CLASS 10TH CHEMISTRY WORKSHEET CHAPTER - ELECTROLYSIS

Intext Question 1

Question 1

Fill in the blanks:

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

(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 .....

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

(d) The electron releasing tendency of zinc is ..... 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 .....

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

(g) We can expect that pure water ..... (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.

Answer

(a) Powdered sodium chloride (common salt) does not conduct an electric current, but it does so when ***in aqueous state*** or when ***in molten state*** .

(b) 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 ***metals*** .

(d) The electron releasing tendency of zinc is ***more*** than that of copper.

(e) 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.***

(f) Pure water consists entirely of ***molecules***

(g) We can expect that pure water ***will not*** normally conduct electricity.

(h) Electrolysis is the passage of ***electricity*** through a liquid or a solution accompanied by a ***chemical*** change.

Question 2

Define the following terms:

(a) Electrolysis

(b) Non-electrolyte

(c) Cation and anion

(d) Weak electrolyte

Answer

(a) **Electrolysis** — It is the process of decomposition of a chemical compound in aqueous solution or in molten state accompanied by a chemical change using direct electric current.

(b) **Non-electrolyte** — It is a compound which neither in solution nor in the molten state allows an electric current to pass through it.

(c) **Cation** — Ions carrying positive charge are called cations.

Anion — Ions carrying negative charge are called anions.

(d) **Weak electrolyte** — Electrolytes which allow small amount of electricity to flow through them and are partially dissociated in aqueous solution are called weak electrolytes.

Question 3(a)

What is the difference between Modern explanation and Arrhenius explanation for the theory of electrolysis

Answer

Modern explanation	Arrhenius explanation
Modern concept considers that electrolytes are ionic even in solid state and their ions are held by strong electrostatics forces which make them immobile. Water renders these ions mobility by breaking the electrostatic forces.	Arrhenius considered that water ionises electrolytes

Question 3(b)

What is the difference between Electrolytic dissociation and ionisation

Answer

Electrolytic dissociation	Ionisation
Separation of ions which are already present in an ionic compound	Formation of positively or negatively charged ions from molecules which are not initially in the ionic state.
Electrovalent compounds show dissociation e.g., potassium chloride, lead bromide, etc.	Polar covalent compounds show ionisation e.g., HCl, NH_4OH etc.,
$KCl \longrightarrow K^+ + Cl^-$	$HCl \xrightarrow{H_2O} H^+ + Cl^-$

Question 3(c)

What is the difference between A cation and an anion

Answer

Cation	Anion
Are positively charged ions.	Are negatively charged ions.
Migrate to the cathode during electrolysis	Migrate to the anode during electrolysis.
Gain electrons from the cathode and get reduced to become a neutral atom.	Lose electrons to the anode and get oxidised to become a neutral atom.
Examples: Cations : Na^+, Ca^{2+}, Al^{3+}	Examples: Anions : PO_4^{3-}, Cl^-, OH^-, SO_4^{2-}

Question 3(d)

What is the difference between Electrolytic dissociation and thermal dissociation

Answer

Electrolytic dissociation	Thermal dissociation
The process due to which an ionic compound dissociates into ions in the fused state or in aqueous solution on application of electric current.	It is the decomposition of a compound into it's elements on application of heat energy.
This is a reversible process	This is generally an irreversible process.

Question 3(e)

What is the difference between Strong electrolyte and weak electrolyte

Answer

Strong electrolyte	Weak electrolyte
Strong Electrolyte allow a large amount of electricity to flow through them.	Weak electrolytes allow small amount of electricity to flow through them.
These are good conductors of electricity.	These are poor conductors of electricity.
These are almost, completely dissociated in fused or aqueous solution state.	These are partially dissociated in fused or aqueous solution state.
These solutions contain (almost) only free mobile ions.	These solutions contain ions as well as molecules.
Strong electrolyte allows a bulb to glow brightly.	Weak electrolyte allows a bulb to glow dimly.
Examples: Acids — Hydrogen chloride, Nitric acid, etc. Bases — NaOH, KOH (aqueous or molten state) Salts — NaCl (molten or aqueous), $PbBr_2$ (molten), $CuCl_2$ (aq.), $CuSO_4$ (aq.)	Examples: Acids — Carbonic acid, acetic acid, oxalic acid etc. Bases — Ammonium hydroxide, calcium hydroxide (aqueous or molten state) Salts — Ammonium carbonate, lead acetate

Question 4

Name:

(a) a salt which is a weak electrolyte

(b) a base which is a weak electrolyte

(c) an inert electrode and an active electrode

(d) a positively charged non-metallic ion

(e) the electrode at which reduction occurs

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

Answer

(a) Lead acetate

(b) Ammonium hydroxide

(c) Inert electrode: Graphite and Active electrode: Copper

(d) H^+

(e) Cathode

(f) Graphite

Question 5

Electrolysis is a redox process. Explain.

Answer

During electrolysis, the reaction at the cathode involves reduction of cations as they gain electrons to become neutral atoms while that at anode involves oxidation of anions as they lose electrons to become neutral. As redox reactions are reactions where oxidation and reduction takes place simultaneously. Hence, electrolysis is a redox process.

Example : Dissociation of sodium chloride during electrolysis.

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

At cathode : $Na^+ + e^- \longrightarrow Na$ (reduction)

At anode : $Cl^- - e^- \longrightarrow Cl$ (oxidation)

$Cl + Cl \longrightarrow Cl_2$

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

Question 6

Classify the following substances under three headings:
(a) strong electrolytes
(b) weak electrolytes
(c) non-electrolytes
Acetic acid, ammonium chloride, ammonium hydroxide, carbon tetrachloride, dilute hydrochloric acid, sodium acetate, dilute sulphuric acid.

