**Engineering Chemistry - BE1/4 -Question Bank** (**2018-2019**)

**UNIT--I : ELECTROCHEMISTRY & CHEMISTRY OF BATTERIES**

**ELECTROCHEMISTRY**

1. Differentiate between
2. Electrochemical cell and Electrolytic cell
3. Single electrode potential and standard electrode potential.
4. **What is salt bridge? Why is Salt Bridge used in electrochemical cells? (What is its role in a galvanic cell?)**
5. W rite down the cell reaction and cell representations of the Daniel cell.
6. **What is the useful electrical energy obtained from Daniel cell under standard conditions? (Eº cell =1.1V, ∆G= -212300J)**
7. Calculate the single electrode potential of Zn+2 (0.01M)| Zn at 250C given Eº Zn+2 | Zn = - 0.76 V**.(-0.8191)**
8. What is electrochemical series? Discuss its applications .**(Q17a, suppl, Jan2015, 4M)**
9. Electrode potential of Zinc is assigned negative value, whereas that of copper positive value. Give reasons.
10. Does the following cell work spontaneously at 25ºC?why? /Why not?

Cu|cu+2 (1.0M)||Ni+2 (1.0M)|Ni Given, E0 cu+2/cu=+0.34, E0Ni+2 /Ni = -0.25v**(Ecell= -ve (does not work spontaneously )**

1. What is a reference electrode? Give two examples with their electrode reactions

11. The standard electrode potential of Cu+2/Cu is 0.334v will copper displace hydrogen from acids. Why?/why not ?

12.For the cell reaction Zn+ Fe+2→Zn+2+ Fe. Calculate the relative concentration of

Zn+2and Fe+2  at which the overall cell emf becomes zero.E˚Fe+2/Fe =-0.44v and

E0 Zn+2/ Zn=-0.76v**.(Ans=6.7x1010**) (**OU,June 2015**)

13. Free energy change for a reaction involving two electrons in a cell is-125KJ/mole. . Calculate emf of the cell.**(-0.647Kv)**

14. Why can glass electrode not be used for a solution of high alkalinity? ( Ans : The glass electrode can be used in solutions only with pH range of 0 to 10. However above the pH 12 (high alkalinity), cations of thesolution affect the glass and make the electrode useless.If the pH of the solution is above 9, the glass membrane of the electrode is attacked by hydroxyl ions. It leads to the alteration in the relationship between pH and glass electrode potential.

15. Mention any two applications of EMF measurement. (Ans: 1. Determination of standard free energy change and equilibrium constant. (i) The standard free energy change of a reaction can be calculated as follows − ΔG° = nFE°)

**16**. Represent Quinhydrone electrode and write the electrodic reaction for reduction process and mention its SRP value **(Q2 Main, June 2017, Q1, supply, Dec. 2016)**

**17.** Represent Calomel electrode and write the electrodic reaction for reduction process and mention its S.R.P. value. **(Q1, Suppl.Dec.2017),(Q3 Suppl Jan 2015,3M)**

**18.** Define single electrode potential. How Zn/Zn2+ electrode potential is determined**?(Q2,Suppl.Dec.2017)**

**19** Define E.M.F. and give the general expression for emf of a galvanic cell and explain the link between emf and cell reaction **(Q4 Suppl Jan 2015,3M)**

**PART-B**

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1. **Derive Nernst equation and give its applications.**
2. What is a Quinhydrone electrode? Write its electrode reaction.
3. Describe the working of Glass – electrode
4. With the help of neat-labeled diagram, explain the construction of saturated calomel electrode. Write the pertinent electrode reaction?
5. Describe with the help of suitable example, diagram and electrode reaction for each of the following types of electrodes.
   * 1. Metal – Metal ion electrode
     2. Gas-ion electrode ( SHE)
     3. Metal – metal insoluble salt electrode.( SCE)
6. For the following Galvanic cell, set up at 25ºC

Pt | S C E || H+ (Test) | Q, QH2 |Pt

pH=?

At what pHsolution containingQuinhydroneelectrode the cell EMF would be zero volts

ESCE=0.242 V, Eº Q / QH2=0.700V**.(Ans, PH =7.7)**

1. Describe Quinhydrone electrode. Derive an expression for the potential of Quinhydrone electrode. Explain how pH of a solution could be determined using this electrode. (Give the redox reactions).
2. Write the different types of electrode systems you have studied. Describe them with their electrode reactions & single electrode potential**.**
3. Calculate the single electrode potential of Cu+2 (0.1 M)/ Cu electrode at 25º C. Given E0 of Cu 0.34 volts**. (Ans=0.31v**)
4. A Hydrogen electrode was combined with a saturated calomel electrode. The emf of the combination was 0.673 volts. What is the pH of the solution if potential of SCE is 0.248 at the same temperature?(Ph=**7.19**)
5. The standard electrode potential for Cu+2/Cu and Cd+2/Cd are 0.337 and -0.403v. Construct a galvanic cell. Give the cell reaction, Calculate EMF of the cell and ΔGO**.(Ans, emf=0.74v , ∆G= - 142820**J)
6. Calculate the EMF for the cell

Zn ‌│ Zn +2 ││ Ag + │ Ag given EOZn+2 │Zn = - 0.762 V and EO Ag + │ Ag = 0.8 V **(Ans=1.562v**)

