Surface Tension

Experiment No. _____ **Date: _____**

Aim:

To determine the surface tension of a liquid by capillary rise method.

Apparatus:

a) Two capillary tubes having different bore
b) Needle
c) Travelling microscope
d) Beaker
e) Clamp
f) Sprit level

Theory:

When a capillary tube is immerged (vertically) in a liquid, the liquid rises in the tube is known as the capillary rise. If the height through which liquid rises is 'h', the surface tension of the liquid (here, water) is given by;

$$S = \frac{\rho g r}{2}\left(h + \frac{r}{3}\right)$$

Where, ρ = density of liquid

r = radius of the capillary tube

g = acceleration due to gravity

S = surface tension of the liquid

h = height of the liquid inside the capillary tube.

Procedure:

a) Clean the capillary tube with some dilute caustic soda and wash out repeatedly with water. Then dry the tubes with dry air.
b) Fill the glass dish with water and note its temperature. Place the dish on an adjustable stand.

c) Take at least three capillary tubes of different diameter. Mount them on the glass strip by a rubber band and set them vertical on the dish. Water will rise in the capillary tubes. Fix the needle on the glass strip parallel to the capillary tubes. Adjust its height such that the tip of the needle just touches the surface of water.

d) Focus the travelling microscope (**TM**) on one of the capillary tubes by removing parallax between the cross wire and the image of the water column in the tube. Set the horizontal cross wire tangential to the meniscus of water at **M** in the tube. The meniscus of the water in the capillary tube will be inverted *i.e, convex*. Read the meniscus **M** by vertical scale of TM (h_1 say).

e) Move the travelling microscope along the horizontal scale and bring it in front of the second and third tube and repeat the step (d) to read the microscope vertical scale.

f) Now, bring the travelling microscope in front of needle and lower it till the horizontal cross wire lies symmetrically between the tip of the needle and its image at N in the water. Note the reading on the vertical scale of TM at N (h_2 say). ($h_1 - h_2$) gives the height 'h' of the water column in the capillary tube.

g) Take out the capillary tubes from the rubber band and find the diameter at the bore of the tubes in two mutually perpendicular directions with the help of travelling microscope.

Observation:

Room temperature = _____

Density of water ρ at t° C = 1 gm.cc^{-1}

Value of acceleration due to gravity g = 980 cm.sec^{-2}

Table – 1: (For capillary rise height 'h')

Tube No.	Microscope reading at the meniscus M				Microscope reading at the Needle N				Capillary rise 'h' in cm
	MSR in cm	VC	VSR in cm	Total = MSR + VSR in cm	MSR (cm)	VC	VSR (cm)	Total = MSR + VSR in cm	
1				R_1				R	$h_1 = (R_1 - R)$
2				R_2					$h_2 = (R_2 - R)$

Table – 2: (For radius of the capillary tube 'r')

Tube No.		MSR (cm)	VC	VSR (cm)	Total = MSR + VSR in cm	Difference in cm	Mean (d) in cm	$r = \frac{d}{2}$ in cm
1	Horizontal Left							r_1
	Horizontal Right							
	Vertical Lower							
	Vertical Upper							
2	Horizontal Left							r_2
	Horizontal Right							
	Vertical Lower							
	Vertical Upper							

Precautions:

a) *Tubes should be of uniform bore and water should rise freely into the tubes.*

b) *Tube should be parallel to each other and vertical.*

c) *The surface of water should not be touched in hand.*

d) *The tip of the needle should just touch the water surface and not dip into it.*

Calculation:

Put the value of 'h' and 'r' in equation, $S = \frac{\rho g r}{2}\left(h + \frac{r}{3}\right)$

$S_1 = \frac{\rho g r}{2}\left(h_1 + \frac{r_1}{3}\right) =$

$S_2 = \frac{\rho g r}{2}\left(h_2 + \frac{r_2}{3}\right) =$

$Mean\ S = \frac{S_1 + S_2}{2}$

Standard value:

The surface tension of water at 20° C = 72.7 Dyne/cm

The surface tension of water at 30°C = 71.2 Dyne.cm^{-1}

The surface tension of water at 40°C = 69.6 Dyne.cm^{-1}

% of Error:

Conclusion:

Surface tension of water at _____ $^{\circ}$C was found to be _____ Dyne.cm^{-1} or N.m^{-1} with _____ % of error.

Marks Awarded

Planning and Execution (2)	Result and Report (6)	Viva (2)	Total (10)

Signature of the Faculty

Signature of the student:

Regd No:

Group:

Branch: