

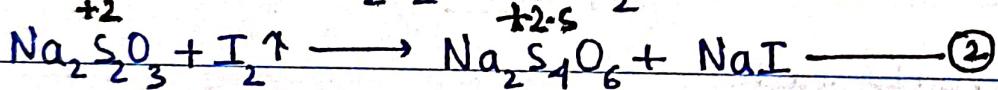
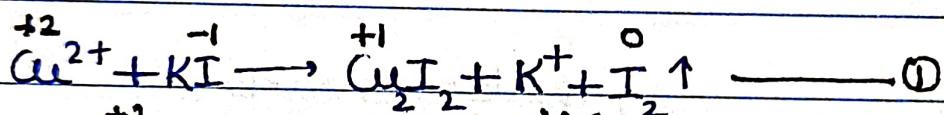
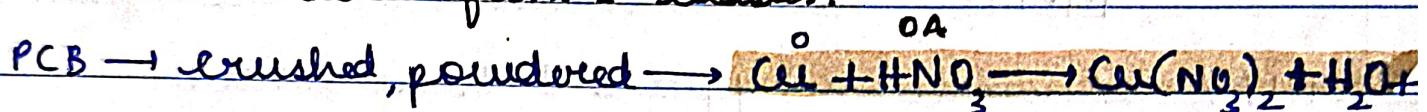
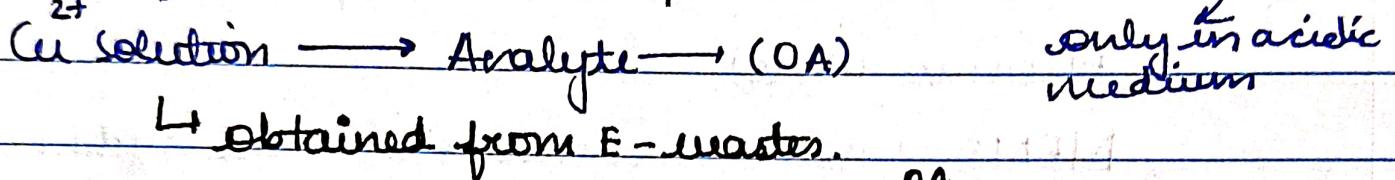
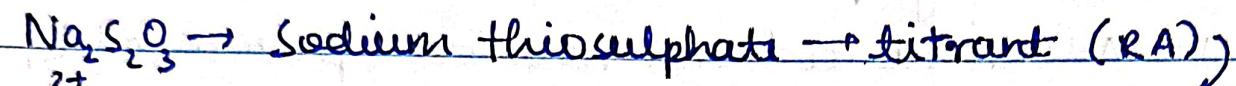
ESTIMATION OF Cu FROM E-WASTE:

Cu → major contributor

Use titration to recover Cu from E-waste.

Redox titration:
 ↗ Iodometry
 ↗ Sodiummetry

IODOMETRY:

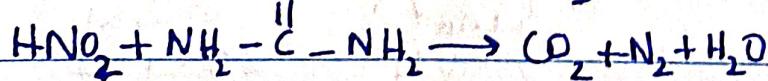
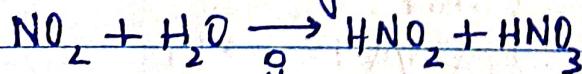


2-12

* Amount of iodine liberated in step ① will be equivalent to the copper present in the solution.

* Before adding KI, we have to remove excess NO_2 and HNO_3 and only Cu^{2+} should remain.

PART A: Preparing std solⁿ of $\text{Na}_2\text{S}_2\text{O}_3$



PART B:

① 1 spatula of urea + boil + cool + 1 vol $\xrightarrow{(+H)}$ H_2O

↳ getting rid of HNO_3

↳ increase the volume

② Add NH_4OH (1-2 drops) → getting rid of HNO_3

reaction: $Cu(NO_3)_2 + NH_4OH \rightarrow Cu(OH)_2 + NH_4NO_3$
 gelatinous blue ppt. ↳ has basic pH

more drops of NH_4OH will form a complex

which is very stable and has no OA properties.

③ Add CH_3COOH ($1/4$ th) → require an acidic medium

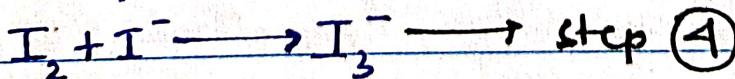
reaction: $Cu(OH)_2 + CH_3COOH \rightarrow Cu(CH_3COO)_2 + H_2O$

④ Add 1 testtube of KI . → solution turns brown
 immediately start the reaction.

Stop the titration when the solution is badam yellow. → amt of iodine is very less.

(2 droppers)

⑤ Add starch (polymer → glycosidic linkage)
 adsorption indicator → intense blue



↳ forms strong complex with

starch so I_2 is not available

for the titration that why

starch is added later on

⑥ continue the titration till you get white colour
↳ end/equivalence point

CALCULATION:

Normality of $\text{Na}_2\text{S}_2\text{O}_3 = Y_N$

IN 100 cm^3 of $\text{Na}_2\text{S}_2\text{O}_3 \equiv 63.54 \text{ g of Cu}$

$Y_N \text{ "x"} \text{ cm}^3 \text{ of } \text{Na}_2\text{S}_2\text{O}_3 \equiv 63.54 * X * Y \text{ g of Cu} = A$

1000

present in 25 mL of Cu soln

$250 \text{ cm}^3 \equiv 10 * A \text{ g of Cu}$

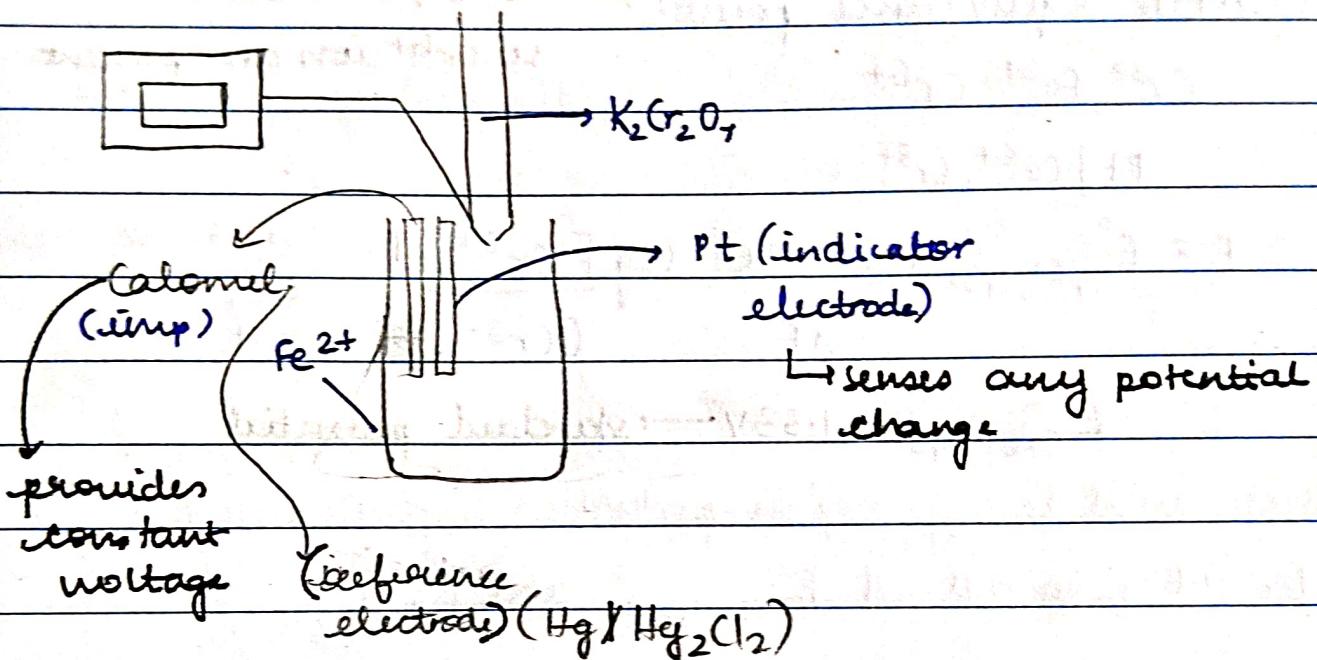
no indicator reqd.

ESTIMATION OF IRON USING POTENTIOMETRY

$$\text{Equation: } E = E_0 + \frac{2.303RT}{nf} \log \frac{[\text{oxidised}]}{[\text{reduced}]} \rightarrow \text{connect potential and conc'}$$

Analyte $\rightarrow \text{Fe}^{2+}/\text{FAS}$

Titrant $\rightarrow \text{K}_2\text{Cr}_2\text{O}_7$

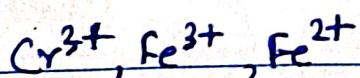
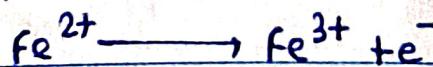
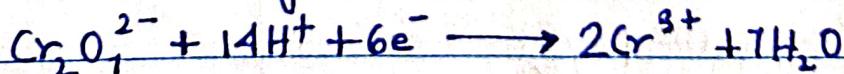


- $\text{K}_2\text{Cr}_2\text{O}_7$ acts as an OA only in acidic medium so we add one test tube of H_2SO_4 (dilute)

CASE ①: Before adding $\text{K}_2\text{Cr}_2\text{O}_7$



CASE ②: After adding $\text{K}_2\text{Cr}_2\text{O}_7$ Before equivalence point

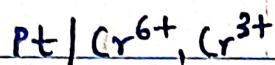
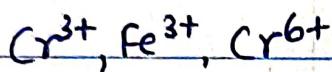


Pt | Fe²⁺, Fe³⁺ → redox couple

$$E = E_{Fe^{2+}, Fe^{3+}}^{\circ} + \frac{2.303RT}{nF} \log \frac{[Fe^{3+}]}{[Fe^{2+}]} \xrightarrow{n=1} \text{imp.}$$

$$E_{Fe^{2+}, Fe^{3+}}^{\circ} = 0.75V \rightarrow \text{standard potential}$$

(3) After equivalence point: $K_2Cr_2O_7$ is in excess
so Cr⁶⁺ ion are present

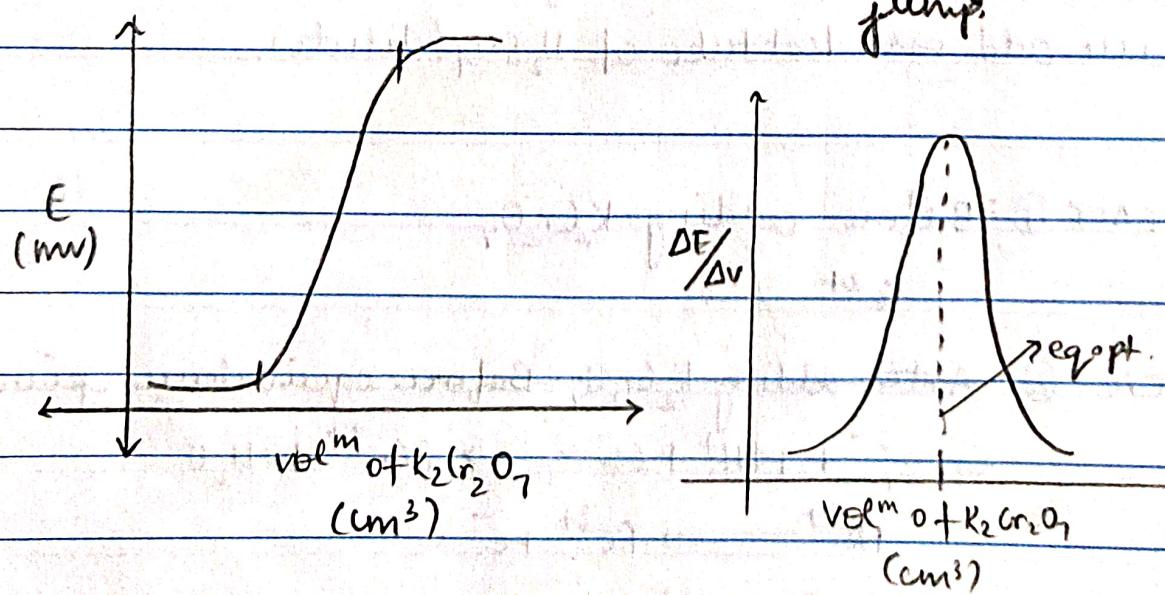


$$E = E_{Cr^{6+}, Cr^{3+}}^{\circ} + \frac{2.303RT}{nF} \log \frac{[Cr^{6+}]}{[Cr^{3+}]} \uparrow ; n=6 \text{ because } \text{at } 2 \text{ Cr}$$

$$E_{Cr^{6+}/Cr^{3+}}^{\circ} = 1.33V \rightarrow \text{standard potential}$$

There will be a jump in potential because of the diff. in the std. potential of $E_{Fe^{2+}/Fe^{3+}}^{\circ}$ and $E_{Cr^{6+}/Cr^{3+}}^{\circ}$.

\circ : negligible change after jump.



normally 0.05N

$$\frac{(N \cdot V)_{K_2Cr_2O_7}}{25ML} = (N \cdot V)_{Fe^{2+}}$$

titre value from
the graph

$$\text{amt of } Fe^{2+} \text{ sol}^n = N * \text{eq-ml}$$

sample table

vol ^{mL} of $K_2Cr_2O_7$ (V)	Potential (mV) (E)	ΔE	ΔV	$\Delta E / \Delta V$
0.0	220		0.02	
0.2	230			
② 0.1	235			
0.6	250			
1.2	350			
1.4	700			
big jump ③	1.6	701		
	1.8	705		
2.0	708			

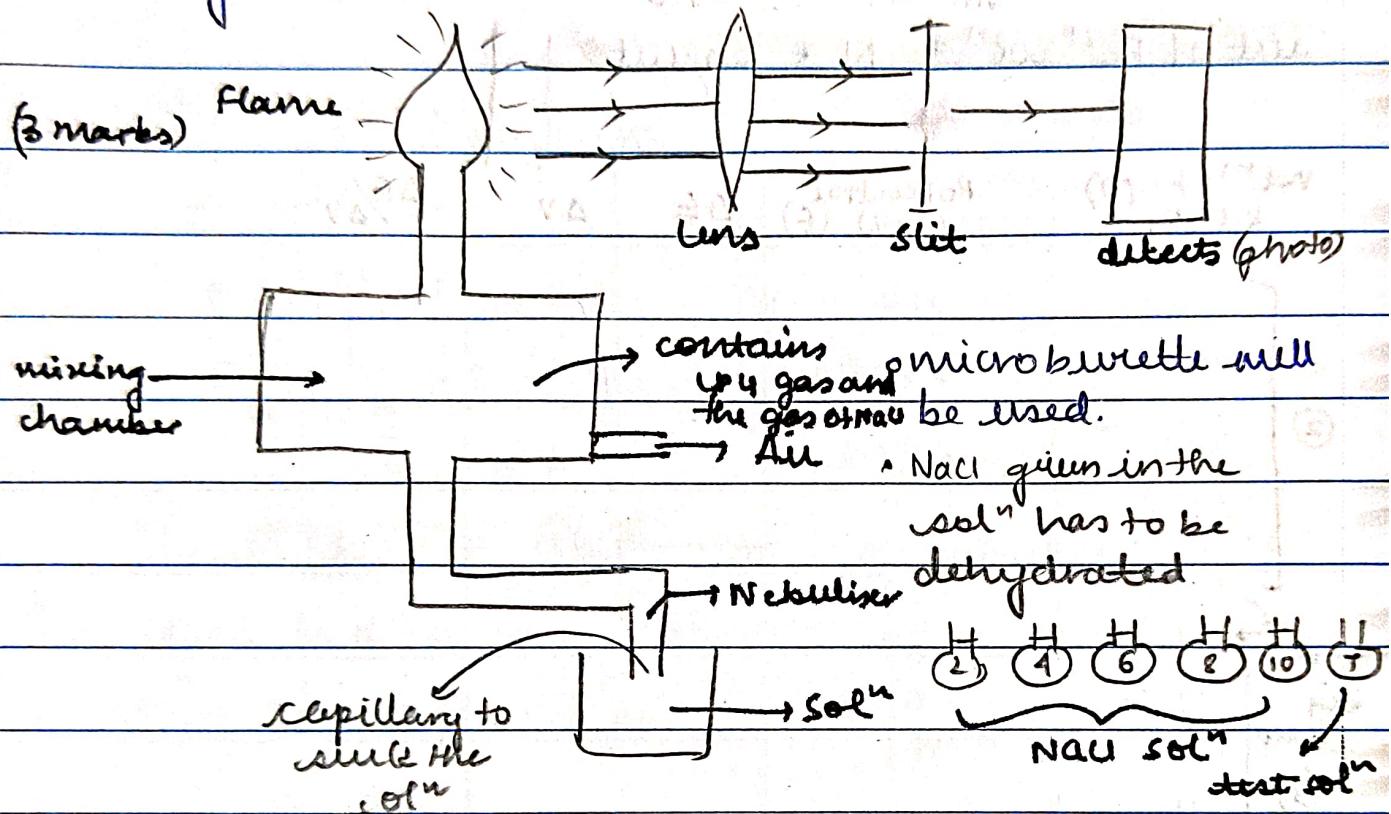
kinder orange in LAB

ESTIMATION OF Na USING FLAME PHOTOMETRY

Basis → atomic spectroscopy → excitation of e^- of Na

Na → 589 nm.

intensity → concentration → find out the wt% of Na



① Dissolution:

② Vaporisation:

③ Atomisation.

