

Magnetism

- **Synopsis**

- The first natural magnet was discovered in Magnesia, a town in Greece. It was called the lodestone.
- Artificial magnets are **made of iron** or steel. They are made of different shapes namely the bar magnet, cylindrical magnet, U-shaped magnet, horse-shoe magnet, magnetic needle and compass.
- The materials which are attracted by a magnet are called magnetic materials. Examples: iron, steel, cobalt.
- The materials which are not attracted by a magnet are called non-magnetic materials. Examples: paper, wood, brass, plastic, copper aluminium, etc.
- A magnet has two poles, a north and a south pole.
- **A magnet has the following properties:**

1. A magnet attracts the small pieces of iron.
2. A magnet always rests in the north-south direction, if it is free to swing.
3. Like poles repel each other and unlike poles attract each other.
4. Poles always exist in pairs, cannot be isolated.

- Magnets are used to separate iron and steel from their mixture with non-magnetic substances. –
- Magnets are used in many electrical appliances such as electric bell, loud-speaker, etc.
- A magnetic compass is used by sailors and navigators to find the north-south direction.
- Magnetic induction is the process in which a piece of iron temporarily behaves like a magnet in the presence of another magnet.
- When a magnet is placed near an iron piece, the iron piece behaves like a magnet. The end of the iron piece near the north pole of the magnet becomes a south pole while the farther end becomes a north pole.
- It is because of magnetic induction that a magnet attracts a piece of iron.
- An iron piece can be made into a magnet by any of the following methods:

1. Magnetic induction
2. Single touch method
3. Double touch method
4. Electrical method

- In the single touch method, we need a single magnet, but in the double touch method we need two magnets, in these methods, the end touched last by the magnet has the polarity opposite to that of the striking pole.
- Powerful magnets are made by the electrical method.
- Electromagnets or temporary magnets are made of soft iron.
- Permanent magnets are made of steel.
- Electromagnets are used in devices like electric bell, magnetic toys, telephone etc.
- Permanent magnets are used in devices like galvanometer, ammeter, voltmeter etc.

- A magnet can be destroyed by rough handling, by dropping it several times, by hammering it repeatedly and by heating it.
- The magnetic field around a magnet is the space in which a magnetic substance such as small iron piece experiences a force of attraction.
- The earth itself behaves like a magnet. It has its own magnetic field.
- The south polarity of the earth is near the geographic north pole and the north polarity of the earth is near the geographic south pole.
- Magnetic keepers are used to store the magnets.
- Magnetic keepers are small pieces of soft iron.

ACTIVITY 1

- **Magnetic objects**

Iron, Steel, Cobalt, Nickel

- **Non-magnetic objects**

Wood, Stone Plastic, Rubber Copper, Sand, Gold, Silver, Brass Paper, Aluminium

- **Test yourself**

- **A. Objective Questions**

- **1. Write true or false for each statement.**

- (a) Artificial magnets are weaker than the natural magnets.

Answer. False

Artificial magnets are stronger than the natural magnets.

- (b) Poles of a magnet cannot be separated.

Answer. True

(c) A magnet can attract only a magnetic substance.

Answer. True

(d) A magnet has no effect when it is heated to a high temperature.

Answer. False.

A magnet get demagnetised when it is heated to a very high temperature.

(e) Permanent magnets get easily demagnetised.

Answer. False.

Permanent magnets cannot be demagnetised.

(f) Magnetic poles occur in pairs.

Answer. True

(g) Single touch method is better than the electrical method for making a magnet.

Answer. False.

Electrical method is better than single touch method.

(h) Magnetic keeper is a wooden piece.

Answer. False.

Magnetic keepers are the pieces of soft iron.

(i) Copper cannot be magnetised.

Answer. True

2. Fill in the blanks

(a) Temporary magnets are usually made up of **soft iron**.

(b) Rough handling destroys the **magnetic** properties of a magnet.

(c) Like poles **repel** each other.

(d) A freely suspended magnet points in the **north-south** direction.

(e) In a magnet, **ends** have the maximum attractive property.

(f) A magnet has **two** poles.

