AIM

To determine surface tension of given liquid at room temperature using Stalagmometer by drop number method.

THEORY

Surface tension is defined as the force in Newtons acting at right angles to the surface of liquid along one metre length of the surface. The magnitude of surface tension is a measure of the strength of intermolecular forces. All the liquids exhibit tension at their surface on the account of unbalanced forces of interaction of molecules that are present in the surface layer. As a result, there will be net downward pull of surface molecules into the bulk of the liquid. The lower the surface tension of the liquid, the smaller the size of drop formed. Hence, simply, counting the number of drops for an unknown liquid and water is sufficient, to calculate surface tension.

$$\frac{\gamma_2}{\gamma_1} = \frac{n_1\rho_2}{n_2\rho_1} = \frac{\text{No. of drops}_1 \times \text{density}_2}{\text{No. of drops}_2 \times \text{density}_1}$$

Where γ_2 = Surface tension of water, N/m.

v_1 = Surface tension of liquid under test, N/m.

REQUIREMENT

Stalagmometer, specific gravity bottle, beaker, pipette, stand with clamp, acetone, distilled water.

PROCEDURE

(A) Determination of Density of Liquid

1. Take a specific gravity bottle and clean with distilled water. Rinse the bottle with little acetone. Use a hot air dryer to dry the specific gravity bottles.
2. Weight the empty specific gravity bottle. Let the weight be w_1.
3. Fill specific gravity bottle with distilled water to its brim. Place the lid and wipe the outer surface of the bottle with blotting paper.
4. Weigh the specific gravity bottle with water. Let the weight be w_2.
5. Remove distilled water from the bottle. Rinse the empty bottle with little acetone. Use hot air dryer to dry the specific gravity bottle.

6. Carefully transfer experimental liquid into specific gravity bottle upto its brim keep the lid in place. Dry outer surface of the bottle with blotting paper.
7. Weigh the specific gravity bottle with the experimental liquid. Let the weight be w_3.

(B) Determination of Number of Drops

1. Select a clean stalagmometer. Rinse the apparatus with acetone and dry it using a hot-air dryer. Fix the stalagmometer to a stand firmly in a vertical positions as in Figure 1(b).

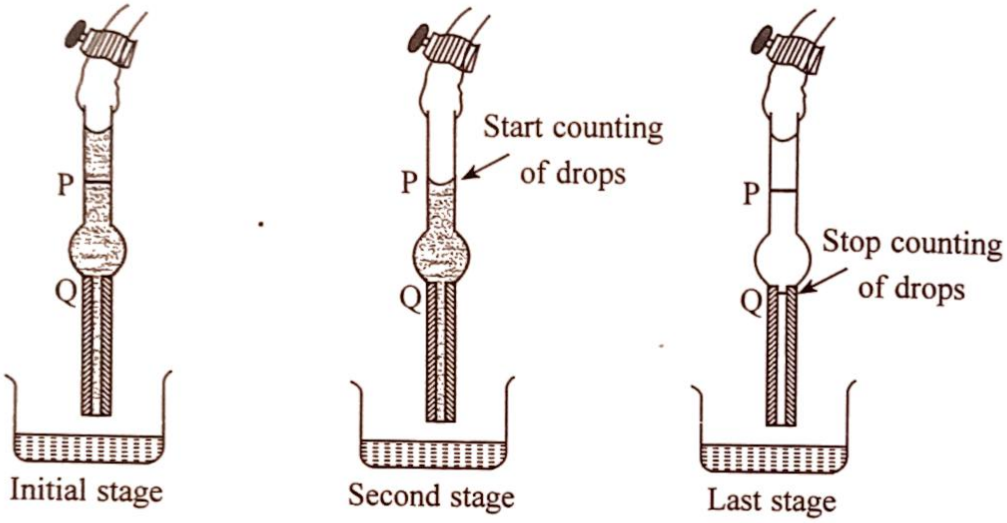

Fig. 1(*b*) Different steps to be followed while determining the number of drops using stalagmometer.

2. Immerse lower end of stalagmometer in a beaker of distill water and suck the water through the rubber tube upto a level higher than the upper mark P.
3. Leave the rubber tube and control the rate of flow of water by adjusting pinch cock so that flow of drops, should be about 15 to 20 per minute.
4. Start counting of drops when water just passes the upper mark, P. and stop counting when passes the lower mark Q. Note the number of drops. Record in Table.
5. Remove water and clean the stalagmometer. Thoroughly rinsed the apparatus with acetone and dry it.
6. Repeat the experiment with the experimental liquid. (Note: Pinch-cock position should not be changed at any stage during the following steps).

OBSERVATIONS

(*i*) Density of liquid.

Weight of empty bottle = $w_1 g$

Weight of bottle + water = $w_2 g$ 24.4 gm. 15 gm.

Weight of water = $(w_2 - w_1)g$

Weight of liquid = $(w_3 - w_1)g$

(*ii*) Surface tension of liquid.

S.No.	No. of drops with water (n_{water})	No. of drops with given liquid (n_{liquid})
1.		
2.		
3.		
4.		

Mean value of n_{water} = _____; Mean value of n_{liquid} = _____

CALCULATION

Determination of density of unknown liquid

$$\frac{\text{Density of liquid}(\rho_1)}{\text{Density of water }(\rho_2)} = \frac{\text{weight of liquid}}{\text{weight of water}}$$

$$\text{Density of liquid } (\rho_1) = \left(\frac{w_3 - w_1}{w_2 - w_1}\right) \times \rho_2 \left(\text{g/cm}^3\right)$$

The surface tension of liquid is given by

$$\gamma_1 = \frac{n_2 \rho_1}{n_1 \rho_2} . \gamma_2$$

$$\gamma_1 = \gamma_2 \frac{w_3 - w_1}{w_2 - w_1} \times \frac{n_2}{n_1} \text{ dynes/cm}$$

The value of surface tension of water γ_2 may be taken from Table 1.1 at t°C.

Substituting all the values as given above, γ_1 the surface tension of given liquid is calculated.

RESULT

The surface tension of given liquid at t°C = _____ dynes/cm

PRECAUTIONS

1. Stalagometer should be fixed to a stand firmly in a vertical position.
2. Drops should fall from the centre of the orifice of stalagmometer.
3. Since, surface tension depends on temperature, a thermostat should be used to maintain constant temperature.
4. Contamination of one liquid with another alters the formation of drops.
5. Pinch-cock of the stalagmometer should be adjusted such that 15 to 20 drops per minute will be obtained for water.
6. Once pinch-cock is adjusted for water, it should not be disturbed for liquids.
7. Drops should be allowed to form round, not cylindrical.