Answer

(a) **Strong electrolytes** — dilute hydrochloric acid, dilute sulphuric acid, sodium acetate, ammonium chloride
(b) **Weak electrolytes** — acetic acid, ammonium hydroxide
(c) **Non-electrolytes** — carbon tetrachloride

Question 7

Explain why:
(a) Cu, though a good conductor of electricity, is a non electrolyte.
(b) Solid sodium chloride does not allow electricity to pass through.

Answer

(a) Copper does not undergo chemical decomposition due to flow of electric current through it. Hence, copper is a good conductor of electricity but it is a non-electrolyte.
(b) In solid sodium chloride, ions Na^+ and Cl^- are not free to move due to the strong electrostatic forces. Hence, solid sodium chloride does not allow electricity to pass through it.

Question 8

Choose A, B, C or D to match the descriptions (i) to (v) below. Some alphabets may be repeated.
A. non-electrolyte
B. strong electrolyte
C. weak electrolyte
D. metallic conductor
(i) Molten ionic compound
(ii) Carbon tetrachloride
(iii) An aluminium wire
(iv) A solution containing solvent molecules, solute molecules and ions formed by the dissociation of solute molecules.
(v) A sugar solution with sugar molecules and water molecules.

Answer

(i) Molten ionic compound — **B (Strong electrolyte)**
(ii) Carbon tetrachloride — **A (Non-Electrolyte)**
(iii) An aluminium wire — **D (Metallic conductor)**
(iv) A solution containing solvent molecules, solute molecules and ions formed by the dissociation of solute molecules — **C (Weak electrolyte)**
(v) A sugar solution with sugar molecules and water molecules — **A (Non-Electrolyte)**

Question 9

An electrolyte which completely dissociates into ions is:
A. Alcohol
B. Carbonic acid
C. Sucrose
D. Sodium hydroxide

Answer

Sodium hydroxide
$NaOH \rightleftharpoons Na^+ + OH^-$

Intext Questions 2

Question 1

Name two substances in each case:

(a) Contain only molecule

(b) Contain only ions

(c) Contain ions as well as molecules

Answer

(a) Distilled water, alcohol

(b) NaOH, KOH

(c) Carbonic acid , acetic acid

Question 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^-

(b) Pb^{2+}, Ag^+, and Cu^{2+}

Answer

(a) OH^-, Lower the position of the anion in the series, more easily it gets discharged at anode.

(b) Ag^+, Elements lower in the series gets discharged more easily at the cathode during electrolysis because their cations can easily gain electrons.

Question 3

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

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

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

Answer

(a) Zn has more tendency to release electrons, thus Zn occurs more readily as ion while Cu as metal.

(b) As copper lies above silver in electrochemical series, hence, Cu is more reactive than silver and it displaces Ag from silver nitrate.

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

(c) Cu is more reactive than Ag hence, Cu lies above Ag in the electrochemical series.

Question 4

(a) How would you change a metal like Cu into it's ions?

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

Answer

(a) By the method of electrolysis, metal like Cu can be changed into it's ions.

Using —

electrolyte : A solution of copper sulphate and dil. sulphuric acid

Cathode : Thin strip of pure copper

Anode: Impure copper

When the current is passed through the electrolyte, the copper block loses electrons and passes into solution as soluble copper ions.

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

(b) By the same process as above, when current is passed through the electrolyte, the copper ions of the copper sulphate solution are attracted to the cathode where they gain electrons and gets deposited on the copper strip.

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

Question 5

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

Answer

When caustic soda is dissolved in water or fused, the forces of attraction between their ions are broken and the ions then move about and conduct electricity.

Question 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.

(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 ?

Answer

(a) SO_4^{2-} and OH^-

(b) SO_4^{2-} and OH^- both migrate to the anode. OH^- being lower in the electrochemical series is discharged preferentially.

OH^- loses one electron to the anode and becomes neutral OH.

$OH^- \longrightarrow OH + e^-$

The combination of OH forms water with the liberation of oxygen, which is given off at the anode.

$OH + OH \longrightarrow H_2O + O$

$O + O \longrightarrow O_2$

(c) The product formed at cathode is hydrogen.

The reaction is : H^+ gains an electron and become neutral hydrogen atom.

$H^+ + e^- \longrightarrow H$

Hydrogen atoms combine to form molecule and this comes out as hydrogen gas.

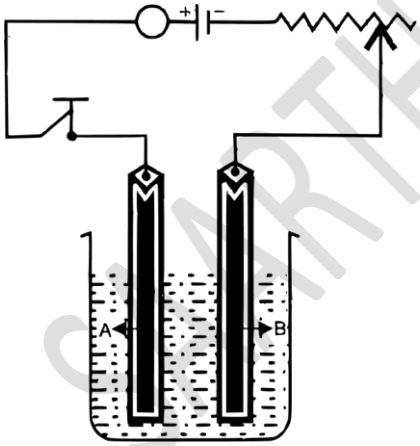
$H + H \longrightarrow H_2$

(d) No change in colour is observed.

(e) Water in pure state consists almost entirely of molecules. It is a polar covalent compound and can form ions when traces of dilute sulphuric acid is added. As dilute sulphuric acid catalyses this ionisation, hence this electrolysis of acidified water is considered as an example of catalysis.

Question 7

Copper sulphate solution is electrolysed using a platinum cathode and carbon anode. Study the diagram given below and answer the following questions:



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

(b) Which electrode is the oxidising electrode ?

Answer

(a) A = Platinum anode, B = Platinum or copper cathode

(b) A = Platinum anode as oxidation of non-metal ions always takes place at the anode.

Question 8

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

Answer

Water in pure state consists almost entirely of molecules. Hence it is a non-electrolyte that will not conduct electricity. Water is a polar covalent compound. It can be electrolytically decomposed by addition of traces of dil. H_2SO_4 which dissociates as: H^{+1} and SO_4^{2-} and help in dissociating water into H^{+1} and OH^- ions. Thus, dilute sulphuric acid catalyses the ionisation of water to produce a conducting solution.

Question 9

(a) 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.

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) .....

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

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

Answer

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

(b) 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 ***redox reaction***

Question 10(a)

Explain the following :

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

Answer

A solution of cane sugar does not conduct electricity because it is composed of molecules that do not dissociate into ions when dissolved in water. In contrast, a solution of sodium chloride does conduct electricity because sodium chloride is an ionic compound consisting of sodium (Na^+) and chloride ions (Cl^-). When dissolved in water, the sodium ions (Na^+) and chloride ions (Cl^-) become free to move independently and can carry an electric current.

Question 10(b)

Explain the following :

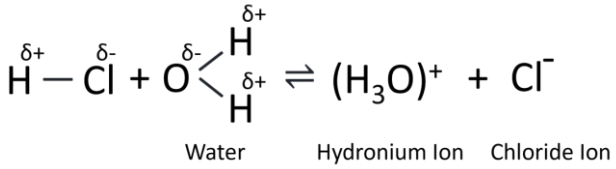
Hydrochloric acid is a good conductor of electricity.

Answer

HCl is polar covalent in nature, i.e., shows charge distribution in its molecules such that the hydrogen atom has a slight positive charge and the chlorine atom has a slight negative charge.

$H^{\delta+} — Cl^{\delta-}$

When hydrogen chloride is added to water [a polar covalent solvent], the slightly negative charged oxygen atom of water exerts an electrostatic pull on the slightly positively charged hydrogen ions present in the molecule of HCl.



Thus, H^+ ions combine with water to form hydronium ions $[H_3O]^+$.

The presence of hydronium and chloride ions makes hydrochloric acid a good conductor of electricity.

Question 10(c)

Explain the following :

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.

Answer

Na^+ and H^+ migrate to cathode, but as H^+ has lower position in electrochemical series than Na^+, so hydrogen ion is reduced at the cathode and not the sodium ion.

$H^+ + e^- \longrightarrow H$

Question 10(d)

Explain the following :

On electrolysis of dilute copper (II) sulphate solution, copper is deposited at the cathode but no hydrogen gas evolves there. Explain why ?

Answer

In the electrochemical series, copper is placed below hydrogen. Thus, copper ions discharge at the cathode over H^+ ions. That's why copper is deposited at the cathode but no hydrogen gas evolves there.

Question 10(e)

Explain the following :

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 ?

Answer

In the electrochemical series, hydrogen is placed much below sodium, hence, hydrogen is discharged at the cathode in preference to sodium.

Question 10(f)

Explain the following :

Zinc can produce hydrogen on reacting with acids but copper cannot. Explain.

Answer

Zinc is more reactive than hydrogen and is placed above hydrogen in the reactivity series, so it displaces hydrogen from acids, but copper is less reactive than hydrogen and is placed below hydrogen in the reactivity series, so it does not liberate hydrogen from acids.

Exercise 6 — Multiple Choice Type

Question 1

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

1. Bromine is released at the cathode
2. Lead is deposited at the anode
3. Bromine ions gain electrons
4. Lead is deposited at the cathode

Answer

Lead is deposited at the cathode

Reason — The positive lead ions (Pb^{2+}) migrate towards the cathode when the current is turned on. They take 2 electrons each and become neutral lead atoms.

Reaction at cathode :

$Pb^{2+} + 2e^- \longrightarrow Pb$

Silvery gray metal lead is formed on the cathode.

Question 2

The aqueous solution of the compound which contains both ions and molecules is :

1. H_2SO_4
2. HCl
3. HNO_3

4. CH_3COOH

Answer

Acetic acid [CH_3COOH]

Reason — Acetic acid is a weak electrolyte and particles in a weak electrolyte are ions and unionized molecules.

Question 3

A compound which during electrolysis in it's molten state liberates a reddish brown gas at the anode :

1. Sodium chloride
2. Copper (II) oxide
3. Copper (II) sulphate
4. Lead (II) bromide

Answer

Lead (II) bromide

Reason — During electrolysis of Lead [II] bromide, Br^{-1} ions are discharged at the anode. Reddish brown fumes are due to bromine vapours.

Question 4

Identify the weak electrolyte from the following:

1. Sodium Chloride solution
2. Dilute Hydrochloric acid
3. Dilute Sulphuric acid
4. Aqueous acetic acid.

Answer

Aqueous acetic acid.

Reason — Aqueous acetic acid is a weak electrolyte because they partially dissociate and allow small amount of electricity to flow through them.

Question 5

An aqueous electrolyte consists of the following ions. The ion which could be discharged most readily during electrolysis is :

1. Fe^{2+}
2. Cu^{2+}
3. H^{+}
4. Al^{3+}

Answer

Cu^{2+}

Reason — Ion's place in the electrochemical (reactivity) series determines how easily they discharge during electrolysis. Ions in a lower position discharge more easily and are less reactive.

Question 6

During silver plating of an article using potassium argento-cyanide as an electrolyte, the anode material should be :

1. Cu
2. Ag
3. Pt
4. Fe

Answer

Ag

Reason — During silver plating using potassium argento-cyanide as an electrolyte, the anode should be block of pure clean silver.

The anode dissolves, supplying Ag^{+} ions to the electrolyte. These Ag^{+} ions then get reduced at the cathode (the article to be plated) and deposited as metallic silver.

Question 7

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

1. Liquid carbon tetrachloride
2. Acetic acid
3. Sodium hydroxide aqueous solution.
4. Potassium chloride aqueous solution.

