UNIT
08

Magnetism

Q1. Define magnetic materials.

Ans: Magnetic Materials: 09108001

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

Examples: Iron, Nickel and Cobalt.

Q2. Define magnetic poles. State characteristics of magnetic poles. 09108002

Ans: Magnetic poles:

If a bar magnet is suspended horizontally through a string and 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) as shown in (Fig. 8.1). Magnetic poles are regions at ends of magnet where magnetic field is strongest.

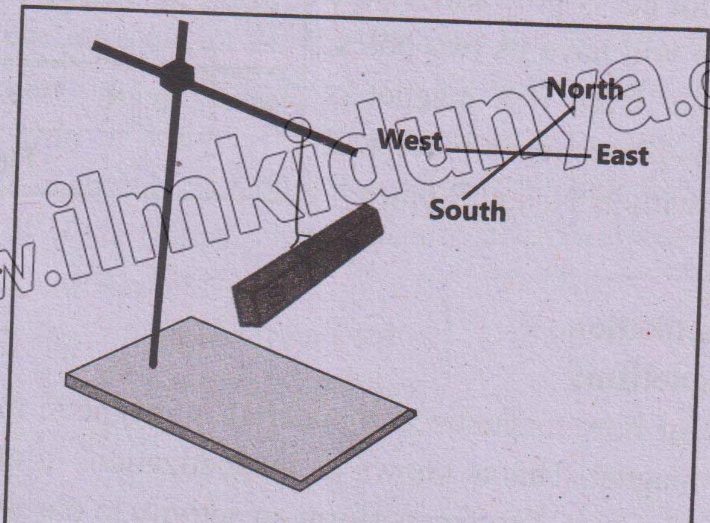


Fig. 8.1

Characteristics of magnetic poles:

Attraction and Repulsion of Magnetic poles:

When two freely suspended bar magnets are placed close to each other, the two north poles will repel each other (Fig. 8.2). So will the two south poles (Fig. 8.3).

However, if the north pole of one is placed near the south pole of the other, the poles will attract (Fig. 8.4 & Fig 8.5). We can say that **Like poles repel and unlike poles attract.**

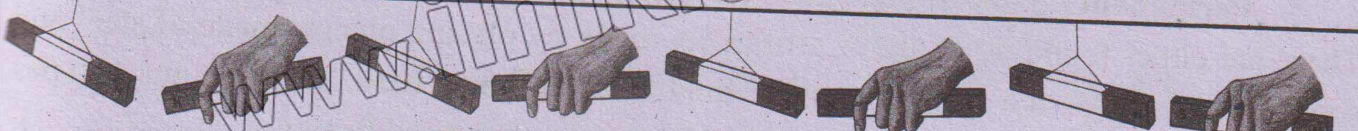


Fig. 8.2 Fig. 8.3 Fig. 8.4 Fig. 8.5

Q3. How can you identify the given object is a magnet or magnetic material? 09108003

Ans: Identification of a Magnet:

To identify whether 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 we can conclude that the end of the object is either of opposite pole to that of the same end of the object lose to the other end 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.

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

09108004

Q4. Is isolated magnetic pole exist? Explain.

Ans: Is Isolate Magnetic Pole Possible?

If we break a bar magnet into two equal pieces, we cannot get N-pole and S-pole separately. 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 completer magnet with its N, and S-poles (Fig. 8.6).

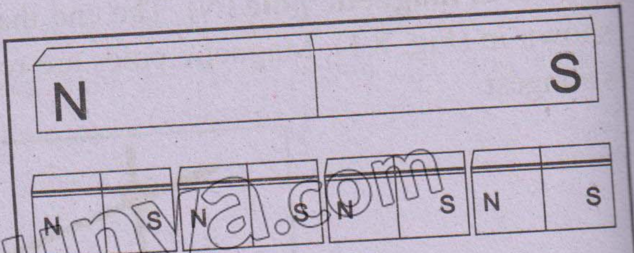


Fig. 8.6

09108005

Q5. Define magnetization.

Ans: Induced Magnetism:

It is measure of how magnetized a material is 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 it. You can perform an activity to observe this fact.

09108006

Q6. Differentiate between temporary and permanent magnets.

Ans: Temporary and Permanent Magnets:

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.

Usually, soft iron is used to make temporary magnets. Paper clips office pins and iron nails can easily be made temporary magnets. Electromagnets are also good examples of temporary magnets. You have already learnt different uses of electromagnets.

Permanent magnets: Permanent magnets retain their magnetic properties for ever. There 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. There are many types of permanent magnetic materials. For example, cobalt, alnico and ferrite.

Q7. Define and Explain: 09108007

1) Magnetic Field 2) Magnetic lines of Force 3) Strength of magnetic field

Ans: 1) Magnetic Fields:

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 that can be explained by the concept of magnetic field around the magnet

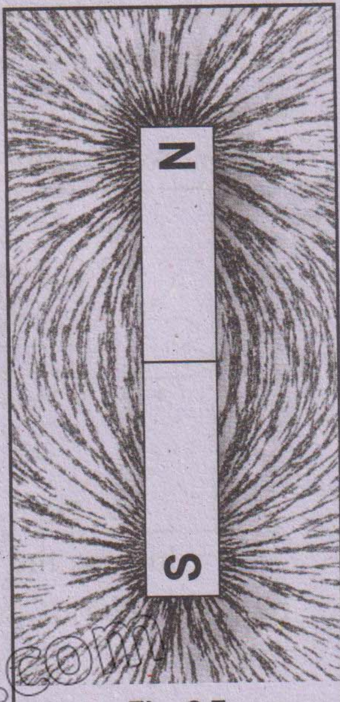


Fig. 8.7

Definition: A magnetic field is the region around a magnet where another magnetic object experiences a force on it. The pattern of a magnetic field around a bar magnet can be seen very easily by a simple experiment.

