PHYSICS PRACTICAL SHEETS

Date 10th Oct 2023 ..... KU ..... CAMPUS
Class ..... CE .....
Roll No. ..... 25 .....
Shift ..... Afternoon .....
Object of the Experiment (Block Letter)

Experiment No. ..... 3 .....
Group ..... T .....
Sub. ..... PHY102 .....
Set .....

Checked 2023/11/11

DETERMINATION OF SURFACE TENSION OF WATER BY CAPILLARY RISE METHOD

Apparatus Required:

i) Capillary tube, uniform bore and diffaent radii ii) Needle
iii) A glass strip iv) Thin rubber band
v) Glass vessel vi) Clamp stand
vii) Travelling microscope viii) Adjustable stand

Theory

When a capillary tube is dipped in water, it rises in the capillary tube till the weight is balanced by the upward component of the surface tension. At equilibrium, the weight of the liquid column and the vertical component of the surface tension are equal. So,

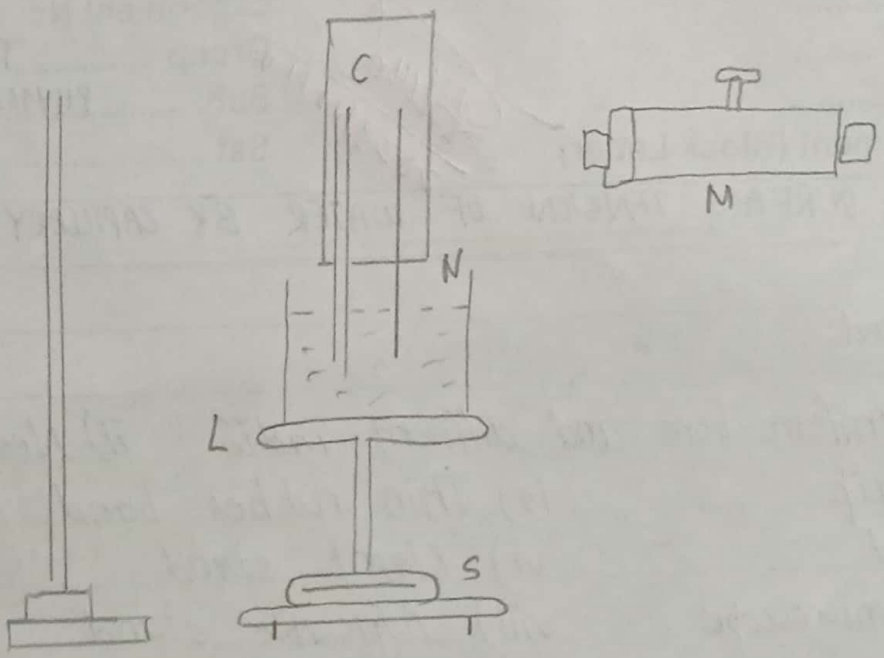
$$2r\gamma\pi\cos\theta = \pi r^2\left(h + \frac{r}{3}\right)\rho g$$

Here,
r = radius of tube h = height of liquid column.
ρ = density of water column γ = surface tension of water.
Since $r \ll h$ and $\theta \approx 8\text{-}9°$, Then the surface tension of the liquid is determined by formula

$$\gamma = \frac{rh\rho g}{2}$$

Observations and Calculations

Temperature of water (T) = 25°C
Least count of vernier scale = 1/20 cm
No. of vernier divisions = 50
Vernier constant = 0.001 cm
Density of water = 1 gm/cc



Experimental arrangement for measuring surface tension.

Fig. Cross-section of capillary tube.

Tube No	No of obs	Position of meniscus: Values of Main scale	Vernier scale	Total X (cm)	Mean (cm)	Position of needle tip: Values of Main scale	Vernier scale	Total Y (cm)	Mean (cm)	Height h=X-Y (cm)
	1	4·70	1	4·7071	4·703	2·50	20	2·520	2·525	2·180
I	2	4·70	5	4·705		2·50	25	2·525		
	1	4·70	3	4·703	4·707	2·50	20	2·520	2·525	2·184
II	2	4·70	11	4·711		2·50	25	2·525		

Determining diameter of the capillary tube.

No of obs	Tube No	Microscope reading a	b	c	d	Diameter b-a	d-c	Mean diameter	Mean radius
1	I	6·040	5·914	7·976	7·846	0·126	0·130	0·128	0·064
2	II	6·087	5·944	7·867	7·722	0·143	0·145	0·144	0·072

#Result

The value of surface tension for
tube I. $\gamma = 68.3148$
tube II. $\gamma = 77.05152$

The mean value of surface tension of water = 72.70816 dyne cm^{-1}.

The surface tension of water ($T = 25°C$) = 70.4 dyne cm^{-1}.

$$\therefore \%\ \text{error} = \left| \frac{72.70816 - 70.4}{70.4} \right| \times 100\% = 3.27\%$$

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