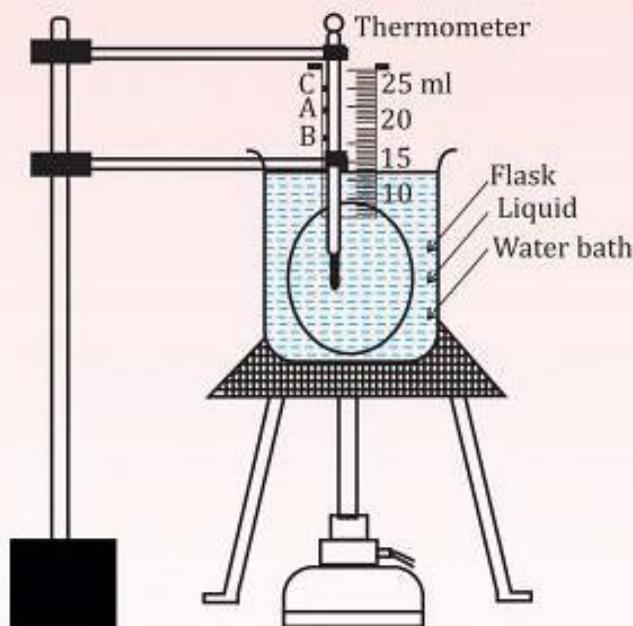# ACTIVITY

AIM

To note the change in level of liquid in a container on heating and interpret the observations.

MATERIAL REQUIRED

A round bottom glass flask, a capillary tube, a cork with a hole in its center, water bath, rubber, strip of graph paper and thermometer, heating arrangement liquid having boiling point above 100 °C such as glycerin and a clamp stand·

DIAGRAM

Real and apparent cubical expansion of a liquid

THEORY

When a liquid enclosed in a vessel is heated, the liquid as well as the vessel both undergo cubical thermal expansion.

Real cubical expansion of the liquid (γ_r) = apparent cubical expansion of the liquid (γ_a) + volume expansion of the vessel (γ_g) that is,

$$\gamma_r = \gamma_a + \gamma_g$$

To contain a liquid during heating, a container is always necessary. When the liquid is heated, the container also experiences an increase in temperature, leading to the expansion of both the liquid and the container. Consequently, both undergo thermal expansion. To specifically observe the expansion of the liquid, two types of expansions must be considered:

(i) Apparent expansion

(ii) Real expansion

The apparent expansion is expressed as follows,

Apparent expansion = Expansion of the liquid − Expansion of the container

The relationship between the real and apparent expansions of the liquid can be defined as,

Real expansion = Apparent expansion of the liquid + Expansion of the container

Therefore, determining the real expansion of the liquid requires considering the expansion of the container.

PROCEDURE

1. Clean and dry the round bottom glass flask.
2. Fill the flask with experimental liquid up to the brim. Fix cork and capillary tube as shown in the figure. Mark the level of liquid in the capillary tube.
3. Make an improvised scale with the help of a strip of graph paper and a white paper card. Mount this scale on the capillary tube with the help of cello tape.
4. Now place the flask in the trough filled with water (at room temperature T_1) and hold the flask in erect position with the help of clamp mounted on stand. The quantity of water in the trough should be sufficient so that the flask may be fully immersed into it.
5. Heat the water with the help of burner or any other source. Up to a steady high temperature T_2.
6. Carefully observe the level of liquid in the capillary tube.
7. As the temperature of flask increases, the level of liquid at A in the capillary tube starts dipping down When the level of the liquid reaches its lowest position, mark it as B.
8. After a while the level of liquid will be found increasing from the level B. Note the highest point of its rise as C.

OBSERVATION

1. Least count of thermometer = _____ °C
2. Initial (Room) temperature of liquid T_1 = _____ °C
3. Final (Hot) temperature of liquid T_2 = _____ °C

TABLE FOR POSITION OF LIQUID LEVEL MARKS

S. No.	Position of level mark			Cubical expansion of container AB (ml)	Real cubical expansion of water BC (ml)	Apparent cubical expansion of water AC (ml)
	A	B	C			
1.						
2.						

RESULT

1. The apparent expansion in the volume of liquid is the volume of capillary tube or length AC
2. The real expansion in the volume of liquid is the volume of capillary tube of length BC.
   Hence, Real cubical expansion (BC) = Apparent cubical expansion of liquid AC + Volume expansion of vessel AB. [BC = AC + AB]
3. Upon immersing the flask in hot water, the glycerin level in the tube within the flask initially descends to point B and subsequently ascends to reach level C.

PRECAUTIONS

1. The capillary tube should be very narrow.
2. Any air bubble should not be there in the liquid filled flask.
3. The boiling point of liquid should be higher than that of water used in the trough.
4. There should be enough hot water in the trough so that the flask may be fully immersed into it.

SOURCES OF ERROR

1. Flask may not be fully immersed in hot water.
2. The heating of experimental liquid may not be uniform.
3. There may be air bubbles in the flask.
4. The temperature may not be uniform.

VIVA VOCE

Q1. What do you mean by thermal expansion of liquid?

Ans. When we heat liquids, they will expand in their volumes. This is known as thermal expansion of liquid.

Q2. Define the term apparent cubical expansion of liquid.

Ans. The observed increase in the volume of a liquid excluding the expansion of the container is known as apparent expansion.

Q3. Define the term 'real expansion of liquid'.

Ans. The actual increase in volume of a liquid on heating taking account of the expansion of the vessel is called real cubical expansion of the liquid.

Q4. What is the relation between real expansion and apparent expansion?

Ans. Real cubical expansion of liquid = apparent cubical expansion of liquid + cubical expansion of vessel.

Q5. Is there a liquid which contracts on heating? If yes, give an example.

Ans. Yes, water contracts on heating from 0 °C to 4 °C.

Q6. Define coefficient of real cubical expansion of a liquid.

Ans. The coefficient of real cubical expansion is defined as the actual increase in the volume of a liquid per unit volume per degree Celsius rise in temperature. It is denoted by γ_r.

Q7. Define coefficient of apparent cubical expansion of a liquid.

Ans. The coefficient of apparent cubical expansion of liquid is defined as the observed increase per unit volume per degree Celsius rise in temperature. It is denoted by "γ_α".

Q8. Why should we not use capillary tube in this experiment?

Ans. Because capillary rise depends on surface tension of liquid and then effects of surface tension dominate over thermal expansion.

Q9. Do you know a relation between γ_α and γ_r?

Ans. Yes, $\gamma_r = \gamma_\alpha + \gamma_g$

Where, γ_g coefficient of cubical expansion of glass.