Explanation: If iron fillings are sprinkled on a thin glass plate placed over a bar magnet, the fillings 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). This pattern can be better shown by line that correspond to the path of the filings. These line are called **magnetic lines of force.**

2) Magnetic lines of Force:

The magnetic line 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. 8.9)

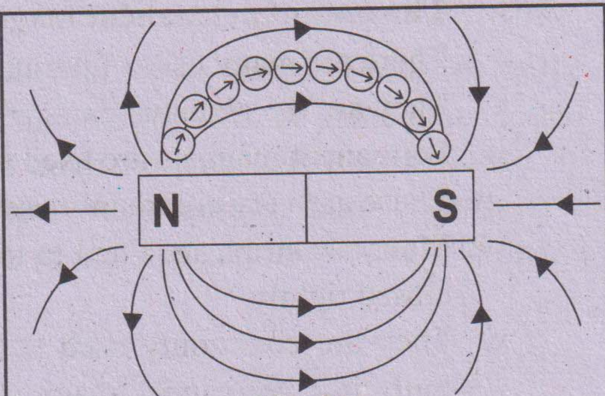


Fig. 8.8

The magnetic field at a point has both a magnitude and a direction.

The direction of the magnetic field a t any point in space is the direction indicated by the N-pole of a magnet or a small compass needle placed at that point. Fig. 8.8 also shows that the field lines appear to originate from the north pole and end on the south pole.

Actually, the magnetic field extends in space all around the magnet but the figure shows the field in one plane only.


Fig. 8.9

3) 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 line are relatively close together and weaker where these are far apart. For example, in Fig. 8.10, the lines are closest together near north and south poles indicating that the strength of the magnetic field is stronger in these region. Away from the poles, the magnetic field becomes weaker.

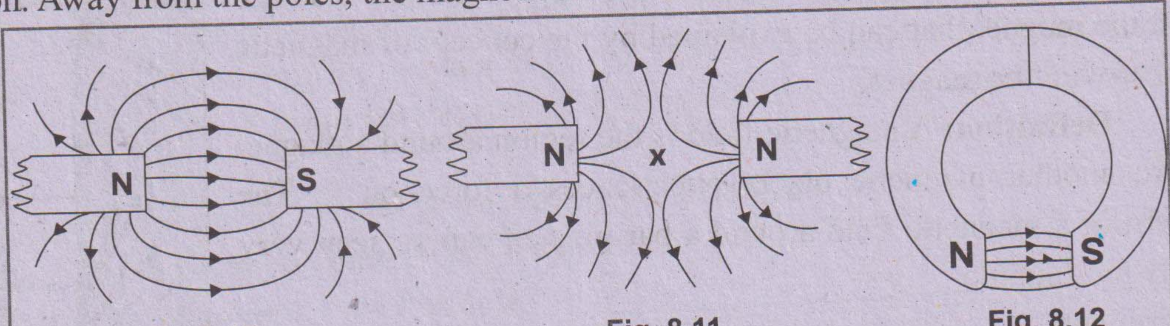


Fig. 8.10 Fig. 8.11 Fig. 8.12

In case 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 point 'x' is called a neutral point because the field due to one magnet cancels out that due to the other magnet. Fig. 8.12 represents the field pattern of horse shoe magnet. The field is almost uniform between the poles except near the edges.

Q8. Describe some uses of permanent magnet. 09108008

Ans: The uses of permanent magnet:

There are many uses of permanent magnets such as:

i. They are the essential parts of DC motors, AC and DC electric generator.
ii. Permanent magnets are used in the moving coil loud-speaker.
iii. These are very commonly used in door catchers.
iv. Magnetic strips are fitted to the doors of refrigerators and freezers to keep the door closed tightly.
v. 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.
vi. In the medical field, they ae used to remove iron splinters from the eyes.
vii. A piece of permanent magnet is used to reset the iron pointer in a maximum and minimum thermometer.

Q9. Explain working of A.C Generator and moving coil loudspeaker are an application permanent magnet. 09108009

Ans: Applications of permanent magnets:

Let see at a glance how some of the following devices use permanent magnets.

A.C Generator:

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 end of the coil (Fig. 8.13). On connecting these ends to an external circuit, an alternating current (AC) flows through the circuit. **Electric motor** is the reverse process of electric generator. When an AC is made to pass through the coil between the poles of a permanent magnet, it starts rotating.

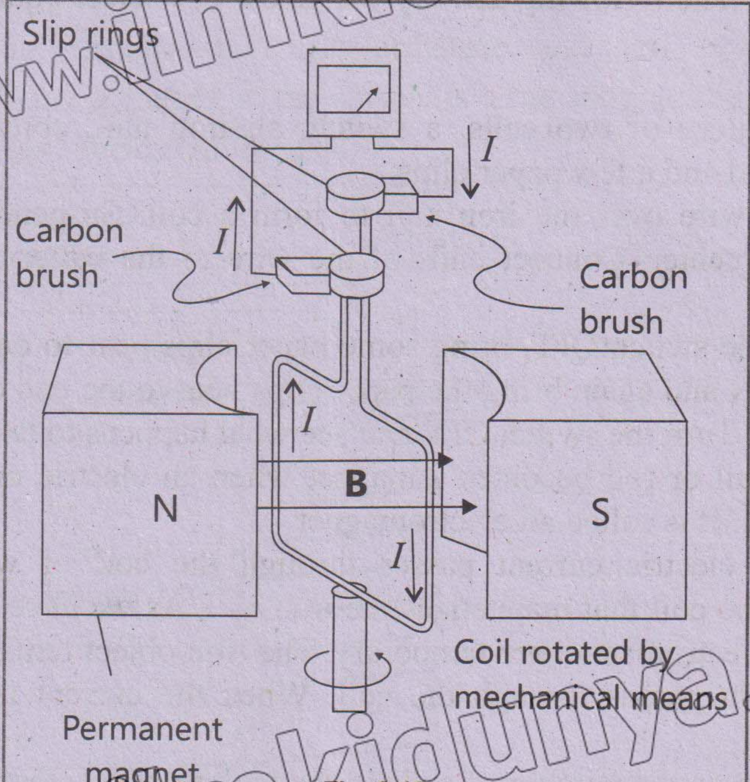


Fig. 8.13

Moving Coil Loudspeaker:

A voice coil attached to the cone of the speaker is lipped 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. This 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.

