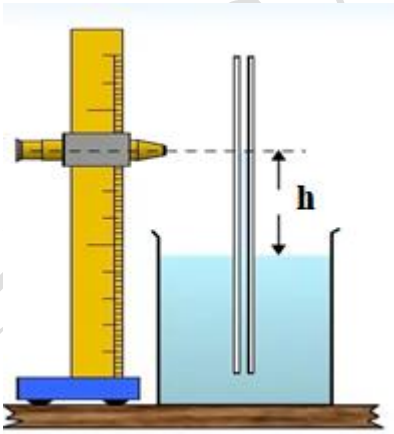
# The surface tension

## The Purpose of Experiment:

To calculate the surface tension of water by the capillary tube method.

## Apparatus used:

1. Capillary tubes.
2. Traveling microscope or glass scale.
3. Beaker.
4. Stand and clamp.
5. Thermometer.




## Theory of Experiment:

*Surface tension is a property of the surface of a liquid that allows it to resist an external force.

*The liquid molecules at the surface are

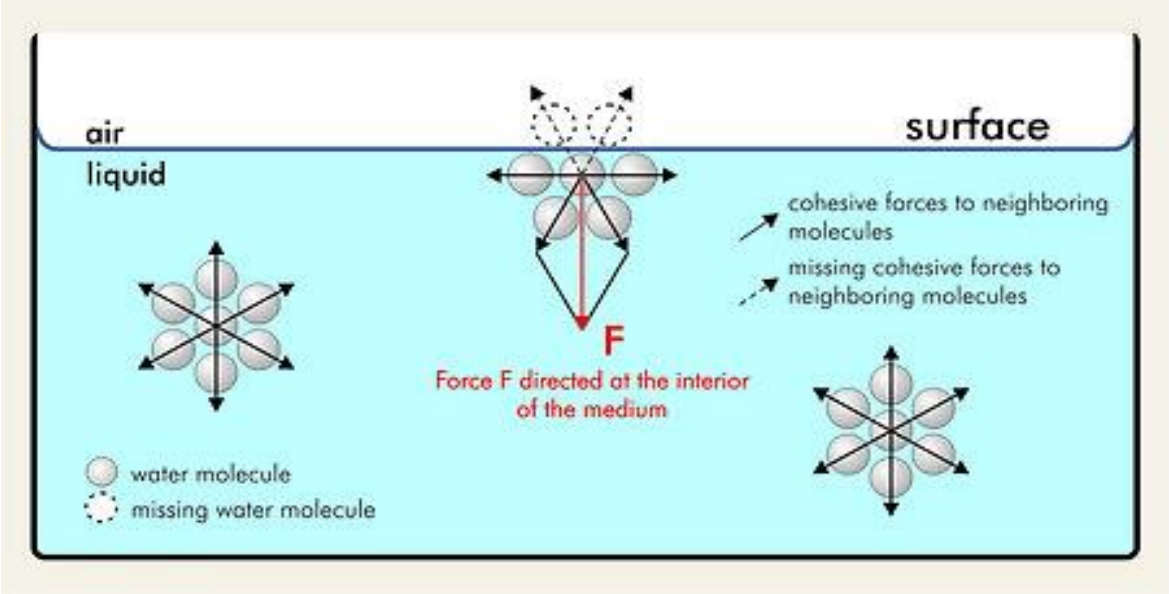
→ affected by the forces of cohesion with the liquid molecules from the lower side.

→ and affected by the forces of adhesion with the air molecules from the upper side. As figure.

*Since the density of the liquid is greater than the density of air ⟹

(1) The result of the surface tension forces are in the direction of the cohesion forces with the liquid molecules from the lower side,

(2) which leads to the contraction of the surface of the liquid to occupy the smallest possible area.




**The Method of Work:**

1. Clean the capillary tube by distilled water and pull the liquid up this capillary tube
2. Immerse the lower end of the capillary tube vertically in the beaker containing the water.
3. Measure the height (h) to which the water level rises in the capillary tube above the level of the water in the beaker.
4. Measure the internal diameter of the capillary tube by using a traveling microscope.
5. Repeat all the measurement with the other capillary tubes.
6. Record the temperature of water, because the surface tension changes with change in temperature.

## Calculations:

1. Tabulate the recorded reading as shown in the table below:

| | Radius of capillary tube, r (mm)*$10^{-3}$ | Height of water $h$ (mm)*$10^{-3}$ | Surface tension of water $\gamma = \frac{1}{2}\rho\, g\, r\, h$ |
|---|---|---|---|
| Tube1 | | | |
| Tube2 | | | |
| Tube3 | | | |
| | | | Mean=……..N/m<br>At ……℃ |

Note: Surface tension relationship is

$$\gamma = \frac{1}{2}\rho\, g\, r\, h$$

Where

$\gamma$: is the surface tension ( N/m).

$\rho$: the density of water in (kg/$m^3$).

$g$: the gravitational acceleration =9.8(m/$s^2$).

## Discussion Questions:

1. What is the reason for the rise of water in the capillary tubes? And if the water is replaced by mercury, what happens? Why?
2. What is effect each of: length of capillary tube and temperature on surface tension?
3. What is the relation between radius of capillary tube and height of liquid?
4. What is the application of surface tension in medicin?

## Reference

**E. Armitage, "Practical Physics in S.I. Paperback", John Murray; 2nd edition (1990).**