EXPERIMENT # 5

PHYSICAL PROPERTIES OF HOUSEHOLD LIQUIDS

PURPOSE:

1. To determine the density of CLEANING FLUID, COOKING OIL and DISTILLED WATER by using a graphing technique.
2. To construct a three layered column of liquids based on the knowledge of density and solubility of the three liquids.

PROCEDURE:

PART I: DENSITY DETERMINATIONS

A. The density of cleaning fluid

1. Weigh a CLEAN, DRY, 25 mL graduated cylinder to the nearest 0.01 g. Record this weight in your Laboratory Notebook
2. Place between 5 and 10 mL of cleaning fluid into the graduated cylinder. Do not attempt to fill the graduated with an 'exact' volume. Read the volume to the nearest 0.1 mL and record this volume in your Laboratory Notebook.

   Note: Always read the volume of a liquid in a graduated cylinder at the bottom of the meniscus (curved surface of the liquid). Make sure that your eye is directly opposite the meniscus. See Figure 1.

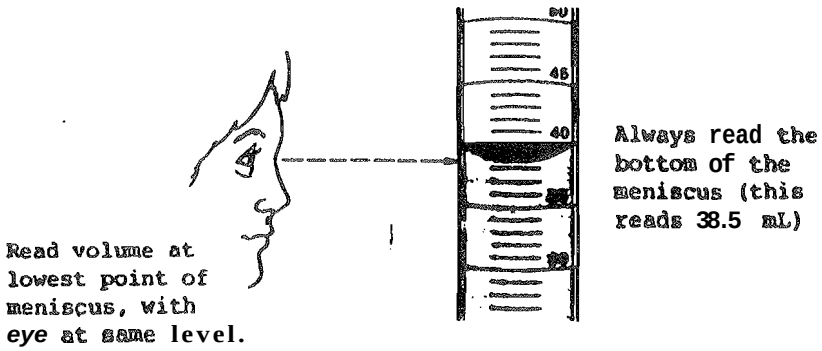

Figure 1

3. Reweigh the graduated cylinder and contents to the nearest 0.01 g. Record this weight on your Laboratory Notebook.
4. Repeat steps 2 and 3 three more times using approximately the following volumes:
   - any volume between 10 mL and 15 mL;
   - any volume between 15 mL and 20 mL;
   - any volume between 20 mL and 25 mL.

   Record the respective volume and mass measurements in your Laboratory Notebook.
5. Dispose of the cleaning fluid in the properly labeled WASTE CONTAINER which is placed for your convenience under the fume hood. Place your LABELED empty graduated cylinder in the fume hood to permit evaporation of the residual cleaning fluid. You may assume that all the residual cleaning fluid has evaporated when you cannot longer detect its characteristic odor at the mouth of the graduated cylinder (this will take only a few minutes).

   NOTE: - DO NOT POUR THE CLEANING FLUID DOWN THE DRAIN.
   - DO NOT WASH THE GRADUATED CYLINDER USED FOR THE CLEANING FLUID.

B. The density of cooking oil

1. Use your CLEAN and DRY graduated cylinder to repeat the procedure you have followed for the cleaning fluid, but this time use cooking oil instead. Record your results in your Laboratory Notebook.
2. Dispose of the cooking oil in the properly labeled WASTE CONTAINER. Wash out the graduated cylinder with plenty of warm water and detergent (use a test tube brush) until all stickiness is gone. Then rinse with tap water and distilled water. Wipe dry the outside of the graduated cylinder with a paper towel. There is no need to dry the inside of the graduated cylinder since In the next step you will fill it with water.

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C. The density of distilled water

1. For this part, use the clean graduated cylinder which you have washed after using it for cooking oil. The graduated cylinder need not be dry on the inside but should be wiped dry on the outside with paper towel.
2. Repeat the procedure you have followed for the cleaning fluid and the cooking oil, but this time use distilled water instead. Fill up your plastic wash bottle with distilled water and use it to add water to the graduated cylinder. Record your results in your Laboratory Notebook. When you finished, dispose of the distilled water in the sink.

RESULTS AND CALCULATIONS

1. Calculate the mass of each volume of cleaning fluid, cooking oil, and water by subtracting the mass of the empy cylinder in each case.
2. Prepare a graph by plotting the mass in grams of the samples on the Y axis, and the corresponding volumes on the X axis.

   NOTE: To assist you in the graphing technique, a sample graph is attached to your Report Form. Your graph should look about the same, but of course it will show three straight lines rather than two. Please pay particular attention to the followings:

   (a) Any graph must have a title.
   (b) The two axis must be labeled with the names of the variables you are plotting, including the units used.
   (c) The data points are shown in one corner of the graph.
   (d) The scale of the graph is clearly indicated.
   (e) The calculation of the slope is done on the graph paper.
3. Draw the BEST STRAIGHT LINES through the points for each liquid. To do this, hold a ruler on your graph and move it back and forth until the line includes most of the points a misses them by equal amounts above and below.

   All three lines should cross the origin, even though their slopes will be quite different since they represent the different densities of the three liquids.

   Label the three straight lines: CLEANING FLUID, COOKING OIL and WATER.

4. Calculate the slope for each of the three lines to the proper amount of significant figures and express them in the appropriate units.
   NOTE: The Slope of a straight line is defined as the steepness of the line as you look at it from left to right. You can calculate the slope of a line by picking any two points (they should be fairly far apart, but they should not be experimental points).
   Since in this case all three lines should cross the origin (0 mL of any liquid has a mass of 0 g), one of these points can be conveniently selected as the origin. The other point is selected at the intersection of the respective straight line with a vertical line corresponding to a volume of 20.0 mL.
   Read the mass corresponding for *20.0* mL of each liquid and calculate the slope.

$$\text{Slope} = \frac{\text{Change in Y}}{\text{Change in X}} = \frac{\text{Change in Mass}}{20.0\ \text{mL}} = \text{DENSITY (in g/mL)}$$

CONCLUSIONS:

Record the density of each liquid as determined by the graphing technique. The slope of each straight line represents the density of the respective liquid.

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PART II: LAYERS OF LIQUIDS

Two characteristic properties of the three liquids will be observed:

1. Solubility

Some liquids when mixed together do not form a homogeneous mixture (solution) but separate in two distinct layers. Such liquids are said to be **insoluble** or **immiscible** in each other.

Other liquids when mixed together form a homogeneous mixture (solution) and they are referred to as **soluble** or **miscible** in each other.

PROCEDURE

(a) Prepare ten clean and dry test tubes of the same size.

(b) Using your 10 mL graduated cylinder measure out 2 mL of distilled water. You can adjust best the liquid level by using a Pasteur pipet. Transfer the 2 mL of distilled water into CLEAN , DRY and PROPERLY LABELED test tube.
Add 2 mL of distilled water to a second test tube, and 2 mL to a third test tube by noting the level of water in the first test tube and trying to match it.
Use your Pasteur pipet for proper level adjustment.

(c) Add three portions of 2 mL of cooking oil into each of three other test tubes by adding the oil dropwise to the proper level. (Use a different Pasteur pipet). Label these test tubes.

(d) Add three portions of 2 mL of cleaning fluid into each of three other test tubes by using the same technique. (Use a different Pasteur pipet). Label these test tubes.

(e) Pour 2 mL of cleaning fluid into one of the test tubes containing distilled water. Shake well the test tube for proper mixing and observe the results. Is the cleaning fluid soluble in distilled water?

(f) Pour 2 mL of distilled water into one of the test tubes containing cooking oil. Shake well the test tube for proper mixing and observe the results. Is the cooking oil soluble in distilled water ?

(g) Pour 2 mL of cleaning fluid into one of the test tubes containing cooking oil. Shake well the test tube for proper mixing and observe the results.
Is the cooking oil soluble in the cleaning fluid ?

