4 Electricity: Magnetic and Heating Effects

Fill in the Blanks

1. When electric current flows through a conductor, it produces a _____ around it.
2. The region around a magnet or current-carrying wire where its magnetic effect can be felt is called a _____.
3. A current-carrying coil that behaves like a magnet is called an _____.
4. Most practical electromagnets have an _____ core to make them stronger.
5. The generation of heat in a conductor due to the flow of electric current is called the _____ effect of electric current.
6. _____ wire is commonly used in electrical heating devices because it offers relatively high resistance.
7. In a Voltaic cell, the liquid or solution that helps conduct electricity is called an _____.
8. In a dry cell, the _____ container acts as the negative terminal.
9. A carbon rod with a metal cap in a dry cell acts as the _____ terminal.
10. Batteries that can be recharged and reused multiple times are called _____ batteries.

Multiple Choice Questions

1. What happens to a magnetic compass placed near a current-carrying wire?
   a) It stops working
   b) Its needle gets deflected
   c) It becomes hot
   d) It loses its magnetism

2. Who discovered the link between electricity and magnetism described in this chapter?
   a) Alessandro Volta
   b) Luigi Galvani
   c) Hans Christian Oersted
   d) Isaac Newton

3. Which of the following makes an electromagnet stronger?
   a) Decreasing the number of turns
   b) Using fewer cells
   c) Increasing the number of turns of the coil
   d) Disconnecting the battery

4. Which material is commonly used as the core of a practical electromagnet?
   a) Wood
   b) Plastic
   c) Iron
   d) Glass

5. Which of the following appliances mainly works on the heating effect of electric current?
   a) Electric iron
   b) Electric bell
   c) Compass
   d) Loudspeaker

6. Why is nichrome used in heating elements?
   a) It has very low resistance
   b) It offers relatively high resistance and produces more heat
   c) It is an insulator
   d) It does not allow current to flow

7. Which of the following is an electrolyte in a lemon cell?
   a) Copper strip
   b) Iron nail
   c) Lemon juice
   d) Connecting wire

8. What acts as the negative terminal in a typical dry cell?
   a) Carbon rod b) Zinc container
   c) Metal cap d) Electrolyte

9. Which type of battery can be recharged and reused?
   a) Single-use dry cell b) Rechargeable battery
   c) Voltaic cell only d) Lemon cell only

10. What happens when the direction of current through an electromagnet is reversed?
   a) It stops producing a magnetic field b) Its poles are reversed
   c) It becomes permanently magnetised d) Its core disappears

Assertion – Reason Questions

Directions:
(a) Both A and R are true and R is the correct explanation.
(b) Both A and R are true but R is not the correct explanation.
(c) A is true but R is false.
(d) A is false but R is true.

1. Assertion (A): A compass needle gets deflected when placed near a current-carrying wire.
   Reason (R): Electric current produces a magnetic field around a conductor.

2. Assertion (A): An electromagnet can be switched on and off.
   Reason (R): Its magnetic effect is present only when electric current flows through its coil.

3. Assertion (A): An iron core makes an electromagnet stronger.
   Reason (R): Iron strengthens the magnetic effect of the current-carrying coil.

4. Assertion (A): Increasing the number of turns in an electromagnet's coil can increase its strength.
   Reason (R): More turns of the coil produce a stronger magnetic effect.

5. Assertion (A): Reversing the battery terminals can reverse the poles of an electromagnet.
   Reason (R): Reversing the battery terminals reverses the direction of current through the coil.

Short Answer Questions

1. What is meant by the magnetic effect of electric current?
2. What is a magnetic field? How can its presence near a current-carrying wire be detected?
3. What is an electromagnet? How is it different from an ordinary bar magnet?
4. Why is an iron nail or iron core inserted inside the coil of an electromagnet?
5. State two ways by which the strength of an electromagnet can be increased.
6. Why does a compass needle return to its original direction when the current through a nearby wire is switched off?
7. What is the heating effect of electric current? Give two examples of appliances that use this effect.
8. Why is nichrome commonly used as a heating element instead of copper?
9. What is an electrolyte? Explain its role in a Voltaic cell.
10. Differentiate between a dry cell and a rechargeable battery.

Long Answer Questions

1. Explain the magnetic effect of electric current with the help of the compass experiment. Describe the observation when the switch is turned ON and OFF.
2. Describe how an electromagnet can be made using an iron nail, insulated wire, and a cell. Explain what happens when the current is switched on and off.
3. Explain the factors that affect the strength of an electromagnet. How do the number of turns, amount of current, and iron core affect its strength?
4. Explain how the poles of an electromagnet can be identified and reversed. What happens when the direction of current through its coil is changed?
5. What are lifting electromagnets? Explain how they work and describe their applications in factories and scrap yards.
6. Explain the heating effect of electric current. Why does a nichrome wire become hot when current passes through it? Mention the factors on which the heat generated depends.
7. Describe the working of a Voltaic cell. Explain the roles of the electrodes and electrolyte and how chemical reactions inside the cell produce electricity.
8. Describe the construction of a dry cell. Explain the functions of the zinc container, carbon rod, metal cap, and electrolyte.
9. Explain how a simple lemon cell can be constructed. What materials are required, and why does an LED glow when the cells are properly connected?
10. Compare single-use cells and rechargeable batteries. Explain their differences, uses, advantages, and why proper disposal or recycling of used batteries is important.

