

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	$\text{Ca}(\text{HCO}_3)_2$	$\text{Mg}(\text{HCO}_3)_2$	CaCl_2	MgSO_4	CaSO
Quantity (mg/L)	1.62	14.6	1.11	24	13.6

Calculate the temporary and permanent hardness of the above sample.c

- Distinguish between temporary and permanent hardness (4 points).
Write the reaction of lime and soda with following impurities
A) $\text{Mg}(\text{HCO}_3)_2$ B) CO_2 C) $\text{Al}_2(\text{SO}_4)_3$ D) H_2SO_4
- ☐ What is the equivalence of CaCO_3 hardness? Find the equivalence of CaCO_3 hardness in ppm and degree Clarke from following data;
- ☐ 73 mg of $\text{Ca}(\text{CO}_3)_2$ dissolved in 500 ml water
- ☐ 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; $\text{Mg}(\text{NO}_3)_2 = 7.4$ mg/L, $\text{CO}_2 = 22$ mg/L, $\text{KNO}_3 = 10$ mg/L, $\text{MgCO}_3 = 2.05$ mg/L, $\text{CaCl}_2 = 3.33$ mg/L, $\text{NaHCO}_3 = 12$ 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: $\text{Mg}(\text{HCO}_3)_2 = 7.3$ ppm, $\text{NaHCO}_3 = 4.2$ ppm, $\text{Ca}(\text{HCO}_3)_2 = 8.1$ ppm, $\text{MgCl}_2 = 3.8$ ppm, $\text{Ca}(\text{NO}_3)_2 = 4.1$ ppm, $\text{NaNO}_3 = 10$ 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 of unknown sample hard water requires 18 mL of the 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

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- of the same EDTA for titration while 50 ml of boiled water sample required 6 ml of EDTA. Calculate the temporary, permanent and total hardness.

- Calculate the quantities of lime and soda (both 100% pure) for softening of 4×10^6 liters of water containing the following constituents:

$\text{CaCl}_2 = 2.22$ ppm, $\text{Mg}(\text{HCO}_3)_2 = 29.2$ ppm, $\text{H}_2\text{SO}_4 = 9.8$ ppm, $\text{MgCl}_2 = 95$ ppm, $\text{CaSO}_4 = 2.72$ ppm, $\text{KCl} = 100$ 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: $\text{Ca}(\text{HCO}_3)_2 = 16.2$ mg/L, $\text{Mg}(\text{HCO}_3)_2 = 14.6$ mg/L, $\text{CaSO}_4 = 1.36$ mg/L, $\text{CaCl}_2 = 11.1$ ppm, $\text{MgCl}_2 = 9.5$ 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: $\text{Ca}(\text{HCO}_3)_2 = 8.1$ ppm, $\text{MgCO}_3 = 2.1$ ppm, $\text{H}_2\text{SO}_4 = 4.9$ ppm, $\text{MgCl}_2 = 1.9$ ppm, $\text{Ca}(\text{NO}_3)_2 = 4.1$ ppm, $\text{KNO}_3 = 10$ 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.x

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

- 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.

- Define BOD/COD and give their significance. Give the necessary formulae. Distinguish between BOD and COD.