



KSSEM
K.S. SCHOOL OF ENGINEERING AND MANAGEMENT

K.S. GROUP OF INSTITUTIONS

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT

#15, Mallasandra, Near Vajarahalli, Off. Kanakapura Road, Bengaluru - 560 109

PRACTICAL RECORD BOOK

NAME : K. G. Soumya
Class : IInd SEM / C.S.E (BCHE5202)
Lab : Chemistry For CSE Stream
USN :

1	K	G	2	3	C	S	0	4	8
---	---	---	---	---	---	---	---	---	---



K.S. GROUP OF INSTITUTIONS
K.S. SCHOOL OF ENGINEERING AND MANAGEMENT

#15, Mallasandra, Near Vajarahalli, Off. Kanakapura Road, Bengaluru - 560 109



KSSEM
K.S. SCHOOL OF ENGINEERING AND MANAGEMENT

Laboratory Certificate

This is to certify that

Mr. / Ms. K.G. Soumya.....
has satisfactorily completed the course of experiment in
.CHEMISTRY...FOR.C.S.E...STREAM..... Laboratory, Code BCHES202
Prescribed by Visvesvaraya Technological University, Belagavi
for theII..... Semester B.E. ...C.S.E..... branch in this
college during in the academic year 20.23... - 20.24....

Name of the Candidate : K.G. Soumya.....

USN : 1KG23C5048..... Lab (with code) BCHES202.....

Marks	
Maximum	Obtained
25	25

Date : 07.01-24

Signature of the
Teacher

[Signature]

Dr. C. VASUDEVA
Head of the Department
Professor & HOD
Department of Applied Science

K.S. School of Engineering & Management
Bangalore - 560 109



Particulars of the Experiments Performed

CONTENTS

Expt. No.	Date	Title of the Experiment	Page No.	Marks Awarded	Remarks
01.	13/03/2024	Estimation of total hardness of water by EDTA method	01-06	5+5+3	13 A
02.	20/03/2024	Potentiometric Estimation of FAS using Standard $K_2Cr_2O_7$ Solution	7-10	5+5+4	14 B
03.	27/03/2024	B1 - Conductometric estimation of an acid mixture	11-14	5+5+5	15 B
04.	27/03/2024	B3 - Determination of pKa of Vinegar using pH Sensor (Glass electrode)	15-20	5+5+5	15 B
05.	03/04/2024	c1 - Estimation of copper present in electroplating effluent of optical sensor (colorimetry)	21-26	5+5+4	14 B
06.	21/05/2024	c2 - Determination of Viscosity Coefficient of lubricant using ostwald's Viscometer.	27-32	5+5+5	15 B
07.		c4 - Estimation of Sodium present in soil/effluent sample			

Particulars of the Experiments Performed

CONTENTS

Expt. No.	Date	Title of the Experiment	Page No.	Marks Awarded	Remarks
07.	13/05/2024	C5 - Determination of chemical oxygen demand (COD) of industrial waste water sample	33-36	5+5+4 = 14	Pl
08.	15/05/2024	A2 8 - Electrolysis of Water	37-40	15	15 Pl
09.	15/05/2024	Synthesis of iron-oxide nanoparticles	41-44	15	15 Pl
10.	23/05/2024	Estimation of percentage of iron in TMT Bar by external indicator method	45-50	5+5+5 = 15	15 Pl
11.	05/06/2024	D1 8 - Evaluation of acid content in beverages by using pH Sensor and simulation	51-54	15	15 Pl
12.	05/06/2024	D3 :- Design an experiment to identify the presence of proteins in given sample	55-56	15	15 Pl
				15	
				10	
				10	
				25	
				25	

OBSERVATION AND CALCULATION

PART A :- Preparation of EDTA Solution

Weight of the Weighing bottle + EDTA = 7.18 g

Weight of the Weighing bottle = 5.37 g

Weight of the EDTA Salt transferred = 1.81 g

$$\begin{aligned}\text{Molarity of EDTA Solution} &= \frac{\text{Weight of EDTA} \times 4}{\text{Gram molecular Wt. of EDTA}} = \frac{1.81 \times 4}{372.24} \\ &= \underline{0.0194 \text{ M (a)}}\end{aligned}$$

PART B :- Estimation of hardness.

Burette : EDTA Solution

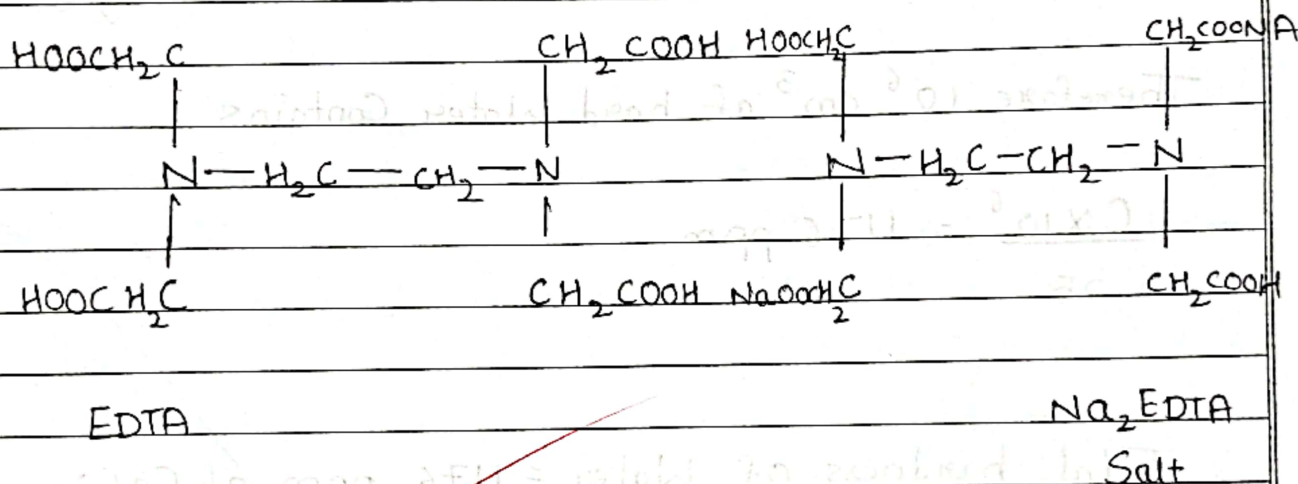
Conical flask : 25 cm³ of hard Water + NH₃-NH₄Cl buffer

Indicator : 2-3 drops of Eriochrome black-T

End point : Wine red to pure blue

Burette reading	Trial I	Trial II	Trial III
Final	16.3	15.2	15.2
Initial	0	0	0
Volume of EDTA run down	16.3	15.2	15.2

Theory - Hardness of Water is mainly due to the presence of Calcium and magnesium salts in it. Total hardness is the sum of temporary hardness (due to bicarbonates of Calcium and magnesium) and permanent hardness (due to chlorides, sulphates etc., of Calcium and Magnesium). Ethylene diamine tetra ~~acetic~~ acetic acid (EDTA) is a reagent, which reacts with metal ions like Ca^{2+} and Mg^{2+} forming complex compounds. Therefore this reagent can be used to determine the concentration of hardness causing substances.



The Completion of the reaction (end point of the titration) is identified using Eriochrome black - T indicator. This is an organic dye, blue in colour. It also forms relatively less stable complexes with bivalent metal ion of Ca & Mg etc., which are wine red in colour. Therefore, addition of the indicator to hard water produces wine-red colour. When EDTA is added to hard water,

Volume of EDTA used : $15.2 \text{ cm}^3 (b)$

1000 cm^3 of 1M EDTA = 100 g of CaCO_3

Therefore $b \text{ cm}^3$ of a molar EDTA = $\frac{b \times a \times 100}{1000}$

$$\frac{15.2 \times 0.0194 \times 100}{1000} = 0.02948$$

$$= 0.02948 (c) \text{ g of } \text{CaCO}_3$$

25 cm^3 of hard Water Contains = $0.02948 (c) \text{ g}$ of CaCO_3

Therefore 10^6 cm^3 of hard Water Contains

$$\frac{C \times 10^6}{25} = 1176 \text{ ppm}$$

Total hardness of Water = 1176 ppm of CaCO_3

It first reacts with free metal ions and then attacks the metal-indicator complex. The latter reaction can be represented as M^{2+} indicator complex + EDTA $\rightarrow$ M^{2+} EDTA complex (COLOURLESS) + free Indicator (Blue) so at the end point a change from wine red to blue colour is observed. Since the reaction involves the liberation of H^+ ions and the indicator is sensitive to the concentration of H^+ ions (pH) of the solution a constant pH of around 10 has to be maintained. For this purpose ammonia-ammonium chloride buffer is used.

PROCEDURE -

Part-A: Preparation of Standard EDTA solution

Weigh the weighing bottle containing disodium salt of EDTA accurately and transfer the salt into the funnel placed on a 250 cm³ Volumetric flask. Weigh the bottle again. The difference between the two weights will give the amount of EDTA transferred. Pour small quantities of water over the salt on the funnel and transfer the salt into the flask. Wash the funnel with the same water 3-4 times; Dissolve the salt by adding 5 ml 1:1 Ammonia and make up the solution to the mark and shake well for uniform concentration.

