

PROCEDURE:

Video link: <https://vimeo.com/366421679/33728efcc4>

Aim:- To determine the cell constant of conductivity cell.

Chemicals :- NaOH, Acid, Mixture of HCl & CH_3COOH

Apparatus:- Beaker, Burette, Digital conductivity meter, conductivity cell.

Procedure:

→ Preparation of 0.1M KCl Solution

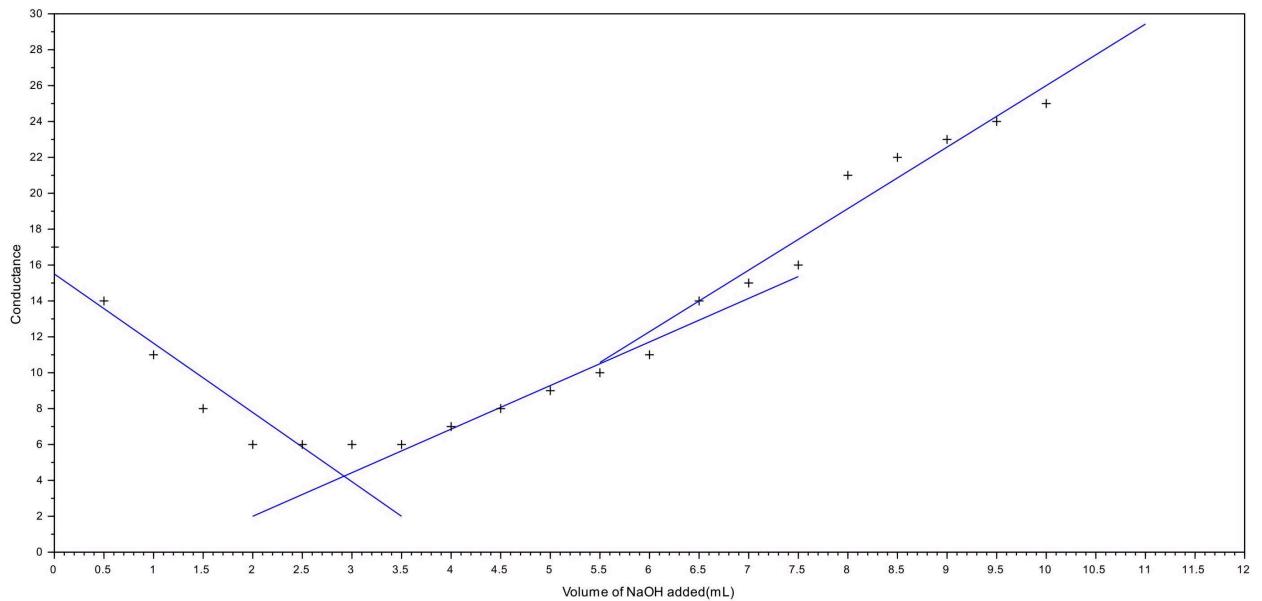
- 1) Take a piece of folded paper & place it on the pan and 'TARE'
- 2) Transfer KCl salt into machine and note the weight
- 3) Transfer the salt into a 100 ml volumetric flask using a funnel
- 4) Add distilled water part by part till just below the graduation mark.

→ Preparation of 0.01M KCl Solution

- 1) Pipette out 10 ml of 0.1M KCl soln & transfer to another flask.
- 2) Add distilled water part by part till it reaches just below the graduation mark.

→ Measuring conductance of 0.1M KCl solution.

- 1) Transfer 50 ml of KCl soln in 100 ml beaker, immerse electrodes in soln & take the reading (conductance value).
- 2) Transfer 30 ml of acid mixture in a beaker, immerse conductivity cell in a mixture & note the conductance values.
- 3) Add 0.5 ml of NaOH from burette & keep measuring conductance after adding 0.5 ml of NaOH in every turn.



OBSERVATIONS AND CALCULATIONS:

A) Determination of cell constant.

a) Preparation of standard solution of KCl:

Mass of KCl per 100 mL = Molarity x Molecular weight of KCl

$$\frac{0.1 \times 74.56}{10} = 0.7456$$

Mass of KCl per 100 mL required for the preparation of 0.1 M solution = 0.7456 g

Mass of KCl per 100 mL required for the preparation of 0.01 M solution = 0.07456 g.

Concentration of KCl solution (N)	G (Observed conductance) (mS)	k (Specific conductance) (mS cm ⁻¹)	C (Cell constant) (cm ⁻¹)	Average Cell constant (cm ⁻¹)
0.1	11.8	12.8	1.0815	0.805
0.01	2.6	1.4	0.53	

b) The cell constant of conductivity cell = 0.805 cm⁻¹

B) Determination of amount of HCl and CH₃COOH present in a given solution:

SL No	Volume of NaOH added in (mL)	Conductance (mS)
1.	0.0	17.0
2.	0.5	14.0
3.	1.0	11.0
4.	1.5	8.0
5.	2.0	6.6
6.	2.5	6
7.	3.0	6
8.	3.5	6
9.	4.0	7
10.	4.5	9
11.	5.0	9
12.	5.5	10
13.	6.0	11
14.	6.5	14
15.	7.0	15

Sl. No.	Volume of NaOH added in (mL)	Conductance (mS)
16.	7.5	16
17.	8.0	21
18.	8.5	22
19.	9.0	23
20.	9.5	24
21.	10.0	25
22.	10.5	
23.	11.0	
24.	11.5	
25.	12.0	
26.	12.5	
27.	13.0	
28.	13.5	
29.	14.0	
30.	14.5	

Calculations:

Strength of NaOH = 1.0 N

Volume of NaOH consumed at first equivalence point (V_1) = 3 cm³Volume of NaOH consumed at second equivalence point (V_2) = 5.5 cm³Volume of NaOH consumed by HCl (V_1) = 3 cm³Volume of NaOH consumed by CH₃COOH ($V_2 - V_1$) = 2.5 cm³

$$N_{HCl} = \frac{N_{NaOH} \times V_1}{25} = \frac{1.0 \times 3}{25-50} = \underline{\underline{0.06}}$$

Amount of HCl present in 1000 mL of the solution = $N_{HCl} \times$ Gram Eq. Wt. of HCl

$$= \underline{\underline{0.06}} \times \underline{\underline{36.5}}$$

$$N_{CH_3COOH} = \frac{N_{NaOH} \times (V_2 - V_1)}{25} = \frac{(1.0 \times 2.5)}{25-50} = \underline{\underline{0.05}}$$

Amount of CH₃COOH present in 1000 mL of the solution = $N_{CH_3COOH} \times$ Gram Eq. Wt. of CH₃COOH

$$1000 \text{ mL of the solution} = \underline{\underline{0.05}} \times \underline{\underline{60}}$$

$$= \underline{\underline{3}}$$
 g

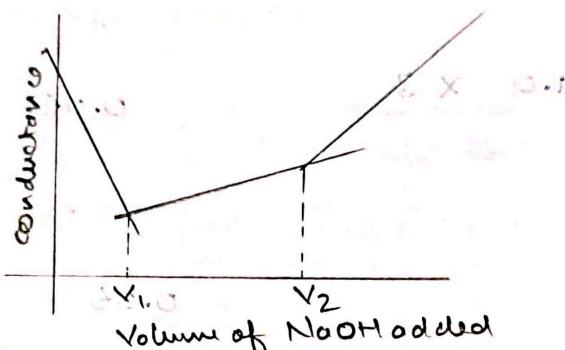
REPORT:A) The cell constant of conductivity cell = 0.805 cm⁻¹B) Amount of HCl present in the solution = 2.19 g/dm³C) Amount of CH₃COOH present in the solution = 3 g/dm³

Date of conduction	Conduction (10)	Procedure writing (10)	Quiz (5)	Total (25)
Assessment				
Faculty signature with date	Date: 10/10/2023			

Quiz:

1. The curve obtained is of 'U' shape. Initially conductance (\downarrow) as the number of H^+ ions (\downarrow) due to neutralisation by OH^- ions. (Reaction between HCl and NaOH). The conductance once again (\uparrow) due to dissociation of acetic acid which produces H^+ ions. Overall the H^+ ions are neutralised, the graph (\uparrow) sharply due to the large amount of OH^- ions which (\uparrow) conductance. (From $\frac{NaOH}{OH^-}$ ions)

Ex



3. Electrolytic conductance is defined as the flow of electricity through electrolyte conductor. It is affected by temperature of electrolyte and concentration of electrolyte.

