

## CHAPTER 7

### ELECTRO CHEMISTRY



Q1. Define electrochemical reactions

#### ELECTROCHEMICAL REACTIONS

The chemical reactions in which chemical energy changes into electrical energy or vice versa are called electrochemical reactions

Q2. What is oxidation reaction. Give two chemical equations for oxidation

#### OXIDATION

Oxidation may involve introduction of oxygen or removal of Hydrogen from a chemical substance.

#### EXAMPLE:

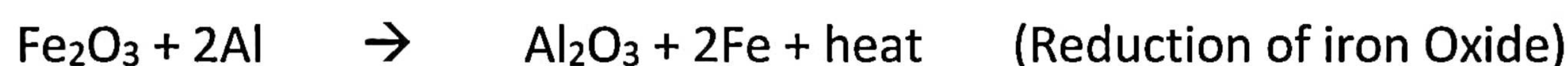


Q3. What is reduction reaction. Give two chemical equations for oxidation

#### REDUCTION

Reduction may involve addition of Hydrogen or removal of oxygen from a chemical substance.

#### EXAMPLE



Q4. Differentiate between oxidation and reduction reaction

<u>Oxidation</u>	<u>reduction</u>
Addition of oxygen from a substance.	Removal of oxygen from a substance.
Removal of hydrogen.	Addition of hydrogen.
Loss of electrons by a substance.	Gain of electrons by a substance.

Q5. What are oxidizing and reducing agent. Give some examples of it

#### OXIDIZING AGENTS



Oxidizing agents are substances that accept electrons.

**EXAMPLE**



$\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$

**REDUCING AGENT**

Reducing agent are substances which loses electrons.

**EXAMPLE**

Alkali metals, Al,  $\text{H}_2\text{S}$ , Zn, NaH, KH

Q6. What is electrochemical cells. Name its types

**ELECTROCHEMICAL CELLS:**

The device which convert chemical energy into electrical energy or vice versa using redox reaction are called electrochemical cells.

**TYPES OF ELECTROCHEMICAL CELL**

(1) Electrolytic Cells

(2) Galvanic Cells or Voltaic Cells

Q7. Define electrolytes and non-electrolytes. Give their examples

**ELECTROLYTES**

The substances which are able to conduct electricity in molten state or in aqueous solution form are called electrolyte

**EXAMPLE**

HCl, KOH, NaCl

**NON-ELECTROLYTES**

The substances which are unable to conduct electricity in molten state or in aqueous solution form are called non electrolyte

**EXAMPLE:**

Benzene, Glucose, Sucrose and Urea

Q8. What are strong electrolytes and weak electrolytes

**STRONG ELECTROLYTE**

The electrolytes which are completely ionized, called strong electrolytes.

**WEAK ELECTROLYTE**



The electrolytes which are partially ionized called strong electrolytes.

Q9. Define Electrolytic cells and Electrolysis. Give an example of Electrolysis in electrolytic cell.

### **ELECTROLYTIC CELLS**



The type of cell which uses electricity for a non-spontaneous reaction to occur is called electrolytic cell.

