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Critical solution Temperature

Date - 21-11-2023

Aim

To determine critical solution Temperature of phenol water system and variation of CST in presence of KCl

Principle

The Temperature at which two partially miscible liquids becomes completely miscible is called critical solution temperature. Mixtures of phenol and different compositions of water is taken and their miscibility temperatures are plotted against their compositions. The maximum temperature point on the curve obtained is the critical temperature.

The critical solution temperature of the partially miscible liquids in fixed proportion increases linearly with the concentration of the impurity soluble only in one liquid.

Procedure

5 ml of phenol is taken in a boiling tube. 2 ml of water is added to it from burette. It is stirred well and the temperature at which two liquids becomes completely miscible is noted. The mixture is then cooled by an air jacket and the temperature at which the turbidity appears is noted. The average of the two values is taken as the miscibility temperature. The experiment is repeated by adding 2 ml

Observation

Phenol-Water System

Trial no:	Phenol	water	Disappear	Appear	Miscible temperature
1	5 ml	2 ml	53.8	52	53.85
2	5 ml	2 ml	54.4	54.5	54.45
3	5 ml	4 ml	65	64	64.5
4	5 ml	4 ml	66	65	65.5
5	5 ml	6 ml	67	67.3	67.15
6	5 ml	6 ml	67	68	67.5
7	5 ml	8 ml	68	69	68.5
8	5 ml	8 ml	69	69.7	69.35
9	5 ml	10 ml	69.6	69.5	69.55
10	5 ml	10 ml	69.1	70	69.6
11	5 ml	12 ml	70	70.5	70.25
12	5 ml	12 ml	70.5	71.2	70.85
13	5 ml	14 ml	71	70	70.5
14	5 ml	14 ml	69.1	69.8	69.45
15	5 ml	16 ml	69	68	68.5
16	5 ml	16 ml	69	67.8	68.4
17	5 ml	18 ml	68	67	67.5
18	5 ml	18 ml	67	67.5	67.25
19	5 ml	20 ml	66	65	65.5
20	5 ml	20 ml	65	66	65.5

