PHYSICS PRACTICAL SHEETS

Date ..Feb 2nd, 2023..... ....K.U.... CAMPUS Experiment No. ....5....
Class .....C.E.I..... Group .....T.....
Roll No. .....25..... Sub. ...Physics.....
Shift ....Morning..... Set .....
Object of the Experiment (Block Letter)

02-02-2023

classmate

DETERMINATION OF VISCOCITY OF WATER BY CAPILLARY TUBE METHOD

Apparatus Required:

i) Viscosity Apparatus
ii) A fine capillary tube of uniform bore
iii) A graduated cylinder
iv) Stop watch
v) Travelling microscope

Theory:

When water is allowed to flow through uniform capillary tube of length 'L' and radius 'r', the time rate of flow of volume 'V' against constant difference of pressure across its ends is given by Poiseuille's relation

$$V = \frac{\pi P r^4}{8 \eta L} \quad \text{——— (i)}$$

where, 'P' is the pressure difference across the end of the capillary tube, 'ρ' is the density of the liquid and 'η' is the coefficient of viscosity. The pressure difference across the end of the capillary tube can be calculated as,

$$P = h \rho g \quad \text{——— (ii)}.$$

Substituting the pressure difference 'P' from eqⁿ(2) to eqⁿ(1), the coefficient of viscosity is given by,

$$\eta = \frac{\pi h \rho g r^4}{8 L V}$$

Observations and Calculations:

Length of the capillary tube (L) = 30cm
Least count of main scale (M) = 0.05 cm
No. of vernier scale division (N) = 50

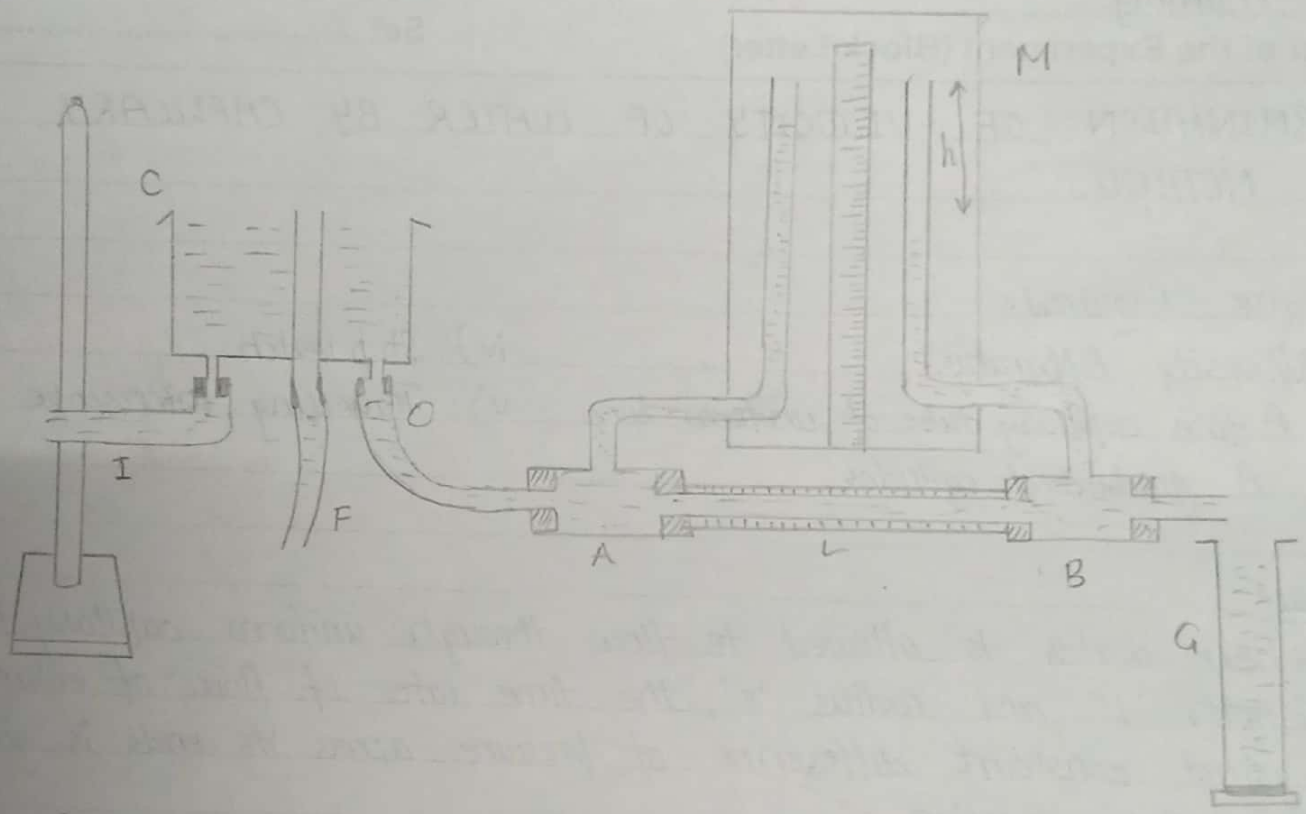


Fig: Schematic diagram of the viscosity apparatus.