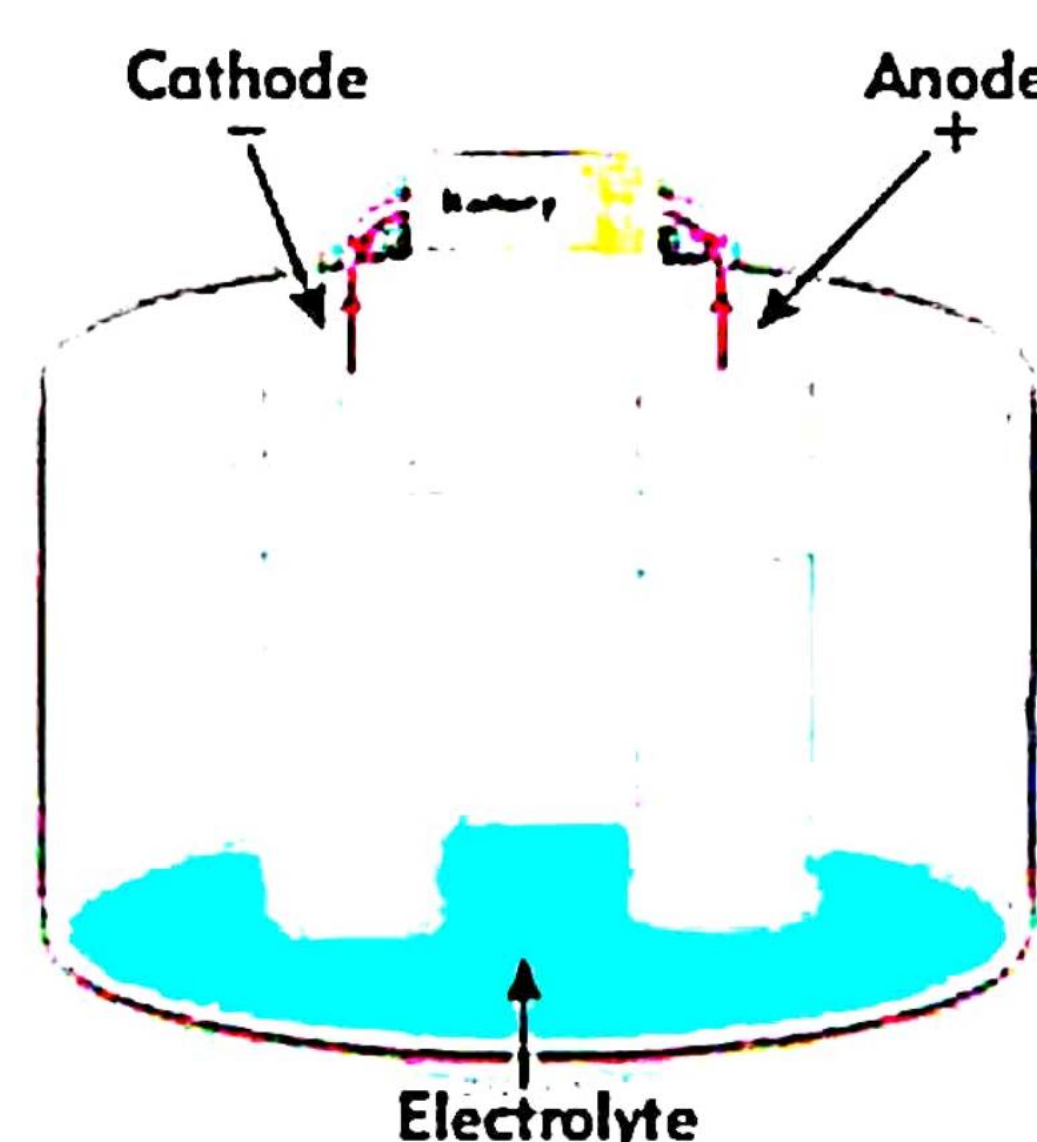
### **ELECTROLYSIS**

The electrolysis involves redox reactions and carried out in electrolytic cell. In electrolysis current passes through an electrolyte, due to this migration of positive and negative ions towards cathode and anode takes place.

### **ELECTROLYSIS IN ELECTROLYTIC CELL**

An electrolytic cell consists of electrolyte in a vessel, electrodes and a battery. The sketch of an electrolytic cell is shown in figure.

The figure shows that electrons from battery enter through cathode at which positive ions are reduced by accepting electrons. At anode negative ions loses electrons and undergoes oxidation. It means at cathode reduction occurs and oxidation takes place at anode.



#### **AT CATHODE**



#### **AT ANODE**



Q10. Give the Applications of Electrolytic cells.

### **APPLICATIONS OF ELECTROLYTIC CELLS:-**

Important uses of electrolytic cell are given below.

1. It is used to prepare sodium metal from molten sodium chloride using the down's cell.
2. It is used to prepare caustic soda (NaOH) from aqueous sodium chloride by Nelson's cell. It is also used to obtain chlorine gas.
3. It is used to extract aluminum metal.
4. It is used in electro refining of copper.
5. Electrolytic cell is used for electro plating of metals

Q11. State Faraday's first law of Electrolysis. Also explain it.



## **FARADAY'S FIRST LAW OF ELECTROLYSIS:-**

It states that amount of any substance that is deposited or liberated at an electrode during electrolysis is directly proportional to the quantity of electricity passed through the electrolyte.

$$W \propto A \times t$$

or  $W = ZAt$



Where,

W = Weight of the substance deposited or liberated

A = Current in ampere

t = time in second

Q12. State Faraday's second law of Electrolysis.

