Sample Questions for reference (Engineering Chemistry)

Water

- How caustic embrittlement occurs due to the use of hard water? Explain with suitable reactions involved.
- What are the disadvantages of hard water in various industries?
- Distinguish between temporary and permanent hardness. Explain disadvantages of hardness in any six industries.
- Distinguish between carbonate and non-carbonate hardness. Write the reactions of lime and soda with following impurities present in hard water; a) Acids b) $CaSO_4$ c) CO_2
- A sample of water on hardness estimation, found to contain:

Impurity	$Ca(HCO_3)_2$	$Mg(HCO_3)_2$	$CaCl_2$	$MgSO_4$	$CaSO_4$
Quantity (mg/L)	1.62	14.6	1.11	24	13.6

  Calculate the temporary and permanent hardness of above sample.

- Distinguish between temporary and permanent hardness (4 points).
  Write the reaction of lime and soda with following impurities
  A) $Mg(HCO_3)_2$ B) CO_2 C) $Al_2(SO_4)_3$ D) H_2SO_4

- What is equivalence of $CaCO_3$ hardness? Find the equivalence of $CaCO_3$ hardness in ppm and degree Clarke from following data;
  a) 73 mg of $Ca(CO_3)_2$ dissolved in 500 ml water
  b) 34 mg of $CaSO_4$ dissolved in 1 lit water

- Define hardness of water. Determine temporary, permanent and total hardness of water having following impurities; $Mg(NO_3)_2$= 7.4 mg/L, CO_2= 22 mg/L, KNO_3= 10 mg/L, $MgCO_3$= 2.05 mg/L, $CaCl_2$= 3.33 mg/L, $NaHCO_3$= 12 mg/L

- Explain the process of determining all types of hardness using EDTA titrations derive the necessary formula.

- State, what is temporary and permanent hardness? Calculate temporary hardness, permanent hardness and total hardness of hard water sample having the following constituents: $Mg(HCO_3)_2$ = 7.3 ppm, $NaHCO_3$ = 4.2 ppm, $Ca(HCO_3)_2$ = 8.1 ppm, $MgCl_2$ = 3.8 ppm, $Ca(NO_3)_2$ = 4.1 ppm, $NaNO_3$ = 10 ppm

- If, 50 mL standard hard water having 1000 mg/L $CaCO_3$ equivalent hardness, requires 25 mL EDTA for titration. 50 mL unknown sample hard water requires 35 mL of same EDTA for titration. After boiling and filtration, 50 mL unknown sample hard water requires 18 mL of same EDTA for titration. Calculate each type of hardness from the given information.

- 50 ml of standard hard water (1.2 g/lit $CaCO_3$) required 13 ml of EDTA for titration using EBT indicator. 100 ml of water sample required 18 ml of same EDTA for titration while 50 ml of boiled water sample required 6 ml of EDTA. Calculate the temporary, permanent and total hardness.

- Give the formulae of finding the quantities of lime and soda requirement. What is the reaction of lime and/or soda with the following constituents in hard water:
  a) $Ca(HCO_3)_2$, b) $MgCl_2$, c) $Ca(NO_3)_2$

- Calculate the quantities of lime and soda (both 100% pure) for softening of 4×10^6 liters of water containing the following constituents:
  $CaCl_2$= 2.22 ppm, $Mg(HCO_3)_2$ = 29.2 ppm, H_2SO_4 = 9.8 ppm, $MgCl_2$= 95 ppm, $CaSO_4$ = 2.72 ppm, KCl = 100 ppm

- Calculate the amount of lime (90 % pure) and soda (95 % pure) in kg, required for softening of 100000 litres of hard water having the following chemical constituents: $Ca(HCO_3)_2$ = 16.2 mg/L, $Mg(HCO_3)_2$ = 14.6 mg/L, $CaSO_4$ = 1.36 mg/L, $CaCl_2$ = 11.1 ppm, $MgCl_2$ = 9.5 ppm.

- Explain the principle, working of cold lime-soda method / hot lime-soda method with suitable diagram.

- Calculate the quantity of lime (80% pure) and soda (70% pure) for softening of 50000 liter of water having following impurities: $Ca(HCO_3)_2$= 8.1 ppm, $MgCO_3$ = 2.1 ppm, H_2SO_4= 4.9 ppm, $MgCl_2$= 1.9 ppm, $Ca(NO_3)_2$= 4.1 ppm, KNO_3= 10 ppm

- An exhausted zeolite softener was regenerated by passing 80 litres of 150 g/litre solution of NaCl. Calculate the volume of water softened (having 600 ppm hardness) using this zeolite softener.

