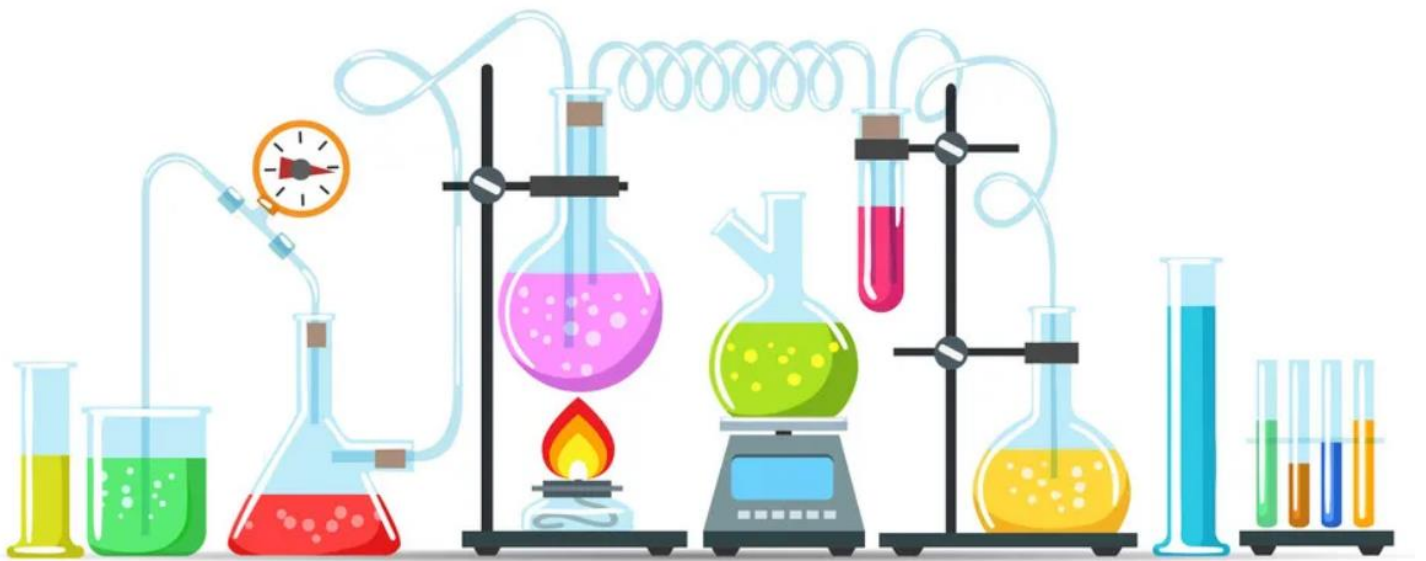


# SCIENCE

## Chapter 14: Chemical Effects of Electric Current

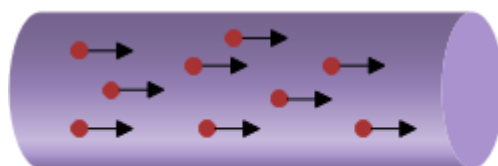


## Chemical Effects of Electric Current

Electricity can be defined as a kind of energy formed by moving charges. Metals are considered a good conductor of electricity due to the flow of electric charges in them.

### Electric Current

It can be defined as the flow of electrons. An electric current can produce chemical, heating and magnetic effects.



Electron Flow

Electric current can not flow on the conductor on its own. An electric circuit, which is a closed-loop path made up of electric components like wire, battery, switch, bulb etc is needed for current to flow in a wire or conductor.

### Conduction of Electricity

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#### Conductors

- Substances which allow electricity to pass through them are called conductors.
- Examples: Silver, gold, acidic solution, salt solution

#### Insulators

- Substances which do not allow electric current to pass through them are called insulators.
- Examples: Plastic, rubber, wood

### Conduction of Electricity through Liquid

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- Liquids which conduct electricity are solutions of acids, bases and salts in water.
- Tap water, acid solutions and salt solutions are good conductors of electricity.
- Distilled water, sugar solution and kerosene are poor conductors of electricity.