Part B: Estimation of hardness of water

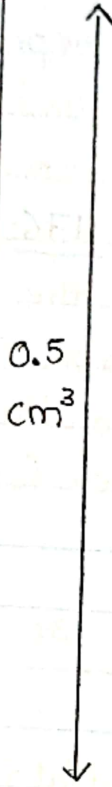
Pipette out 25 cm³ of the given sample of hard water

in to a Clean Conical flask. Add 5ml of $\text{NH}_3\text{-NH}_4\text{Cl}$ buffer followed by 3-4 drops of Eriochrome black T indicator. Titrate this against EDTA taken in a burette till the Colour changes from Wine red to pure blue. Note down the burette reading and repeat the titration to get Concordant Values.

REPORT: Total hardness of Water = 1176 ppm of CaCO_3

5

27/3

Volume of $K_2Cr_2O_7$ in cm^3	ΔV	E in mV	ΔE	$\Delta E/\Delta V$
0.0		244	—	—
0.5		258	14	28
1.0		266	8	16
1.5		284	18	36
2.0		296	12	24
2.5		315	19	38
3.0		359	44	88
3.5		728	369	738
4.0		753	25	50
4.5		761	8	16
5.0		769	8	16
5.5		781	12	24
6.0		784	3	6

Calculations:

$V_1 \cdot N_1 = V_2 \cdot N_2$ Where V_1 = Volume of $K_2Cr_2O_7$ at the equivalence point (from the graph)

N_1 = Normality of $K_2Cr_2O_7$ Sol = 0.5 N (Given)

V_2 = Volume of FAS Solution = 25 cm^3

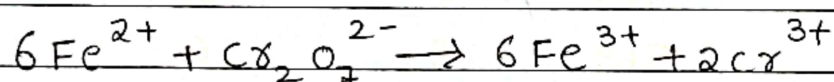
N_2 = Normality of FAS Solution = 0.0700 N

$$\therefore N_2 = \frac{V_1 \times N_1}{V_2} = \frac{3.5 \times 0.5}{25} = 0.0700 N$$

Principle: Redox titrations can be carried out potentiometrically using platinum-Calomel electrode combination. For the reaction: Reduced form $\rightarrow$ oxidized form $+ ne^-$,

$$E = E^\circ + \frac{0.0591}{n} \log \frac{[\text{Oxidized form}]}{[\text{Reduced form}]}$$

The potential, E , is given by Nernst equation, Where, E° is the Standard potential of the System, and $[X]$ represent the molar Concentration X . Suppose that, in beaker we have acidified Fe^{2+} Solution, and we add slowly $K_2Cr_2O_7$ from a burette, then following reaction takes place.



Before the equivalence point, the potential is determined by the Fe^{2+}/Fe^{3+} system.

$$E = E^\circ + \frac{0.0591}{n} \log \frac{[Fe^{3+}]}{[Fe^{2+}]} = 0.7V + 0.0591 \log \frac{[Fe^{3+}]}{[Fe^{2+}]}$$

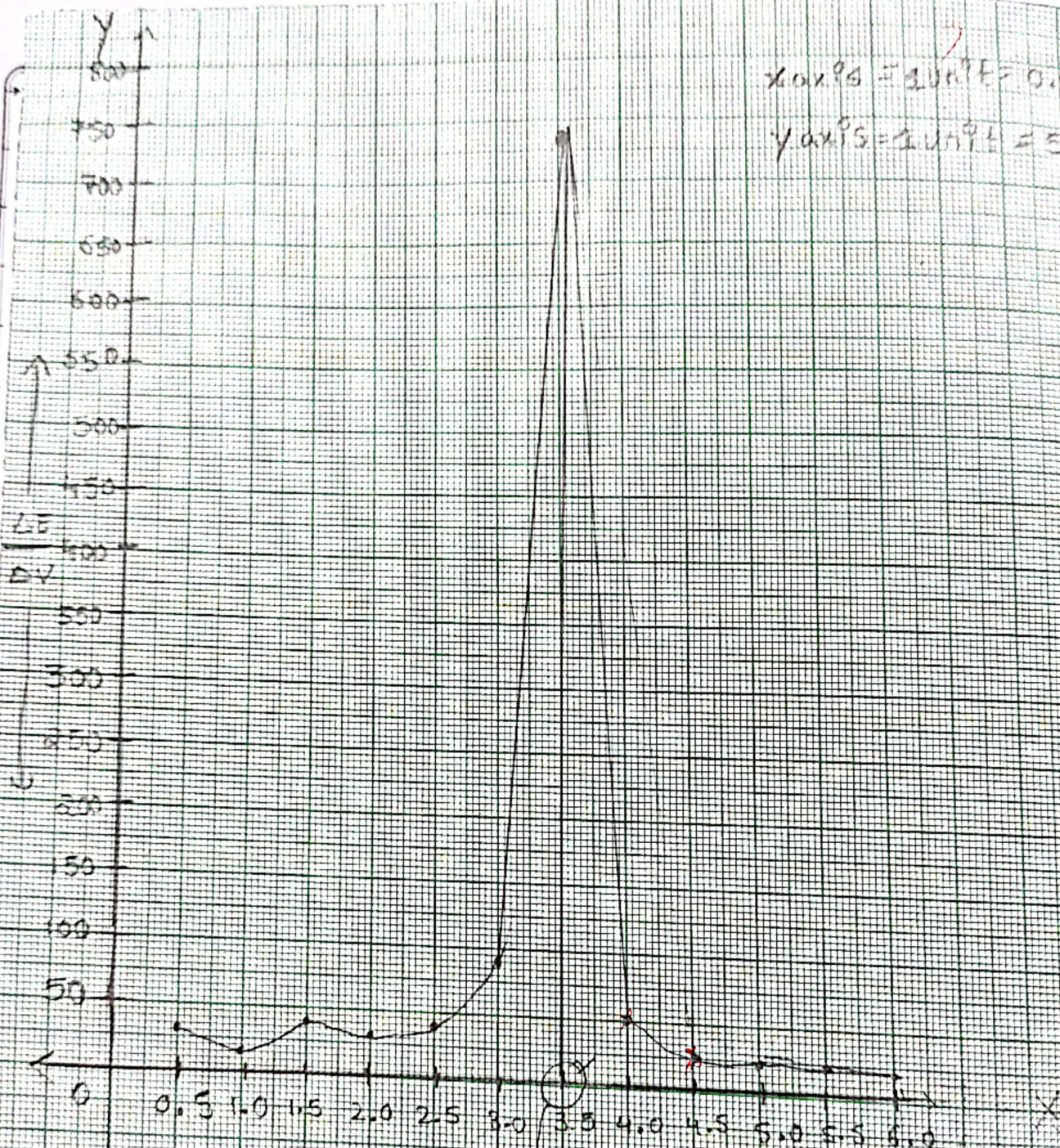
The potential of the solution will be around 0.75 V (since the contribution from the second term is negligible).

After the equivalence point, the potential is determined by the $Cr_2O_7^{2-}/Cr^{3+}$ system.

$$E = E^\circ + \frac{0.0591}{6} \log \frac{[Cr_2O_7^{2-}]}{[Cr^{3+}]^2} = 1.33V + 0.00985 \log \frac{[Cr_2O_7^{2-}]}{[Cr^{3+}]^2}$$

X-axis = 1 unit = 0.5 cm

Y-axis = 1 unit = 50 cm



Volume of $K_2Cr_2O_7$ in cm³
Equivalent point

3.5

$E = E^{\circ} + 0.059 \log \frac{[Cr^{VI}]}{[Cr^{III}]}$
 $E = E^{\circ} + 0.059 \log \frac{[Cr^{VI}]}{[Cr^{III}]}$

The potential of the Solution will be around 1.3 V
At the equivalence point, the potential is average potential of both systems.
Thus, there is an abrupt increase in potential of the Solution near the end point.

PROCEDURE -

Add 25 cm^3 of ferrous ammonium Sulfate (FAS) Solution into a 100 ml beaker. Add 25 cm^3 of dilute Sulphuric acid. Immerse the platinum - Calomel electrodes assembly in the Solution. Measure the potential by adding $\text{K}_2\text{Cr}_2\text{O}_7$ Solution from the burette in increments of 0.5 cm^3 . Stir the Solution gently and note down the emf. Measure the potential of each addition.

plot a graph of $\Delta E / \Delta V$ against Volume of $\text{K}_2\text{Cr}_2\text{O}_7$ as shown in the figure. Find the equivalence point from the graph. knowing the equivalence point, Calculate the normality of the FAS Solution and determine the amount of FAS per liter of the Solution.

Report : Mass of FAS present in one dm^3 of Solution =
27.44 g.

