Aim: Determine the absolute viscosity of organic liquids.

Instruments required: ostwald viscometer, stopwatch.

Theory: the internal property of a fluid for its resistance to flow is known as viscosity.

In 1844, Hagen-Poiseuille did their work concerning the interpretation that liquid flow through tubes and he proposed an equation for viscosity of liquids. This equation is called Poiseuille's equation

$$\eta = \frac{\pi r^4 P T}{8 V L}$$

where, r = radii
P = pressure
t = time
V = Volume
l = length
η = absolute viscosity.

Procedure :

1. Clean the viscometer :
   - Rinse the viscometer with distilled water.
   - Dry it completely to avoid contamina-tion or mixed densities.

2. Fill with known liquid (water)
   - Pour the distilled water into the viscometer until it reaches the bulb below the upper mark.
   - Ensure no air bubbles are present.

3. Measure flow time of water
   - Using a suction bulb, draw water above the upper timing mark.
   - Release suction and start the stopwatch.
   - let water flow under gravity and stop the watch when the meniscus reaches the lower mark.
   - Repeat 3-4 times and calculate the average flow time (t_w).

4. Repeat for unknown liquid.
   - Empty and rinse the viscometer thoroughly.

- Fill it with the unknown liquid to the same level.

- Use the same method to draw the liquid above the upper mark and record the flow time.
- Again, repeat several times to get average flow time (t_ℓ).

⑤ Measure Densities
- Use a pycnometer or refer to standard values to determine the densities of both liquids.
  - Density of water (ρ_w)
  - Density of unknown liquid (ρ_ℓ).

Experiment :

Observation table :

	liquid	Flowtime t_1	t_2	t_3	Average Avg. time
1	water	29·1	29·0	28·1	28·7
2.	Unknown liquid	26·3	26·1	26·5	26·3

Calculation : $\eta = \frac{\pi P r^4 t}{8 V L}$

Pressure $\propto$ density

$$\eta_w = \frac{\pi d_w r^4 t_w}{8 V L} \quad -①$$

$$\eta_l = \frac{\pi d_l r^4 t_l}{8 V L} \quad -②$$

on dividing, we get; ①/②.

$$\frac{\eta_w}{\eta_l} = \frac{d_w}{d_l} \times \frac{t_w}{t_l}$$

η_w = viscosity of water = 0.89 centipoise

η_l = viscosity of unknown liquid = ?

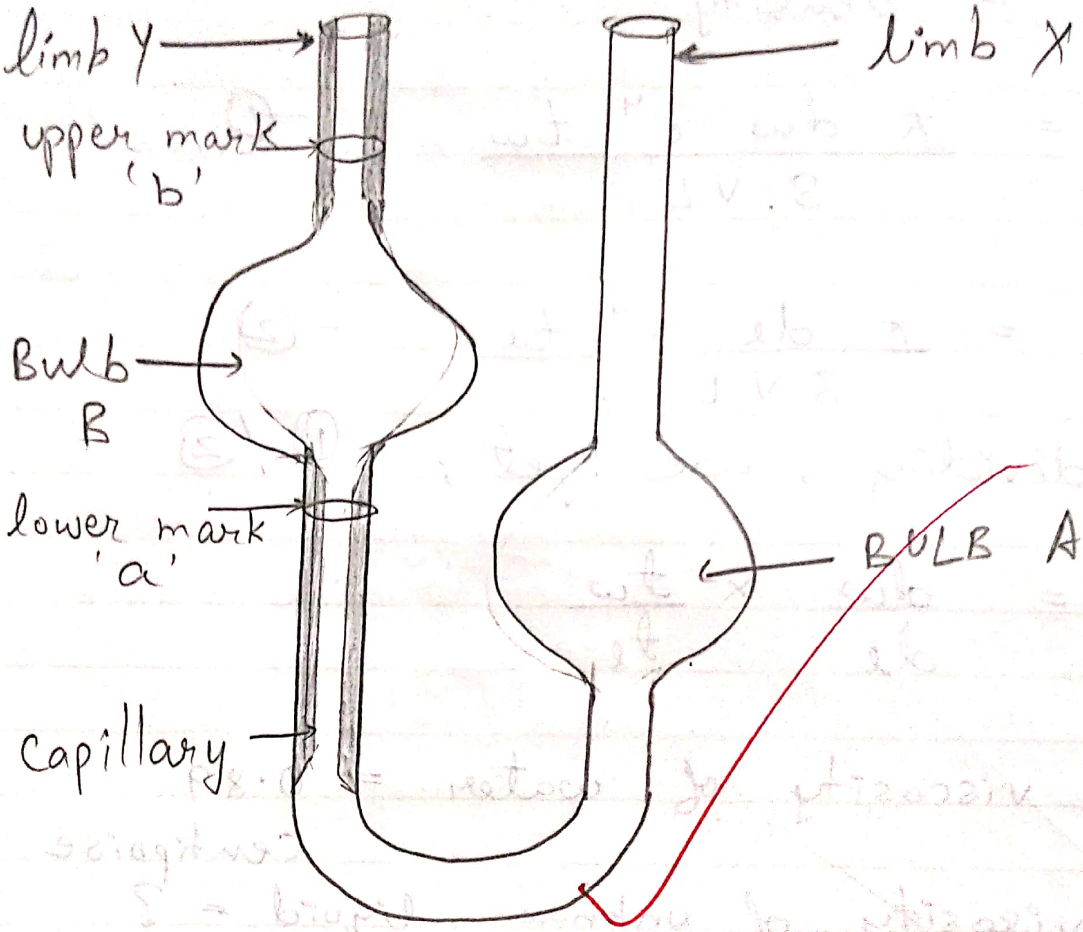
d_w = density of water = 0.997 g/cm³.