#### Difference in Conduction by Solids and Liquids

Differences in Conduction	
<b>By Solids</b> <ul style="list-style-type: none"><li>• Electricity is carried by electrons.</li><li>• No chemical change takes place.</li></ul>	<b>By Liquids</b> <p>Electricity is carried by positively and negatively charged ions.</p> <ul style="list-style-type: none"><li>• Chemical change takes place.</li></ul>

### To Test whether Liquids Conduct Electricity

- The conduction of electricity through a liquid can be tested by a conduction tester.
- A conduction tester is a device used to determine whether a substance is a good or poor conductor of electricity.
- A substance can be tested using
  - a. An electric cell and a torch bulb – for relatively strong currents
  - b. Using a light emitting diode (LED) – for weak currents
  - c. Magnetic compass – for weak currents

## Chemical Effects of Electric Current

- When an electric current is passed through a conducting solution, some chemical reaction occurs.
- Examples:
  - a. When electric current is passed through water, water dissociates into hydrogen and oxygen. Hydrogen is deposited on the negative pole, and oxygen is deposited on the positive pole. Deposition of hydrogen and oxygen at different poles is visible in the form of bubbles.
  - b. When an electric current is passed through the solution of a metal salt, such as a solution of copper sulphate, the metal gets deposited at the negative pole because metal is positively charged.
  - c. Sometimes, the colour of a solution also changes when an electric current passes through it.
- In the above examples, the chemical reaction depends on the nature of the conducting solution and on the nature of electrodes used for the passage of electric current.

## Heating Effect of Electric Current

- Heat is produced when an electric current flows through a conductor.
- This is referred to as the heating effect of electric current.

- The glowing of the bulb is caused by the heating effect of the current flowing through it.



**To determine if a substance conducts or not by the heating effect:**

- When current is passed through the bulb, the filament (tungsten) heats up to a high temperature, causing the bulb to glow.
- However, if the current is extremely small, the filament will not be heated to a high temperature and will thus not glow as a result of this.

**LED bulbs are more suitable for testing:**

As the LED bulbs can detect the flow of even a small amount of electric current. The electric current causes a heating effect due to which the filament of the bulb gets heated up and glows. Some liquids are capable of conducting electricity but they are weak conductors of electricity and the current that passes through them are not that strong enough to heat up the filament. But the use of LED bulbs overcome this situation.



**Chemical Effects of Electric Current**

The chemical effects of electric current can be defined as the passage of an electric current

through a conducting solution or an electrolyte that causes chemical changes.

This is because of chemical reactions that take place when an electric current passes through a solution.

### Applications of Chemical Effect Of Electric Current

- Extraction of metals from their ores.
- Purification of metals
- Production of compounds.
- Decomposition of compounds.

Note- William Nicholson, was the first to discover the chemical effect of current. He discovered that if electrodes were immersed in water, and a current was passed they dissociate into hydrogen ions and oxygen ions.