Answers

Fill in the blanks

1. magnetic field
2. magnetic field
3. electromagnet
4. iron
5. heating
6. Nichrome
7. electrolyte
8. zinc
9. positive
10. rechargeable

MCQs

1. (b) Its needle gets deflected
2. (c) Hans Christian Oersted
3. (c) Increasing the number of turns of the coil
4. (c) Iron
5. (a) Electric iron
6. (b) It offers relatively high resistance and produces more heat
7. (c) Lemon juice
8. (b) Zinc container
9. (b) Rechargeable battery
10. (b) Its poles are reversed

Assertion – Reason

1. (a)
2. (a)
3. (a)
4. (a)
5. (a)

Short Questions – Answers

Ans 1: When electric current flows through a conductor such as a wire, it produces a magnetic field around the conductor. This phenomenon is called the magnetic effect of electric current. The magnetic effect disappears when the current stops flowing.

Ans 2: A magnetic field is the region around a magnet or a current-carrying conductor where its magnetic effect can be felt. Its presence near a current-carrying wire can be detected using a magnetic compass. When current flows through the wire, the compass needle gets deflected. When the current is switched off, the needle returns to its original direction.

Ans 3: An electromagnet is a coil of wire that behaves like a magnet when electric current flows through it. An iron core is generally inserted inside the coil to make the electromagnet stronger.

Unlike an ordinary bar magnet, an electromagnet can be switched on and off by controlling the flow of electric current. Its strength can also be changed, and its poles can be reversed by changing the direction of current.

Ans 4: An iron core is inserted inside the coil because it strengthens the magnetic field produced by the current-carrying coil. As a result, the electromagnet becomes stronger and can attract more iron or steel objects.

Ans 5: The strength of an electromagnet can be increased by:
- Increasing the number of turns of wire in the coil.
- Increasing the amount of electric current flowing through the coil, for example, by using more cells.

Using an iron core inside the coil also makes the electromagnet stronger.

Ans 6: A current-carrying wire produces a magnetic field that deflects the compass needle. When the current is switched off, the magnetic field produced by the wire disappears. Therefore, the compass needle is no longer affected by the wire and returns to its original north-south direction.

Ans 7: The heating effect of electric current is the phenomenon in which a conductor gets heated when electric current passes through it. The resistance offered by the conductor causes some electrical energy to be converted into heat energy.

Examples of appliances using this effect include electric irons, electric heaters, electric stoves, kettles, immersion rods, and hair dryers.

Ans 8: Nichrome is commonly used because it offers higher resistance than copper of the same size and length. When current passes through nichrome, its resistance causes more electrical energy to be converted into heat. Therefore, it can produce sufficient heat for use in appliances such as electric heaters, irons, and stoves.

Ans 9: An electrolyte is a liquid or solution that helps conduct electricity and participates in the chemical reactions inside a cell. In a Voltaic cell, the electrodes are partly dipped in the electrolyte. A chemical reaction between the electrodes and the electrolyte produces electricity.

For example, in a lemon cell, lemon juice acts as the electrolyte.

Ans 10:

Dry Cell	Rechargeable Battery
It is generally a single-use cell.	It can be recharged and reused many times.
Its electrolyte is a thick, moist paste.	It contains materials that allow the battery to be recharged.
Once its chemicals are used up, it cannot normally be reused.	It can be charged again after its stored electrical energy is used.
It is commonly used in devices such as torches and other small appliances.	It is used in mobile phones, laptops, cameras, inverters, and electric vehicles.

Long Questions – Answers

Ans 1: When electric current flows through a conductor, it produces a magnetic field around the conductor. This can be demonstrated using a magnetic compass.

A wire is connected to an electric cell and a switch, and a magnetic compass is placed below the wire. When the switch is turned ON, electric current flows through the wire. The magnetic field produced by the current-carrying wire causes the compass needle to deflect from its original direction.

When the switch is turned OFF, current stops flowing and the magnetic field around the wire disappears. The compass needle then returns to its original direction.

This experiment shows that electricity and magnetism are linked. The magnetic effect of electric current was discovered by Hans Christian Oersted.

Ans 2: An electromagnet can be made by tightly winding an insulated wire around an iron nail to form a coil. The two ends of the wire are connected to an electric cell.

When the circuit is completed and current flows through the coil, the coil produces a magnetic field. The iron nail becomes magnetised and can attract iron objects such as paper clips. Thus, the coil and iron nail together behave like an electromagnet.