Answer

Liquid carbon tetrachloride

Reason — Carbon tetrachloride (CCl_4) is a liquid that does not conduct electricity because it is a non-polar covalent compound. In the case of CCl_4, carbon atom shares electrons with four chlorine atoms. The electrons are shared equally between the atoms, and the molecule has no permanent dipole moment, meaning there is no separation of charge. Therefore, there are no ions present in the compound, and no free electrons to carry an electrical current.

Question 8

The observation seen when fused lead bromide is electrolysed is:

1. a silver grey deposit at anode and a reddish brown deposit at cathode.
2. a silver grey deposit at cathode and a reddish brown deposit at anode.
3. a silver grey deposit at cathode and reddish brown fumes at anode.
4. silver grey fumes at anode and reddish brown fumes at cathode.

Answer

a silver grey deposit at cathode and reddish brown fumes at anode.

Reason — Silver grey colour is due to lead metal deposited at cathode and reddish brown fumes at anode is due to bromine vapours.

Question 9

During electroplating an article with silver, the electrolyte used is:

1. Silver nitrate solution
2. Silver cyanide solution
3. Sodium argentocyanide solution
4. Nickel sulphate solution

Answer

Sodium argentocyanide solution

Reason — Sodium argentocyanide solution is used as electrolyte during silver plating because it allows slow and smooth plating, which is essential for a uniform and bright finish. If silver nitrate solution is used directly instead of double cyanide of sodium and silver, the deposition of silver will be very fast and hence not very smooth and uniform .

Question 10

The metallic electrode which does not take part in an electrolytic reaction :

1. Cu
2. Ag
3. Pt
4. Ni

Answer

Pt

Reason — Platinum is used as a inert electrolyte, as they will not take part in the electrolytic reaction.

Question 11

The ion which is discharged at the anode during the electrolysis of copper sulphate solution using platinum electrodes as anode and cathode is:

1. Cu^{2+}
2. OH^-
3. SO_4^{2-}
4. H^+

Answer

OH^-

Reason — The SO_4^{2-} and OH^- ions both migrate to the anode. The OH^- ions, being lower in electrochemical series as compared to SO_4^{2-} ions, discharge to form neutral (OH) radical. The neutral (OH) radicals reunite to form water and oxygen.

$4OH^- - 4e^- \longrightarrow 4OH$

Question 12

When dilute sodium chloride is electrolysed using graphite electrodes, the cation which is discharged at the cathode most readily :

1. Na^+
2. OH^-
3. H^+
4. Cl^-

Answer

H^+

Reason — Na^+ and H^+ (H_3O^+) migrate to cathode. But despite high concentration of Na^+, H^+ gains electron more easily than Na^+, (sodium is above hydrogen in electro-chemical series). It is the H^+ ions that accept electrons.

$H^+ + e^- \longrightarrow H$

Question 13

Cathode is a reducing electrode because :

1. it has less number of electrons
2. it has deficiency of electrons
3. cations gain electrons from cathode
4. anions lose electrons to cathode

Answer

cations gain electrons from cathode

Reason — The reaction at cathode involves reduction of cations as they gain electrons to become neutral atoms. Hence, cathode is a reducing electrode and cations gain electrons from cathode.

Question 14

Which statement about conduction of electricity is correct?

1. Electricity is conducted in an aqueous solution by electrons.
2. Electricity is conducted in a metal wire by ions.
3. Electricity is conducted in a molten electrolyte by electrons.
4. Electricity is conducted in an acidic solution by ions.

Answer

Electricity is conducted in an acidic solution by ions.

Reason — Acids when dissolved in water get ionized into their respective ions.These ions are mobile and allow the solution to carry electric current.

For example :

HCl in water conduct electricity through ions like H^+ and Cl^-.

However, in aqueous solutions (like saltwater or acids) or in molten electrolytes (like molten NaCl), electricity is conducted by ions, not electrons. In metals, electricity is conducted by free electrons, not ions. Hence other options cannot be right.

Question 15

The oxidation reaction among the following is :

1. $Fe^{3+} + 3e^- \longrightarrow Fe$
2. $Fe^{2+} - e^- \longrightarrow Fe^{3+}$
3. $Cl_2 + 2e^- \longrightarrow 2Cl^-$

4. $Cu^{2+} + 2e^- \longrightarrow Cu$

Answer

$Fe^{2+} - e^- \longrightarrow Fe^{3+}$

Reason — Oxidation is defined as a process in which an atom or an ion loses electron(s).

In the reaction

$Fe^{2+} - e^- \longrightarrow Fe^{3+}$

Fe^{2+} loses one electron and forms Fe^{3+}. So, this is an oxidation reaction.

Question 16

During electrolysis, what happens to metallic ions and at which electrode do they get discharged ?

P Reduction of metallic ions, cathode

Q Oxidation of metallic ions, anode

R Oxidation of metallic ions, cathode

1. Only P
2. Only Q
3. both P and Q
4. Both Q and R

Answer

Only P

Reason — Metallic ions, which are positively charged cations, migrate to the cathode during electrolysis. At the cathode, they gain electrons and are discharged as neutral metal atoms. Hence, during electrolysis, reduction of metallic ions occurs at cathode.

Question 17

Assertion (A): Electrolysis establishes a relationship between electrical energy and chemical energy.

Reason (R): Substances like metals, carbon (graphite) are conductors while salts like NaCl, KCI are electrolytes.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation — Electrolysis is a process that demonstrates the conversion of electrical energy into chemical energy. Hence, assertion (A) is true.

Metals and graphite are conductors, while salts like NaCl and KCl (in molten or aqueous form) are electrolytes. Hence, Reason (R) is true.