4.

Metallic Conductor	Electrolytic Conductor
Conductivity decreases with increase in temperature	Conductivity increases with increase in temperature.
Flow of electricity takes place without the decomposition of substance	Flow of electricity takes place with decomposition of substance.

5. Two advantages:-

- endpoint in conductometric titration is determined by a sudden change in conductivity, which is more precise and reproducible than the visual endpoint in volumetric analysis
 - Conductometric can be used for determination of weak acids and bases, which are not suitable for volumetric analysis.
10. Take 0.7456g of KCl soln and pour it into the flask. Add distilled water till the graduation mark. Put the cork and mix well to obtain 100ml of 0.1M KCl soln.

PROCEDURE:

Video link: <https://vimeo.com/365552118/a311b27de8>

AIM: To estimate the amount of copper present in a given solution by colorimetric method.

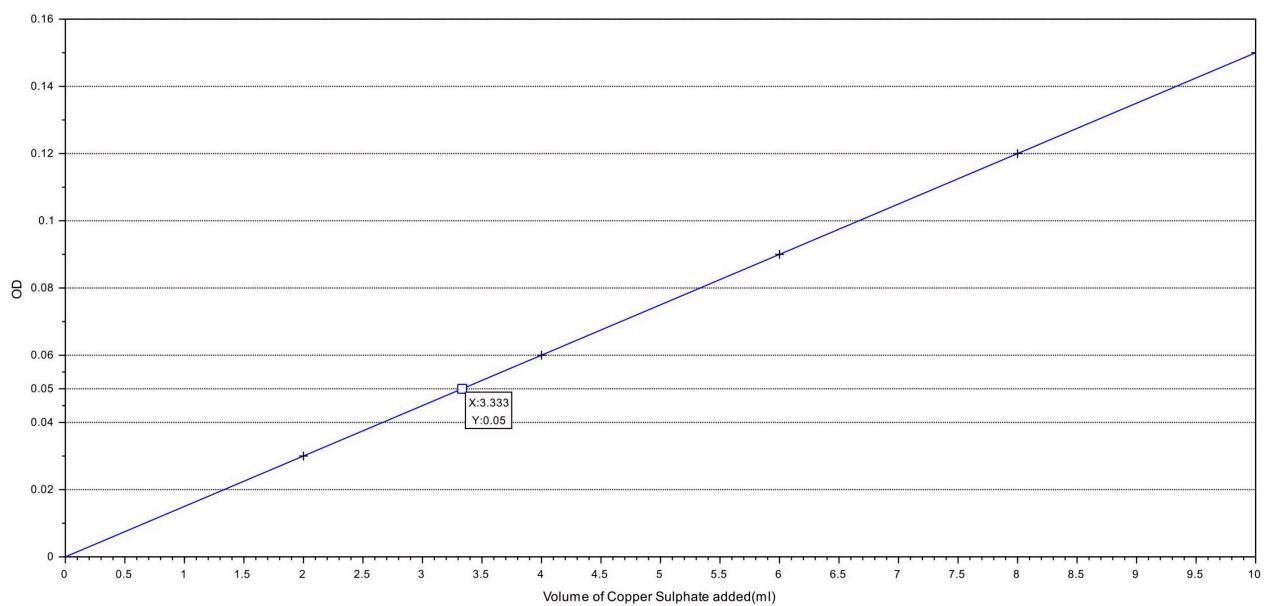
CHEMICALS: CuSO_4 , NH_3 , H_2O

APPARATUS: Test tube, Conical flask, Burette, Dropper

Instrument: Colorimeter.

Procedure

- Fill 3 burettes with Ammonium solⁿ, CuSO_4 solⁿ, distilled water.
- Transfer 2, 4, 6, 8 and 10 ml of CuSO_4 in 5 different standard 100 cm^3 volumetric flask.
- Add 2.5 ml of Ammonia solⁿ to each flask.
- Dilute the solⁿ with water upto the mark and mix well.
- Measure the absorbance of the solⁿ including the test solⁿ against blank at 620 nm wavelength light in a colorimeter.
- Draw a graph of absorbance v/s volume of CuSO_4 .



OBSERVATIONS AND CALCULATIONS:

Weight of copper sulphate present in 100 mL of given solution = 0.4 g (W)

$$\text{Weight of CuSO}_4 \cdot 5\text{H}_2\text{O in 1 mL of its solution} = \frac{0.4}{100} = 0.004 \text{ (W}_1\text{) g}$$

$$\text{Weight of copper in 1 mL of its solution} = \frac{0.004 \times 63.54}{249.54} = 1.0185 \times 10^{-3} (\text{W}_2\text{) g}$$

Sl. No.	Volume of copper sulphate added (mL)	Volume of ammonia added (mL)	Optical Density
Blank	0.0	2.5	0.0
1.	2.0	2.5	0.03
2.	4.0	2.5	0.06
3.	6.0	2.5	0.09
4.	8.0	2.5	0.12
5.	10.0	2.5	0.15
Unknown	--	2.5	0.05

From the graph volume of copper sulphate present in the given solution is = 3.333 (V₁)mL

Amount of copper present in the given solution is = V₁ × W₂ g = 3.394 × 10⁻³ g = 3.394 mg.

REPORT:

Amount of copper present in the given unknown solution = 3.394 mg

Date of conduction				
Assessment	Conduction (10)	Procedure writing (10)	Quiz (5)	Total (25)
Faculty signature with date				

Quiz:

- 1) Beer Lambert's law is defined as - when a monochromatic light passes through a transparent medium, the rate of decrease in intensity with concentration of the absorbing species is proportional to the intensity of light.
- 3) Amount in CuSO_4 in 100ml = $\frac{4}{250} \times 100 = 1.6\text{g}$
 Weight of copper in 1ml soln = $\frac{0.016 \times 64}{249} = 4.112 \times 10^{-3} \text{ g}$
 Amount of Copper in unknown soln = $5.5 \times 4.112 \times 10^{-3} = 22.616 \text{ mg}$
- 4) Blank solution contains all of the components of the solution to be analyzed except for the one compound we are testing for. So that the instrument can zero out these background reading and only report values for the compound of interest.
- 5) Why Ammonia is added because the cupric ions (Cu^{2+}) react with ammonia to give a deep blue colour due to the formation of cupric ammonium complex ion.
- 6) The wavelength for maximum absorbance (λ_{max}) is 620nm, so the colorimetric estimation of copper is done at 620nm.