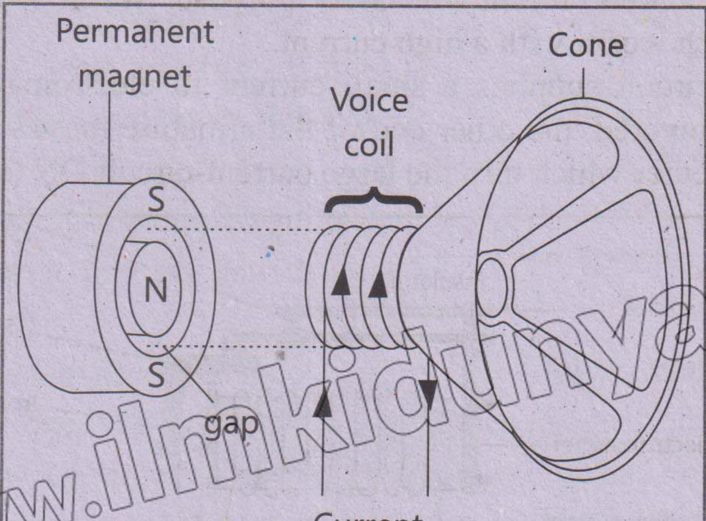


Fig. 8.14

Q10. What are Electromagnet? Explain its important applications. 09108010

Ans: Electromagnets:

Electromagnets are also a kind of temporary magnets which form when current flow through coil. The following activity will show how electromagnets can be made and tested.

Explanation:

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 center. Connect ends of the wire to the battery through the switch as shown in figure.

Keeping the switch OFF, bring some paper clips near to one end of the nail. Now turn the switch ON and again bring the paper clips near to the end of the nail. The nail has become a magnet. Turn the switch OFF and see what happens to the clips.

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

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, the magnetic properties of an electromagnet are temporary. The 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.

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 magnetite field in each case increases. This will be indicated by the more number of clips held by the nail in these cases.

The 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. Functions of some of them are described below.

1. Magnetic Relay:

This is a type of switch which works with an electromagnet. 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.

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 large current-circuit ON (Fig. 8.15).

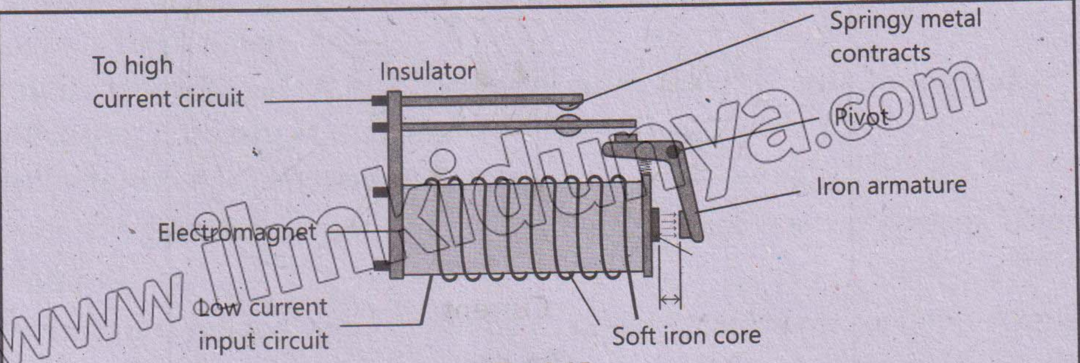


Fig. 8.15

2. **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. As shown in Fig 8.16, 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.

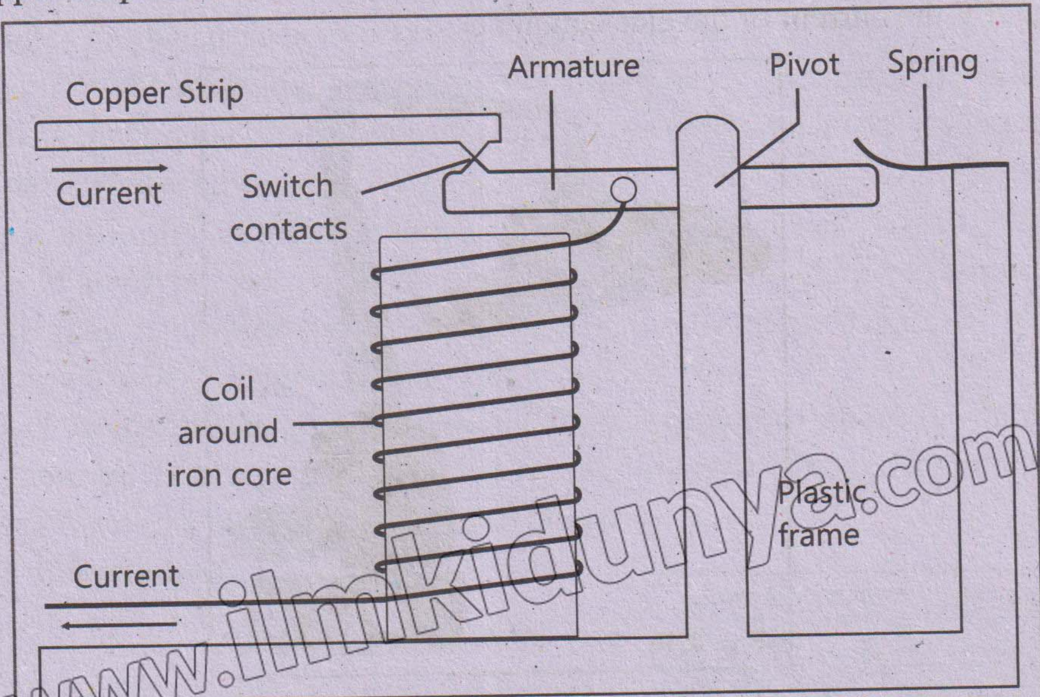


Fig. 8.16

3. **Telephone Receiver:**

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.