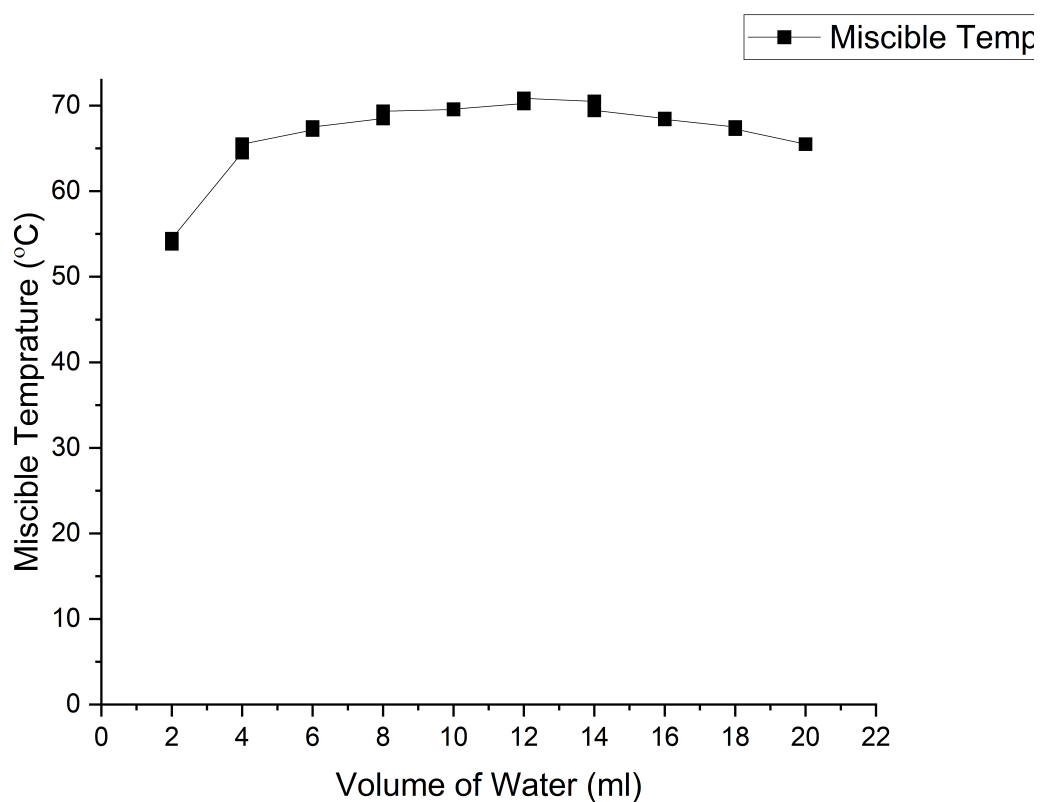


Figure 1: Miscibility temparture vs Volume of Phenol in water

Effect of KCl on Phenol Water System

Trial no:	KCl	phenol	Disappear	Appear	Miscible temperature
1	5 ml	5 ml	76.5	76	76.25
2	5 ml	5 ml	76	76	76
3	10 ml	5 ml	75	75	75
4	10 ml	5 ml	75	74	74.5
5	15 ml	5 ml	75	73	74
6	15 ml	5 ml	74.5	73	73.75
7	20 ml	5 ml	71.5	73	72.25
8	20 ml	5 ml	69	69.5	66.75

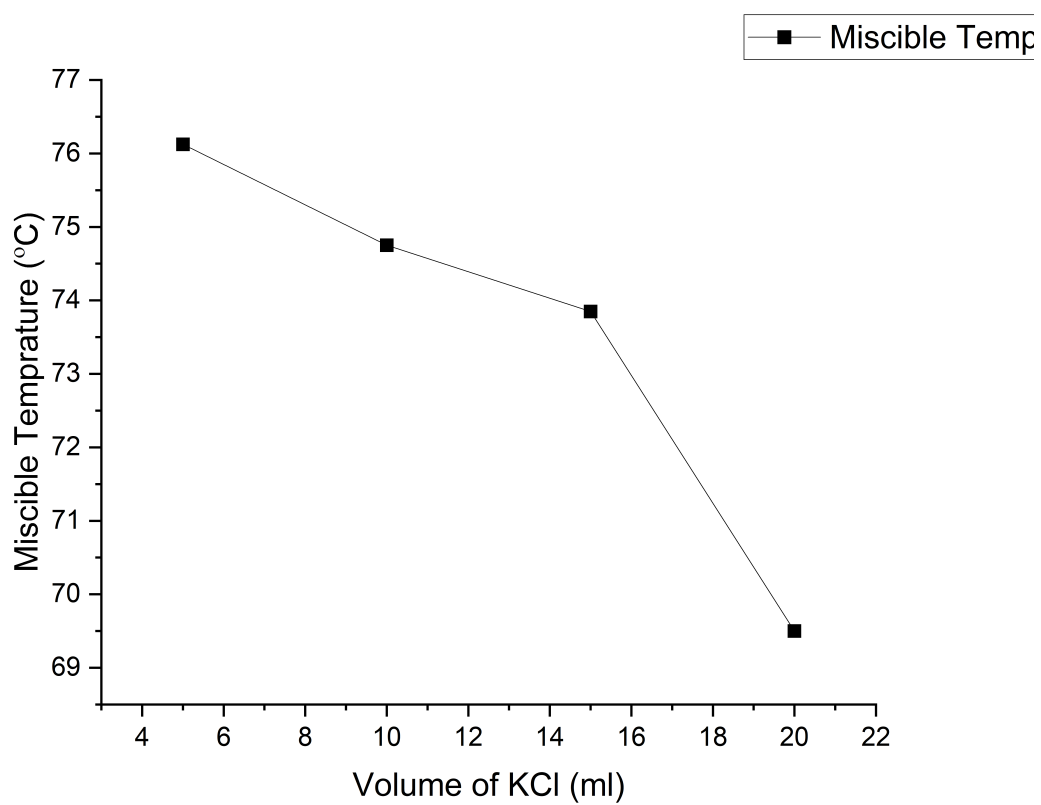


Figure 2: variation of CST of Phenol-Water system with change in conc. of KCl

Result

The maximum of the graph gives CST of the phenol water system

Critical solution temperature of phenol water system in degree celsius = 76.25°C

Composition From Viscosity Measurement

Date - 5-12-2023

Aim

Determine viscometrically the percentage composition of given sucrose solution.

