KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act 1956)

Coimbatore – 641 021.

SYLLABUS
DEPARTMENT OF CHEMISTRY
B.Sc CHEMISTRY

Class : B.Sc Chemistry
Subject : States of matter and ionic equilibrium-Practical
Subject Code : 18CHU112
Semester / Year : 1 / I

Semester-I

18CHU112 **STATES OF MATTER AND IONIC EQUILIBRIUM - PRACTICAL** **2H 1C**

Instruction Hours/week:L: 0 T:0 P:2 Marks: Internal:40 External: 60 Total:100

Scope

This course is an introduction to chemistry lab that illustrates principles of chemistry and laboratory techniques. The course presents the practical knowledge of the states of matter and ionic equlibria. It deals with the measurement of the properties of different states of matter and PH of buffer solutions.

Programme Objective
To develop skills
1. To determine surface tension of a liquid
2. To determine the viscosity of a liquid
3. To prepare a buffer solution and to measure the PH of asolution
4. How to monitor the PH of a solution during the course of a titration.

Programme Outcome
The students develops the practical skill
1. Knows to determine surface tension of a liquid
2. Knows to determine the viscosity of a liquid
3. Knows to prepare a buffer solution and to measure the PH of asolution
4. Knows how to monitor the PH of a solution during the course of a titration.
5. The lab will also provide hands-on opportunities to develop and apply this knowledge

Methodology
Block Board teaching, Demonstration.

1. **Surface tension measurements**
   a. Determination of the surface tension of a liquid.
   b. Study the variation of surface tension with different concentration of detergent solutions.

2. **Viscosity measurement.**
   a. Determination of co-efficient of viscosity of an unknown aqueous solution.
   b. Study the variation of co-efficient of viscosity with different concentration of Poly VinylAlcohol (PVA) and determine molar of PVA.
   b. Study the variation of viscosity with different concentration of sugar solutions.

3. **Solid State:**
   a. Indexing of a given powder diffraction pattern of a cubic crystalline system.

4. **pH metry**:
   a. Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium
   acetate and their mixtures.
   b. Preparation of buffer solutions of different pH values (i). Sodium acetate-acetic acid (ii).Ammonium chloride-ammonium hydroxide
   c. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base.

   Determination of dissociation constant of a weak acid.

Suggested Readings:
Text Books:

1. Khosla, B. D., Garg, V. C. & Gulati, A.(2011).*Senior Practical Physical Chemistry*. New Delhi :R. Chand &Co.

Reference Books:

1. Garland, C. W., Nibler, J. W. & Shoemaker, D. P. (2003). *Experiments in PhysicalChemistry*. 8th Ed.New York : McGraw-Hill.
2. Halpern, A. M. & McBane, G. C.(2003).*Experimental Physical Chemistry*. 3rd Ed. New York : W.H. Freeman & Co.

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act 1956)

Coimbatore – 641 021.

LECTURE PLAN
DEPARTMENT OF CHEMISTRY
M.Sc CHEMISTRY

Name of the Staff	:	**Dr. M. Makeswari**
Department	:	**Chemistry**
Title of the Paper	:	**States of matter and Ionic Equilibrium Practical**
Paper Code	:	**18CHU112**
Class	:	**I-B.Sc-Chemistry**
Year and Semester	:	**I Year and I-Semester**
Total Hours	:	**24 Hours**

S. No.	**Duration Hours**	**Name of the Experiment**	***Support Material***
1.	2	Procedure Writting	
2.	2	Demonstration for the Experiments	
3.	2	Determination of surface tension of Water	*R1*
4.	2	Determination of coefficient of viscosity of a aqueous solution	*R1*
5.	2	Determination of coefficient of viscosity of a solution	*R1*
6.	2	Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.	*R1*
7.		Preparation of buffer solutions of different pH values (i). Sodium acetate-acetic acid (ii).Ammonium chloride-ammonium hydroxide	*R1*
8.	2	pH metric titration of Acid and base	*R1*
9.	2	Repetition Class	
10.	2	Repetition Class	
11.	2	Viva-voice questions	
12.	2	Model practical examination	

SUGGESTED READINGS:

REFERENCE BOOKS

R1: Khosla, B. D., Garg, V. C. & Gulati, A.(2011).*Senior Practical Physical Chemistry*. New Delhi :R. Chand &Co.