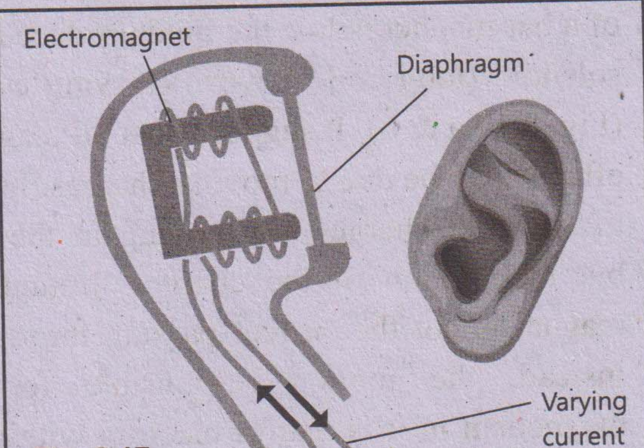


Fig. 8.17

For your Information:

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 float a few centimeters 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/ h.

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.

4. Electromagnetic Cranes:

Huge electromagnets are used in cranes at scrapyard, steel works and on ships. These are so powerful that they can lift iron and steel objects such as cars as shown in Fig. 8.18. 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

Q11. Describe Domain theory of Magnetism. 09108011

Ans: 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. 8.19 a & b). It suggests that all magnetic effects may be due to moving charges. In case of solenoid charges are moving in the wire but the motion of the charges through the magnet is not the current passing through it. Instead, the motion responsible for the magnetism in it is that of electron within the atoms of the material.

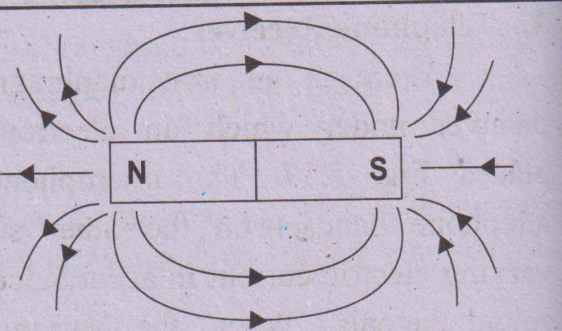


Fig. 8.19 (a)

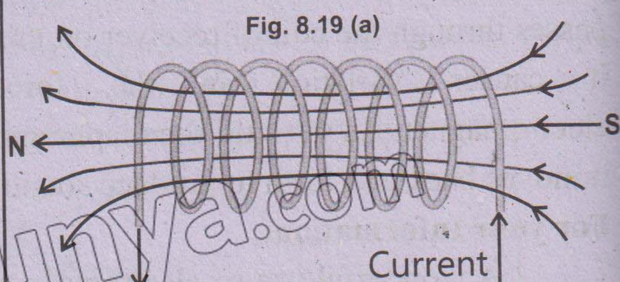


Fig. 8.19 (b)

We know that an 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 another if an atom has some resultant magnetic field, it behaves, like a tiny magnet. It is called a **magnetic dipole.**

Q12. Differentiate between paramagnetic, diamagnetic and ferromagnetic materials with reference to the domain theory. 09108012

Ans: 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 behave like a tiny magnet, the materials with such atoms are called paramagnetic materials such as aluminum and lithium.

Diamagnetic 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. Their examples are copper, bismuth, water etc.

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 neighboring atoms of the order 10^{16} because they have electron spins that are naturally aligned parallel to each other. These are known as ferromagnetic materials.

The group of atoms in this type of material form a region of about 0.1 mm size that is highly magnetized. This region is called as a **magnetic domain**. Each domain behaves as a small magnet with its own north and south poles.

Alignment of Domains:

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 unmagnitized piece of iron can be magnetized by placing it in an external magnetic field provided by a permanent magnet or an electromagnet.

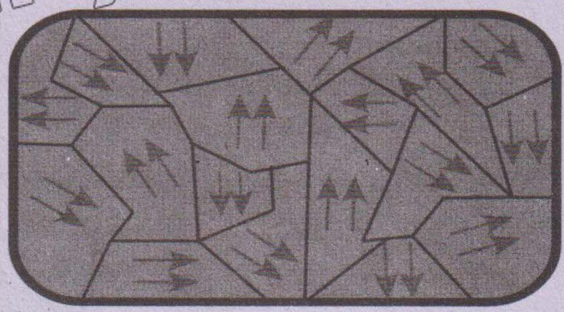


Fig. 8.20 (a)

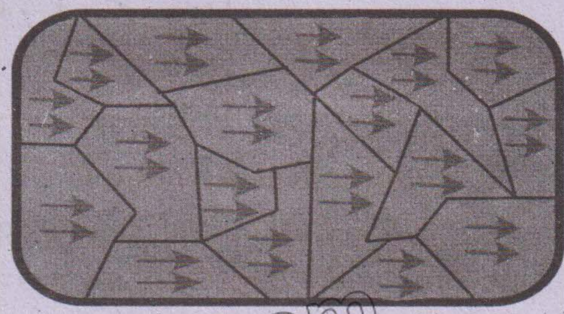


Fig. 8.20 (b)

The external magnetic field penetrates the unmagnetized iron and induces magnetism is parallel or nearly parallel to the external magnetic field grow in size at the expense of other domains that are not oriented. In addition, 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.

Q13. Why ferromagnetic materials are suitable for making magnets? 09108013

Ans: 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. On the other hand, 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.

In non-ferromagnetic materials, such as aluminium and copper the formation of magnetic domain does not occur, so magnetism cannot be induced into these substances.

Q14. Describe methods to magnetization a steel bar. **09108014**

Ans: Magnetization:

There are two methods used for magnetizing a steel bar.

i. 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:

Steel bar is placed on a horizontal surface. It is stroked from one end to the other several times 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 (Fig. 8.21).