Principle

The viscosity of the solution increases linearly with the concentration. By measuring the time of flow of the solution of different concentrations through a capillary tube, a graph is drawn between time of flow and the percentage composition. From the graph, the concentration of the given solution can be found by measuring its time of flow.

Procedure

Prepare sucrose solutions of different concentrations 1%, 2%, 3%, 4% etc. Using the 15 percentage of stock solution of sucrose the viscometer is cleared. It is dried and rinsed with the sugar solution. Pipetted volume (10ml) of the solution into the limb of the viscometer using a rubber tube. Suck the solution through the capillary tube above the mark and release. When the solution just passes over the mark. Start stop watch and stop it when the solution just crosses the mark below the bulb. The time of flow is found out two or three times and the average time is found out. Clean the viscometer each time and dry or rinse when fresh solution is used. Repeat the experiment with sugar solution of known concentrations. A graph is drawn between the time of flow and percentage of composition. From the graph the percentage of composition of unknown solution is found out.

Observation

No.	Composition %	Time of Flow (s)
1	0	99
2	1	95
3	2	98
4	3	99
5	4	101
6	5	103
7	4	108

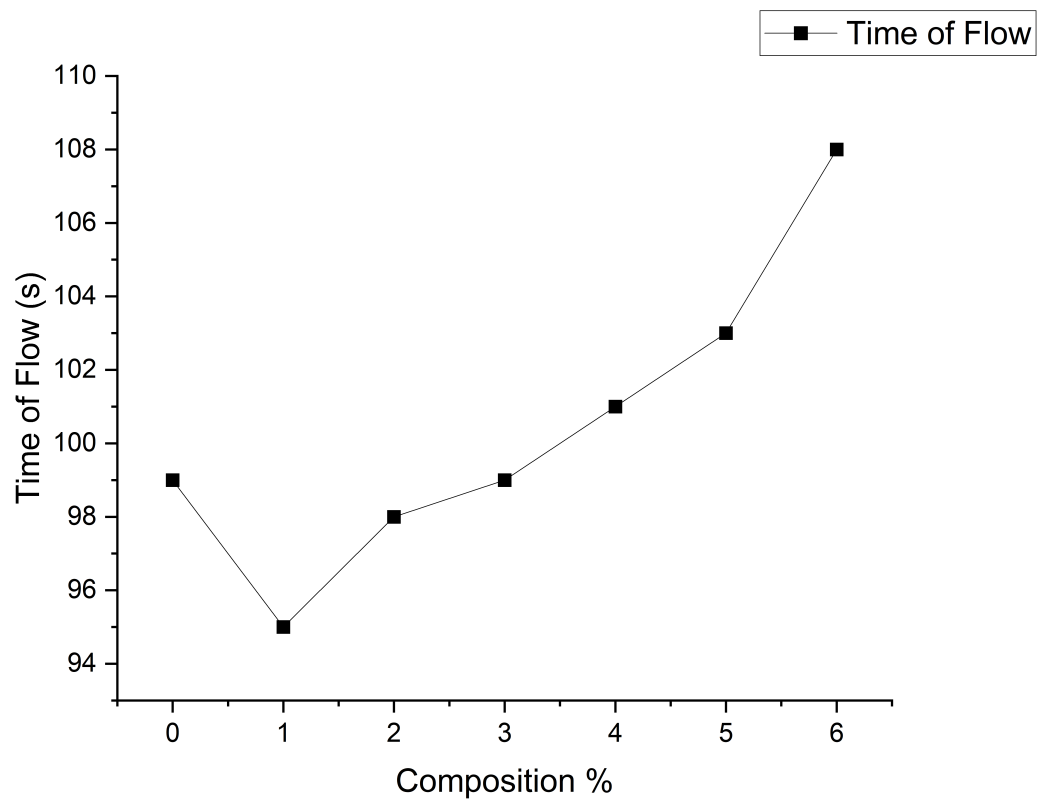


Figure 3: Composition percentage vs Time of Flow in seconds

Result

The percentage composition of given solution is 4

Caliberation of pH meter and Measurement of pH of solution

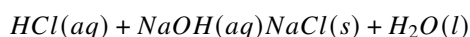
Date - 5-12-2023

Aim

To perform pH metric titration of a strong acid Hydrochloric acid with a strong alkali sodium hydroxide.

Principle