### Electrode and Electrolyte

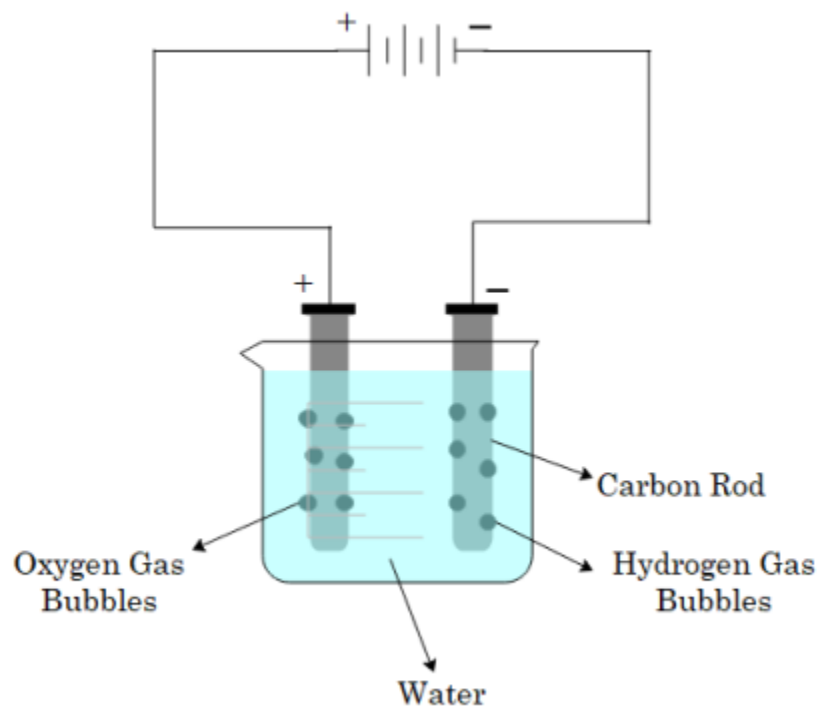
**Electrode:** An electrode is a conductor of electricity that can carry electric current into non-metals and other poor conductors of electricity.

**Electrolyte:** The electrolyte can be defined as the liquids which allow an electric current to pass through them and split themselves on the passage of electric current.

**Electrolysis:** The production or occurrence of chemical change in an electrolyte when an electric current is passed through it. The process of electrolysis shows the following things Depending on the nature of the solution and the electrode.

### Release of gas bubbles on the electrodes.

- When current is conducted through water, oxygen and hydrogen bubbles are created.
- On the positive electrode, oxygen bubbles will be present, whereas hydrogen bubbles will be present on the negative electrode.
- Chemical reaction takes place when an electric current passes through a conducting solution.
- As a result, gas bubbles could form on the electrodes.



- Release of bubbles when current passes through liquid
- Deposits of metal on electrodes.
- Change of colour of solution depending upon the electrodes.

### Cathode and Anode

The electrode connected to the negative terminal of the battery is called the cathode (negative electrode).

The electrode connected to the positive terminal of the battery is called an anode (positive electrode).

### Applications of electrolysis

Electroplating

Purification of metals

Extraction of metals from metallic ores.

### Electroplating or Electro-deposition

The process by which a layer of metal is deposited over another metal by the passage of electric current. The kind of metal that is usually electroplated are gold, silver, tin, zinc, copper, chromium.

### Reason for electroplating

Electroplating is a very useful process and widely used in industry. Electroplating is a technique for depositing a layer of metal with desired properties on another metal that is utilized in various

industries. The main reason is as follows

- To protect the metal object by coating different metal on the metal object.
- Cost-efficient for example since chromium is a costly metal, the objects are made of a cheaper metal and a chromium coating is applied for a shiny appearance.
- Prevent metal from corrosion

### **Applications of electroplating**

- Jewellery makers electroplate silver and gold on less expensive metals.
- Medical equipment is made up of nickel which is harmful to the human body hence to avoid it from coming in contact with the body a coating of platinum or gold is applied on the surface of the nickel.
- Tin cans used to store food are made of iron coated with zinc. As zinc is less reactive than iron.
- Thus, the food is prevented from coming in contact with iron and getting spoilt.
- Iron is used in bridges and automobiles to provide strength. However, iron tends to corrode and rust. So, a coating of zinc is deposited on iron to protect it from corrosion and the formation of rust.
- Because of its shiny appearance, chromium plating is used for vehicle parts and bath fittings.
- Galvanization – Coating of zinc is deposited on iron to protect it from corrosion.
- Bridges and various parts of automobiles are made up of iron and are coated with zinc in order to prevent rust (Galvanization) because it provides strength.

### **How electroplating can be done?**

Electroplating is based on the chemical effects of electricity. Electroplating helps to prevent rusting.

### **To get the coating of a different metal the following is the process**

- Two electrodes should be made of different metals.
- The metal on which coating is to be done should be used as a cathode while the metal to be deposited should be made the anode.
- The electrolyte should be a solution of the metal to be coated. For example - The coating of zinc over a copper object, the copper object is used as a cathode and a zinc plate as an anode and zinc sulphate as the electrolyte.
- The container or vessel consisting of the cathode, anode and electrolyte is called an electrolytic cell.

