LAD 5.1 (pg 1 of 3) Density of Various Liquids

Name_____

Introduction:

We will start our investigation by comparing the viscosity of the four liquids that we will be studying. Viscosity is a characteristic property that measures a materials resistance to flowing. A characteristic property is one that can be used to help identify a substance. For instance ketchup has a high viscosity and water has a lower viscosity. Before we start we will qualitatively compare the viscosity of all four liquids and propose a correlation between viscosity and density. After we measure and calculate the density of the liquids we will determine if our proposed correlation is valid.

Density is also characteristic property. Density is a measure of the mass per unit volume. In other words it is a ratio of a substance's mass compared to its corresponding volume. It can be easily calculated after measuring the mass and volume of some substance and then using the formula Density = mass / volume.

Goggles must be worn at all times during the LAD.

A random amount of liquid means to just pour some in not trying to hit any particular line.

(NO NEED TO MAKE A DATA TABLE, I HAVE PROVIDED ONE FOR YOU ON PAGE 3)

Procedure A: This data will be collected together as a class. Water in a large beaker

a Determine the mass and volume of a random amount of water in a large beaker.
b Repeat the process for a total of 6 trials using different random amount of water in a large beaker.

Processing the data A:

a Calculate the density of the water in each trial. Round the answer off appropriately and be sure and put a unit label at the head of the column (or row).
b We will report the 6 trials on the class data table.

Procedure B: Alcohol in a small graduated cylinder

a Determine the mass and volume of a random small amount of alcohol in a 10 ml graduated cylinder.
b Repeat the process by adding a little bit more alcohol for a total of 4 trials using different random amounts of the liquid in the 10 ml graduated cylinder.
c After returning the alcohol to the appropriate container, no need to wash the cylinder, simply grip it tightly and shake it dry.

Processing the data B:

a Calculate the density of the liquid in each trial. Round the answer off appropriately, be sure and put a unit label at the head of the column (or row).
b Calculate an average of all four values.
c Report the average to the class data table.

Procedure C: Water in a small graduated cylinder

- Repeat the procedure B for water. Use a squirt bottle for the water rather than the faucet so that the water doesn't squirt all over the outside of the graduated cylinder. The squirt bottles are much easier to aim than the water coming out of the faucets.

Processing the data C:

- Repeat the calculations in part B for the water trial.

Procedure D & E: Oil and corn syrup in a cylinder

- Repeat procedure B for the last two liquids, oil and corn syrup.
- Use the same graduated cylinder from trial C for one liquid, then use a clean cylinder for the second liquid. No need to clean the cylinders when you are done, just leave them in the soapy water in sink at the back of the lab.
- Repeat the calculations for both liquids reporting your average value of each to the class data table.

Procedure F: Water in a volumetric flask

a Determine the mass of the volumetric flask.
b Fill the flask with water to the etched line. The volume of the flask is listed on the flask.
c Determine the mass of the flask with water in it.

Processing the data F:

a Subtract the mass of the flask to determine the mass of the water.
b Calculate the density of the water for the one trial. Round the answer off appropriately.
c Report your density value to the class data table.

Disposal:

If they have NOT been contaminated, all the liquids, other than water should be returned to their respective containers on the center lab bench. If the liquids were contaminated with another liquid, they can be poured down the sink with plenty of wash water.

Post LAD Questions

1. Mass and volume are physical properties. Their value will vary with the amount of material. Tolerating the fact that there is error in the density values, the data should demonstrate that density is a physical property that does not change with the amount of material being measured. Why is density a constant quantity for any one material even for varying amounts of a substance?

2. The theoretical value for the density of water at room temperature is 0.998 g/ml, four our purposes, we'll consider it to 1 g/ml (Review NS 5.9 before working this question.)
   a. Comment on the accuracy and precision of the class data for the density of water using the small graduated cylinder and the volumetric flask compared with the beaker used during the class demo, Procedure A.

   b. Does the data indicate which measuring device is least precise or accurate - a beaker or a graduated cylinder or a volumetric flask? If one is less precise or accurate than the others, explain why.

3. In class, a correlation between viscosity and density was proposed. State the correlation that was made earlier and then, based on the findings in this lab, is the proposed correlation between viscosity and density valid?

The real story about viscosity.

It is tempting to suggest that density causes viscosity, or viscosity causes density, however, the reality is that viscosity is caused by the ease with which molecules of a liquid can move with respect to one another. Thus viscosity of a *pure* substance can *depend* on several different factors:

- the attractive forces between molecules (a topic we will study in chap 14)
- the size and shape of the molecules in a liquid.

In summary, stronger intermolecular forces, larger, and longer molecules are all more likely to become entangled with each other. It is this "stickiness between molecules" that is more important than the density of the substance in causing the material's viscosity.

The viscosity of a *solution* is associated with the density of that solution

- The number of molecules dissolved will affect how crowded together the particles are and will affect their ability to move around and thus affect the viscosity.

In summary, a more crowded solution (which will be a more dense solution), the molecules are more likely to become entangled with each other affecting the material's viscosity.

Error Analysis - review NS 5.6 for more information on doing Error Analysis

- State the source of the error,
- state which data and how it would be affected (higher or lower?)
- then state how the calculated value(s) would be affected (higher or lower?)

4. Since the corn syrup is so viscous, it takes time for it to run down the sides into the graduated cylinder. Why would it be a problem if the measurements were taken very quickly for the corn syrup trial?

5. If the oil got shook up when it is put into the cylinder, bubbles may form. Why would these bubbles be a problem?

6. It is always important to keep a clean lab, especially around the balances. Why would it be a problem if there were liquid on the outside of the cylinder or spilled on the balance pan that you were not aware of?