

EXP.NO.(2)

Flow of water through a capillary tube

The aim of experiment

- a-To show that the flow rate of water is proportional to the applied pressure
- b-To deduce the viscosity of water

Theory:-

Viscosity is the quantity that describes a fluid resistance to flow. Poiseuille's law states that the flow through a tube depends on the pressure difference from one end to the other, the length of the capillary tube (L), the radius of the tube (r) and the viscosity (η). The flow rate varies inversely with the length of capillary tube (L) and the viscosity (η) while, directly proportional with pressure (ρgh) and the radius of the tube (r) parameters. Where:

ρ : is density of water = 1000 kgm^{-3} ,

h :represent the distance between the water level in the container and the level of the capillary tube.

g :is the gravity = 10 ms^{-2}

The value of the viscosity can be calculated from the following equation:

$$\eta = \frac{\pi r^4 \rho g}{8L} \cdot \frac{h}{v/t}$$
$$\eta = \dots\dots\dots \text{Nsm}^{-2} \text{ at} \dots\dots \text{C}$$

Apparatus:-

Glass capillary tube of internal radius 0.04 cm and length 4cm, stop watch, a graduated cylinder, ruler, thermometer and rubber tube.

Methodology

- 1-Connect the rubber tube to a tap water and see the surplus water discharges into the sink as shown in Figure 1.
- 2-When the water start flow through the capillary tube, make sure that there is no air bubbles in the tube.
- 3- When the flow of water is steady, hold the capillary tube horizontally in the clamp .
- 4-measuer the temperature of the water.
- 5-Measure the height between the level of water and the horizontal capillary tube , record the height in the table .

6-Hold the stop watch in one hand and the beaker in the other, collect the water in the beaker for a time of 30 second.

7-Read the volume of water and record as shown in Table 1.

8-Change the height by increase it 5 cm , and go back to step 5and repeat it 5 times.

Table 1:The change of flow rate with the distance between water level and capillary tube

h/cm	Volume/cm³	Time/sec	Rate of flow v/t cm³s⁻¹
30			
.			
.			

9-Plot a graph between the values of h/cm on the X axis against the corresponding values v/t cm³s⁻¹ on the Y axis

10-The slope of the plotted graph represent the flow rate value h/(v/t) cm²s⁻¹

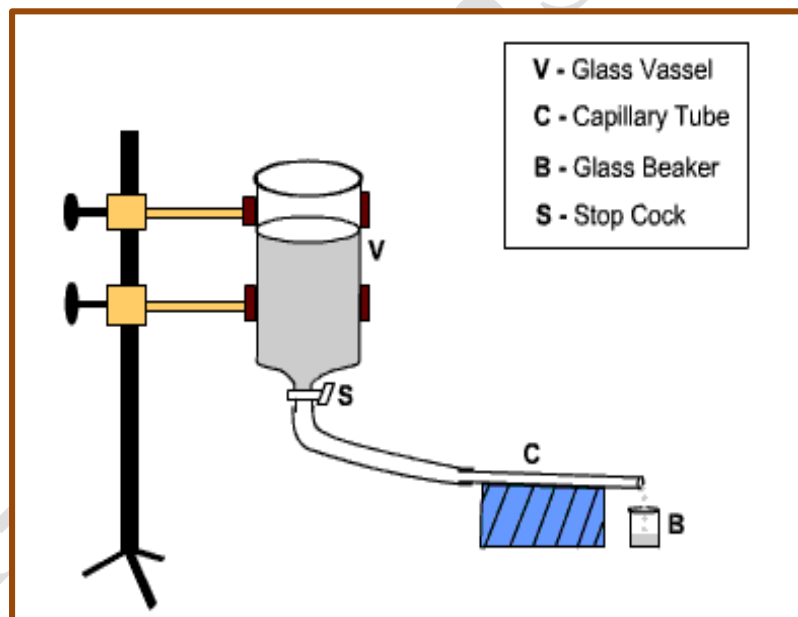


Figure 1: The flow rate devices

Medical application

- 1-blood and nutrition transfusion .
- 2-Sickle cell test (which is screening test for sickle cell anemia).
- 3-Studying hematocrit , fibrinogen level .
- 4-Studying or test plasma viscosity .