Introduction to Natural Science (2006/07)

Fall 2006 Quarter

Chemistry Lab I: "Chemical Foundations"

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A good website for density of elements is: www.science.co.il/PT elements.asp?s=Density

All liquids are alcohols. Look up the CRC under "organic liquids"

Pre-Lab Assignment

Complete the Pre-lab before coming to lab

Part I: Exploring physical and chemical properties

Define the following terms using your own words (you can read the chemistry text, but use your own words).

- Chemical property (give 2 examples)
- Physical property (give 2 examples)

PART 2: Density Measurements

1. Define the term "density" using your own words.

2. How would you use a demonstration to compare the densities of water, oil, wood and iron nails to a sixth grade student. Describe your demonstration in detail and draw a labeled diagram of your experiment.

3. Determine the volume of the following. Pay attention to units.
   - A cube that has a length of 12.5 cm
   - A sphere with a radius of 2.34 cm

4. Volumes of solids are often determined by displacement, specially when they are irregular in shape. For this purpose you must first find a liquid in which the solid of interest in not soluble. Then add a specific volume of the liquid to a graduated cylinder (or other graduated device). Add the solid to the liquid in the cylinder. Measure the combined volume of the liquid and the submerged solid. The difference between these two volumes is the volume of the solid. It is important that the liquid you select have a density lower than that of the solid so that the solid will not float on the liquid.

A metal block has a mass of 12.5 g. When placed in a graduated cylinder containing 32.5 ml of water, the volume of the block and water was found to be 54.2 ml. Calculate the density of the metal block and express it in correct units. Show all work.

PART 3: Precision and Accuracy when Dispensing Liquids

Using your own words, write definitions for the following. You can use your chemistry textbook (Appendix A) to get information, but write in your own words.

- Precision
- Accuracy
- Systematic errors
- Random errors

Lab Assignment

Part I: Exploring physical and chemical properties

Work in pairs. Carryout the following experiments and record your observations. Determine whether your observations warrant a physical property or a chemical property.

Experiment	Observations	Physical/chemical property
Do this in the hood. Clean a piece (about 2 inches long) of magnesium ribbon. Using forceps to hold the ribbon, hold it to the flame of a Bunsen burner.		
Leave a piece of ice on a dish for 10 minutes		
Pour out approximately 25 ml of vinegar into a beaker. Add about one tablespoon of baking soda to the beaker. Clean up all glassware when you are done.		
Take a piece of aluminum foil (2”x 2” will be enough). Roll into a dense ball and place it in a tray filled with water.		
Observe the test tube filled with solid iodine placed in hot water (in the hood)		

PART 2: Density Measurements

Work in pairs.
You are provided with four unknown samples. Two of them are liquids and two are solids. These are pure substances. Your task is to determine the density of these samples. Then use this density data to identify the unknowns. You will need to refer to a standard table that gives you the densities of pure substances (use your chemistry textbook or the Hand Book of Chemistry and Physics available in Lab Stores). Be sure to cite the references used.

- When determining the mass of substances, use the analytical balance that enables you to weigh to the nearest 0.0001 grams.
- When determining the volume of solids use the displacement method **only**. **First weigh the dry solid sample**. Add a known volume of an appropriate liquid to a graduated cylinder (3-5 ml is a good volume to begin). Then add the weighed solid and read the displacement.
- When determining the volume of liquids, use a **burette** to obtain the required volume. A burette will be set up in the lab for each unknown liquid. Find this burette. Take a **covered** (with an aluminum foil)**, pre-weighed beaker** to the burette. Dispense about 5 ml of the unknown liquid into the weighed beaker and cover with the foil. Be sure to record the **exact volume** of liquid you dispensed. Now weigh the covered beaker again and determine the mass of the liquid.
- In all cases report the mass, volume and density data to the correct number of significant figures. (You can use your Chemistry textbook to learn more about significant figures).
- Measure and record room temperature. You will need this for density information.
- Report your data in tabulated form (example shown below) in your lab notebook. **Be sure to include the correct units for each measurement.** The following table will work well for solid samples. Construct a similar one for liquid samples.

Unknown Substance	**A**	**B**	**C etc.**
Room temperature			
Mass of the unknown			
Liquid used for displacement			
Volume of liquid			
Volume of liquid + unknown			
Volume of unknown			
Density of unknown			
Identity of the unknown			
Reference used for identification			

Do these calculations at home

Note: The following instructions pertain to reading a volume in a graduated cylinder, a burette or any other graduated device.

