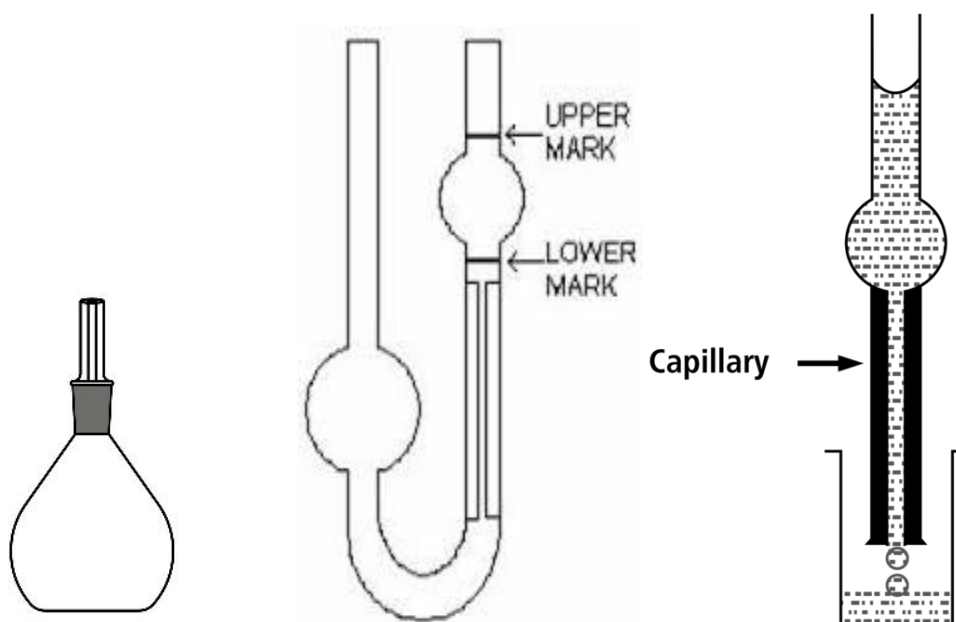


BGS SCIENCE ACADEMY & RESEARCH CENTER

Agalagurki, Chikkaballapura



II Semester B.Sc., Chemistry Laboratory Manual



CONTENTS

- 1. Determination of density and viscosity of a liquid (time of flow method) Using Ostwald's Viscometer.**
- 2. Determination of percentage composition of binary liquid mixture by Viscosity method.**
- 3. Determination of density and Surface tension of a liquid (drop number method) Using Stalagmometer.**
- 4. Determination of Molar mass of a non-electrolyte by Walker-Lumsden method.**
- 5. Determination of degree of dissociation of an electrolyte by ebullioscopic method.**
- 6. Determination of Transition temperature of the given salt hydrate by thermo-metric method**
- 7. Determination of distribution coefficient of benzoic acid between Water and Toluene.**
- 8. Determination of Molar mass of a polymer by viscosity method.**
- 9. To study the effect of surfactants on the surface tension of water.**
- 10. Determination of distribution coefficient of acetic acid between water and butanol**

OBSERVATIONS

I. DETERMINATION OF DENSITY OF A LIQUID USING SPECIFIC GRAVITY BOTTLE

1. Laboratory temperature: $(t^{\circ}\text{C} + 273)\text{K} = \dots\dots\dots\text{K}$
2. Density of water at T K = $\dots\dots\dots\text{kg/m}^3$
3. Mass of empty specific gravity bottle with glass plug = $m_1 \text{ g} = \dots\dots\dots\text{g}$
4. Mass of specific gravity bottle + liquid with glass plug = $m_2 \text{ g} = \dots\dots\dots\text{g}$
5. Mass of specific gravity bottle + water with glass plug = $m_3 \text{ g} = \dots\dots\dots\text{g}$
6. Mass of liquid = $(m_2 - m_1) = \dots\dots\dots = \dots\dots\dots\text{g}$
7. Mass of water = $(m_3 - m_1) = \dots\dots\dots = \dots\dots\dots\text{g}$
8. Density of given liquid = $\frac{\text{mass of liquid}}{\text{mass of water}} \times \text{density of water}$
 $= (m_2 - m_1) / (m_3 - m_1) \times \text{density of water}$
 $= \dots\dots\dots \text{kg/m}^3$

