

Chemistry Chapter 6 -Electrolysis

1. Give reasons for the following:

- a. Electrolysis of molten lead bromide is considered to be a reaction in which oxidation and reduction go side by side, i.e., a redox reaction.
- b. The blue colour of aqueous copper sulphate fades when it is electrolysed using platinum electrodes.
- c. Lead bromide undergoes electrolytic dissociation in the molten state but it is a non-electrolyte in the solid state.
- d. Aluminium is extracted from its oxide by electrolytic reduction and not by conventional reducing agents.
- e. The ratio of hydrogen and oxygen formed at the cathode and anode is 2:1 by volume.
- f. In the electrolysis of acidified water dilute sulphuric acid is preferred to dilute nitric acid for acidification.
- g. Ammonia is unionized in the gaseous state but in the aqueous solution it is a weak electrolyte.
- h. A graphite anode is preferred to other inert electrodes during electrolysis of fused lead bromide.
- i. For electroplating with silver, silver nitrate is not used as electrolyte.
- j. Carbon tetrachloride is a liquid but does not conduct electricity.
- k. Potassium is not extracted by electrolysis of its aqueous salt solution.

Solution:

- a. During lead bromide electrolysis, bromine loses electrons at the anode whereas lead gains electrons at the cathode. Hence, it is a redox reaction because reduction and oxidation occur simultaneously.
- b. As the concentration of Cu^{2+} ions decreases the blue colour of the copper ions starts fading. As soon as the concentration of Cu^{2+} ions is finished, the solution becomes colourless.
- c. The ions of molten lead bromide are free and loosely packed. In the solid state the ions are packed tightly due to the electrostatic force of attraction. Thus, lead bromide undergoes electrolytic dissociation in the molten state.
- d. Aluminium cannot be reduced by the reducing agent because of its greater affinity towards oxygen. That is why it is extracted from its oxide by electrolytic reduction.
- e. In the electrolytic reactions, 4H^{1+} is required at the cathode while 4OH^{-} at the anode while two molecules of oxygen are produced at the anode. Two hydrogen molecules and one oxygen molecule are liberated at the cathode and anode respectively for every two molecules of water. Hence, the ratio of hydrogen and oxygen is 2:1 at cathode and anode.
- f. Dilute nitric acid is volatile in nature. Hence, dilute sulphuric acid is preferred to dilute nitric acid.
- g. Ammonia, being a covalent compound, is unionized in the gaseous state but forms NH_4OH in aqueous solution which can dissociate into ions.
- h. Graphite is unaffected by the bromine vapours evolved during electrolysis of lead bromide. Hence it is preferred over any other electrode.
- i. If silver nitrate is used in the electroplating of silver, the silver deposition will be very quick and will not be uniform and smooth.
- j. Carbon tetrachloride is a covalent compound and has no free ions. It only contains molecules. Therefore, it does not contain electricity.
- k. Potassium reacts with water. Hence it cannot be by the electrolysis of its aqueous salt solution.

2. Copy and complete the following table which shows two practical applications of electrolysis.

Chemistry Chapter 6 -Electrolysis

	Anode	Electrolyte	Cathode
Silver plating of spoon		Solution of potassium argentocyanide	
Purification of copper			

Solution:

	Anode	Electrolyte	Cathode
Silver plating of spoon	Clean pure silver plate	Solution of potassium argentocyanide	Article to be electroplated
Purification of copper	Impure copper	Copper sulphate and dilute sulphuric acid solution	Pure copper strips

3. Element X is a metal with valency 2. Element Y is a non-metal with valency 3.

- Write equations to show how X and Y form ions.
- If Y is a diatomic gas, write equation for the direct combination of X and Y to form a compound.
- If the compound formed between X and Y is melted and an electric current is passed through the molten compound, element X will be obtained at the _____ and Y at the _____ of the electrolytic cell.

Solution:

- $X \rightarrow X^{2+} + 2e^{-}$; $Y + 3e^{-} \rightarrow Y^{3-}$
- $Y_2 + 3X \rightarrow X_3 Y_2$
- Cathode, anode

3. Write two applications of electrolysis in which anode diminishes in mass.

Solution:

The two applications include electroplating and electrorefining of metals.

4. A strip of copper is placed in four different colourless salt solutions. They are KNO_3 , $AgNO_3$, $Zn(NO_3)_2$, $Ca(NO_3)_2$. Which of the solutions will finally turn blue?

Solution:

$AgNO_3$ turns blue. This is because copper being higher in the electrochemical series displaces silver and forms $Cu(NO_3)_2$ which is blue in colour.