3. Match the following

Column A

(a) Steel

(b) Soft iron

(c) Use in electric bell

(d) Magnetic keepers

Column B

(i) to store magnets

(ii) temporary magnet

(iii) permanent magnet

(iv) electromagnet

Ans. Column A

(a) Steel

(b) Soft iron

(c) Use in electric bell

(d) Magnetic keepers

Column B

(iii) permanent magnet

(ii) temporary magnet

(iv) electromagnet

(i) to store magnets

4. Select the correct answer

(a) If we suspend a magnet freely, it will settle in .

1. east-west direction
2. **north-south direction**
3. north-east direction
4. east-south direction

(b) Making a magnetic substance a magnet by bringing it closer to another magnet without touching it, is

1. **magnetic induction method**
2. single touch method
3. double touch method
4. electrical method

(c) An example of natural magnet is

1. iron
2. steel
3. **lodestone**
4. none of above

(d) The artificial magnet used to detect direction in the laboratory is

1. U-shaped magnet
2. horse shoe magnet
3. electromagnet
4. **magnetic compass**

B. Short/Long Answer Questions

Question 1.

What is a magnet ?

Answer:

The substances which have the property of attracting iron, are called magnets.

Question 2.

What are magnetic and non-magnetic substances ? Give two examples of each.

Answer:

Magnetic substances: The substances that get attracted by a magnet are called magnetic substances. Iron, steel, cobalt and nickel are magnetic substance

Non-magnetic substances : The substances that do not get attracted by a magnet are called non-magnetic substances, e.g., wood, plastic, copper, paper, aluminum, rubber, stone.

Question 3.

What are natural and artificial -magnets ?

Answer:

Natural magnets: Natural magnets are those which are found in nature e.g. load stone.

Artificial magnets: Man made magnets are called artificial magnets, e.g. electromagnet.

Question 4.

How is an artificial magnet prepared from a natural magnet ?

Answer:

Pieces of iron or other materials are made magnets by rubbing them with natural magnets (or by passing direct current through a wire wound around them). This is how artificial magnets are made.

Question 5.

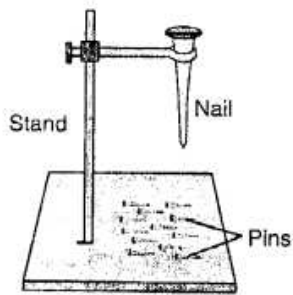
State two ways of magnetising an iron piece.

Answer:

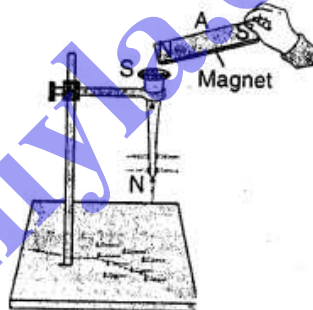
The two ways of magnetising an iron piece are:

1. Magnetic induction method.

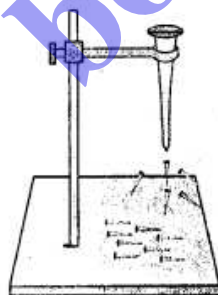
Take a long iron nail and test it for magnetic properties by bringing near the magnetic substances. You will see nail does not attract the magnetic substances. Now bring near a pole of a bar magnet to the head of the nail. Now bring the iron paper clips near the pointed end of the nail, you will observe that the iron paper clips now get attracted towards the nail. This is because iron nail has become magnet. Now take the bar magnet away from the iron nail, paper clips fall off. This magnetism is temporary.



No pin clings to the nail



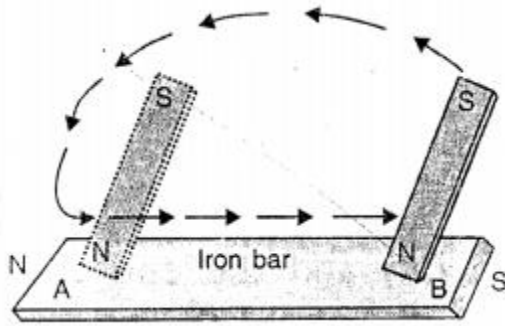
Some pins cling to the nail



*On removal of the magnet,
pins fall down*

2. Single touch method: Take a demagnetised piece of iron. Place it on a table surface. Take a magnet and select its one pole. Now rub it with the selected pole on the iron in one direction for several times. After sometime, the iron piece turns

into a magnet.



Question 6.

How can magnetic properties of a magnet be destroyed ?

Answer:

1. By hammering the magnet repeatedly.
2. By rough handling
3. By heating.

Question 7.