5

27/3

P

Volume of NaOH (cm ³)	Conductance (mS)	Volume of NaOH (cm ³)	Conductance (mS)
0.0	29	2.0	13
0.5	23	3.05	15
1.0	15	4.0	20
1.5	9	4.05	24
2.0	11	4.50	28
2.05	12	5.05	29

Normality of NaOH = 1 N (Given)

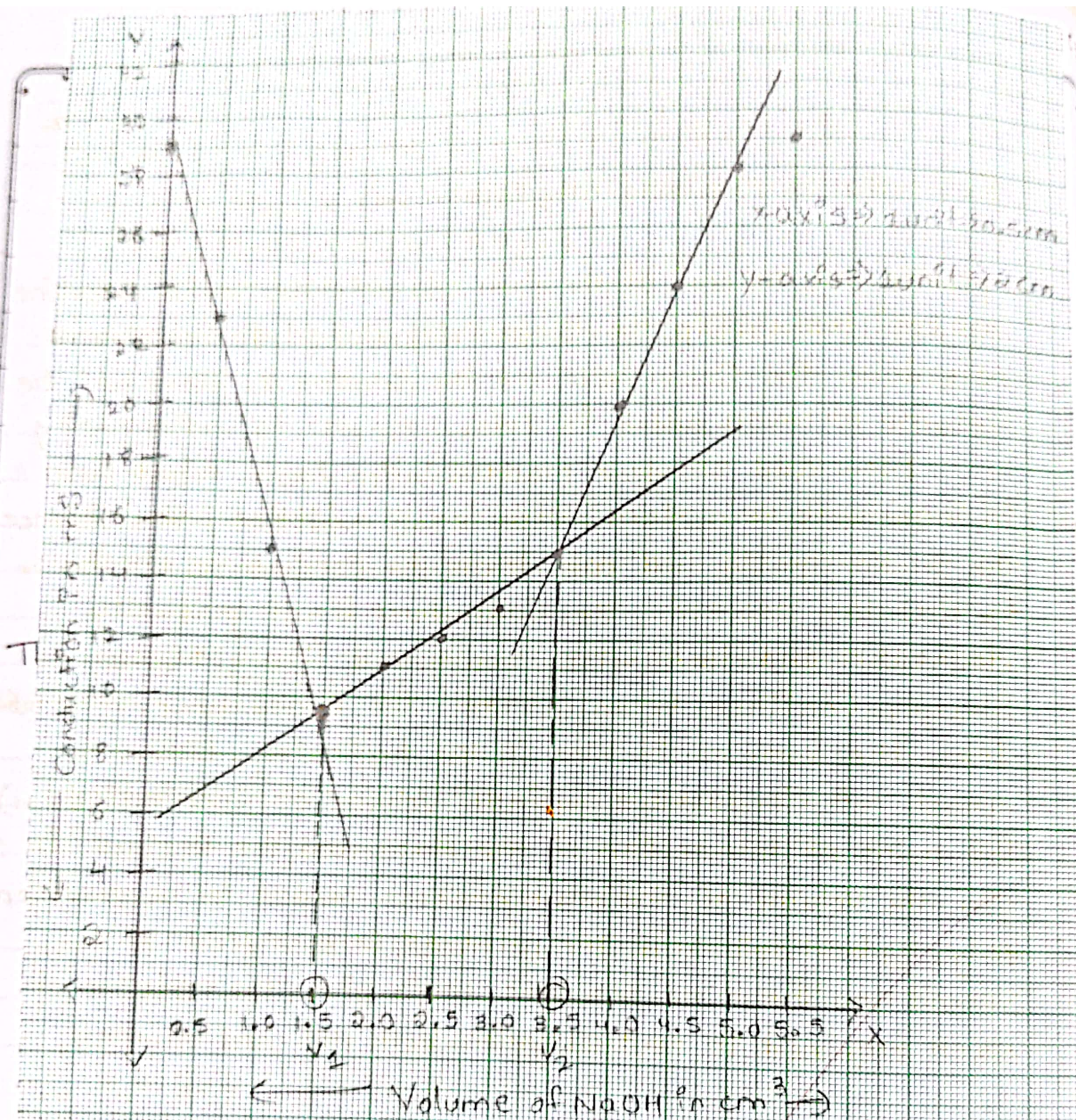
Estimation of HCl

Volume of NaOH at first equivalence point 1.5 cm³ (HCl)
 Volume of acid mixture = 50 cm³

$$\frac{N_{\text{NaOH}} \times V_{\text{NaOH}}}{V_{\text{HCl}}} = \frac{1 \times 1.5}{50} = 0.03 \text{ N}$$

principle -

Measurement of Conductance can be employed to determine the end point in acid base titrations. In Conductometric titrations, there is a sudden change in Conductance of the solution at the equivalence point. The principle underlying Conductometric titrations is the Substitution of ions of one mobility by ions of mobility. Therefore the Conductance of a solution depends on the number and mobility of ions. The equivalent point is determined graphically by plotting Conductance (ordinate) against titre values (abscissa). Conductometric titration may be applied for the determination of acids present in a mixture. In the titration of a mixture of a strong acid (HCl) and a weak acid (CH_3COOH) with strong base (NaOH), the Conductance decreases upon adding NaOH to acid mixture owing to the substitution of highly mobile H^+ ion (mobility: $350 \text{ ohm}^{-1}\text{m}^{-1}$) by the less mobile Na^+ ion (mobility: $50 \text{ ohm}^{-1}\text{m}^{-1}$). This trend continues till all the H^+ ions of HCl are replaced i.e. the strong acid is neutralized. Continued addition of NaOH raises the Conductance moderately, as the weak acid (CH_3COOH) is converted into its salt CH_3COONa . Further addition of NaOH raises the Conductance steeply due to the presence of free OH^- ions (mobility: $198 \text{ ohm}^{-1}\text{m}^{-1}$). The titration curve depicting the location of the equivalence points is shown in fig (graph).



Estimation of HCl and CH_3COOH -

pipette out 50 cm^3 of the given acid mixture into a clean 100 cm^3 beaker. Dip the Conductivity Cell in the Solution and note down the Conductance of the Solution i.e. when the Volume of NaOH added is zero.

Now add standard NaOH Solution from a but burette in increments of 0.5 cm^3 . After each addition, stir the Solution gently and note down the Conductance. As the titration proceeds, the Conductance first gradually decreases and then rises slowly and finally rises sharply. Continue titration until the Conductance more or less the same as it was in the beginning. Draw a graph of Conductance against Volume of NaOH added. The point of intersection of the first and the second lines give the Volume of Sodium hydroxide needed to neutralize only hydrochloric acid. The point of intersection of the second and the third straight lines give the Volume of NaOH required to neutralization both HCl and CH_3COOH .

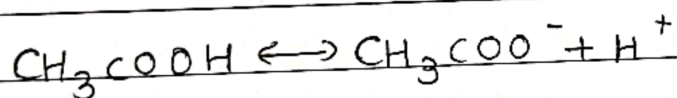
Report : Amount of HCl and CH_3COOH present in a given acid mixture = 1.095 g and 2.4 g

PS
5/4

Volume of NaOH in cm^3	ΔV	pH	ΔpH	$\Delta \text{pH} / \Delta V$
0.0	$\uparrow$ 0.5 cm^3 $\downarrow$	1.88	-	-
0.5		2.97	0.99	1.98
1.0		3.16	0.29	0.58
1.5		3.45	0.29	0.58
2.0		3.83	0.38	0.76
2.5		4.11	0.28	0.56
3.0		4.40	0.29	0.58
3.5		4.69	0.29	0.58
4.0		4.83	0.14	0.28
4.5		5.01	0.18	0.36
5.0		5.95	0.94	1.88
5.5		11.11	5.16	10.32
6.0		12.04	0.93	1.86
6.5		12.50	0.46	0.92
7.0		12.69	0.19	0.38
7.5		13.09	0.4	0.8
8.0		13.33	0.24	0.48

principle -

Vinegar is an aqueous solution of acetic acid and trace compounds that may include flavorings. Vinegar typically contains 5-8 % acetic acid by volume [1] usually, the acetic acid is produced by a double fermentation, converting simple sugar to ethanol using yeast, and ethanol to acetic acid by acetic acid bacteria. [2] Many types of vinegar are available, depending on source materials. We make a solution of this acid, a part of the acid molecules dissociate.



For this reaction, the equilibrium constant, K_a is given by the equation:

$$K_a = \frac{[\text{H}^+] \times [\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$$

' K_a ' is also known as acid dissociation constant.

The negative logarithm to base 10 of K_a is called pK_a .

i.e., $pK_a = -\log_{10} K_a$.

