ICSE Selina Solutions for Class 10

Chemistry

Chapter 6- Electrolysis

1. Fill in the blanks:

(a) Powdered sodium chloride (common salt) does not conduct an electric current, but it does so when____or when_____.

Ans: Powdered sodium chloride (common salt) does not conduct an electric current, but it does so when electrolyte or when melted .

(b) Molten lead bromide conducts electricity. It is called an____. It is composed of lead_____and bromide_____. The lead ions are_____charged and are called_____. The bromide ____ are _____ charged and are called_____.

Ans: Molten lead bromide conducts electricity. It is called an electrolyte. It is composed of lead ions and bromide ions. The lead ions are positively charged and are called cations. The bromide ions are negatively charged and are called anions.

(c) Substances which conduct electricity in the solid state are generally_____.

Ans: Substances which conduct electricity in the solid state are generally metals.

(d) The electron releasing tendency of zinc is_____than that of copper.

Ans: The electron releasing tendency of zinc is more than that of copper.

(e) A solution of HCl gas in water conducts electricity because_ , but a solution of HCl gas in toluene does not conduct an electric current because .

Ans: A solution of HCl gas in water conducts electricity because it ionizes, but a solution of HCl gas in toluene does not conduct an electric current because it does not ionize into toluene.

(f) Pure water consists entirely of ..... (ions/molecules).

Ans: Pure water consists entirely of molecules(ions/molecules).

(g) We can expect pure water …… (will/will not) normally conduct electricity.

Ans: We can expect pure water will not (will/will not) normally conduct electricity.

(h) Electrolysis is the passage of……. (electricity/electrons) through a liquid or a solution accompanied by a.....(physical/chemical) change.

Ans: Electrolysis is the passage of electricity (electricity/electrons) through a liquid or a solution accompanied by a chemical (physical/chemical) change.

2. Define the following terms:

(a) 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.

(b) Non-electrolyte

Ans: It is a compound that neither in solution nor in the molten state allows an electric current to pass through it.

(c) Cation and an anion

Ans: Ions carrying the positive charge are called cations.

Ions carrying the negative charge are called anions.

(d) Weak electrolyte

Ans: Electrolytes that allows small amount of electricity to flow through them and are partially dissociated in aqueous solution are called weak electrolytes.

3. What is the difference between:

(a) Modern explanation and Arrhenius explanation for the theory of electrolysis

Ans:

Modern Theory	Arrhenius Theory
This theory states that water helps in the ionization of electrolytes.	This theory states that electrolytes are ionic in nature even in solid state, ions are held together by strong electrostatic force of attraction which makes the ions immobile.

(b) Electrolytic dissociation and ionization

Ionization	Electrolytic dissociation
It is the formation of positively and negatively charged ions.	It is the separation of ions present in ionic form.
Polar covalent compounds show ionization. e.g. HCl, H_2CO_3, NH_4OH etc.	Electrovalent compounds show dissociation. e.g. Potassium chloride , lead bromide, etc.

(c) A cation and an anion

Ans:

Cation	Anion
It is a positively charged ion.	It is a negatively charged ion.
During electrolysis, cation moves to the cathode.	During electrolysis, anion moves to anode.
Gain electrons and become the neutral atom.	Lose electrons and become the neutral atom.

(d) Electrolytic dissociation and thermal dissociation

Ans:

Electrolytic Dissociation	Thermal Dissociation
Electrolytic dissociation is the dissociation of an electrovalent compound into ions in the fused state or in aqueous solution state.	Reversible breakdown of a chemical compound into simpler substances by heating it. The splitting of ammonium chloride into ammonia and hydrogen chloride is an example. On cooling, they recombine to form the salt.

(e) Strong electrolyte and weak electrolyte

Ans:

Strong Electrolyte	Weak Electrolyte
Strong electrolytes allow large amounts of electricity to pass through it.	Weak electrolytes allow a small amount of electricity to pass through it.
They are good conductors of electricity.	They are poor conductors of electricity.
They completely dissociate into ions in aqueous solution.	They partially dissociate into ions.
They only contain free ions.	They contain free ions as well as molecules.

4. Name:

(a) A salt which is a weak electrolyte

Ans: Sodium carbonate

(b) A base which is a weak electrolyte

Ans: NH_4OH

(c) An inert electrode and an active electrode

Ans: An inert electrode: graphite and Active electrode: silver

(d) A positively charged non-metallic ion

Ans: H^+

(e) The electrode at which reduction occurs

Ans: Cathode

(f) A non-metallic element which is a conductor of electricity

Ans: Graphite

5. Electrolysis is a redox process. Explain.

Ans: Redox reactions are reactions where oxidation and reduction takes place simultaneously. In the process of electrolysis, cations move to cathode and undergo reduction(gain of electron) while anions move to anode and undergo oxidation(loss of electron).

$NaCl \rightarrow Na^+ + Cl^-$

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

$Cl^- - e^- \rightarrow Cl$(oxidation)

$Cl + Cl \rightarrow Cl_2$

Overall reaction: $2NaCl \rightarrow 2Na + Cl_2$

6. Classify the following substances under three headings:

Acetic acid, ammonium chloride, ammonium hydroxide, carbon tetrachloride, dilute hydrochloric acid, sodium acetate, dilute sulphuric acid.

a. strong electrolytes

Ans: dilute hydrochloric acid, dilute sulphuric acid, sodium acetate

b. weak electrolytes

Ans: acetic acid, ammonium hydroxide

c. non-electrolytes

Ans: carbon tetrachloride

7. Explain why:

a. Cu, though a good conductor of electricity, is a nonelectrolyte.

Ans: Copper is a good conductor of electricity due to the presence of free electrons. But copper does not dissociate into its ions in solution so considered to be non electrolyte.

b. Solid sodium chloride does not allow electricity to pass through.

Ans: In solid state, no free Na^+ and Cl^- ions are present. So sodium chloride will not allow electricity to pass through.

8. Choose A, B, C or D to match the descriptions

(i) to (v) below. Some letters may be repeated.

A. non-electrolyte

B. strong electrolyte

C. weak electrolyte

D. metallic conductor

i. Molten ionic compound

Ans: Strong electrolyte

ii. Carbon tetrachloride

Ans: Non- Electrolyte

iii. An aluminium wire

Ans: Metallic conductor

iv. A solution containing solvent molecules, solute molecules and ions formed by the dissociation of solute molecules.

Ans: Weak electrolyte

v. A sugar solution with sugar molecules and water molecules.

Ans: Non électrolyte

9. An electrolyte which completely dissociates into ions is:

a. Alcohol

b. Carbonic acid

c. Sucrose

d. Sodium hydroxide

Ans: d. Sodium hydroxide

Intext questions

1. Name two substances in each case:

(a) Contain only molecules

Ans: Glucose, kerosene

(b) Contain only ions

Ans: NaCl and NaOH

(c) Contain ions as well as molecules

Ans: CH_3COOH and NH_4OH

2. Select the ion in each case that would get selectively discharged from the aqueous mixture of the ions listed below:

a. SO_4^{2-}, NO_3^-, and OH^-

Ans: OH^-

b. Pb^{2+}, Ag^+, and Cu^{2+}

Ans: Ag^+

3. (a) Among Zn and Cu, which would occur more readily in nature as metal and which as ion?

Ans: Zn is more reactive than copper. Zn has more tendency to release electrons and thus Zn more readily occurs as ion while Cu as metal.

(b) Why cannot we store $AgNO_3$ solution in copper vessels?

Ans: Copper lies above silver in electrochemical series so its Cu is more reactive than silver. So Cu displaces Ag from silver nitrate.

$$Cu + AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$$

(c) Out of Cu and Ag, which is more active?

Ans: Cu is more reactive than Ag, Cu lies above Ag in the electrochemical series.

4. (a) How would you change a metal like Cu into ions?

Ans: By treating its salt with a more reactive metal.