1. A cell is constructed using SCE and Hydrogen electrode with an acid having [H+]=0.05N. Calculate the ECell if ESCE=0.242. What is the cell notation and cell reaction?(**emf= 0.32v**)
2. Emf of combined cell using Quinhydrone and saturated calomel electrodes at 25ºC was found to be 0.380v. Calculate the pH of unknown acid solution used in the experiment. **(Ph=1.319)**
3. Calculate the Emf of cell at 25ºc

Fe |Fe SO4 (0.05M)|| Cu SO4 (0.2M)| Cu

Eº Fe+2/Fe = - 0.44v, Eº cu+2 /cu =0.34v.**(Ans,emf=0.798v)**

1. Calculate the EMF for the following cell at 25ºc

Pb| Pb+2(0.001)||Ag+­(0.01) | Ag

Eº for the cell is 0.925V.**(Ans, emf=0.895v**)

1. The standard reduction potential of Cu+2 / Cu and Ag+/Ag electrodes are 0.337 and 0.799 V. Construct a galvanic cell using these electrodes. For what concentration of Ag+ will the cell emf be 0, if concentration of Cu+2 is 0.01M? (**Ans, [Ag+]=1.52x10-9)**
2. Calculate the emf of the following cell at 250C

Fe |Fe SO4 (0.01M)|| Cu SO4 (0.01M)|Cu.Given E0 of Fe &Cu as - 0.44 and 0.34V respectively.**(Ans,emf=0.78v)**

1. Predict whether Cu(s) can reduce Ag+ ion in an aqueous solution. Given standard reduction potentials Cu+2/Cu=0.34v Ag+/Ag=0.80v.
2. How would you represent copper, iron voltaic cell given std. reduction potentials of Cu and Fe are respectively 0.34v, -0.44v? Calculate the emf of cell.
3. In pH metric experiment using Glass – SCE combination the Emf of cell is found to be 178mv when a buffer solution of pH = 4.0 is used. Calculate the EGo of Glass electrode. State whether Glass electrode acts as anode or cathode. Justify your answer.

(ans,When glass electrode is cathode,E˚glass=0.654, which is greater than E SCE, hence glass electrode acts as cathode.)

1. Write the cell reaction and calculate the emf of following cell at 25◦ C.

Zn(s) I Zn+2 (0.2M) II Ag+ (0.02M) I Ag(s) Given E◦ Zn/Zn+2 =+0.76v, E◦ Ag/Ag+ = -0.8v.

(**Ans, emf=1.4801)**

1. Explain the principle involved in the potentiometric acid base titrations (strong acid Vs strong base) using a calomel and Quinhydrone electrode [Hint- Galvanic cell construction, Description, Cell notation, Cell reaction, Emf of Cell reaction].
2. Represent the cell, write electrode reactions and Ecell,for potentiometric redox titration.
3. Explain the principle involved in Potentiometric titration using quinhydrone and calomel electrode.
4. Differentiate between Potentiometric and PH metric titrations for HClvsNaOH.
5. Write the cell reaction for the cell

Pt,H2 l HCl l AgCl l Ag . Eo for this cell is 0.222V. If measured emf of the cell is 0.385valcula. C te the pH of the HCl solution (Pressure of Hydrogen = 1 atm ).

**(Ans,Ph=2.758)**

**28**Explain various types of potentiometric titrations and draw the suitable graphs**6M(Q11a, Main, June 2017)**

**29.**Calculate the e.m.f. of the following cell at 250C

Zn/ZnSO4(0.1M)//CdSO4(0.01M)/Cd

The standard reduction potential of Zn and Cd electrodes at 298K are -0.76V and -0.40Vrespectively. **(Ans 1.13v) 5M (Q16a,Main, June 2017)**

**30.** The e.m.f. of a cell consisting of quinhydrone electrode and a saturated calomel electrode is 0.2640 Volts at 300K. What will be PH of a solution?

Given E0SCE = +0.242V and E0(CH,Q,QH2) = + 0.6996V **(ans,Ph=3.27)**

**31.**Consider the cell Ag/AgBr(s)/Br-(M=0.32)//Cu2+(M=0.42)/Cu(s). theemf of the cell at 250C is 0.565v.Write the cell reaction and calculate standard emf of

**CHEMISTRY OF BATTERIES**

1. What is the difference between a cell and a battery?

**2. Explain construction, working and applications of Zinc-Carbon battery.**

3. What are the advantages and applications of Lithium ion cells?

4. ExplainLead-Acid battery with suitable reactions**.(Q12a,Main, June2017, 5M)(Q17a, Main, May2007, 4M)**

5. Whatare advantages and applications of fuel cells?

6. Describe in detail the working of Methanol– Oxygen FuelCells.

7. Differentiate primary battery from secondary battery.**(Q9, Suppl.,Jan. 2015,2M)(Q3,Main, June2017, 2M)(Q1, Main, May2007, 2M)**

8. Write the charging and discharging reactions in Lead-acid battery.**(Q3,Suppl.. Dec.2017, 2M)**

9.Write advantages of fuel cells **(Q4, Suppl., Dec. 2017,2M)**

10.What are fuel cells?

11.Write a note on Lithium ion batteries.**(Q16b, Suppl., Dec. 2017, 5M),**and their advantages and applications**(Q12b, Main, June 2017,5M)**

12. Write characteristics of fuel cells**(Q4, Main, June 2017,2M)**