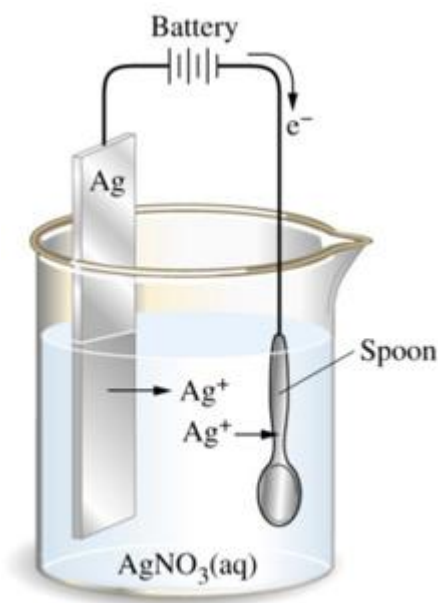
### **How a layer of one metal can be deposited on top of another?**

When an electric current is passed through the copper sulphate solution, copper sulphate

dissociates into copper and sulphate. The free copper gets drawn to the electrode connected to the negative terminal (cathode) of the battery and gets deposited on it. The process of electroplating takes some time to complete. The time taken by the process depends upon the strength of the current and also on the concentration of the electrolyte. These two help to increase the speed of electroplating. We should make sure that the electrode should be clean. The electrodes used are made up of different materials. One of the electrodes is of the same metal of which the electrolyte solution is. The second electrode needs to be the material on which coating takes place.

### Effects of electroplating

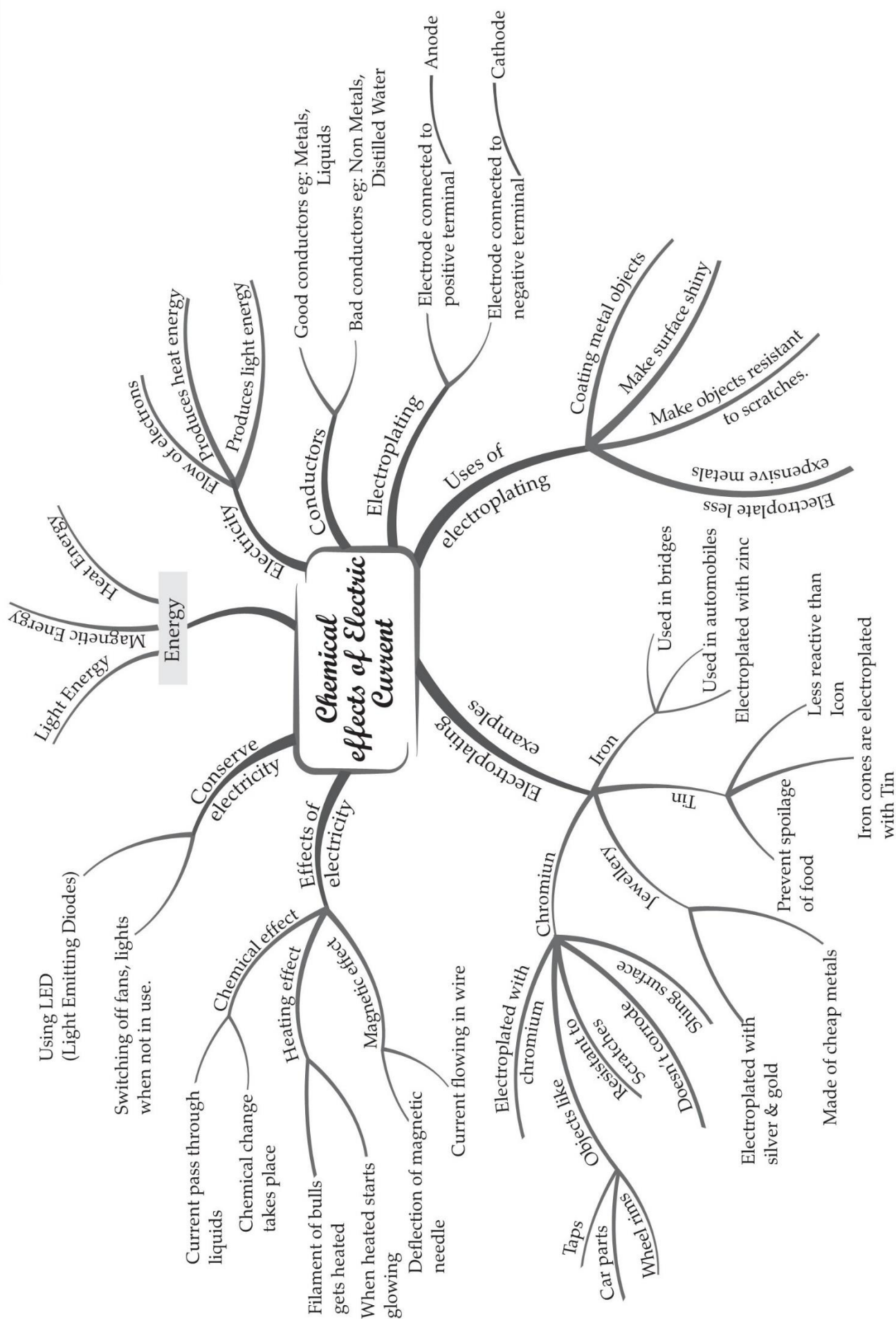
Electroplating results in the production of harmful chemicals. The disposal of these chemicals is a big concern.





