1.Calculate the standard emf in volts for a cell containing Sn2+ / Sn and Br2 / Br -  electrodes.

   [ Eo ( Sn2+ / Sn) = − 0.14 V, Eo ( Br2 / Br -) = 1.08 V]

Ans: Eocell = Eocathode − Eo anode

Because   reduction potential of  Eo ( Br2 / Br-) is higher, it is cathodic

Eocell  =  Eo ( Br2 / Br -) - Eo ( Sn2+ / Sn)

              = 1.08 – (− 0.14)

              = 1.22 V

2.Using the electrochemical series, calculate the emf in volts for the cell  Fe(s) | Fe2+(0.1 M) ||  Cd2+(0.2 M) | Cd at 298 K. Write the cell reactions.

Ans:  From the series we have;

Eo Cd2+/Cd  = − 0.40 V  ; Eo Fe2+/Fe  = − 0.44 V

At anode        Fe →Fe2+   + 2 e−

At Cathode   Cd2+ + 2 e−  → Cd

Net reaction:  Fe + Cd2+→ Fe2+ + Cd

EMF of the cell at 298 K is given by

Eocell = Eocathode − Eo anode

           = − 0.40 − (− 0.44)

             =          0.04 V

Ecell = Eocell  − (0.0591 / n)   log  [ Fe2+ ] / [Cd2+]

                  = 0.04   −( 0.0591/ 2 ) log [0.1] / [0.2]

                 =    0.0488 V

3.Find the molar concentration of Cd2+ ions in the given electrochemical cell.

Zn / Zn2+ (0.1 M) // Cd2+(M)/ Cd

Given Eo Zn2+/Zn  = − 0.76 V; Eo Cd2+/Cd  = − 0.40 V ;  and  Ecell = 0.3305 V at 298 K

Ans: Cell representation

Zn / Zn2+ (0.1 M) // Cd2+(M)/ Cd

Ecell = Eocell −  (0.0591/n ) log [ Zn2+]/ [Cu2+]

4.Write the cell reactions and calculate the EMF in volts for the following cell at 298K.

Mg/ Mg2+ (0.001M) // Cu2+ ( 0.0001M)  / Cu .

Given Eo Cu2+/Cu   = 0.34 V  and    Eo Mg2+/Mg = − 2.37V

Ans: At anode Mg → Mg2+ + 2 e−

At cathode  Cu2+ + 2 e− → Cu

Net reaction Mg + Cu2+ → Mg 2+  + Cu

Ecell = Eocell −  (0.0591/n ) log [ Mg2+]/ [Cu2+]

Eocell = Eocathode − Eo anode

          = 0.34 – [ −2.37]

         = 2.71V

Ecell = 2.71 – (0.0591 /2)  log [0.001]/ [0.0001]

           = 2.6805 V

5. Emf of Weston Cadmium cell is 1.0183 V at 293 K and 1.0l81 V at 298 K. Calculate ∆G, ΔH and ΔS  of the cell reaction at 298 K.

∆G = - n FE

n = 2 for the cell reaction;

F = 96,500 C   E= 1.0181 V at 298 K

∆G = -2 x 96,500 x 1.0181  J = -196.5 KJ

∆H  =  nF [ T (δE /δT)P – E]

(δE/δT)p = 1.0181 – 1.0183 / 298-293  = -0.0002 / 5

                                = - 0.00004VK-1

T = 298 K

∆H = 2 x 96,500 { [298 x (-0.00004)] – 1.0181}

                                = -198. 8 KJ

ΔS = nF(δE / δT) P

     = 2 x 96,500 x (0-00004) = -7.72JK-1

6. The emf of a cell consisting of a hydrogen and the normal calomel is 0.664 V at 25 ºC. Calculate the pH of the solution containing the hydrogen electrode.

Ecell= Ecal (normal) –( −0.0591pH)

0.664 = 0.2810+0.0591 pH

0.383=0.0591 pH

pH= 6.48

7. A glass electrode dipped in a soln. of pH = 4 offered an emf of 0.2066 V with decinormal calomel electrode at 298 K. When dipped in a soln. of unknown pH at the same temperature, the recorded emf was 0.1076 V. Calculate the pH of the soln. [CE = 0.2412 V].

pH= (Ego− Ecell − Ecal(decinormal)  ) / 0.0591

4=( Ego− 0.2066− 0.3335) /0.0591

Ego= 0.7765 V

pH= ( 0.7765− 0.1076−0.3335) / 0.0591

pH= 5.67

8. Write the cell scheme and determine the electrode potential of zinc immersed in 0.1 M ZnSO4. Given E.M.F. of cell =1.0022 V and  Eo (Calomel electrode) =0.2422V.