d_l = density of liquid (methanol) = 0.7866

t_w = time for water.

t_l = time for liquid.

Fig: Ostwald's Viscometer



at Room temperature 25°C

$$\frac{0.89}{\eta_l} = \frac{0.997}{0.7866} \times \frac{28.7}{26.3}$$

$$\eta_l = \frac{0.89 \times 0.7866 \times 26.3}{0.997 \times 28.7} = 0.643$$ centipoise

23/7/20

Aim: Determination of Surface tension of given liquid at room temperature by Stalagmo-meter.

Apparatus required: Stalagmometer, specific gravity bottles, and piece of rubber tubing with screw clip.

Chemicals required: Given liquid, water, etc

Theory: Surface tension, represented by the symbol γ, is defined as the force per unit length applied parallel to the surface to compensate the total inward pull. The units of surface tension are dyne/cm or N/m.
The surface tension of a given liquid is determined relative to water at room temperature by Stalagmometer. The same volume of water and liquid is taken for the experiment.
The number of drops of both the liquids is counted.

let the number of drops in water $= n_1$
number of drops in the given liquid $= n_2$

when determined by using specific gravity bottle or pycnometer,

Density of water at room temperature $= d_1$
density of given liquid at room temperature $= d_2$
the surface tension γ_2 of the given liquid can be calculated by using the following formula:

$$\frac{\gamma_1}{\gamma_2} = \frac{n_2}{n_1} \times \frac{d_1}{d_2}$$

$n_2 = 144$ drops
$n_1 = 44$ drops.
$\gamma_1 = 72.6$ dyne
$\gamma_2 = ?$
$d_1 = 0.997$ gm/cm^3
$d_2 = 0.792$ gm/cm^3

Expt. No. ______ Date ______

Procedure :

1. First, clean the specific gravity bottles and the stalagmometer using chromic acid solution. Wash them properly with distilled water and then dry.

2. Immerse the lower end of stalagmometer in a beaker containing distilled water and draw up the water until it rises above the mark and then tighen the screw of the screw-pinch.

3. Loosen the screw of the screw-pinch carefully and allow the drops of liquid to fall at an interval of about 2-3 seconds.

4. Start counting the drops when the water meniscus arrives at the upper mark and stop counting when the meniscus just passes the lower mark.

5. Repeat step 4 to get 3 Readings and calculate the mean value.

6. Clean and dry the Stalagmometer. Fill it with the given liquid until it rises above the upper mark. and then count the number of drops as noted in step 4.

