

Experiment-1

Objective :-

To calculate the given burette.

Requirements :-

Burette of 50 ml, water, beaker (100 ml), thermometer, digital balance.

Procedure :-

First of all the given burette is cleaned, wash and dried. The burette is fixed vertically in a burette stand and filled with distilled water above zero mark. Now flow the water by opening the stopcock and remove air bubble at the tip of the burette. Bring the water level slowly upto zero mark. Check that water should not be drained when stopcock is closed. Take weighed stoppered 100 ml Erlenmeyer flask and allow the flow of water slowly from 0.00 to 10.00 ml mark of the burette. The tip of burette is touched with the inside wall of flask. Weigh accurately the flask with water and calculate the value of delivered water; Note the difference in volume.

Now, again fill up the burette upto zero mark and deliver the water as above from 0.00 to 20.00 ml

mark. Calculate the volume of delivered water and Note the difference in volume. Perform the same procedure for the delivery of 20 ml, 40 ml etc-

Observation Table:-

S.No	Water delivered from the burette (x) ml	Wgt of empty beaker (W ₁)	Wgt of beaker + water (W ₂)	Wgt of water (W ₂ - W ₁)	Actual Vol. of H ₂ O (y)	Error (y-x) ml	% Error $\frac{\text{Error} \times 100}{x}$
		W ₁	W ₂	(W ₂ - W ₁)	$\frac{W_2 - W_1}{\text{Sp. gravity of H}_2\text{O}}$		
1.	0-10	127.43	137.80	10.37	0.37	0.37	3.7%
2.	0-20	127.43	148.29	20.86	0.86	0.86	4.3%
3.	0-30	127.43	158.70	31.27	1.27	1.27	4.2%
4.	0-40	127.43	168.00	40.57	0.57	0.57	1.4%
5.	0-50	127.43	178.83	51.4	1.4	1.4	2.8%

- (1) Temperature of water = 22°C
 (2) specific gravity of water at 22°C = 0.9982 gm/ml
 (3) weight of empty beaker (W₁) = ~~50.7~~ ^{127.43} gm.

Result:-

% Average of error of 50 ml burette

$$= \frac{3.7 + 4.3 + 4.2 + 1.4 + 2.8}{5}$$

$$= \frac{16.4}{5}$$

$$= 3.28\%$$

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Experiment-2

Objective-

To calibrate the given pipette-

Requirements-

Beaker, water, thermometer, pipette

Procedure-

First of all the given pipette is cleaned, washed and dried. Suck the distilled water in it slightly above the mark and close the upper end of the pipette with index finger. Now water is allowed to flow out slowly upto the mark of pipette. The tip is wiped off to remove any adhering drop if any.

Take a weighed volumetric flask or stoppered weighing bottle. The tip of the pipette is brought into contact with the wall of the flask (or bottle) and allowed to deliver the water freely while held vertically. The pipette is contacted with the wall for about 30 second after out flow. (Do not blow out water remaining in the tip).

Weight the flask with water and find out the mass of the water delivered from the

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pipette. Calculate the volume of water delivered. Repeat this process 3-5 times.

Observation-

- ① Temperature of water = 22°C
- ② specific gravity of water at 22°C = 0.9982 gm/ml
- ③ weight of empty beaker W_1 = 127.51
- ④ weight of empty beaker + water W_2 = 147.57
- ⑤ weight of water delivered from the pipette = $W_2 - W_1$
 $= 147.57 - 127.51$
 $= 20.06 \text{ gm}$

$$\text{⑥ Actual volume of water } Y = \frac{W_2 - W_1}{\text{sp. gravity of H}_2\text{O}}$$