Consider a solution of a vinegar; say acetic acid, in a beaker. Let ' K_a ' be the acid dissociation constant. Let us partially neutralize the acid by adding a base, say, NaOH from a burette. Addition of base of the acid result

X-axis = 1 unit = 0.5 cm

Y-axis = 1 unit = 1 cm

ΔpH

ΔV

5

4

3

2

1

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5

Volume of NaOH in cm³

equivalent point

Now from a further addition of base the pH would

In the formation of Salt and Water. The pH of the partially neutralized solution is related to pK_a of the acid by the Henderson - Hasselbalch equation,

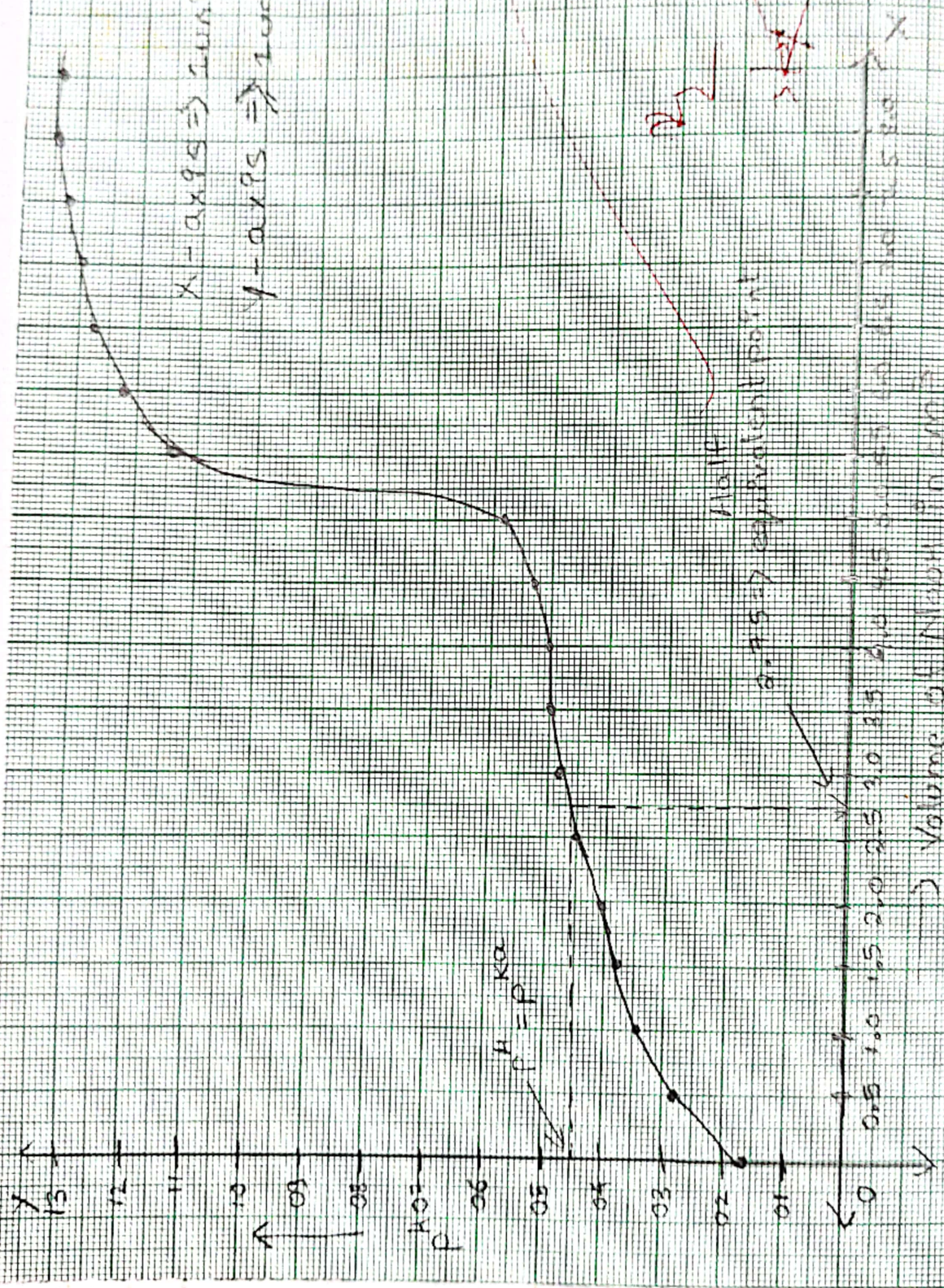
$$pH = pK_a + \log \frac{[Salt]}{[Acid]}$$

If we titrate the acid against NaOH, the pH of the mixture in the beaker continuously changes. When we plot a graph of pH vs. Volume of NaOH, we get a 'S' shaped curve. We find that there will be a sharp jump in pH at the equivalence point. At half equivalence point, $[Salt] = [Acid]$. Thus, according to the Henderson equation pH becomes equal to pK_a at half equivalence point.

PROCEDURE -

Add 25 cm^3 of the given Vinegar sample into a 100 cm^3 beaker and add one test tube of water. Immerse the combined glass electrode into the acid. Connect the electrode terminals to a pH meter. Measure the pH of the acid. Add NaOH solution from a micro burette in increments of 0.5 cm^3 . After each addition, stir the solution and measure the pH. (After the jump in the pH, take six ~~and~~ more readings).

Plot a graph of $\Delta pH / \Delta V$ against Volume of NaOH and determine the equivalence point. Plot another graph pH / Volume of NaOH, and note the pH at half equivalence



X-axis $\Rightarrow$ Volume $\Rightarrow$ 0.5 cm
 Y-axis $\Rightarrow$ pH $\Rightarrow$ 0.5 cm

Volume of NaOH, and note the bit of half equivalence

point (which is nothing but p^{ka}).

Report: The p^{ka} of the given Vinegar Sample = 4.5 ± 4.5

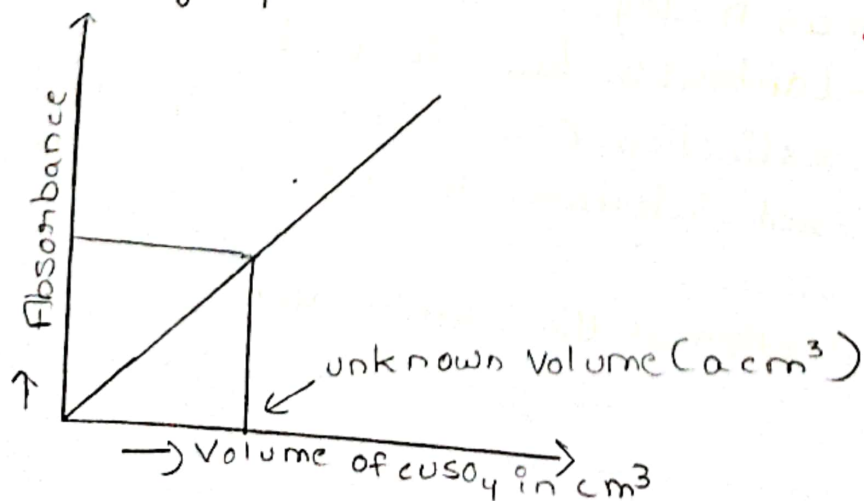
5

3/4

Observation and Calculations:

Sl. No of Volumetric flask	Volume of CuSO_4 in cm^3	Volume of ammonia solution in cm^3	Concentration of Copper = $1.018 \text{ mg} \times \text{Vol. of } \text{CuSO}_4 \text{ Solution}$	Absorbance
1.	0.0 (Blank sol)	2.0	$1.018 \times 0 = 0$	0.0
2.	2.0	2.0	$1.018 \times 2 = 2.036$	0.03
3.	4.0	2.0	$1.018 \times 4 = 4.072$	0.05
4.	6.0	2.0	$1.018 \times 6 = 6.108$	0.07
5.	8.0	2.0	$1.018 \times 8 = 8.144$	0.11
6.	Electroplating effluent sample	2.0	$1.018 \times 4 = 4.072$	0.05

Expected graph



Theory:-

E-waste, "electronic waste", "e-Scrap" are used electronics that are nearing the end of their useful life, and are discarded. Waste printed circuit boards (PCBs). PCBs comprise metals (Cu, Sn, Pb, Ag, Au, Pd, Fe, Ni and Cr), nonmetals (glass fibers, electronic component insulators, capacitors, resistors, and so on), and organic compounds (epoxy resin, paints....). Copper is the primary component of PCB, which is employed as an electric current conductor. These discarded metals without treatment threaten the economy, the environment, and human health.

Principle:-

When a monochromatic light of intensity I_0 is incident on a colored solution, a part (I_a) of it is absorbed, a part (I_r) is reflected and the remaining part (I_t) is transmitted.