2. DETERMINATION OF VISCOSITY OF THE LIQUID

Sl No.	Time of flow for liq. (t_l) s.	Time of flow for H_2O (t_w) s	Density of Liquid (d_l) kg/m^3	Density of water (d_w) kg/m^3	Viscosity of Water (n_w) N.s.m^{-2}	$n_l = t_l d_l / t_w d_w \times n_w$ N.s.m^{-2}

EXPERIMENT NO.1

AIM: DETERMINATION OF DENSITY AND VISCOSITY OF A LIQUID (TIME OF FLOW METHOD) USING OSTWALD'S VISCOMETER

The experiment consists of two parts:

PART-I: DETERMINATION OF DENSITY OF A LIQUID USING SPECIFIC GRAVITY BOTTLE

Principle: The density of a liquid is defined as the mass per unit volume of the liquid. It is determined based on relative density of water. A specific gravity bottle or a pycnometer is used to determine the density of a liquid.

Procedure: A cleaned, dried and empty specific gravity bottle is weighed accurately along with the plug its mass is recorded (m_1 g). The bottle is filled completely with the given liquid, the glass plug is applied to it, then weighed accurately (m_2 g). The specific gravity bottle is cleaned, washed and dried. The bottle is then filled with water, glass plug is applied and weighed accurately (m_3 g). The density of the liquid is calculated by knowing the density of water at the given temperature.

PART-II: DETERMINATION OF VISCOSITY OF A LIQUID USING OSTWALD'S VISCOMETER

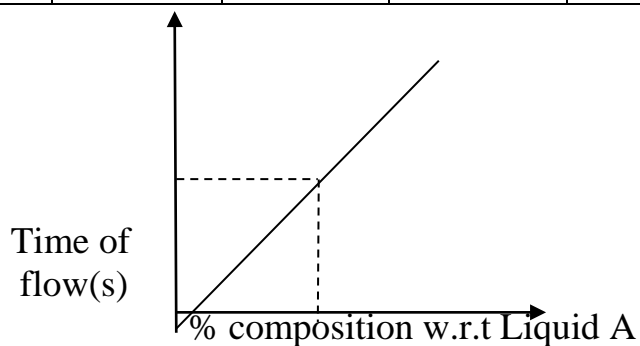
Principle: The viscosity of a liquid is defined as the frictional drag as one layer of a liquid flows over a neighbouring layer. It is determined using the Poiseuille's equation $n = \frac{P\pi r^4}{8Vl}$, where 't' is the time required for a volume 'V' of the liquid to flow through a capillary tube of length 'l' and radius 'r' under an applied pressure 'P'. The determination of the absolute viscosity of a liquid is difficult. However, the viscosity of a liquid, relative to another liquid whose viscosity is known can be determined. Using the same capillary tube (viscometer) and the same volume for two liquids, the relative viscosity is determined by using the equation: $n_2 = t_2 d_2 n_1 / t_1 d_1$ where t_1 and t_2 are the times of flow of the two liquids 1 and 2 and their corresponding densities d_1 and d_2 . n_1 is the viscosity of water which is taken as the known liquid.

Procedure: The viscometer is cleaned and dried. It is clamped vertically in a thermostat. A known volume (15/20 cm³) of the liquid is pipetted out into the wider tube of the viscometer. Using a rubber tube, the liquid sucked up through the capillary tube into the bulb until the level of the liquid rises above the mark in the smaller bulb. The liquid is allowed to flow down the capillary tube and a stop watch is started, when the meniscus passes the upper mark of the bulb and stopped when it passes the lower mark of the bulb. The procedure is repeated for three times, the viscometer is cleaned and dried. The whole experiment is repeated with distilled water and the time of flow is determined as before.

Result: The viscosity of the given liquid isx 10⁻⁴ N.s.m⁻².