(b) How would you change Cu^{2+} ions to Cu?

Ans: $Cu^{2+} + 2e^- \rightarrow Cu$

5. A solution of caustic soda (NaOH) in water or when fused, conducts an electric current. What is the similarity in these two cases?

Ans: In an aqueous state, the slightly negatively charged oxygen atoms of the polar water molecule pull on the positively charged sodium ions in the aqueous state. The mildly charged hydrogen atoms of water exert a similar force on the negatively charged chloride ions. As a result, the ions in solution become free. These free ions are electrical conductors.

The high temperatures required to melt the solid weaken the link between the particles in the molten state, allowing the ions to escape.

6. 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.

Ans: SO_4^{2-} and OH^-

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

Ans: OH^- is discharged at anode and the main product of the discharge of OH^- is O_2

Reaction is :

$OH^- \rightarrow OH + e^-$

$4OH \rightarrow 2H_2O + O_2$

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

Ans: The product formed at cathode is hydrogen. The reaction is :

$$H^+ + e^- \rightarrow H$$
$$H + H \rightarrow H_2$$

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

Ans: No change in colour is observed.

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

Ans: The breakdown of water molecules into ions is catalysed by dilute sulphuric acid, hence electrolysis of acidified water is an example of catalysis.

7. Copper sulphate solution is electrolysed using a platinum anode. Study the diagram given alongside and answer the following questions:

a. Give the names of the electrodes A and B.

Ans: A = Platinum anode, B = Platinum or copper cathode

b. Which electrode is the oxidising electrode?

Ans: A = Platinum anode

8. To carry out the so-called 'electrolysis of water', sulphuric acid is added to water. How does theaddition of sulphuric acid produce a conducting solution?

Ans: Water is dissociated into H+ ions and OH- ions when sulfuric acid is added.

9. Choosing only words from the following list, write down the appropriate words to fill in the blanks (i) to (v) below: Anions , anode, cathode, cations , electrode, electrolyte, nickel , voltameter.

a. The electroplating of an article with nickel requires an (i)____ which must be a solution containing (ii) ions. The article to be plated is placed as the (iii)_____ of the cell in which the plating is carried out. The (iv)_____ of the cell is made from pure nickel. The ions that are attracted to the negative electrode and discharged are called (v) _____.

Ans:

i. Electrolyte

ii. Nickel

iii. Cathode

iv. Anode

v. Cations

b. When a molten ionic compound is electrolysed, the metal is always formed at …… and the non-metal is formed at ……..

Ans: When a molten ionic compound is electrolysed, the metal is always formed at cathode and the non-metal is formed at anode.

c. Electrolysis of acidulated water is an example of.....(Reduction/ oxidation/ redox reaction/synthesis).

Ans: Electrolysis of acidulated water is an example of redox reaction.

10. Explain the following :

(a) A solution of cane sugar does not conduct electricity, but a solution of sodium chloride is a good conductor.

Ans: Cane sugar is a molecule-only substance that does not contain any ions, even in solution. As a result, it is not an electrical conductor. Sodium chloride solution, on the other hand, has free mobile ions and permits electric current to pass through it. As a result, it is a great conductor of electricity.

(b) Hydrochloric acid is a good conductor of electricity.

Ans: Hydrochloric acid is a powerful electrolyte that totally dissociates in water. Electric current can travel through the solution because it contains free mobile ions. As a result, hydrochloric acid is a strong electrical conductor.

(c) During the electrolysis of an aqueous solution of NaCl, hydrogen ion is reduced at the cathode and not the sodium ion though both Na+ and H+ ions are present in the solution.

Ans: In the electrochemical series, hydrogen is placed lower, while sodium is at the higher position. This is due to the fact that H+ ions discharge more quickly at the cathode during electrolysis than Na+ ions and gain electrons more readily.

As a result, the H+ ion, rather than the Na+ ion, is reduced at the cathode.

(d) On electrolysis of dilute copper (II) sulphate solution, copper is deposited at the cathode but hydrogen gas evolves there. Explain why.