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PROCEDURE:

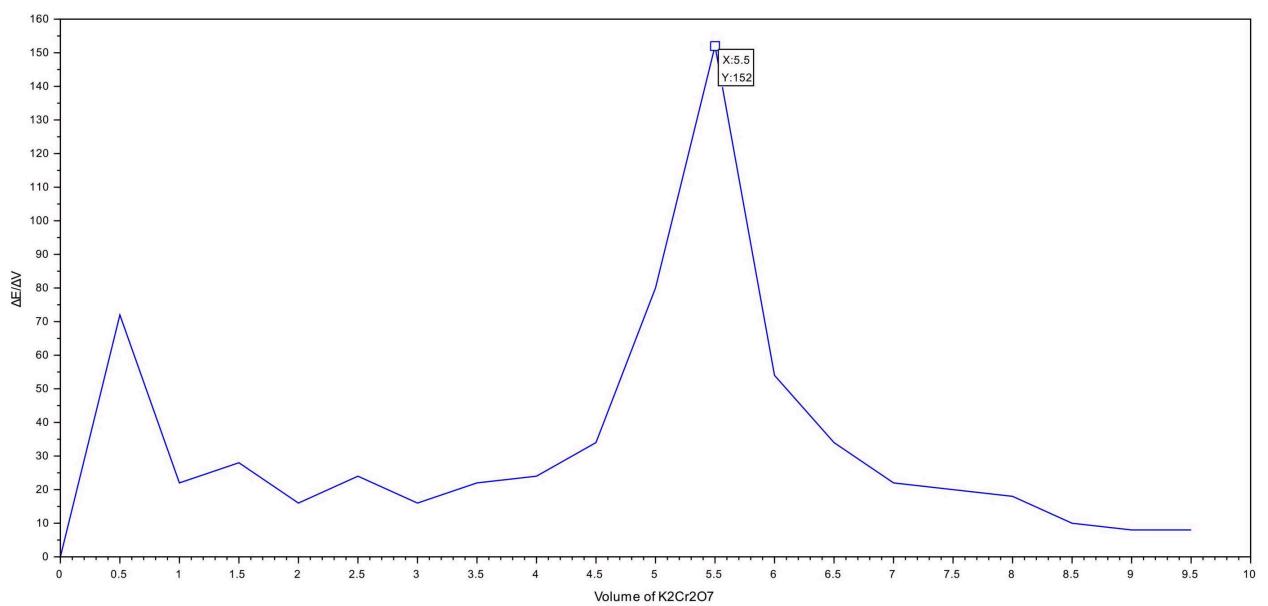
Video link: <https://player.vimeo.com/video/472895282>

AIM: Estimation of Ferroriron by Potentiometric Titration Method.

APPARATUS: Beaker, Pipette-Burette, FAS solⁿ, dil H₂SO₄, K₂Cr₂O₇ solⁿ, electrodes,

PROCEDURE :

- 25 ml of FAS solⁿ is pipetted out and taken in a beaker with a test tube full of dil H₂SO₄
- To this 0.5 ml of K₂Cr₂O₇ is titrated out dropping 0.5 ml at once and checking potential every 0.5 ml
- Potential is checked by dipping potential electrode as indicated and calomel as a reference.
- ΔE and ΔV are found by and ΔE/ΔV is determined.
- A graph of ΔE/ΔV v/s volume of K₂Cr₂O₇ is plotted.
- 'V' value is found using the peak of the graph.



OBSERVATIONS AND CALCULATIONS:

Sl. No.	Volume of $K_2Cr_2O_7$ added in mL	Potential (E) in mV	ΔE	ΔV	$\Delta E/\Delta V$
1.	0.0	328			
2.	0.5	364	36	0.5	72
3.	1.0	375	11	0.5	22
4.	1.5	389	14	0.5	28
5.	2.0	397	8	0.5	16
6.	2.5	409	12	0.5	24
7.	3.0	417	8	0.5	16
8.	3.5	428	11	0.5	22
9.	4.0	440	12	0.5	24
10.	4.5	457	17	0.5	34
11.	5.0	497	40	0.5	80
12.	5.5	573	76	0.5	152
13.	6.0	600	27	0.5	54
14.	6.5	617	17	0.5	34
15.	7.0	628	11	0.5	22
16.	7.5	638	10	0.5	20
17.	8.0	647	9	0.5	18
18.	8.5	652	5	0.5	10
19.	9.0	656	4	0.5	8
20.	9.5	660	4	0.5	8

Volume of $K_2Cr_2O_7$ required for the reaction = 5.5 'V' mL (From graph)

$$N_{FAS} = \frac{(NV)_{K_2Cr_2O_7}}{V_{FAS}} = \frac{0.1 \times 5.5}{25} = 0.022 \text{ (A)}$$

$$N_{FAS} = N_{Iron}$$

Amount of iron present in 1000 mL of its solution = $N_{FeS} \times$ Gram equivalent weight of iron

$$\text{Amount of iron present in 1000 mL of its solution} = A \times 55.85 = \underline{0.022} \times 55.85 \\ = \underline{1.2287} \text{ g}$$

REPORT:

Amount of iron present in the solution = 1.2287 g/dm³

Date of conduction	Conduction (10)	Procedure writing (10)	Quiz (5)	Total (25)
Assessment				
Faculty signature				

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Quiz:

- 1) There is a sudden (\uparrow) in potential at equivalence point due to complete neutralisation of soln during titration. Here complete neutralisation of FAS takes place.
- 3) Advantages of Potentiometric titration
 - Potentiometric titration is a rapid analysis method whereas volumetric estimation is slower.
 - Potentiometric titration requires less amount of reagents whereas volumetric requires a lot of equipment and chemicals.
- 5) Indicator electrode is used to sense the presence or change in concentration of oxidized and reduced forms of redox couple. e.g. Platinum electrode.
- 8) $N_{FAS} \cdot V_{FAS} = N_{K_2Cr_2O_7} \cdot V_{K_2Cr_2O_7}$
 $\hookrightarrow N_{FAS} \times 55 = 0.049 \times 48 \Rightarrow N_{FAS} = 0.00672$
 \therefore Gram equivalent weight of iron = 55.85
 \therefore Amount of iron = 0.00672×55.85
 $= 0.375\text{ g}$
- 9) Reagent used in preparation estimation of iron in FAS is Potassium dichromate ($K_2Cr_2O_7$)

PROCEDURE:

Video link: <https://vimeo.com/365550866/09bb52b40f>

AIM: To determine the pKa value of weak acid by pH Metre Titration

CHEMICALS: Acetic Acid, NaOH soln

APPARATUS: Beaker, Burette, Glass electrode, Distilled water, digital pH meter.

PROCEDURE:

- 1) Add 25 ml of (4N) acetic acid in a clean beaker
- 2) Drop a magnetic bead in the beaker to help stir the solution
- 3) Take a clean burette and fill it with standard NaOH soln upto your eye level, so we can see the lower meniscus properly.
- 4) Wash the combined glass electrode with distilled water and immerse the electrode into the beaker containing acetic acid and switch on the magnetic stirrer.
- 5) Note down the initial pH reading from the digital pH meter.
- 6) Now add 0.5 ml of NaOH from the burette to the beaker and wait of 10 seconds and note down the reading from pH meter.
- 7) Repeat step 5 until you see a sudden jump in the pH value take 4 additional readings after the sudden jump
- 8) Note down the readings, turn off the magnetic stirrer, clean the electrode with distilled water and dispose the used acetic acid soln and dip the electrode in a beaker of distilled water
- 9) From the observation table, plot a graph of 'vol of NaOH' against $\Delta \text{pH}/\Delta V$ and calculate equivalence point, half equivalence point, pH corresponding to half of point and pKa of given weak acid.