5. Select the right answer. The aqueous solution of the compound which contains both ions and molecules is:

- H_2SO_4
- HCl
- HNO_3
- CH_3COOH

Chemistry Chapter 6 -Electrolysis

Solution:

CH₃COOH contains both ions and molecules.

6. Correct the given statement: “Lead bromide conducts electricity.”

Solution:

Molten lead bromide conducts electricity.

7. The aqueous solution of Nickle sulphate contains Ni²⁺ and SO₄²⁻ ions.

- Which ion moves towards cathode?
- What is the product at the anode?

Solution:

- Ni²⁺ ions move towards cathode.
- Oxygen gas is produced at the anode.

8. During electroplating of an article with nickle,

(i) Name

- The electrolyte
- The cathode
- The anode

(ii) Give the reaction of electrolysis at

- The cathode
- The anode

Solution:

- (i)**
- Nickle sulphate
 - Article
 - Pure nickle plate
- (ii)**
- $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$
 - $\text{Ni} - 2\text{e}^- \rightarrow \text{Ni}^{2+}$

9. Give reason: Electrolysis of acidulated water is considered to be an example of electrolysis.

Solution:

Dilute sulphuric acid acts as a catalyst in dissociation, therefore, it is an example of catalysis.

10. Differentiate between electrical conductivity of copper sulphate solution and that of copper metal.

Solution:

Copper Sulphate Solution	Copper Metal
Aqueous solution of ionic compound.	Metal in solid state.
Flow of ions facilitate conduction of electricity.	Flow of electrons facilitate conduction of electricity.
Undergoes a chemical change	Does not change chemically

11. Match the columns:

Chemistry Chapter 6 -Electrolysis

Column A	Column B
Ammonium hydroxide solution	Contains only ions
Dilute hydrochloric acid	Contains only molecules
Carbon tetrachloride	Contains ions and molecules

Solutions:

Ammonium hydroxide solution - Contains ions and molecules

Dilute hydrochloric acid - Contains only ions

Carbon tetrachloride - Contains only molecules

12. Give reason: An aqueous solution of sodium chloride conducts electricity.

Solution:

There are free sodium and chloride ions in the aqueous solution of sodium chloride. This allows a large amount of electricity to pass through it.

13. State which of these will act as a non-electrolyte:

- Liquid carbon tetrachloride
- Acetic acid
- Sodium hydroxide aqueous solution
- Potassium chloride aqueous solution

Solution:

Liquid carbon tetrachloride acts as a non-electrolyte.

14. Identify a gas which cannot conduct electricity in the liquid state but conducts electricity when dissolved in water.

Solution:

The gas is Hydrogen chloride.

15. Give one word for: Electrolytic deposition of a superior metal on a baser metal.

Solution:

Galvanisation

16. State which electrode: anode or cathode is an oxidising electrode? Give a reason for the same.

Solution:

Anode is the oxidising electrode. Here, the electrons are lost by the anions to form neutral atoms. Due to the loss of electrons, the ions are said to be oxidised.

17. Give reasons why:

- Sodium chloride conducts electricity only in fused or aqueous solution state.
- In the electroplating of an article with silver, the electrolyte sodium argentocyanide solution is preferred over silver nitrate solution.
- Although copper is a good conductor of electricity, it is a non-electrolyte.

Solution:

Chemistry Chapter 6 -Electrolysis

- a. In the solid state, the electrostatic forces of attraction between molecules are very strong. These forces weaken in the fused state and the ions become mobile.
- b. Silver deposits very fast and is not smooth and uniform. Hence silver nitrate solution is not used in the electroplating of an article with silver.
- c. Copper contains free electrons. The movement of free electrons conducts electricity. But copper does not dissociate into ions. Hence, it is a non-electrolyte.

18. M_2O is the oxide of metal "M" which is above hydrogen in the activity series. M_2O , when dissolved in water, forms the corresponding hydroxide which is a good conductor of electricity.

- a. State the reaction taking place at cathode.
- b. Name the product at the anode.

Solution:

- a. $M^+ + 1e^- \rightarrow M$
- b. Oxygen gas is produced at the anode.

19. Name the kind of particles present in

- a. Sodium hydroxide solution
- b. Carbonic acid
- c. Sugar solution

Solution:

- a. Na^+ ions and OH^- ions
- b. H^+ , HCO_3^- , CO_3^{2-} ions and H_2CO_3 molecules
- c. $C_{12}H_{22}O_{11}$ molecules

20. State an observation for: Electricity is passed through molten bromide.

Solution:

Greyish white metal lead is formed at the cathode while dark reddish-brown fumes are formed at the anode.