Ans: In the electrochemical series, copper is placed below hydrogen. Cu2+ on reduction is discharged as metallic copper in preference to hydrogen.

(e) When a dilute aqueous solution of sodium chloride is electrolysed between platinum electrodes, hydrogen gas is evolved at the cathode but metallic sodium is not deposited. Why?

Ans: Since hydrogen is much below sodium in the activity series, hydrogen is discharged at the cathode in preference to sodium.

(f) Zinc can produce hydrogen by reacting with acids but copper cannot. Explain.

Ans: Zinc is more reactive than hydrogen, so it displaces hydrogen from acids, but copper is less reactive than hydrogen, so it does not liberate hydrogen from acids.

Exercise Questions

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.

Ans: Electrolysis of lead bromide results in the loss of electrons at the anode by the bromine and the gain of electrons at the cathode by the lead. As a result, oxidation and reduction takes place simultaneously. Hence its a redox reaction.

$PbBr_2 \rightarrow Pb^{2+} + 2Br^-$

(b) The blue colour of aqueous copper sulphate fades when it is electrolyzed using platinum electrodes.

Ans: The blue colour of copper ions diminishes as Cu^{2+} ions decrease, and the solution eventually becomes colourless after Cu^{2+} ions are exhausted.

(c) Lead bromide undergoes electrolytic dissociation in the molten state but is a non-electrolyte in the solid state.

Ans: In the molten state, lead bromide dissociates into ions, but it does not dissociate in the solid state. When lead bromide is molten, the ions become free, but when it is solid, the ions are not free because they are packed tightly together due to electrostatic forces. As a result, in the molten state, lead bromide undergoes electrolytic dissociation.

(d) Aluminium is extracted from its oxide by electrolytic reduction and not by conventional reducing agents.

Ans: Because aluminium has a strong affinity for oxygen, it cannot be reduced by a reducing agent. As a result, electrolytic reduction is used to separate it from its oxide.

(e) The ratio of hydrogen and oxygen formed at the cathode and anode is 2:1 by volume.

Ans: $4H^{1+}$ at the cathode and $4OH^-$ at the anode are required for electrolytic reactions, and two molecules of water are generated at the anode. Two molecules of hydrogen at cathode and one molecule of oxygen at anode are liberated for every two molecules of water.

$2H_2 \rightarrow 2H_2(\text{cathode}) + O_2(\text{anode})$

(f) In the electrolysis of acidified water, dilute sulphuric acid is preferred to dilute nitric acid for acidification.

Ans: Because HNO_3 is volatile

(g) Ammonia is unionized in the gaseous state but in the aqueous solution, it is a weak electrolyte.

Ans: The chemical molecule ammonia is a covalent compound. In the gaseous state, it is unionised, but in aqueous solution, it yields NH_4OH, which is a weak electrolyte that dissociates into ions.

(h) A graphite anode is preferred to other inert electrodes during electrolysis of fused lead bromide.

Ans: Graphite is unaffected by bromine vapours

(i) For electroplating with silver, silver nitrate is not used as electrolyte.

Ans: Silver nitrate is not utilised as an electrolyte for silver electroplating because the silver deposition is very fast and hence not very smooth and uniform.

(j) Carbon tetrachloride is a liquid but does not conduct electricity.

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

(k) Potassium is not extracted by electrolysis of its aqueous salt solution.

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

2. a.Copy and complete the following table which refers to two practical applications of electrolysis

	Anode	**Electrolyte**	**Cathode**
Silver plating of a spoon		**Solution of potassium argentocyanide**	

Purification of copper			
Extraction of sodium			

Ans:

	Anode	**Electrolyte**	**Cathode**
Silver plating of a spoon	Plate of pure clean silver	Solution of potassium argentocyanide	Article to be electroplated
Purification of copper	Impure copper	Solution of copper sulphate and dilute sulphuric acid	Thin strip of pure copper
Extraction of sodium	Nickel	Fused sodium chloride	Iron

b. Write the equation taking place at the anode for Q. 2(a).