④ Excitation

⑤ Emission

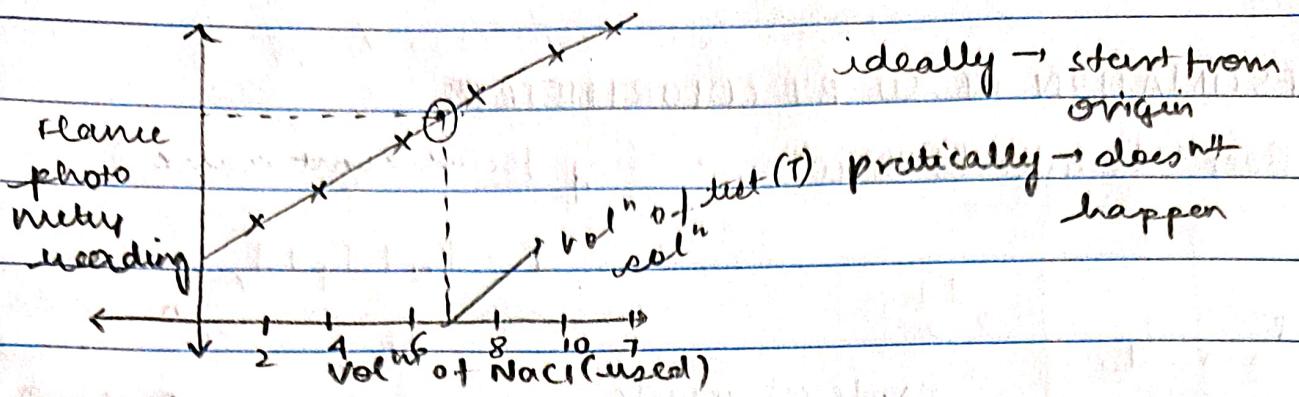
vol m of NaCl cm^3	flame photome	wt% of Na
2	2.1	2%
4	3.2	4%
6	1.5	6%
7	7.0	7%
10	8.0	10%
7	6.0	

Curve calibration method:

Used when vol wt% NaCl

and flame photometry

readings are given.



CALCULATION:

2.5g of NaCl in 100mL

58.5g of NaCl contains 23g of Na

100cm³ of NaCl contains $\frac{23 \times 2.5}{58.5}$

$$= 58.5$$

$$1\text{cm}^3 \text{ of NaCl contains} = \frac{23 \times 2.5}{58.5 \times 100} = 4\text{g}$$

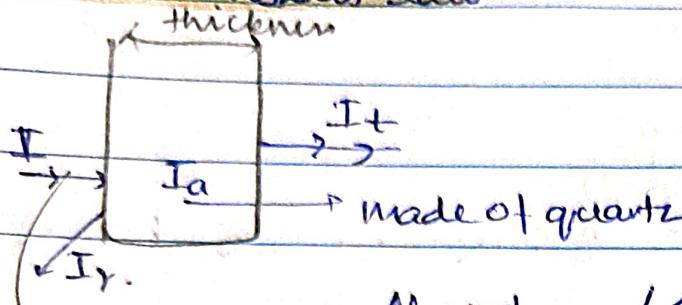
$$2\text{cm}^3 \text{ of NaCl contains} = \frac{23 \times 2.5 \times 2}{58.5 \times 100} = 21\text{g}$$

length (l) → kept constant

concentration (c) → varying

ESTIMATION OF Cu BY COLORIMETRY

Beer - Lambert's law → they found light absorbed



$$I = I_a + I_f \rightarrow T = \frac{I_f}{I}$$

conⁿ path length $\propto cL$

Absorbance $\leftarrow a \propto \log \frac{I_a}{I_f}$

monochromatic light

Optical density

$$a \propto \log \left(\frac{1}{T} \right) \rightarrow a \propto -\log(T)$$

$$a \propto \log \left(\frac{1}{T} \right)$$

decreasing

$$\frac{-dI}{dc} \propto L$$

Beer's law:

$$a \propto a \propto c$$

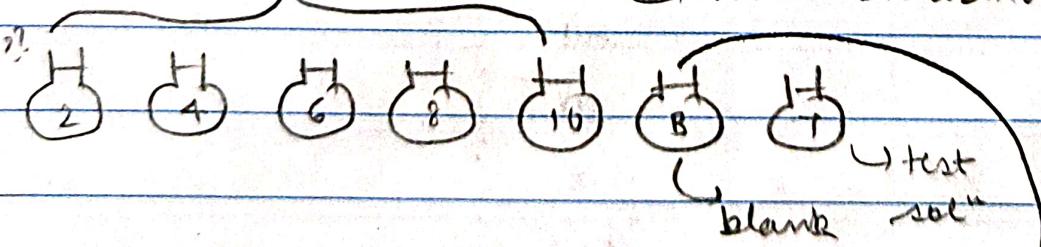
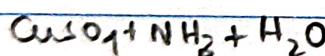
Lambert's law:

$$a \propto L$$

Beer-Lambert's law: $a \propto CL \rightarrow 1/\text{molar}$

$$a \propto ECL$$

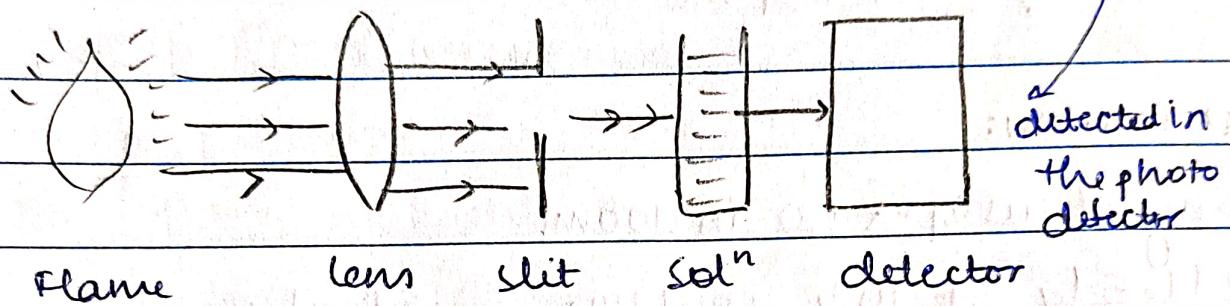
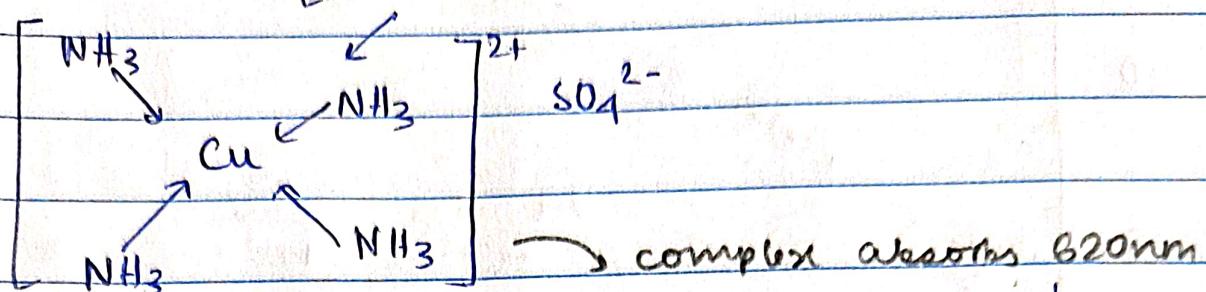
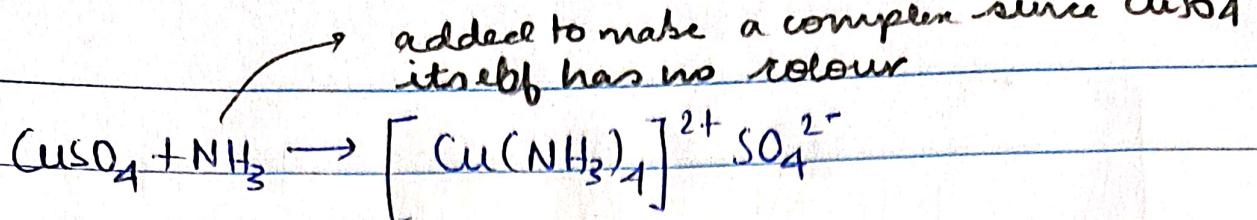
Molar extinction coefficient



→ add ammonia (NH_3)

4-2.5 mL

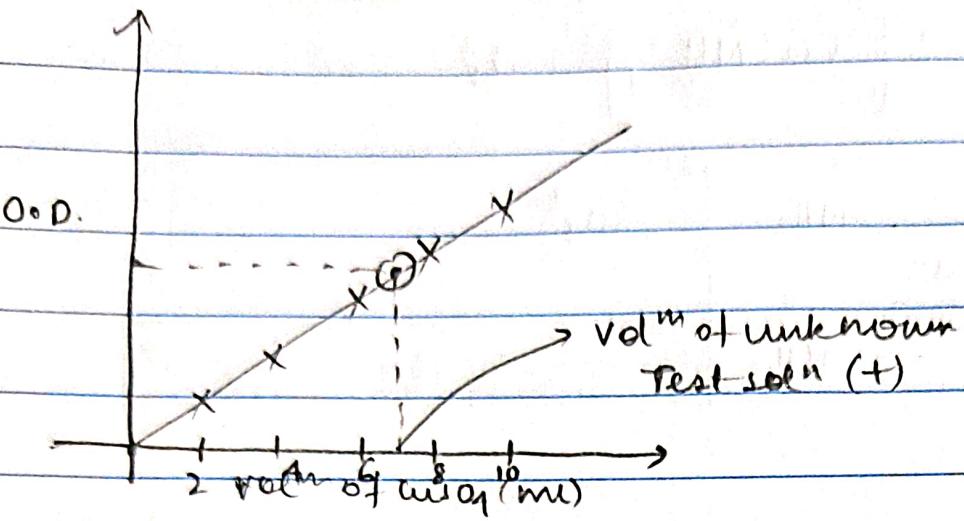
⊗ → don't take CuSO_4 soln



Blank soln is taken $\rightarrow \text{NH}_3 + \text{H}_2\text{O}$ → absorbant value = 0.

there might be extra absorbant that will cause Cu to lose its property \rightarrow to nullify their effects we have blank soln.