CLASS : I B.Sc CHEMISTRY
COURSE NAME : STATES OF MATTER AND IONIC EQUILIBRIUM -PRACTICAL
COURSE CODE : 18CHU112 SEMESTER : I BATCH-2018-2020

LAB MANUAL
DEPARTMENT OF CHEMISTRY
B.Sc CHEMISTRY

CONTENTS

Suggested Readings:

Text Books:

1. Khosla, B. D., Garg, V. C. & Gulati, A.(2011).*Senior Practical Physical Chemistry*. New Delhi :R. Chand &Co.

SURFACE TENSION MEASUREMENTS

Experiment No 1

DETERMINATION OF THE SURFACE TENSION OF A LIQUID

Aim:

Determine the surface tension of a given liquid at room temp using stalgmometer by drop number method.

Requirements:

Stalgmometer, specific gravity bottle, a small rubber tube with a screw pinch cork, distilled water, experimental liquid.

Theory:

In the drop number method, the number of drops formed by equal volumes of two liquid is counted. If $m_1$and $m_2$is the mass of one drop of each of the liquid having densities d_1 and d_2 respectively. If $n_1$and n_2 is the number of drops formed by volume v of the two liquids, then their surface tensions are relatedas

$$\text{¥}_1/\text{¥}_2= (d_1/d_2)*(n_2/n_1)$$

One of the liquid is water its surface tension and density are known.Then the surface tension of the given liquid can be calculated.

Procedure:

1. Clean the stalgmometer with chromic acid mix, wash with water and dry it
2. Attach a small piece of rubber tube having a screw pinch cock at the upper end of thestalgmometer.
3. Immerse the lower end of the stalgmometer in distilled water and suck the water 1-2cm above mark A. adjust the pinch cork so that 10-15 drops fall per minute.

4. Clamp the stalgmometer allow the water drops to fall and start counting the number of drops when the meniscus crosses the upper mark A and stop counting when the meniscus passes markB
5. Repeat the exercise to take three to fourreadings
6. Rinse the stalgmometer with alcohol and dryit
7. Suck the given liquid in the stalgmometer and count the drops as in case ofwater

8. Take a clean dry weighing bottle weighs it with water as well as with liquid.
9. Note the temp of water taken in abeaker.

Observations:

Room temp=t^{0}C Density of water=d_w
Surface tension of water=¥ dynes/cm

No of drops From a Fixed Volume				Mean
Liquid	1….	2……	3…..	n_l=
Water	1….	2…….	3……	n_w=

Weight of empty specific gravity bottle=$w_1$gram
Weight of specific gravity bottle+water=w_2 gram
Weight of empty sp.gravity bottle+liquid=$w_3$gram
Weight of water=(w_2-w_1)gram
Weight of liquid=(w_3-w_1)gram

Calculations:

Density of the liquidD_l= (w_3-w_1)/(w_2 –w_1) *d_w
Surface tension of liquid=¥$_l$/¥$_w$ = (d_l/d_w)*(n_w/n_l)* ¥$_w$

Result

The surface tension of a given liquid is = ----- dynes/c

VISCOSITY MEASUREMENTS

Experiment No 2

DETERMINATION OF CO-EFFICIENT OF VISCOSITY OF AN UNKNOWN AQUEOUS SOLUTION

Aim:

To determine the viscosity of a given unknown liquid with respect to water, at laboratory temperature, by viscometer.

Requirements:

Ostwald viscometer, rubber tube with screw pinch cock, stand, beaker, unknown liquid, distilled water. specific gravity bottle

Theory:

The force of friction which one part of the liquid offers to another part of the liquid is called viscosity. For measuring the viscosity coefficient, Ostwald viscometer method is used which is based on Poiseuille’s law. According to this law, the rate of flow of liquid through a capillary tube having viscosity coefficient, η, can be expressed as

$$\eta = \pi \cdot r^4 tP/8vl$$

where, v= vol. of liquid (in ml)
t= flow time (in sec.) through capillary r= radius of the capillary (in cm)
l= length of the capillary (in cm)
P= hydrostatic pressure (in dyne/sq.cm)
η= viscosity coefficient (in poise).