However, knowing which substances are conductors or electrolytes does not establish the relationship between electrical and chemical energy. Hence, both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

Question 18

Assertion (A): Benzene acts as non-electrolyte.

Reason (R): Benzene does not have free ions.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true and R is the correct explanation of A.

Explanation — Benzene is a non-electrolyte that does not have ions even in solution. They contain only molecule. Hence both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

Question 19

Assertion (A): Metals and alloys conduct electricity with the help of electrons.

Reason (R): Non-metals do not have free electrons.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation — Metal and alloys (mixtures of metals) conduct electricity using free electrons in their outer shells that move easily in solid state. Hence assertion (A) is true. Non-metals generally do not have free electrons, which is why they are poor conductors of electricity. Hence the reason (R) is true.

However,it does not precisely explain why metals and alloys conduct electricity , the reason (R) only explains why non-metals are poor conductor of electricity. Hence reason (R) is not correct explanation for assertion (A).

Question 20

Assertion (A): Weak electrolytes do not allow any electricity to flow through them.

Reason (R): Substances which are composed of only molecules do not allow any current to flow through them.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is false but R is true.

Explanation — Electrolytes which allow small amounts of electricity to flow through them are called weak electrolytes. These are poor conductors of electricity. Hence the assertion (A) is false.

Substances which are composed of only molecules are non electrolytes, they do not allow any current to flow through them. For example, Benzene, glucose.

Hence the reason (R) is true.

Question 21

Assertion (A): NaCl is an example of an electrolyte.

Reason (R): NaCl conducts electricity in aqueous or molten state.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true and R is the correct explanation of A.

Explanation — NaCl is an electrolyte because it conducts electricity when dissolved in water or in molten form, due to the presence of free-moving ions. Therefore, both the assertion (A) and the reason (R) are true, and the reason correctly explains why NaCl is an electrolyte.

Question 22

Assertion (A): An electrolyte can be acid, base or salt.

Reason (R): An electrolyte is a substance which can conduct electricity in aqueous or molten state.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation — Electrolytes include acids (like HCl), bases (like NaOH), and salts (like NaCl). Hence, assertion (A) is true.

Electrolytes conduct electricity in aqueous or molten states because they produce ions. Hence, Reason (R) is true.

The reason correctly describes what an electrolyte does, but it doesn't directly explain why acids, bases, and salts are classified as electrolytes. Hence, both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

Question 23

Assertion (A): Oxidation occurs at the anode.

Reason (R): Electrons are gained at the anode.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation — The reaction at anode involves oxidation of anions as they lose electrons to become neutral. Hence the assertion (A) is true.

Electrons are **donated or lost** at the anode. However, gain of electrons takes place at cathode, where cations are reduced. Hence the reason (R) is false.

Question 24

Assertion (A): Polar covalent compounds can form ions when dissolved in water.

Reason (R): Electrovalent compounds show dissociation.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation — Polar covalent compounds are converted into ions in water , and these ions conduct electricity. Hence assertion (A) is true.

For example : water.

Electrovalent compounds when melted or dissolved in water, electrostatic force of attraction is broken and they dissociate into ions and conduct electricity.Hence the reason (R) is true.

Since reason (R) doesn't explain the ionisation of polar covalent compound it is not correct explaination of assertion (A).

Question 25

Assertion (A): A block of pure silver metal is used as anode during silver plating.

Reason (R): Silver ions are deposited as metal at the anode.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation — The block of pure silver is used as anode because it is active electrode, as it slowly dissolves in the solution, Ag^+ ions are produced for the plating process. Hence the assertion (A) is true.

Silver ions are deposited on to the article that acts as **cathode**. Hence reason (R) is false.

Exercise 6 — Very Short Answer Type

Question 1

(Choose the correct word to fill in blank)

Cations are formed by ..... (loss/gain) of electrons and anions are formed by ..... (loss/gain) of electrons.

Answer

Cations are formed by ***loss*** of electrons and anions are formed by ***gain*** of electrons.

Question 2

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

Answer

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

Question 3

Name the kind of particles present in:

(i) Sodium hydroxide solution

(ii) Carbonic acid.

(iii) Sugar solution

Answer

(i) Strong electrolyte — Sodium (Na^+) ions and hydroxide (OH^-) ions.

(ii) Weak electrolyte — Ions (H^+, HCO_3, CO_3^{2-}) and molecules (H_2CO_3)

(iii) Non-electrolyte — Molecules of sugar soln.

Question 4

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

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

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

Answer

(a) Non-electrolyte contains **molecules**.

(b) Molecules of HX and H^+ and X^- ions.

(c) The electrolyte must contain ions of the metal which is to be electroplated on the article.

Question 5

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?

Answer

$AgNO_3$ solution will turn blue.

Reason — Copper is unable to displace potassium, calcium and zinc from their nitrate solution as they are higher than copper in the metal activity series.
But silver being lower than copper in metal activity series gets displaced by copper and blue coloured copper nitrate is formed.
$2AgNO_3 + Cu \longrightarrow Cu(NO_3)_2 + 2Ag$

Question 6

Here is an electrode reaction:
$Cu \longrightarrow Cu^{2+} + 2e^-$.
At which electrode (anode or cathode) would such a reaction take place ? Is this an example of oxidation or reduction ?

Answer

$Cu \longrightarrow Cu^{2+} + 2e^-$
This reaction takes place at **anode**.
This is an example of **oxidation**.

Question 7

Aqueous solution of nickel sulphate contains Ni^{2+} and SO_4^{2-} ions
(i) Which ion moves towards the cathode?
(ii) What is the product at the anode?