## **FARADAY'S SECOND LAW OF ELECTROLYSIS: -**

The number of different substances deposited or liberated due to passage of same quantity of current through different electrolytes are proportional to their chemical equivalent masses.

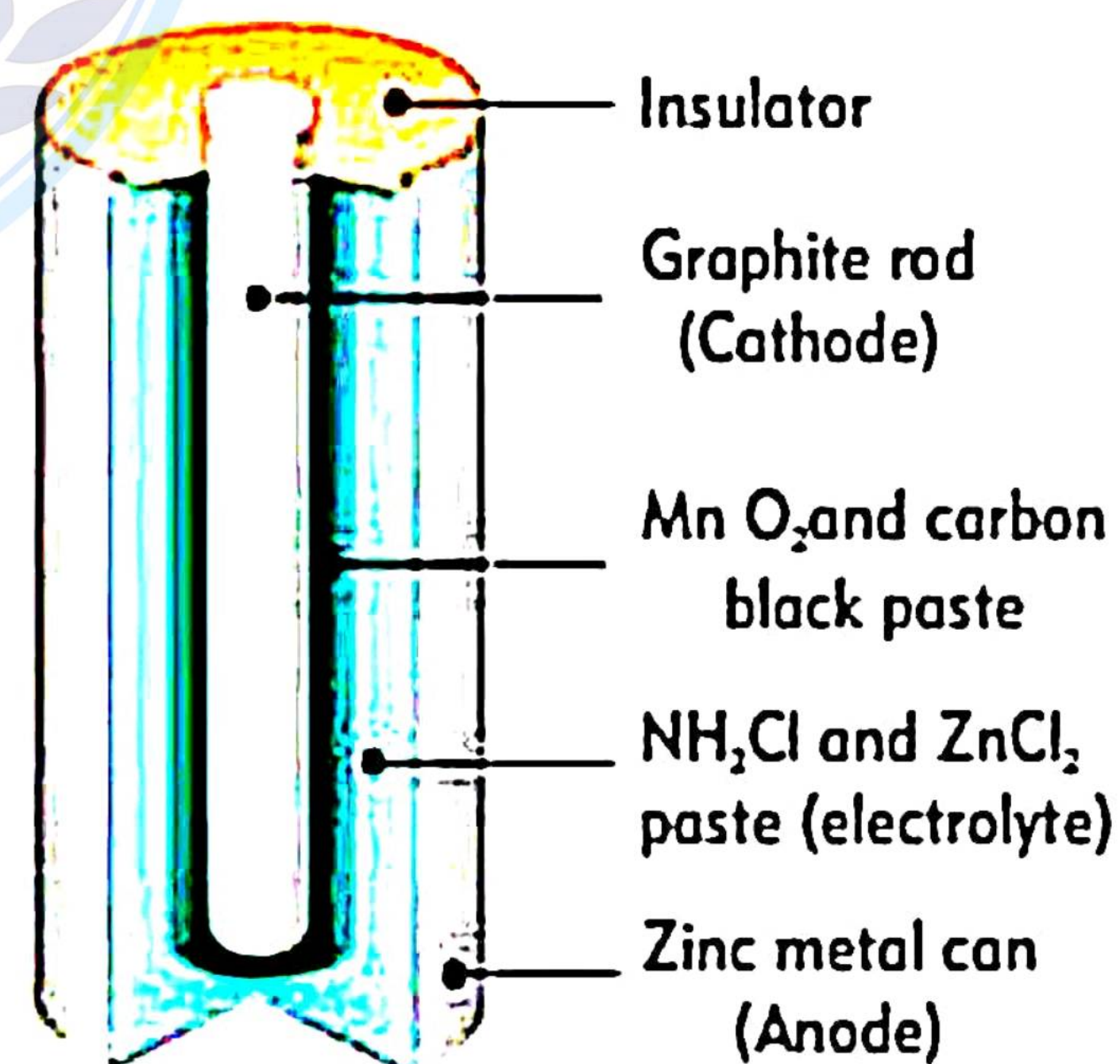
Q13. Write shote note on dry cell and Lead Storage Battery

### **DRY CELL: -**

It is also known as Leclanche cell. It is a type of primary cell which produce electricity using redox reaction between their chemical substances placed in it.

