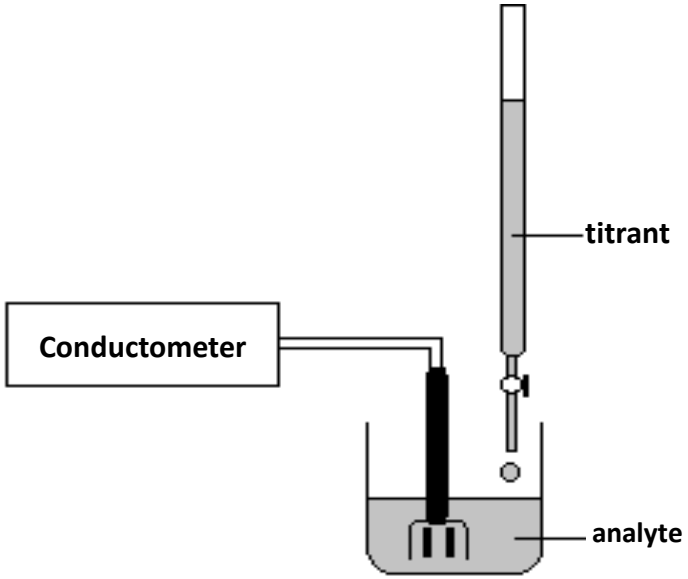
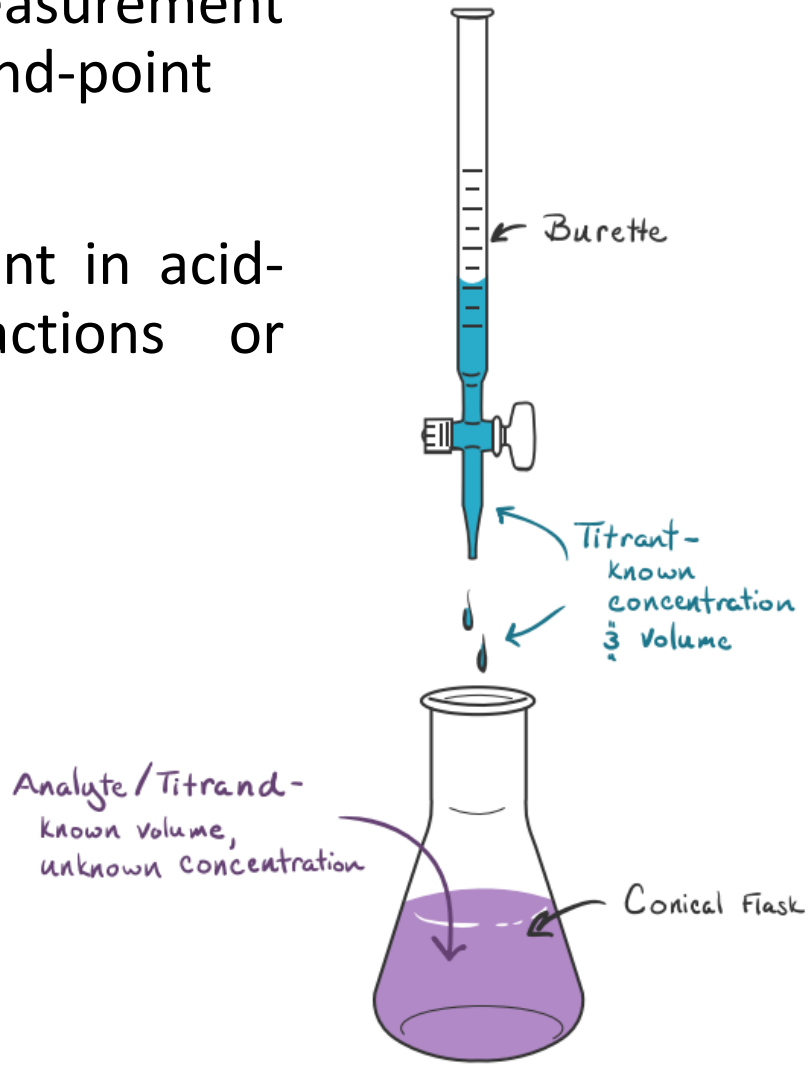
Conductometric titration to determine the strength of strong acid by strong base

