



## Electrolysis

**1. What is Electrolysis?**

Ans. It is the process of decomposition of a chemical compound in aqueous solutions or in molten state accompanied by a chemical change using direct electric current.

**2. What are called Electrolytic and Non-Electrolytic Compounds?**

Ans. Compounds which conduct electricity when dissolved in water are called Electrolytic Compound.

Ex: NaCl, CuSO<sub>4</sub>.

Compounds which do not conduct electricity when dissolved in water are called Non-Electrolytic Compound.

Ex: Alcohol, Sugar etc.

**3. What are the differences between Electrolytes and Non-electrolytes?**

Ans.

Electrolytes	Non-electrolytes
Chemical compounds which conduct electricity in the aqueous solution and undergo chemical decomposition due to the flow of current through it.	Chemical compounds which do not conduct electricity in the aqueous solution and do not undergo chemical decomposition due to the flow of current through it.
Particles in electrolytes Ions only or Ions and Molecules.	Particles in non-electrolytes Molecules only.
Ex: Acid: dil. HCl, HNO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub> Alkali: KOH, NaOH solutions Ionic Salts; CuSO <sub>4</sub> , PbBr <sub>2</sub>	Ex: Pure or distilled water, alcohol, Kerosine, Glucose, Sucrose, Sugar Solution etc.

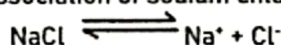
**4. What is called Electrolysis Cell?**

Ans. It is a device in which electrolysis is carried out are called Electrolytic Cell.

**5. "Electrolysis is a redox process." Explain.**

Ans. Electrolysis is a redox process. The reaction at the cathode involves reduction of cations as they gain of electrons while the reaction at anode involves oxidation of anions as they loss of electrons to become neutral.

Example: Dissociation of sodium chloride during electrolysis.



Cathode:  $\text{Na}^+ + e^- \rightarrow \text{Na}(\text{reduction})$

$\text{Cl}^- - e^- \rightarrow \text{Cl}(\text{oxidation})$

$\text{Cl} + \text{Cl} \rightarrow \text{Cl}_2$

Overall reaction:  $2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2$

**6. What is Electrode?**

Ans. As per the definition of the electrode, it is any substance that is a good conductor of electricity and this allows the electric current to enter or leave the electrolytic solution.

Metals or Carbon are used as Electrodes.

**7. When Graphite electrodes are used?**

Ans. Graphite electrodes are used when the products formed during electrolysis reacts with the metallic electrodes.

**8. What are Anode and Cathode?**

Ans. In Electrolytic Cell the electrode which is connected to the positive terminal is called **Anode** and the electrode is connected to the negative terminal is called **Cathode**.

**9. What are the materials used for anode and cathode?**

Ans. Metals like zinc and lithium are often used as substrates for anodes.

**10. What are the differences between Anode and Cathode?**

Ans.

Anode	Cathode
The anode is the electrode where electricity moves into.	The cathode is the electrode where electricity is given out or flows out of.
The anode is usually the positive side.	A cathode is a negative side.
It acts as an electron donor.	It acts as an electron acceptor.
In an electrolytic cell, oxidation reaction takes place at the anode.	In an electrolytic cell, a reduction reaction takes place at the cathode.
In galvanic cells, an anode can become a cathode.	In galvanic cells, a cathode can become an anode.

**11. What are Ions?**

Ans. They are atoms which carry a positive or a negative charge and become free and mobile when an electric current is passed through an aqueous solution of a chemical compound.

Ions are two types:

- a. Cation
- b. Anion.

**12. What are Cation and Anion?**

Ans. Atoms which carry positive charge are called cations.

Atoms which carry negative charge are called anions.

**13. Write the differences between Cation and Anion?**

Ans.

Cation	Anion
Are positively charged ions.	Are negatively charged ions.
Migrate to cathode during electrolysis.	Migrate to anode during electrolysis.
Gain electron from the cathode and get reduced to become a neutral atom.	Lose electrons to the anode and get oxidized to become a neutral atom.

