***Tutorial Sheet – Module-2* (Water Treatment)**
Course: B.Tech Year/Semester:I/II Session: 2022-2023
Subject Name & Code: Engineering Chemistry (BCHS-1101)

Q.1. Calculate the temporary and permanent hardness of water sample containing- Ca $(HCO_3)_2$ = 40.5ppm; Mg $(HCO_3)_2$ =36.5 ppm; $MgSO_4$= 30.0ppm; $CaSO_4$ = 34.0 ppm; $CaCl_2$=27.75 ppm

Q.2. Find out temporary, permanent and total hardness in a sample of water with following impurities. (i) $Ca(HCO3)_2$ = 81 ppm (ii) $MgCO_3$ = 84 ppm (iii) CaCl2 = 22.2 ppm (iv) MgSO4 = 60 ppm (v) KCl = 20 ppm (vi) Ca(NO3)2 = 30 ppm

Q3. What is the carbonate and non carbonate, temporary and permanent hardness of water sample which has following impurities? (i) Ca(HCO3)2 = 40.5 ppm (ii) Mg(HCO3)2 = 29.1 ppm (iii) CaCl2 = 11.1 ppm (iv) MgCl2 = 15.82 ppm (v) NaCl = 28.5 ppm (vi) CO2 = 20.2 ppm Express result in ppm.

:**Q.4.** A zeolite bed on softening 7000 liters of hard water required 60 liters of 10% NaCl solution for regeneration. Calculate the hardness of water in ppm.

Q.5. A water sample having hardness 250 ppm was softened by zeolite process. The exhausted zeolite bed required 50 litres 15 % NaCl solution for regeneration. Calculate the quantity of water softened using the zeolite bed.

Q.6. A zeolite bed got exhausted after softening 5000 litres of hard water. The hardness of water was 250 mg CaCO3 equivalent per litres. How many litres of 10% NaCl solution would be required to regenerate zeolite bed?

Q.7. Calculate the amount of lime required for softening of 50000 litres of hard water containing 72 ppm of MgSO4.

Q.8. Calculate the amount of lime and soda required for softening of 15000 litres of water, which analyzed as follows- temporary hardness = 20 ppm, permanent hardness = 15 ppm and permanent Mg hardness = 10 ppm.

Q.9. A sample water contain following impurities: Mg(HCO3)2 = 73 mg/l , CaCl2 = 222 ml/l, MgSO4 = 120 mg/l, Ca(NO3)2 = 164 mg/l . Calculate the quantity of lime (74% pure) and soda (90% pure) needed for softening of 5000 L of waer. Q.4. Calculate the amount of lime (90% pure) and soda (98% pure) for the treatment of 106 litres of water containing: (i) Ca $(HCO3)_2$ = 8.1 ppm (ii) $CaCl_2$ = 33.3 ppm (iii) $MgCl_2$ = 38 ppm (iv) $Mg(HCO_3)_2$ = 14.6 ppm

: ***Tutorial Sheet – Module-2*** **(PH & Buffer solution)**
Course: B.Tech Year/Semester:I / II Session: 2022-2023
Subject Name & Code: Engineering Chemistry (BCHS-1101)

Q.1. Calculate the P_H and POH of the following- (a) 0.001 M HCl (b) 0.04 M HNO3 (c) 3.2 x 10-3 M $Ba(OH)_2$

Q.2a. Calculate the pH of 1 x 10-7 solution of HCl at 25^0C.
Q.2b Calculate pH of 10-8 M HCl solution at 25^0C.

Q.3. Calculate the pH of the solution obtained by mixing 50 ml of 0.2 M HCl with 50 ml of 0.1 M NaOH.

Q.4. Calculate the pH of solution obtained by mixing 25 ml of 0.2 M with 50 ml of 0.25 M NaOH.

Q.5. Calculate the pH and hydrogen and hydroxyl ion concentration of a 3.3 x 10-3 M solution of Ca $(OH)_2$. at 25^0C.

Q.6.What would be the pH of the solution obtained by mixing 5 gram of acetic acid and 7.5 gram of sodium acetate and mixing the volume equal to 500 ml? Dissociation constant of acetic acid at 25 is 1.75 x 10^{-5}.

Q.7. A buffer solution contains 0.2 mole of NH4OH and 0.25 mole of NH4Cl per liter. Calculate the pH of the solution. Dissociation constant of NH4OH is 1.81 x $10^{-5.}$

Q.8. A buffer solution contains 0.2 mole of CH_3COOH and 0.25 mole of CH_3COOK per liter. Calculate the change the pH of the solution if 0.5 ml of 1M HCl is added to it. The dissociation constant of CH_3COOH at RT is 1.75 x 10^{-5}. (The volume change on the addition of HCl may be neglected).

Q.9. Calculate the pH before and after the addition of 0.01 M of NaOH to one litre of a buffer solution that is 0.1 M CH3COOH and 0.1 M CH3COONa. The dissociation constant of CH3COOH is 1.75 x 10^{-5}.

Q.10. Derive Henderson equation for acidic buffer solution.

Q.11. Calculate pH of a litre of solution containing 0.1 M CH_3COONa and 0.01 M CH_3COOH solutions. Ka for CH_3COOH is 1.8 X $10^{-5.}$

Q.12. Calculate pH of a liter of solution containing 0.2 M NH4OHand 0.01 M, 0.1M NH4Cl solutions.Kb for NH_4OH is 1.8 X 10^{-5}.