OBSERVATIONS AND TABULATIONS

Sl.No.	Volume of liquid A(cm ³)	Volume of liquid B(cm ³)	% of liquid A	Time of flow (seconds)		
				I	II	Mean
1.	04	16	20			
2.	08	12	40			
3.	10	10	50			
4.	12	08	60			
5.	16	04	80			
6.			Unknown			



Note: The different volumes of Liquid A and B be rundown from burettes are calculated as follows.

$$\text{Volume of Liquid A} = \frac{\text{Required \%} \times X}{100}$$

where, X = total volume of the liquid mixture to be prepared

Volume of Liquid B = X – volume of Liquid A

EXPERIMENT NO.2

AIM: DETERMINATION OF THE PERCENTAGE COMPOSITION OF A BINARY LIQUID MIXTURE BY VISCOSITY METHOD

Principle: For mixture of two completely miscible organic liquids whose molecules do not have mutual interactions, the viscosities seem to be additive. Hence, viscosity measurements of such mixtures can be used to determine the percentage composition which is unknown. Since viscosity is proportional to the time of flow of a liquid, the later can be measured for various compositions of the liquid mixture using Ostwald's Viscometer. When time of flow is plotted against percentage compositions, a straight line is obtained . The percentage composition which is unknown can be determined from the graph.

Procedure: Various compositions of the mixture are prepared by mixing different volumes of aniline(A) and toluene(B). For a definite volume of these compositions, time of flow is measured in a viscometer at laboratory temperature. The time of flow values are plotted against the percentage compositions. The time of flow of unknown composition is determined. The corresponding composition can be determined from the graph.

Result: The percentage composition by volume of the binary mixture from the graph is.....

OBSERVATIONS:

I. DETERMINATION OF DENSITY OF A LIQUID USING SP.GR.BOTTLE

1. Laboratory temperature: $(t^{\circ}\text{C} + 273)\text{K} = \dots\dots\dots\text{K}$
2. Density of water at T K = $\dots\dots\dots\text{kg/ m}^3$
3. Mass of empty specific gravity bottle with glass plug = $m_1 \text{ g} = \dots\dots\dots\text{g}$
4. Mass of specific gravity bottle + liquid with glass plug = $m_2 \text{ g} = \dots\dots\dots\text{g}$
5. Mass of specific gravity bottle + water with glass plug = $m_3 \text{ g} = \dots\dots\dots\text{g}$
6. Mass of liquid = $(m_2 - m_1) = \dots\dots\dots = \dots\dots\dots\text{g}$
7. Mass of water = $(m_3 - m_1) = \dots\dots\dots = \dots\dots\dots\text{g}$
8. Density of given liquid = $\frac{\text{mass of liquid}}{\text{mass of water}} \times \text{density of water}$
 $= (m_2 - m_1) / (m_3 - m_1) \times \text{density of water}$
 $= \dots\dots\dots \text{kg/m}^3$

2. DETERMINATION OF SURFACE TENSION OF THE LIQUID

Sl No.	No.of Drops of liquid.(n_1)	No.of Drops of water.(n_w)	Density of Liquid(d_1) kg/m^3	Density of water(d_w) kg/m^3	Surf.ten. of Water(n_w) N.s.m^{-2}	$\gamma_l = \frac{d_l \times n_w \times \gamma_w}{d_w \times n_1}$ N/m

EXPERIMENT NO.3

AIM: DETERMINATION OF DENSITY AND SURFACE TENSION OF A LIQUID(BY NUMBER OF DROPS USING STALAGMOMETER

The experiment consists of two parts:

PART-I: DETERMINATION OF DENSITY OF A LIQUID USING SPECIFIC GRAVITY BOTTLE

Principle: The density of a liquid is defined as the mass per unit volume of the liquid. It is determined based on relative density of water. A specific gravity bottle or a pycnometer is used to determine the density of a liquid.

Procedure: A cleaned, dried and empty specific gravity bottle is weighed accurately along with the plug, its mass is recorded (m_1 g). The bottle is filled completely with the given liquid, the glass plug is applied to it, then weighed accurately (m_2 g). The specific gravity bottle is cleaned, washed and dried. The bottle is then filled with water, glass plug is applied and weighed accurately (m_3 g). The density of the liquid is calculated by knowing the density of water at the given temperature.

PART-II: DETERMINATION OF SURFACE TENSION OF A LIQUID BY NUMBER OF DROPS

METHOD USING STALAGMOMETER

Principle: A molecule in the centre of liquid is attracted by its neighbours equally in all directions. A molecule on the surface of a liquid is attracted only inwards, this inward attraction is called surface tension. A more convenient method of determination is the drop number method falling from a capillary tube. The apparatus used is called Stalagmometer. Relative to water as standard, surface tension of the liquid is determined using the equation.

$$\gamma_l = \frac{d_l \times n_w}{d_w \times n_l} \times \gamma_w \quad \text{N.m}^{-1}$$

Where d_l and d_w are the densities of liquid & water
 n_l and n_w are the number of drops of liquid & water
 γ_w is the surface tension of water.

