**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) CaSO4 c) CO2
* A sample of water on hardness estimation, found to contain:

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| --- | --- | --- | --- | --- | --- |
| **Impurity** | **Ca(HCO3)2** | **Mg(HCO3)2** | **CaCl2** | **MgSO4** | **CaSO4** |
| **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

1. Mg(HCO3)2 B ) CO2 C) Al2(SO4)3  D) H2SO4

* What is equivalence of CaCO3 hardness? Find the equivalence of CaCO3 hardness in ppm and degree Clarke from following data;

1. 73 mg of Ca(CO3)2 dissolved in 500 ml water
2. 34 mg of CaSO4 dissolved in 1 lit water

* Define hardness of water. Determine temporary, permanent and total hardness of water having following impurities; Mg(NO3)2= 7.4 mg/L, CO2= 22 mg/L, KNO3= 10 mg/L, MgCO3= 2.05 mg/L, CaCl2= 3.33 mg/L, NaHCO3= 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(HCO3)2 = 7.3 ppm, NaHCO3 = 4.2 ppm, Ca(HCO3)2 = 8.1 ppm, MgCl2 = 3.8 ppm, Ca(NO3)2 = 4.1 ppm, NaNO3 = 10 ppm
* If, 50 mL standard hard water having 1000 mg/L CaCO3 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 CaCO3) 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 anda/or soda with the following constituents in hard water:

a) Ca(HCO3)2, b) MgCl2, c) Ca(NO3)2

* Calculate the quantities of lime and soda (both 100% pure) for softening of 4 x 106 liters of water containing the following constituents:

CaCl2= 2.22 ppm, Mg(HCO3)2 = 29.2 ppm, H2SO4 = 9.8 ppm, MgCl2= 95 ppm, CaSO4 =

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(HCO3)2 = 16.2 mg/L, Mg(HCO3)2 = 14.6 mg/L, CaSO4 = 1.36 mg/L, CaCl2 = 11.1 ppm, MgCl2 = 9.5 ppm.
* Calculate the quantity of lime (80% pure) and soda (70% pure) for softening of 50000 liter of water having following impurities: Ca(HCO3)2= 8.1 ppm, MgCO3 = 2.1 ppm, H2SO4= 4.9 ppm, MgCl2= 1.9 ppm, Ca(NO3)2= 4.1 ppm, KNO3= 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 CaCO3/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 regeneration of exhausted column 175 liter of 0.1 N HCl solution. Calculate the hardness of hard water.
* What is BOD / COD. Give the significance of each with suitable formulae.
* Distinguish between BOD and COD.
* Numerical on BOD and COD.

**Polymers**

* Distinguish between Condensation polymers and addition polymers or Condensation polymerization and addition polymerization.
* Distinguish between Thermosetting plastics and thermoplastics or thermosetting polymers and therm-softening polymers
* Explain with suitable examples, following ingredients and there use in compounding of plastics: a) Filler b) Binder c) Catalyst d) Pigment
* What are bio-degradable polymers? Give the properties (any two) and uses (any two) of plexi-glass and Kevlar polymer.
* Explain the preparation, properties and uses of poly-paraphenylene terephthalamide polymer.
* Explain the classification of polymer with suitable example on the basis of

a) Tacticity b) Origin c) polymerization

* Explain the synthesis, properties and applications of the following polymers (any one will be expected in the exam):

1. Poly Vinyl Acetate (PVAc)
2. Poly Methyl Methacrylate (PMMA)
3. Poly-Paraphenylene Terephthalamide (KEVLAR)
4. Polylactic acid
5. PDMS

* Explain the following conducting polymers with suitable examples. State two applications of conducting polymers.

1. Intrinsically conducting polymers
2. Doped conducting polymers
3. Extrinsically conducting polymers

* State six characteristics of thermosetting polymers. What is average molecular weight of a polymer? Give the formula for Mark-Houink equation for calculation of viscosity average molecular weight.
* In a polymeric mixture, there are 500 molecules with molecular weight 5000, 700 molecules with molecular weight 3500 and 300 molecules with molecular weight 2000. Find Mn, Mw and P.D.I.
* In a given polymer, there are 200 molecules of molecular weight 2000, 100 molecules of molecular weight 5000 and 300 molecules of molecular weight 3000. Find number average, weight average and PDi of the polymer.
* In a polymer having composition as given in the following table, calculate number average, weight average molecular mass and PDI.

|  |  |
| --- | --- |
| **Molecular weight** | **Number of molecule** |
| 500 | 100 |
| 1000 | 200 |
| 3000 | 1000 |
| 5000 | 3000 |