Why does a freely suspended magnet always rest in north- south direction ?

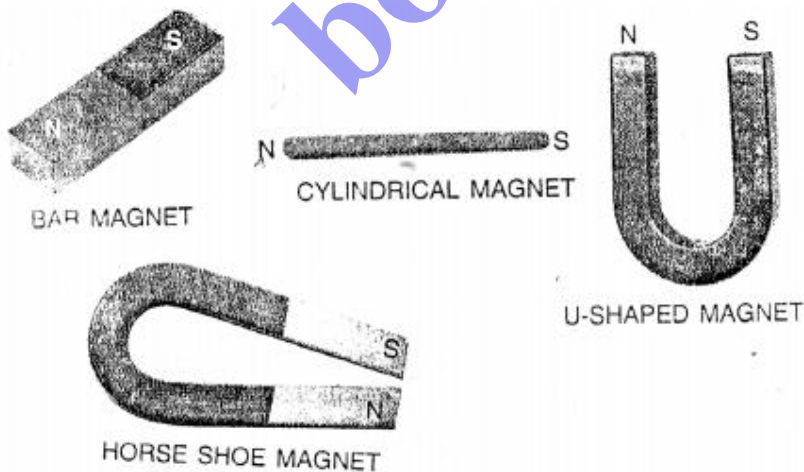
Answer:

A freely suspended magnet always rest in north-south direction because the north-pole of the magnet lies in the geographic north direction and the south pole of the magnet lies in the geographic south direction. So it aligns itself in N-S direction. As unlike poles attract and like poles repel.

Question 8.

Draw diagrams of the artificial magnets of four different shapes.

Answer:



Question 9.

Why are the artificial magnets preferred over the natural magnets ?

Answer:

Artificial magnets are preferred over natural magnets because natural magnets are weak and often irregular in shape, they can readily be magnetised and demagnetised by turning the current on or off in the coil.

Question 10.

Describe an experiment to show that the maximum attractive property is at the poles of a magnet.

Answer:

Take a bar magnet and place a steel pin at some distance. We observe that nothing happens. Now, bring the steel pin near the pole of the bar magnet. We notice that pin sticks to the magnet. This experiment shows that maximum magnetic force acts at the poles of the magnet.

Question 11.

State four important properties of a bar magnet.

Answer:

1. Attractive property: A magnet can attract small pieces of iron filing or other ferromagnetic materials.
2. Directive property: If a magnet is suspended horizontally by a thin thread (say silk thread), it rests always pointing north-south direction of earth.
3. Like poles always repel each other and unlike poles attract each other.
4. Poles always exist in pairs : Single pole can never exist.

Question 12.

Explain the attractive property of a magnet with the help of an experiment.

Answer:

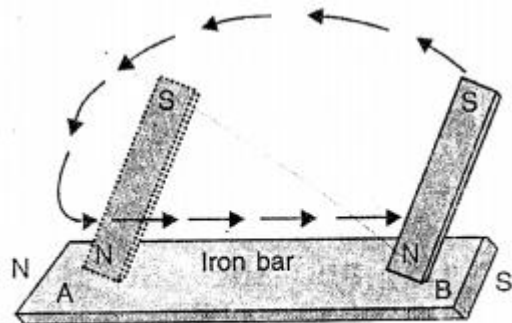
Take iron filling on a piece of paper. Bring a bar magnet near it. Iron filling will cling to it. It shows the attractive property of magnet.

Question 13.

Describe the method by which an iron bar can be made a magnet.

Answer:

Single touch method : Place the iron bar (or the needle) AB on a table. Take a bar magnet NS and place it almost vertical with its north pole (N) on the end A of the bar. Move the magnet along the iron bar till the other end B is reached.



Single touch method

Lift the magnet at the end B and again place it on the first end A. Again stroke the bar. Repeat the process about 20 times. Then turn the iron bar AB upside down. Again stroke it with the magnet about 20 times. The bar now becomes a magnet.

Question 14.

How are the magnets kept safely? What is the role of keepers in storing the magnets?