Conductometric titration

- Titration in which conductance measurement are made use of in determining the end-point

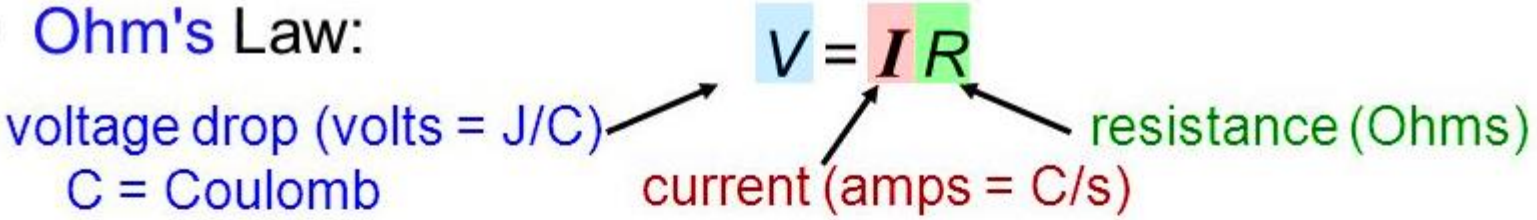
- Method used to determine end point in acid-base reactions, precipitation reactions or complexation reactions





Theory

- Ohm's Law:



- Resistivity, ρ:
  -- a material property that is independent of sample size and geometry

$$\rho = \frac{RA}{l}$$

surface area of current flow

current flow path length

- Conductivity, σ

$$\sigma = \frac{1}{\rho}$$

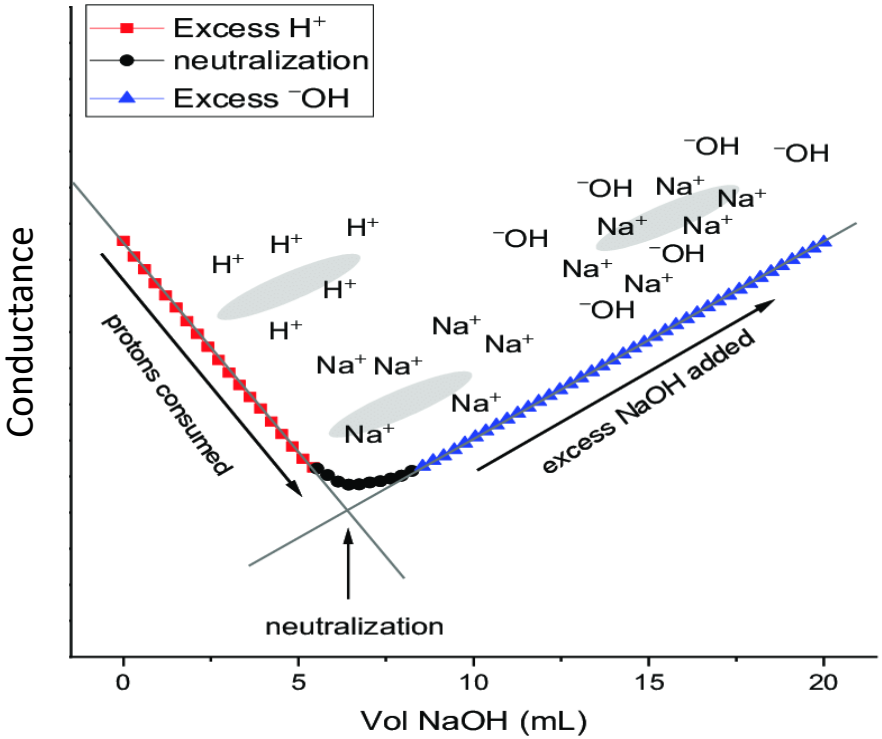
Depends on no. of free ions, charge & size of the ions, mobility of the ions

