Chemistry 3
Set of exercises-2
Part 1: Acids and bases

Exercise 1: Knowing that the ion-product of water at 100°C is 6.10^{-13}, calculate the pH of the following solutions at this temperature:

- a- Pure water
- b- HCl at 0.1 mol/l.
- c- NaOH at 0.2mol/l.

Compare the obtained results with those corresponding to room temperature (25°C). Conclude.

Exercise 2 Identify the conjugate acid-base pairs in the following reactions:

(a) $HI(aq) + H_2O(l) \rightarrow H_3O^+(aq) + I^-(aq)$

(b) $CH_3COOH(aq) + OH^-(aq) \rightarrow CH_3COO^-(aq) + H_2O(l)$

(c) $NH_3(aq) + H_2O(l) \rightarrow NH_4^+(aq) + OH^-(aq)$

Exercise 3: Calculate the pH of the following solutions

1) HCl at 0.02 M   2) NaOH at 0.8 g/L   3) NaCl at 0.1 M   4) NH_3 at 0.51 g/L

5) CH_3COOH at 0.1 M   6) C_6H_5COONa at 0.02M   7) NH_4Cl at 26.75 g/L

Data: $pK_a(CH_3COOH/CH_3COO^-)=4.75$, $pK_a(NH_4^+/NH_3)= 9.25$, $pK_a(C_6H_5COOH/ C_6H_5COO^-)= 4.17$

$M(NaOH)= 40$ g/mol, $M(NH_3)=17$g/mol, $M(NH_4Cl)= 53.5$ g/mol

Exercise 4: Calculate the pH of the following mixtures

-50 ml of HCl at 0.01 M and 25 ml of perchloric acid ($HClO_4$) at 0.02M

-2.1 g NaOH and 0.83 g of Na_2O (strong base) in 100 ml of pure water.

-20 ml of HCl at 0.01 M and 20 ml at 0.1 M of monochloroacetic acid.

-25 ml of formic acid at 0.1 M and 50 ml of acetic acid at 0.01 M.

-10 ml NaOH at 0.001M and 10 ml of ammonia at 0.1 M

$pK_a(ClCH_2COOH/ ClCH_2COO^-)= 2.85$, $pK_a(HCOOH/ HCOO^-)= 3.74$

Exercise 5: The dissociation constant of chloroacetic acid ($Cl-CH_2COOH$) is $1.4x10^{-3}$. Calculate the dissociation degree of this acid in aqueous solution for the following concentrations: M, M/10, M/100.

Exercise 6: A 1.0 M aqueous solution of ammonia (NH_3) has a pH of 11.63 at 25°C. Calculate K_b and pK_b for ammonia.

Exercise 7 (homework) : A 0.150 M solution of formic acid (HCO_2H) at 25°C has an acidity constant of $K_a = 1.8 \times 10^{-4}$ at 25°C. Calculate the corresponding dissociation degree and dissociation constant of this acid.