

**Engineering Chemistry  
(CH-101, Dec-07)**

**Note:** Section A is Compulsory. Attempt any five questions from Section B and C taking at least two questions from each Section.

**Section-A**

- Iron does not rust when zinc coating is broken in a galvanized iron pipe but rusting occurs if a coating of tin over iron is broken?
  - What is Calgon conditioning of boiler feed water?
  - What is the importance of IR spectroscopy in finger print region?
  - Why is TMS used as an internal standard in NMR spectroscopy?
  - What is chemiluminescence? Give examples.
  - What are eutectics? Give an example.
  - The standard EMF of the Daniell cell involving cell reaction  

$$\text{Zn(s)} + \text{Cu}^{+2}(\text{aq}) \leftrightarrow \text{Zn}^{+2}(\text{aq}) + \text{Cu(s)}$$
 is 1.10 volts. Calculate the equilibrium constant of the cell reaction at 25°C.
  - What is  $R_f$  value in chromatography?
  - Why does hard water consumes a lot of soap?
  - Why are electronic absorption bands generally broad as compared to infra red?

**Section-B**

- Describe the ion exchange process of softening hard water. What are its advantages?
  - Calculate the amount of lime (91% pure) and soda (97.2% pure) required for softening one million litres of water containing:  
 $\text{H}^+$  (free acidity) = 1.5 ppm;  $\text{HCO}_3^-$  = 396.5 ppm;  $\text{Mg}^{+2}$  = 42 ppm;  $\text{Ca}^{+2}$  = 90 ppm;  
 $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  = 14 ppm.  
 (Given atomic masses of H=1, Ca=40, Mg=24, O=16, C=12, S=32, Fe=56)
- Describe various methods employed for protection of metals from corrosion.
  - explain briefly (i) Galvanic cell corrosion (ii) Pitting corrosion
- What are various classes of chromatography? Bring out clearly the principles involved in each case.
  - Write short notes on (i) Liquid chromatography (ii) Vapor phase chromatography
- What are secondary cells? Describe the construction of one secondary cell. Write the cell reactions and mentions its uses.
  - A cell consists of two hydrogen electrodes. The negative electrode is in contact with a solution of  $10^{-6}\text{M}$  hydrogen ions. The EMF of the cell is 0.118V at 25°C. Calculate the concentration of hydrogen ion at the positive electrode.

**Section-C**

- Explain photosensitization and quenching by taking suitable examples.
  - What are lasers? Explain laser action with reference to a three energy level laser and a four energy level laser. Discuss briefly the practical uses of lasers.
- State and illustrate with suitable potential energy curves the Franck-Condon principle in the vibronic spectrum of a diatomic molecule.
  - A substance when dissolved in water at  $10^{-3}\text{M}$  concentration absorbs 10 percent of an incident radiation in a path of 1 cm length. What should be the concentration of the solution in order to absorb 90 percent of the same radiation?
  - Define wave number. What are its units?
- What are the advantages of taking of NMR spectrum at more than one radiofrequency?
  - Write brief notes on (i) Chemical shift (ii) Spin-spin coupling
  - How will you verify that a particular signal in NMR spectrum arises from -OH, -NH or -SH groups?
- Draw and discuss the phase diagram for carbon dioxide system. In what respect does this system differ from the water system?
  - Liquid A and B form an ideal solution obeying Raoult's law. At 50°C the total pressure of a solution containing 1 mole of A and 2 moles of B is 300 torr. When 1 mole of A is added to the solution, the total vapor pressure increases to 400 torr. Calculate the vapor pressure of the pure components.