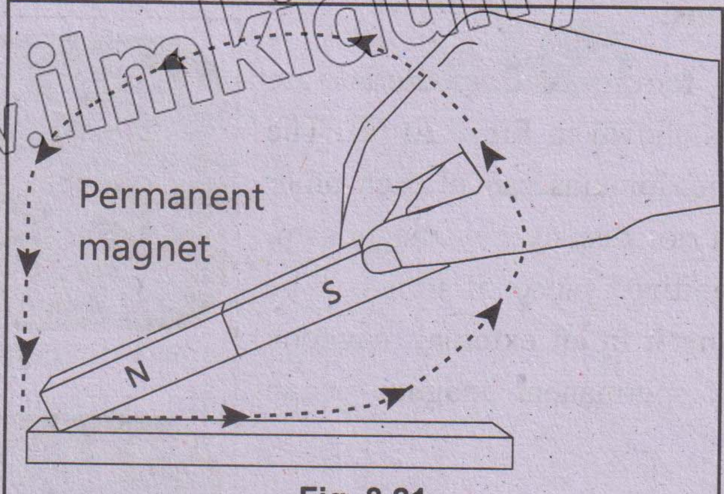


Fig. 8.21

b. Double Touch Method:

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.

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.

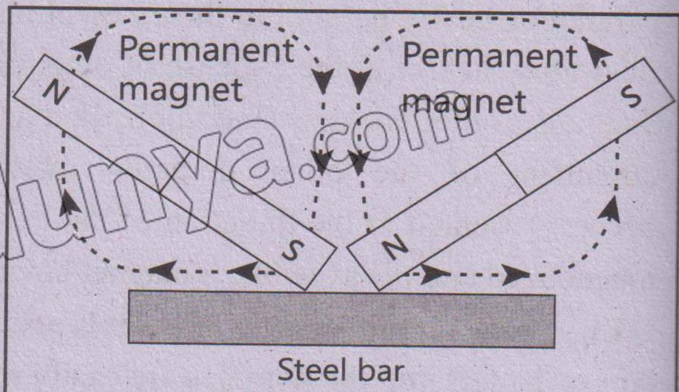


Fig. 8.22

ii. Making a Magnet using Solenoid:

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** which is stated as below.

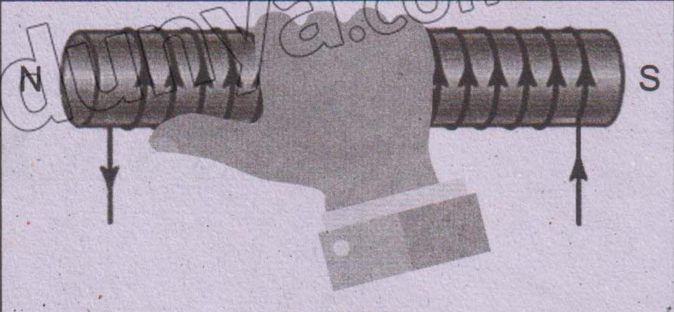


Fig. 8.23

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.

Q15. Describe methods to Demagnetisation of Magnets. 09108015

Ans: 1) Heating:

Thermal vibrations tend to disturb the orderliness of the domain. Therefore, if we heat a magnet strongly, the magnet loses its magnetism very quickly (Fig. 8.24).

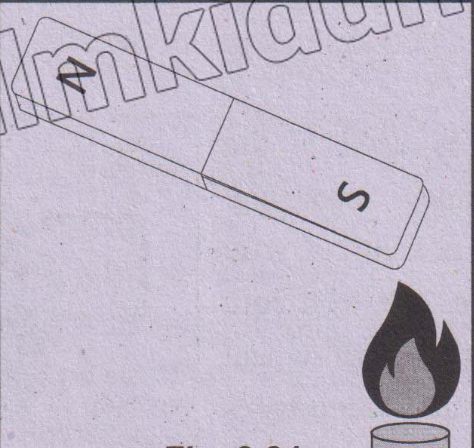


Fig. 8.24

2) Hammering:

If we beat a magnet, the domain loses their alignment and the magnet is demagnetised. It is also called hammering (Fig. 8.25).

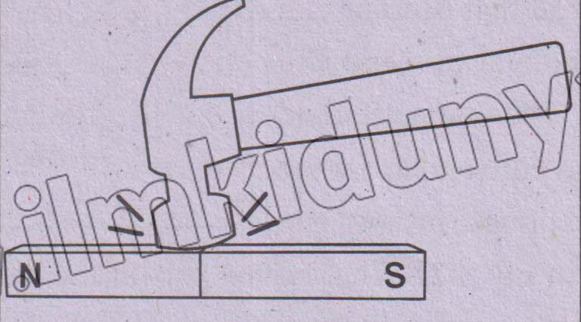


Fig. 8.25

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 demagnetised (Fig. 8.26).

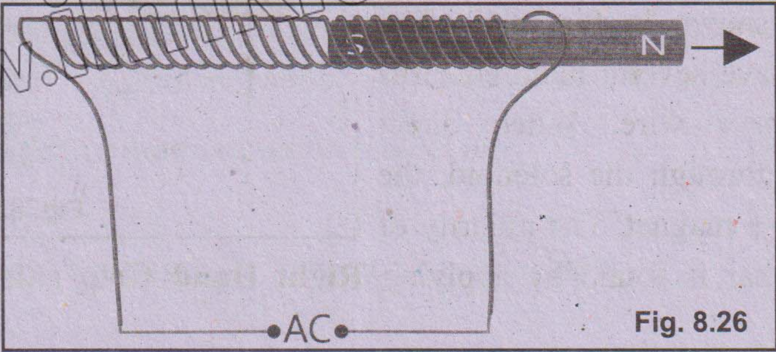


Fig. 8.26

Q16. Describe applications of Magnets in Recording Technology. 09108016

Ans: Application of Magnets in Recording Technology:

Electromagnets have widely used in recording technology of sound, video and data in the form of electrical signals through magnetization of portions of a magnetic material. Most common magnetic recording mediums are **magnetic tapes** and **disk recorders** which are used only to produce audio and video signals but also to store computer data. These materials are usually coated with iron oxide. Some other recordings mediums are magnetic drums, ferrites cores and magnetic bubble memory. We will discuss process of magnetic recording on tapes and disks in some detail.

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. The iron core has a horse shoe shape with a narrow gat between its two ends. Audio and video tapes are synthetic tapes coated with layer of ferromagnetic material.

