Electro-Chemistry

SHORT QUESTION WITH ANSWERS

Q.1 Differentiate electrolytic and voltaic cell.

Ans.

An electrochemical cell in which electric current is used to drive a non–spontaneous redox reaction is called electrolytic cell. e.g. electrolysis of molten NaCl.

An electrochemical cell in which electricity is produced as a result of spontaneous redox reaction is called Galvanic or voltaic cell e.g. Zn – Cu cell.

Q.2 Differentiate b/w ionization and electrolysis.

Ans.

Ionization Electrolysis 1. The process of splitting up of an ionic compound into charged particles when fused or dissolved in water is called ionization. 1. The process of decomposing a substance usually in solution or in molten state is called electrolysis. 2. In this process, there is no need of electrodes. 2. In this process, electrodes are required. 3. There is no need of electricity for ionization. 3. There is a need of electricity for electrolysis. 4. During ionization ions are produced. 4. In electrolysis, ions are oxidized or reduced to neutral atoms or molecules. Q.3 What are conductors? Define electronic conductors and electrolytic conductors.

Ans. Conductor:

The substance through which electricity can pass is called conductor. There are two types of conductors.

Electronic Conductor:

The conductors in which electricity is passed due to the movement of free electrons e.g. metals.

Electrolytic Conductors:

The conductors in which electricity is passed, due to movement of ions to their respective electrodes.

Q.4 Differentiate b/w oxidation and reduction.

Ans. Oxidation:

(i) Addition of oxygen
(ii) Removal of electrons or
(iii) Removal of hydrogen is called as oxidation.
Reduction:
(i) Addition of hydrogen
(ii) Addition of electrons or
(iii) Removal of oxygen is called as reduction.
Q.5 Define oxidation number. Write down the rules for assigning oxidation number.
Ans. Oxidation Number:
The apparent charge present on an atom in a molecule or ionic compound is called oxidation number.
Rules:
(1) Oxidation state of all elements in free state is zero e.g.
O eq \a\co1(0,2) , N eq \a\co1(0,2) , F eq \a\co1(0,2) , Cl eq \a\co1(0,2) etc.
(2) Oxidation number of hydrogen is + 1 except in case of metal hydride where its is – 1 H+1Cl and NaH–1.
(3) Oxidation number of oxygen is – 2 except in case of per oxides and super oxide. Where it is – 1 and – eq \f(1,2) respectively.
(4) In binary compounds of halogens, the charge of halogen is – 1 e.g. NaCl–1.
(5) Oxidation number of IA group elements in combined form is + 1, Group II is + 2 and group III is + 3.
(6) The sum of oxidation state of all elements in neutral compounds is zero e.g.
K+1M+7nO eq \a\co1(–2(4),4) .
(7) The sum of oxidation states of ion is equal to charge present on it P+5O eq \a\co1(–3,4) eq \x(P = + 5)
Q.6 K2Cr2O7 + HCl (KCl + CrCl3 + Cl2 + H2O
Calculate the oxidation number of each element in above equation?
Ans.
K eq \a\co1(+1(2),2) Cr eq \a\co1(+6(2),2) O eq \a\co1(–2(7),7) + H+1Cl–1 (
K+1Cl–1 + Cr+3 Cl eq \a\co1(–1(3),3) + Cl eq \a\co1(0,2) + H eq \a\co1(+1(2),2

) O

Q.7 Calculate oxidation number of Cr in the following compounds.

(i) CrCl3 (ii) Cr2(SO4)3 (iii) K2CrO4

(iv) K2Cr2O7 (v) CrO3 (vi) Cr2O3

(vii) Cr2O eq \a\co1(2–,7)

Ans.

(i) CrCl3 (x + (–1) 3 = 0 x = 0 + 3

(ii) Cr2(SO4)3 (2x + 6 (3) + (–2) 4 (3) = 0

= 2x + 18 – 24 = 0

2x – 6 = 0

2x = 6 eq \x(x = 3)

(iii) K2CrO4 (+ 1 (2) + x + – 2 (4) = 0

= 2 + x – 8 = 0 eq \x(x = + 6)

(iv) K2Cr2O7 (+ 1 (2) + 2x + – 2 (7) = 0

+ 2 + 2x – 14 = 0

2x – 12 = 0

2x = 12

eq \x(x = + 6)

(v) CrO3 (x + (–2) 3 = 0

eq \x(x = + 6)

(vi) Cr2O3 (2x + (–2) 3 = 0

2x – 6 = 0

2x = + 6

eq \x(x = + 3)

(vii) Cr2O eq \a\co1(–2,7) (2x + (–2) 7 = – 2

2x – 14 = – 2

2x = + 12

eq \x(x = + 6)

Q.8 In a Galvanic cell chemical energy is converted to electrical energy. How?