Ans: i. $Ag - e^- \rightarrow Ag^+$

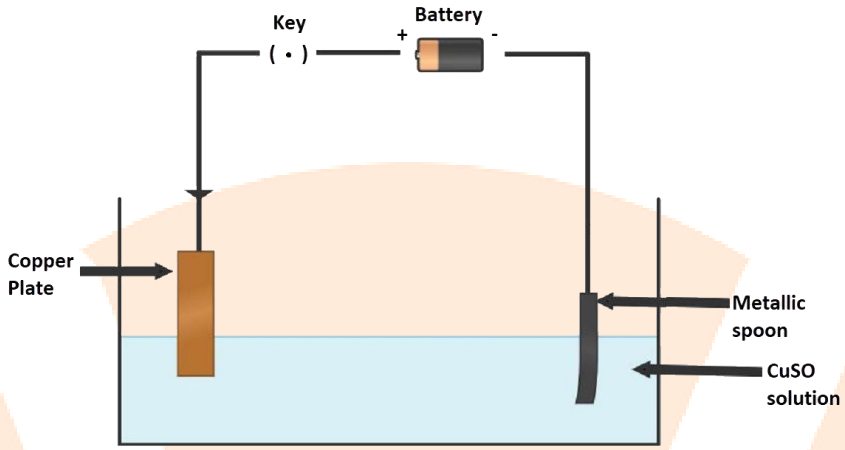
ii. $Cu - e^- \rightarrow Cu^{2+}$

iii. $Cl^- - e^- \rightarrow Cl$

$Cl + Cl \rightarrow Cl_2$

3. (a) Draw a labeled diagram to show how iron is electroplated with copper.

Ans:



(b) Which solution is preferred as electrolyte, $CuSO_4$ or $FeSO_4$?

Ans: $CuSO_4$ is preferred as an electrolyte.

(c) Describe what happens to the iron object and the copper rod.

Ans: The copper anode continuously dissolves as ions in solution and is replaced periodically. The electrolyte dissociates into Cu^{2+} ions which migrate towards the iron object taken as the cathode and are deposited as neutral copper atoms on the cathode.

Electrolyte: Aqueous solution of nickel sulphate

Dissociation: $CuSO_4 \square Cu^{2+} + SO_4^{2-}$

$H_2O \square H^+ + OH^-$

Electrodes:

Cathode: Article to be electroplated

Anode: Block of pure copper

Electrode reactions:

Reaction at cathode: $Cu^{2+} + 2e^- \rightarrow Cu$ (deposited)

Reaction at anode: $Cu - 2e^- \rightarrow Cu^{2+}$

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

(a) Write equations to show how X and Y form ions?

Ans

$X \rightarrow X^{2+} + 2e^-$

$Y + 3e^- \rightarrow Y^{3-}$

(b) If Y is a diatomic gas, write the equation for the direct combination of X and Y to form a compound.

Ans $= Y_2 + 3X \rightarrow X_3Y_2$

(c) If the compound formed between X and Y is melted and an electric current passed through the molten compound, the element X will be obtained at the _____ and Y at the_____of the electrolytic cell.(Provide the missing words)

Ans: Cathode , Anode

5. Write two applications of electrolysis in which the anode diminishes in mass.

Ans: i. Electroplating of metals

ii. Electrorefining of metals

6. (a) What kind of particles will be found in a liquid compound which is a non-electrolyte?

Ans: Non-electrolyte contains molecules.

(b) If HX is a weak acid, what particles will be present in its dilute solution apart from those of water?

Ans: Molecules of HX and H+ and X- ions.

(c) Cations are formed by_____(loss/gain) of electrons and anions are formed by_____(loss/gain) of electrons. (Choose the correct word to fill in blank)

Ans: Loss

(d) What ions must be present in a solution used for electroplating a particular metal?

Ans: The electrolyte used for the purpose must contain the ions of metal which is to be electroplated on the article.