Since, the hydrostatic pressure (the driving force) of the liquid is given by P = dg h (where h is the height of the column and d is the density of the liquid); $\eta \propto Pt$; or, $\eta \propto d\,g\,ht$

If, η1 and η2 are the viscosity coefficients of the liquids under study, d1, d2, are their densities and t1 and t2 are their times of flow of *equal volume* of liquids through the same capillary respectively, then

$\eta1 \propto d1\ g\ h\ t1$ and
$\eta2 \propto d2\ g\ h\ t2$

$\underline{\eta_{1} =}$ $\underline{d_{1}t_{1}}$

Hence, =
$\eta_{2} = d2t2$

Here, usually the viscosity of given liquid is measured with respect to water whose viscosity is known very accurately at different temperatures. The SI physical unit of viscosity is the pascal-second (**Pa·s**), (i.e., $kg \cdot m^{-1} \cdot s^{-1}$). This means if a liquid with aviscosity of one Pa·s is placed between two plates, and one plate is pushed sideways with a shear stress of one pascal, it moves a distance equal to the thickness of the layer between the plates in one second. The cgs unit for the same is the poise (P), (named after J. L. Marie Poiseuille). It is more commonly expressed, as centipoise (cP). [1 cP = 0.001 Pa·s]. Water at 20°C has a viscosity of 1.0020 cP.

Procedure:

1. Note the laboratory temperature.
2. Wash the specific gravity bottle with distilled water anddry.
3. Take the weight of the empty & filled (with distilled water) specific gravity bottle (with stopper). Then, weigh the filled with specific gravity bottle h unknown given liquid. Use the data for measuring thedensities.
4. Clean and rinse the viscometer properly with distilled water. Fix the viscometer vertically on the stand and filled with specific amount (say 20ml) of mixture (every time take the samevolume).
5. Time of flows were recorded for each solutions (water and the given liquid).
6. Take 3 to 4readings.

Observations:

Laboratory temperature=….°C

Density measurement:

Weight of empty R.D.bottle (w1) =…g.
Weight of R.D.bottle with water (w2) =…g.
Weight of R.D. bottle with liquid (w3) =…g. So,
weight of water (ww) = (w2-w1) =…g.

l no.	Flow times (sec)			
	t1	t2	t3	mean
1				
2				
3				
4				

Calculations:

Determination of the density of the liquid(dl):

$$\frac{\text{Density of liquid (dl)}}{\text{Density of water (dw)}} = \frac{\text{Weight of liquid (wl)}}{\text{Weight of water (ww)}}$$

Density of liquid (*dl*) =*wl* /*d w ww*

(Take density of water =1.0g/ml at 25

Determination of the viscosity of the liquid (η_l)

$$Viscosity of the liquid, \eta_l = \frac{t_1 d_1}{t_w d_w}$$

Result:

The viscosity of the given liquid with respect to water atlaboratory temperature was foundtobe cP.

PH-METRY EXPERIMENTS

Experiment No 3

STUDY THE EFFECT OF ADDITION OF HCl/NaOH ON PH TO THE SOLUTIONS OF ACETIC ACID, SODIUM ACETATE AND THEIR MIXTURES

Aim

To study the effect of addition of HCl and NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.

Introduction

Often the pH of the solution will change dramatically by the addition of a strong acid(HCl) or a base(NaOH). A pH meter is used to measure the pH as the acid (HCl)/base(NaOH) is added in small increments (called aliquots) to an acid/basic solution. A graph is then made with pH along the vertical axis and volume of base added along the horizontal axis. The addition of an acid or a base to a buffer solution the pH will not change appreciably.

Materials

1. pH meter with standard buffers of pH 4.0, pH 7.0, and pH 10.0
2. 50 mL burette
3. burette clamp stand
4. 100 mL beaker
5. Acetic acid and sodium acetate solutions
6. HCl solution of known normality
7. NaOH Solution of unknown normality

Procedure

1. Obtain about 100 mL of 0.1N HCl in a clean, dry beaker. This beaker should be labeled.
2. Rinse your burette with distilled water. Then use a small amount of the 0.lN HCl solution to rinse the burette. The rinsing solution should be discarded into the sink.
3. Fill the burette to some point with HCl.

4. Obtain about 100 mL of NaOH solution in another clean, dry beaker. This beaker should also be labeled.
5. Rinse and fill the other burette with NaOH as indicated in step 2
6. Standardize the pH meter using buffer solutions with known PH.