1. Place a piece of white paper or card directly behind the cylinder at the meniscus.
2. Do not hold the graduated device in your hand. Rest it on a tabletop. Then, position your head so that your eye is at the same height as the level of the liquid.
3. Look straight at the meniscus through the glassware so that you see only a concave line not a concave surface.
4. Read the level of the liquid at the bottom of the meniscus, the curved surface of the liquid.

PART 3: Precision and Accuracy when Dispensing Liquids

This portion of the lab enables you to understand more about accuracy, precision, random errors and systematic errors in scientific data.

Introduction:

You will use a 10.00 ml volumetric pipette to obtain a fixed volume of water. You will weigh this volume of water as accurately as possible. You will also measure the temperature of water and record the density of water at that temperature using standard tables (the Hand Book of Chemistry and Physics is a good source). Then you will use this data to calculate the volume of water. Your data enables you to determine the **accuracy** of your pipetting and weighing techniques. By taking repetitive measurements, you can also investigate the **precision** of your measurements.

If the volumes you delivered each time with the pipette are close together in value, you can have confidence that your technique is reproducible or precise. If you deliver amounts that are close to the recorded volume for the pipette, you can be confident that your technique is accurate.

Do this lab individually.

You will be provided with a chemically cleaned (acid washed) pipette for this lab. Check your pipette for cleanliness by filling and delivering distilled water from it. If the water runs off cleanly, the pipette is chemically clean. If it forms beads or drops on the surface, it will have to be cleaned. Consult the instructor for cleaning procedures. Do not attempt to clean glassware on your own.

1. Obtain a 250 ml beaker and fill it with about 200 ml of **distilled (or de-ionized) water (not tap water)**.
2. Measure the temperature of the distilled water. Be sure that the bulb of the thermometer is inside the liquid while taking the temperature measurement. Record this temperature in your lab notebook.
3. Find the density of water at this temperature using the Hand Book of Chemistry and Physics and record it in your lab notebook.
4. Using an analytical balance weigh a clean, dry, 100 ml beaker covered with a piece of aluminum foil. Be sure to use an analytical balance accurate to 0.0001 grams. The beaker needs to be dry on the **outside** but not necessarily on the inside. Pipette out 10.00 ml of distilled water using a 10 ml volumetric pipette. Transfer this distilled water into the pre-weighed beaker. Follow the instructions given in class when doing the transfer. This is a very important step. The accuracy of your data will depend on it. When the transfer is complete, weigh the beaker with water (again covered with the foil cap) using **the same analytical balance**.

- The tip of the volumetric pipette must be kept under the surface of the liquid being measured out during the entire time suction is being applied. If not, air will be sucked into the pipette.
- When emptying the contents of the pipette into a beaker, hold the pipette vertically and tilt the beaker. Let the tip of the pipette touch the inside surface of the beaker. Let the liquid drain from the pipette into the beaker**. Do not blow the liquid out of the pipette**.
- When draining is complete, hold the pipette in the draining position (with the pipette tip touching the inside surface of the beaker) for **at least one more minute**. **Do not blow the liquid out of the pipette.**

5. Repeat the above procedure three more times so you have four measurements using the same volumetric pipette. Be sure to use a clean, dry beaker (again, only the **outside must be** dry) every time. **Be sure to use the same analytical balance each time.**
6. Tabulate your data as follows in your lab notebook.

Data from the volumetric pipette
I. D. number of the analytical balance _____________

	Trial 1	Trial 2	Trial 3	Trial 4
Weight of empty beaker with cover (g)				
Weight of beaker with cover + water (g)				
Weight of water (g)				

The following calculations can be done at home.

1. For each of the four trials, determine the volume of water transferred by the pipette. A table as follows will be helpful.

	Trial 1	Trial 2	Trial 3	Trial 4
Weight of water (g)				
Density of water (g ml^{-1})				
Volume of water (ml)				

2. Comment on the precision of your work (by referring to the values obtained for volume of water in the table above).

3. Comment on the accuracy of your work. The following information will help you in answering this question.

   Accuracy is expressed as a single number and is calculated as follows:

   Accuracy = observed value - true value

   Observed value is the average value you obtained from your volume data.
   True volume for the 10 ml volumetric Pipette is 10.00 ml

4. In this experiment, you weighed the volume of water in a pre-weighed beaker. The beaker must be dry on the outside, but can be wet on the inside. Why?