OBSERVATIONS AND CALCULATIONS:

Sl. No.	Volume of NaOH added in mL	pH	ΔpH	ΔV	$\Delta pH/\Delta V$
1.	0.0	2.37	—	—	—
2.	0.5	2.92	0.55	0.5	1.1
3.	1.0	3.13	0.23	0.5	0.46
4.	1.5	3.16	0.03	0.5	0.06
5.	2.0	3.45	0.29	0.5	0.58
6.	2.5	3.67	0.22	0.5	0.44
7.	3.0	3.82	0.15	0.5	0.3
8.	3.5	3.98	0.16	0.5	0.32
9.	4.0	4.17	0.19	0.5	0.38
10.	4.5	4.44	0.27	0.5	0.54
11.	5.0	4.84	0.40	0.5	0.8
12.	5.5	8.46	3.62	0.5	7.24
13.	6.0	10.26	1.8	0.5	3.6
14.	6.5	10.67	0.36	0.5	0.72
15.	7.0	10.79	0.17	0.5	0.34
16.	7.5	10.93	0.14	0.5	0.28
17.	8.0	11.00	0.07	0.5	0.04
18.	8.5	11.06	0.06	0.5	0.12
19.	9.0	11.11	0.05	0.5	0.1
20.	9.5	11.19	0.08	0.5	0.16

Plot the graphs and determine the pK_a of the given weak acid from the two graphs.

i) pH against volume of NaOH added

ii) $\Delta pH/\Delta V$ against Volume of NaOH added

From the graph:

Equivalence point: 5.5 (X) mL

Half equivalence point: 2.25 (X/2) mL

pH corresponding to half equivalence point: 3.56 (Y)

pK_a of the given weak acid: 3.56 (Y)

REPORT:

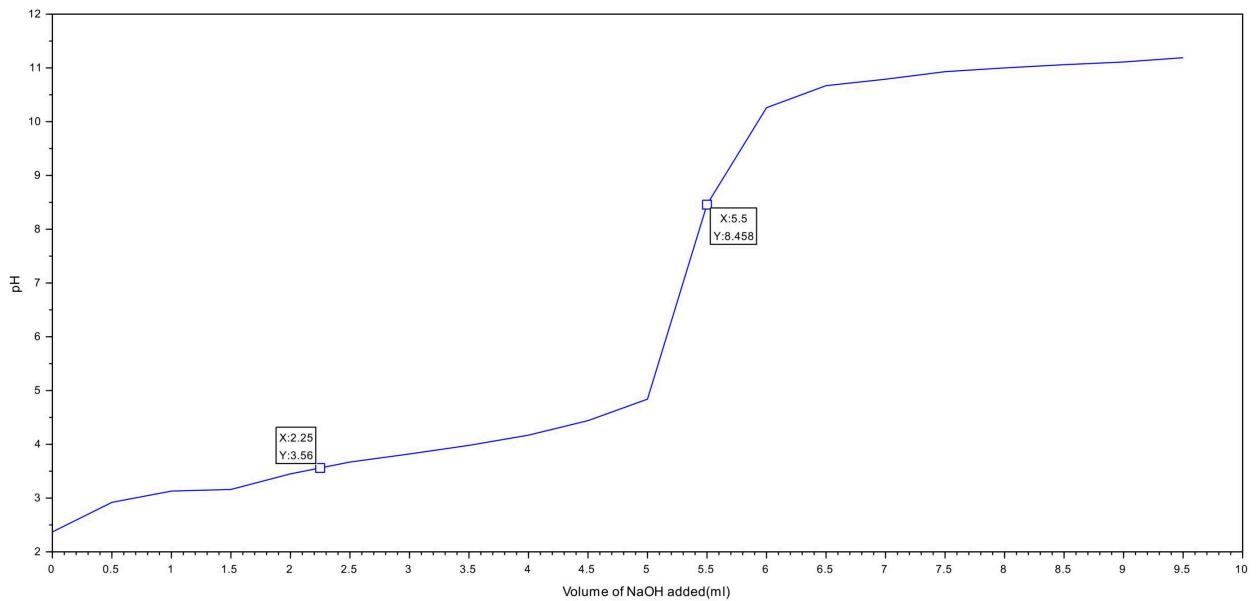
pK_a of the given weak acid = 3.56

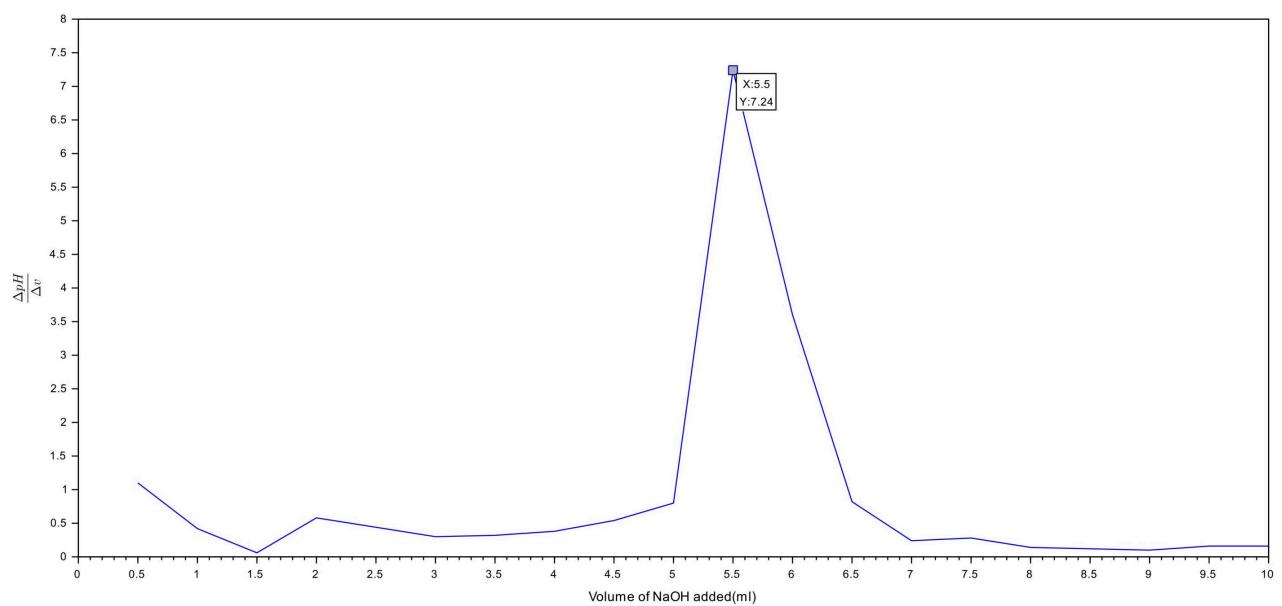
Date of conduction

Conduction (10) Procedure writing (10) Quiz (5) Total (25)

Assessment

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with date**





Quiz:

1) pKa is the number that describes the acidity of a molecule

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

For a weak acid eq:-



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

2) A glass electrode along with a calomel electrode (combined electrode) is used to find value of pKa. If it is called so, as it is used to find the H⁺ ion activity using a glass bulb.