Answer:

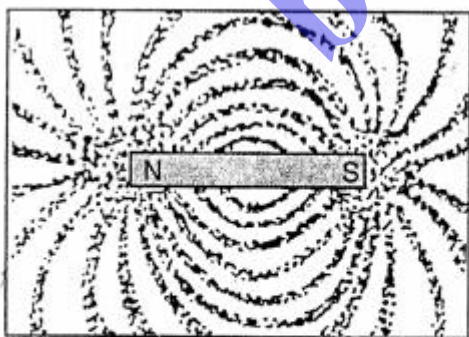
When magnets are not in use they should be kept and stored in magnetic keepers. The magnetic keepers are the pieces of soft iron. A magnetic keeper has a card board with one or two iron soft pieces. Two magnets are placed in such a way that their opposite poles are close to each other and then a soft iron keeper is attached with it.

Question 15.

Define the term magnetic field of a magnet. How will you recognise it experimentally?

Answer:

The space around a magnet in which if a magnetic substance such as small pieces of iron, are placed, they get attracted towards the magnet, is called the magnetic field. Recognition of the magnetic field around a magnet: If a magnet is placed below a sheet of stiff paper and some iron filings are spread on it, then on tapping the sheet gently, the iron filings are found to arrange themselves in a definite pattern as shown in fig.



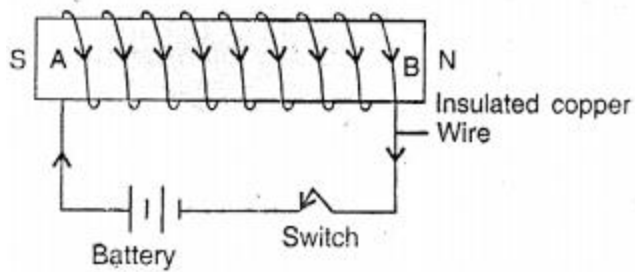
Arrangement of iron filings on a sheet above a magnet

Question 16.

How will you make an iron bar electromagnet ? Draw a diagram showing the polarities of the electromagnet.

Answer:

Take the given iron bar AB. Wound several turns of insulated copper wire over the bar. Connect the ends of the wire to a battery through a switch. Press the switch to pass current. After some time, the bar AB becomes a magnet.



Electrical method

The end A of the bar at which the current enters the coil in clock-wise direction becomes the south pole (S) and the end B of the bar at which the current leaves the coil in anti-clockwise direction becomes the north pole (N).

Question 17.

State two ways of increasing the strength of an electro Magnet

Answer:

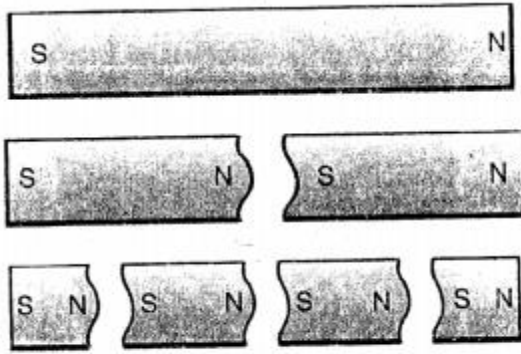
Strength of the electromagnet: The strength of the electromagnet can be increased:

1. by increasing the current in the coil, and
2. by increasing the total number of turns of the coil.

Question 18.

Suppose you are given a long bar magnet and you are asked to break it into four small magnets. Draw diagrams showing the polarities of each broken part.

Answer:



Poles exist in pairs

Question 19.

State three important uses of a magnet.

Answer:

Use of magnet:

1. Magnets are used in magnetic compass, door bells, refrigerators.
2. Magnets are used in dynamos, motors, loudspeakers, microphones etc.
3. Ceramic magnets are used in computers.
4. Magnets are used in toys to give magic effect.

Question 20.

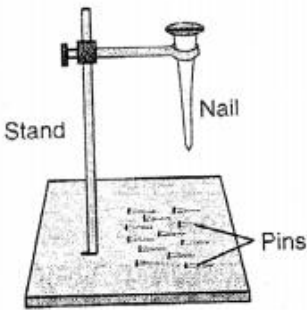
What is magnetic induction ? Explain with the help of a diagram.

