S-pole. Even if a magnet is divided into thousands of pieces, each piece will be a complete magnet with its N and S-poles.

5. Name of many types of the permanent magnet.

Ans. There are many types of permanent magnetic materials. These are cobalt, alnico and ferrite.

6. The strongest permanent magnets are made from which material.

Ans. The strongest permanent magnets are made from Alloy of neodymium, iron and boron to form $Nd_2Fe_{14}B$ structure.

7. How magnetic lines of force are produced?

Ans. The magnetic lines of force around a bar magnet can be drawn by using a small

compass. The needle of the compass will move along the magnetic lines of force. The magnetic lines of force around a bar magnet drawn by this method. The compass needle is symbolized by an arrow being the north pole.

8. Where the field lines appear?

Ans. The field lines originated from the north pole and end on south pole.

9. Why points x-called neutral point?

Ans. Because the field due to one magnets cancel out that due to other magnets. Therefore point x-called neutral point.

10. If we increase the number of cells in the battery or increase the number of turns of coil, so what we will observe?

Ans. We observe that the strength of the magnetic field in each case increase. This will be indicated by the more number of clips held by the nail.

11. When a circuit is breaks?

Ans. A circuit breaker is designed to pass a certain maximum current through it safely. If the current becomes excessive, it switches OFF the circuit. Thus, electric appliances are protected form burning. Inside a circuit breaker, the current flows along a copper strip, through the iron armature and coil of electromagnet. The electromagnet attracts the armature. If the current is large enough, the armature is detached from the copper strip and the circuit breaks.

12. Why steel is used to make a permanent magnet?

Ans. Steel is not so easily oriented to change order. It requires very strong external field, but once, oriented, retains the alignment. That is why steel is used to make permanent magnet.

13. Can a magnet demagnetize by storing it near another magnet.

Ans. Yes, a magnet can be demagnetized by storing it near another magnet. The opposing magnetic field can cause the magnetic domains to become randomly aligned, resulting in a loss of magnetic field.

14. What is the effect of alternating current on a magnet?

Ans. An alternating current demagnetizes a magnet by repeatedly reversing the direction of the magnetic field. This causes the magnetic domains to become randomly aligned, resulting in a loss of magnetic field.

15. Why is iron more effective as a magnetic shield than other materials?

Ans. Iron is more effective as a magnetic shield than other materials because of its high permeability, which allows it to become strongly magnetized and absorb the external magnetic field.

16. Can iron permanently eliminate a magnetic field?

Ans. No, iron cannot completely eliminate a magnetic field. While it can reduce the magnetic field strength, some magnetic field lines may still pass though the iron shield.

17. What is the purpose of using iron as a magnetic shield?

Ans. Iron is used as a magnetic shield to protect objects from external magnetic field.

18. What is the role of permanent magnets in magnetic storage device?

Ans. Permanent magnets are used to store data in magnetic storage device such as hard disk drives.

19. What type of permanent magnet is commonly used in refrigerator magnets?

Ans. Ferrite magnets are commonly used in refrigerator magnets. They are made from the ferrite, a ceramic material. They are also used in other application such as magnetic hooks and magnetic catches.

20. What is the primary use of permanent magnets?

Ans. Permanent magnets are primarily used to produce a constant magnetic field. This magnetic field is used in various applications such as electric motors, generators and magnetic resonance imaging (MRI) machines.

21. How do domains align when a magnetic material is placed in a magnetic field?

Ans. When a magnetic material is placed in a magnetic field, the domains align themselves in the direction of the magnetic field.

22. What is the application of magnetization in electromagnets?

Ans. Magnetization is used in electromagnets to produce a strong magnetic field, which is used in various applications such as motors, generators, and transformers.

23. What is the effect of heat on the domains of a magnetic material?

Ans. Heat causes the domains of a magnetic materials to become randomly aligned resulting in a loss of magnetization.

24. What is domain theory of magnetism?

Ans. The domain theory of magnetism states that a magnetic material is divided into a small regions called domains, each having it's own magnetic field.

25. What is principle behind magnetic recording?

Ans. The principle behind a magnetic recording is the alignment of magnetic domains in a magnetic material to represent digital data.