Beaker 1

7. Take 20 ml of acetic acid in a 100 ml beaker. Measure the pH.
8. Set the beaker and position the burette containing the NaOH solution just above the beaker with acetic acid solution.
9. Set up your data table to include mL of NaOH added and the pH of the solution.
10. Add 1 ml of NaOH from the burette at a time, stir well with the help of a glass rod and note down the PH. Continue adding NaOH in 1.0 mL increments until you have obtained a pH reading greater than 12.

Table 1

S.No	Volume of the acetic acid	Volume of NaOH added	pH of the solution

A graph is then made with pH along the vertical axis and volume of base added along the horizontal axis.

Beaker 2

11. Take 20 ml of acetic acid in a 100 ml beaker. Measure the pH.
12. Set the beaker and position the burette containing the HCl solution just above the beaker with acetic acid solution.
13. Set up your data table to include mL of HCl added and the pH of the solution.
14. Add 1 ml of HCl from the burette at a time, stir well with the help of a glass rod and note down the PH. Continue adding HCl in 1.0 mL increments until you have obtained a pH reading below pH 2.

Table 2

S.No	**Volume of the Acetic acid**	**Volume of HCl added**	**pH of the solution**

A graph is then made with pH along the vertical axis and volume of acid added along the horizontal axis.

Beaker 3

15. Take 20 ml of Sodium acetate in a 100 ml beaker. Measure the pH.
16. Set the beaker and position the burette containing the NaOH solution just above the beaker.
17. Set up your data table to include mL of NaOH added and the pH of the solution.
18. Add 1 ml of NaOH from the burette at a time, stir well with the help of a glass rod and note down the PH.
19. Continue adding NaOH in 1.0 mL increments until you have obtained a pH reading greater than 12.

Table 3

S.No	**Volume of the Sodium acetate**	**Volume of NaOH added**	**pH of the solution**

Beaker 4

20. Take 20 ml of sodium acetate in a 100 ml beaker. Measure the pH.
21. Set the beaker and position the burette containing the HCl solution just above the beaker.
22. Set up your data table to include mL of HCl added and the pH of the solution.
23. Add 1 ml of HCl from the burette at a time, stir well with the help of a glass rod and note down the PH. Continue adding HCl in 1.0 mL increments until you have obtained a pH reading below pH 2.

Table 4

S.No	**Volume of**	**Volume of**	**pH of the**

	Sodium acetate	HCl added	solution

Beaker 5

24. Take 10 ml of acetic acid and 10 ml of sodium acetate and 10 ml of acetic acid in a 100 ml beaker. Measure the pH.
25. Set the beaker and position the burette containing the HCl solution just above the beaker Set up your data table to include mL of HCl added and the pH of the solution.
26. Add 1 ml of HCl from the burette at a time, stir well with the help of a glass rod and note down the PH. Continue adding HCl in 1.0 mL increments until you have obtained a pH reading below pH 2.

Table 5

S.No	Volume of the mixture of acetic acid & sodium acetate	Volume of HCl added	pH of the solution

Beaker 6

27. Take 10 ml of acetic acid and 10 ml of sodium acetate and 10 ml of acetic acid in a 100 ml beaker. Measure the pH.
28. Set the beaker and position the burette containing the NaOH solution
29. Set up your data table to include mL of NaOH added and the pH of the solution.
30. Add 1 ml of NaOH from the burette at a time, stir well with the help of a glass rod and note down the PH. Continue adding NaOH in 1.0 mL increments until you have obtained a pH reading greater than 12.

Table 6

S.No	Volume of	Burette reading	Burette	Volume of	pH of

	the mixture of acetic acid & sodium acetate	**Initial**	**reading Initial**	**NaOH added**	**the solution**

A graph is then made with pH along the vertical axis and volume of acid/base added along the horizontal axis.

Result:

1. By the addition of HCl acid to acetic acid the pH ----------------------------
2. By the addition of NaOH to acid acid the pH -------------------------------
3. By the addition of HCl acid to sodium acetate the pH ----------------------------
4. By the addition of NaOH to sodium acetate the pH -------------------------------
5. By the addition of HCl acid to a mixture of acetic acid and sodium acetate pH -----
6. By the addition of NaOH to a mixture of acetic acid and sodium acetate pH -----

Experiment 4

PREPARATION OF BUFFER SOLUTIONS OF DIFFERENT PH VALUES

Aim

To prepare an acidic buffer solution of different pH values using acetic acid and sodium acetate.