The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. It affords a direct method of obtaining a titration curve. The titration curve is a graph of measured pH values versus the volume (ml) of titrant added. The pH values of the solution at different stage of acid-base neutralization are determined and plotted against the volume of alkali added. On adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H^+ ion decreases gradually due to the consumption of some amount of HCl by NaOH resulting in the formation of NaCl (whose amount will be the same as that of NaOH added).



Procedure

A 0.1(M) HCl solution and unknown concentration of NaOH solution are given. With pH 4, 7, and 10 solutions, calibrate the pH metre. When cleaning the electrode, use purified water and tissue or filter paper. Place the electrode in a 25ml solution of NaOH in a 50ml beaker. Make a note of the pH range. Rinse the burette twice: once with HCl solution and once with distilled water. After that, pour HCl solution into the burette. The pH value of the NaOH solution is indicated by the reading on the pH meter's scale. Using a glass rod to vigorously stir the mixture, add drops of HCl solution from the burette (1ml at a time), then record the resulting pH values. Because the acid is neutralised and there will be a dramatic increase in pH values near the end point, the volume of HCl administered should be as tiny as possible.

Even a small further addition of 1ml of HCl will raise the pH level to around 9-10. After each pH measurement, reset the selection to its initial position, and maintain it there whenever it's not in use.

Plot the graph of pH of solution v/s volume of HCl in ml.

Observation

Sl.No.	Composition	pH of solution
1	HCl + 1 ml NaOH	12.02
2	HCl + 2 ml NaOH	12.12

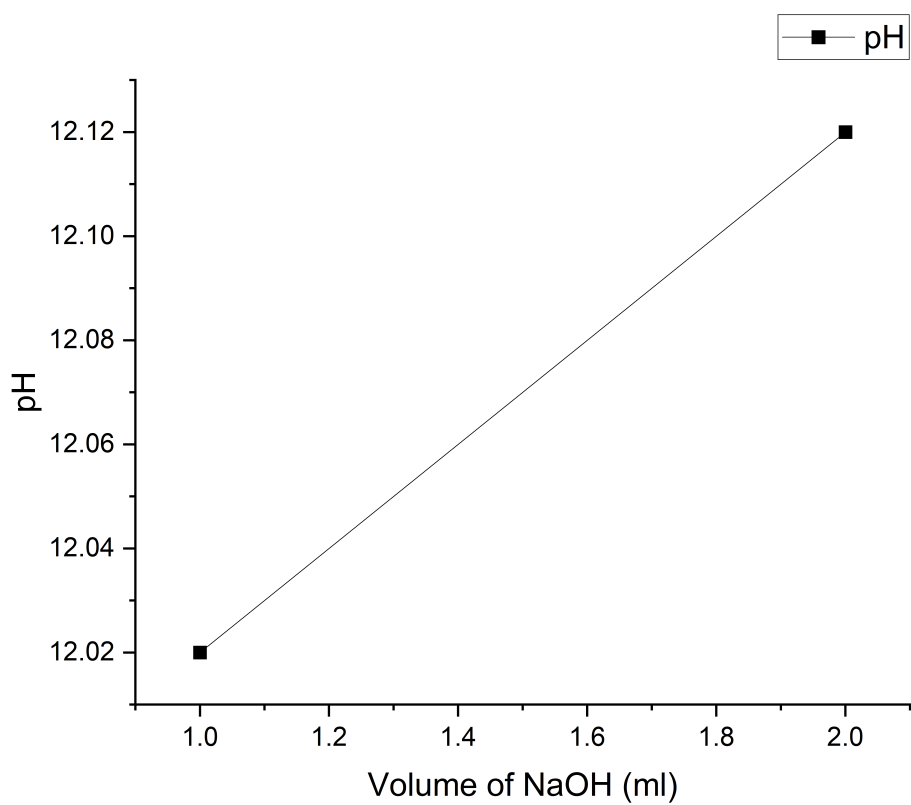


Figure 4: Variation of pH with NaOH added

Result

The graph of pH of solution v/s volume of HCl is plotted.