26. How does a magnetic tape work?

Ans. A magnetic tape works by aligning the magnetic domains on the tape to represent digital data, which is then read by a magnetic head.

27. How does a hard disk drive work?

Ans. A hard disk drive works by aligning the magnetic domains on a magnetic disk to represent digital data, which is then read by a magnetic head.

28. What are the advantage of magnetic recording?

Ans. The advantage of magnetic recording is that it allows from high-density data storage and fast data retrieval.

29. What is magnetic disk?

Ans. A magnetic disk is a flat, circular disk coated with a magnetic material used for a storing digital data.

Conceptual Short Questions

1. What is magnetism?

Ans. Magnetism is the force that magnets exert when they attract or repel each other. It

is caused by the motion of electric charges.

2. **What are the two poles of a magnet?**

Ans. A magnet has a north pole and a south pole. The end that points north is the north pole and the other end is the south pole.

3. **What are three types of magnets?**

Ans. The three types of magnets are

1. Permanent magnets
2. Temporary magnets
3. electromagnets

4. **What are ferromagnetic material?**

Ans. Ferromagnetic materials are attracted to magnets and can be magnetized themselves.

Examples: iron, cobalt, nickel and some rare-earth metal alloys.

5. **What are temporary magnets?**

Ans. Temporary magnets are made of soft metals and only exhibit magnetic properties when near a permanent magnet or an electric magnet.

6. **What are some applications of magnets?**

Ans. Magnets are used in many electronic devices, such as TVs, speakers and radios. They are also used in computers to store data on hard disks, and in generators to convert mechanical energy to electrical energy.

7. **What is meant by diamagnetism?**

Ans. Diamagnetism is a fragile type of magnetism generated by a change in the electrons orbital motion due to an enforced magnetic field. When the source of the induced magnetic field is removed the magnetization of the given material is disappear.

8. **What is a permanent magnet?**

Ans. A permanent magnet is a material made from a magnetized substance and generates its own magnetic fields. A familiar example is a magnet used to stick notes on metal objects.

9. **What is an electromagnet?**

Ans. An electromagnet is composed of a coil of wire that behaves like a magnet when an electric current flows through it.

Exercise Questions

A Multiple Choice Questions

Tick (✓) the correct answer:

8.1 Which one of the following is not a magnetic material?

- (a) Cobalt (b) Iron (c) Aluminum (d) Nickel

8.2 Magnetic lines of force;

- (a) are always directed in a straight line (b) cross one another
(c) enter into the north pole (d) enter into the south pole

8.3 Permanent magnets cannot be made by:

- (a) soft iron (b) steel (c) neodymium (d) alnico

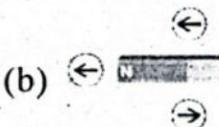
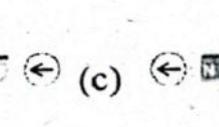
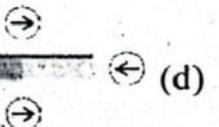
8.4 Permanent magnets are used in:

- (a) circuit breaker (b) loudspeaker
(c) electric crane (d) magnetic recording

8.5 A common method used to magnetise a material is:

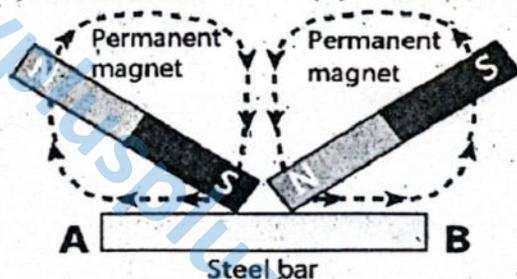
- (a) stroking (b) hitting (c) heating
(d) placing inside a solenoid having AC current

8.6 A magnetic compass is placed around a bar magnet at four points as shown in figure below. Which diagram would indicate the correct directions of the field?

