TABLES ⟹

1) Standard sodium hydroxide vs unknown HCl.
(Pilot Titration)

Sr. No.	Volume of NaOH	Conductance
	ml	Ω^{-1}
1.	0	4.5
2.	1	4.2
3.	2	3.9
4.	3	3.7
5.	4	3.3
6.	5	3.0
7.	6	2.7
8.	7	2.3
9.	8	2.1
10.	9	1.836
11.	10	1.543
Endpoint 12.	11	1.289
13.	12	1.333
14.	13	1.438
15.	14	1.619
16.	15	1.796
17.	16	1.938

2) Standard sodium hydroxide vs unknown HCl.
(Fair Titration)

Date 26/04/2021

Expt. No. 2 Page No.

CONDUCTOMETRIC TITRATION - DETERMINATION OF STRENGTH OF AN ACID.

AIM ⟹

To determine the strength of a given solution of HCl using the given NaOH solution by conductometric titration.

APPARATUS REQUIRED ⟹

Burette, pipette, standard measuring flask, glass rod, beaker, wash bottle, funnel, conductivity meter, conductivity cell, etc.

REAGENTS ⟹

1) Sodium hydroxide solution (0.1 N).
2) Distilled water.
3) HCl solution whose concentration is to be determined.

PRINCIPLE ⟹

Conductance depends upon the number of ions present in a solution and their ionic mobility. For a neutralization reaction between an acid and a base, the addition of the base would lower conductivity of the solution initially. This is because the H^+ ions would be replaced by the slow moving Na^+ ions of the base. After the equivalence point is reached, further addition of excess alkali introduces fast moving OH^- ions and hence the conductance of the solution increases.

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Sr. No.	Volume of NaOH	Conductance
	ml	Ω^{-1}
1.	9.4	1.846
2.	9.86	1.791
3.	9.8	1.716
4.	10.0	1.677
5.	10.2	1.626
6.	10.4	1.547
7.	10.6	1.508
8.	10.8	1.454
9.	11.0	1.385
Endpoint 10.	11.2	1.363
11.	11.4	1.375
12.	11.6	1.390
13.	11.8	1.407
14.	12.0	1.421
15.	12.2	1.446
16.	12.4	1.467
17.	12.6	1.495

CALCULATIONS ⟹

V_1 = Volume of HCl solution (10 ml)

N_1 = Normality of HCl solution

V_2 = Volume of NaOH (from graph)

N_2 = Normality of NaOH (0.1N)

$$\therefore N_1 = \frac{V_2 \times N_2}{V_1} = \frac{11.16 \times 0.1}{10} = \frac{1.116}{10}$$

$$= 0.1116\ N$$

Therefore, two straight lines with opposite slopes will be obtained when the conductance values are plotted graphically against volume of sodium hydroxide added. The point where these two lines intersect is the equivalence point.

PROCEDURE ⟹

1) Burette solution : NaOH solution.
2) Pipette solution : 10ml made up of HCl solution.
3) The given HCl solution is made upto 100ml in a standard Flask.
4) 10ml of the made up HCl solution is pipetted out into a 250ml beaker.
5) It is diluted with 90ml distilled water so that the conductivity cell is completely immersed in solution.
6) The solution is stirred well with a glass rod and the initial conductance of the solution is noted.
7) 1ml of NaOH is added from the burette and conductance is measured after each addition.
8) Initially, the conductance decreases and at one point it starts increasing.
9) The point at which the conductance starts increasing shows the endpoint has been reached.
10) A plot of conductance against volume of sodium hydroxide gives the endpoint. The intersection of the two straight lines and the volume corresponding to the intersection point to the axis is noted.
11) In order to get, the accurate endpoint, the fair titration is performed in the same manner, by

adding NaOH in increments of 0.2ml before and after the endpoint.

12) The strength of HCl can be calculated using the formula: $V_1N_1 = V_2N_2$.

RESULT ⟹

The strength of the given HCl solution = 0.1116 N.