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

Ans: $AgNO_3$ solution

2008

(a) Here is an electrode reaction :

$Cu \rightarrow Cu^{+2} + 2e^-$

At which electrode (anode or cathode) would such a reaction take place? Is this an example of oxidation or reduction?

Ans: The reaction takes place at anode. This is an example of oxidation

(b) A solution contains magnesium ions (Mg^{2+}), iron (II) ions (Fe^{2+}) and copper ions (Cu^{2+}). On passing an electric current through this solution, which ions will be first to be discharged at the cathode? Write the equation for the cathode reaction.

Ans: Cu^{+2} will discharge easily at cathode.

Reaction at cathode:

$Cu^{+2} + 2e^- \rightarrow Cu$

(c) Why is carbon tetrachloride, which is a liquid, a non-electrolyte?

Ans: Carbon tetrachloride is a non-electrolyte because it is a covalent compound. It does not ionize and hence does not conduct electricity.

(d) During the electrolysis of molten lead bromide, which of the following takes place?

A. Bromine is released at the cathode

B. Lead is deposited at the anode

C. Bromine ions gain electrons

D. Lead is deposited at the cathode

Ans: D. Lead is deposited at cathode.

2009

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

A. H_2SO_4

B. HCl

C. HNO_3

D. CH_3COOH

Ans: D. CH_3COOH

b. Correct the following statement: Lead bromide conducts electricity.

Ans: Molten lead bromide conducts electricity.

c. A metal article is to be electroplated with silver. The electrolyte selected is sodium argentocyanide.

i. What kind of salt is sodium argentocyanide?

Ans: Complex salt

ii. Why is it preferred to silver nitrate as an electrolyte?

Ans: 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. State one condition to ensure that the deposit is smooth, firm and long lasting.

Ans: A long current for a longer time should be used.

iv. Write the reaction taking place at the cathode.

Ans: $Ag^+ + e^- \rightarrow Ag$

v. Write the reaction taking place at the anode.

Ans: $Ag - e^- \rightarrow Ag^+$

2010

Select the correct answer: A compound which during electrolysis in its molten state liberates a reddish brown gas at the anode.

i. Sodium chloride

ii. Copper [II] oxide

iii. Copper [II] sulphate

iv. Lead [II] bromide

Ans: iv. Lead [II] bromide

During electroplating of an article with nickel,

i. Name

A. The electrolyte

Ans: Aqueous solution of nickel sulphate with few drops of dil. sulphuric acid.

B. The cathode

Ans: Article

C. The anode

Ans: Pure nickel

ii. Give the reaction of electrolysis at

A. The cathode

Ans: $Ni^{2+} + 2e^- \rightarrow Ni$

B. The anode

Ans: $Ni \rightarrow Ni^{2+} + 2e^-$

c. 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 very 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.

2011

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

Ans: Dissociation is catalysed by dilute sulphuric acid, so electrolysis of acidified water is considered an example of catalysis.

b. During the electrolysis of copper [H] sulphate solution using platinum as a cathode and carbon as an anode,

i. State what you observe at the cathode and at the anode.

Ans: Red shiny metal deposits at the cathode.

ii. State the change noticed in the electrolyte.

Ans: The electrolyte colour changes gradually from blue to colourless.

iii. Write the reactions at the cathode and at the anode.

Ans: At the cathode:

$Cu^{2+} + 2e^- \rightarrow Cu$

Reaction at the anode:

$OH^- \rightarrow OH + e^-$

$4OH \rightarrow 2H_2O + O_2$

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

2012

a. Identify the weak electrolyte from the following:

i. Sodium chloride solution

ii. Dilute hydrochloric acid

iii. Dilute sulphuric acid

iv. Aq. acetic acid

Ans: iv. Aq. acetic acid

b. Match the following in Column A with the correct answer from the choices given in Column B:

Column A	Column B
1. Ammonium hydroxide solution	**(i) Contains only ions**
2. Dilute hydrochloric acid	**(ii) Contains only molecules**
3. Carbon tetrachloride	**(iii) Contains ions and molecules**