$$= \frac{20.06}{0.9982}$$

$$= 20.06 \text{ ml}$$

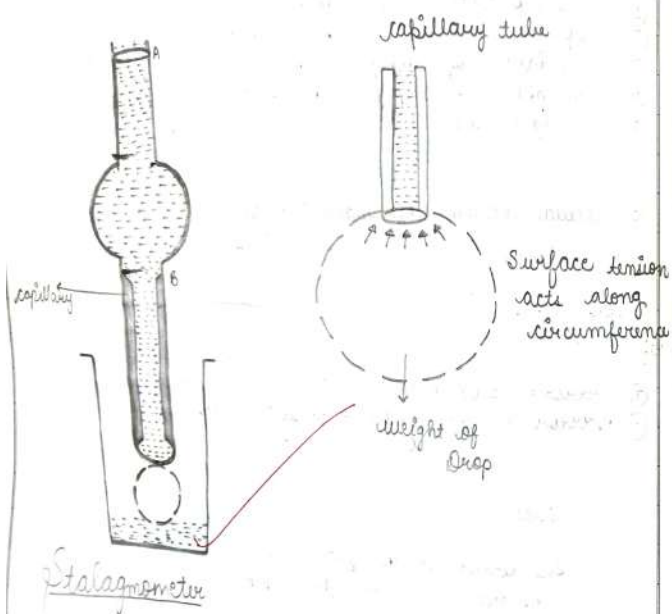
$$\text{⑦ Error} = \pm (Y - X) \text{ ml} = \pm 20.6 - 20 = 0.6 \text{ ml}$$

$$\text{⑧ \% Error} = \frac{\text{Error} \times 100}{X} = \frac{0.6 \times 100}{20} = 3\%$$

Result-

The error in the given pipette = 0.6 ml .
 % error in the given pipette = 3% .

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Experiment-3

Objective-

To determine the surface tension of the given liquid by drop weight method (~~Frank's method~~).

Requirements-

stalagmometer, a lamp stand, a small rubber tubing with a screw pinch cock, beaker, water, experimental liquid, relative density bottle.

Theory-

The tension or force in Newton acting at right angles along the surface of liquid on meter in length is known as surface tension. units dyn/cm in CGS or N/m in SI system.

Formula used

The formula for the surface tension of the liquid is given by-

$$\frac{\gamma_1}{\gamma_2} = \frac{n_1 l_1}{n_2 l_2}$$

where, γ_1 = surface tension of water

γ_2 = surface tension of liquid

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n_1 = No. of drops of water
 n_2 = No. of drops of liquid
 ρ_1 = Density of water
 ρ_2 = Density of liquid.

Method:-

The stalagmometer is cleaned first with chromic acid and finally with distilled water four or five times so as to remove any greasiness. The stalagmometer is then immersed in beaker of distilled water and it is sucked till the water rises 2-3 cm above the mark A. The stalagmometer is kept strictly vertical and water is allowed to fall till level reaches at A. Now start counting, the number of drops at A and till the water level reaches the lower mark B. It gives the drop number (n_1) of water.

The stalagmometer is then dried in hot air or in electric oven and filled with given liquid upto the upper mark. The drop number of liquid is determined exactly in the same manner. The density of liquid is then determined with the help of density bottle or pycnometer. The surface tension of liquid may be easily, calculated from the above formula. It is noted that the density and surface tension of water are 1.0 gm/cm^3 and 72.6 dynes/cm respectively at 20°C .

Observation -(a) Table for the measurement of drop numbers (n_1 & n_2)

S.No.	Water		Given liquid	
	Drop numbers btw A and B	Mean (n_1)	Drop numbers btw A and B	Mean (n_2)
1	42		45	
2	43	42	47	45
3	41		45	

(b) Table for measurement of density (d_2).

weight of empty pyknometer (w) = 37.15 gm
 weight of pyknometer + water (w_1) = 103 gm
 volume of water ($w_1 - w$) = $103 - 37.15 = 65.85$ gm
 weight of pyknometer + liquid (w_2) = 90.9 gm
 weight of liquid ($w_2 - w$) = $90.9 - 37.15 = 53.75$ gm
 = 53.75 gm

$$\begin{aligned}
 \text{Density of liquid } (d_2) &= \frac{\text{weight of liquid}}{\text{vol. of water}} \\
 &= \frac{53.75}{65.85} \\
 &= 0.816 \text{ gm/cm}^3
 \end{aligned}$$

(c) Room Temperature = 20°C (d) Density of water (d_1) = 1 gm/cm^3 (e) Surface tension of water (γ_1) = 72.6 dynes/cm