Thus, $I_0 = I_a + I_r + I_t$

$$\frac{I_0}{I_t}$$

$$I_t$$

Absorbance is given as $A = \log$

According to Beer-Lambert's law, $A = \epsilon c l$

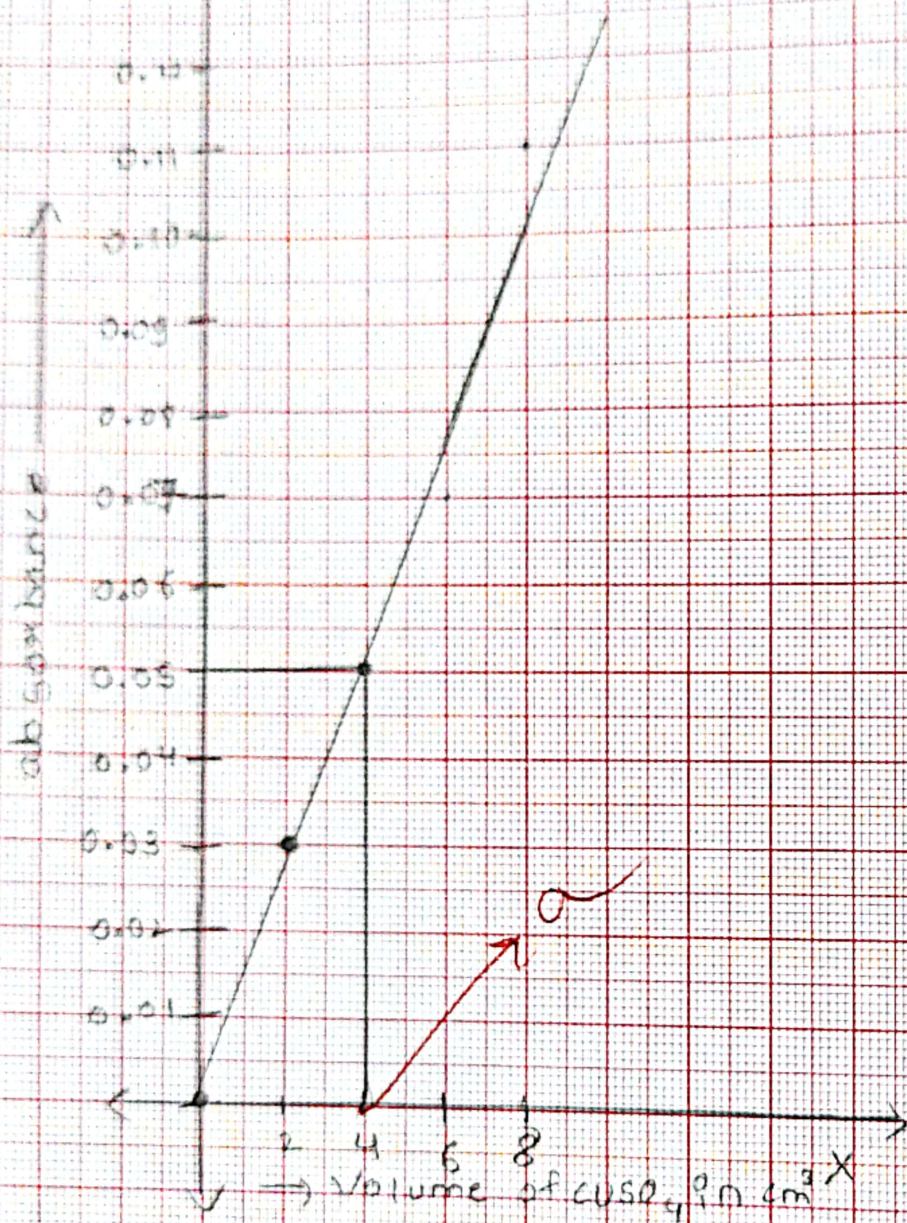
Where, ϵ = molar extinction coefficient, a constant for any particular colored substance for a given wave length of light,

c = Molar Concentration of the solution and

l = path length

x-axis = 1 unit = 2 cm

y-axis = 1 unit = 0.01 cm



When the path length is kept constant, then $A \propto c$. Hence a plot of absorbance, A , against concentration c , gives a straight line.

chemical analysis through measurements of absorption of light of a particular wavelength is known as Colorimetry. The absorbance of light of a particular wavelength by a substance in solution varies directly with its concentration and the thickness of the solution. When the thickness of the medium is kept constant, the absorbance directly depends upon the concentration.

A series of solutions with different concentrations of Cuprammonium ions is prepared and absorbance of each is measured at 620 nm radiation. A calibration graph is obtained. The absorbance of Cuprammonium ions of unknown solution is also measured and the unknown volume is determined using the calibration graph.

PROCEDURE -

All the detachable components free from copper (e.g., relays, capacitors, and resistance) were separated, the bare PCB boards were shredded and crushed by a cutting and grinding machine and passed through a sieve mesh to obtain the WPCB powder of varying particle sizes. Then the mixer of WPCB powder and $K_2S_2O_8$ (with suitable mass ratios) together with grinding balls, were sealed in the 2802 plot. The mixture was co-ground at different rotary speeds under ambient conditions for different periods of time (Stage I). Co-ground products of PCB products powder and $K_2S_2O_8$ is

1000 cm³ of Stock Solution Contains 4g of CuSO4.5H2O

249.54 g of CuSO4.5H2O = 63.54 g of Cu

4 g of CuSO4.5H2O = $63.54 \times 4 / 249.54 = 1.018$ g of Cu per 1000 cm³ of Stock Solution

$\therefore 4 \text{ cm}^3 \text{ of } \text{CuSO}_4 \cdot 5\text{H}_2\text{O} = \frac{1.018}{1000} = 0.001018 \text{ g of Cu} = 1.018 \text{ mg}$

Volume of CuSO4 in the unknown solution = 4 cm³

$\therefore$ Cu present in 'a' cm³ of electroplating effluent sample

= 'a' cm³ $\times$ 1.018 mg

= 4 $\times$ 1.018

= 4.072 mg

leached in deionized Water with Constant magnetic stirring at different temperatures: 25, 35, 45, and 55 °C. The leaching solution and solid residues were rapidly separated by Vacuum filtration after the reaction was complete. (Stage-II). After filtration, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ could be easily separated from K_2SO_4 solution because of their differences in solubility. (Stage-III).

Take six 50 cm^3 Volumetric flasks. Transfer 0, 2, 4, 6 and 8 cm^3 of CuSO_4 to first five flasks. Take the above extracted electroplating effluent unknown solution in the six flasks. Add 2 cm^3 of ammonia solution of each one of the six flasks. Dilute up to the mark and mix well. After 10 minutes, set the absorbance of first solution to zero at 620 nm radiations in the instrument. Then, measure the absorbance of remaining five solutions with the same settings.

Draw a Calibration Curve by Volume of CuSO_4 on x-axis and absorbance on y-axis. (Draw a straight line passing through the origin). Using the graph and knowing the absorbance of six solutions, find out the Volume of CuSO_4 in the sixth flask.

Report: Mass of Cu in the Electroplating Effluent sample
 $= 4.072 \text{ mg}$

5
17/11

Observation and Calculation -

Liquid	Time of flow (Seconds)	Average time of flow (Seconds)
Given Lubricant Liquid (l)	65 87 70	$t_l = 74$
Water (w)	110 62 109	$t_w = 93$

Lab temperature = 28 °C

d_l (Density of organic liquid) = 0.8663 g cm⁻³

d_w (Density of Water) = 0.9962 g cm⁻³

η_w (Viscosity Coefficient of Water) = 8.360 milli poise

$$\frac{\eta_1}{\eta_2} = \frac{t_l d_l}{t_w d_w}$$

$$\eta_1 = \frac{t_l d_l}{d_w d_w} \times \eta_w = \frac{74 \times 0.8663}{93 \times 0.9962} \times 8.360 = 5.7846 \text{ milli poise}$$

principles- Viscosity arises due to friction between moving layers of a liquid. A liquid flowing through a Cylindrical tube of uniform diameter is expected to move in the form of molecular layers. Layer close to the Surface is almost Stationary While that at the axis of the tube moves faster than any other intermediate layer. A slow moving layer exerts a drag or friction on its nearest moving layer backwards. This property of the liquid, which retards or opposes the motion between the layers, is called Viscosity. The Coefficient of Viscosity is defined as the tangential force per unit area required maintaining a unit Velocity gradient between the two successive layers of the liquid situated unit distance apart. The Coefficient of Viscosity of a liquid is given by the poiseuille's formula.

$$\eta = \frac{\pi p r^4 t}{8 v l}$$

Where 'v' is the Volume of the liquid, 'r' is the radius of the tube and 'p' is the pressure between the two ends of the tube is the Coefficient of Viscosity. It equals Volumes of the two different liquids are allowed to flow through the same tube under identical Conditions then,

$$\eta_1 = \frac{t_1 d_1}{t_2 d_2}$$

$$\eta_2 = \frac{t_2 d_2}{t_1 d_1}$$

The time 't' taken by the given liquid to travel through a certain distance in the tube is determined. The time 't' taken by Standard liquid to travel through the same

distance is measured. Knowing the densities of the two liquids (d_1 and d_2) and also the Coefficient of Viscosity η of the Standard liquid, Coefficient of Viscosity of test liquid is Calculated.

Procedure:-

Take a dry Viscometer. (Do not Wash!) Attach a rubber to the narrow limb. Immerse the Viscometer in ~~Wash~~ Water bath and fix it Vertically to a Stand. Using a pipette, transfer 10cm^3 of the given liquid into the wider limb of the Viscometer. Suck the lubricant liquid and fill the bulb on the narrow limb Slightly above the upper mark. Allow the liquid to flow down through the Capillary. Start a stop clock When the level of the liquid crosses the lower mark. Note down the time of flow.