Answer

(i) Nickel ion moves towards the cathode.
(ii) Product at anode - Nil [Nickel anode loses electrons to give Ni^{2+} ions in solution]

Question 8

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

Answer

Hydrogen chloride gas

Question 9

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

Answer

Electroplating

Exercise 6 — Short Answer Type

Question 1(a)

Give reason for the following:
The blue colour of aqueous copper sulphate fades when it is electrolyzed using platinum electrodes.

Answer

The blue colour of $CuSO_4$ solution is due to the Cu^{2+} ions. During it's electrolysis using Pt electrodes, at the cathode Cu^{2+} ions are discharged as neutral copper atoms by accepting electrons. These are not replaced by Cu^{2+} ions from the anode because at the anode, OH^- ions are discharged. As Cu^{2+} ions decrease, the blue colour of $CuSO_4$ solution fades and it becomes almost colourless as soon as Cu^{2+} ions are finished.

Question 1(b)

Give reason for the following:
Lead bromide undergoes electrolytic dissociation in the molten state but is a non-electrolyte in the solid state.

Answer

Solid lead bromide is a non-electrolyte since it's ions are not free but held together by strong electrostatic forces of attraction. These ions become free when lead bromide is in fused or molten state, hence it undergoes electrolytic dissociation in the fused or molten state.

Question 1(c)

Give reasons for the following:
Aluminium is extracted from it's oxide by electrolytic reduction and not by conventional reducing agents.

Answer

As aluminium is higher in the electrochemical series, hence it has a strong affinity for oxygen and its oxides are highly stable. It is not possible to reduce the oxides by common reducing agents like carbon monoxide and hydrogen. Hence, electrolytic reduction is used.

Question 1(d)

Give reasons for the following:

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

Answer

In the electrolysis of acidified water:

At anode OH^- loses one electron and becomes neutral OH.

$OH^- \longrightarrow OH + e^-$

The combination of OH forms water with the liberation of oxygen.

$2OH + 2OH \longrightarrow 2H_2O + O_2$

Since, 4 OH neutral particles are involved in the equation so 4 electrons are lost in order to get 4 OH neutral particles.

$4OH^- \longrightarrow 4OH + 4e^-$

Thus, the formation of 1 molecule of oxygen at the anode releases 4 electrons and to ensure that there is no build-up of electrons in any part of the circuit, the reaction of the cathode must take up 4 electrons,

i.e., $4H^+ + 4e^- \longrightarrow 2H_2$

This shows that the number of molecules of hydrogen is twice that of oxygen.

According to Avogadro's Law, molecules can be substituted by volumes. Hence, electrolysis of water gives 2 volumes of H_2 and 1 volume of O_2.

Question 1(e)

Give reasons for the following:

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

Answer

Dilute sulphuric acid is non-volatile while dilute nitric acid is a volatile acid. It may decompose and nitrate radical (NO_3^{1-}) may tend to interfere with the electrolytic reaction. Hence, in the electrolysis of acidified water, dilute sulphuric acid is preferred to dilute nitric acid.

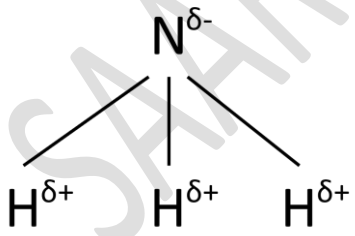
Question 1(f)

Give reasons for the following:

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

Answer

NH_3 is polar covalent in nature, i.e., shows charge distribution in its molecules such that the 3 hydrogen atoms have a slight positive charge and Nitrogen atom has a slight negative charge.



The nitrogen atom in ammonia has a lone pair of electrons. In aqueous solution, the ammonia molecule combines with a hydrogen atom H^+ by sharing the lone pair of electrons of nitrogen atom to form ammonium ion (NH_4^+). Thus, in water, ammonium hydroxide (NH_4OH) dissociates into NH_4^+ (ammonium ion) and OH^- (hydroxide ion) as follows:

$NH_4OH \longrightarrow NH_4^+ + OH^-$

Due to this ionization, aqueous solution of ammonia (NH_4OH) behaves as a weak electrolyte.

Question 1(g)

Give reasons for the following:

A direct current instead of alternating current should be used in electrolysis.

Answer

Direct current flows in one direction, allowing the electrodes to maintain fixed polarity. One electrode is always the anode (+) (where oxidation occurs), and the other is always the cathode (–) (where reduction occurs).

Question 1(h)

Give reasons for the following:

Carbon tetrachloride is a liquid but is a non-electrolyte which does not conduct electricity.

Answer

Carbon tetrachloride (CCl_4) is a liquid that does not conduct electricity because it is a non-polar covalent compound. In the case of CCl_4, carbon atom shares electrons with four chlorine atoms. The electrons are shared equally between the atoms, and the molecule has no permanent dipole moment, meaning there is no separation of charge. Therefore, there are no ions present in the compound, and no free electrons to carry an electrical current.

Question 1(i)

Give reasons for the following:

Potassium is not extracted by electrolysis of it's aqueous salt solution.

Answer

Potassium is not extracted from it's aqueous salt solution by electrolysis as aqueous solution will contain H^+ ion along with metal ion. On the passage of electric current the H^+ ion gets discharged in preference to metal. Thus, the product formed at cathode is hydrogen gas and not the metal.

Question 1(j)

Give reasons for the following:

The electrolysis of acidulated water is considered to be an example of catalysis.

Answer

Water in pure state consists almost entirely of molecules. It is a polar covalent compound and can form ions when traces of dilute sulphuric acid is added. As dilute sulphuric acid catalyses this ionisation, hence this electrolysis of acidified water is considered as an example of catalysis.

Question 1(k)

Give reasons for the following:

During electrolysis of molten lead bromide, graphite anode is preferred to other electrodes.