3) Glass electrode and calomel electrode

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

4) It is the measure of tendency of an acid to donate proton

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

5) It is a type of ion selective electrode made by doping to identify specific ions

6) They are the solutions which resist change in pH upon dilution. An acid buffer is formed during pKa experiment

$$W.A \rightarrow \text{CH}_3\text{COOH}; S.A \rightarrow \text{HCl}; W.B \rightarrow \text{NH}_4\text{OH}; S.B \rightarrow \text{NaOH}$$

7) At equivalence point, a small excess of acid becomes a small excess of base with addition of a few more drops, so pH abruptly changes thus accounts for sudden jump.

PROCEDURE:

Video link: <https://vimeo.com/366421847/a840c64ed7>

Chemicals required: Biphenyl and Naphthalene

Apparatus required : Electronic weight balance, spatula, temperature probe, stopwatch, waterbath, Boiling tube

Procedure:

- In the experiment we have to take different composition of naphthalene and Biphenyl
- Out of which we start with one composition (0.5g naphthalene and 1.5g of Biphenyl)
- Use small piece of paper to weigh the chemicals
- First weigh the paper and set it to zero using kar
- Using spatula weigh exactly 0.5g of naphthalene and 1.5g of Biphenyl
- Transfer all the crystals into boiling tube
- Keep boiling tube in water bath and start heating
- Mixture starts melting
- Once the mixture is completely liquefied, measure the temperature using temperature probe.
- Measure temperature (initially it increases and reached the maximum value of 80°C)
- Once the temperature starts falling, record the temperature every 30 sec
- Record the temperature for 30 min.
- In same way we must record temperature for all the composition of naphthalene and biphenyl

OBSERVATIONS AND CALCULATIONS:**Table 1 : 0.5 g Naphthalene and 4.5 g Biphenyl**

Time (min)	Temp. (°C)	Time (min)	Temp. (°C)	Time (min)	Temp. (°C)
0.0	61.8	10.5	55.5	21.0	44.1
0.5	61.3	11.0	55.1	21.5	43.7
1.0	60.9	11.5	54.8	22.0	43.3
1.5	60.5	12.0	54.2	22.5	42.9
2.0	60.0	12.5	53.8	23.0	42.7
2.5	59.5	13.0	53.2	23.5	42.3
3.0	59.1	13.5	52.6	24.0	42.1
3.5	58.7	14.0	52.0	24.5	41.8
4.0	58.3	14.5	51.5	25.0	41.5
4.5	58.1	15.0	50.7	25.5	41.2
5.0	58.0	15.5	50.1	26.0	40.9
5.5	58.0	16.0	49.4	26.5	40.8
6.0	58.0	16.5	48.8	27.0	40.4
6.5	57.9	17.0	48.7	27.5	40.2
7.0	57.8	17.5	47.9	28.0	40.0
7.5	57.5	18.0	47.8	28.5	39.8
8.0	57.3	18.5	47.7	29.0	39.5
8.5	57.1	19.0	48.9	29.5	39.3
9.0	56.8	19.5	45.3	30.0	39.1
9.5	56.1	20.0	44.9	30.5	38.9
10.0	55.9	20.5	44.5	31.0	38.8

From the graph, (Temperature vs Time)

Freezing point of the mixture = 65 °CEutectic point = 45 °C

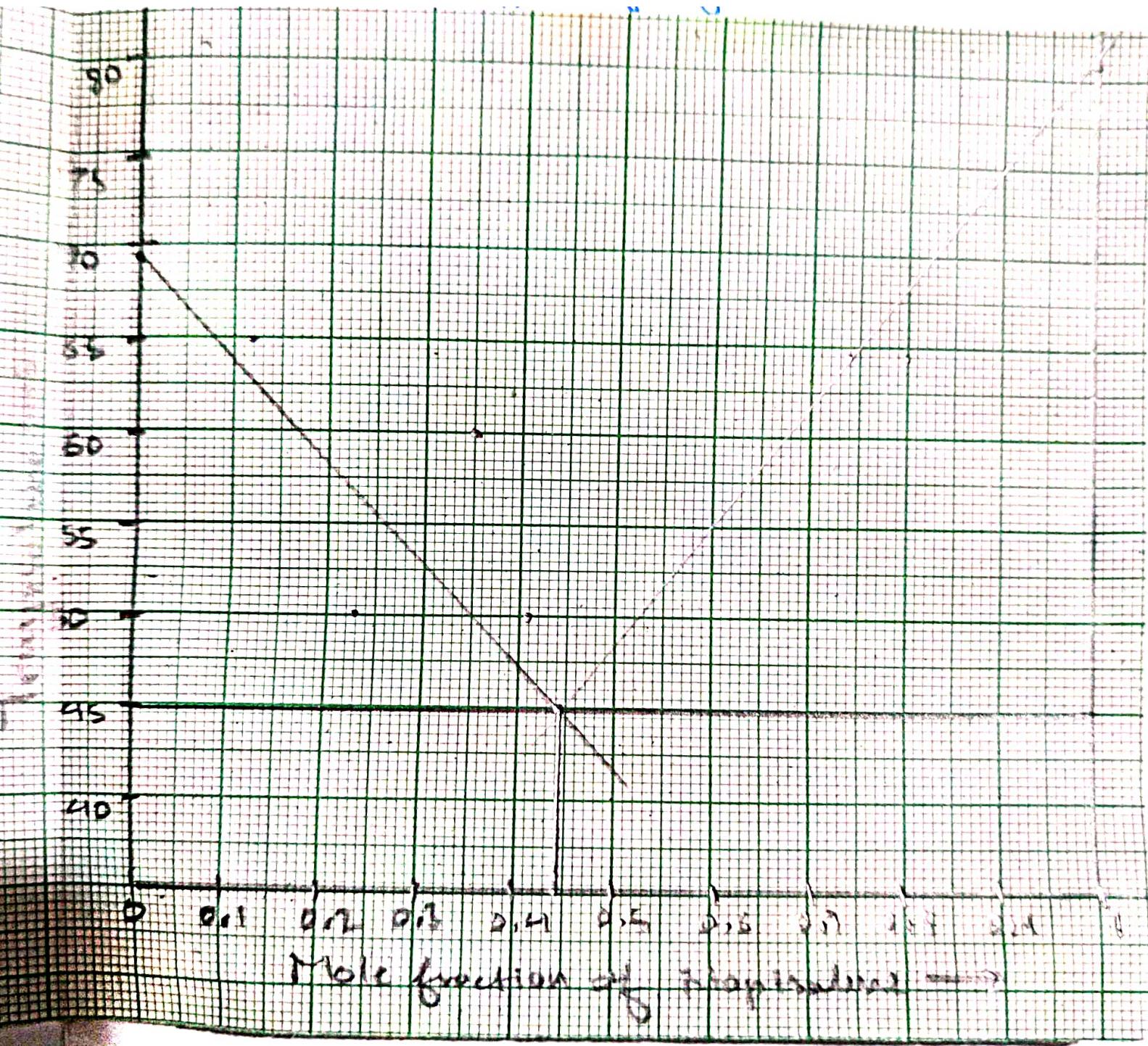
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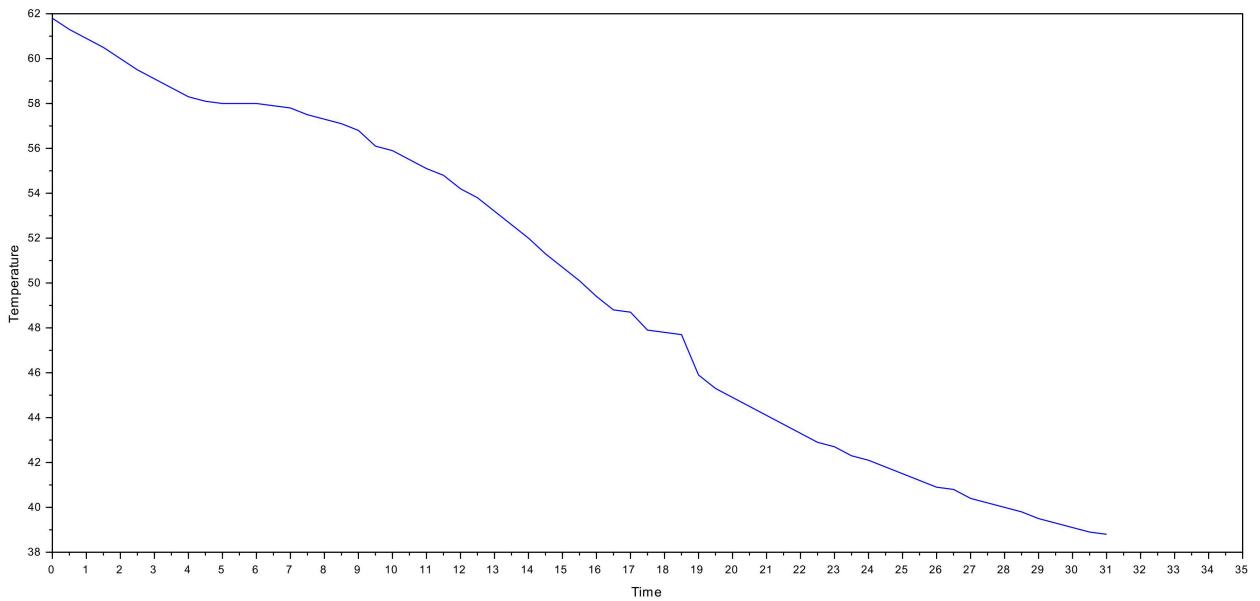
Table 2: Freezing points for Naphthalene-Biphenyl mixtures:

Sample	Mass of Naphthalene (g)	Mass of Biphenyl (g)	Mole fraction of Naphthalene	Eutectic point (°C)	Freezing point (°C)
1	0.0	Pure Biphenyl	0.0		69.2
2	0.5	4.5	0.12	45°C	65°C
3	1.0	4.0	0.23	45°C	51°C
4	1.5	3.5	0.35	45°C	60°C
5	2.0	3.0	0.41	45°C	50°C
6	3.0	2.0	0.44	45°C	45°C
7	3.5	1.5	0.74	45°C	64°C
8	4.0	1.0	0.80	45°C	64°C
9	4.5	0.5	0.89	45°C	
10	Pure Naphthalene	0.0	1.0	45°C	80.2

REPORT:A) Eutectic composition (mole fraction of naphthalene) = 0.49B) Eutectic temperature = 45°C

Date of conduction	1-1-17			
Assessment	Conduction (10)	Procedure writing (10)	Quiz (5)	Total (25)
Faculty signature with date				





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Quiz:

1. For pure solid: When the freezing point is reached, T remains constant until the liquid fully solidify.
- For eutectic point: When crystallisation of one of the component starts, cooling curve exhibits a break. The temperature decreases continuously until the eutectic point.
2. Eutectic solid have a single melting point and single eutectic composition.
3. In Naphthalene and Biphenyl system, Condensed phase rule is applied because the pressure of the system is monitored at constant atmospheric pressure.
4. Eutectic point is lowest possible temperature at which liquid phase is stable at a given ~~temperature~~ pressure.
5. Freezing point is a temperature at which liquid becomes solid.
6. degree of freedom at eutectic point
 $P = 3, C = 2$
 $F = C - P + 1 = 0$
7. degree of freedom along the freezing point curve.
 $P = 2, C = 1$
 $F = C - P + 2 = 1$

PROCEDURE:

Video link: <https://vimeo.com/365298616/c37ad31b43>

Chemicals required: Polyvinyl alcohol, acetone

Apparatus required: Viscrometer, volumetric flask, stop watch, Burette, stand

Procedure:

- Prepare the soln of polyvinyl alcohol of concentration 0.2 g /dL and 0.5 g /dL
- Make sure that viscometer is clean and dry
- Fix the viscometer to a vertical stand in a constant temperature bath.
- Allow it to thermally equilibrate for 5 minutes
- Suck the soln through smaller bulb up the upper mark
- Allow the soln to move down the capillary
- Start the stop watch when soln is at upper mark
- Stop the stop watch, when it crosses the lower mark
- Note down the time taken.
- In the same way take the timing of 2nd and 3rd trial of same soln
- Calculate the average t in sec.
- Follow the same procedure to get the flow time of 0.2 g /dL and 0.5 g /dL soln
- Once the flowtime is found calculate the average
- every time before taking different soln, clean the viscometer with acetone and allow it to dry.

OBSERVATIONS AND CALCULATIONS:

Solvent used	= Water
K of poly vinyl alcohol-water system	= 45.3×10^{-4}
'a' of poly vinyl alcohol-water system	= 0.64

Sl No	Cone. g/dL (C)	Flow time (t) sec	$\eta_r = \frac{t}{t_0}$	$\eta_{sp} = \eta_r - 1$	$\frac{\eta_{sp}}{C}$
1	0.0 (distilled water)	Trial 1= 1.0 Trial 2= 1.0 Trial 3= 1.0 Average t ₀ = 1.0	$\eta_r = 1$	0	0
2	0.2	Trial 1= 1.155 Trial 2= 1.155 Trial 3= 1.155 Average t = 1.155	$\eta_r = 1.155$	0.155	0.725
3	0.5	Trial 1= 1.53 Trial 2= 1.53 Trial 3= 1.53 Average t = 1.53	$\eta_r = 1.53$	0.53	1.06

[η] from the graph = 0.586

Substituting the values of K, a and [η] in Mark-Houwink equation, $[\eta] = KM^a$