**14. What is Degree of dissociation?**

Ans. The degree of dissociation is the extent to which an electrolyte dissociates or breakup into ions.



**15. The amount of electricity conducted by the electrolyte depends on which factors?**

Ans. The amount of electricity conducted by the electrolyte depends upon the concentration of the ions in the solution.

**16. What are the characteristics of electrolysis?**

Ans. The characteristics of Electrolysis are:

- The passage of electricity through an electrolyte causes the metallic ions to migrate towards the cathodes and non-metallic ions to migrate towards the anode.
- The preferential discharge of the ions depends on its position in the electrochemical series.
- The number of electrons gained by the anode is equal to the number of electrons denoted by the cathodes.
- The products of electrolysis are formed in the anode and cathode itself since the exchange of electrons takes place only at the surface of electrodes.
- Only Hydrogen Gas and metals are liberated at the cathode and are called electropositive elements.
- Only non-metals are liberated at the anode and are called Electronegative Elements.

**17. What is Electrolytic Dissociation?**

Ans. The process due to which an ionic compound in the aqueous solution state dissociates into ions by passage of electric current through it is called Electrolytic Dissociation.

**18. What are the differences between Electronic Dissociation and Ionisation?**

Ans.

Ionization	Dissociation
1) Formation of positively or negatively charged ions from molecules which are not initially in the ionic state.	1) Separation of ions which are already present in an ionic compound.
2) Covalent compounds show ionization. e.g. $\text{HCl}$ , $\text{H}_2\text{CO}_3$ , $\text{NH}_4\text{OH}$ etc.	2) Electrovalent compounds show dissociation e.g. Potassium chloride, lead bromide, etc.

**19. Explain why Cu, though a good conductor of electricity, is a non-electrolyte.**

Ans. Copper metal is a solid and has no mobile ions, whereas an electrolyte should dissociate into oppositely charged ions to conduct the electric current.

**20. Explain why Solid sodium chloride does not allow electricity to pass through.**

Ans. In solid sodium chloride,  $\text{Na}^+$  and  $\text{Cl}^-$  ions are not mobile to conduct the electric current.



**21. What is the difference between Metallic Conduction and Electrolytic Conduction?**

Ans.

<b>Metallic Conduction</b>	<b>Electrolytic Conduction</b>
The flow of electricity takes place by flow of electrons which have negligible mass.	The flow of electricity takes place by flow of ions. Which are denser compared to electrons.
There is no decomposition of the parent metals and thus the chemical properties of metals are intact.	There is decomposition of the electrolytic solution and thus the chemical properties of electrolyte are altered.
Metals are good conductors of electricity in the solid state and in the molten state.	Electrolytes are good conductors of electricity in aqueous solution or molten state but not in solid state.
During metallic conduction there is no transfer of matters.	During electrolytic conduction there is transfer of ions.
The flow of electricity only produces heat energy and no new products are formed.	The flow of electricity decomposes the electrolyte and new products are formed.

**22. What are Strong Electrolytes?**

Ans. Compounds which in the fused or in the aqueous solution state are almost completely dissociated and are good conductors of electricity are called Strong Electrolytes.

**23. What are Weak Electrolytes?**

Ans. Compounds which in the fused or in the aqueous solution state are feebly or partially dissociated and are poor conductors of electricity are called Weak Electrolytes.

**24. What are the differences between Strong Electrolytes and Weak Electrolytes?**

Ans.

<b>Strong electrolyte</b>	<b>Weak electrolyte</b>
The electrolytes which are completely ionised, called strong electrolytes.	The electrolytes which are partially ionised called strong electrolytes.
The extension of ionisation is more.	The extension of ionisation is less.
They have high electrical conductivity.	They have low electrical conductivity.
Ostwald's dilution law is not applicable.	Ostwald's dilution law is applicable.

