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Department of Science and Humanities
Applied Chemistry Laboratory

Subject: Engineering Chemistry

CO- 1 + 5: Apply basic concepts of spectroscopy and electroanalytical techniques in characterizing chemical compounds.

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28/30

Experiment No. 2

Title: ACID- BASE TITRATION USING **pH**-METER

Aim: To determine the normality of base using pH meter.

Requirements: (Unknown Conc.) KOH Solution, 0.1 N HCl solution
Distilled water

Apparatus: Burette, pipette, beaker, pH meter etc.

Theory: In an acid-base titration, the equivalence point is reached when equal number of moles of base has been added from the burette. The molarity of the base can then be calculated since the number of moles of base added is the same as the number of moles of acid in the flask, and the volume of the base added is also known.

Often the pH of the solution will change sharply at the equivalence point. An acid-base indicator works by changing color over a given pH range. If an indicator which changes color near the equivalence point is chosen, there is also a sharp change in the color of the indicator at the equivalence point because of sharp change in pH.

Such titration can also be performed by pH meter without using an indicator. PH metric titrations have additional advantage due to their use in the titration where colour change is gradual and may not be detected precisely by colour change.

In pH metric titration, a graph is made with pH along the Y axis and volume of base added along the X axis. From this graph the equivalence point can be determined and the normality of the base can be calculated.

Nernst Equation:

$$E_{cell} = E^{0}_{cell} - \frac{2.303RT}{nF} \log Q$$

$$E_{cell} = E^{0}_{cell} - \frac{2.303RT}{nF} \left[\log \frac{[H^+]}{[OH^-]} \right]$$

Cell Representation:

$Ag_{(s)} | AgCl_{(s)} | Cl^-_{(aq.)} || H^+_{(aq.\ unknown)} || H^+_{(aq.,\ fixed)}, Cl^-_{(aq.)} | AgCl_{(s)} | Ag_{(s)}$

Glass Membrane

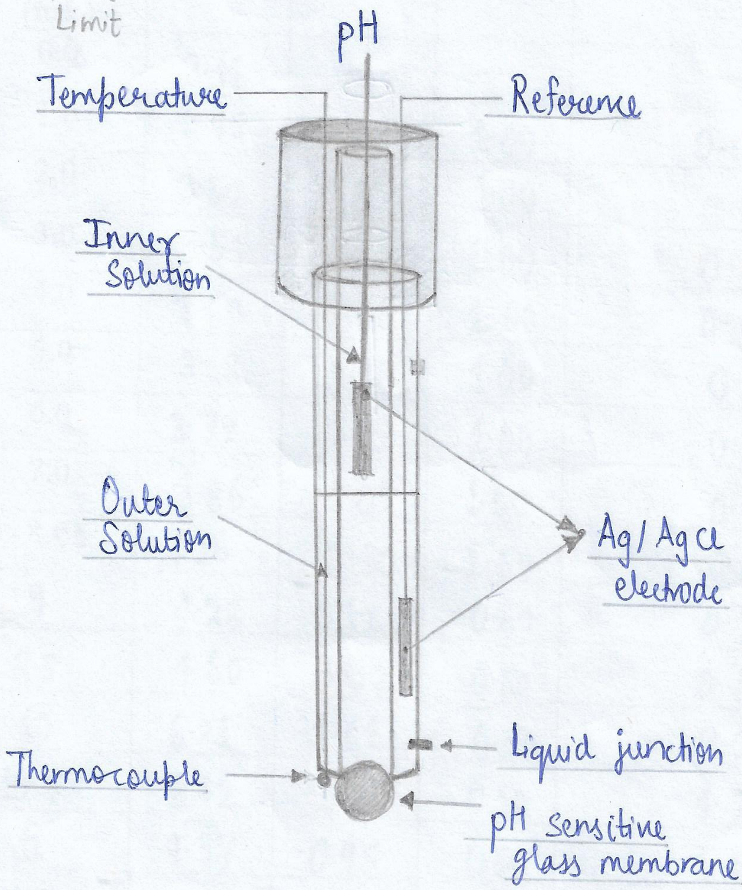
Porus Limit

Outer Reference Electrode

Internal Reference electrode

Diagram:

Silver - Silver Chloride



CALCULATIONS

Use the relationship: N_1V_1 (acid) = N_2V_2 (base) to determine the Normality of the base.

$N_2 = N_1V_1/V_2$

$$N_1V_1 = N_2V_2$$

$$0.1 \times 10 = N_2 \times 10.5$$

$$N_2 = \frac{10}{10.5}$$

$$\boxed{N_2 = 0.095}\ g/l$$

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Observations:

No	Volume of KOH Solution (mL)	pH of solution	ΔpH	ΔV	ΔpH/ΔV
1	0.0	3.41	—	—	—
2	1.0	3.45	0.04	1.00	0.04
3	2.0	3.50	0.05	1.00	0.05
4	3.0	3.54	0.04	1.00	0.04
5	4.0	3.60	0.06	1.00	0.06
6	5.0	3.68	0.08	1.00	0.08
7	6.0	3.77	0.09	1.00	0.09
8	7.0	3.86	0.09	1.00	0.09
9	8.5	4.16	0.30	1.50	0.20
10	9	4.28	0.12	0.50	0.24
11	9.5	4.60	0.32	0.50	0.64
12	10	6.21	1.61	0.50	3.22
13	10.5	8.42	2.21	0.50	4.42
14	11	9.37	0.95	0.50	1.90
15	11.5	9.78	0.40	0.50	0.80
16	12	10.04	0.27	0.50	0.54
17	12.5	10.20	0.16	0.50	0.32
18	13	10.36	0.16	0.50	0.32
19	14	10.53	0.17	1.00	0.17
20	15	10.63	0.10	1.00	0.10
21	16	10.72	0.09	1.00	0.09

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Procedure:

Calibrate the pH meter using standard buffer solution. Pipette out 10ml of 0.1N HCl solution in 125ml beaker. Insert probe of pH meter in the beaker add distilled water. Measure and record the pH of the solution before any KOH has been added.

