Prelim Experiment-3

Surface Tension of Liquids

Be it raindrops, dew drops or drops created by us, these are a constant source of wonder. Study of a drop created under controlled conditions can lead to many important parameters of the drop, one of them being the surface tension.

You will also need to find the density of a liquid to get its surface tension. The process of finding the density is discussed after Part-C.

Part-A: Surface tension of water

Take a syringe without its needle. Fill with water. Measure the volume from the graduations on the syringe. Keep the syringe in vertical position with the nozzle at the bottom. Now make the water come out of the nozzle drop by drop. Count the drops as a certain volume of water runs out of the syringe. Tabulate your observations. Calculate the average volume of one drop.

What is balancing the weight of a drop just before it leaves the nozzle? A suggested relation to estimate the surface tension is

W(weight of drop)= $2\pi rT$

where T is the surface tension of water and r is the inner radius of the nozzle. Explain this relation in terms of forces on the drop.

Find the inner radius of the nozzle using your own method. Determine the surface tension of water.

Part-B: Surface tension of soap solution

Make soap solution of various concentrations. First make a very concentrated soap solution. Dilute this with water to prepare soap solutions of different concentrations.

Now, for each concentration, create drops of the soap solution with a syringe and find the surface tension. Tabulate your observations. Plot surface tension vs concentration of soap solution.

Is the value of surface tension of water calculated in part-A consistent with this graph? Justify your conclusion.

Part-C: Surface tension of water – oil interface

Dip the nozzle of the water filled syringe in some transparent oil and form water drops in oil.

Write the visible differences in the drops formed in the oil and in air.

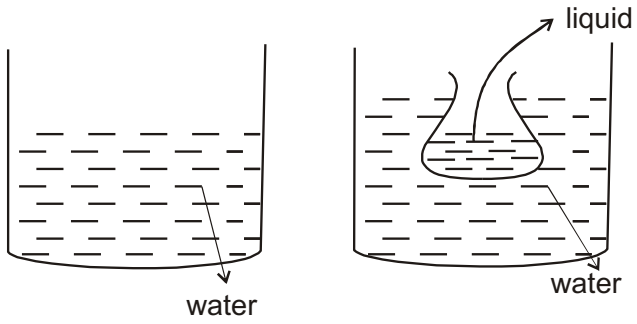
Calculate the average volume and the weight of each drop.

Find an expression for the force of surface tension acting on the water drop in oil. Hence find the surface tension of water in oil.

Finding the density of a liquid using the principle of floatation:

Take a transparent cylindrical vessel and put some water in it. Take another small vessel/container and see that it floats in the water of the bigger vessel.

Pour a measured volume of the liquid in the smaller vessel. Measure the change in the height of water in the outer vessel. Derive an expression for the volume of water displaced in terms of measurable parameters. Use it to find the volume of water displaced due to addition of oil in the inner container. Use the principle of floatation to find the mass of the liquid and then its density.



Describe the process followed by you in detail, in your report.

Suggested Extra Explorations:

1. You can think of making drops of oil in air and find its surface tension. Explore the possible relation between the three surface tensions - water in air, water in oil and oil in air.
2. You can also explore making oil drops at the bottom of a water column and study their motion.

Expected photos and videos:

1. Video of
   a. formation of water drops in air and the no of drops in the measured volume.
   b. Video of formation of water drop in oil.
   c. Video of measurement of density of oil.
2. Photo of
   a. measurement of radius of the nozzle
   b. your set up to find the density with measurements clearly visible.

Note: <u>All videos should be less than one minute.</u>