Ans.

In galvanic cell chemical energy changes to electrical energy because in this cell redox reaction takes place spontaneously. As a result of which electrons are transferred from anode to cathode. These electron flow is called current or

electrical energy.

Q.9 Zn acts as anode when connected to Cu but as cathode when connected to Al?

Ans.

Zn acts as anode when connected to Cu because reduction potential of Cu is greater than Zn. So Zn will be oxidised and acts as anode Cu acts as cathode. But in case of Al connected to Zn. Zinc acts strong oxidising agent (with greater reduction potential) than Al so Al will act as anode and Zn acts as cathode.

Q.10 Explain through equations how lead battery is discharged.

Ans.

In this process, the anode and cathode of an external source are joined to the anode and cathode of the cell respectively. Then the redox cathode of the cell respectively. Then the redox reactions at respective electrodes are reversed. Hence cell begins to recharge reaction at cathode:

Pb eq \a\co1(+2 ,(aq)) + Ze– (Pb eq \a\co1(0 ,(s)) (Reduction)

PbSO4(s)

SO eq \a\co1(2–,4) (aq)

Reaction at Anode:

+2H2O

Pb+2(aq) (PbO2 + OH+ + 2e–

PbSO4(s)

SO eq \a\co1(2– ,4(aq))

Overall Reaction:

2PbSO4(s) + 2H2O(l) (Pb(s) + PbO2(s) + 4H+ + 2SO eq \a\co1(2– ,4(aq))

Q.11 What is density of acid used in lead accumulator and voltage of cell?

Ans.

When lead accumulator is in use it acid conc. falls and density decrease to 1.15 g/cm3. Its e.m.f. also decreases. After recharging conc. of acid is increased to make up its density to 1.25 gcm–3 and voltage becomes 2 volts.

Q.12 What are advantages of Alkaline battery?

Ans.

(1) It can be used over a wider range of temp due to more stability of

electrolysis.

(2) It requires very little electrolyte so it is very compact.

(3) It maintains a constant voltage for a longer period of time and therefore lasts longer.

Q.13 What are silver oxide batteries?

Ans.

These are tiny and expensive batteries, which are commonly used in electronic watches, auto exposure camera and calculators. These are small button shape cells. In these types of batteries silver oxide (Ag2O) mixed with NaOH or KOH acts as cathode and zinc functions as anode.

Q.14 Discuss reactions taking place in the Ni–Cd cell.

Ans.

It is strong cell. The anode is made up of cadmium at which oxidation reaction takes place while cathode consists of NiO2. In this cell, an alkaline electrolyte is used.

Reactions:

At anode:

Cd(s) + 2OH eq \a\co1(– ,(aq)) (Cd(OH)2(s) + 2e–

NiO2(s) + 2H2O(l) + 2e– (Ni(OH)2(s) + 20H–

Overall Reactions:

Cd(s) + NiO2(s) + 2H2O (Cd(OH)2(s) + Ni(OH)2(s)

Q.15 How fuel is converted into electrical energy in fuel cells?

Ans.

A type of cell, which is similar to galvanic cell in which, fuel used may be gaseous or liquid substance e.g. hydrogen, hydrazine, methanol, ammonia etc. and oxidants are generally oxygen or air. Fuel and oxidant are supplied to respective electrodes, which are porous and activated with catalyst.

Reactions:

At anode:

H2(g) + 2OH eq \a\co1(– ,(aq)) (2H2O(l) + 2e– (oxidation)

At cathode:

O2(g) + 2H2O(l) + 4e– (4OH eq \a\co1(– ,(aq)) (Reduction)

Overall reaction

$H_2(g) + O_2(g)$ ($2H_2O(l)$

Q.16 What is importance of fuel cells?

Ans.

The fuel cells are of great importance and used in space vehicles. In these cells, electrodes are made up of porous compressed carbon, which is impregnated with platinum. Which acts as catalyst. This fuel cell works at high temp in order to evaporate water, which is formed in it. After condensation, this water can be used for drinking water for astronauts.

Q.17 How prediction about feasibility of chemical reaction is made by electrochemical series?

Ans.

For a particular reaction, it is easy to predict whether it will take place or not. This is done by using electrochemical series e.g. Cu^{+2} can oxidise zinc metal but Zn^{+2} cannot oxidise Cu metal because Cu is below Zn in the electrochemical series. i.e.

Cu eq \a\co1(+2 ,(aq)) + Zn(s) (Cu(s) + Zn eq \a\co1(2+,(aq)) . E eq \a\co1(0 ,cell) = 1.10 v

Cu(s) + Zn+2 (Cu+2 + Zn(s) E eq \a\co1(0 ,cell) = – 1 . 1

This is not feasible.