C = beaker

I = pipe connected to the tap

F = pipe for overflow

O = connecting pipe to capillary tube and manometer

M = manometer

L = capillary tube

G = graduated cylinder

h = difference in height of liquid column

Vernier constant (V.C.) = M/N = 0.05/50 = 0.001 cm

-Table for radius of capillary tube:

No. of obs	Microscopic reading (cm)				Diameter (cm)		Mean diameter	Mean radius.
	a	b	c	d	b-a	c-d		
1	3.300	3.550	5.500	5.234	0.250	0.266	0.252 cm	0.130 cm
2	3.300	3.530	5.500	5.239	0.230	0.261		

-Table for the height difference and the rate of flow of water:

No. of obs.	Height (h) difference (cm)	Volume (V_b) collected (cc)	Time (t) taken (s)	$V = V_b/t$ (cc/s)	Mean V (cc/s)	h/v (cm-s/cc)	η (Poise)
1	0.5	50	172	0.291			
2		50	178	0.281	0.286	1.748	0.007
3	1	50	98	0.510			
4		50	109	0.459	0.485	2.062	0.008
5	1.5	50	79	0.633			
6		50	85	0.588	0.611	2.455	0.010
7	2	50	67	0.746			
8		50	71	0.704	0.752	2.759	0.011

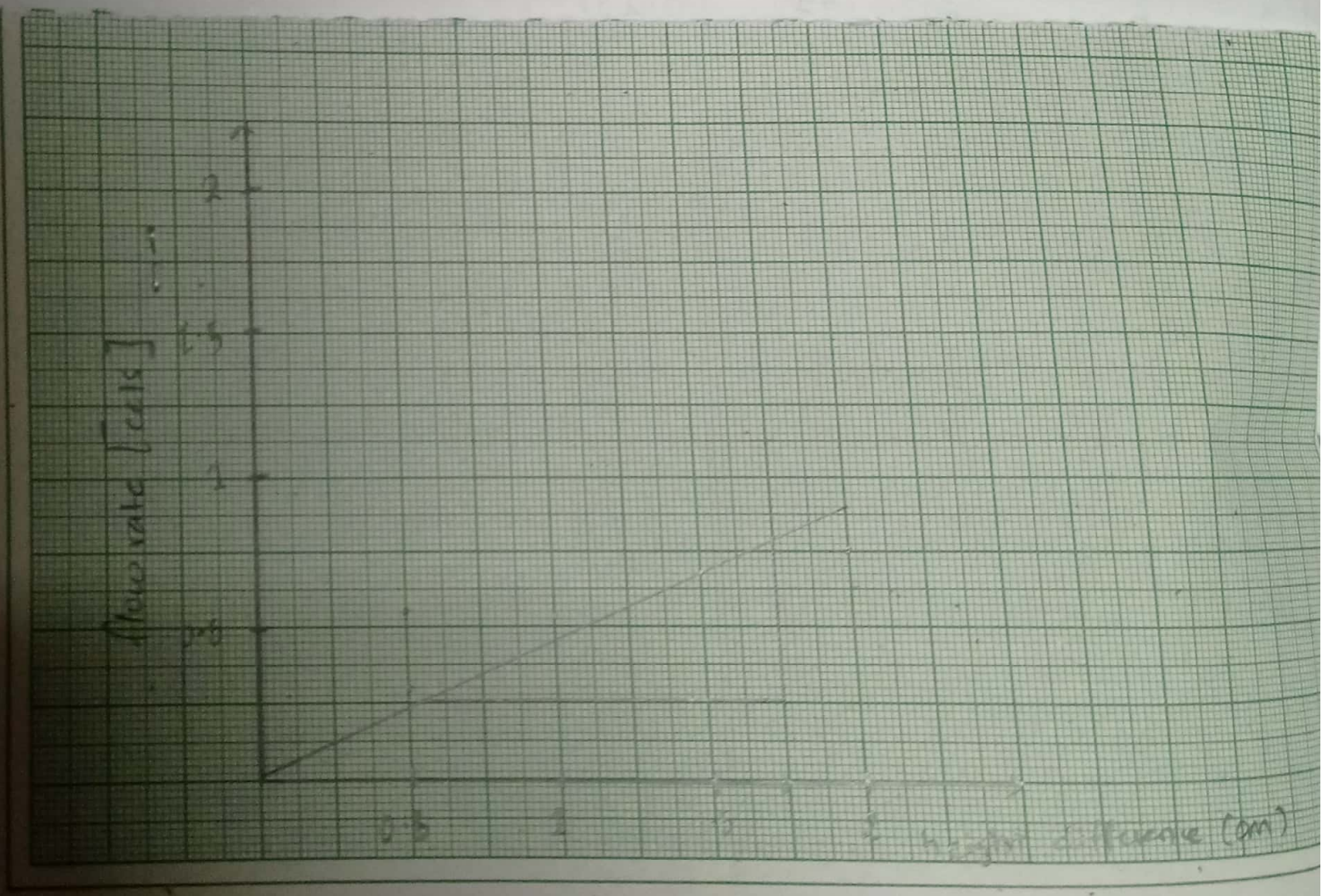
Result:

The mean value of the coefficient of viscosity = 0.009

From the graph, slope of graph (V/h) = $\frac{0.004}{0.455}$ = 0.455

∴ The coefficient of viscosity of water (η) = $\frac{0.004}{0.455}$ = 0.009 ≈ 0.01 poise.

Fig: Cross-sectional view of capillary tube.



Precautions:

(i) The bore of the capillary tube should be narrow and uniform.

(ii) The capillary tube should be positioned horizontally.

(iii) The flow of water through the tube should be streamlined.

(iv) The temperature should remain constant during the experiment.