Theory

Buffer solutions are those solutions which resist the change in their pH by the addition of an acid or a base. In this experiment, a series of buffer solutions are prepared by mixing different volumes of equimolar solutions of acetic acid and sodium acetate. Acetic acid is slightly dissociated while sodium acetate being a salt is completely dissociated. Thus the mixture contains CH_3COOH, CH_3COO^- and Na^+ ions. The pH of the buffer solution is calculated using Hendersen equation.

Procedure

1. Prepare 100 ml of 0.4N NaOH solution and 0.4N acetic acid solution
2. Prepare 100 ml of 0.2 N sodium acetate solution(by mixing 50 ml of 0.4N NaOH solution and 50 ml of 0.4N acetic acid solution)
3. Prepare 100 ml 0.2N acetic acid solution (by mixing 50 ml of distilled water with 50 ml of 0.4N acetic acid solution)
4. Prepare the following buffer solutions

Test tube	1	2	3	4	5	6	7	8	9
Vol. of sodium acetate solution	9	8	7	6	5	4	3	2	1

Vol. of acetic acid solution	1	2	3	4	5	6	7	8	9
pH	5.70	5.35	5.12	4.93	4.75	4.56	4.38	4.15	3.79

5. Standardize the pH meter using buffer solutions with known PH.
6. Note down the PH of the above test solutions using the PH meter.

Results:

The PH of the above prepared buffer solutions from acetic acid and sodium acetate are :

Experiment No 5

PH-METRIC TITRATION OF STRONG ACID WITH STRONG BASE

AIM

Perform pH metric titration of a strong acid, hydro chloric acid with a strong alkali, sodium hydroxide. **Take 25 mL of 0.05 M HCl in 50 mL beaker and titrate with0.1M NaOH solution in an interval of 0.5 mL**

APPARATUS REQUIRED

1. A Ph meter (an electronic meter and glass combination electrode),
2. 50mL beaker,
3. burette and burette stand,
4. wash bottle,
5. pipette,
6. plasticfunnel,
7. glass rod.

CHEMICALS REQUIRED

1. 0.05 M HCl solution ,
2. 0.1 M NaOH solution,
3. distilled water

THEORY

Most of the chemical and biochemical processes are profoundlyaffected by the acidity or alkalinity of the medium in which thereaction takes place. All acids dissociate in aqueous solution to yieldH+ ions. Some acids like HCl, H2SO4, HNO3 etc. are completely ionizedin aqueous medium where as CH3COOH, HCOOH etc. ionize to asmall extent only. The former are known as strong and the later asweak acids. **pH of any solution is defined as (–log H+)** and has valuesbetween 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution.In an acid-base titration, the important information to obtain is the equivalence point.

It is the point at which an equal amount of acidhas been neutralised by equal amount of base or vice versa. If thereare a number of moles of acid in the titration flask, the equivalencepoint is reached when that same number of moles of base added isthe same as the number of moles acid in the titration flask, and thevolume of the base added is also known. Similarly, if the number ofmoles acid in the titration flask is unknown, it can be calculated forthe equivalence point if the molarity of the base and the volume ofbase added are known.

The pH of a solution can be measured accurately with the help of apH meter. Measurement of pH is employed to monitor the cause ofacid-base titration. It affords a direct method of obtaining a titrationcurve. The titration curve is a graph of measured pH values versusthe volume (ml) of titrant added.The pH values of the solution atdifferent stage of acid–base neutralization are determined andplotted against the volume of alkali added on adding a base to anacid, the pH rises slowly in the initial stages as the concentration ofH+ ion decreases gradually due to the consumption of some amountof HCl by NaOH resulting in the formation of NaCl (whose amountwill be the same as that of NaOH added).

$$HCl(aq)+NaOH(aq)\ NaCl(s)+H_2O(l)$$

But, at the equivalence point (the point at which an equal amount ofacid has been neutralised by equal amount of base or vice versa), pHincreases rapidly as at the equivalent point H+ ion concentration isvery small. Then it flattens out after the end point. The end point ofthe titration can be detected where the pH value changes mostrapidly. However, the shape of the curve depends upon theionisability of the acid and the base used and also on the acidity ofbase and basicity of the acid.Once a titration curve is constructed and the equivalence pointestablished the experimenter could then chose an indicator toperform the titration calorimetrically that would give a suitableendpoint (point at which indicator changes colour).