- Explain the ion exchange process for removal of hardness with schematic diagram. Write the reactions during softening and regeneration process.

- Explain the demineralization process of softening hard water, with suitable reactions with suitable diagram.

- 50 ml of hard water (1 g $CaCO_3$/liter) required 22 ml of EDTA solution for titration using EBT. 50 ml of unknown water sample required 18 ml of same EDTA for titration. 100 ml of boiled water sample required 14 ml of same EDTA solution. Calculate temporary hardness.
- Explain with suitable diagram and reactions softening of hard water using Zeolite Permutit Method. Write its 2 advantages over lime soda Method.
- 25000 liter of hard water was softened by ion exchange column. For the regeneration of exhausted column 175 liter of 0.1 N HCl solution was used. Calculate the hardness of hard water.

- For BOD and COD numerical refer study material

IMP Engineering materials

Polymer Questions

1. How we can classify the polymers on the basis of
    a. SOURCES
    b. TACTICITY
    c. THERMAL PROPERTIES
    d. INTERMOLECULAR FORCES
    e. STRUCTURE
2. Write difference between –
    a. Thermoplastic and thermosetting
    b. Addition and condensation Polymerization
3. What is Polymerization? Explain Addition Polymerization. Identify type of polymerisation – (Polypropylene, Polyamide)
4. What is Polymerization? Explain Condensation Polymerization. Identify type of polymerisation – (Polypropylene, Polyamide)
5. What is Number average Molecular weight, Weight average Molecular weight and Polydispersity index?
6. Give any two applications of the polymer mentioned below -
   Poyethylene, Poly Propylene, Polystyrene, Polybutene, Spandex, Kevlar and Polyterpthalate
7. Explain the working principle of following fabrication method with labelled diagram –
    a. Compression moulding
    b. Transfer moulding
    c. Injection moulding
    d. Extrusion moulding
8. Explain compression moulding? For which type of polymer it is applicable?
9. Which type of moulding is used for coating the wires used for insulation?
10. What are conducting polymers? How we can classify it?
11. Explain –
    a. Intrinsic Conducting Polymer
    b. Extrinsic Conducting Polymer
12. Write a note on Doped Conducting Polymers (DCP)
13. What are Biodegrdable Polymer? State the advantages of Biodegradable polymer

Nanomaterials

1. What are Nanomaterials? How we can classify nanomaterials?
2. Expalin –
    a. Surface Effect
    b. Quantum Effect
3. What are top down and bottom up approach in synthesis of nanoparticles?
4. What are Fullerenes? Mention its properties and applications?
5. What are Quantum Dot? Mention its properties and applications?
6. What are CNT's? Mention its properties and applications?
7. Explain the following methods of Carbon Nanotubes preparation –
    a. Arc method
    b. Laser ablation Method
    c. Chemical Vapour Deposition Methods

Biomaterials

1. What are biomaterials?
2. Applications of metals and alloys in biomedical field
3. What are bioceramics? Classify them
4. Properties and Applications of bioceramics
5. Applications of ceramic nano-biocomposites

MEMS

1. What is MEMS?
2. Discuss the applications of silicon as a substrate in MEMS
3. Discuss the applications of MEMS as chemical and biological sensors
4. Describe the working principle of chemical and biosensors
5. Applications of MEMS as chemical and biological sensors

Spectrophotometry

1. What is spectroscopy and spectrophotometry? What are electroanalytical techniques?
2. State and derive Beer's law.
3. State and derive Lambert's law
4. State and derive Beer -Lambert's law
5. Explain the construction and working of a single-beam spectrophotometer with neat labelled diagram.
6. Explain the construction and working of a double-beam spectrophotometer with neat labelled diagram.
7. State the Applications of Beer -Lambert's law?
8. State the advantages and limitations of UV-Vis spectrophotometry.
9. What are fundamental modes of vibrations in IR spectroscopy?
10. Discuss finger print region in IR spectroscopy with suitable examples.

Computers and Chemistry

1. **What is computational chemistry? State its advantages**
2. **Describe various computational methods**
3. **Discuss the various quantum mechanics methods**