7. Now clean and dry the specific gravity bottle to measure the density of a liquid.

Observation:

liquid	Number of drops			Mean Value
	1	2	3	
Water	40	41	44	42
Given liquid	144	143	144	144

Calculation: $\frac{\gamma_1}{\gamma_2} = \frac{n_2}{n_1} \times \frac{d_1}{d_2}$

$$\frac{72.6}{\gamma_2} = \frac{144}{42} \times \left(\frac{0.997}{0.792}\right)$$

$$\gamma_2 = \frac{72.6 \times 42 \times 0.792}{144 \times 0.997}$$

$$= \frac{2414.96}{143.56} = \boxed{16.82} \text{ dyne/cm.}$$

Aim: to determine the viscosity of given sample of lubricating oil with Redwood viscometer and to study the viscosity at various temperature.

Apparatus required: Redwood viscometer, thermometers, and measuring flask 50 ml.

Chemicals required: Oil sample.

Theory:
The property of a homogeneous liquid that offers a frictional resistance to its motion is called viscosity.
The viscocity of lubricating oil signifies how well it can be used for the lubricating purpose to reduce the friction between surfaces in motion. It also prevents direct contact between metals.

It can be expressed in the following three ways:

(1) In C.G.S. unit absolute kinematic viscosity is expressed as stoke.

(2.) In C.G.S unit absolute dynamic viscosity is expressed as poise.

(3) Time is taken by the instrument in seconds noted by the name of the given instrument.

The aim of this experiment is to examine if the lubricating oil is viscous enough to adhere onto the surface where it has been applied or is it thin enough that can probably be squeezed out of the applied surface as a result of high pressure and temperature.

Procedure :

(1.) Clean the Viscometer and level it using a circular spirit level and base screws the tripod.

(2) Align the ball valve and fix it in its position in the oil cup.

(3.) Fill the oil cup with oil up to the level mark.

4. Fill the water bath with water approximately to the point of oil level in the cup.

5. Insert the thermometers in place in water bath and oil cup.

6. Place the measuring cylinder (50ml) exactly at the center of the position below the jet.

7. Properly stir the oil and water and record their temperatures.

8. Raise the ball valve and suspend it from the thermometer bracket when the temperature of oil and water are stable and equivalent.

9. Now allow the oil to flow into the measuring cylinder placed below it.

10. Start a stop watch when the level of oil flowing into the measuring cylinder approaches 50ml. Record the time (in seconds) taken to collect the 50ml oil at room temperature.

Date

Expt. No.

(11) Replace the position of the ball valve to seal the jet in order to prevent the overflow of the oil.

(12) Put the oil from the measuring cylinder into the oil cup until the indicator tip of the cup.

(13) Replace, clean, and dry the standard measuring cylinder centrally under-neath the jet properly.

(14) Heat the water bath to heat the oil. When the temperature of the oil reaches the test temperature, stop heating and bring down the temperat-ure of water in equilibrium with the temperature of the oil by flowing out some hot water through the outlet and adding some cold water from the top while constant stirring.

(15) Collect 50 ml of oil when the temperatures of oil and water remain at equilibrium. Record the time required in seconds.

(16) Repeat the experiment at five high temperatures keeping the temperature difference of 5°c to 10°c between the two. While keeping a record of the observation, it should be noted that the temperatures of oil and water should be the same.

(17) Plot a graph of temperature vs time

Calculation :

Kinematic viscosity = $At - \frac{B}{t}$

where, A & B are constants known as instrument factors.
t = time taken by 50ml oil to flow in the vessel.