**25. What is Electrochemical Series?**

Ans. Electrochemical series also sometimes referred to as activity series is a list that describes the arrangement of elements in order of their increasing electrode potential values. The series has been established by measuring the potential of various electrodes versus standard hydrogen electrode (SHE).



26. What are the positions of metals which are ionize most readily in the Electrochemical Series?  
Ans. Metals which are ionize most readily are places at the top of the Electrochemical series.  
Ex: K, Ca, etc.
27. What are the positions of metals which are ionize most least in the Electrochemical Series?  
Ans. Metals which are ionize most least are places at the bottom of the Electrochemical series.  
Ans. Hg, Ag, etc.
28. What is Selective discharge of ions?  
Ans. The preferential discharge of ions present in an electrolyte at the respective electrodes is also known as Selective discharge of ions.
29. What is Electroplating?  
Ans. Electroplating is basically the process of plating a metal onto the other by hydrolysis mostly to prevent corrosion of metal or for decorative purposes. The process uses an electric current to reduce dissolved metal cations to develop a lean coherent metal coating on the electrode. Electroplating is often applied in the electrical oxidation of anions on a solid substrate like the formation of silver chloride on silver wire to form silver chloride electrodes.
30. What is Electrefining of Metals?  
Ans. Electrefining is a process by which metals containing impurities are purified electrolytically to give a pure metal.
31. Which metals are generally refined by Electrolysis?  
Ans. Metals which are extracted by electrolysis i.e. highly electropositive metals are already deposited at the cathode in the pure state and hence need not be refined further.  
Zinc, Lead, Copper, mercury and silver are thus generally refined by Electrolysis.
32. 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." - Give reasons  
Ans. During electrolysis of lead bromide, there is loss of electrons at anode by bromine and gain of electrons at cathode by lead. Thus, oxidation and reduction go side by side. Therefore, it is a redox reaction.
- $$\text{PbBr}_2 \rightleftharpoons \text{Pb}^{+2} + 2\text{Br}^-$$
33. The blue colour of aqueous copper sulphate fades when it is electrolyzed using platinum electrodes. - Give reasons  
Ans. The blue colour of copper ions fades due to decrease in  $\text{Cu}^{+2}$  ions and finally the solution becomes colourless as soon as  $\text{Cu}^{+2}$  ions are finished.
34. Ammonia is unionized in the gaseous state but in the aqueous solution, it is a weak electrolyte. - Give reasons  
Ans. Ammonia is a covalent compound. Therefore, it is unionized in the gaseous state but in the aqueous solution it gives  $\text{NH}_4\text{OH}$  which is a weak electrolyte and dissociates into ions.

35. Lead bromide undergoes electrolytic dissociation in the molten state but is a non-electrolyte in the solid state. - Give reasons

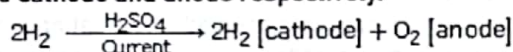
Ans. Lead bromide dissociate into ions in the molten state whereas it does not dissociate in solid state. The ions become free when lead bromide is in molten state but in the solid state the ions are not free since they are packed tightly together due to electrostatic force between them. Therefore, lead bromide undergoes electrolytic dissociation in the molten state.

36. Aluminium is extracted from its oxide by electrolytic reduction and not by conventional reducing agents. - Give reasons

Ans. Aluminium has great affinity towards oxygen, so it is not reduced by reducing agent. Therefore, it is extracted from its oxide by electrolytic reduction.

37. The ratio of hydrogen and oxygen formed at the cathode and anode is 2:1 by volume. - Give Reason.

Ans. As per electrolytic reactions,  $4H^{+1}$  is needed at cathode and  $4OH^{-}$  at the anode and two molecules of water are produced at the anode. Hence for every two molecules of water, two molecules of hydrogen and one molecule of oxygen are liberated at the cathode and anode respectively.