Answer

As graphite is unaffected by the reactive bromine vapours released at the anode hence, a graphite anode is preferred to other inert electrodes like platinum during the electrolysis of molten lead bromide.

Question 1(l)

Give reason for the following:

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

Answer

Electrolysis of molten lead bromide involves oxidation and reduction reactions and hence is a redox reaction.

Reduction reaction at cathode:

$Pb^{2+} + 2e^- \longrightarrow Pb$

Oxidation reaction at the anode:

$Br^{1-} - 1e^- \longrightarrow Br$

$Br + Br \longrightarrow Br_2$

Question 2

Explain :

(a) Sodium Chloride will conduct electricity only in fused or aq. soln. state.

(b) In the electroplating of an article with silver, the electrolyte sodium argento-cyanide solution is preferred over silver nitrate solution.
(c) Although copper is a good conductor of electricity, it is a non-electrolyte.

Answer

(a) The ions Na^+ and Cl^- are not free but held together by strong electrostatic force of attraction. In fused or molten state the ions break free and move. Hence, NaCl will conduct electricity only in fused state or aq. soln. state.
(b) Migration of Ag^{1+} ions from sodium argento-cyanide solution is slow compared to that from silver nitrate. Hence, an even deposition of metal silver is obtained on the article. Therefore, the electrolyte sodium argento-cyanide solution is preferred over silver nitrate solution.
(c) Copper does not undergo chemical decomposition due to flow of electric current through it. Hence, copper is a good conductor of electricity but it is a non-electrolyte.

Question 3

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

Answer

1. Electroplating of metals
2. Electrorefining of metals

Question 4

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

Answer

Cu^{2+} (Copper ions will get discharged at cathode) as between magnesium, iron and copper, copper is the lowest in electrochemical series.
Reaction at Cathode:
$Cu^{2+} + 2e^- \longrightarrow Cu$

Question 5

During electroplating of an article with nickel —
(i) Name —
A. The electrolyte
B. The cathode
C. The anode
(ii) Give the reaction of the electrolysis at
A. The cathode
B. The anode

Answer

(i)
A. The electrolyte — Aq. soln. of nickel sulphate
B. The cathode — Cleaned article to be electroplated
C. The anode — Plate or block of nickel metal
(ii) the reaction of the electrolysis at:
A. At Cathode: $Ni^{2+} + 2e^- \longrightarrow Ni$
B. At Anode : $Ni - 2e^- \longrightarrow Ni^{2+}$

Question 6

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.

Answer

As NaCl is a strong electrolyte (i.e., cell A), therefore it allows large amount of electricity to flow through it. Hence, the bulb glows brightly.
Acetic acid is a weak electrolyte (i.e., cell B) and it allows a small amount of electricity to flow through them hence, the bulb glows dimly.
Sugar soln. is a non-electrolyte (i.e., cell C), therefore it does not conduct electricity and do not undergo chemical decomposition due to the flow of current through it. Hence, the bulb does not glow

Question 7

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

Answer

Electrical conductivity of copper sulphate solution	**Electrical conductivity of copper metal**
The flow of electricity takes place by flow of ions which are denser compared to electrons.	The flow of electricity takes place by flow of electrons which have negligible mass.
There is decomposition of the copper sulphate solution and thus the chemical properties of electrolyte are altered.	There is no decomposition of copper metal and thus the chemical properties of copper are intact.
Good conductors of electricity in aq. soln. or molten state but not in solid state.	Good conductor of electricity in solid and in molten state.
During conduction through copper sulphate solution, there is transfer of ions.	During conduction through copper metal, there is no transfer of matter.
The flow of electricity decomposes the electrolyte and new products are formed.	The flow of electricity only produces heat energy and no new products are formed.

Question 8

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

Answer

When electricity is passed through molten lead bromide solution, dark reddish brown fumes of bromine evolve at the anode.

$Br^- - e^- \longrightarrow Br$

$Br + Br \longrightarrow Br_2$

Question 9

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

Answer

Copper, a brownish pink metal is deposited at the cathode when acidified aqueous copper sulphate solution is electrolysed with copper electrodes.

Question 10

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

Answer

Copper anode shows a loss in mass.

Question 11

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

Answer

Anode is the oxidizing electrode.

Reason — The anions donate the excess electrons to the anode and are oxidized to neutral atoms. Hence, the anode is the oxidizing electrode by which the electrons leave the electrolyte.

Question 12

M_2O is the oxide of a metal 'M' which is the 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 the cathode.

(b) Name the product at the anode.

Answer

(a) Reaction at cathode : $M^+ + e^- \longrightarrow M$

(b) Product at anode : Oxygen

Exercise 6 — Long Answer Type

Question 1

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?

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

(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)

Answer

(a) $X \longrightarrow X^{2+} + 2e^-$

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

(b) $3X + Y_2 \longrightarrow X_3Y_2$

(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 ***cathode*** and Y at the ***anode*** of the electrolytic cell.

Question 2

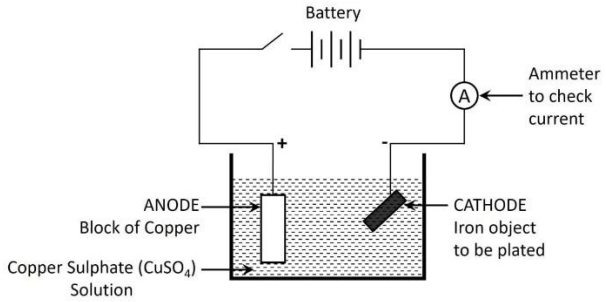
(a) Draw a labeled diagram to show how iron is electroplated with copper.

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

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

Answer

(a) Labeled diagram showing electroplating of Iron with Copper is shown below:



(b) $CuSO_4$ is preferred as electrolyte must be a solution of a salt of metal to be electroplated.