INDICATOR

The pH at the equivalence point is 7 and slightly before and after theequivalence point , it encompasses an interval from pH = 3 to pH =11. Therefore, any indicator whose pH range is within this intervali.e. indicators which will change there colour within this pH range canbe used. However, the range of the steep change of pH at theequivalence point depends upon the concentrations of acid and basebeing titrated. Methyl orange, methyl red and phenolphthalein, thecommon laboratory indicators can be used for this purpose as thererespective pH ranges lie in the interval 3-11. The usual choice,however, is phenolphthalein because the colour change in this caseis from colourless to a slight pink colour , a change which can beeasily detected.

PROCEDURE

1. 0.1(M) NaOH solution is provided.
2. HCl solution of unknown strength is provided.
3. Calibrate the pH meter with the solutions of pH 4,7 and 10.

pH-METRIC TITRATION:

Clean the electrode with distilled water andwipe them with tissue paper or filter paper. Take 25mL of HClsolution in a 50 mL beaker and immerse the electrode in it. Notedown the pH range.Rinse the burette with distilled water and thenwith NaOH solution.After that fill the burette with NaOH solution.The reading shown on the scale of pH meter is pH value of the HClsolution. Add NaOH solution drop wise from the burette (maximum0.5 mL at a time), shake the solution well with the help of glass rodand note the corresponding pH values. Near the end point, volume ofNaOH added should be as small as possible (0.1 ml at a time, which is the least count of an burette that we use in our laboratory) because theacid is neutralized and there will a sharp increase in pH values.Further addition of even 0.01 mL of NaOH, increase the pH value toabout 9–10. Put back the selector to zero position after each pHmeasurement, and always keep the selector at zero position when it is not in use.Plot the graph of pH of solution v/s volume of NaOH added.

OBSERVATIONS AND CALCULATIONS

1. **Preparation of 250 mL 0.05 Mstandard oxalic acid solution**:

Mass, w of oxalic acid to be weighed for the preparation ofsolutionw= .05×126×250= 1.5750 g / 1000
Mass of empty weighing bottle = x =
Mass of weighing bottle and oxalic acid = y =
Mass of weighing bottle after transfer = z =
Actual mass of oxalic acid transfer = w1 = (y-z) =

2. **Titration of standard oxalic acid solution against NaOH**:

Solution in burette = oxalic acid
Solution in titrating flask = V1= 20 mL standard oxalic acid
Indicator used = phenolphthalein
End point = colourless to pink

Table 1:- pH metric Titration

S.No	**Burette reading** **Initial Final**	**Burette reading** **Initial Final**	**Volume of HCl used**	**Concordant volume(V2)=**
			1.	

			2. 3.	

Volume of HCl taken = (V3) (mL)
Volume of NaOHadded = (V) (mL)
pH25VNaOH pH
ΔpH =pHf – pHi
ΔV=Vf – Vi
ΔpH/ΔV Vavg=(Vi+Vf)/2

CALCULATIONS

1.Molarity of standard oxalic acid solution:

M1 = w1× 1000/(molar mass × V)
M1= w1 ×1000/126× 250
M1=

2. **Molarity of given NaOH solution**:

M1 V1 /n1 = M2V2/n2
(Standardoxalic acid) (NaOH)
n1 = 1; n2 = 2
M2 = M1 × V1× n2
V2× n1=

3. **Molarity of given HCl solution**:

M3 V3/1 = M2V4/1
(Given HCl) (NaOH)
M3 = M2 × V4
V3=

Strength of the given HCl will therefore be = S1 = M3 x 126 =

Plot a graph between pH and volume of NaOH (VNaOH) added. Thereshould be a region in your graph where the slope is very steep. Determine the mid point of this region. This is the equivalence point.Find out the corresponding volume of NaOH required (V4 mL) forcomplete neutralization of HCl from the graph. Then find out thestrength of HCl (S1).

25 x M3 = V4x M2
(HCl) (NaOH)
Strength of HCl (S1) = (M1) x 126 (molar mass of HCl)

Plot a graph between ΔpH/ΔV and Vavg. There should be a peak inyour graph which is the equivalence point. Find out the correspondingaverage volume of NaOH required (V4 mL) for completeneutralization of HCl from the graph. Then find out the strength ofHCl (S1).

25 x M3 = V4x M2
(HCl) (NaOH)
Strength of HCl (S1) = (M1) x 126 (molar mass of HCl)

RESULT

The strength of the unknown HCl =S1 = ________ g L-1