TABLE ⟹

Sr. No.	Volume of NaOH added	Conductance
	mℓ	Ω^{-1}
1.	0	5.6
2.	0.5	5.0
3.	1.0	4.3
4.	1.5	3.5
5.	2.0	2.9
6.	2.5	2.4
7.	3.0	2.2
8.	3.5	2.4
9.	4.0	2.5
10.	4.5	2.7
11.	5.0	2.8
12.	5.5	3.0
13.	6.0	3.2
14.	6.5	3.6
15.	7.0	4.0
16.	7.5	4.5
17.	8.0	4.9
18.	8.5	5.4
19.	9.0	5.8
20.	9.5	6.3
21.	10.0	6.7
22.	10.5	7.1

Date 10/06/2021

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DETERMINATION OF THE STRENGTH OF A MIXTURE OF ACETIC ACID AND HYDROCHLORIC ACID BY CONDUCTOMETRY.

AIM ⟹

To estimate the strength of the mixture of acetic acid and hydrochloric acid present in a given mixture by conductometry.

APPARATUS REQUIRED ⟹

Conductivity bridge, conductivity cell, beaker, pipette, micro-burette, glass rod, etc.

REAGENTS ⟹

1) Hydrochloric acid (HCl) - 0.1N.
2) Acetic acid (CH_3COOH) - 0.1 N.
3) Sodium Hydroxide (NaOH) - 0.5N.

PRINCIPLE ⟹

The conductivity of the solution is related to the mobility of ions which in turn is related with the size of ions. When a mixture of acids like a strong acid (HCl) and weak acid (CH_3COOH) is titrated against a strong base (NaOH). HCl reacts first followed by CH_3COOH. When titration of strong acid and strong base is carried out, there is a decrease in conductivity, as highly mobile H^+ ions are replaced by Na^+.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

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23.	11.0	7.5
24.	11.5	8.0
25.	12.0	8.4
26.	12.5	8.8
27.	13.0	9.2
28.	13.5	9.6
29.	14.0	10.0
30.	14.5	10.4
31.	15.0	10.7

CALCULATIONS ⟹

1) Strength of HCl.

Volume of mixture (V_1) = 30 ml

Normality of NaOH (N_2) = 0.5 N

Volume of NaOH (V_2) = 2.7 ml

$\therefore$ Normality of HCl (N_1) = $\frac{V_2 \times N_2}{V_1} = \frac{2.7 \times 0.5}{20}$

$= \frac{1.35}{20} = 0.0675$ N

2) Strength of CH_3COOH.

Volume of mixture (V_1) = 20 ml

Normality of NaOH (N_1) = 0.5 N

Volume of NaOH ($V_2 - V_1$) = 3.3 ml

$\therefore$ Normality of CH_3COOH (N_2) = $\frac{N_1 \times (V_2 - V_1)}{V_1}$

$= \frac{0.5 \times 3.3}{20} = \frac{1.65}{20} = 0.0825$ N

When the whole strong acid is consumed, base reacts with weak acid and conductivity increases as unionized weak acid because ionized salt.

$$CH_3COOH + Na^+ + OH^- \longrightarrow CH_3COOH$$

After both the acids are consumed, there is a step increase in conductivity which gain endpoint and this increase in conductivity is due to fast moving OH^- ions from NaOH solution.

By the amount of base consumed, amount of acid present is calculated.

PROCEDURE ⟹

1) The solution is diluted to 100ml, 20ml of which is pipetted out into a clean beaker and 100ml of distilled water is added.
2) Conductivity cell is dipped into the test solution and titrated against NaOH with strong conductance is measured for each addition of 0.5ml NaOH.
3) After neutralization, amount of acid present is determined by amount of NaOH consumption of strong acid and weak acid.
4) Volume of base consumed for strong acid and weak acid are determined by plotting a base added first, endpoint corresponds to strong acid into the other is for weak point.

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RESULTS ⟹

1) The strength of HCl present in given solution = 0.0675 N.

2) The strength of CH_3COOH present in given whole of the solution = 0.0825 N.