(c) 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. Here, the Cu^{2+} ions gain electrons and become atoms of copper which deposit on the iron object as a firm coating. Thus, the iron object gets electroplated with copper.

Question 3

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

(a) What kind of salt is sodium argentocyanide.

(b) Why is it preferred to silver nitrate as an electrolyte?

(c) State one condition to ensure that the deposit is smooth, firm and long lasting.

(d) Write the reaction taking place at the cathode.
(e) Write the reaction taking place at the anode.

Answer

(a) It is a Complex Salt.
(b) Migration of Ag^{1+} ions from above complex salt soln. is slow compared to that from silver nitrate. Hence, an even deposition of silver metal is obtained on the article. Therefore, the electrolyte sodium argentocyanide soln. is preferred over silver nitrate solution.
(c) A low current for a longer time should be used to ensure that the deposit is smooth, firm and long lasting.
(d) $Ag^{1+} + 1e^- \longrightarrow Ag$ [deposited]
(e) $Ag - 1e^- \longrightarrow Ag^{1+}$ [Anode diminishes in mass]

Question 4

During the electrolysis of copper (II) sulphate solution using platinum as a cathode and carbon as an anode,
(a) State what you observe at the cathode and at the anode.
(b) State the change noticed in the electrolyte
(c) Write the reactions at the cathode and at the anode.

Answer

(a) At cathode — Cu^{2+} ions and H^{1+} ions migrate to the cathode. Cu^{2+} ions are below H^{1+} ions in the activity series, thus Cu^{2+} ions are discharged in preference to H^{1+}, to form neutral copper atoms. Thus, copper atoms deposit themselves on the cathode.
At anode — SO_4^{2-} and OH^{1-} ions migrate to the anode but OH^{1-} ions are discharged since they are lower in the electrochemical series. The neutral (OH) radicals reunite to form water and oxygen.
(b) The blue colour of $CuSO_4$ solution fades since the blue Cu^{2+} ions which are discharged at the cathode are not replaced at the anode.
(c) Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$
Anode: $4OH^{1-} - 4e^- \longrightarrow 4OH$
$2OH + 2OH \longrightarrow 2H_2O + O_2$

Question 5(a)

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

	Anode	**Electrolyte**	**Cathode**
(i) Silver plating of a spoon		Solution of potassium argentocyanide	
(ii) Purification of copper			
(iii) Extraction of copper			

Answer

	Anode	**Electrolyte**	**Cathode**
(i) Silver plating of a spoon	***block of pure silver***	Solution of potassium argentocyanide	***spoon to be electroplated***
(ii) Purification of copper	***Impure block of copper***	***A solution of copper sulphate and dil. sulphuric acid.***	***Thin strip of pure copper***
(iii) Extraction of sodium	***Graphite***	***fused sodium chloride***	***Iron***

Question 5(b)

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

Answer

(i) $Ag - e^- \longrightarrow Ag^+$

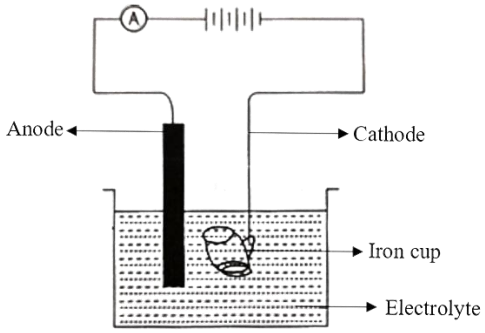
(ii) $Cu - 2e^- \longrightarrow Cu^{2+}$

(iii) $Cl^- - e^- \longrightarrow Cl$

$Cl + Cl \longrightarrow Cl_2$

Question 6

The following sketch represents the electroplating of an Iron cup with Nickel metal. Study the diagram and answer the following questions :



(a) During electroplating the iron cup is placed at the cathode. Why?

(b) Name the ion that must be present in the electrolyte.

(c) State one condition that is necessary to ensure that the deposit is smooth, firm and even.

(d) Write the reaction taking place at the cathode.

(e) What change would you observe at the anode ?

Answer

(a) In electroplating, the cathode is the electrode where reduction (gain of electrons) occurs. The iron cup is placed at the cathode because the metal ions from the electrolyte will be reduced and deposit onto the iron cup. This process coats the iron cup with a layer of metal, achieving the plating effect.

(b) Ni^{2+} must be present in the electrolyte.

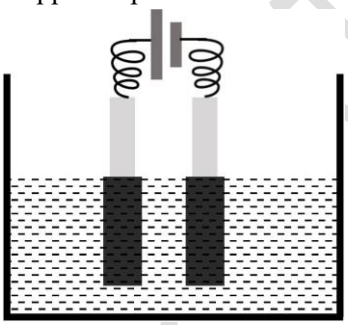
(c) A low current for a longer time should be used as longer time and low current initiates a thicker, uniform deposit.

(d) $Ni^{2+} + 2e^- \longrightarrow Ni$

(e) The Nickel plate is gradually dissolved as ions in solution.

Question 7

Copper sulphate soln. is electrolysed using copper electrodes as seen in diagram.



(a) Which electrode to your left or right is known as the oxidising electrode and why?

(b) Write the equation representing the reaction that occurs.

(c) State two appropriate observations for the above electrolysis reaction.

Answer

(a) The electrode connected to the positive terminal of the battery (i.e., electrode on the left) is the oxidizing electrode as anions donate excess electrons to the anode and are oxidized to neutral atoms.

(b) $Cu - 2e^- \longrightarrow Cu^{2+}$

(c) Copper anode shows a loss in mass. The blue colour of aq. copper sulphate soln. remains unchanged.