Calorimetric Determination of copper ions in solution

Date - 23-01-2024

Aim

Estimate the mass of copper in the whole of the given copper sulphate solution.

Principle

When a monochromatic light of intensity I_0 is incident on a transparent medium a part, I_a of it is absorbed, a part I_r is reflected and the remaining part I_t is transmitted.

$$I_0 = I_a + I_r + I_t$$

$$\text{Glass-air interface} = I_0 = I_a + I_t$$

$\frac{I_t}{I_0}$ is called transmittance.

$\log \frac{1}{T}$ is called the absorbance optical density.

By Beer-Lamberts law,

$$A = \log \frac{1}{T} = act$$

where a = molar extinction coefficient

t = path length

c = constant for a given substance at a given wavelength.

Procedure

A standard solution of copper sulphate is transferred to a burette and draw out 2,4,6,8 and 10 ml of the solution in 100 ml standard flask 5 ml of the solution is added to each of those. shake well and then dilute up to the mark with distilled water stopper the flasks and mix the solution well. The given unknown is also made up the same way.

Prepare a blank solution by diluting only 5 ml of ammonia solution in a 100 ml measuring flask up to the mark with distilled water and after 10 minutes, measure the absorbance of the solution against the blank at 590 nm using a calorimetre. Tabulate the readings against volume of copper sulphate solution.

Observation

No	Volume of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	Volume of 1:1 ammonia	Volume of distilled water	total volume	Optical density
1	0 ml	5 ml	95 ml	100 ml	0
2	2 ml	5 ml	93 ml	100 ml	-4
3	4 ml	5 ml	91 ml	100 ml	-6
4	6 ml	5 ml	89 ml	100 ml	-7
5	8 ml	5 ml	87 ml	100 ml	-8
6	10 ml	5 ml	85 ml	100 ml	-9