Vol ^m of CuSO ₄ soln	Optical density	wt of Cu
Blank	0.0	
2	0.01	2A
4	0.07	4A
6	0.09	6A
8	0.10	8A
10	0.20	10A
T	0.095	



CALCULATION:

55 mg of $\text{CuSO}_4 \cdot \text{H}_2\text{O}$ in 100 ml

249.51 g of CuSO_4 contains 63.51 g of Cu

$$\therefore 100 \text{ cm}^3 \text{ of } \text{CuSO}_4 \rightarrow \frac{63.51 \times 55 \times 10^{-3}}{249.51} \text{ of Cu}$$

$$\therefore 1 \text{ cm}^3 \text{ of } \text{CuSO}_4 \rightarrow \frac{63.51 \times 55 \times 10^{-3}}{249.51 \times 100} \text{ of Cu} = \text{Ag}$$

pKa determination of weak acid:

$$pK_a = -\log(K_a)$$

$K_a \rightarrow 1.8 \times 10^{-5} \rightarrow$ very small value

$pK_a = 5 \rightarrow$ convenient to use instead of K_a

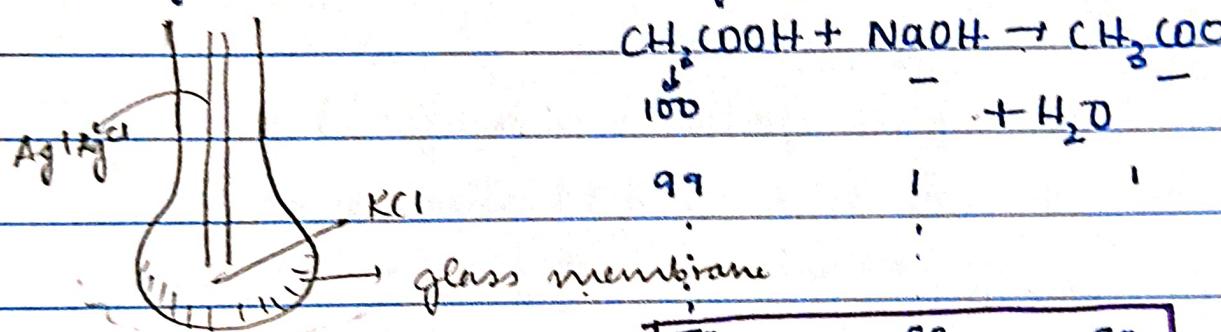
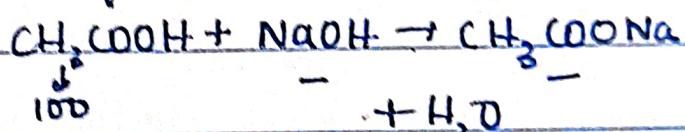
$$pH = pK_a + \log_{10} \frac{[\text{salt}]}{[\text{acid}]}$$

$$[\text{salt}] = [\text{acid}] \rightarrow pH = pK_a$$

$\text{NaOH} \rightarrow$ burette

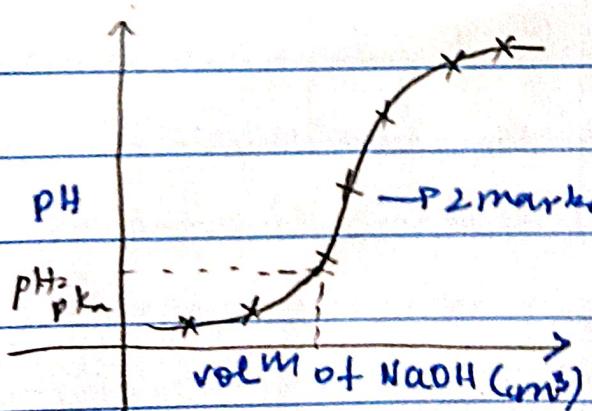
$\text{CH}_3\text{COOH} \rightarrow$ volumetric flask

$\text{Pt}, \text{Ag} | \text{AgCl} \rightarrow$ electrode *tip is covered with glass membrane*

