

Q1. 1.0 gm of CaCO_3 was dissolved in HCl and the solution made up to 1000 ml with distilled water. 50 ml of the solution required 45 ml of EDTA solution for titration. 50 ml of hard water sample required 28 ml of EDTA and after boiling and filtering required 15 ml of EDTA solution. Calculate the hardness of water.

ANS: Total Hardness 621.6 ppm, Permanent hardness 333 ppm, Temp. hardness 288.6 ppm

Q2. 0.45 gm of CaCO_3 was dissolved in HCl and the solution made up to 500 ml with distilled water. 50 ml of the solution required 50 ml of EDTA solution for titration. 50 ml of hard water sample required 18 ml of EDTA and after boiling and filtering required 10 ml of EDTA solution. Calculate each type of hardness of water.

ANS: Total Hardness 324 ppm, Permanent hardness 180 ppm

Q3. 1.53 gm of CaCO_3 was dissolved in HCl and the solution made up to 1000 ml with distilled water. 50 ml of the solution required 32 ml of EDTA solution for titration. 50 ml of hard water sample required 16 ml of EDTA and after boiling and filtering required 9 ml of EDTA solution. Calculate temporary, permanent and total hardness of water.

ANS: Total Hardness 748.8 ppm, Permanent hardness 421.9 ppm, Temp. hardness 326.9 ppm

Q4. 0.30 gm of CaCO_3 was dissolved in HCl and the solution made up to 1000 ml with distilled water. 100 ml of the solution required 30 ml of EDTA solution for titration. 100 ml of hard water sample required 35 ml of EDTA and after boiling and filtering required 12 ml of EDTA solution. Calculate temporary hardness of water.

ANS: Total Hardness 350 ppm, Permanent hardness 120 ppm, Temp. hardness 230 ppm

Q5. 0.25 gm of CaCO_3 was dissolved in HCl and the solution made up to 250 ml with distilled water. 50 ml of the solution required 20 ml of EDTA solution for titration. 50 ml of hard water sample required 18 ml of EDTA and after boiling and filtering required 10 ml of EDTA solution. Calculate temporary hardness of water.

ANS: Total Hardness 900 ppm, Permanent hardness ~ 500 ppm, Temp. hardness 400 ppm

6. 20 ml of std water containing 1 g of pure CaCO_3 per lit consumed 25 ml of EDTA. 100 ml of water sample consumed 18 ml of EDTA using EBT as indicator. While same water sample requires 12 ml of EDTA solution. Calculate carbonate and non-carbonate hardness of water

Ans Permanent hardness = 96 ppm Temporary hardness = 48 ppm

7. 0.5g of CaCO_3 was dissolved in dilute HCL and diluted to 500 ml with distilled water, 50 ml of this solution required 48 ml of EDTA solution for titration. 50 ml of hard water sample required 15 ml of EDTA solution for titration. 50 ml of same water sample on boiling and filtering requires 10 ml of EDTA solution. Calculate temporary, permanent and total hardness in ppm.

Ans. Permanent hardness of sample = 208.33 ppm Temporary hardness = 104.17

8. Calculate the temporary and permanent hardness of water sample containing $\text{Mg}(\text{HCO}_3)_2 = 7.3\text{mg/L}$, $\text{Ca}(\text{HCO}_3)_2 = 16.2\text{mg/L}$, $\text{MgCl}_2 = 9.5\text{mg/L}$, $\text{CaSO}_4 = 13.6\text{mg/L}$.

Ans Temporary hardness 15ppm. Permanent hardness 20ppm.

9. Calculate the temporary and total hardness of a water sample containing $\text{Mg}(\text{HCO}_3)_2 = 73\text{mg/L}$, $\text{Ca}(\text{HCO}_3)_2 = 162\text{mg/L}$, $\text{MgCl}_2 = 95\text{mg/L}$, $\text{CaSO}_4 = 136\text{mg/L}$.

Temporary hardness = 150mg/L or ppm.

Total hardness of water = 350 mg/L or ppm.

10. 50ml of a sample water consumed 15ml of 0.01 EDTA before boiling and 5ml of the same EDTA after boiling. Calculate the degree of hardness, permanent hardness and temporary hardness.

Ans. permanent hardness = 100mg/L or ppm

∴ Temporary hardness = 300-100=200ppm

11. 0.5g of CaCO_3 was dissolved in HCl and the solution made up to 500ml with distilled water. 50ml of the solution required 48ml of EDTA solution for titration. 50ml of hard water sample required 15ml of EDTA and after boiling and filtering required 10ml of EDTA solution. Calculate the hardness.

Ans. 312.5 mg CaCO_3 eq

11. A sample containing following impurities in the concentration of mg/Lit: $\text{CaCl}_2 = 212$; $\text{Ca}(\text{NO}_3)_2 = 134$; $\text{Mg}(\text{HCO}_3)_2 = 63$; $\text{MgSO}_4 = 110$; calculate the amount of lime (80% pure) and soda (95% pure) required for softening 10,000 liters of water.

12.

A sample of water in analysis shows following impurities expressed in mg/lit.

Sr. No.	Impurity	Quantity in ppm
1.	$\text{Ca}(\text{HCO}_3)_2$	220
2.	$\text{Mg}(\text{HCO}_3)_2$	56
3.	MgCl_2	130
4.	MgSO_4	84
5.	CaSO_4	98

Calculate amount of lime and soda required to soften 10^6 liters of water.

13.

Calculate amount of lime (88.3 % pure) and soda (99.2 % pure) required to soften 24000 liters of water per day for a year containing the following

$\text{CaCO}_3 = 1.85 \text{ mg / l}$	$\text{CaSO}_4 = 0.34 \text{ mg / l}$
$\text{MgCO}_3 = 0.42 \text{ mg / l}$	$\text{MgCl}_2 = 0.76 \text{ mg / l}$
$\text{MgSO}_4 = 0.90 \text{ mg / l}$	$\text{NaCl} = 2.34 \text{ mg / l}$
$\text{SiO}_2 = 2.32 \text{ mg / l}$	

14.

Calculate quantity of lime and soda required for softening 60000 liters of water containing following:-

$\text{CO}_2 = 20 \text{ mg / l}$	$\text{Ca}(\text{HCO}_3)_2 = 20 \text{ mg / l}$
$\text{Mg}(\text{HCO}_3)_2 = 25 \text{ mg / l}$	$\text{HCl} = 8.4 \text{ mg / l}$
$\text{Al}_2(\text{SO}_4)_3 = 40 \text{ mg / l}$	$\text{MgCl}_2 = 12 \text{ mg / l}$