Add 1.0 mL of KOH solution carefully from the burette. Record the pH when it has stabilized. Add another 1.0mL of KOH and record the pH. Continue adding KOH in 1.0 mL increments until you have obtained a pH reading around 11.

Remove the pH electrode from the solution, rinse it with distilled water.

1. Plot a graph of the **pH vs Volume of KOH** added. The pH should be on the Y axis and the mL of KOH should be on the X axis. The pH scale is spread out as much as possible.

2. Plot another graph of **ΔpH/ΔV vs Volume of KOH** added. There should be a region on your graph where the sharp peak will be observed. This is the equivalence point. Use this volume corresponding to the peak for the calculation of normality of base.

Result: The Normality of Base solution = 0.095 g/L.

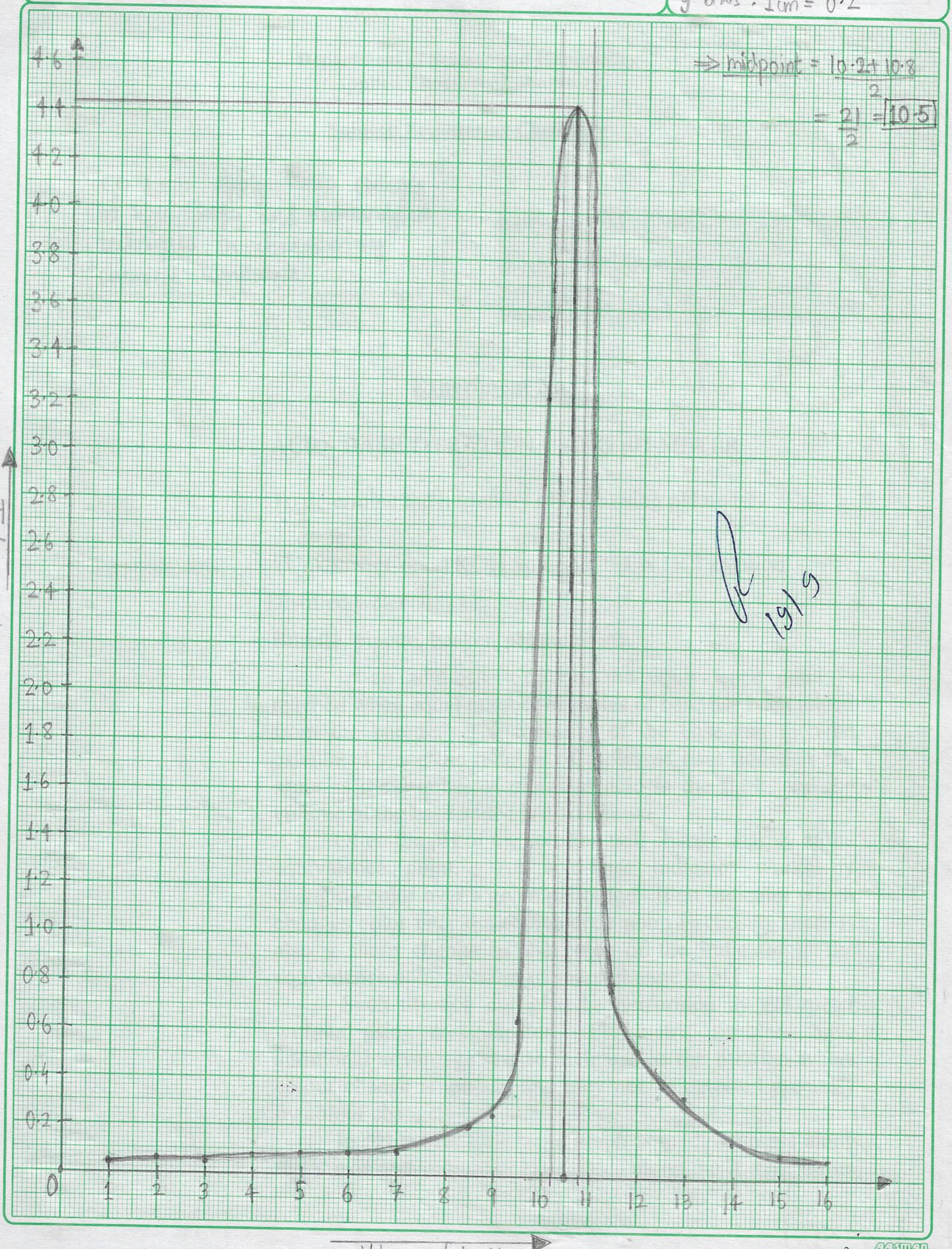
RAJAT KUMAR, C7-57, pH-metry (1)

SCALE :-
x-axis : 1cm = 1 ml
y-axis : 1cm = 0.5

Volume of KOH

RAJAT KUMAR , C7-57 , pH-metry 2

SCALE :-
x-axis : 1cm = 1ml
y-axis : 1cm = 0.2



Volume of KOH