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Calculations:-

$$\frac{\gamma_1}{\gamma_2} = \frac{n_2 d_1}{n_1 d_2}$$

$$\gamma_2 = \frac{\gamma_1 n_1 d_2}{n_2 d_1}$$

$$\gamma_2 = \frac{72.6 \times 42 \times 0.816}{45 \times 1}$$

$$= \frac{2488.14}{45}$$

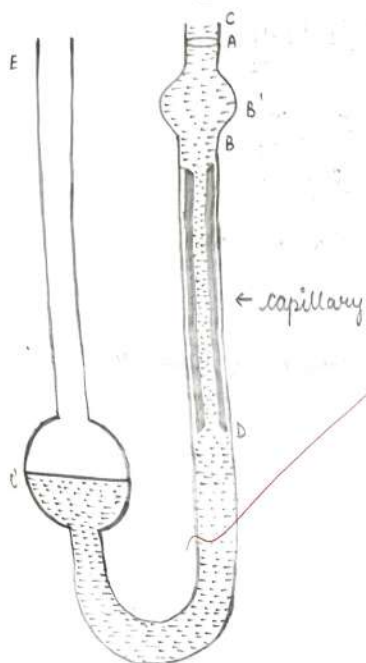
$$= 55.29 \text{ dynes/cm}$$

Result -

~~the surface tension of liquid at 20°C = 55.29 dynes/cm~~

~~NaCl~~

OSTWALD'S VISCOMETER



Experiment-4

Objective-

To determine the viscosity of given liquid (^{Alcohol} ~~benzene~~) with the help of Ostwald's viscometer.

Apparatus and chemicals-

Ostwald's viscometer, pycnometer, pure benzene, distilled water, chemical balance, stop watch.

Description-

Ostwald's viscometer is a very convenient apparatus for determination of viscosity at higher temperature as it can be easily suspended in thermo state. It consists of a fine capillary tube so connected as its upper part with a bulb 'B' and its lower part with a wider V-tube provided with bulb 'C'. On the right hand, this narrow stem is etched with two marks one above the bulb (A) and other below it (B). A certain volume of liquid is introduced into C, through E which is then sucked at C into the right limb till the liquid rises above the mark A. This whole apparatus should be well polished.

~~Pycnometer~~

~~It is an apparatus for measuring the density or specific gravity of a liquid. It consists of a~~

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revised



Specific gravity bottle

very fine capillary U-tube having a bulb on one side. It is etched with two marks A and B.

Specific Gravity Bottle -

It is also an apparatus used for measuring the density or specific gravity of a liquid. Usually its capacity is of 25 ml at 20°C.

Theory -

Let l be the length of the capillary tube BD and r its radius, then the volume of liquid (V) flowing through the capillary tube for difference of pressure, P is given by the formula -

$$V = \frac{\pi P r^4}{8 \eta l}$$

where η is the viscosity of a liquid taken in viscometer.

For the first liquid - $V_1 = \frac{\eta P_1 r^4}{8 \eta_1 l} \dots (i)$

For the second liquid - $V_2 = \frac{\eta P_2 r^4}{8 \eta_2 l} \dots (ii)$

i.e. $\frac{V_1}{V_2} = \frac{P_1}{P_2} \times \frac{\eta_2}{\eta_1} \dots (iii)$

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New pressure of the liquid, $P = h \cdot \rho$

Since h and g are the same for two liquids -

Hence, $P \propto \rho$

i.e. pressure of the liquid in each case is proportional to the density of liquid therefore -

$$P_1 \propto \rho_1 \quad \text{and} \quad P_2 \propto \rho_2$$

$$\frac{P_1}{P_2} = \frac{\rho_1}{\rho_2} \quad \text{--- (iv)}$$

Let Q be the each liquids' volume passing through the capillary tube in time t_1 and t_2 seconds then,

$$V_1 = \frac{Q}{t_1} \quad \text{and} \quad V_2 = \frac{Q}{t_2}$$

$$\therefore \frac{V_1}{V_2} = \frac{t_2}{t_1} \quad \text{--- (v)}$$

Substituting the value of $\frac{P_1}{P_2}$ and $\frac{V_1}{V_2}$ from equations

civ and (v) respectively in the equation (iii), we get

$$\frac{t_2}{t_1} = \frac{P_1}{P_2} \times \frac{\eta_2}{\eta_1}$$

$$\text{Or } \frac{\eta_1}{\eta_2} = \frac{t_1}{t_2} \times \frac{P_1}{P_2}$$

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Thus, the comparison of viscosities is made by knowing the time for corresponding flow and the densities of the liquids.