## MIND MAP : LEARNING MADE SIMPLE

## CHAPTER-18



# Important Questions

## Multiple Choice questions-

Question 1. Which of the following is a bad conductor of electricity?

- (a) Distilled water
- (b) Silver nitrate
- (c) Sulphuric acid
- (d) Copper sulphate

Question 2. Which of the following does not conduct electricity?

- (a) Sugar solution
- (b) Vinegar solution
- (c) Lemon juice solution
- (d) Caustic soda solution

Question 3. An electric current can produce

- (a) heating effect
- (b) chemical effect
- (c) magnetic effect
- (d) all of these

Question 4. Pure or distilled water is a

- (a) poor conductor
- (b) good conductor
- (c) both (a) and (b)
- (d) none of these

Question 5. Which of the following is a good conductor?

- (a) Brick
- (b) Steel
- (c) Plastic
- (d) Cotton

Question 6. Polythene is

- (a) a conductor
- (b) an insulator
- (c) both (a) and (b)
- (d) none of these

Question 7. Electroplating is based on

- (a) heating effect of electricity
- (b) chemical effect of electricity
- (c) physical effect of electricity
- (d) magnetic effect of electricity

Question 8. Copper is

- (a) a good conductor
- (b) an insulator
- (c) both (a) and (b)
- (d) none of these

Question 9. Waste from an electroplating factory must be disposed off

- (a) in the nearby river
- (b) in the nearby pond
- (c) in the nearby cornfield
- (d) according to the disposal guidelines of Waste Management Bodies

Question 10. An electrolyte is

- (a) a metal
- (b) a liquid that conducts current
- (c) a non-metal
- (d) none of these

Question 11. Flow of electron is called

- (a) electrolyte
- (b) electroplating
- (c) electrodes
- (d) electric current

Question 12. Which is not a non-electrolyte?

- (a) Ethyl alcohol
- (b) Sodium chloride
- (c) Urea
- (d) Sodium solution

Question 13. An electric lamp glows due to

- (a) heating effect
- (b) magnetic effect
- (c) chemical effect
- (d) physical effect

Question 14. Electroplating prevents

- (a) corrosion
- (b) passing of current
- (c) dissociation
- (d) shining

Question 15. Which of the following is not used for electroplating metal articles?