Remove the Viscometer from the Stand. Remove the rubber tube. Pour out the liquid from the Viscometer into the beaker. Using acetone (through a dropper) rinse the Viscometer. Dry it in air over for 20 minutes. Take out the Viscometer and follow a similar procedure for determining the average time of flow for deionized water. (Use a different pipette for water).

Using a thermometer note the temperature of the Water bath. This is lab temperature.

From your teacher, get the values of d_1 (density of organic liquid), d_2 (density of water) and η_2 (Viscosity Coefficient of water).

Find η_1 (Viscosity Coefficient of organic liquid) Using the relation

$$\eta_1 = \frac{t_1 d_1}{t_2 d_2} \times \eta_2$$

Report:- Viscosity Coefficient of the given lubricant liquid = 5.7846 millipoise.

5 ✓

Observation and Calculation -

part A :- preparation of ferrous ammonium Sulphate (FAS) Solution.

Weight of the Weighing bottle + FAS = 2.58 g

Weight of the weighing bottle = 0.55 g

Weight of the FAS salt transferred = 2.0300 g

$$\begin{aligned}\text{Normality of FAS Solution} &= \frac{\text{Wt of FAS} \times 4}{\text{Gram eq. wt of FAS}} \\ &= \frac{2.0300 \times 4}{392} = 0.0207 \text{ N (a)}\end{aligned}$$

Volume of FAS Consumed in the blank titration = . cm³ (b)

part B :- FAS Solution Back Solution :-

Burette :- FAS Solution

Conical flask : 25 cm³ of Waste Water Sample + 25 cm³ of potassium dichromate + 10 cm³ of 1:1 Sulphuric acid containing mercuric Sulphate and Silver Sulphate

Indicator : 3-4 drops of ferroin indicator.

End point : Blue green to reddish brown.

Theory:- COD is a measure of oxygen equivalent of that portion of oxidisable materials that can be oxidized by a strong oxidizing agent. Chemical oxygen demand is an important parameter in industrial wastewater management treatment. Straight chain aliphatic Compounds, aromatic hydrocarbons, Straight Chain alcohol, acids, pyridine and other oxidisable material are present as impurities in wastewater. Straight chain Compounds, acetic acid etc. are oxidisable more effectively when Silver Sulphate is added as Catalyst. Addition of mercuric Sulphate would help avoid interference of chloride ions.

procedure:-

part A:- Preparation of Standard ferrous ammonium Sulphate (FAS) Solution:

Weigh accurately the given FAS and transfer it into a 250 cm³ Standard flask using a funnel. Add 30 cm³ of dilute Sulphuric acid followed by about 100 cm³ of Water. Dissolved, make it up to the mark and shake well for uniform Concentration.

Part B:- Blank titration:

pipette out 25 cm³ of potassium dichromate into a Conical flask - using pipette. Add 10 cm³ of 1:1 Sulphuric acid containing mercuric Sulphate and Silver Sulphate and 3 drops ferroin indicator. Titrate against FAS taken in the burette until the colour changes from blue green to reddish brown. Note the burette reading and repeat the titration to get Concordant Values.

Burette readings	Trial I	Trial II	Trial III
Final	15.7	15.8	15.7
Initial	0	0	0
Volume of FAS run down (cm^3)	15.7	15.8	15.7

Back titration Value = 15.7 cm^3 (c)

Amount of potassium dichromate (in terms of FAS) that has reacted With Water Sample = $(b) - (c) \text{ cm}^3$

1000 cm^3 of 1N FAS Solution = 1 equivalent of oxygen = 8 g of oxygen

$$= \frac{(b-c) \times a \times 8}{1000} = \frac{9.3 \times 0.0207 \times 8}{1000} = 1.54008 \times 10^{-3} \text{ g of oxygen}$$

$b - c \text{ cm}^3$ of a N FAS Solution = 1.54008×10^{-3} (d)

25 cm^3 of Waste Water requires (d) g of oxygen

$$\frac{d \times 1000}{25} = \underline{0.0616} \text{ g of oxygen}$$

Therefore, 1000 cm^3 of Waste Water requires = 0.0616 oxygen

COD of the given Sample of Water = 61.6 mg/dm^3 of oxygen

Part - c :- Back titration :-

pipette out 25 cm^3 of given Sample of Waste Water into a Conical flask. Add 25 cm^3 of Standard potassium dichromate Solution using a pipette. Add 10 cm^3 of 1:1 Sulphuric acid Containing mercuric Sulphate and Silver Sulphate while Shaking the flask Constantly. Reflux the Content of flask for 30 minutes. Cool to room temperature. Add 3-4 drops ferric indicator and titrate against FAS Solution taken in the burette Until the Colour changes from bluish green to reddish brown. Note down the burette reading and repeat the titration to get Concordant Values.

REPORT :- COD of the given Sample of Water = 61.6 mg/dm^3 of oxygen.

(5)

Electrolysis of Water, also known as electrochemical Water Splitting, is the process of using electricity to decompose Water into oxygen and hydrogen gas by electrolysis. Hydrogen gas released in this way can be used as hydrogen fuel, or mixed with the oxygen to create oxyhydrogen gas, which is used in welding and other applications.

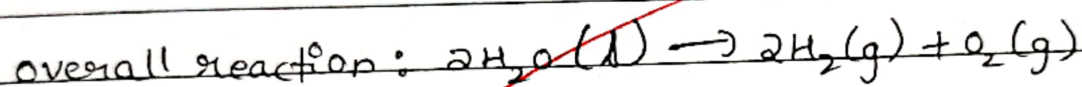
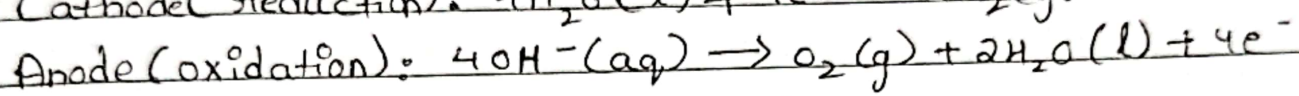
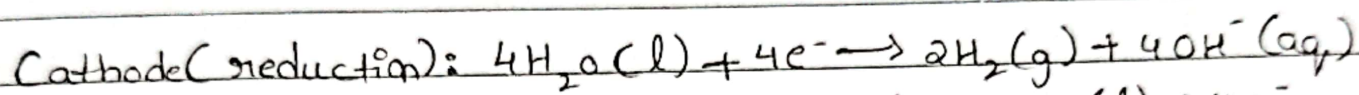
Electrolysis of Water requires a minimum potential difference of ~~1~~ 1.23 Volts, though at that voltage external heat is required from the environment.

A DC electrical power source is connected to two electrodes, or two plates (typically made from an inert metal such as platinum or graphite) which are placed in the water. Hydrogen will appear at the Cathode (where electrons enter the water), and oxygen will appear at the anode. Assuming ideal faradaic efficiency, the amount of hydrogen generated is twice the amount of oxygen, and both are proportional to the total electrical charge conducted by the solution. However, in many cells competing side reactions occur, resulting in different products and less than ideal faradaic efficiency.

Electrolysis of pure water requires excess energy in the form of over potential to overcome various activation barriers. Without the excess energy, the electrolysis of pure water occurs very slowly or not at all. This is in part due to the limited self-ionization of water. Pure water has an electrical conductivity about one-millionth that of seawater. Many electrolytic cells may also lack the requisite electrocatalysts. The efficiency of electrolysis is increased through

the addition of an electrolyte (such as a salt, an acid or a base) and the use of electrocatalysts.

The reactions taking place at cathode and anode of the cell during electrolysis of water in an acid medium are given below.



15

✓

In recent years, iron oxide nanoparticles have demonstrated great potential in biomedical applications due to their non-toxic role in biological systems. Also, the magnetic and semiconductor properties of iron oxide nanoparticles can lead to ~~me~~ multifunctional applications in medicine. These nanoparticles have been developed as antibacterial, antifungal and anticancer. For cancer treatment and diagnosis, iron oxide nanoparticles have been functionalized with drugs. However, many of those drugs have been related to adverse effects on health. On the other hand, phytochemicals from extracts of plants have been used as an alternative for the functionalization of these nanoparticles preventing negative effects. The main advantage of these nanoparticles is the high biodistribution in the organism compared with other drug delivery systems. The magnetism of iron oxide nanoparticles has been used in cancer treatment and diagnosis, for example, thrombolysis, hyperthermia and contrast media in magnetic resonance imaging.

Iron oxide nanoparticles are synthesized by precipitation method, which is a simple technique among chemical route. This method is given more priority due to its low cost and easy industrialization with improved reproducibility. This method offers low temperature growth and scale-up fabrication which yields colloidal solutions with wide range of particle distributions.