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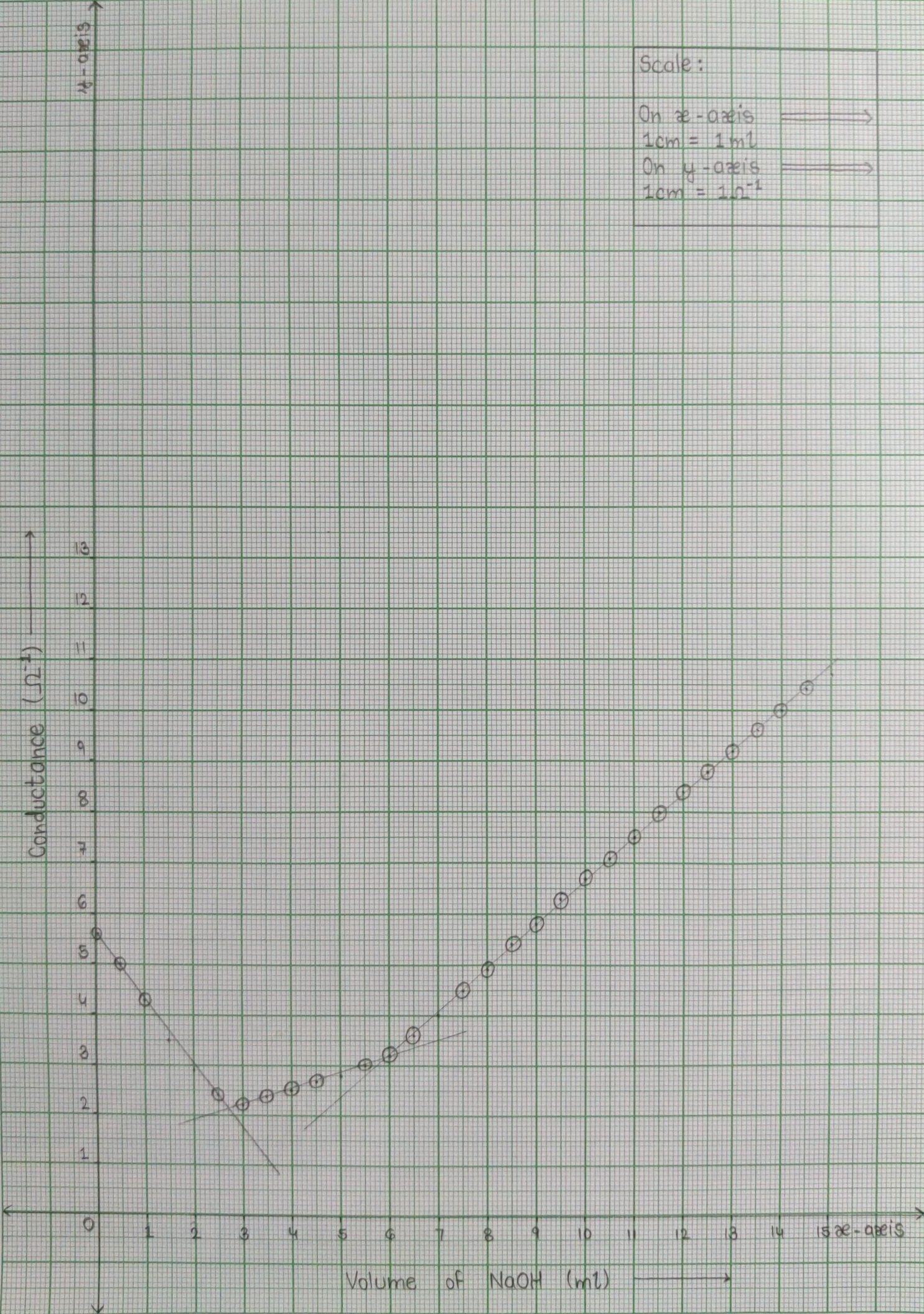
Scale:
On x-axis
1cm = 1 ml
On y-axis
1cm = 1 Ω⁻¹
y-axis
Conductance (Ω⁻¹)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
x-axis
Volume of NaOH (ml)