It uses zinc as anode, magnesia dioxide as cathode and aqueous ammonium chloride (NH<sub>4</sub>Cl) or zinc chloride (ZnCl<sub>2</sub>) as electrolyte. The cell diagram is given in Fig.

A copper cap is fixed on the top of the carbon rod for conduction of electricity. Zinc and graphite are then connected by a metal wire as a result following reaction take place



### **REACTION AT ANODE**



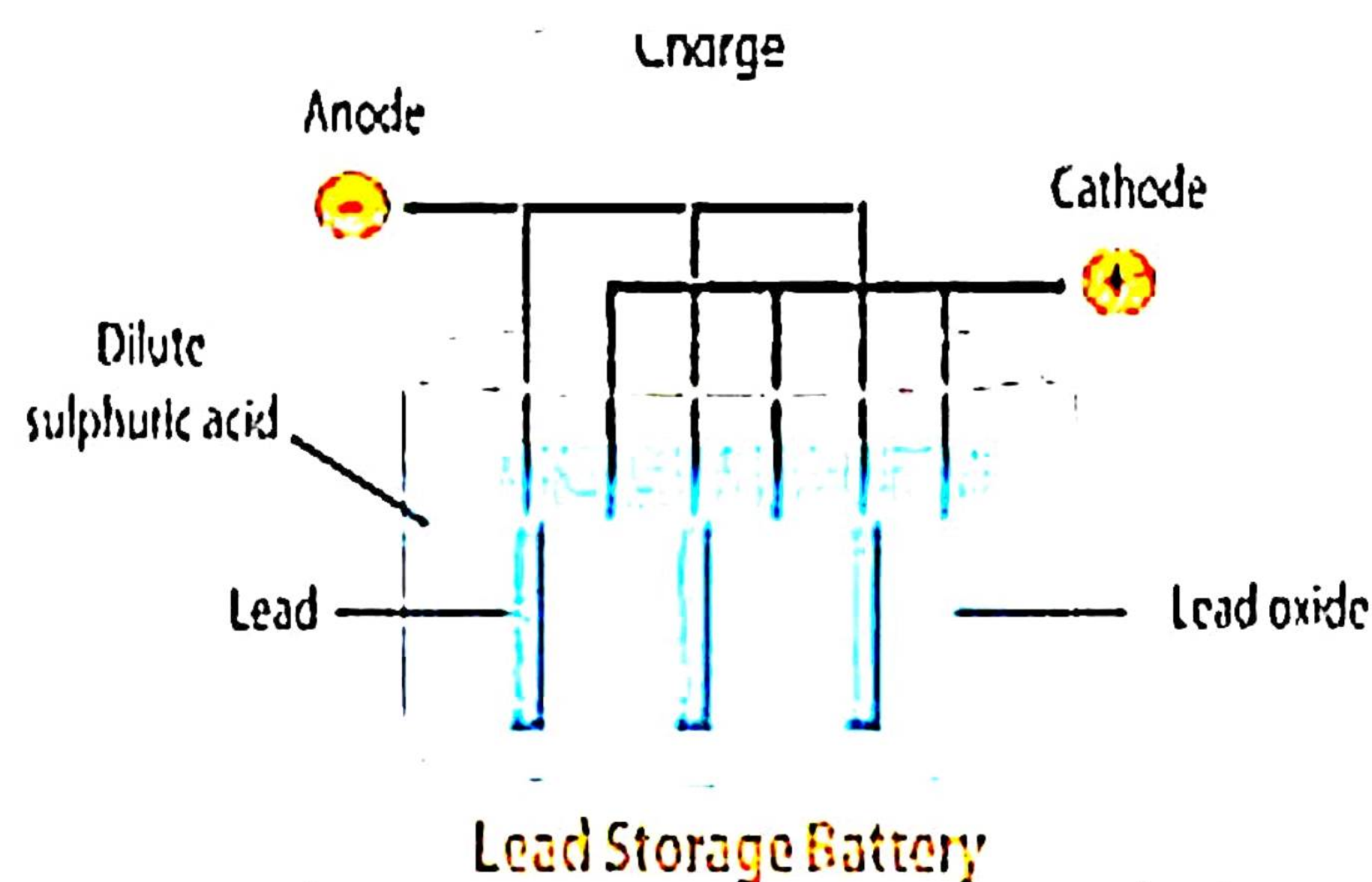
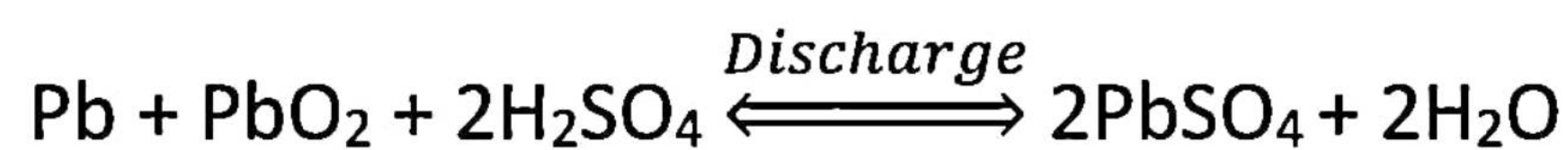
### **REACTION AT CATHODE**