Method-

The viscometer is thoroughly rinsed with chromic acid and finally four or five times with distilled water. It is then rinsed with alcohol, ether and then dried in hot air or in electric oven.

About 10 ml of distilled water is introduced in the bulb C and through it the water is sucked until it rises 1-2 cm above the mark A. The viscometer is strictly kept vertical and the water is allowed to reflux under its own weight. When the liquid is just at A, the stop watch is started and stopped immediately when the liquid passes through the point B. This is the time of flow of water. The experiment is repeated five to six times and the mean value (t_1) is calculated.

The viscometer is dried up and the same procedure is repeated with liquid, of which viscosity is to be determined. Its time of flow (t_2) is also recorded.

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Observations-

(a) Table of measurement of flow time (t_1 and t_2)

S No	Water		(Benzene) / Alcohol	
	Flow time b/w A and B	Mean (t_1)	Flow time between A and B	Mean (t_2)
1	1.00		2.30	
2	1.30	1.25	2.98	2.76
3	1.45		3.00	

(b) Table for measurement of density (ρ_2) -

weight of empty pycnometer (x) = 20.53 gm
weight of ^{specific gravity bottle} pycnometer + water (y) = 55.59 gm
weight of pycnometer + (benzene) (z) = 50.39 gm
 $\therefore$ weight of water filled = ($y - x$) = 55.59 - 20.53
= 35.06 gm
and wgt of ^{alcohol} (benzene) filled = ($z - x$) = 50.39 - 20.53
= 29.86 gm

$\therefore$ Density of ^{Alcohol} (benzene) = $\frac{(z - x)}{(y - x)} = \frac{29.86}{35.06}$

(ρ_2) = 0.8516

(c) Room Temperature = 20°C

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- (d) Density of water at $20^{\circ}\text{C} = 1.00 \text{ g/cm}^3 \text{ (Cl}_1\text{)}$
(e) Viscosity of water at $20^{\circ}\text{C} = 0.0101 \text{ poise } \eta_1$

Calculations-

The viscosity of (Gentene) is calculated from the following formula assuming η_1 and ρ_1 for water and respectively at 20°C -

$$\frac{\eta_1}{\eta_2} = \frac{t_1 \times \rho_1}{t_2 \times \rho_2}$$

$$\eta_2 = \frac{\eta_1 t_2 \rho_2}{t_1 \rho_1}$$

$$\eta_2 = \frac{0.0101 \times 2.76 \times 0.8516}{1.25 \times 1.00}$$

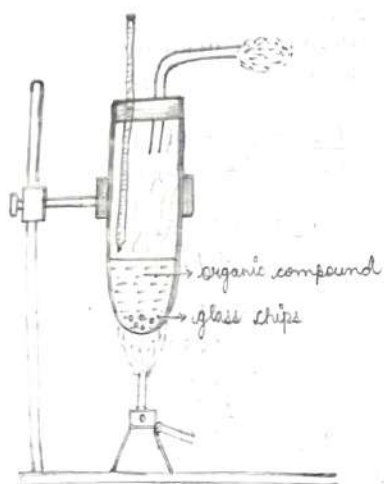
$$\eta_2 = \frac{0.02373}{1.25}$$

$$\eta_2 = 0.01899 \text{ poise}$$

Result-

viscosity of liquid at $20^{\circ}\text{C} = 0.01899 \text{ poise}$.

~~Correct~~



Experiment-5

Objective-

To determine the boiling point of the given organic compound (Lumene).

Apparatus-

Test Tube, bend tube, thermometer, cork, stand -

Procedure-

A simple apparatus for the determination of boiling point is shown in the figure. It consists of a hard glass test tube. It is fitted with a cork having two holes, one for the thermometer and other for bend tube.

The liquid, whose boiling point is to be determined, is taken in this tube and the bulb of thermometer is adjusted about one cm above its surface. The tube is very gently heated. Heating must be very carefully regulated so that the temperature rises slowly and boiling takes place gently. A rapid stream of bubbles starts issuing from the liquid and the temperature in the thermometer ceases to increase and becomes constant. This temperature is the boiling point of the liquid.

To ensure a constant heating and to stop the bumping the glass chips may be added in the

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test tube-

Result-

The boiling point of the benzene = 78.5°C

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