Procedure: The stalagmometer is cleaned and dried. It is fixed vertically to a stand and the liquid is sucked into it. By careful manipulation of the pinch cock, the liquid is allowed to flow down at the rate of 15 to 20 drops per minute.

The liquid is sucked above the top mark and the number of drops is counted during the passing of the liquid from top to bottom mark. The experiment is repeated three times for reproducibility. The stalagmometer is washed with acetone and then with water, the number of drops for water is counted as before.

Result: The surface tension of the given liquid is.....x 10^{-3} N.m⁻¹.

OBSERVATIONS

1. Laboratory temperature = $t^{\circ}\text{C} + 273 = \dots\dots\dots\text{K}$
2. Mass of the empty weighing bottle + solute = $m_1 \text{ g} = \dots\dots\dots\text{g}$
3. Mass of the empty weighing bottle with remaining = $m_2\text{g} = \dots\dots\dots\text{g}$
4. Mass of the solute taken = $(m_1 - m_2) = W_2\text{g} = \dots\dots\dots\text{g}$
5. Boiling point of pure water = $T_1\text{K} = \dots\dots\dots\text{K}$
6. Boiling point of solution = $T_2\text{K} = \dots\dots\dots$
7. Elevation in boiling point = $(T_2 - T_1) = \Delta T_b = \dots\dots\dots\text{K}$
8. Volume of the solution = $V \text{ cm}^3 = \dots\dots \text{ cm}^3$.
9. Density of the solvent = $d = \dots\dots\dots\text{g} / \text{ cm}^3$
10. Mass of the solvent(W_1) = $V \times d = \dots\dots\dots\text{g}$
11. $K_b = 0.52 \text{ K.kg.mol}^{-1}$.

$$\text{Molar mass of the solute} = K_b \times W_2 / W_1 \times \Delta T_b \text{ Kg/mol}$$

=

$$\text{Molecular weight of the solute}(M_2) = \text{Molar mass} \times 10^3$$

=.....

EXPERIMENT NO.4

AIM: DETERMINATION OF MOLAR MASS OF A NON-ELECTROLYTE BY WALKER LUMSDEN OR EBULLIOSCOPIC METHOD

Principle: When a non-volatile solute is added to a solvent, the vapour pressure is lowered or the boiling point of the solution is elevated which is in turn proportional to the molarity of the solute

$$M = K_b \times W_2 / W_1 \times \Delta T_b \quad \text{where } K_b = \text{Ebullioscopic constant} = 0.52 \text{ for water}$$

W_2 = Mass of the solute

W_1 = Mass of the solvent

ΔT_b = Elevation in boiling point

The most accurate and quicker method of determination can be carried out using Walker-Lumsden set.

Procedure: Water is taken in a conical flask, about 10 cc of water is placed in the graduated inner tube of the Walker Lumsden set. The water in the flask is boiled, the vapours are passed through the graduated inner tube where it condenses. When the solvent in the tube boils, a constant temperature is recorded by the thermometer(T_1) Heating is stopped and the graduated inner tube is emptied. A known mass of the Solute is transferred and washed down with about 10 cc of water. Steam is again passed into the tube and the steady temperature is recorded, which is the boiling point of the solution(T_2). The tube is cooled to the room temperature and the volume of the solution is noted. This is regarded as the volume of the solvent as it is very dilute.

Result: The Molecular weight of the given solute is

OBSERVATIONS

1. Laboratory temperature = $t^{\circ}\text{C} + 273 = \dots\dots\dots\text{K}$
2. Mass of the empty weighing bottle + solute = $m_1 \text{ g} = \dots\dots\dots\text{g}$
3. Mass of the empty weighing bottle with remainings = $m_2\text{g} = \dots\dots\dots\text{g}$
4. Mass of the solute taken = $(m_1 - m_2) = W_2\text{g} = \dots\dots\dots\text{g}$
5. Boiling point of pure water = $T_1\text{K} = \dots\dots\dots\text{K}$
6. Boiling point of solution = $T_2\text{K} = \dots\dots\dots\text{K}$
7. Elevation in boiling point = $(T_2 - T_1) = \Delta T_b = \dots\dots\dots\text{K}$
8. Volume of the solution = $V \text{ cm}^3 = \dots\dots \text{ cm}^3$.
9. Density of the solvent = $d = \dots\dots\dots\text{g} / \text{cm}^3$
10. Mass of the solvent(W_1) = $V \times d = \dots\dots\dots\text{g}$
11. $K_b = 0.52 \text{ K.kg.mol}^{-1}$.

