Cooperative Project I: Density

For Cooperative Project I, we will follow the lab on page 93 of the *Cooperative Chemistry Laboratory Manual, 5th edition* with some deviation from the lab manual. You will be required to devise and carry out one experiment that will allow you to measure the density of a solid material and one experiment that will allow you to measure the density of a liquid material. You will be graded on the method you devise so be sure to read the background material so that you can use the best methods for making measurements. We will use two different methods for analyzing the data you collect.

Requirements for collecting data:

- Work in groups of 2 to collect data, but collaborate with another group of two and share your data.
- Each group of two must determine the density of one solid and one liquid. Share your results with another group of two who worked with a different solid and liquid.

Requirements for analyzing your data for the density of the solids:

- Create a table showing the data you collected. One table should show the data for both solids.
- After generating your table, calculate the density for each trial and be sure to report these values in your table.
- Calculate the mean density and the standard deviation for each solid. (What is the best format for reporting this data in your results section of your lab report?)

Requirements for analyzing your data for the density of the liquids:

- Create a table showing the data you collected. One table should show the data for both liquids. There are directions for using Excel on the general chemistry home page.
- For each liquid, the density will be determined graphically. Thus, prepare a graph of mass of water vs. volume using an Excel spreadsheet. We will use the convention y vs. x, thus mass of water on the y-axis. Be sure to follow guidelines in the lab manual and the Graphing with Excel web tutorial for proper graphing requirements.
- A plot of mass vs. volume should produce a straight line with the slope of the line equal to the density. Be sure to add a trendline and include the equation of the line on your graph.
- **Using the equation of the line from your graph, calculate 1) the volume of a sample of water with a mass of 8.653 g; and 2) the mass of 14.36 mL of ethanol. Include the answer in your final report along with the calculation.**

Requirements for keeping a laboratory notebook:

- Each member of your group is required to keep a scientific notebook. Your notebook is where you will record your day-to-day activities in the lab. You should describe experiments as you do them and note observations as you make them. You should also record and analyze your data in your notebook.
- The notebook must be a carbonless, duplicate page notebook. Place the flap between the active page/carbon copy (white/yellow page) and the next set of data pages to protect against erroneously writing on multiple pages. Never tear out any original data pages (white).
- Submit the carbon copy of your notebook pages to your instructor at the end of lab.
- Be sure to keep the following in mind when recording data in your notebook:
    - Include a descriptive Table of Contents
    - Pages must be numbered
    - Include date data was collected
    - Record raw data
    - Record procedures and observations
    - Write in ink
    - Mistakes must be crossed out appropriately (one single line through the mistake, initial and date) or follow your instructor's policy.

Requirements for writing weekly summaries:

- List all group members present for the lab

- Give a short overview of the lab
- Present results in tables and/or graphs
- Discuss future work

Requirements for writing your lab report:

- The lab report is an individual project. Although you collected data in a group, the lab report is an individual project. Thus each member of the group must generate their own tables and graphs and write their own lab report.
- All results must be reported in tabular format. (Use your textbook as a reference to see the proper format for a scientific table.)
- Your lab report will consist of a results and discussion section with data tables and graph. In the results and discussion section, you must include an example of how you calculated the density and show the calculation for the standard deviation.
- All lab reports must be typed including all tables.

Additional requirements- Literature Search:

- Provide the answers to the following questions in your lab report. You must find this data in a CRC Handbook or a Merck Index. You must provide a reference for **each response**.
    - What is the CAS RN for water?
        - Every chemical has a unique CAS RN. The CAS RN is a unique number assigned to a specific chemical. The CAS RN allows for accurate identification of a chemical. The CAS RN is often referred to as the CAS number.
    - What does the abbreviation CAS RN stand for?
    - What is the density of water (in g/mL) at 10 °C? at 25 °C?
    - What is the density of ethanol? Density changes with temperature, be sure to state the temperature.
    - According the CRC Handbook, ethanol is soluble in what solvents?

- Provide the answers to the following questions in your lab report. You must find this data in a material safety data sheet (MSDS). You must provide a reference for the MSDS used.
    - What is the CAS number for ethanol?
    - What is the PEL-TWA for ethanol according to OSHA?
    - What is the TLV-TWA for ethanol according to the ACGIH?
    - What are the NFPA ratings of Health, Flammability and Reactivity for ethanol?
    - What is the LD50 for ethanol? (there is more than one, but you only need to provide one value)
- Reference format for referencing a scientific handbook:
    - Editor, A. A., Editor, B. B., Eds. *Handbook Title (italics)*, Edition number [Online if online]; Publisher: Place of Publication, Year; Pagination or other identifying information.
    - Example:
        - Lide, D. R., Ed. *CRC Handbook of Chemistry and Physics*, 84th ed. [Online]; CRC Press: Boca Raton, FL, 2003; p 83.
- Reference format for referencing an MSDS:
    - **Hard copy (paper) MSDS**
        - *Titanium Dioxide*; MSDS No. T3627; Mallinckrodt Baker: Phillipsburg, NJ, November 12, 2003.
        - If there is not a MSDS No., *Titanium Dioxide*; MSDS; