EXPERIMENT NO. 6

Aim: To determine the alkalinity in given water sample.

Apparatus required: Burette, conical flask, pipette, beaker and measuring cylinder.

Chemical required: HCl, N/20 Na_2CO_3 solution, phenolphthalein, methyl orange.

Theory: Alkalinity is a measure of the acid buffering capacity of water. Alkalinity of a sample of water is due to the presence of hydroxide ion (OH^-) bicarbonate ion (HCO_3^-) and carbonate ion (CO_3^{2-}) or the mixture of any of the two ions present in water. But the (OH^-) and (HCO_3^-) ions together is not possible as they combine together to form (CO_3^{2-}) ion.

(OH^-) + (HCO_3^-) = (CO_3^{2-}) + H_2O

Reactions involved:

$OH^- + H^+ \longrightarrow H_2O$

$CO_3^{-2} + H^+ \longrightarrow HCO_3^-$

$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$

$Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$

$NaHCO_3 + HCl \longrightarrow H_2O + NaCl + CO_2$

Procedure:

I- Standardization of HCl

1. 50 ml HCl is filled in the burette.
2. 10 ml Na_2CO_3 solution is pipette out in the conical flask.
3. 2-3 drops of Methyl Orange is added and titration done is till end point observed.

II- Titration with H_2O Vs. HCl

1. 50 ml HCl is filled in the burette.
2. 10 ml H_2O is pipette out in the conical flask.
3. 2-3 drops of Phenolphthalein is added.
4. Run the HCl in conical flask.
5. Titration is done till the solution turns pink to colourless.
6. 2-3 drops of Methyl Orange is added and titration is continued till the Orange-Pink colour is observed.

Observations:

Standardization of HCl

Solution in burette = HCl

Solution in conical flask = 10 ml of Na_2CO_3

Indicator = Methyl Orange

End Point = Pink colour

Observation Table:

Serial no.	Burette Reading		Volume of HCl (ml)
	Initial	Final	

1	0	17.9	17.9
2	17.9	35.8	17.9

HCl Vs H_2O

Solution in burette = HCl
In conical flask = Water (10 ml)
Indicator = Phenolphthalein and Methyl Orange
End Point 1st = Pink to colourless
End Point 2nd = Colourless to pink

Observation Table:

Serial no.	Phenolphthalein			Methyl orange			$V_1 + V_2$ (ml)
	Initial	Final	V_1(ml)	Initial	Final	V_2(ml)	
1	0	16.5	16.5	16.5	20.5	4.0	20.5
2	20.5	37	16.5	37	41	4.0	20.5

Calculations :

i)Standardization of HCl

$N_1 V_1$ = $N_2 V_2$
(HCl) (Na_2CO_3)
N(HCl) = (1/20) X 10 / 17.9
N(HCl) = 0.027 N

II)HCL Vs Water

a) For Phenolphthalein-

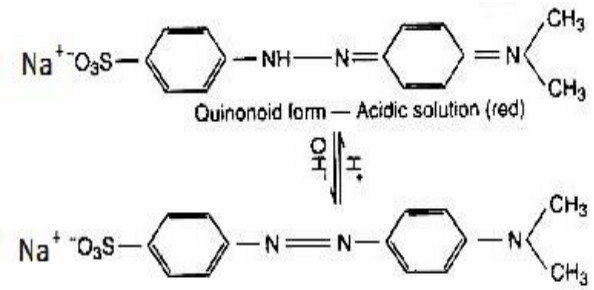
$N_1 V_1$ = $N_2 V_2$
(H_2O) = (HCl)
N (H_2O) = (0.027 X 16.5) / 10
= 0.033 N
Strength = 0.033 X 50
P = 1.65 g/L
= 1650 ppm

b) For Methyl Orange-

$N_1 V_1$ = $N_2 V_2$
(H_2O) = (HCl)
N (H_2O) = (0.027 X 20.5) / 10
= 0.055 N
Strength = 0.055 X 50
M = 2.76 g/L
= 2767 ppm

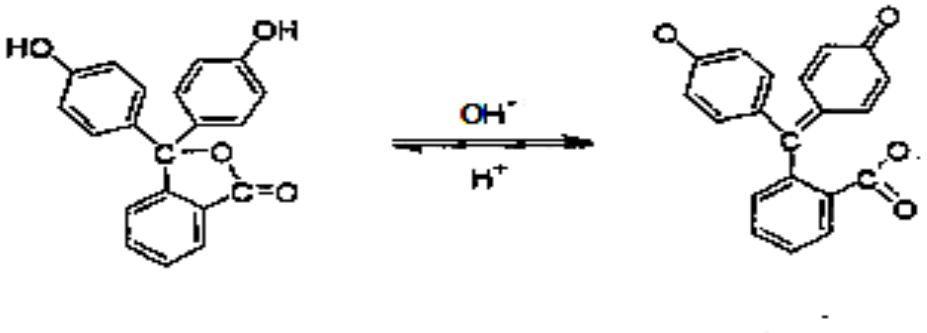
P> (1/2) M, so OH^- and CO_3^{-2} ions are present in water
Concentration of OH^- = (2 P-M) = 533 ppm
Concentration of CO_3^{-2} = 2 (M-P) = 2234 ppm

Structure:
Methyl Orange
Pink (Acidic Medium)



Yellow (basic Medium)

Phenolphthalein



Colourless (Acidic Medium) **Pink(Basic Medium)**

Result: Since P > (M/2), thus OH^- and CO_3^{-2} ions are present in the sample of water.
OH^- Concentration = 1250 ppm
CO_3^{-2} Concentration = 800 ppm

Precautions:

1. Wash the apparatus before use.
2. Rinse the burette with the solution to be filled in it.
3. For measuring coloured solution the upper meniscus is taken and for colourless solution measure the lower meniscus is taken.