Zn / ZnSO4( 0.1M)// KCl; Hg2Cl2;Hg

**Ecell  = E cathode – E anode**

        1.0022 = 0.2422 – E Zn2+ / Zn

         E Zn2+ / Zn = 0.2422 – 1.0022

**= - 0.76 V**

1. In aerated and neutral condition the corrosion product formed at the cathodic site is

A) **OH –**

B) H2O

C) H2 and OH –

D) H2O and OH –

2. Chemical composition of black rust is ----------.

1. 2Fe2O3. 3H2O
2. Fe2O3. 3H2O
3. 2Fe3O4. 3H2O
4. **Fe3O4. 3H2O**

3. Galvanic series represents the corrosion behavior of -------------.

A) non-metals and alloys

B) non-metals and passive metals

C) metals and nonmetals

D) **metals and alloys**

4. Which among the following factors will increase the rate of pitting corrosion?

**A) Small anodic area and large cathodic area**

B) Small cathodic area and large anodic area

C) Cathodic and anodic area are equal

D) Anodic inhibitor added above the critical concentration

5. Stainless steel with 18% chromium content, when heated to 300 °C undergoes ---------

corrosion.

1. Pitting
2. Stress
3. **Intergranular**
4. Galvanic

6. Stress corrosion in mild steel boilers can be prevented by the addition of

A) Na2S

B) **Na2SO4**

C) Na2SO3

D) Na2S2O3

7. Identify the wrong statement.

A) Pitting corrosion is characterized by small anodic and larger cathodic area

B) Passive metals are less prone to corrosion

C) Dry corrosion occurs slower than wet corrosion

**D) Depolarization decreases the rate of corrosion.**

8. The rate of corrosion due to dissolved gases in the corrosion medium ---------- with rise in

temperature.

Increases

**Decreases**

Increases and then decreases

Decreases and then increases

9. Which of the following describes cathodic protection method?

A) Select a nonreactive electrode and prevent corrosion

**B) Protect a metal from corrosion by converting it completely into cathode**

C) Maintain the metal at the passivating potential

D) Coat with cathodic metal coating

10. Rusting of iron is quicker in sea water than in ordinary water, due to

A) More oxygen concentration

B) Low temperature

C) **More conductivity**

D) Low pH

The anode used in the electroplating of chromium is

1. Pb – Zn alloy
2. Pb - Ag alloy
3. **Pb – Sn alloy**
4. Pb - As alloy

Choose the incorrect statement about chromium plating.

**Chromium acts as the anode**

Chromium coating is microporous

Cathode efficiency is 20%

 Chromic acid acts as electrolyte

 In electroless plating the activation of nonmetallic material is done by using

**Stannous chloride and palladium chloride**

Stannic chloride and Palladium chloride

Stannous chloride and ammonium chloride

stannic chloride and platinum chloride

Identify the wrong statement regarding electroless plating of copper.

1.         Reducing agent is formaldehyde

2.         Optimum temperature is 25 °C

3.         Disodium salt of EDTA acts as complexing agent

4.         **Optimum pH of the bath is 5**

The role of complexing agent in electrodeposition process is to

**Maintain low metal ion concentration**

Control the pH of the electroplating bath

Oxidise the coating metal

Increase the rate of deposition

The throwing power in an electrodeposition process is a measure of the tendency of the plating bath to

Increase the rate of deposition of coating metal ion

Supply constant power during electrodeposition process

Decrease the rate of deposition of coating metal ion

**Give uniform coating irrespective of the shape of the object**

The characteristics of a good deposit in an electroplating process are ----------.

continuous, uniform, microporous

**continuous, uniform, nonporous**

non-continuous,uniform, microporous

continuous, nonuniform, microporous

Nickel cadmium cell provides good performance at low temperature because

1. Cd(OH)2 has low freezing point
2. **KOH has low freezing point**
3. Nickel does not crystallize at low temperature
4. Cd(OH)2 has high melting point

Nickel-Cadmium batteries are preferred to lead-acid batteries in military application because………

**1. it delivers large amount of power**

       2. has low environmental impact

       3. it is a low cost battery

       4. of ease in servicing

The preferred electrolyte in Li ion batteries is

1. Aqueous solution of LiPF6
2. **Dry polar ether solution of LiPF6**
3. Aqueous solution of LiCl
4. Non polar solution of LiPF6

Which of the following statements is correct?

1. In fuel cells, oxidation and reduction occur on the same electrode
2. Ambient air can be used as oxidant in alkaline fuel cell
3. **Proton conducting membrane acts as an electrolyte and a separator in PEMFC**
4. The residual product of hydrogen oxygen fuel cell is hydrogen peroxide

Identify the incorrect statement among the following

1. Overcharging of lead acid battery can lead to corrosion of lead grids

2. Alkaline fuel cell is sensitive to CO2

3. **Electrolytic cells involve spontaneous reactions**

4. At equilibrium, the overall cell potential is zero.