Answer:

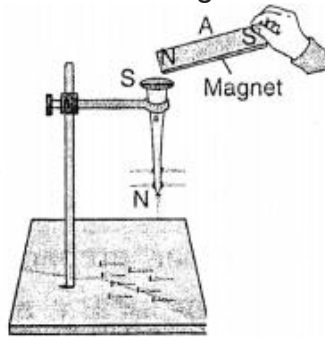
Magnetic Induction: The property by which an ordinary piece of iron acquires magnetic properties temporarily due to the presence of another magnet close to it, is known as magnetic induction

Take a long nail. Put it on the arm of a stand. Spread some iron pins on the base of stand. You will find that the pins do not get attracted towards the nail. Now touch a magnet at the end of nail. As the end is brought close to the head of nail, some pins cling to the nail. It happens because the nail turns into magnet and acquires the properties of magnetism. The moment you remove the magnet from the head of the

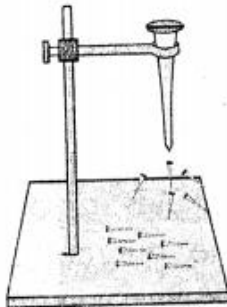
nail. The pins will fall down. It will no more be a magnet.



No pin clings to the nail



Some pins cling to the nail



*On removal of the magnet,
pins fall down*

Question 21.

In which direction does a suspended bar magnet come to rest? Give reason.

Answer:

A magnet always rests in North and South direction, i.e. N-end always towards North of Earth and S-end towards South of Earth.

Question 22.

State three differences between the temporary and permanent magnets.

Answer:

Temporary magnet

1. It is made up of soft iron.
2. The magnet which loses its magnetism as soon as magnetising force is removed away from it.
3. Because of its weak power, it is not used to make iron piece into magnet.

Permanent magnets

1. It is made up of steel, cobalt and nickel.

2. The magnet, which does not lose its magnetic properties easily is called permanent magnet.
3. It can convert ordinary piece of iron into a temporary magnet.

Question 23.

State three ways of demagnetising a magnet.

Answer:

A magnet can be demagnetized in the following ways

1. rough handling
2. hammering the magnet several times.
3. passing an alternating current around the magnet.
4. dropping the magnet on the floor several times.
5. heating the magnet to a very high temperature.

Question 24.

Suggest one way to recognise the magnetic field of the earth.

Answer:

If we suspend a magnet such that it is free to swing, we see that it always rests in the north-south direction. The north pole of the magnet lies in the geographic north direction and the south pole of the magnet lies in the geographic south direction. So it aligns itself in N-S direction.

Question 25.

Name the material of core of an electromagnet for

1. temporary magnet
2. permanent magnet.

Answer:

1. They are made of soft iron.
2. They are made of iron, steel, cobalt, nickel or an alloy called ANILCO.

Question 26.

You are given an iron nail, a torch cell and a long piece of insulated copper wire. With the help of a labelled neat diagram, describe in steps how you will make the nail, an electromagnet.

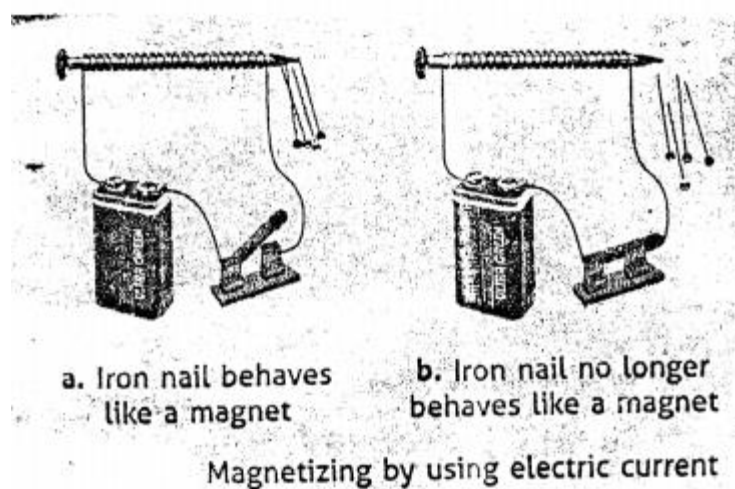
Answer:

Aim : To make an electromagnet.

Materials Required : An iron nail, a battery, a switch, some insulated copper wire and some iron paper pins.

Procedure : Coil the insulated copper wire around the iron nail. Connect the ends of the wire to the battery through the switch. Close the switch so that electric current flows through the copper wire. Now bring the iron paper pins close to the iron nail.