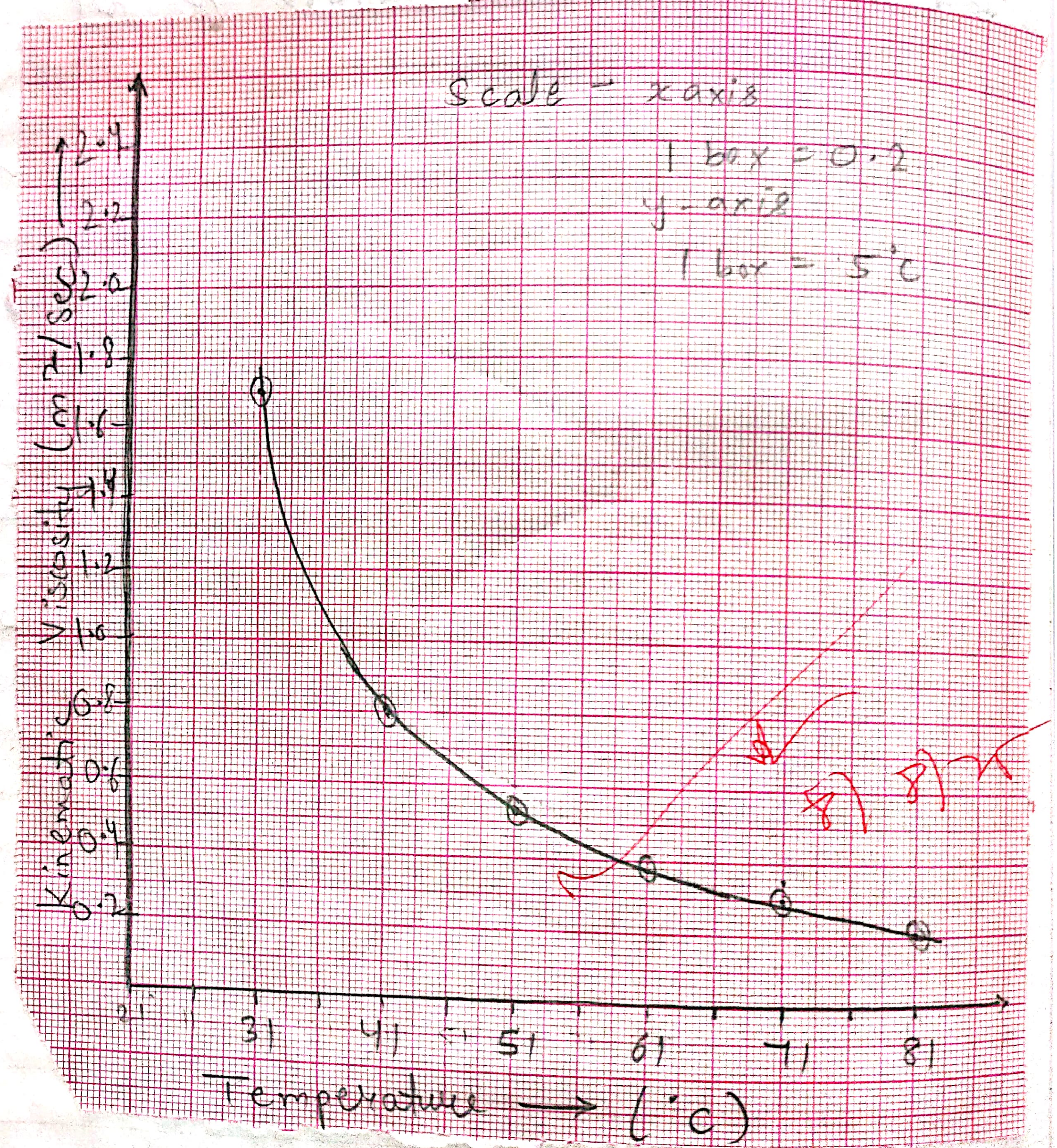
$A = 0.0026$, $B = 1.1176$

$(K.V)_{31} = 0.0026 \times 650 - \frac{1.1176}{650}$

$= 1.69 - 0.0017$
$= 1.69 \approx \boxed{1.7}$

$(K.V)_{41} = 0.0026 \times 325 - \frac{1.1176}{325}$

$= 0.845 - 0.00$
$= 0.84 \approx \boxed{0.8}$


Scale - x axis
1 box = 0.2
y - axis
1 box = 5°C
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Kinematic Viscosity (m²/sec)
21
31
41
51
61
71
81
Temperature → (°C)

$$(k.V)_{51} = 0.0026 \times 264 - \frac{1.1176}{264}$$

$$= \boxed{0.61}$$

$$(k.V)_{61} = 0.0026 \times 178 - \frac{1.1176}{\cancel{264}\ 178}$$

$$= \boxed{0.4}$$

$$(k.V)_{71} = 0.0026 \times 136 - \frac{1.1176}{136}$$

$$= \boxed{0.35}$$

$$(k.V)_{81} = 0.0026 \times 104 - \frac{1.1176}{104}$$

$$= \boxed{0.27}$$

Result: Redwood viscosity of the given oil at 81°C temperature is 0.27.