- (a) Nickel
- (b) Silver
- (c) Chromium
- (d) Sodium

### Very Short Questions :

1. What is electricity?
2. What is the cause of electricity?
3. What is charge?
4. What is the charge on 1 electron?
5. What are the two types of electricity on the basis of charge?
6. What is the cause of the flow of charge?
7. What do you mean by chemical effect of current?
8. What do you mean by heating effect of current?
9. What do you mean by magnetic effect of current?

10. What is LED?

### Short Questions :

1. Differentiate between good conductors and bad conductors of electricity.
  2. Describe an electrical tester.
  3. How can we check whether a tester is working or not?
  4. How can you test whether lemon juice is good conductor or poor conductor of electricity?
  5. In some situation even liquid is allowing the electric current to pass but, bulb does not glow. Why so?
  6. Why the filament of bulb does not get heated sometimes in a circuit?
  7. Is it possible for an electric tester to detect weak current also, if no how can we detect weak current flowing in a circuit?
  8. Why materials classified as poor conductors, also allow electricity to pass under certain conditions?
  9. Distilled water is good conductor or bad, how can we make distilled water a good conductor?
10. Explain the functioning of a LED.

### Long Questions :

1. On what factors thickness of the electroplated items depend?
2. With the help of a suitable diagram, explain electrolytic refining of copper.
3. Does water conduct electricity? Show with the help of an activity.

OR

Show the conductivity of water with the help of an activity.

4. What is electroplating? On which effect of the electric current is it based? Why is it done?
5. What are the advantages and disadvantages of electroplating?

## ANSWER

### MCQ:

1. Answer: (a) Distilled water
2. Answer: (a) Sugar solution
3. Answer: (d) all of these
4. Answer: (a) poor conductor
5. Answer: (b) Steel
6. Answer: (b) an insulator

7. Answer: (b) chemical effect of electricity
8. Answer: (a) a good conductor
9. Answer: (d) according to the disposal guidelines of Waste Management Bodies
10. Answer: (b) a liquid that conducts current
11. Answer: (d) electric current
12. Answer: (b) Sodium chloride
13. Answer: (a) heating effect
14. Answer: (a) corrosion
15. Answer: (d) Sodium

### Very Short Answer:

1. Answer: Electricity is a phenomenon known for its effect like chemical effect, Heating effect and magnetic effect.
2. Answer: The flow of charge is the main cause of electricity.
3. Answer: The fundamental properties of matter caused by gain or loss of electrons. SI unit of charge is Coulomb or C
4. Answer:  $1.6 \times 10^{-19} \text{C}$
5. Answer: The two types of electricity on the basis of charge are:
  - (a) Static electricity: The electricity caused by the charge at rest.
  - (b) Current electricity: The electricity caused by the charge when in motion
6. Answer: Electric potential or potential difference is the main cause of electric charge.
7. Answer: The phenomenon of causing chemical change by passing electric current through a conduction solution is called chemical effect of current. For example: Electrolysis and Electroplating
8. Answer: Whenever current flows through a conductor it causes heating of material. This effect of current is known as heating effect of current.
9. Answer: Whenever current flows through a conductor it behaves like a magnet. This effect of current is known as magnetic effect of current.
10. Answer: LED stands for Light Emitting Diode. LED glows even when a weak electric current flows through it.

### Short Answer :

1. Answer:

Good conductors of electricity	Bad conductors of electricity
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They allow electricity to pass through it	They do not allow electricity to pass through it
Metals are generally good conductors	Non- Metals are generally bad conductors
Eg: copper, aluminium	Eg: rubber, wood

