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 …….....

Solution 1:

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

(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 in toluene.

Question 2:

Define the following terms:

(a) Electrolysis,

(b) Non-electrolyte,

(c) Cation and anion,

(d) Weak electrolyte,

Solution 2:

(a) Electrolysis: 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: It is a compound which neither in solution nor in the molten state allows an electric current to pass through it.

(c) Cation and anion: Atoms which carry positive charge are called cations.

Atoms which carry negative charge are called anions.

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

Question 3:

What is the difference between:

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

(b) electrolytic dissociation and ionization :

(c) A cation and an anion,

Solution 3:

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

Arrhenius considered that water ionizes electrolytes but Modern theory explained that electrolytes are ionic even in solid state and their ions are held by strong electrostatic forces which make them immobile. Water renders these ions mobility by breaking the electrostatic forces.

(b) Difference between electrolytic dissociation and ionization :

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. Polar covalent compounds show ionization. e.g. HCl, H_2CO_3, NH_4OH etc.	2. Electrovalent compounds show dissociation. e.g. Potassium chloride, lead bromide, etc.

(c) A cation and anion:

Cation	Anion
1. Are positively charged ions.	Are negatively charged ions.
2. Migrate to cathode during electrolysis.	Migrate to anode during electrolysis.
3. 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.

(d) Electrolytic dissociation and thermal dissociation:

Electrolytic dissociation is the dissociation of an electrovalent compound into ions in the fused state or in aqueous solution state.

Thermal dissociation: 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.

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 charges non-metallic ion,
(e) the electrode at which reduction occurs,
(f) a non-metallic element which is a conductor of electricity.

Solution 4:
(a) Sodium carbonate
(b) NH_4OH
(c) An inert electrode: graphite and Active electrode: silver
(d) H^+
(e) Electrode is cathode
(f) Graphite

Question 5:
Electrolysis is a redox process. Explain.

Solution 5:
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.
$NaCl \rightleftharpoons Na^+ + Cl^-$
Cathode : $Na^+ + e^- \longrightarrow Na$ (reduction)
$Cl^- - e^- \longrightarrow Cl$(oxidation)
$Cl + Cl \longrightarrow Cl_2$
Overall reaction : $2NaCl \longrightarrow 2Na + Cl_2$

INTEXT – QUESTION – 2

Question 1:
Name two substances in each case:
(a) Contain only molecules,
(b) Contain only ions,
(c) Contain ions as well as molecules.

Solution 1:
(a) Glucose, Kerosene
(b) NaCl and NaOH
(c) CH_3COOH and NH_4OH

Question 2:
Explain the following:
(a) A solution of cane sugar does not conduct electricity, but a solution of solution of sodium chloride is a good conductor,
(b) Hydrochloric acid is a good conductor of electricity,
(c) During the electrolysis of an aqueous solution of NaCI, hydrogen ion is reduced at the cathode and not the sodium ion though both Na^+ and H^+ ions are present in the solution.

Solution 2:
(a) Cane sugar is a compound which does not have ions even in solution and contains only molecules. Hence, it does not conduct electricity. On the other hand, sodium chloride solution contains free mobile ions and allows electric current to pass through it. This makes it a good conductor of electricity.
(b) Hydrochloric acid is a strong electrolyte and dissociates completely in aqueous solution. The solution contains free mobile ions which allow electric current to pass through it. Hence, hydrochloric acid is a good conductor of electricity.
(c) Hydrogen is placed lower in the electrochemical series and sodium is placed at a higher position. This is because H^+ ions are discharged more easily at the cathode than Na^+ during electrolysis and gains electrons more easily.
Therefore, H^+ ion is reduced at the cathode and not Na^+ ion.

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

Solution 3:
(a) Zn occurs readily as ion whereas Cu occurs more readily as metal in nature.
(b) Copper is above silver in the electrochemical series and is thus more reactive than silver. So, copper displaces silver from silver nitrate. Hence, we cannot store AgNO3 solution in copper vessel.
$Cu + AgNO_3 \longrightarrow Cu(NO_3)_2 + 2Ag$
(c) Copper is more active than Ag.

Question 4:
(a) How would you change a metal like Cu into its ions?
(b) how would you change Cu^{2+} ion to Cu?
Solution 4:
(a) By treating its salt with a more reactive metal.
(b) By supplying two electrons to Cu+2
$Cu^{+2} + 2e^- \longrightarrow Cu$

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?
Solution 5:
In the aqueous state, the slightly negatively charged oxygen atoms of the polar water molecule exerts a pull on the positively charged sodium ions. A similar pull is exerted by the slightly charged hydrogen atoms of the water on the negatively charged chloride ions. Thus the ions become free in solution. These free ions conduct electricity.

In the molten state, the high temperatures required to melt the solid weakens the bond between the particles and the ions are set free.