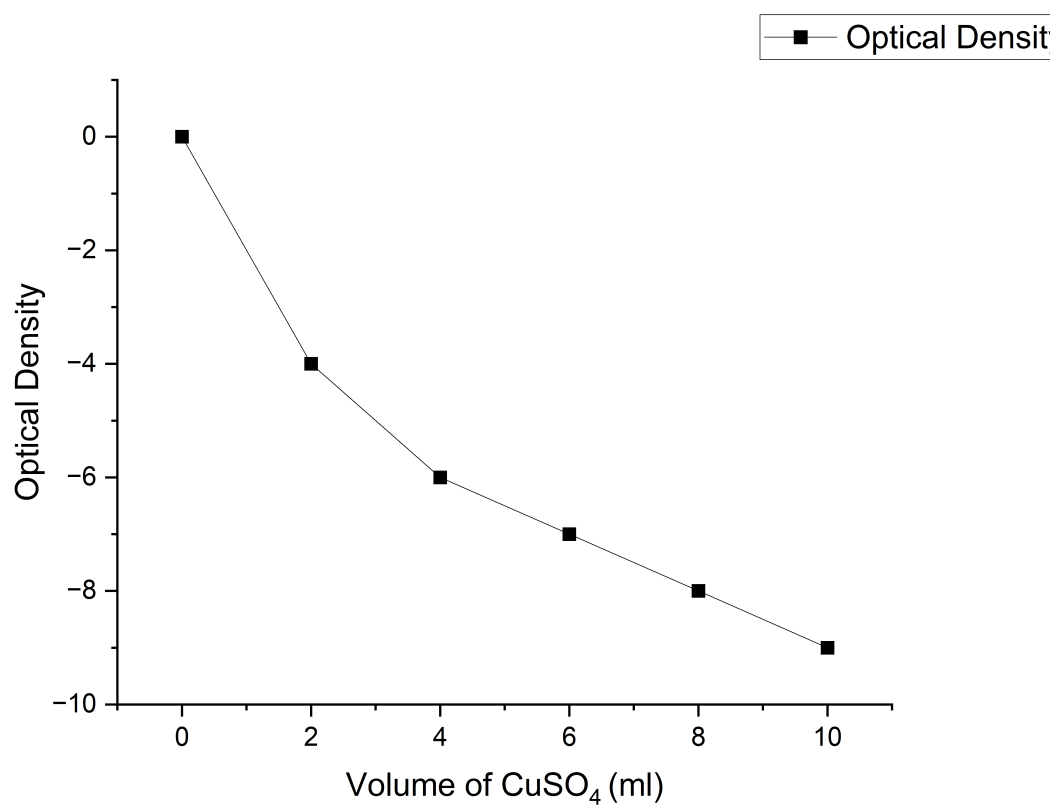


Figure 5: Variation of optical density with volume of CuSO_4 added

Result

The absorption vs volume of CuSO_4 solution is plotted

Conductometric titration

Date -30-1-2024

Aim

Determine the strength of the given acid

Principle

The conductance of a solution of an electrolyte is due to presence of ions. The change in conductance of a solution by addition or removal of ions may be employed to follow the course of a titration. When a solution of HCl is titrated with NaOH, the reaction may be represented as follows: $H^+ + Cl^- + Na^+ + OH^- \longrightarrow Na^+ + Cl^- + H_2O$ The conductance of HCl due to presence of Cl^- ions and fast moving H^+ ions are removed as unionized H_2O molecules. The decrease in conductance will take place until the equivalence is reached. Further addition of alkali sharply increases conductance of solution owing to introduction of free fast moving OH^- ions. Then measured value of conductance of various stages of neutralization is plotted against the volume of alkali added. The point of neutralization and give volume of alkali required to neutralize the acid.

Procedure

The given solution is made up to 100ml. Take out 20ml HCl in a 100ml beaker. The conductivity cell and a glass rod are introduced into it. If the cell is not fully immersed, sufficient water is added. The cell is connected and conductivity of solution is noted. The NaOH is added from burette in small quantities and conductance and volume of NaOH is measured. Find the equivalence point and calculate strength of HCl. The point of intersection of 2 straight line gives equivalent point.

Observation

No.	Volume of NaOH (ml)	Conductance (ms)
1	0	150
2	1	137
3	2	124
4	3	110
5	4	98
6	5	88
7	6	79
8	7	71
9	8	63
10	9	57
11	10	51
12	11	47
13	12	43
14	13	40
15	14	38
16	15	36
17	16	34
18	17	32
19	18	32
20	19	36
21	20	39
22	21	42
23	22	45
24	23	47
25	24	50
26	25	52
27	26	55
28	27	57
29	28	61