Observation And Conclusion : The paper pins get attracted to the nail, showing that the nail has turned into an electromagnet. Now, if you switch off the current, the iron paper pins will drop off the iron nail.

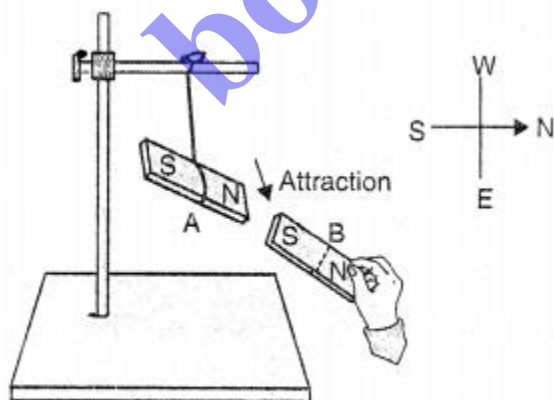


Question 27.

Describe an experiment to illustrate that like poles repel while the unlike poles attract.

Answer:

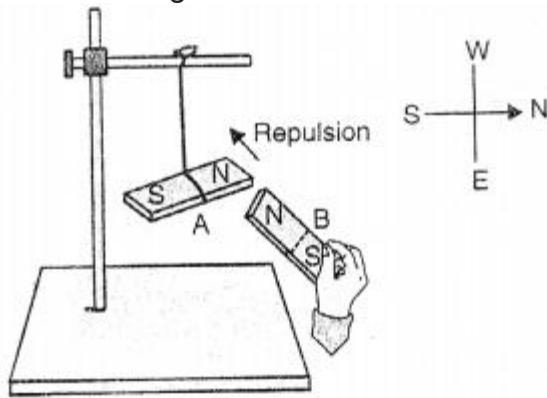
1. Take two bar magnets A and B. Suspend one magnet A with a silk thread from a support so that it is free to swing. The magnet will come to rest in the north-south direction. The north pole of the magnet is in the north direction and the south pole of the magnet is in the south direction.
2. Now holding the other magnet B in your hand, bring its north pole near the north pole of the suspended magnet A (such that the two magnets do not touch each other) as shown in figure. You will observe that the suspended magnet A moves away from the magnet B. This shows that the like poles repel each other.



Like poles of magnets repel each other

Now bring the south pole of the magnet B near the north pole of the suspended magnet A as shown in figure, without touching it. You will observe that the magnet A moves

towards the magnet B. This shows that the unlike poles attract each other.



Unlike poles of magnets attract each other

Question 28.

What are magnetic keepers? Name its material.

Answer:

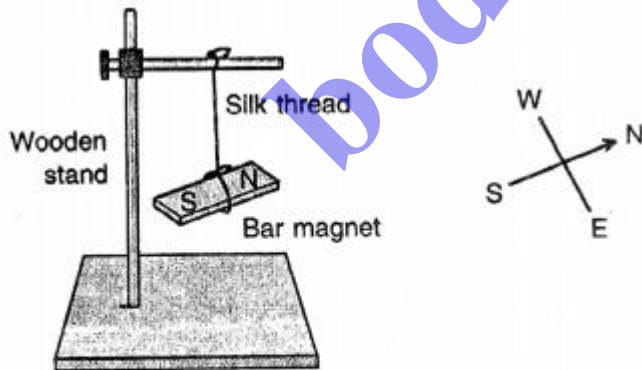
Magnetic keepers are used to store the magnets. Magnetic keepers are small pieces of soft iron.

Question 29.

How are the north and south poles of a magnet located? Explain.

Answer:

Suspend a bar magnet with a silk thread from a wooden stand as shown in figure. The magnet swings for some time and then eventually comes to rest in a particular direction i.e., north-south direction. If we disturb the magnet a little, the magnet again comes to rest in the north-south direction.



A freely suspended magnet rests in north-south direction

The end of the magnet which points towards the north is called the north seeking pole or simply the north pole and the end which points towards the south is called the south seeking pole or simply the south pole. The north and south poles are marked by the letters N and S respectively.

ADDITIONAL QUESTIONS

Check Your Progress

Answer the following.

Question 1.

What are magnetic substances ?

Answer:

Substances such as iron, nickel, cobalt, or their alloys that get attracted by a magnet are called magnetic substances.

Question 2.

What are artificial magnets ?