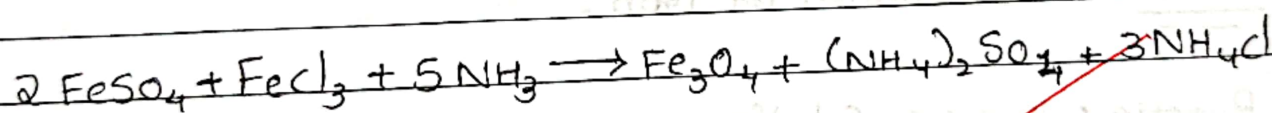
~~principle: Co-precipitation is a very facile and convenient way to synthesize iron oxide nanoparticles (Fe_3O_4) from~~

aqueous $\text{Fe}^{2+}/\text{Fe}^{3+}$ Salt Solutions by the addition of a base at room temperature or at elevated temperature.

Chemical required - $\text{FeSO}_4 \cdot 2\text{H}_2\text{O}$ (0.2M), $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ (0.1M), Ammonia Solution (3M) and deionized water

procedure - 0.2M ferrous Sulphate Solution and 0.1M ferric chloride Solutions are mixed with 100 ml deionized water in a beaker. Ammonia Solution (3M) is added dropwise with constant stirring at 1000 rpm using a magnetic stirrer till pH 10. The black precipitate of iron oxide obtained is filtered and dried in hot-air oven at $150-200^\circ\text{C}$

Reaction -



Report: Weight of Iron oxide nanoparticles = 50 g

15

Observation and Calculation :

Part A :- preparation of potassium dichromate solution

Weight of the Weighing bottle + $K_2Cr_2O_7$ = 5.46 g

Weight of the Weighing bottle = 4.06 g

Weight of the $K_2Cr_2O_7$ Salt transferred = 1.40 g

$$\begin{aligned}\text{Normality of } K_2Cr_2O_7 \text{ Solution} &= \frac{\text{Wt. of } K_2Cr_2O_7 \times 4}{\text{Gram Eq. wt. of } K_2Cr_2O_7} \\ &= \frac{1.40 \times 4}{49.06} \\ &= 0.1141 \text{ N (a)}\end{aligned}$$

Part B : estimation of iron :

Burette : $K_2Cr_2O_7$ Solution

Conical flask : 25 cm³ of TMT bar solution + 5 cm³ of Conc. HCl, heat nearly to boiling add Stannous chloride from a dropper unit Colourless Solution is obtained. Cool the Solution to room temperature, Add 2tt of DM Water. Add 5cm³ of mercuric chloride at a stretch.

indicator : Drops of potassium ferricyanide on Wax paper (external indicator)

End point : No blue coloration When a drop of the mixture is mixed with a drop of indicator.

DATE 23/05/2024

EXP. NO. C.3

principle

Thermo

for all

Using

Solution

form

1:1 HCl

the high

reduced

chloride

by ad

Since

Solut

K_2C

The

of

PA

We

ac

Di

m

P

C

principle:-

Thermo mechanically tested bars (TMT bars) are essential for all type of construction purpose. It is manufactured using Virgin iron ore. TMT bars is electrolysed in a solution of Sodium bicarbonate (an inert electrolyte) to form ferric oxide. Ferric oxide so formed is treated with 1:1 HCl to form FeCl_3 . Since iron in FeCl_3 is already in the highest possible oxidation state (Fe^{3+}), it is first reduced to ferrous state by using a slight excess of Stannous chloride. The excess of Stannous chloride added is destroyed by adding saturated solution of ~~mercuric~~ mercuric chloride, since SnCl_2 can reduce potassium dichromate. Then, the solution is titrated $\text{K}_2\text{Cr}_2\text{O}_7$ with standard solution of $\text{K}_2\text{Cr}_2\text{O}_7$ using potassium ferricyanide as an external indicator. The volume of $\text{K}_2\text{Cr}_2\text{O}_7$ consumed is a measure of the amount of iron present in rust solution.

PART-A :- preparation of Standard $\text{K}_2\text{Cr}_2\text{O}_7$ Solution

Weigh about 1.25 g of potassium dichromate Crystals accurately and transfer to a 250 cm^3 Volumetric flask. Dissolve in ion exchange water and dilute up to the mark and mix well.

PART-B :- Estimation of Iron

Pipette out 25 cm^3 of the TMT bar solution into a clean conical flask. Add a quarter test tube of concentrated HCl

Burette readings	Trial I	Trial II	Trial III
Final	7	6.8	6.7
Initial	0	0	0
Volume of $K_2Cr_2O_7$ run down (in cm^3)			

Calculations :-

Volume of $K_2Cr_2O_7$ Used = 6.7 cm^3 (b)

Weight of TMT in 25 cm^3 = 0.12 g (To be given)

1000 cm^3 of $1 \text{ N } K_2Cr_2O_7$ = 55.85 g of Fe (1 equivalent of Fe)

'b' cm^3 of 'a' $N K_2Cr_2O_7$ Solution

$$= \frac{55.85 \times a \times b}{1000 \times 1} = \frac{55.85 \times 0.1141 \times 6.7}{1000 \times 1}$$

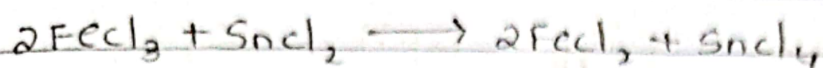
= 0.0427 g (c) of Fe / 25 cm^3 of Solution

percentage of iron in the TMT bar Sample

$$= \frac{c \times 100}{\text{Weight of TMT bar}} = \frac{0.0427 \times 100}{0.12}$$

$$= 35.58 \%$$

and heat the solution to be boiling. Add stannous chloride to the hot solution dropwise till the yellow solution turns colourless. Add ^{more} 2 drops to ensure complete reduction. Cool and add a quarter quarter test tube of mercuric chloride rapidly. A silky white precipitate of mercurous chloride is formed. Add one test tube of ion exchange water. Place a number of drops of freshly prepared potassium ferricyanide indicator on a wax paper. Add a small ~~qual~~ quantity of potassium dichromate from a burette to the conical flask and bring it in contact with a drop of the indicator on the wax paper. The colour of the indicator turns blue. Repeat this operation after adding 1 cm^3 more of the potassium dichromate solution. The indicator turns blue as long as the titration is incomplete. Continue the titration by adding increments of 1 cm^3 of $\text{K}_2\text{Cr}_2\text{O}_7$ at a time and testing as above till a drop of the mixture fails to produce any colour with the indicator drop. (Note: Clean the glass rod after every test). Repeat the titration by taking another 2.5 cm^3 of the rust solution. This time add most of the potassium dichromate solution required at a stretch and then titrate dropwise. Mix the contents of the flask after every addition and test a drop of the titrated mixture with a drop of the indicator as described above till the colour of the indicator drop does not change. Repeat for ~~or~~ agreeing values.

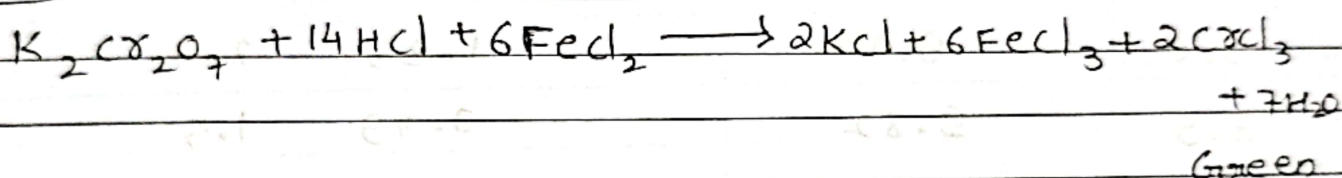
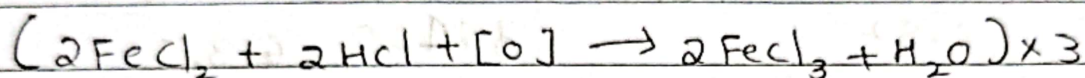
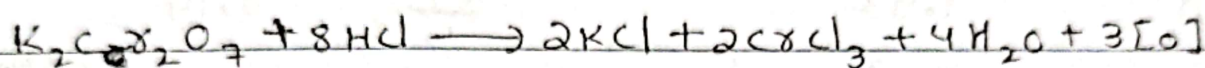


yellow

Colourless



Silky White

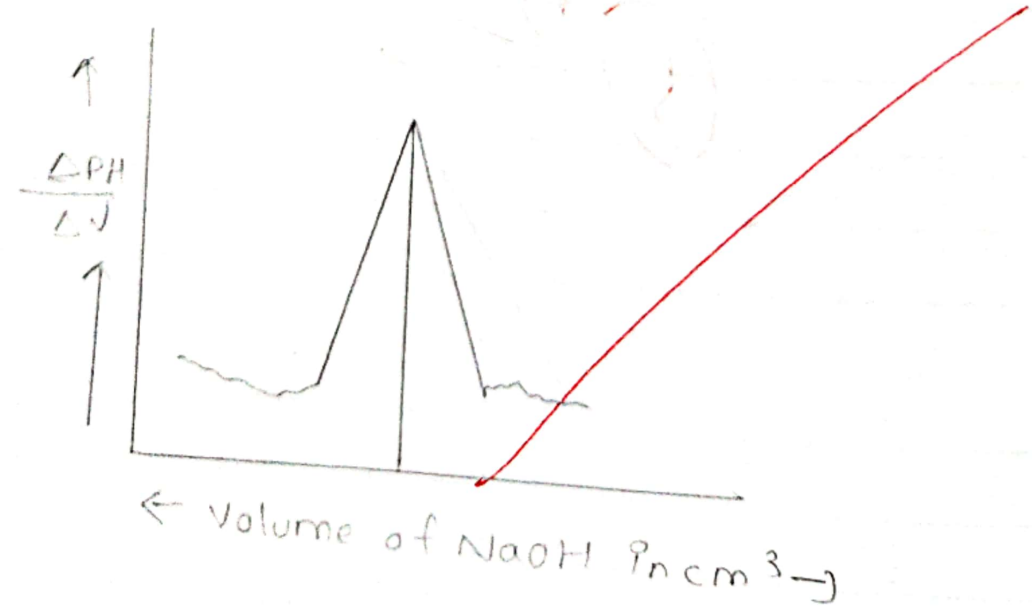


Report : percentage of iron in TMT bar = 35.38 %

(5)