$$\text{Molar mass of the solute} = K_b \times W_2 / W_1 \times \Delta T_b \quad \text{Kg/mol}$$

=

$$\text{Molecular weight of the solute}(M_2) = \text{Molar mass} \times 10^3$$

(Experimental)

=

$$\text{Theoretical Molecular weight(calculated)} = \dots\dots\dots$$

$$\text{Vant Hoff factor}(i) = M_{\text{theoretical}} / M_{\text{experimental}} = \dots\dots\dots = \dots\dots\dots$$

$$\text{Degree of dissociation}(\alpha) = (i-1)/(n-1) = \dots\dots\dots$$

Where n is the number of particles

EXPERIMENT NO.5

AIM: DETERMINATION OF DEGREE OF DISSOCIATION OF AN ELECTROLYTE BY EBULLIOSCOPIC METHOD

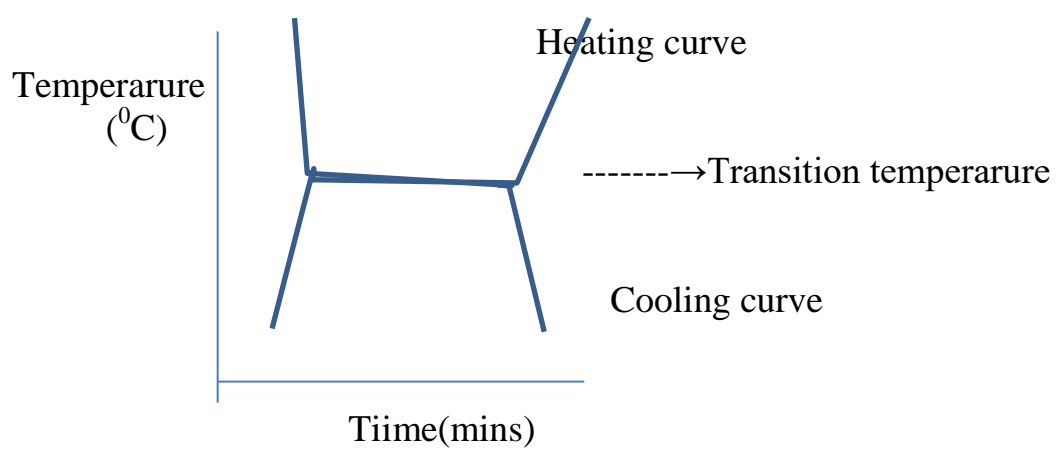
Principle: Electrolytes, when dissolved in water undergo dissociation, consequently the number of particles in the solution exceeds the number expected on the basis of normal behaviour of the solutes. Thus experimental determination of apparent molecular weight of an electrolyte in water enables to calculate the degree of dissociation of the substance.

Procedure: Water is taken in a conical flask, about 10 cc of water is placed in the graduated inner tube of the Walker Lumsden set. The water in the flask is boiled, the vapours are passed through the graduated inner tube where it condenses. When the solvent in the tube boils, a constant temperature is recorded by the thermometer(T_1). Heating is stopped and the graduated inner tube is emptied. A known mass of the Solute is transferred and washed down with about 10 cc of water. Steam is again passed into the tube and the steady temperature is recorded, which is the boiling point of the solution(T_2). The tube is cooled to the room temperature and the volume of the solution is noted. This is regarded as the volume of the solvent as it is very dilute. The experimental value of the molecular mass is calculated using the above equation. The molecular weight of the solute is theoretically calculated using the atomic masses by knowing its molecular formula. From these two data, the Vant- Hoff's factor is calculated and then the degree of dissociation of the electrolyte.

Result: The degree of dissociation of the electrolyte is

Observations

Heating Process		Cooling Process	
Time(mins)	Temperature(°C)	Time(mins)	Temperature(°C)



EXPERIMENT NO.6

TRANSITION TEMPERATURE OF A SALT HYDRATE BY THERMOMETRIC METHOD

Aim: Determination of the transition temperature of a salt hydrate by thermometric method.