Q.18 How e.m.f. of galvanic cell is calculated with the help of electrochemical series?

Ans.

The standard electrode potential values can be used to determine e.m.f. of a given galvanic cell i.e. e.m.f. of Daniel cell is calculated as

Zn(s) | Zn eq \a\co1(+2,(aq)) || Cu eq \a\co1(2+,(aq)) | Cu(s)

(Anode) Cathode

(Oxidation half cell) Reduction half cell)

Reactions:

At anode

Zn (Zn2+ + 2e– E0 = + 0.76 v

+2e–

Cu+2 (Cu(s) E0 = + 0.34 v

E eq \a\co1(0 ,cell) = E eq \a\co1(0 ,Anode) + E eq \a\co1(0

,Cathode)

= 0.76 + 0.34 = 1.10 v

Q.19 What are relative reactivity of metals? Explain by electrochemical series?

Ans.

Reactivity of a metal depends upon its ability to lose electrons to change into M+ cation. It is clear from electrochemical series that smaller the value of standard reduction potential, greater its tendency to lose electrons. Alkali metals (Li, NaK) having lower value of reduction potentials are highly reactive then coinage metals

(Cu, Ag, Au).

Q.20 How it is possible to select a element as anode or cathode?

Ans.

The electrode, which has lower value of reduction potential acts as anode and that which has higher value of reduction potential acts as cathode E0 eq \b(\f(Cu+2,Cu)) = 0.34 has a lower value of reduction potential than eq \f(E\a\co1(0 ,Ag+),Ag) = 0.80 v anode and Ag as cathode.

Q.21 How we can predict whether it takes place or not?

Ans.

With the help of electrochemical series, it can be determined whether a reaction will occur spontaneously or not. Consider the following reaction

Pb+2 + 2Ag0 (2Ag+ + Pb0

The reaction will occur only if E eq \a\co1(0 ,Cell) is positive

E eq \a\co1(0 ,Cell) = E eq \a\co1(0 ,Anode) + E eq \a\co1(0 ,Cathode)

E eq \a\co1(0 ,Cell) = E eq \a\co1(0 ,2Ag/Ag+) + E eq \a\co1(0 ,Pb2+/Pb)

E eq \a\co1(0 ,Cell) = – 0.80 + (– 0.13)

= – 0.93

E eq \a\co1(0 ,Cell) is negative so reaction will not take place spontaneously.

Q.22 How can a non–metal displace another non–metal?

Ans.

A non–metal of higher standard reduction potential can displace other non–metal of lower standard reduction potential

Cl2 + MgBr2 (MgCl2 + Br2

or Cl2(g) + 2Br eq \a\co1(– ,(aq)) (2Cl eq \a\co1(– ,(aq)) + Br2(g)

In above reaction E eq \a\co1(0 ,Cl2/2Cl–) = + 1.36 v

is greater than E eq \a\co1(0 ,Br2/2Br–) = + 1.06 v.

Q.23 What is standard hydrogen electrode (SHE)?

Ans.

Standard hydrogen electrode is used to determine the electrode potential of other electrodes. It is used as reference electrode and its value is taken as 0.0 v.

SHE consist of platinum foil, coated with finally divided black platinum and suspended in 1 M HCl solution. Pure H2 gas at one atm pressure is bubbled into 1M HCl solution. The value of this half cell will be zero either it is oxidised or reduced

2H+ + 2e– (H2 0.00 V (Reduction)

H2 (2H+ + 2e– 0.00 V (Oxidation)

Q.24 What is difference b/w cell and battery?

Ans.

The arrangement in which electrical energy is converted to chemical energy or chemical energy is converted to electrical energy is called cell.

The combination of two or more cells is called battery.

Q.25 Outline the important applications of electrolysis?

Ans.

(1) Electroplating

(2) Electro–refining

(3) Electro–manufacturing

(4) Electrotyping

Q.26 What is salt bridge? Also give its function?

Ans:

It is U-shaped glass tube having saturated solution of strong electrolyte like KCl. The glass tube is filled with jelly type material

It has two major functions:

It connects the two solutions in two half cells

It maintains the electrical neutrality by the diffusion of ions through it.

Q.27 What is the difference between primary and secondary cell?

Ans:

The cell which is not rechargeable called primary cell e.g Dry cell

The cell which is rechargeable called secondary cell. e.g lead accumulator

Q.28 What is electrochemical series?

Ans:

A list of elements in which they are arranged in the order of their standard electrode potential on hydrogen scale is called electrochemical series.