Observation and Calculation -

Volume of NaOH in cm ³	ΔV PH ΔV	PH	ΔPH	$\Delta PH / \Delta V$
0.0		2.51	—	—
0.5		3.11	0.6	1.2
1.0		4.33	1.22	2.44
1.5		4.81	0.48	0.96
2.0		5.23	0.42	0.84
2.5		5.58	0.35	0.7
3.0	0.5	6.39	0.8	1.62
3.5		8.80	2.4	4.82
4.0		8.54	0.26	0.52
4.5		8.85	0.31	0.62
5.0		9.12	0.27	0.54
5.5		9.33	0.21	0.42
6.0		9.51	0.18	0.36



Principles -

When an alkali is added to an acid the pH of the solution increases slowly. But at the equivalence point the rate of change of pH is very rapid. A plot is drawn between Volume of the Alkali added and pH of the solution. The sharp break in the curve gives the equivalence point from which the strength can be evaluated using normality equation.

$$pH = -\log[H^+]$$

The pH of solution is defined as the negative logarithm of the hydrogen ion concentration.

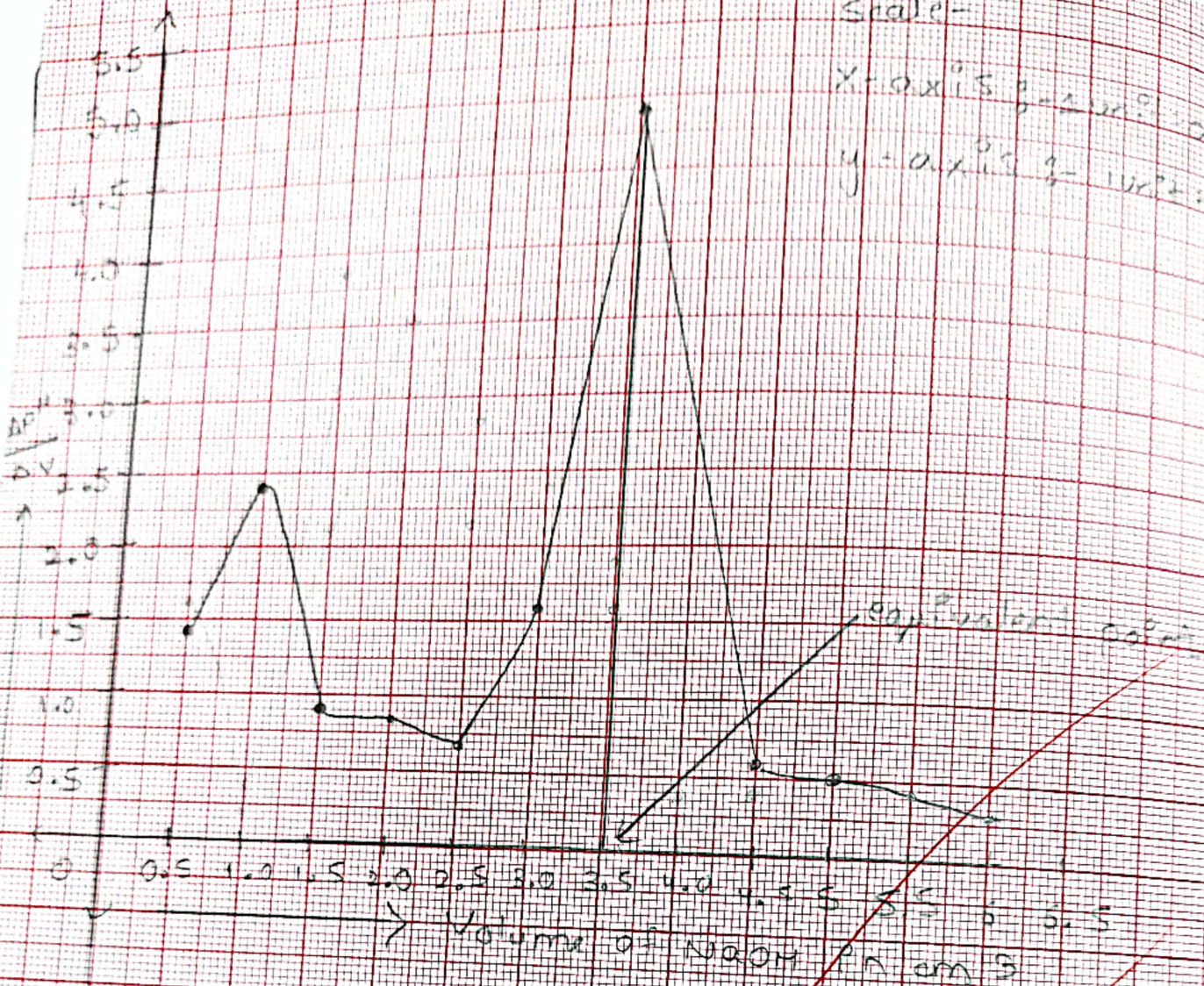
Procedure :-

Add 50 cm^3 of the given beverage (carboxylic acid) into a 100 cm^3 beaker and immerse the combined glass electrode into the acid. Connect the electrode terminals to a pH meter. Measure the pH of the acid. Add NaOH solution from a micro burette in increments of 0.5 cm^3 . After each addition, stir the solution and measure the pH. plot a graph of $\Delta pH / \Delta V$ against Volume of NaOH and determine equivalence point.

Scale-

$$x = 0.1 \text{ g} \rightarrow 1 \text{ cm} = 0.1 \text{ g}$$

$$y = 0.1 \text{ g} \rightarrow 1 \text{ cm} = 0.1 \text{ g}$$



$$= 0.02 \times 31$$

DATE

EXPT TITLE:

EXP. NO.

PAGE NO. 54

Report :-

Amount of Carboxic acid: 1.085 g

15

g

Observation -

Test	observation
Ninhydrin Test	The appearance of deep blue or purple Confirms the presence of proteins

proteins are the essential biomolecules. Consisting of one or more long chains of amino acid residues. Proteins are the main constituents of all living cells and are the building blocks of life.

Ninhydrin Test:-

proteins react with pyridine solution of ninhydrin and change to a colored solution from a deep blue to violet pink or sometimes even to a red color. Ninhydrin solution is prepared by dissolving 0.1 gm of ninhydrin in about 100 ml of distilled water. But this solution of ninhydrin is unstable and can be kept for two days.

procedure:-

1. Take a cleaned and dried test tube
2. Add the food samples of your choice into the test tube.
3. Add 1-2 ml of ninhydrin solution to it and shake the test tube.
4. Boil the mixture and observe the change.
5. If there is the appearance of deep blue or purple color then the presence of proteins is confirmed.

Report:-

The result is positive

The given food sample contains protein in it

The appearance of violet color solution confirms the presence of proteins.



K.S. School of Engineering and Management



K.S. School of Engineering and Management



K.S. School of Engineering and Management



K.S. School of Engineering and Management



Vision

"To impart quality education in engineering and management to meet technological business and societal needs through holistic education and research".

Mission

K.S. School of Engineering and Management shall,

- Establish state-of-art infrastructure to facilitate effective dissemination of technical and managerial knowledge.
- Provide comprehensive educational experience through a combination of curricular and experiential learning, supported by industry-institute interaction.
- Pursue socially relevant research and innovation to generate knowledge.
- Inculcate leadership skills and foster entrepreneurial spirit among students.



K.S. GROUP OF INSTITUTIONS K.S. SCHOOL OF ENGINEERING AND MANAGEMENT

#15, Mallasandra, Near Vajarahalli, Off. Kanakapura Road, Bengaluru - 560 109

Ph. : +91 80 28425163 / +91 88844 44408, website : www.kssem.edu.in