### **LEAD STORAGE BATTERY: -**



A battery is a device which produces electricity through electro chemical reactions. Lead storage battery is an example of secondary cell in which chemical changes can be reversed. It has several voltaic cells connected in series. It contains lead plates which serve as anode and lead oxide (PbO<sub>2</sub>) which acts as cathode. These electrodes are immersed in electrolytic solution of dilute Sulphuric acid (H<sub>2</sub>SO<sub>4</sub>). Chemical changes during charging and discharging processes can be shown as



Q14. Define alloy. Also give examples

### **ALLOY**

Alloy is the mixture of metal with metal or metal with nonmetal. There are about 7000 alloys which are used for different purposes in the world.



### **EXAMPLE:**

Brass is an alloy of Copper (Cu) and Zinc (Zn). Steel is a alloy of iron and carbon.

Q15. Give application of some alloys

<u>NAME OF ALLOY</u>	<u>COMPONENTS</u>	<u>APPLICATIONS</u>
Bell metal	Cu-Sn	Casting of bell
Brass	Cu Zn	Door nobs and hand rails due to antibacterial nature, Hose nozzles, Stamping dies.
Bronze	Cu-Zn Sn	Coins, medals, tools, etc.
Monel	Ni-Cu-Fe	Corrosion resistant containers
Duralumin	Al-Cu-Mg-Ni	Boat, Air craft etc



Solder	Sn-Pb-Cu-Sb	Joining electrical components into circuits.
Alnico	Fe-Al-Ni-Co	Magnets used in loudspeakers
Amalgam	Hg-Ag-Cu-Zn	Dental filling
Cupronickel	Cu-Ni-Mn	Coins
Sterling silver	Ag-Cu	Cutlery set, medical tools
White gold	Au-Pb-Ag-Cu	Jewelry (18 carat)

Q16. What is corrosion. Give methods for prevention form corrosion.

### **CORROSION AND ITS PREVENTION:**

Metals react with oxygen in presence of moisture and can form harmful metal oxide. These metal oxide layers are porous and expose metal for further reaction with oxygen to form harmful metal oxide. It is called Corrosion of metal.

### **PREVENTION FROM CORROSION:**

All metals can be prevented from corrosion by following methods.

#### **1- ALLOYING:**

Formation of alloy prevents metal from corrosion by reducing its ability of oxidation. Example: Iron (Fe) can be changed into stainless steel by mixing with chromium (Cr) and Nickle (Ni). Thus iron (Fe) is prevented from corrosion.

#### **2- METALLIC COATING (ELECTROPLATING)**

All metals can be protected from corrosion by coating its surface with other metal like tin (Sn) or zinc (Zn). The coating of metal at the surface of other metal by electrolytic process is called electroplating. Metals like iron can be electroplated with chromium (Cr), Nickle (Ni) and silver (Ag).

#### **3- CATHODIC PROTECTION:**

It is applied to protect underground pipes tanks, oil rigs etc. from corrosion by making these materials as cathode. The active metal like magnesium (Mg) or aluminum (Al) is used as Anode and connected with iron (Fe). These active metals itself oxidizes and prevent other metal from corrosion.