When the wire is disconnected from the cell, current stops flowing. The magnetic effect of the coil disappears, and the iron nail loses its ability to attract the paper clips.

Thus, an electromagnet can be controlled by switching the electric current ON and OFF.

Ans 3: The strength of an electromagnet depends on several factors:

- **Number of turns:** Increasing the number of turns of wire in the coil makes the electromagnet stronger.
- **Amount of current:** Increasing the current flowing through the coil increases the strength of the magnetic field. For example, using more cells can provide a larger current.
- **Iron core:** Inserting an iron nail or iron core inside the coil makes the electromagnet much stronger.

Therefore, an electromagnet can be made stronger by using more turns of wire, a larger current, and an iron core.

Ans 4:
An electromagnet has two poles - North and South, just like a bar magnet. Its poles can be identified using a magnetic compass.

If the north pole of the compass is attracted towards one end of the electromagnet, that end is the South pole, because unlike magnetic poles attract each other.

The poles of an electromagnet can be reversed by changing the direction of current through its coil. This can be done by reversing the connections of the battery.

Thus, unlike a permanent bar magnet, the polarity of an electromagnet can be conveniently changed by changing the direction of electric current.

Ans 5: Lifting electromagnets are strong electromagnets used for lifting and moving heavy iron and steel objects. They are commonly attached to cranes.

When the electric current is switched ON, the electromagnet produces a strong magnetic field and attracts iron or steel objects. The crane can then lift and move these objects.

When the current is switched OFF, the magnetic field disappears and the objects are released.

Lifting electromagnets are widely used in factories and scrap yards to move, lift, separate, and sort heavy metal objects efficiently.

Ans 6: When electric current passes through a conductor, the conductor offers some resistance to the flow of current. Due to this resistance, some electrical energy is converted into heat energy. This phenomenon is called the heating effect of electric current.

Nichrome wire has relatively high resistance compared with copper wire of the same size and length. Therefore, when current flows through it, a considerable amount of electrical energy is converted into heat, causing the wire to become hot.

The heat generated in a wire depends on:

- The material of the wire
- The thickness of the wire
- The length of the wire
- The magnitude of electric current
- The duration for which current flows

The heating effect is used in appliances such as electric heaters, irons, stoves, kettles, immersion rods, and hair dryers.

Ans 7: A Voltaic cell, also called a Galvanic cell, consists of two metal plates made of different materials and a liquid called an electrolyte. The metal plates are called electrodes and are partly dipped in the electrolyte.

Chemical reactions take place between the electrodes and the electrolyte. These reactions produce electricity. When the cell is connected to an external circuit, electric current flows through the circuit.

For example, in a lemon cell, an iron nail and copper strip act as electrodes, while lemon juice acts as the electrolyte.

As the chemical substances inside the cell are gradually used up, the cell eventually stops supplying electricity and is considered dead.

Ans 8: A typical dry cell contains the following parts:

- Zinc container: It forms the outer container and acts as the negative terminal.
- Carbon rod: It is placed at the centre of the cell.
- Metal cap: It covers the carbon rod and acts as the positive terminal.
- Electrolyte: It is present around the carbon rod in the form of a thick, moist paste.

The cell generates electricity through chemical reactions involving its materials. When connected to an external circuit, electric current flows through the circuit.

Dry cells are called “dry” because their electrolyte is a thick, moist paste rather than a freely flowing liquid. They are convenient and widely used, but ordinary dry cells are single-use cells.

Ans 9: A simple lemon cell can be made using lemons, copper wires or strips, iron nails, an LED, and connecting wires.

First, a copper wire and an iron nail are inserted into each lemon, keeping them apart. The copper and iron electrodes of different lemons are then connected as shown in the circuit. The LED is connected between the free electrodes at the two ends of the arrangement.

The lemon juice acts as the electrolyte, while the copper and iron act as the electrodes. Chemical reactions between the different metals and the electrolyte produce electricity.

When the cells are properly connected, the electric current flows through the circuit and the LED glows. If the LED does not glow, its connections may need to be reversed because an LED allows current to pass in only one direction.

Ans 10: Single-use cells, such as ordinary dry cells, are designed to be used until their chemicals are consumed. Once they are used up, they cannot normally be recharged and reused. They are commonly used in small electrical devices.

Rechargeable batteries, on the other hand, can be recharged and reused multiple times. They are used in mobile phones, laptops, cameras, inverters, vehicles, and electric vehicles. Rechargeable batteries reduce waste and can save money over time.

However, rechargeable batteries also wear out after being charged and used many times. Used batteries should not simply be thrown into regular garbage. They may contain substances and metals that can be harmful to the environment and may also present fire risks. Many of their materials can be recovered and reused through proper recycling.

Therefore, used batteries should be disposed of through appropriate battery or e-waste recycling facilities.