Principle: Many of the substances can occur in more than one form. The stability of each form is different at different temperature. At a particular temperature one form of the substance changes to other form. Transition temperature is a temperature at which substance (given salt hydrate) changes over from one crystalline form to another crystalline form.

Procedure: The given salt hydrate was powdered and about 10-15g of salt hydrate and 5 cm³ of liquid paraffin were taken in the inner tube of critical solution temperature apparatus. It was fitted with a thermometer and a stirrer. Then it was fixed to the outer tube and the entire set of apparatus was kept in a water bath. The water bath was heated very slowly. By maintaining constant stirring, the temperature of the salt hydrate was recorded at the end of each minute in the given temperature range. The temperature increases gradually and remains constant at its transition point and further increases. When the temperature was increased after remaining considerable length of time, the burner was removed and the system was cooled with constant stirring. The temperature at the end of each minute was noted as before. A graph was plotted with temperature as ordinate and the time in minute as abscissa. The temperature corresponding to the horizontal position of the curve was the transition temperature of the given salt hydrate. It was expressed in °C.

Result: The transition temperature of the given salt hydrate was found to be _____ °C.

OBSERVATIONS

Tabulations of Results: Burette: 0.1M NaOH solution
Indicator: Phenolphthalein
End point: Permanent pale pink color

Volume of NaOH required:

Bottle No.	5 cm ³ of toluene layer			25 cm ³ of aqueous layer	
	Trial No.	1	2	1	2
1.	Final Bur.reading				
	Initial Bur.reading				
	Vol. of NaOH(ml)				
	Final Bur.reading				
2.	Initial Bur.reading				
	Vol. of NaOH(ml)				
	Final Bur.reading				

Calculation of concentrations and distribution coefficient

Bottle No.	V _{aq}	V _{org}	$C_{org} = \frac{0.1 \times V_{org}}{5}$	$C_{aq} = \frac{0.1 \times V_{aq}}{25}$	$K_d = \frac{C_{org}}{C_{aq}}$
1.					
2					

EXPERIMENT NO. 7

AIM: DETERMINATION OF THE DISTRIBUTION COEFFICIENT (PARTITION COEFFICIENT) OF BENZOIC ACID BETWEEN WATER AND TOLUENE

Principle: When a solute is added to a pair of immiscible liquids, it is distributed in such a way that the ratio of concentration of solute in both the solvents is always a constant at a given temperature. The constant is called partition co-efficient or Distribution co-efficient

When benzoic acid is added to a mixture of water and toluene solvents and shaken Well, benzoic acid forms a dimer in toluene layer and monomer in water layer, Hence

Distribution co-efficient(K_d). = $\frac{\text{Concentration of benzoic acid in toluene}}{\text{Concentration of benzoic acid in water}}$

$$K_d = \frac{(C_{org})^{1/2}}{C_{aqu}}$$

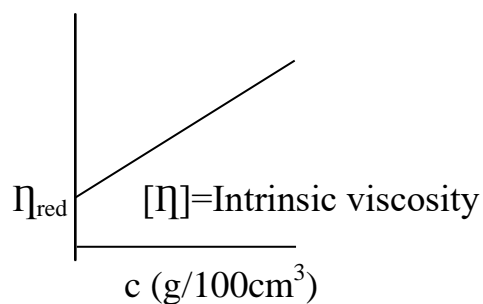
Materials required: 250 ml stoppered glass bottles, pipettes (5 and 25 ml), 0.1M NaOH, benzoic acid solid and toluene, phenolphthalein indicator.

- Procedure:**
1. Two different bottles are labeled as nos. 1 and 2.
 2. 50 cm³ of toluene and 50 cm³ of distilled water are added separately to each bottle.
 3. 2g and 3g of accurately weighed amounts of benzoic acid crystals are transferred to Sl. No. 1 and 2 bottles respectively.
 4. All the three bottles are stoppered tightly and shaken vigorously for half an hour and allowed to settle down for about 15 minutes.
 5. The contents of each bottle are transferred into separating funnels, allowed to settle down and each layer that is aqueous and toluene layers are collected in two separate beakers.
 6. 5 cm³ of toluene layered liquid is pipetted out into cleaned conical flask containing 20 to 30 cm³ of distilled water. The resulting mixture is titrated against 0.1M NaOH solution taken in the burette using phenolphthalein and indicator till a permanent pale pink color is obtained. The titre values are recorded.
 7. 25 cm³ of the aqueous layer of the same bottle is pipetted out into a clean conical flask and titration is performed in the usual way as explained above, the titre values are recorded.
 8. The experiment is performed in the same way as explained above for the other bottle also. The burette readings are recorded.