2. Answer: An electrical tester is a simple piece of electronic test equipment used to determine the presence or absence of an electric voltage in a piece of equipment under test. It is also used to test whether a liquid allows electric current to pass through it or not.
3. Answer: Join the free ends of the tester together, for a moment, and check whether the bulb glows or not, if the bulb glows it means tester is working and if not it means tester is not working. In case it does not glow check that all connections are tight, or not.
4. Answer: Pour one table spoon of lemon juice in a plastic cap of discarded bottle, dip the end of tester into lemon juice, make sure that the tester should not more than 1 cm apart at also should not touch each other, we will observe the current flows in the circuit and bulb glows, this proves that lemon juice is good conductor.
5. Answer: This happens when current through the circuit is too weak to make the bulb glow.
6. Answer: This is because current through the circuit is too weak so the filament of the bulb does not get heated sufficiently and it does not glow.
7. Answer: If weak current flows through the circuit then bulb in it will not glow. In order to detect weak current we use LED or may use another effect of electric current that is it produces magnetic effect also so we can use this property of electric current to detect weak current.
8. Answer: Under certain condition most of the materials can conduct electricity thus it is right to say poor conductors instead of bad conductors or insulators.
9. Answer: Distilled water is a poor conductor but if we add some salt in it the resulting salt solution is good conductor.
10. Answer: LED stands for Light emitting diode. It is a semiconductor light source, use to detect weak current in the circuit. There are two wires attached to a LED, one lead is slightly longer than the another one, the longer lead is always connected to the positive terminal of battery and shorter lead is connected to negative terminal of battery

### Long Answer:

#### 1. Answer:

Thickness of electroplated items depend upon:

- The strength of the current passing through the circuit.
- The concentration of the metal ion in the solution.

- The duration of the time the article has been in the solution.

## 2. Answer:

To purify copper, a thin plate of pure copper and a thick rod of impure copper are used as electrodes in the acidified solution of  $\text{CuSO}_4$ . Pure copper is used as cathode and impure copper is used as anode. When electric current is passed through the copper sulphate solution, copper sulphate dissociates into copper and sulphate. The free copper gets drawn to the electrode connected to the negative terminal of the battery and gets deposited on it. From impure copper electrode, an equal amount of copper gets dissolved in the solution. Thus, the loss of copper from solution is restored and the process continues. The impurities are left behind at anode.

## 3. Answer:

Normal or ordinary water is a good conductor of electricity while distilled water is a bad conductor or insulator. Ordinary water may contain small amount of mineral salts dissolved in it naturally; on the other hand, distilled water is free of salts.

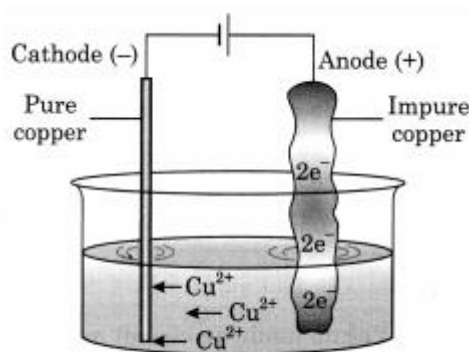


Fig. 14.9 Electrolytic refining of copper

## The following activity shows this fact:

About 50 mL of distilled water is taken in a clean and dry beaker. When the tester is dipped into the distilled water, the bulb does not glow which shows that distilled water is a bad conductor of electricity. But when a small amount of common salt is dissolved in distilled water and again tested the bulb glows which shows that distilled water when mixed with salts conduct electricity.

## 4. Answer:

The process of depositing or coating a layer of any desired metal on the surface of other material by means of electricity is called electroplating. It is one of the most common applications of chemical effects of electric current.

Electroplating is a very useful process. It is widely used in industry for coating metal objects with a thin layer of a different metal. The layer of metal deposited has some desired property, which the metal of the object lacks. For example, chromium plating is done on many objects to make them shiny and attractive.

## 5. Answer:

Electroplating is a very useful process. It is widely used in industry for coating metal objects with a



thin layer of different metal. The advantages and disadvantages of electroplating are:

**Advantages:**

- It protects the metals from being corroded.
- It prevents the rusting of metals.
- It makes cheap and dull metals shiny and attractive.
- It can make more reactive metals like iron less reactive.
- Chromium coating on metals give lustre to objects.

**Disadvantages:**

- Pollutants from electroplating industries are very harmful. Some chemicals are very lethal for both human and animals.
- It is an expensive process.