- (a)  (b)  (c)  (d) 

8.7 A steel rod is magnetised by double touch stroking method. Which one would be the correct polarity of the AB magnet?

- (a)  (b)  (c)  (d) 



8.8 The best material to protect a device from external magnetic field is:

- (a) wood (b) plastic (c) steel (d) soft iron

ANSWERS:

1. (c) 2. (d) 3. (a) 4. (b) 5. (a) 6. (c) 7. (a) 8. (d)

B Short Answer Questions

8.1 What are temporary and permanent magnets?

Ans: Temporary magnets: Temporary magnets are the magnets that work in the presence of a magnetic field of permanent magnets. Once the magnetic field vanishes, they lose their magnetic properties.

Permanent magnets: Permanent magnets retain their magnetic properties for every. These are either found in nature or artificially made by placing objects made of steel and some special alloys in a strong magnetic field for a sufficient time.

8.2 Define magnetic field of a magnet.

Ans: A magnetic field is the region around a magnet where an other magnetic object experience a force on it.

Explanation: When a magnet attracts a certain magnetic material, it exerts some force to do so. Similarly, when it attracts or repels a magnetic pole of another

magnet, it exerts a force on it. This force can be observed upto a certain distance from the magnet.

8.3 What are magnetic lines of force?

Ans: Magnetic lines of force are imaginary lines that represent the direction and strength of a magnetic field; their density indicates field strength, and they form closed loops from north to south pole.

8.4 Name some uses of permanent magnets and electromagnets.

Ans: Use of permanent magnets: Speakers, compasses, electric meters.

Use of electromagnets: Electric bells, lifting Cranes, MRI machines.

8.5 What are magnetic domains?

Ans: Magnetic domains are microscopic regions with in a ferromagnetic material where atomic magnetic moments are aligned, creating a localized magnetic field, their alignment determines the overall magnetism of the material.

8.6 Which type of magnetic field is formed by a current-carrying long coil?

Ans: A long coil of wire carrying a current produces a magnetic field that is similar to that of a bar magnet. The field lines are concentrated inside the coil and spread out outside, resembling the field lines of a bar magnet.

8.7 Differentiate between paramagnetic and diamagnetic materials.

Ans: Paramagnetic materials: Paramagnetic materials are weakly attracted to external magnetic fields due to unpaired electrons.

Diamagnetic materials: Diamagnetic materials are weakly repelled due to paired electrons and induced opposing magnetic moments.

© Constructed Response Questions

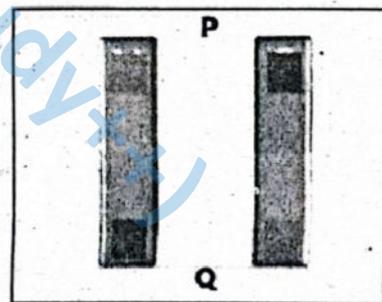
8.1 Two bar magnets are stored in a wooden box. Label the poles of the magnets and identify P and Q objects.

Ans. To store the magnets safely, we should keep the P object (N-pole) of one magnet near the Q-object (S-pole) of the other magnet.

Reason: This is because opposite poles attract each other and this arrangement will help prevent the magnets from attracting other metal objects for each other.

Magnet 1: P(N-pole) Q(S-pole)

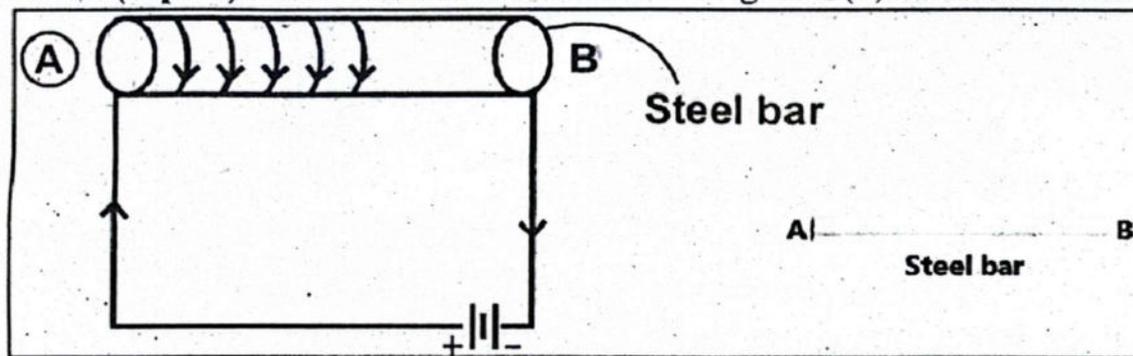
Magnet 2: P(N-pole) Q(S-pole)



8.2 A steel bar has to be magnetised by placing it inside a solenoid such that end A of a bar becomes N-pole and end B becomes S-pole. Draw circuit diagram of solenoid showing steel bar inside it.