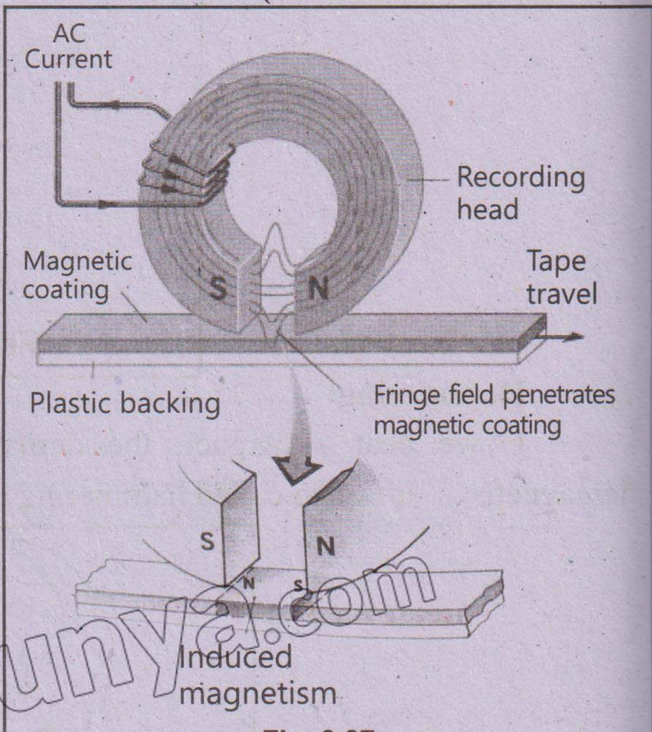


Fig. 8.27

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 fields lines in the gap curve outward as shown in Fig 8.27. The curved part of the magnetic field as **Fringe field** penetrates magnetic coating on the moving tape and induces magnetism in the coating. 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.

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.

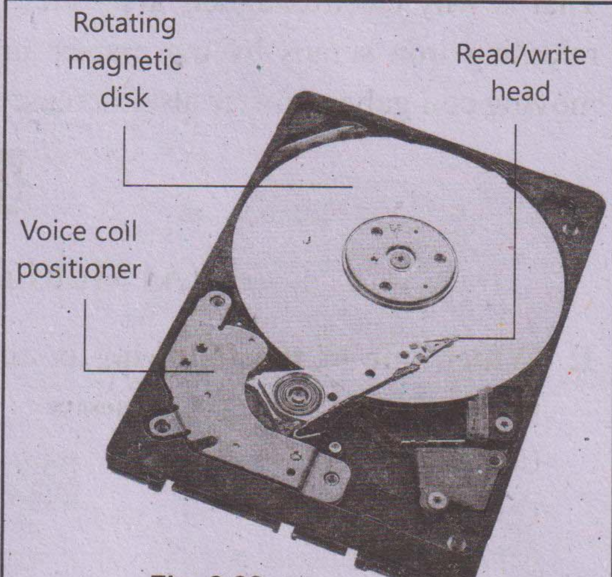


Fig. 8.28

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 (Fig. 8.28). The term hard disk is also used to refer to the whole of a computer's internal data storage.

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 tape4 may take many minutes.

Electronic devices can be protected from strong magnetic effects by enclosing them in the boxes made of soft iron. We will describe it in detail in the next season.

Q17. Describe Soft Iron as Magnetic Shield. **09108017**

Ans: Soft Iron as Magnetic Shield:

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

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.

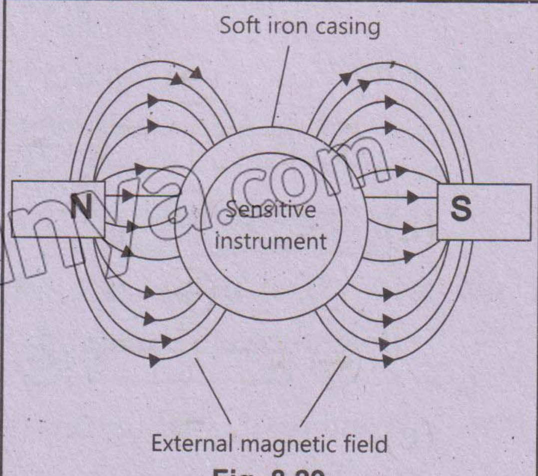


Fig. 8.29

Fig 8.29 can explain this phenomenon well. 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 ion. 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.

Soft iron is generally use 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 lose 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 also increased by placing a soft iron core inside the coil.

Exercise

(A) Multiple Choice Questions

1. **Which one of the following is not a magnetic material?** **09108018**
   (a) Cobalt
   (b) Iron
   (c) Aluminium
   (d) Nickel

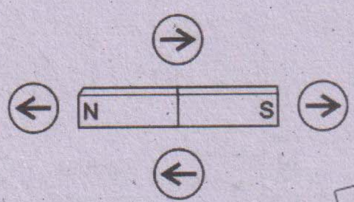
2. **Magnetic lines of force:** **09108019**
   (a) are always directed in a straight line
   (b) cross one another
   (c) enter into the north pole
   (d) enter into the south pole

3. **Permanent magnet cannot be made by:** **09108020**
   (a) soft iron
   (b) steel
   (c) neodymium
   (d) alnico

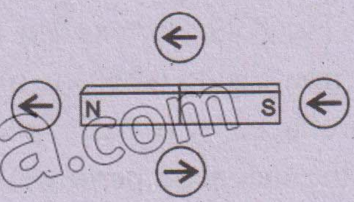
4. **Permanent magnets are used in:** **09108021**
   (a) circuit breaker
   (b) loudspeaker
   (c) electric crane
   (d) magnetic recording

5. **A common method used to magnetise a material is:** **09108022**
   (a) stroking
   (b) hitting
   (c) heating
   (d) placing inside a solenoid having AC current

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?** **09108023**



(a)