Ans: Ammonium hydroxide solution - Contains ions and molecules

Dilute hydrochloric acid - Contains only ions

Carbon tetrachloride - Contains only molecules

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

Ans: An aqueous solution of sodium chloride consists of free sodium and chloride ions which are responsible for conducting electricity.

d. Select the correct answer from the list in brackets:

i. An aqueous electrolyte consists of the ions mentioned in the list. The ion which could be discharged most readily during electrolysis... [Fe^{2+}, Cu^{2+}, Pb^{2+}, H^{+}]

Ans: Cu^{2+}

ii. The metallic electrode which does not take part in an electrolytic reaction... [Cu, Ag, Pt, Ni]

Ans: Pt

iii. The ion which is discharged at the anode during the electrolysis of copper sulphate solution using copper electrodes as anode and cathode… [Cu^{2+}, OH^{-}, SO_4^{2-}, H^{+}]

Ans: Cu^{2+}

iv. When dilute sodium chloride is electrolysed using graphite electrodes, the cation which is discharged at the cathode most readily... [Na^{+}, OH^{-}, H^{+}, Cl^{-}]

Ans: H^{+}

v. During silver plating of an article using potassium argentocyanide as an electrolyte, the anode material should be... [Cu, Ag, Pt, Fe]

Ans: Ag

2013

a. State one appropriate observation for: Electricity is passed through molten lead bromide.

Ans: Dark red brown fumes of bromine release at the anode and greyish white metal lead is formed on the cathode.

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

i. Liquid carbon tetrachloride

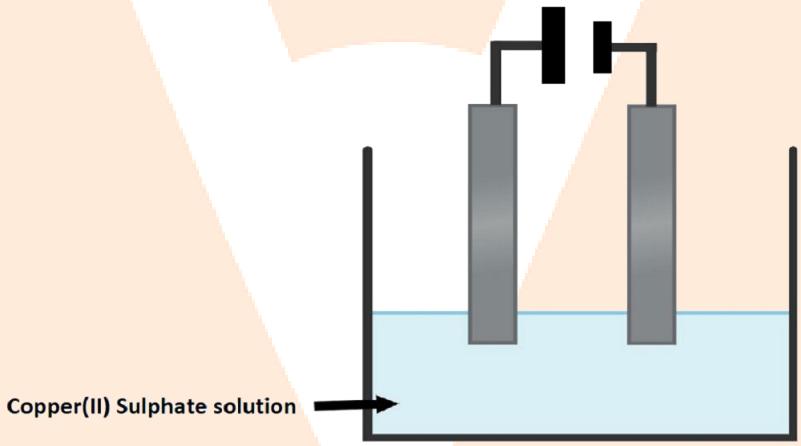
ii. Acetic acid

iii. Sodium hydroxide aqueous solution

iv. Potassium chloride aqueous solution

Ans: i. Liquid carbon tetrachloride

c. Copper sulphate soln. is electrolysed using copper electrodes.



i. Which electrode to your left or right is known as the oxidising electrode and why?

Ans: The right electrode is the anode and oxidising electrode. $Cu \rightarrow Cu^{2+} + 2e^-$ losing electrode.

ii. Write the equation representing the reaction that occurs.

Ans: Reaction at the anode: $Cu \rightarrow Cu^{2+} + 2e^-$

Reaction at the cathode: $Cu^{2+} + 2e^{-} \rightarrow Cu$

iii. State two appropriate observations for the above electrolysis reaction.

Ans: The anode dissolves and anode mud containing precious metal is recovered.

d. Identify: A gas which does not conduct electricity in the liquid state but conducts electricity when dissolved in water.

Ans: Hydrogen chloride

2014

The observation seen when fused lead bromide is electrolysed is

i. A silver grey deposit at anode and a reddish brown deposit at cathode.

ii. A silver grey deposit at cathode and a reddish brown deposit at anode.

iii. A silver grey deposit at cathode and reddish brown fumes at anode.

iv. Silver grey fumes at anode and reddish brown fumes at cathode.