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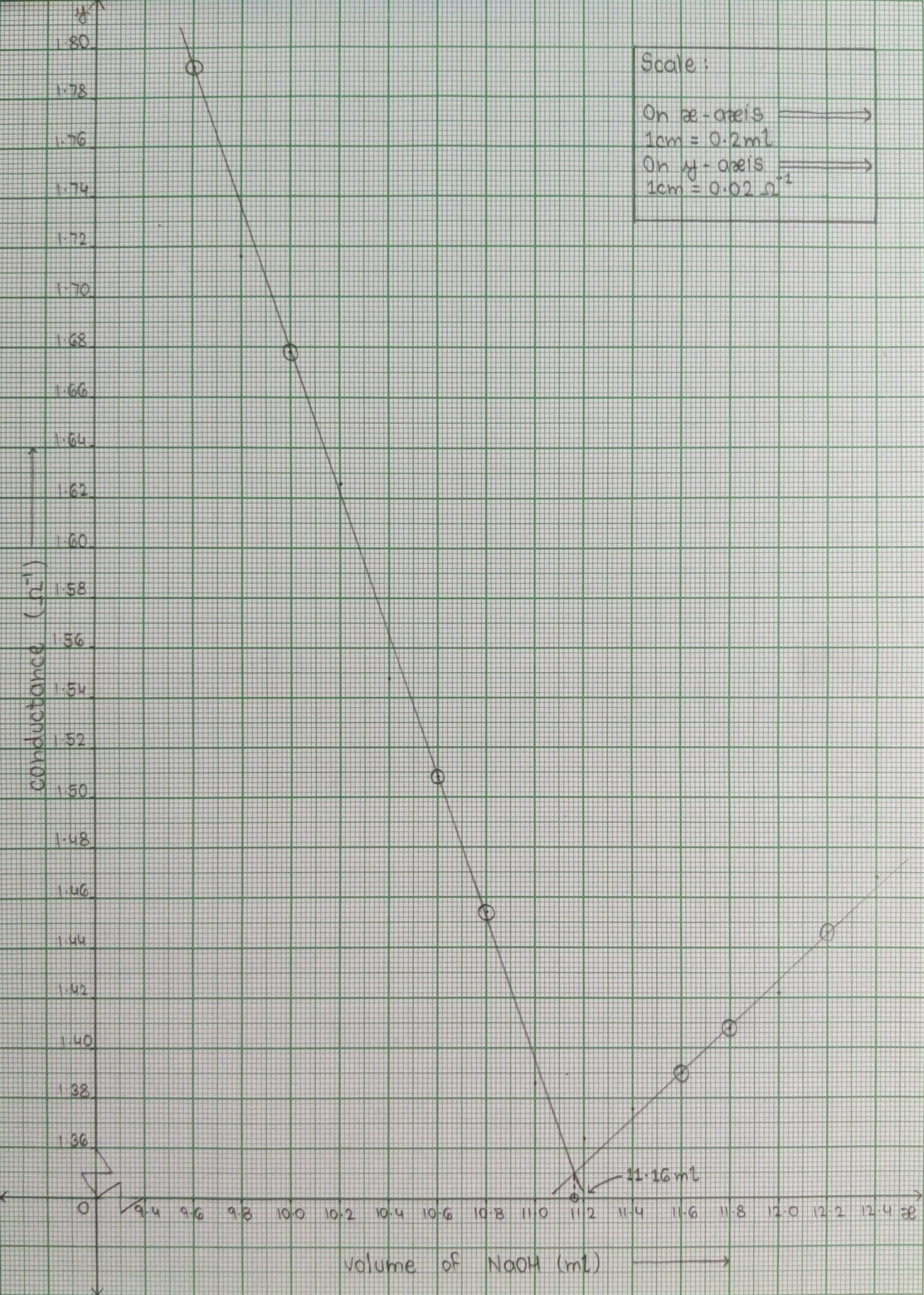
Scale:
On x-axis
1cm = 0.2ml
On y-axis
1cm = 0.02 Ω⁻¹
y
1·80
1·78
1·76
1·74
1·72
1·70
1·68
1·66
1·64
1·62
1·60
1·58
1·56
1·54
1·52
1·50
1·48
1·46
1·44
1·42
1·40
1·38
1·36
Conductance (Ω⁻¹)
0
9·4
9·6
9·8
10·0
10·2
10·4
10·6
10·8
11·0
11·2
11·4
11·6
11·8
12·0
12·2
12·4
x
11·16 ml
volume of NaOH (ml)