The graph plotted between temperature (y-axis) and time (x-axis) implies that a rise in temperature decreases the time. This implies that the viscosity of the oil decreases with the rise in temperature.

Viva Questions :

(1) What is the relation between density and viscosity?

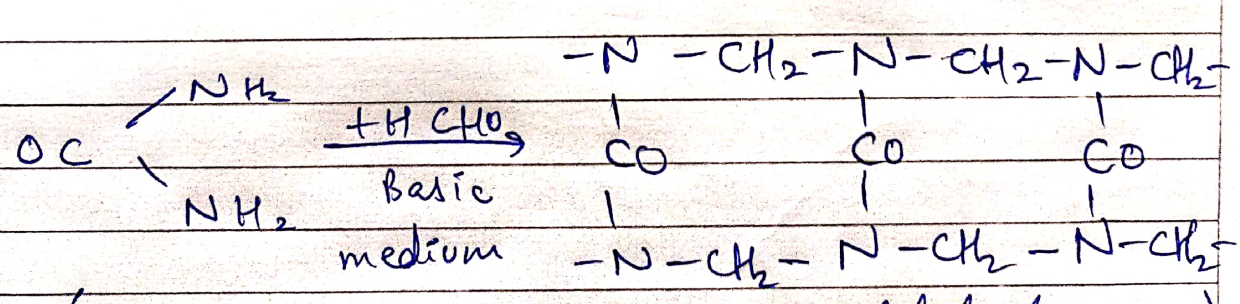
⇒ There is no relationship between density and viscosity of a fluid. Viscosity refers to the thickness or thinness of fluid and density refers to the space between the particles of fluid.

8/8/23

Object: preparation of urea formaldehyde resin.

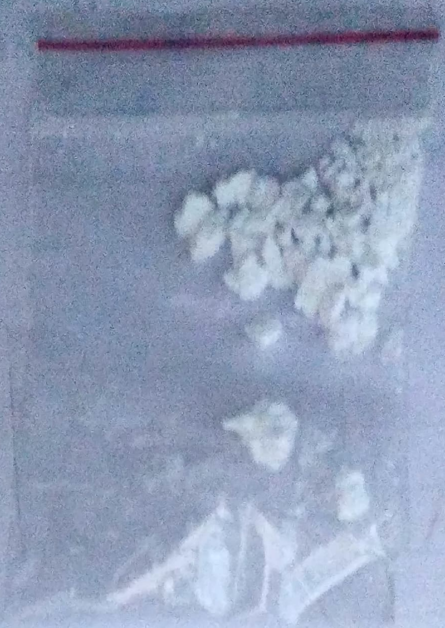
Apparatus and Reagents: Beaker (250 ml), measuring cylinder (25 ml), stirring rod, formaldehyde (40%), urea, H_2SO_4 (conc.), distilled water.

Theory: The urea formaldehyde resin is produced by condensation polymeri-zation, reaction of urea with aqueous formaldehyde. Such resin is commercially important, it is used in packaging, water tumbles, unbreakable dishes, buttons, clock cases, etc. Urea formaldehyde resins is water soluble and hence, are used as sizing agents and textile finishing resin. It is also used in the ~~paper~~ paper industry to improve the wet strength of paper. These also used as insulators.



(urea)

(urea formaldehyde resin)
(Cross-linked polymer)



Procedure :

Take 25 ml of 40% formaldehyde solution in 250 ml beaker. Then add 10 gram of urea in to the beaker. Stir the solution constantly until a saturated solution is obtained. Add few drops of H_2SO_4 (conc.) stir cautiously during the addition. At once voluminous white solid mass appears in the beaker. When the reaction is complete, wash the residue with water and dry the products formed and weigh the urea formaldehyde resin formed.

Precautions :

It is a vigrously reactive reaction, Add HCl slowly and carefully.