Answer:

Magnets that are made by humans from magnetic substances are called artificial magnets. They can be made in different shapes and sizes like bar magnet, horseshoe magnet, etc.

Question 3.

Why is it not possible to isolate a single magnetic pole?

Answer:

Magnetic poles always exist in pairs and cannot exist independently. If a bar magnet is broken into two or more pieces, each of them will have a north pole and a south pole. Hence, it is impossible to obtain a piece of magnet with only one magnetic pole.

Question 4.

Can you bring two similar poles of two different magnetic close together easily? Why?

Answer:

No, because like poles repel each other, when two magnetic are brought close to each other.

Question 5.

What is meant by the directional property of magnets ?

Answer:

Directional property of magnets states that a freely suspended magnet always points towards the geographical north-south direction. Every magnet, irrespective of its shape, has a north pole and a south pole.

Exercises

A. Tick the most appropriate answer.

1. Temporary magnets are made of

1. **soft iron**
2. steel
3. stainless steel
4. copper

2. The surest test of magnetism is

1. attraction
2. **repulsion**
3. diffusion
4. hammering

3. Which of the following methods is used to magnetize a magnetic without touching it by a magnet ?

1. Single-touch
2. Double-touch
3. **Using electric current**
4. None of these

4. The region around a magnet where its magnetic force can be experienced is called

1. magnetic axis
2. magnetic equator
3. **magnetic field**
4. magnetic poles

5. A permanent magnet can be demagnetized by

1. hammering
2. heating
3. rough handling
4. **all of these.**

B. Fill in the blanks.

1. A freely suspended magnet always comes to rest in the **north- south** direction.
2. Permanent magnets are generally made of steel, cobalt, nickel, or an alloy called **ALNICO**.
3. The perpendicular bisector of the line joining the two poles of a magnet is called **magnetic equator**.
4. The north pole of the imaginary magnet of the earth is near the

geographic **south** pole.

5. Magnetic poles always exist in **pairs**.

C. State if the following statements are true or false. Correct the statement if it is false.

1. If a bar magnet is cut in two pieces, then one piece will have only the north pole and the other will have only the south pole.

Answer. False.

If a bar magnet is cut in two pieces, then each of the piece will have the north pole and the south pole.

2. Attraction is the surest test for magnetism.

Answer. False.

Repulsion is the surest test for magnetism.

3. Temporary magnets are made of cobalt.

Answer. False.

Temporary magnets are made of soft iron.

4. As we move away from a magnet, its attraction power weakens.

Answer. True.

5. Whenever a magnet is not in use, it should be stored along with other magnets.

Answer. False.

Whenever a magnet is not in use, it should not be stored along with other magnets.

D. Give reasons for the following.

Question 1.

Magnets must be bandied with care.

Answer:

Magnets must be handled with care or else they lose their magnetic properties and become weak. To prevent a magnet from becoming demagnetized, magnet should not be handled roughly, hammered, dropped, heated. It should be stored using magnetic keepers.

Question 2.

Iron is a magnetic substance.

Answer:

Iron is a magnetic substance because it gets attracted by a magnet.

Question 3.

The directive property of magnets is used in a compass.

Answer:

The directive property of magnet is used in a compass for navigation purposes as the magnetic needle inside the compass always rests in the geographical north-south direction.

Question 4.

Electromagnets are temporary magnets.

Answer:

An electromagnet is a temporary magnet because it behaves like a magnet only till the current is passed through it. When the ~ current is stopped, it stops behaving like a magnet.

Question 5.

Magnets are used to close the doors of a refrigerator tightly.

Answer:

Because of the attractive property of a magnet. A magnet attracts magnetic substances by exerting a force called magnetic force. , This keeps the door of a refrigerator closed tightly.

E. Answer the following in short.

Question 1.

Give two examples each of magnetic and. non-magnetic substances.

Answer:

Examples of magnetic substances – Iron, nickel, cobalt

Examples of non-magnetic substances – Plastic, wool, wood, paper, rubber, etc.

Question 2.

What is a magnet ? Differentiate between natural and artificial magnets.

Answer:

A magnet is a piece of metal that can attract metals such as iron cobalt and nickel.

Naturally occurring rocks such as Lodestone or magnetite have the ability of attracting magnetic substances and hence are called natural magnets.

Magnets that are made by man from magnetic substances ara called artificial magnets.