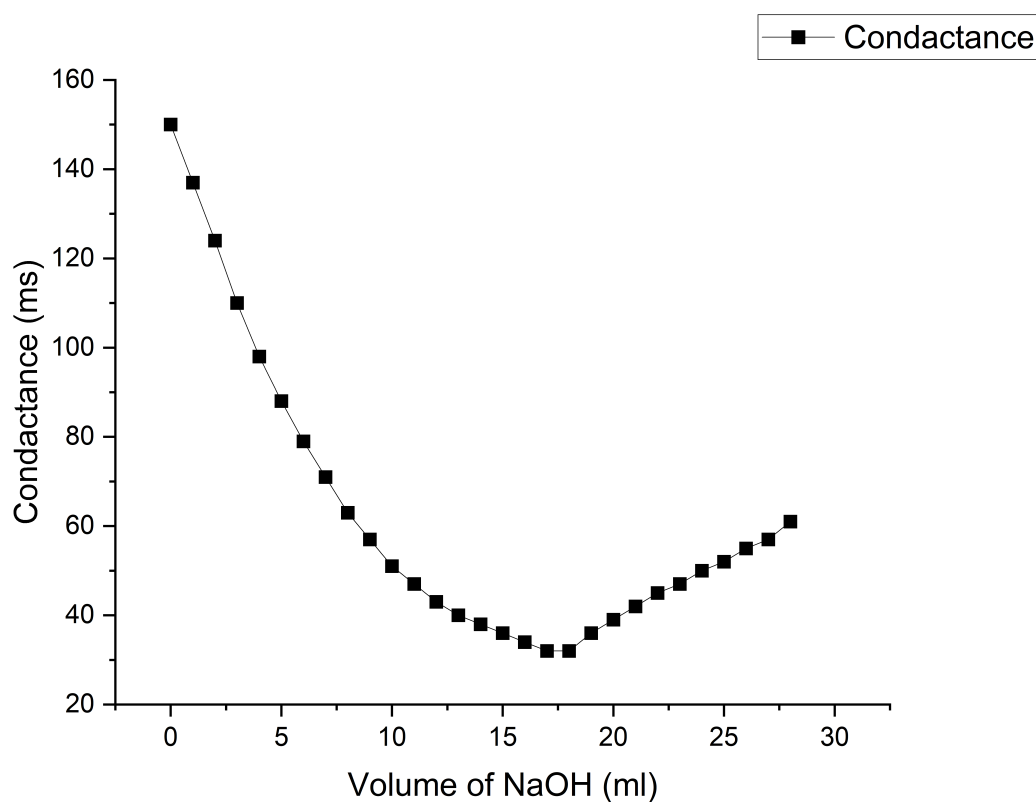


Figure 6: Variation of conductance with volume of NaOH added

Normality of NaOH = 1.58 N

Normality of NaOH X Volume of NaOH = Normality of HCl X Volume of HCl

$0.4 \times 18 = N \times 20$

Normality of HCl = 0.36

Result

Strength of HCl in given solution = 0.36 N

Determination Of Molecular Mass Of A Compound By Rast's Method

Date -15-02-2024

Aim

To determine molecular mass of a compound by Rast's method.

Principle

When a non volatile solute is dissolved, freezing point of the solvent is lowered. The difference of the freezing point of the pure solvent and the solution is referred as the depression in freezing point and it is related to the molecular mass of the non volatile solute as:

$$\Delta 1000k_f \times w/M \times W$$

where, Δ is the depression in freezing point

k_f is the molar depression constant of solvent

W is the mass of the solvent

w is the mass of the solute

M is the molar mass of solute

Procedure

The given solvent(10g) is taken in a boiling tube provided with a stirrer and thermometer. It is corked well and placed in a large beaker of water, which is heated by small flame. The temperature is increased by about 5°C. The tube is then taken out placed in an air jacket. A stop watch is started and the time-temperature readings recorded every 30 seconds, till the substance freezes. A constant temperature is noted from the graph plotted with time against the temperature.

A known weight of solute (0.3 g) is added and transition temperature is determined as above by plotting time-temperature graph. Again about 0.2g of solute is added and experiment is repeated and the freezing point determined from it's cooling curves. Knowing the depression in freezing point, molar mass solute can be determined by using formula