Ans. End A (N-pole): Current flow from (+) terminal of battery to end A.

End B (S-pole): Current flow from End B to negative (-) terminal of battery.



- 8.3 Two bar magnets are lying as shown in the figure. A compass is placed at the middle of the gap. Its needle settles in the north-south direction. Label N and S poles of the magnets. Justify your answer by drawing field lines.

Ans. Magnet 1: S-pole (Left) and N-pole (Right)

Magnet 2: S-pole (Right) and N-pole (left).

Justification: The compass needle settles in the north-south direction, the magnetic field lines at the middle of the gap must be from north to south.

Field lines: The field lines should show the magnetic field lines emanating from the North poles and converging into the south poles of both magnets. The lines should show a repulsive force between like poles. The compass needle aligns with the net magnetic field, which is horizontal at the centre.



- 8.4 Electric current or motion of electrons produce magnetic field. Is the reverse process true, that is the magnetic field gives rise to electric current? If yes, give an example and describe it briefly.

Ans. Yes, the reverse process is true. A changing magnetic field can induce an electric current. This phenomenon is known as electromagnetic induction.

Example: Generation of electricity in a coil. Consider a coil of wire placed near a bar magnet. When the magnet is moved towards or away from the coil, a changing magnetic field is created. This changing magnetic field induces an electric current in the coil.

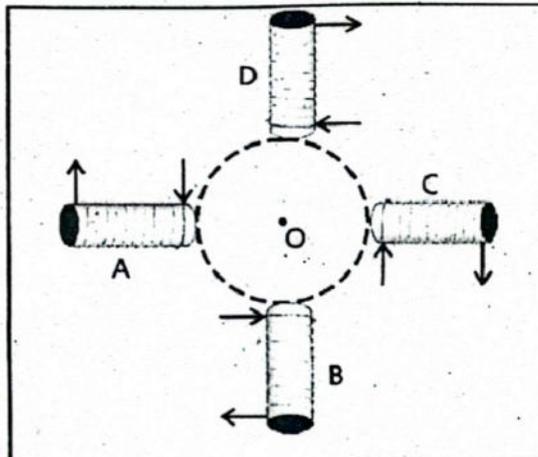
- 8.5 Four similar solenoids are placed in a circle as shown in the figure. The magnitude of current in all of them should be the same. Show by diagram, the direction of current in each solenoid if any one solenoid is switched OFF, the net magnetic field at the centre O is directed towards that solenoid. Explain your answer.

Ans. **Explanation:** To achieve the desired magnetic field direction, the current in each

solenoid should flow as follows:

- Solenoid A:** Clockwise
- Solenoid B:** Counter clockwise
- Solenoid C:** Clockwise
- Solenoid D:** Counterclockwise

when current in anyone solenoid is switched OFF, the net magnetic field at the center O will be directed towards that solenoid due to the remaining magnetic fields from the other three solenoids.



D Comprehensive Questions

8.1 How can you identify whether an object is a magnet or a magnetic material?

Ans. See to Question No. 2

8.2 Describe the strength of a magnetic field in terms of magnetic lines of force. Explain it by drawing a few diagrams for the fields as examples.

Ans. See to Question No. 5 or 6

8.3 What is a circuit breaker? Describe its working with the help of a diagram.

Ans. See to Question No. 11

8.4 A magnet attracts only a magnet. Explain the statement.

Ans. See to Question No. 2

8.5 Differentiate between paramagnetic, diamagnetic and ferromagnetic materials with reference to the domain theory.

Ans. See to Question No. 14

8.6 Why ferromagnetic materials are suitable for making magnets?

Ans. See to Question No. 14, 15