These come in different shapes such as bar magnets, horse shoe magnets, disc magnets and ring magnets. Artificial magnets can be made in any size, shape or strength as desired but natural magnets cannot be made as desired.

Question 3.

If a bar magnet is placed over iron fillings, where will the attraction of the iron fillings be

1. maximum ?

2. minimum ?

Answer:

1. At the ends of the bar magnet.
2. At the centre of the magnet.

Question 4.

Define the following terms regarding a bar magnet,

1. Magnetic axis
2. Effective length
3. Magnetic equator
4. Magnetic field

Answer:

1. An imaginary line (XY) passing through the magnetic north pole and magnetic south pole of a bar magnet is called its magnetic axis.
2. The distance (NS) between the north pole and south pole of a magnet is called the length or effective length of the magnet.
3. An imaginary line (PQ) bisecting the effective length of a magnet is called the magnetic equator of the magnet.
4. The region around a magnet where its magnetic force can be experienced is called the magnetic field.

Question 5.

Name a few common appliances that use electromagnets.

Answer:

Electric bells, electric motor, telephones, loudspeakers and generators are few common appliances that use electromagnets.

F. Answer the following in detail.

Question 1.

Distinguish between a temporary magnet and a permanent magnet.

Answer:

Temporary magnet

1. These magnets retain their magnetic property for a short duration of time.
2. These are made of soft iron.
3. They lose their magnetic properties once the magnetizing force is removed.

Permanent magnet

1. These magnets retain their magnetic property always.
2. These are made of iron, steel, cobalt, nickel or an alloy called ALNICO.
3. They retain their magnetic properties even after the magnetizing force is removed.

Question 2.

Write a short note on the theory of magnetism.

Answer:

All substances are made of minute particles. In a magnetic substance whether magnetized or non-magnetized), each individual particle behaves like an independent magnet. In the unmagnetized state, these particles within the substance are present in a random fashion such that they cancel out the magnetic effects of each other. In a magnetized state, these particles align in a particle direction and the substance behaves like a magnet.

Question 3.

List four methods of magnetizing a magnetic substance.

Answer:

Methods of magnetizing a magnetic material are :

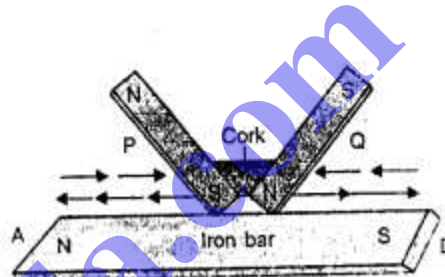
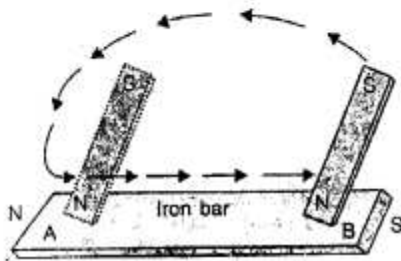
1. **Single-touch method** – A magnet is rubbed along the magnetic substance from one end to another.
2. **Double-touch method** – Opposite poles of two magnets are placed next to each other at the centre of the magnetic substance and rubbed in opposite direction along it.
3. **Magnetizing by induction** – It is a method to make temporary magnets under the influence of a magnetizing force. The magnetic properties disappear when the influence of the magnetizing force is removed.
(A permanent magnet is brought close to the magnetic substance but not touched.)
4. **Electric current** – A magnet made by using electric current is called an electromagnet. It is a temporary magnet and stops behaving like a magnet when the current is stopped. Electromagnets can become permanent magnets if certain materials like steel and special alloys are placed in a coil and very strong current is passed through the coil.

Question 4.

How is the single-touch method of magnetism different from the double-touch method ?

Answer:

Single-touch method of magnetism	Double-touch method of magnetism
(i) A magnet is rubbed along the magnetic substance (needle or iron piece) from one end to another and lifted vertically upwards.	Opposite poles of two magnets are placed next to each other at the centre of the magnetic substance and rubbed in opposite direction.



Question 5.

How can a magnet be demagnetized ?

Answer:

A magnet can be demagnetized in the following ways :

1. rough handling
2. hammering the magnet several times.
3. passing an alternating current around the magnet.
4. dropping the magnet on the floor several times.
5. heating the magnet to a very high temperature.