Result: The partition coefficient of benzoic acid between water and toluene is.....

OBSERVATIONS

SL.No.	Concentration g/100cm ³	t(mean) s.	$\eta_r = t_s/t_o$	$\eta_{sp} = \eta_r - 1$	$\eta_{red} = \eta_{sp}/c$
1	0 Water(solvent)				
2					
3					
4					
5					
6					



For poly-vinyl alcohol in water,
 $K = 20 \times 10^5$, $a = 0.76$

$$\text{Molar mass} = \text{Antilog} \left| \frac{\log[\eta] - \log K}{a} \right|$$

EXPERIMENT NO.8

AIM: DETERMINATION OF MOLAR MASS OF A POLYMER BY VISCOSITY METHOD

Principle: Addition of small amounts of polymer to solvents causes large increase in their viscosities and this change in viscosity is related to the molar mass of the polymer by the equation $[\eta] = K M^a$ where $[\eta]$ = Intrinsic viscosity obtained by the plot of reduced viscosity Vs concentration of the polymer, M =molar mass of the polymer K and a are constants for a given polymer in the particular solvent at a given temperature. ($\eta_{\text{relative}} = \text{time of flow of solution of the polymer} / \text{time of flow of the solvent}$. $\eta_{\text{specific}} = t_s/t_o - 1 = \eta_{\text{relative}} - 1$,

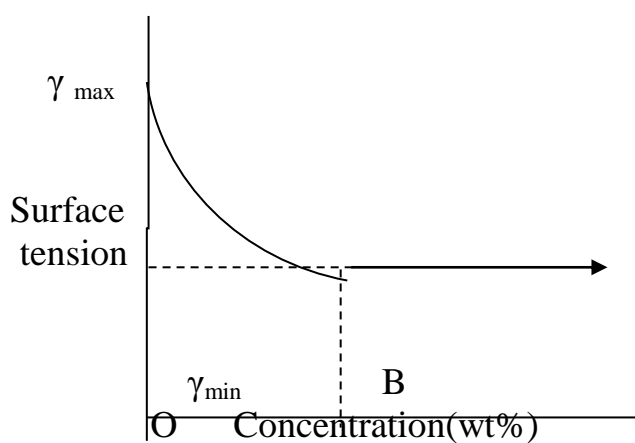
$$\eta_{\text{red}} = \eta_{\text{specific}} / c, \text{ c= concentration of the polymer.})$$

Procedure: 4 to 5 g of dry poly-vinyl alcohol is weighed on a watch glass. About 200 ml of hot distilled water is taken in a beaker. The weighed amount of the polymer is gradually spread on the surface of hot water in small lots and stirred slowly without forming bubbles of foam. When the whole polymer is dissolved, cover the solution and allowed to cool. The solution is slowly transferred to a 250 ml standard flask along the sides, rinse the beaker with small lots of distilled water and transferred to the flask till solution volume is made up to the mark, this solution is called stock solution. From the above stock solution other Five different concentrations are prepared (80%, 60%, 50%, 30%, 20%) in standard volumes. 20 ml of each is transferred into a viscometer and time of flow is determined and the corresponding times are recorded. The used viscometer is cleaned and dried. 20ml of distilled water is transferred into it and the time of flow is determined and recorded.

Result: The molar mass of the given polymer is.....

OBSERVATIONS

Serial No.	Concn.(wt%) of the surfactant	No. of drops of water(n_w)	No. of drops of surfactant (n_s)	Surface tension $\gamma = n_w / n_s$
1	0			
2	0.1			
3	0.2			
4	0.3			
5	0.4			
6	0.5			



EXPERIMENT NO. 9

AIM: TO STUDY THE EFFECT OF SURFACTANTS ON THE SURFACE-TENSION OF WATER

Principle: A soap or a surfactant solution in water lowers the surface tension of water due to preferential adsorption of the surfactant on water. As the concentration of the surfactant is increased the surface tension decreases rapidly in the beginning then reaches a minimum value, afterwards it remains constant due to saturation. This minimum concentration of the detergent has the maximum cleansing efficiency.