$$M^a = \frac{[\eta]}{K}$$

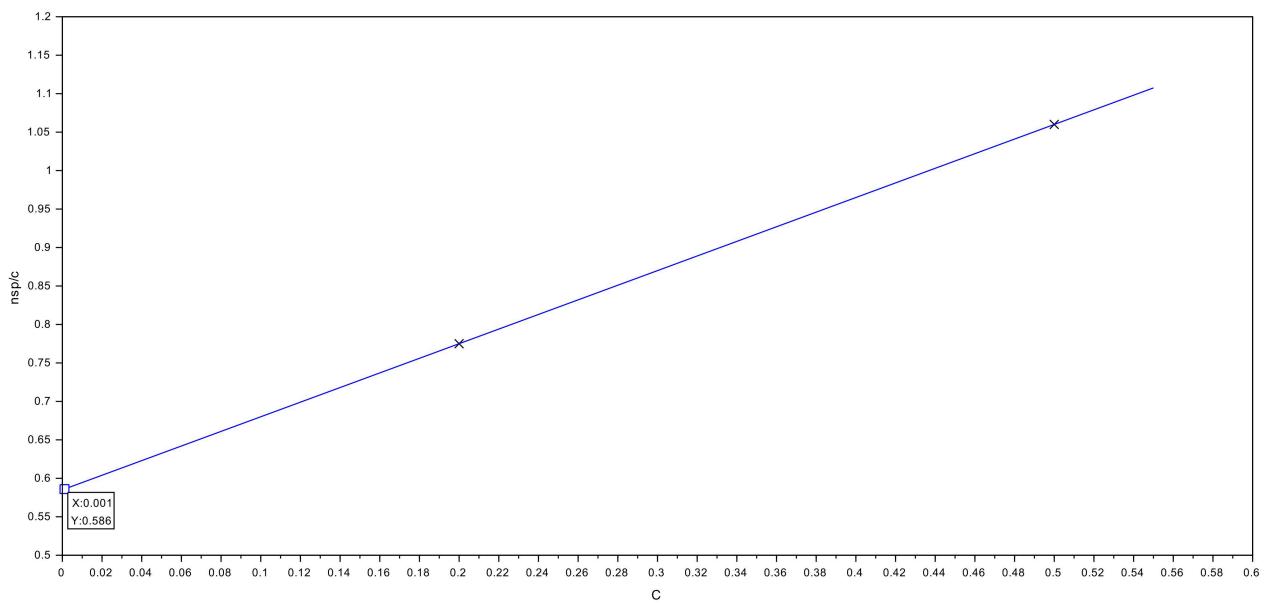
$$\text{Therefore } M = \left[\frac{[\eta]}{K} \right]^{1/a} = \left(\frac{0.586}{45.3 \times 10^{-4}} \right)^{\frac{1}{0.64}}$$

$$M = 72808.53$$

REPORT:

Viscosity average molecular weight of poly vinyl alcohol = 72808.53 g

Date of conduction	Assessment			
	Conduction (10)	Procedure writing (10)	Quiz (5)	Total (25)
Faculty signature with date				



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Quiz:

- Viscosity coefficient of a liquid is the tangential force per unit area required to maintain a unit velocity gradient between two successive layer of liquid situated unit distance apart.
- Because in the estimation of molecular weight of polymer, radius and length are considered constant. So we require same viscometer for correct results
- $[\eta] = K \times M^a$
 - $\eta \rightarrow$ viscosity coefficient
 - $M \rightarrow$ Molecular weight
 - K and $a \rightarrow$ constant of a particular polymer
- Nature and Temperature of Liquid.
- Intrinsic viscosity $[\eta] = \lim_{C \rightarrow 0} \frac{\eta_{sp}}{C}$ extrapolated value of $\frac{\eta_{sp}}{C}$ at zero concentration
- $\eta = 0.73$
 $K = 11.5 \times 10^{-5}$
 $a = 0.73$
 $[\eta] = K \times M^a$
 $\Rightarrow M = \left[\frac{[\eta]}{K} \right]^{1/a} = 161836.08$

PROCEDURE:

Video link: <https://vimeo.com/365325177/d60cfdeb75>

Chemicals Required: Hard water, Ammonia, Buffer solⁿ, Eno-chromic block T (EBT)

Apparatus required: Burette, pipette, volumetric flask, small funnel and crucible, conical flask, beaker, bunsen burner, weighing balance, pH meter, conductivity meter.

Procedure:Part 01: Determination of pH

- Take water sample in a beaker and measure pH using glass electrode and note down the pH value.

Part 02: Determination of conductivity

- Take water sample in a beaker, and measure pH conductivity using conductivity cell and note down the value.

Part 03: Total dissolved salt (TDS)

- Note down the weight of clean, dry empty crucible
- Pipette 25ml of water sample in crucible and allow it to evaporate
- Once the crucible is cooled to room temperature, Note down the weight of crucible

Part 04: Preparation of Standard EDTA Solⁿ

- Take calculated weight of salt in a volumetric flask
- Add one test tube full of ammonia
- add distilled water up to the mark and Homogenize the solⁿ

Part 05: Estimation of Hardness

- Fill the burette with prepared EDTA solⁿ
- Add one test tube full of ammonia
- Pipette out 25ml of Hard water in a conical flask
- Add 1/4th of test tube of Buffer solⁿ (to maintain pH level)
- Add pinch of EBT indicator (colour changes to wine red)
- Titrate this against Na₂EDTA solⁿ
- End point is reached once the colour changes to clear blue
- Note down the volume of Na₂EDTA required for end point
- Repeat the same procedure and take 2 more trials.

OBSERVATIONS AND CALCULATIONS:

A) pH:

$$\text{pH of the water sample} = \underline{\underline{7.4}}$$

B) Conductivity:

$$\text{Cell constant of conductivity cell} = \underline{\underline{1 \text{ cm}^{-1}}}$$

$$\text{Conductance of the water sample} = \underline{\underline{1.14 \times 200 \text{ mS}}}$$

$$\text{Conductivity of the water sample} = K = \text{Cell Constant} \times \text{Conductance of the water sample}$$

$$K = \underline{\underline{1 \times 1.14 \times 200 \text{ mS cm}^{-1}}}$$

C) Total dissolved salts:

$$\text{Weight of empty crucible} = \underline{\underline{39.5822 \text{ (W}_1\text{ g)}}}$$

$$\text{Weight of crucible after evaporation} = \underline{\underline{39.6249 \text{ (W}_2\text{ g)}}}$$

$$\text{TDS} = \frac{W_2 - W_1}{10} \times 10^6 \text{ ppm}$$

$$= \underline{\underline{4.27 \times 10^3 \text{ ppm}}}$$

D) Hardness:

a) Preparation of standard Na₂EDTA solution:

Weight of weighing bottle + Na ₂ EDTA	6.6142 g
Weight of empty weighing bottle	3.8839 g
Weight of Na ₂ EDTA salt transferred	2.73 g

$$\text{Molarity of Na}_2\text{EDTA solution} = \frac{\text{Weight of Na}_2\text{EDTA dissolved in } 250 \text{ mL} \times 4}{\text{Gram molecular weight of Na}_2\text{EDTA}}$$

$$= \frac{2.73}{372.14} \times 4$$

$$= \underline{\underline{0.029 \text{ (A)}}}$$

b) Estimation of hardness:Burette : Na₂EDTA solution

Conical flask : 25 mL hard water + 3 mL buffer solution

Indicator : Pinch of Eriochrome black-T

End point : Wine red to pure blue

Burette readings	Trial-I	Trial-II	Trial-III
Final	8	15	22.6
Initial	0	8	15
Volume of Na ₂ EDTA required (mL)	8	7	7.6

Volume of Na₂EDTA consumed for 25 mL hard water = 7.6 (B) mL1000 mL of 1M Na₂EDTA ≡ 100 g of CaCO₃

$$\text{Therefore, 'B' mL of 'A' M Na}_2\text{EDTA} = \frac{100 \times A \times B}{1000} = \frac{100 \times 0.021 \times 7.6}{1000}$$

$$= \underline{\underline{0.02204}} \text{ (C) g of CaCO}_3$$

25 mL of hard water contains 'C' g of CaCO₃

Therefore,

$$10^6 \text{ mL of hard water contains } \frac{C \times 10^6}{25} \text{ g of CaCO}_3 = \underline{\underline{880.6}} \text{ g of CaCO}_3$$

$$\underline{\underline{881.6}} \text{ g}/10^6 \text{ ml hard water} = \underline{\underline{881.6 \times 10^{-6}}} \text{ mg/dm}^3 = \underline{\underline{881.6 \times 10^{-6}}} \text{ ppm}$$

