1. How many grams of $MgCl_2$ dissolved per litre will give hardness of 76 ppm?
2. A water sample contains 168 mg of $MgCO_3$ per litre. Calculate hardness of the sample in ppm and in grains/gallon.
3. What role does "coagulants" play in lime soda process to remove hardness? Give examples of coagulants.
4. Calculate the quantity of lime and soda required for softening 50,000 litres of water containing the following salts per litre: $Ca(HCO_3)_2$ = 8.1 mg; $Mg(HCO_3)_2$ = 7.5 mg; $CaSO_4$ = 13.6 mg; $MgSO_4$ = 12.0 mg; $MgCl_2$ =2.0 mg and NaCl = 4.7 mg.
5. A sample of water on analysis gave the following results: Ca^{2+} = 30 mg/L; Mg^{2+} = 18 mg/L; K^+ = 19.5 mg/L; CO_2 = 11 mg/L; HCO_3^- = 122 mg/L; Cl^- =35.5 mg/L; SO_4^{2-} = 48 mg/L. Calculate total hardness and alkalinity present in water sample.
6. The carbonate alkalinity of water sample was found to be 75 ppm $CaCO_3$ equivalent. After carrying out lime treatment, the alkalinity of water was found to increase to 300 ppm $CaCO_3$ equivalent. Calculate the excess amount of $Ca(OH)_2$ present in water after lime treatment. Express it in terms of mg/L of $Ca(OH)_2$.
7. Why calgon conditioning is better than phosphate conditioning?
8. Why water softened by zeolite process is unfit for use in boilers?
9. The hardness of 25,000 litres of a sample of water was removed by passing it through a zeolite softener. The softener then required 100 litres of NaCl solution, containing 125 gm/L of NaCl for regeneration. Calculate the hardness of the sample of water.
10. A zeolite bed was exhausted after completely removing the total hardness of 10,000 L of hard water. The zeolite bed was regenerated using 8 L of NaCl containing 150 gm/L of NaCl. Calculate the hardness of water.
11. After treating 10,000 L of water by ion exchanger, the cationic resin required 200 L of 0.1 N HCl and anionic resin required 200 L of 0.1 N NaOH solutions. Find the hardness of the water sample.
12. In demineralization process, water is usually first passed through the cation-exchanger and then through anion-exchanger. Why?
13. Why is demineralization process preferred over zeolite process for softening of water for use in boilers?
14. Name the important discovery that has helped using the principle of reverse osmosis for the purification of water on commercial scale.
15. Why commercial RO technique as available today is not recommended by environmental agencies?

(At. wt. Ca = 40; Mg = 24; Cl = 35.5; S = 32; Na = 23; K = 39)