(9)

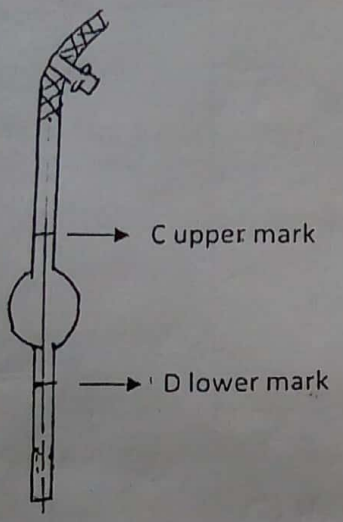
# EXPERIMENT

## Objective:

To determine the relative surface tension of liquid with respect to water, at room temperature, by stalagmometer.

## Apparatus and Chemicals required:

Distilled water, Stop watch, Stalagmometer, unknown liquid, R.D. bottle, beaker, rubber tube with screw pinch cock etc.




## Theory:

The measurement of surface tension of liquid is based on the fact that the drop of liquid at the lower end of capillary falls down when weight of drop becomes just equal to the surface tension.

(1) The force of gravity (wt. of drop) to pull the drop downward = $v.d.g$ where $v$ and $d$ are volume and density respectively.

(2) Force tending to uphold the drop = $2\pi r\gamma$

where $2\pi r$ is circumference of circular surface of radius $r$. $\gamma$ is surface tension.

Hence at equilibrium (i.e., when two forces are balanced)

$$2\pi r\gamma = v.d.g \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

If n = number of drops in volume $V$ of liquid, then volume of each drop, $v = -$

Then from eq. (1) we have $2\pi r\gamma = \frac{V}{n} d.g$ .....(2)

If $n_1$ and $n_2$ are the number of drops counted in the same volume of two liquids of densities $d_1$ and $d_2$, using the same capillary tube, then

$$2\pi r\gamma_1 = \frac{V}{n_1} d_1.g \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$$2\pi r\gamma_2 = \frac{V}{n_2} d_2 \cdot g \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

1 - Liquid
2 → Water

Dividing eq. (3) by (4), we have

$$\frac{\gamma_1}{\gamma_2} = \frac{n_2 \cdot d_1}{n_1 \cdot d_2} \quad \frac{t_1}{t_2} \quad \frac{d_1}{d_2}$$

If $\gamma_1$ is the surface tension of liquid and $\gamma_2$ is the surface tension of water then

$\frac{\gamma_1}{\gamma_2}$ = Relative surface tension of liquid with respect to water.

## Procedure:

(1) Clean the stalagmometer first with distilled water. (2) By immersing the lower end in a beaker containing water, suck up water until it rises above the mark C. (3) Control the rate of flow of water with the help of screw pinch cock so that the number of drops per minute is about 15 –20. This adjustment is essential otherwise the drops will not be spherical. (4) The counting of drops started when the water meniscus just reaches the upper mark C, and stopped when the water meniscus just passes the lower mark D. (5) Take 4 readings with water and take the mean of them. (6) Remove the water from stalagmometer and dry it. (7) Now, fill it with given liquid rises above the mark C and repeat the experiment as before 4 times. Count the number of drops.

## Observation:

Room temperature= °C.

| S.No. | No. of drops for water ($n_2$) | No. of drops for liquid ($n_1$) |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |

Density of liquid ($d_1$) and of water ($d_2$)

Wt. of empty R.D. bottle = .....gm.

Wt. of empty R.D. bottle + water = .....gm.

∴ Wt. of water = gm.

Similarly, Wt. of empty R.D. bottle + liquid = .....gm.

∴ Wt. of liquid = gm.

$$\frac{d_1}{d_2} = \frac{weight\ of\ liquid}{weight\ of\ water}$$

## Calculation:

Relative surface tension of liquid, $\frac{\gamma_1}{\gamma_2} = \frac{n_2 d_1}{n_1 d_2}$

## Result:

The relative surface tension of this liquid with respect to water at room temperature is.....

## Precautions:

(1) Number of drops per minute must be in between 15– 20.

(2) Viscometer must be kept in vertical position.