38. In the electrolysis of acidified water, dilute sulphuric acid is preferred to dilute nitric acid for acidification. - Give reasons

Ans. This is because  $HNO_3$  is volatile.

39. A graphite anode is preferred to other inert electrode during electrolysis of fused lead bromide. - Give reasons

Ans. Graphite is unaffected by the bromine vapours.

40. For electroplating with silver, silver nitrate is not used as electrolyte. - Give reason

Ans. Silver nitrate is not used as electrolyte for electroplating with silver because the deposition of silver will be very fast and hence not very smooth and uniform.

41. Carbon tetrachloride is a liquid but does not conduct electricity. - Give reasons

Ans. Carbon tetrachloride is a liquid and does not conduct electricity because it is a covalent compound and there are no free ions present and contain only molecules.

42. Potassium is not extracted by electrolysis of its aqueous salt solution. - Give reasons

Ans. Potassium is not extracted from its aqueous salt solution by electrolysis as it can react with water.

43. Give reason: The electrolysis of acidulated water is considered to be an example of catalysis.

Ans. Dilute sulphuric acid catalyses dissociation, so electrolysis of acidified water is considered an example of catalysis.





44. A metal article is to be electroplated with silver. The electrolyte selected is sodium argent cyanide.

- What kind of salt is sodium argent cyanide?
- Why is it preferred to silver nitrate as an electrolyte?
- State one condition to ensure that the deposit is smooth, firm and long lasting.
- Write the reaction taking place at the cathode.
- Write the reaction taking place at the anode.

- Ans. i. Complex salt  
ii. On using silver nitrate, the deposition of silver on the cathode is very fast and hence not very smooth and uniform because it is a strong electrolyte.  
iii. A long current for a longer time should be used.  
iv.  $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$   
v.  $\text{Ag} - \text{e}^- \rightarrow \text{Ag}^+$

45. During electroplating of an article with nickel,

- Name
  - The electrolyte
  - The cathode
  - The anode
- Give the reaction of electrolysis at
  - The cathode
  - The anode

- Ans. i.
  - Aqueous solution of nickel sulphate with few drops of dil. sulphuric acid
  - Article (e.g. key chain)
  - Pure nickelii.
  - $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$
  - $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$

46. A, B and C are three electrolytic cells connected in different circuits. Cell 'A' contains NaCl solution. And the bulb in the circuit glows brightly when the circuit is completed. Cell 'B' contains acetic acid and the bulb glows dimly. Cell 'C' contains sugar solution, and the bulb does not glow. Give reason for each observation.

Ans. Cell A contains sodium chloride solution which is a strong electrolyte and contains only ions. So, it conducts electricity and the bulb glows brightly.  
Cell B contains both ions and molecules. So, there are few ions to conduct electricity and the bulb glows dimly.  
Cell C contains sugar solution which is a non-electrolyte and does not contain ions. So, it is a bad conductor of electricity and the bulb does not glow.

47. During electrolysis of an aqueous solution of sulphuric acid between platinum electrodes, two types of anions migrate towards the anode but only one of them is discharged.

(a) Name the two anions.

(b) Name the main product of the discharge of anion at the anode and write the anode reaction.

(c) Name the product at the cathode and write the reaction.

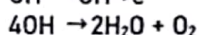
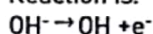
(d) Do you notice any change in colour. State why?

(e) Why this electrolysis is considered as an example of catalysis.

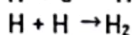
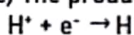
Ans. (a) Two  $\text{SO}_4^{2-}$  anions are and  $\text{OH}^-$ .

(b)  $\text{OH}^-$  is discharged at anode and the main product of the discharge of  $\text{OH}^-$  is  $\text{O}_2$

Reaction is:



(c) The product formed at cathode is hydrogen. The reaction is :



(d) No change in colour is observed.

(e) Dilute sulphuric acid catalyses the dissociation of water molecules into ions, hence electrolysis of acidified water is considered as an example of catalysis.