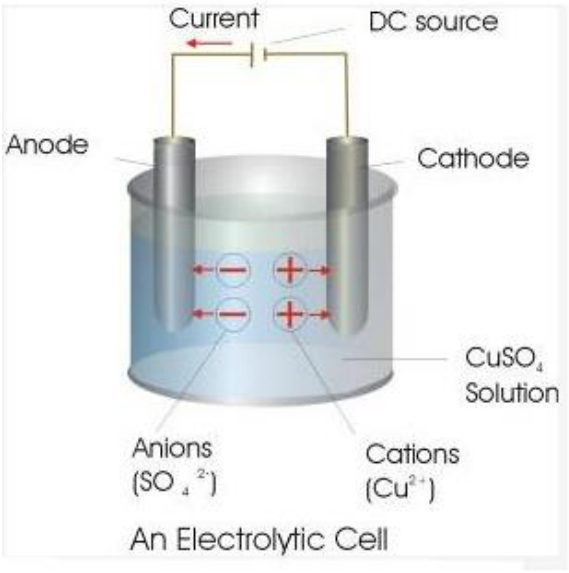
Question 6:
During electrolysis of an aqueous solution of sulphuric acid between platinum electrodes, two types of anions migrate towards the anode but only one of themis discharged:
(a) Name the two anions,
(b) Name the main product of the discharge of anion at the anode and write the anode reaction,
(c) Name the product at the cathode and write the reaction.
(d) How you notice any change in colour. State why?
(e) Why this electrolysis, is considered as an example of catalysis?
Solution 6:
(a) Two anions are SO_4^{2-} and OH^-.
(b) OH^- is discharged at anode and the main product of the discharge of OH^- is O2
Reaction is :
$OH^- \longrightarrow OH + e^-$
$4OH \longrightarrow 2H_2O + O_2$
(c) The product formed at cathode is hydrogen. The reaction is :
$H^+ + e^- \longrightarrow H$
$H + H \longrightarrow H_2$
(d) No change in colour is observed.
(e) Dilute sulphuric acid catalyse the dissociation of water molecules into ions, hence electrolysis of acidified water is considered as an example of catalysis.

Question 7:

An electrolytic cell is set up using two platinum electrodes and an aqueous solution of copper (II) sulphate,
(a)draw a labelled diagram of the electrolytic cell,
(b)Name the ions present in the cell,
(c)Name the ions migrating towards the anode,
(d)Name the ions migrating towards the cathode,
(e)Name the ions which will not be discharged at electrodes during electrolysis,
(f)Write the reaction at the cathode,
(g)Write the reaction at the anode,
(h)Name the spectator ion in the solution.

Solution 7:

(a) Labelled diagram of electrolytic cell is:



(b) The ions present in the cell are Cu^{2+}, H^+, SO_4^{2-}, OH^-.
(c) SO_4^{2-} and OH^- ions both migrate towards anode.
(d) Both Cu^{2+} and H^+ ions migrate towards cathode.
(e) SO_4^{2-} and H^+ will not discharge at electrodes.
(f) Reaction at cathode:

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

(g) Reaction at anode:

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

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

(h) Sulphate ions are the spectator ions because they do not change in the reaction.

Question 8:
State the electrode reaction at the anode during electrolysis of:
(a) very dilute sulphuric acid,
(b) Aqueous copper sulphate solution
(c) sodium chloride solution,
(d) Fused lead bromide,
(e) magnesium chloride (molten).

Solution 8:
(a) Reaction at anode during the electrolysis of very dilute sulphuric acid:

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

$4OH \longrightarrow 2H_2O + O_2$

(b) Reaction at anode during the electrolysis of aqueous copper sulphate solution

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

$4OH \longrightarrow 2H_2O + O_2$

(c) Reaction at anode during the electrolysis of sodium chloride solution

$2Cl^- \longrightarrow Cl2 + 2e^-$

(d) Reaction at anode during the electrolysis of fused lead bromide

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

$Br + Br \longrightarrow Br_2$

(e) Reaction at anode during the electrolysis of magnesium chloride (molten)

$2Cl^- \longrightarrow Cl2 + 2e^-$

Question 9:
Choosing only words from the following list, write down the appropriate words to fill in the blanks (a) to (e) below: anions, anode, cathode, cations, electrode, electrolyte, nickel, voltameter.
The electroplating of an article with nickel requires an
(a)_____which must be a solution containing (b)____ions. The article to be plated is placed as the (c)____of the cell in which the plating is carried out. The (d)____of the cell is made from pure nickel. The ions that are attracted to the negative electrode and discharged are called (e)_____

Solution 9:
(a) Electrolyte
(b) Nickel
(c) Cathode
(d) Anode
(e) Cations

INTEXT – QUESTION - 3

Question 1:

Give reasons for the following:

(a) Electrolysis of molten lead bromide is considered to be a reaction in which oxidation and reduction go side by side, i.e., a redox reaction.

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

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

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

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

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

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

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

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

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

Solution 1:

(a) 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.