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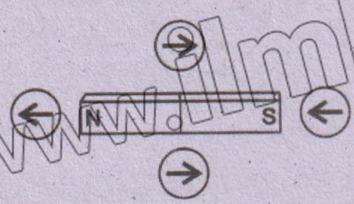
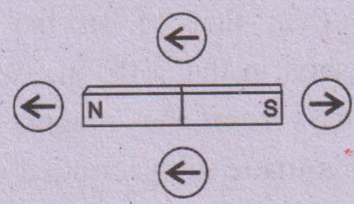
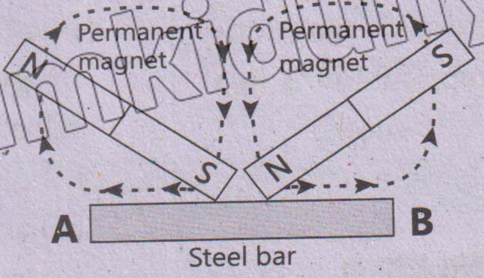


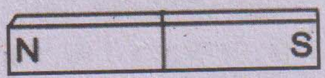
(c)



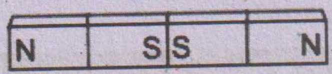
(d)

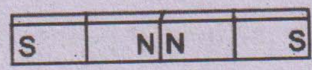
7. **A steel rod is magnetized by double touch stroking method. Which one would be the correct polarity of the AB magnet?** **09108024**



(a) 

(b) 

(c) 

(d) 

8. **The best material to protect a device from external magnetic field is:** **09108025**

(A) wood (B) plastic (c) steel (d) soft iron

Answer Key

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

SLO based Additional MCQs

Magnet

1. **If a bar magnet is cut in half it will become:** **09108026**
(a) a monopole
(b) magnetized
(c) the same magnet
(d)magnet of less strength

Magnetization Method

2. **Which one is the quickest method to magnetize a material?** **09108027**
(a) strike with hammer
(b) moving into magnetic field
(c) stroking the opposite pole
(d) putting inside a current carrying coil

Magnetic Field

3. **Earth's magnetic field intensity is:** **09108028**
(a) constant every ware
(b) very high at equator
(c) very low at poles
(d) varies place to place

4. **The cause of the Earth's magnetic field is:** **09108029**
(a) rotational motion of Earth
(b) spinning of Earth
(c) pull of the sun
(d)motion of ions in the core

Permanent Magnet

5. **Material which is the best one for making a permanent magnet:** **09108030**
(a) soft iron
(b) nickel
(c) cobalt
(d)steel

Electromagnet

6. **Material which is the best one for making an electromagnet:** **09108031**
(a) soft iron (b) nickel
(c) cobalt (d) steel

Shielding of Magnet

7. A sensitive magnetic material is to shielded by the external magnetic field. It should be kept inside a box of: 09108032

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

Magnetic Field Lines

8. Magnetic field lines: 09108033

(a) are farthest at poles
(b) intersect each other
(c) are closed
(d) do not pass in vacuum

Force on Current Carrying Wire in Same Direction

9. When two current carrying wires in the same direction are placed parallel near each other, due to magnetic field produced by each wire they: 09108034

(a) repel each other
(b) attract each other
(c) have no effect on each other
(d) stop moving the current through them

Ferromagnetic Material

10. Which of the following material is ferromagnetic? 09108035

(a) sliver (b) copper
(c) aluminum (d) nickel

Answer Key

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

(B) Short Answer Questions

8.1 What are temporary and permanent magnets? 09108036

Ans: See theory of Q No.6.

8.2 Define magnetic field of a magnet. 09108037

Ans: See theory of Q No.7.

8.3 What are magnetic line of force? 09108038

Ans: See theory of Q No. 7 (ii)

8.4 Name some uses of permanent magnets and electromagnets. 09108039

Ans: See Q No. 8 and 10.

8.5 What are magnetic domains? 09108040

Ans: The group of atoms in ferromagnatic material form a region of about 0.1 mm size that is highly magnetized. This region is called as a **magnetic domain**. Each domain behaves as a small magnet with its own north and south poles.

8.6 Which type of magnetic field is formed by a current-carrying long coil? 09108041

Ans: A current-carrying long coil forms a solenoidal magnetic field, which is similar to the magnetic field of a bar magnet. When an electric current flows through the coil, a magnetic field is generated, with lines of force emerging from the north pole and entering the south pole. The magnetic field is strongest at the center of the coil and weakens as you move away from it. The solenoidal magnetic field is nearly uniform and is commonly used in applications such as electromagnets, transformers, and inductors.

8.7 Differentiate between paramagnetic and diamagnetic materials. 09108042

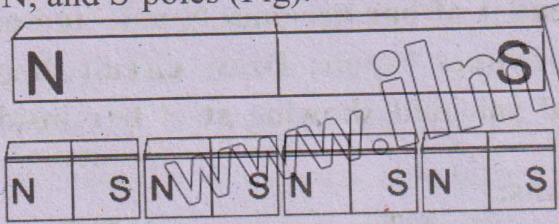
Ans: See theory of Q No.12.

SLO Based Additional Short Questions

Magnetic Poles

8.1 Is isolated magnetic pole possible? 09108043

Ans. No, it is not possible 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 complete magnet with its N, and S-poles (Fig).



8.2 Describe the direction of internal and external magnetic field. 09108044

Ans. The direction of internal magnetic field is from magnetic field is from North Pole to South Pole. But in case of internal magnetic field the direction of magnetic field is from South Pole to North Pole.

Electromagnet

8.3 Explain use electromagnetic in maglev train. 09108045

Ans. A wonderful use of electromagnets is seen in the Maglev trains. This 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. This 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.

8.4 Why high field electromagnet are made by cores of soft iron. 09108046

Ans. The magnetism induced in a ferromagnetic material can be surprisingly large in the presence of weak external field. In come 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.

8.5 State some uses of electromagnet. 09108047

Ans. There are some uses of electromagnet:

(i) Magnetic Relay

(ii) Circuit Breaker

(iii) Telephone Receiver

(iv) Electromagnetic Cranes

8.6 State right hand grip rule. 09108048

Ans. Right hand Grip rule is stated as below:

"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."