Titration curve of a strong acid (HCl) with a strong base (NaOH)

- Before NaOH is added, the conductance is high due to the presence of highly mobile H^+
- When the NaOH is added, the conductance falls due to the replacement of H^+ by the added Na^+ as H^+ ions react with OH^- ions to form un-dissociated water

$$H^+ + Cl^- + Na^+ + OH^- \quad = \quad Na^+ + Cl^- + H_2O$$

- This decrease in the conductance continues till the equivalence point
- At the equivalence point, the solution contains only NaCl
- After the equivalence point, the conductance increases due to the large conductivity of OH^- ions
- You will get a titration curve - point of intersection of the two lines gives the point of neutralization i.e. equivalence point



AIM: Conductometric titration to determine the strength of strong acid (HCl) by strong base (NaOH)

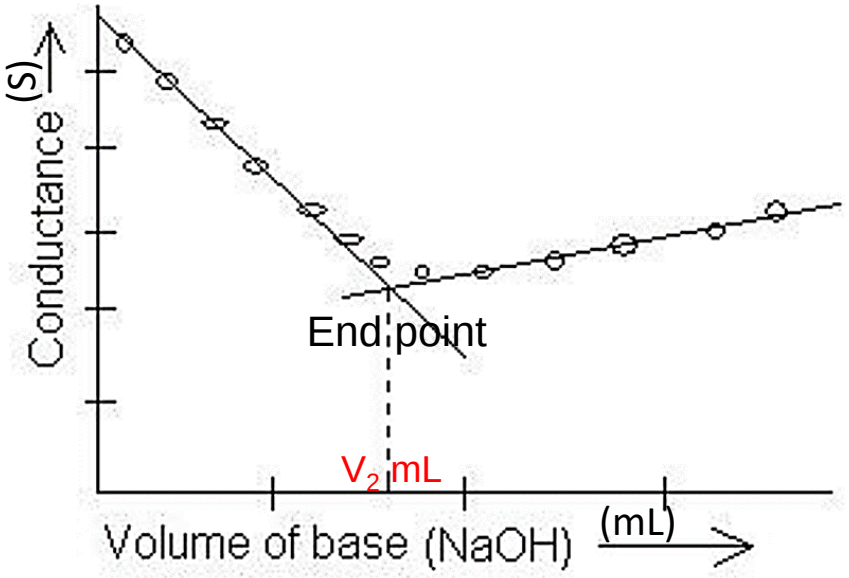
Procedure:

- Rinse the conductivity cell with double distilled water
- Pipette out 20 mL HCl (unknown conc.) in a beaker and dip the conductivity cell in it
- Add small amount of NaOH (0.1N) from burette, stir and measure the conductance
- Measure conductance after each addition
- Take at least five readings after the end point

Observation Table

Vol. of NaOH added (V_2, mL)	Conductance (S)

Plot Graph



Let, V_2 be the volume of 0.1N (N_2) NaOH required to complete the neutralization (end point volume from the graph) 20 mL (V_1) of xN (N_1) HCl

Calculations:

$N_1V_1 = N_2V_2$, $N_1 = N_2V_2/V_1$

Strength(g/L) = Normality × Eq.wt.