Ans: iii. A silver grey deposit at cathode and reddish brown fumes at anode.

b. During electroplating an article with silver, the electrolyte used is

i. Silver nitrate solution

ii. Silver cyanide solution

iii. Sodium argentocyanide solution

iv. Nickel sulphate solution

Ans: iii. Sodium argentocyanide solution

c. Give one word or phrase for: Electrolytic deposition of a superior metal on a baser metal.

Ans: Galvanisation

d. State your observation seen: At the cathode when acidified aqueous copper sulphate solution is electrolysed with copper electrodes.

Ans: Acidified aqueous copper sulphate solution is electrolysed with copper electrodes by electrolysis. The electrolysis of an aqueous solution of copper sulphate using copper electrodes (i.e. using active electrodes) results in transfer of copper metal from the anode to the cathode during electrolysis. The copper sulphate is ionised in the aqueous solution.

Copper sulphate solution is ionised by the following chemical equation:

$CuSO_4 \rightarrow Cu^{2+} + SO_4^{2-}$

The positively charged copper ions migrate to the cathode, where each gains two electrons to become copper atoms which are deposited on the cathode.

$Cu^{2+} + 2e^- \rightarrow Cu$

Hence, the colour of copper sulphate changes from

blue to colourless.

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

Ans: Cathode (Reducing electrode): At the cathode, the cations gain electrons to form neutral atoms. As electrons are gained, the ion is said to be reduced.

Anode (Oxidising electrode): At the anode, the anions lose electrons to form neutral atoms. As electrons are lost, the ion is said to be oxidised.

f. Name the kind of particles present in

i. Sodium hydroxide solution

Ans: Positive sodium ions and negative hydroxide ions

ii. Carbonic acid

Ans: Hydrogen ions and carbonate ions

iii. Sugar solution

Ans: Glucose, fructose and galactose

g. M_2O is the oxide of a 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.

i. State the reaction taking place at the cathode

Ans: $M^+ + 1e^- \rightarrow M$

ii. Name the product at the anode

Ans: Oxygen gas

2015

State the observation at the anode when aqueous copper sulphate solution is electrolysed using copper electrodes.

a. Copper anode itself ionises to give Cu^{2+} ions.

Ans: $Cu - 2e^- \rightarrow Cu^{2+}$

b. During electrolysis of molten lead bromide, graphite anode is preferred to other electrodes. Give a reason.

Ans: During the electrolysis of molten lead bromide, a graphite anode is preferred because graphite remains unaffected by the reactive bromine vapours which are released at the anode.

c. Electrolysis of molten lead bromide is considered to be a redox reaction. Give a reason.

Ans: In the electrolysis of molten lead bromide, the following reactions take place:

At the cathode: $Pb^{2+}(l) + 2e^- \rightarrow Pb(l)$

At the anode: $2Br^-(l) \rightarrow Br_2(g) + 2e^-$

Lead (II) ions (Pb^{2+}) are attracted to the negative electrode, and the Pb^{2+} ions are forced to accept two electrons. Pb^{2+} ions are reduced. Bromide ions (Br^-) are attracted to the positive electrode, and the bromide ions are forced to give away their extra electrons to form bromine atoms. Thus, bromide ions are oxidised. So, electrolysis of molten lead bromide is a redox reaction.

2016

Give reasons why :

(a) Sodium Chloride will conduct electricity only in fused or aqueous solution state.

Ans: Electrostatic forces of attraction between ions in the solid state are very strong. These forces weaken in the fused or solution state. Hence, ions become mobile.

(b) In the electroplating of an article with silver, the electrolyte sodium argentocyanide solution is preferred over silver nitrate solution.

Ans: If silver nitrate solution is used directly instead of double cyanide of silver and sodium, silver will deposit very fast and its deposition will not be smooth and uniform.

(c) Although copper is a good conductor of electricity, it is a non-electrolyte.

Ans: Copper has no mobile electrons in the solid state and an electrolyte should dissociate into oppositely charged ions to conduct electricity.

Hence, copper is a non-electrolyte.