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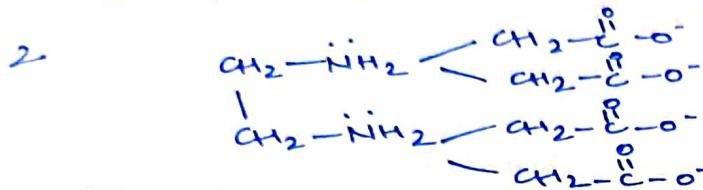
REPORT:A) pH of water = 7.4B) Conductivity of water sample = 280 mS cm⁻¹C) Total dissolved salts in water = 4.27×10^3 ppmD) Total hardness of water = 0.8816×10^{-3} ppm

Date of conduction				
Assessment	Conduction (10)	Procedure writing (10)	Quiz (5)	To
Faculty signature				

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Quiz:

1. Temporary hardness is the hardness of water due to presence of bicarbonates of Magnesium and Calcium (can be removed easily by boiling of water)



3. Colour change towards the end of reaction is due to the following reaction



- $$7. \text{ } 30 \text{ ml of hardwater has } \frac{100(18.3)(0.08)}{10^6} = 0.146 \text{ g of Total hardness}$$

10. Buffer soln is the soln that resists the change in pH (Ammonium buffer)

11. EDTA forms very stable complexes with the metal ion, present in hard water and since stability constants are different, selective estimation of these ions is also possible.

15. Control of pH is important, as H⁺ ions play important role in chelation of ligands.

PROCEDURE:

Video link: <https://vimeo.com/365552326/0de82b5573>

Chemicals Required: Industrial waste water sample, Potassium dichromate soln,
Feroin Indicator, Sulphuric acid

Apparatus required: 250 ml volumetric flask, 25 ml pipette, 10 ml pipette,
Conical flask, funnel, Burette, test tube

Procedure:

- Transfer FAS soln upto the mark

BLANK TITRATION

- Transfer 25 ml of $K_2Cr_2O_7$ into clean conical flask
- Add 2 dropper full of H_2SO_4 to the flask
- Add 3 drops of feroin indicator (Soln turns bluish green colour)
- Titrate the soln against standard FAS soln taken in burette.
- Once the colour changes from bluish green to ~~reddish~~ end point is reached.
- Note down the FAS required for end point.

BACK TITRATION

- Pipette out 25 ml of industrial waste water in conical flask
- Pipette out 25 ml of $K_2Cr_2O_7$ to the same flask.
- Add 2 dropper full of H_2SO_4
- Add 3 dropper of feroin Indicator (solution turns bluish green colour)
- Titrate against the standard FAS, until colour changes to ~~reddish~~.
- Once the colour is changed - end point is reached. Note FAS volume required
- Follow same procedure to do more trials.

PREPARATION OF FAS SOLUTION

- Take specific weight of salt (FAS) and transfer in volumetric flask.
- Add 2-3 drops of H_2SO_4
- Dilute with water upto the mark and dissolve the salt completely.
- Transfer the FAS soln upto mark in burette.

OBSERVATIONS AND CALCULATIONS:**A) Preparation of standard FAS Solution:**

Weight of the Weighing Bottle + FAS	=	7.417	g
Weight of the empty weighing bottle	=	3.9248	g
Weight of the FAS salt transferred	=	3.5	g

$$\text{Normality of FAS Solution} = \frac{\text{Weight of FAS dissolved in } 250 \text{ mL} \times 4}{\text{Gram equivalent weight of FAS salt}} = \frac{3.5 \times 4}{392.13}$$

$$\text{Normality of FAS Solution} = \underline{0.03} \text{ (A)}$$

B) Blank titration:

Burette : FAS Solution

Conical Flask : 10mL of $\text{K}_2\text{Cr}_2\text{O}_7$ + 3/4th test tube of 1:1 sulfuric acid

Indicator : 3-4 drops of Ferroin

End point : Bluish Green to Reddish Brown

Burette Readings	Trial-I
Final	15.6
Initial	0.0
Volume of FAS run down in mL	15.6

$$\text{Volume of FAS consumed for Blank Solution} = \underline{15.6} \text{ (V}_1\text{) mL}$$

C) Back titration (Estimation of COD):

Burette : FAS solution

Conical flask : 25 mL of water sample + 10 mL of $\text{K}_2\text{Cr}_2\text{O}_7$ + 3/4th test tube of 1:1 H_2SO_4

Indicator : 3-4 drops of Ferroin

End point : Bluish Green to Reddish Brown

Burette Readings	Trial-I	Trial-II	Trial-III
Final	27.7	40	12.7
Initial	15.6	27.7	0
Volume of FAS run down in mL	12.1	12.3	12.7

$$\text{Volume of FAS consumed for } 25 \text{ mL of water sample solution} = \underline{12.36} \text{ (V}_2\text{) mL}$$

Amount of $K_2Cr_2O_7$ (in terms of FAS) that has reacted with waste water sample = $(V_1 - V_2)$ mL

Amount of $K_2Cr_2O_7$ (in terms of FAS) = 3.24 mL

1000 mL of 1N FAS solution = 1 Equivalent of Oxygen = 8 g of Oxygen

$$(V_1 - V_2) \text{ mL of 'A' N FAS solution} = \frac{8 \times (V_1 - V_2) \times A}{1000} = \frac{8 \times (15.6 - 12.38) \times 0.03}{1000}$$

$$= \frac{777.6 \times 10^{-6}}{1000} = \underline{\underline{777.6}} \times 10^{-6}$$

= (B) g of oxygen

25 mL of Industrial waste water requires 'B' g of Oxygen

$$\text{Therefore, } 1000 \text{ mL of Industrial waste water requires} = \frac{B \times 1000}{25} = \frac{\cancel{777.6} \times 1000 \times 10^{-6}}{25}$$

$$= \underline{\underline{0.031104}} \text{ (C) g of oxygen}$$

$$= \underline{\underline{31.104}} \text{ (D) mg of oxygen}$$

REPORT:

COD of the given sample of Industrial waste water = 31.104 ppm

Date of conduction				
Assessment	Conduction (10)	Procedure writing (10)	Quiz (5)	Total (25)
Faculty signature with date				

Prashant
Date: 27/10/2022
Signature: _____

Prashant
Date: 27/10/2022
Signature: _____

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Quiz:

1. BOD is defined as the amount of dissolved oxygen needed by biological organisms in the body of water to break down.



COD	BOD
COD is performed by chemical reagents	BOD is performed by aerobic organisms
COD is capable of degrading industrial waste	BOD is used to oxidize natural organic matter
COD completes within hours and is very accurate	BOD takes many days to complete and is not very accurate

- a. Amount of O_2 required = $\frac{8(45-12.5) \times 0.05}{1000} = \frac{13 \times 10^{-3} \times 1000}{25} = 0.52 \text{ mg} = 0.52 \text{ ppm}$
10. Silver sulphate acts as an oxidizing agent and Mercuric sulphate binds with halide ion
13. COD is the measure of amount of Oxygen required to oxidize the waste materials
17. We need to determine COD as it is an important water quality parameter and gives the measure of waste present in water and is more accurate than BOD
19. Blank titration is carried out to account for any impurities or contaminants in the reagents used