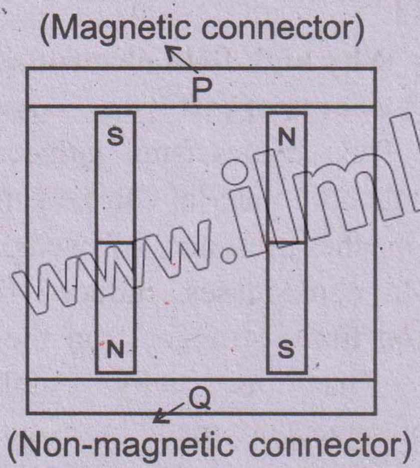
Application of Soft Iron

8.7 Why soft iron is used in cores of transformer? **09108049**

Ans. Soft iron is generally use 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 lose 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 also increased by placing a soft iron core inside the coil.

(C) Constructed Response Questions

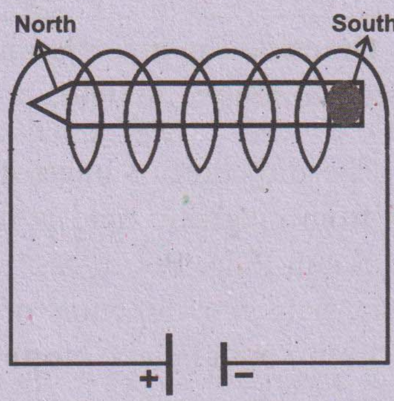
8.1 Two bar magnets are stored in a wooden box. Label the poles of the magnets and identify P and Q objects. **09108050**



Ans: Two bar magnets are stored in a wooden box with poles labelled as the North (N) of one magnet faces the South (S) of other $(N-S, S-N)$. P is the magnet connector used to preserve magnetism and Q is a non-magnetism material like wood or plastic.

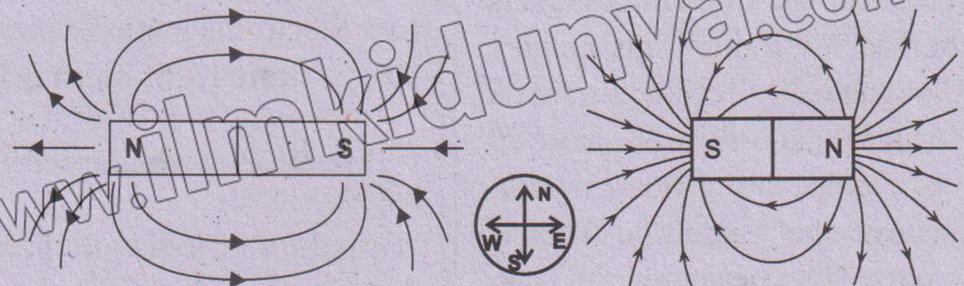
8.2 A steel bar has to be magnitised by placing it inside a solenoid such that end A of bar becomes N-pole and end B becomes S-pole. Draw circuit diagram of solenoid showing steel bar inside it. **09108052**

Ans:



8.3 Two bar magnets are lying as shown in 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. **09108053**

Ans:



8.4 Electric current or motion of electron 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.

09108054

Ans: Yes, the reverse process is true a changing magnetic field can give rise to an electric current. This phenomenon is known as electromagnetic induction and is governed by Faraday's law of induction.

Example: In an electric generator, mechanical energy is converted into electrical energy using electromagnetic induction. When a coil of wire is rotated within a magnetic field, the magnetic field through the coil changes continuously. According to Faraday law, this change in magnetic field induced on electromotive force (EMF) in the coil, when drives an electric current.

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

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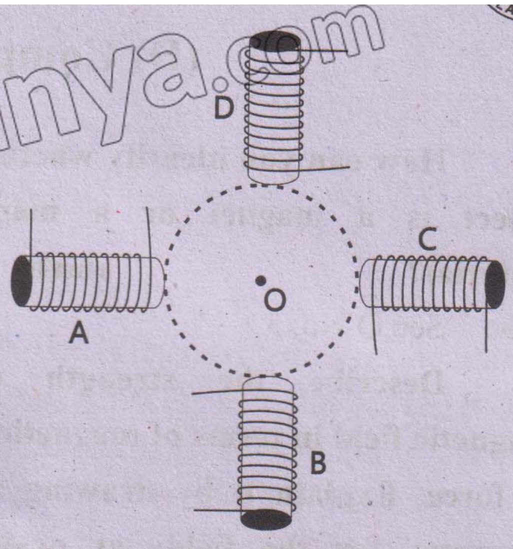

Ans: For Solenoid 1(Top):

Current should flow in a counterclockwise direction, so the magnetic field at the center 0 will point downward when viewed from the top.

For Solenoid 2 (Bottom):

Current should flow in a counterclockwise direction, so the magnetic field at the center 0 will point upwards when viewed from the bottom.

For Solenoid 3 (Right):

Current should flow in a clockwise direction, so the magnetic field at the center 0 will point left when viewed from the right.

For Solenoid 4 (Left):

Current should flow in a clockwise direction, so the magnetic field at the center 0 will point right when viewed from the left.

This arrangement ensures that the magnetic field produces by each solenoid will contribute to pointing towards the solenoid that is switched off, maintaining symmetry and achieving the desired effect.

(D) Comprehensive Questions

8.1 How can you identify whether an object is a magnet or a magnetic material? **09108056**

Ans: See Q No. 3

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. **09108057**

Ans: See Q No .7

8.3 What is a circuit breaker? Describe its working with the help of a diagram. **09108058**

Ans: See Q No. 10.

8.4 A magnet attracts only a magnet. Explain the statement. **09108059**

Ans: A magnet attracts certain materials, not just other magnets. These materials include ferromagnetic materials like iron, nickel, and cobalt, as well as paramagnetic materials like aluminum and oxygen. When a magnet is brought near these materials, it induces magnetization in them, causing them to be attracted to the magnet. However, non-magnetic materials like wood, plastic, and glass are not attracted to magnets, and diamagnetic materials like copper and silver are actually repelled by them.

8.5 Differentiate between paramagnetic, diamagnetic and ferromagnetic materials with referene to the domain theory. **09108060**

Ans: See Q No. 12

8.6 Why ferromagnetic materials are suitable for making magnets? **09108061**

Ans: See Q No. 13

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