2. Sink or Float ?

have probably observed that some things sink, whereas others float in water.

The tendency of a liquid to sink in water a to float on it is determined by relative densities of the water and of the liquid and their respective solubilities in each other.

Procedure:

(a) Using your recently acquired knowledge about the densities of the three liquids and their respective solubilities in each other, pour 2 mL of each liquid into the tenth test tube in such a manner as to obtain a column of three distinctly separated layers. Before adding the three different liquids into the test tube consider carefully the order in which you are going to add them.

Present the test tube with the layered liquids to your laboratory instructor and make a sketch of it in your notebook. On the sketch clearly label each layer and indicate its experimetally determined density.

(b) Cork the test tube with the three layered liquids and shake it, so as to mix the three liquids well. Remove the cork observe the contents of the test tube for five minutes. Report your observations and make a sketch of this test tube in your notebook by clearly identifying the contents of each layer. Calculate the density of the bottom layer.

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Name_____
Date_____
Partner_____

NAME: _____

PHYSICAL PROPERTIES OF HOUSEHOLD LIQUIDS

REPORT FORM

PART I: DENSITY DETERMINATIONS

A: The density of cleaning fluid

Trial	Volume of liquid (mL)	Mass of cylinder (g)	Mass of cylinder + liquid (g)	Mass of liquid (g)

B: The density of cooking oil

Trial	Volume of liquid (mL)	Mass of cylinder (g)	Mass of cylinder + liquid (g)	Mass of liquid (g)

C: The density of distilled water

Trial	Volume of liquid (mL)	Mass of cylinder (g)	Mass of cylinder + liquid (g)	Mass of liquid (g)

CONCLUSIONS:

1. (a) The DENSITY of the CLEANING FLUID is : _____ g/mL

   (b) The DENSITY of COOKING OIL is _____ g/mL

   (c) The DENSITY of DISTILLED WATER is : _____ g/mL

2. MASS and VOLUME are _____ proportional.
   (directly or inversely)

   As the _____ of the liquid was increased, the _____ increased accordingly.

PART II: LAYERS OF LIQUIDS

1. Solubility

   Describe what you observed when you mixed cleaning fluid with distilled water :

   _____

   _____

   Describe what you observed when you mixed distilled water with cooking oil :

   _____

   _____

   Describe what you observed when you mixed cleaning fluid with cooking oil:

   _____

   _____

   Summarize your observations regarding the respective solubilities of the three liquids in each other

   (Note : Use S for soluble and I for insoluble)

   CLEANING FLUID and DISTILLED WATER : ____

   DISTILLED WATER and COOKING OIL: ____

   CLEANING FLUID and COOKING OIL: ____

2. Sink or Float ?

Sketch below the test tube containing the three liquids in a column of three distinctly separated layers. Label each layer and indicate the experimentally determined density of each layer.

In which order did you add the liquids to the test tube

First : _____ Second : _____ Third : _____

Could you add the liquids in a different order and obtain the same column with three distinctly separated layers ? ____

Explain how you would this OR why this is *not* possible:

_____

_____

_____

What did you observe after mixing the three liquids and letting the test tube stand undisturbed for five minutes ?

_____

_____

_____

Sketch below this test tube and clearly identifying the contents of each layer.

Calculate below the density of the bottom layer:

Cleaning Fluid		Cooking Oil		Distilled Water	
Volume mL	Mass g	Volume mL	Mass g	Volume mL	Mass g
5.0	10.00	5.0	3.00	5.0	5.00
10.0	20.00	10.0	6.00	10.0	10.00
15.0	30.00	15.0	9.00	15.0	15.00
20.0	40.00	20.0	12.00	20.0	20.00

Solution	Slope of Line	Average Density
Cleaning Fluid	2.00 g/ml	2.00 g/ml
Cooking Oil	0.60 g/ml	0.60 g/ml
Distilled Water	1.00 g/ml	1.00 g/ml