#### **4- COATING WITH PAINT:**

A metal is commonly coated with paint to protect it from corrosion. Paint prevents the reaction of metal with oxygen moisture and other harmful chemical agents.

Q17. Write short note on rusting of iron

### **RUSTING OF IRON**



Corrosion of iron is an electro chemical process. Iron under goes redox reaction in presence of air or water to form iron (III) oxide ( $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ ) called rusting of iron. Rusty surface of iron provides no protection to underlying iron and eventually convert whole iron into reddish brown rust. Rusting occurs at different places of metal surface. A metal surface area of less moisture act as anode and oxidizes iron in this region.



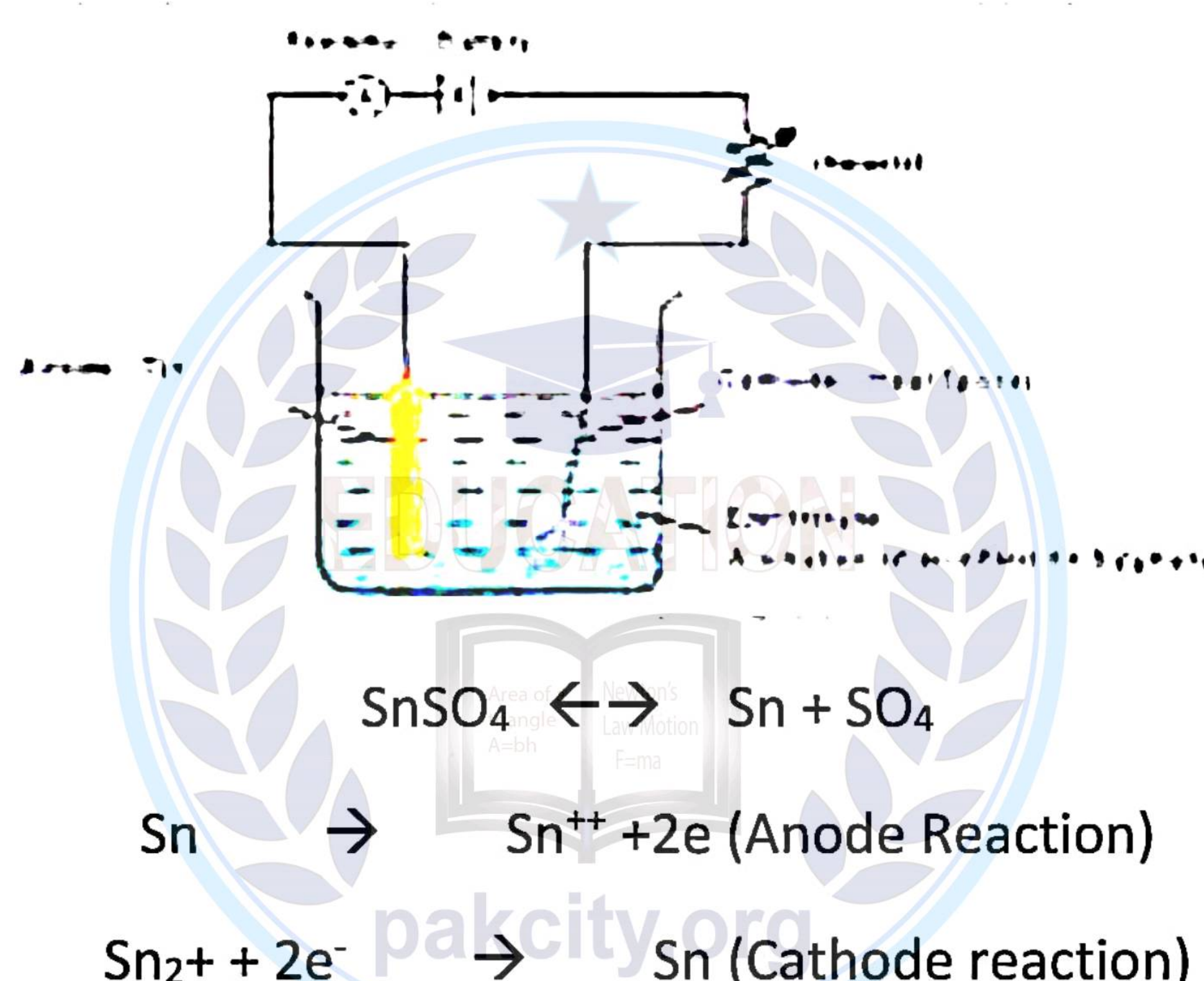
Q18. What is electroplating. Describe tin plating, zinc plating, silver plating and chromium plating

## **ELECTROPLATING**

The process of deposition of metal at the surface of other metal through electrolysis is called electroplating.