Procedure: Different concentration in weight percentage of the detergent is prepared in the range of 0.1 to 0.5% (0.025 g, 0.05 g, 0.075 g, 0.01 g, 0.0125 g of the detergent is dissolved in 25ml of water separately). The solution should be made from preheated and pre measured volume of water in a beaker, it is made by gently swirling around the solution, foam formation should be avoided. If gels are formed, or precipitate is formed, it should be filtered and used.

Each of the above solutions of the detergent prepared is sucked into the stalagmometer through a suction to the upper mark and number of drops fallen is determined till it reaches to the lower mark. The stalagmometer is cleaned well and dried. Then the number drops of water fallen is determined as above. A graph is plotted with surface tension(n_w/n_s , since the solutions are of low concentrations, their densities will almost the same as that of water, and the surface tension of water is also same for all concentrations) versus concentration of the surfactant. It is found that the surface tension decreases to a limiting value then remains constant. From this graph unknown concentration of the surfactant and cleansing action of the surfactant are determined.

Result: The optimum concentration of the surfactant is..... and the given concentration of the surfactant is

Observations:1. Determination of titre values

Sl.No.	Vol. of butanol(cm^3)	Vol. of ethanoic acid(cm^3)	Vol. of water(cm^3)	Volume of NaOH required(cm^3)		
				Organic layer (V_{org}) FBR IBR Vol.		Aqueous layer (V_{aq}) FBR IBR Vol.
1	25	10	40			
2	25	25	25			
3	25	35	15			
4	25	50	0			

2. Calculation of concentrations and distribution coefficient

Bottle No.	V_{aq}	V_{org}	$C_{\text{org}} = \frac{0.1 \times V_{\text{org}}}{10}$	$C_{\text{aq}} = \frac{0.1 \times V_{\text{aq}}}{10}$	$K_d = \frac{C_{\text{org}}}{C_{\text{aq}}}$
1.					
2.					

Experiment No.10.

Aim: Determination of distribution coefficient of ethanoic acid(acetic acid) between water and butanol

Principle: When a solute is added to a pair of immiscible liquids, it is distributed in such a way that the ratio of concentration of solute in both the solvents is always a constant at a given temperature. The constant is called partition co-efficient or Distribution co-efficient

When acetic acid is allowed to distribute between two immiscible solvents butan-1-ol and water. Solutions of the acid in the two solvents are shaken together, allowed to separate and analyzed by titrating a sample of each layer with sodium hydroxide solution.

Distribution co-efficient(Kd) = Concentration of acetic acid in butanol layer

Concentration of acetic acid in water

$$Kd = \frac{C_{org}}{C_{aqu}}$$

Materials required: 1. Measuring cylinder(10/25ml) 2. pipette fillers, pipette (10ml) 3. separating funnel (250ml) 4. Labelled bottles (250ml) 5. Butan-1-ol 6. 2M ethanoic acid. 7. 0.5M NaOH 8. phenolphthalein indicator

Procedure: 1. From the measuring cylinder, add 25cm³ of butan-1-ol, 10cm³ 2M ethanoic acid and 40 cm³ water into the labelled bottle No.1. 2. Shake the mixture for about 5 minutes to allow ethanoic acid to dissolve in both the layers. Open the tap to release the build-up pressure, approximately every 30 seconds. After shaking, transfer the contents into a separating funnel, the funnel is clamped on a stand vertically and allow the layers to separate. 3. Separate the two layers in the flask and collected separately in two beakers. Transfer 10cm³ of the upper layer (butan-1-ol) into a conical flask. Using a measuring cylinder, add about 25cm³ of water to the flask, followed by 3 drops of phenolphthalein indicator. The resulting mixture is titrated against the standard 0.5N NaOH solution. The titre value is recorded. 4. Withdraw 10cm³ of the aqueous layer into a titration flask. Add 25cm³ of water to the flask, followed by 3 drops of phenolphthalein indicator. The resulting mixture is titrated against the standard 0.5N NaOH solution. The titre value is recorded. 5. The experiments are repeated as above with three other mixtures of butan-1-ol, water and ethanoic acid outlined in the table.

Result:

The distribution coefficient of acetic acid between water and butan-1-ol is