Observation

Time-Temperature data of Naphthalene

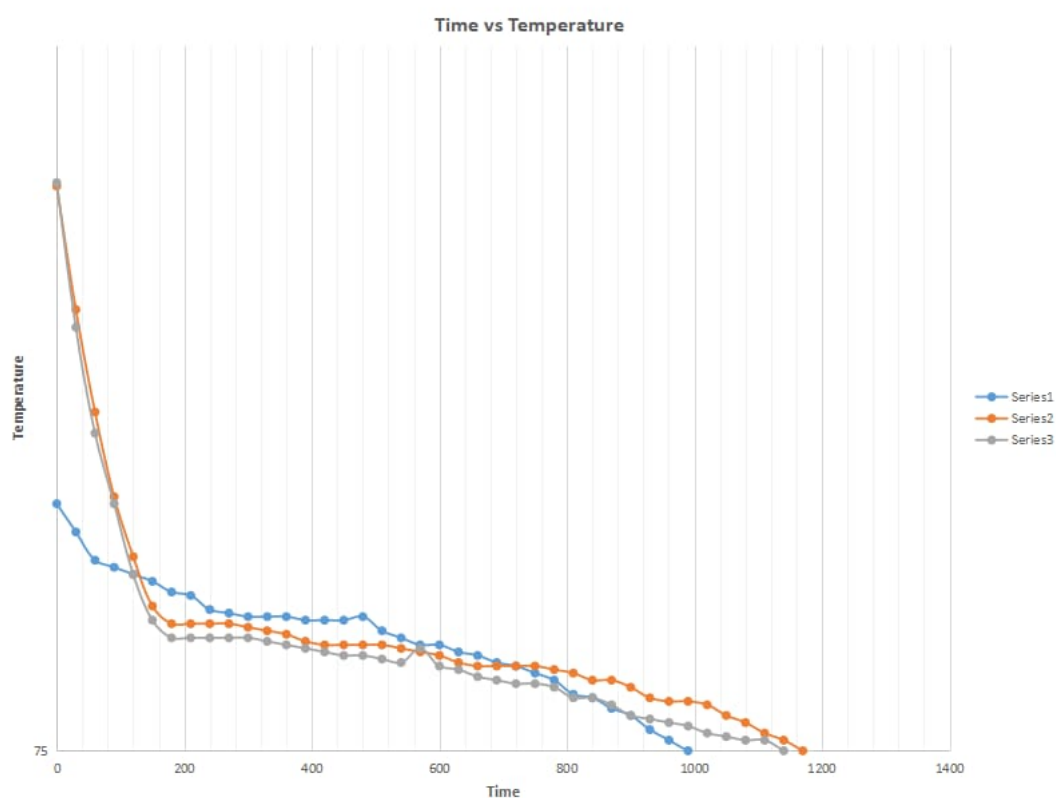
Time	Temperature
0	82
30	81.2
60	80.4
90	80.2
120	80
150	79.8
180	79.5
210	79.4
240	79
270	78.9
300	78.8
330	78.8
360	78.8
390	78.7
420	78.7
450	78.7
480	78.8
510	78.4
540	78.2
570	78
600	78
630	77.8
660	77.7
690	77.5
720	77.4
750	77.2
780	77
810	76.6
840	76.5
870	76.2
900	76
930	75.6
960	75.3
990	75
1020	74.8
1050	74.4

Time-Temperature data of Naphthalene With 0.3g of acetanilide

Time	Temperature
0	91
30	87.5
60	84.6
90	82.2
120	80.5
150	79.1
180	78.6
210	78.6
240	78.6
270	78.6
300	78.5
330	78.4
360	78.3
390	78.1
420	78
450	78
480	78
510	78
540	77.9
570	77.8
600	77.7
630	77.5
660	77.4
690	77.4
720	77.4
750	77.4
780	77.3
810	77.2
840	77
870	77
900	76.8
930	76.5
960	76.4
990	76.4
1020	76.3
1050	76
1080	75.8
1110	75.5
1140	75.3
1170	75

Time-Temperature data of Naphthalene With 0.5g of acetanilide

Time	Temperature
0	91.1
30	87
60	84
90	82
120	80
150	78.7
180	78.2
210	78.2
240	78.2
270	78.2
300	78.2
330	78.1
360	78
390	77.9
420	77.8
450	77.7
480	77.7
510	77.6
540	77.5
570	77.9
600	77.4
630	77.3
660	77.1
690	77
720	76.9
750	76.9
780	76.8
810	76.5
840	76.5
870	76.3
900	76
930	75.9
960	75.8
990	75.7
1020	75.5
1050	75.4
1080	75.3
1110	75.3
1140	75
1170	75



Normality of NaOH = 1.58 N

Normality of NaOH X Volume of NaOH = Normality of HCl X Volume of HCl

$0.4 \times 18 = N \times 20$

Normality of HCl = 0.36

Result

Strength of HCl in given solution = 0.36 N