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

(b) The blue colour of copper ions fades due to decrease in Cu^{+2} ions and finally the solution becomes colourless as soon as Cu^{+2} ions are finished.

(c) 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.

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

(e) As per electrolytic reactions, $4H^{+1}$ are 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.

$2H_2 \xrightarrow[\text{Current}]{H_2SO_4} 2H_2\,[\text{cathode}] + O_2\,[\text{anode}]$

(f) This is because HNO_3 is volatile.

(g) Ammonia is a covalent compound. Therefore, it is unionized in the gaseous state but in the aqueous solution it gives NH_4OH which is a weak electrolyte and dissociates into ions.

(h) Graphite is unaffected by the bromine vapours.
(i) 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.
(j) 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.

Question 2:
Classify the following substance 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.

Solution 2:
(a) Strong electrolyte: Dilute hydrochloric acid, dilute sulphuric acid, ammonium chloride, sodium acetate
(b) Weak electrolyte: Acetic acid, ammonium hydroxide
(c) Non-electrolyte: Carbon tetrachloride

Question 3:
Write down the words or phrases from the brackets that will correctly fill in the blanks in the following sentences:
(a) Pure water consists entirely of _____ (ions/ molecules).
(b) We can expect that pure water _____ (will / will not) normally conduct electricity.
Solution 3:
(a) Molecules
(b) Will not

Question 4:
To carry out the so-called "electrolysis of water". Sulphuric acid is added to water.
How does the addition of sulpuric acid produce a conducting solution?
Solution 4:
Water is a non-conductor of electricity and consists entirely of molecules. It can be electrolytically decomposed by addition of traces of dilute sulphuric acid which dissociate as H^+ and SO_4^{2-} ions and help in dissociating water into H+ and OH^-, water being a polar solvent.

Question 5:
Copy and complete the following table which refers to two practical applications of electrolysis

	Anode	Electrolyte	Cathode
Silver plating of a spoon	Plate of pure clean	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

Question 6:
Complete the sentence by choosing correct words given in brackets.
Electrolysis is the passage of _____
(electricity / electrons) through a liquid or a solution accompanied by a _____ (Physical / chemical) change.
Solution 6:
Electricity, Chemical

Question 2004:
Element X is an 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) Write two applications of electrolysis in which the anode diminishes in mass,
(d) 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)
Solution 2004:
(a) $X \longrightarrow X^{2+} + 2e^-$, $Y + 3e^- \longrightarrow Y^{3-}$
(b) $Y_2 + 3X \longrightarrow X_3Y_2$
(c)
(i) It is used for the electroplating of metals.
(ii) It is also used in purification of metals.
(d) Cathode, Anode

Question 2004(2):
(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 its dilute solution apart from those of water?

(c) Cations are formed by …….. (loss/gain) of electrons and anions are formed by ……
(a) (loss / gain) of electrons. (Choose the correct word to fill in the blanks).
(d) What ions must be present in a solution used for electroplating a particular metal?
(e) Explain how electrolysis is an example of redox reaction.

Solution 2004(2):

(a) Non-electrolyte contains molecules.
(b) Molecules of HX and H^+ and X^- ions.
(c) Loss
(d) The electrolyte used for the purpose must contain the ions of metal which is to be electroplated on the article.
(e) 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.

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 2005:

1. 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?

Solution 2005:

(a) Because Copper is an electronic conductor as it is a metal.
(b) In solid sodium chloride, Na^+ and Cl^- ions are not free due to strong electrostatic forces of attraction among them. The ions, therefore are unable to move to any large extent when electric field is affected. Hence no current.

Question 2005(2):

Name the gas released at cathode when acidulated water is electrolyzed.

Solution 2005(2):

Hydrogen gas is released at cathode when acidulated water is electrolyzed.

Question 2006:

Copper sulphate solution is electrolyzed using a platinum anode.
(a) Study the diagram given alongside and answer the following questions:

(i) Give the name of the electrodes A and B.
(ii) Which electrode is the oxidizing electrode?

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

Solution 2006:

(a) (i) The name of electrode A is Platinum anode and that of electrode B is platinum or copper cathode.
(ii) Anode act as oxidizing electrode.
(b) $AgNO_3$ solution will turn blue.

Question 2007:

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.

Solution 2007:

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

Question 2008:

(a) 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?
(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 the first to be discharged at the cathode? Write the equation for the cathode reaction.
(c) Why is carbon tetrachloride, which is a liquid, a of the following takes place?

Solution 2008:

(a) The reaction takes place at anode. This is an example of oxidation.
(b) Cu^{+2} will discharge easily at cathode.
Reaction at cathode:
$Cu^{+2} + 2e^{-} \longrightarrow Cu$
(c) Carbon tetrachloride is a non-electrolyte because it is a covalent compound. It does not ionize and hence do not conduct electricity.

Question 2008(2):
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.
Solution 2008(2):
During the electrolysis of molten lead bromide. Lead is deposited at cathode.