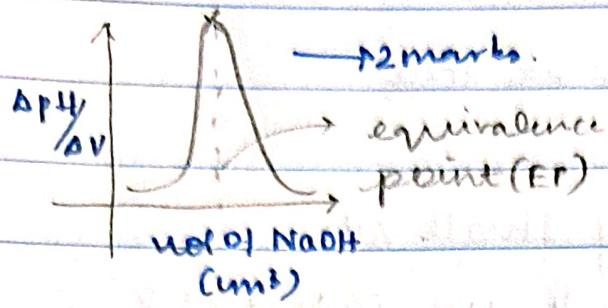


equivalence point

half equivalence point



Volume of NaOH	pH	$\Delta pH / \Delta V$
0	3.4	
0.2	4.0	
1.6		
1.8	7.1	
2.0	10.0	



$$(NV)_{\text{CH}_3\text{COOH}} = (NV)_{\text{NaOH}}$$

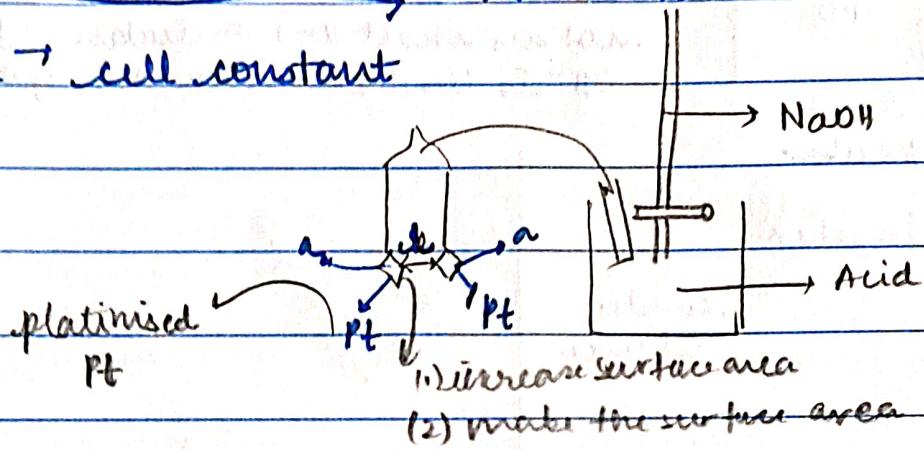
conductometric estimation of CA. using SB

$$R \propto l/a \Rightarrow R = \rho l \Rightarrow \frac{Ra}{l}$$

$$K = \frac{1}{\rho} = \frac{l}{Ra} \rightarrow \text{specific conductance / specific conductivity}$$

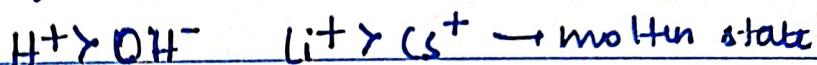
$\rightarrow \text{S m}^{-1} \rightarrow \text{unit}$

$l/a \rightarrow \text{cell constant}$



Principle: → (1) size and mobility.

size ↑ conductance ↓



$Li^+ + Cs^+ \rightarrow$ molten state
 $Li^+ + Cs^+ \rightarrow$ water state → solvation property

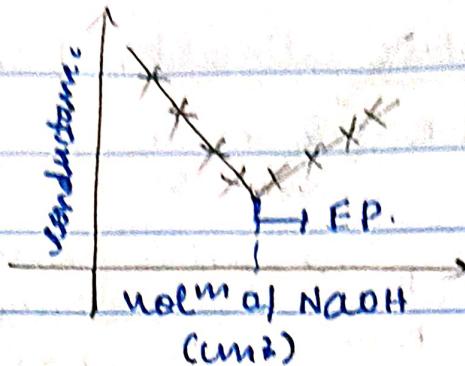
mobility ↑ conductance ↑

(2) concentration ↑ conductance ↑

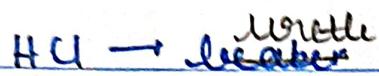
(3) Temperature ↑ conductance ↑

(4) viscosity ↑ conductance ↓

Vol of NaOH (cm³)	Conc C-taric(m)
0.0	11.0
0.2	
0.4	
1.6	3.0
1.8	1.0
2.0	1.0

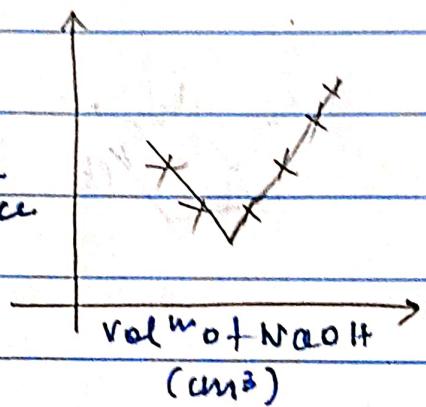


not an exact v → conductance of OH^- is less than conductance of H^+



conduc
ctance

$$(NV)_{\text{HCl}} = (NV)_{\text{NaOH}}$$



Mixture of acids: $\text{HCl}, \text{CH}_3\text{COOH}$