### **TIN PLATING:**

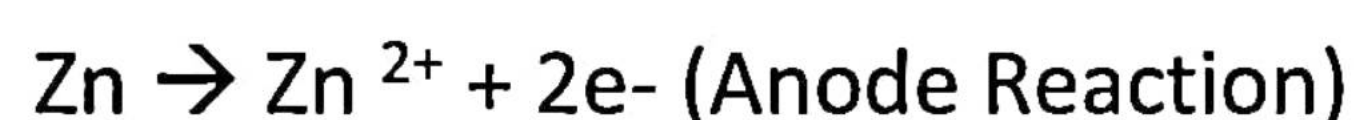
Steel spoon can be tin plated by using acidified tin sulphate as electrolyte. Tin (Sn) metal is used as anode and steel spoon is used as cathode. When current passes through electrolyte tin ions ( $\text{Sn}^{+2}$ ) deposits at cathode as tin (Sn) metal. Tin (Sn) electrode is then changes into tin ion ( $\text{Sn}^{2+}$ ).



### **ZINC PLATING:**

The process in which zinc is electrolytically coated at the surface of other base metal is called galvanizing. Potassium zinc cyanide is used as electrolyte to produce zinc ions ( $\text{Zn}^{+2}$ ). Zinc (Zn) metal serves as anode and steel object is used as cathode. During electrolysis  $\text{Zn}^{++}$  deposits at cathode and Zinc (Zn) anode is then changes into zinc ion  $\text{Zn}^{2+}$ .

Following reactions occur during zinc electroplating.



### **ELECTROPLATING OF SILVER:**

In this process silver (Ag) is coated electrolytically at the surface of steel or other metal. It is called silver plating. In this process aqueous solution of silver chloride ( $\text{AgCl}$ ) is used as electrolyte to produce silver ( $\text{Ag}^+$ ) ions. Silver (Ag) metal is used as anode and steel object like spoon used as cathode. Silver ( $\text{Ag}^+$ ) ions are reduced at cathode by accepting electron. Silver anode loses electron and oxidized to silver ( $\text{Ag}^+$ ) ion.





Following chemical changes takes place.



### **AT CATHODE**



### **AT ANODE**



### **CHROMIUM PLATING:**

The process in which chromium (Cr) is coated electrolytically at the surface of other base metal is called chromium plating. Acidified chromium sulphate  $\text{Cr}_2(\text{SO}_4)_3$  is taken as electrolyte to produce chromium ( $\text{Cr}^{+3}$ ) ion. Chromium metal serves as anode and other metal object is used as cathode. Following chemical changes take place in chromium plating.

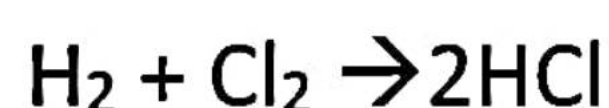


### **EXERCISE/ NUMERICAL**

Q1. Identify the oxidizing and reducing agents from the following.

1. Al    2. Na    3.  $\text{H}_2\text{S}$     4.  $\text{H}_2\text{SO}_4$     5.  $\text{KMnO}_4$   
6. Zn

Q2. Identify the oxidizing and reducing agents for the following reaction.



Q3. Identify strong and weak electrolytes from the following

1.  $\text{HCl}_{(\text{aq})}$ , 2.  $\text{KI}_{(\text{aq})}$ , 3.  $\text{NaOH}_{(\text{aq})}$ , 4.  $\text{H}_2\text{S}_{(\text{aq})}$ , 5.  $\text{CH}_3\text{COOH}_{(\text{aq})}$ , 6.  $\text{NH}_4\text{OH}_{(\text{aq})}$

Q4. Identify cathode and anode, oxidation, reduction reaction, movement of electron from the following sketch of electrolytic cell.