$= N_1 \times 36.5$

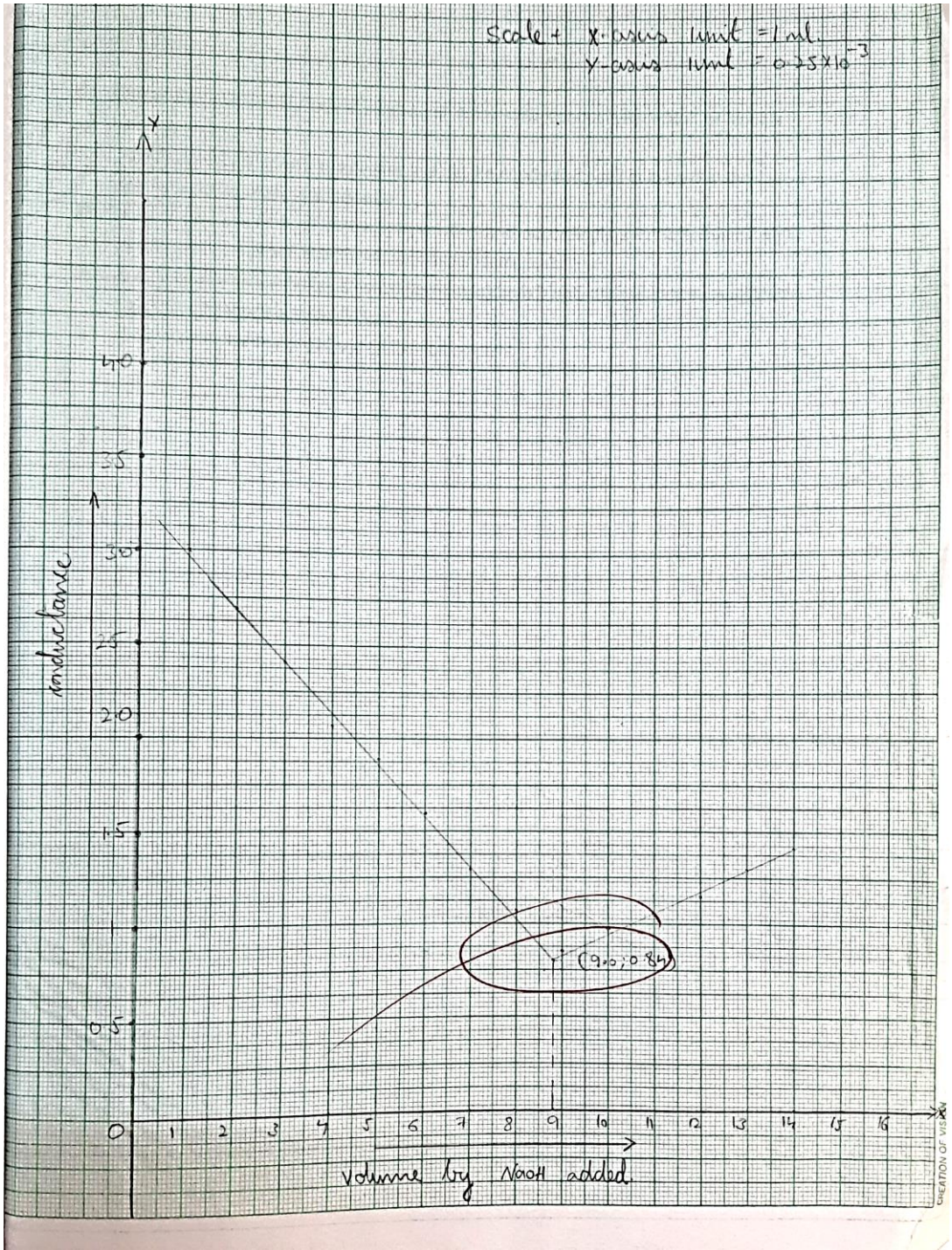
For example:

OBSERVATION TABLE:

No.	Volume of NaOH added (V_2) (ml)	Conductance (S)
1	0	3.34×10^{-3}
2	1	3.15×10^{-3}
3	2	2.69×10^{-3}
4	3	2.43×10^{-3}
5	4	2.07×10^{-3}
6	5	1.87×10^{-3}
7	6	1.57×10^{-3}
8	7	1.29×10^{-3}
9	8	1.08×10^{-3}
10	9	0.84×10^{-3}
11	10	0.91×10^{-3}
12	11	1.05×10^{-3}
13	12	1.15×10^{-3}
14	13	1.28×10^{-3}
15	14	1.37×10^{-3}

PLOT GRAPHS:-

(i) Conductance → Volume of NaOH added (mL)



Results:

Normality of HCl = _____ N

Strength of HCl = _____ g/L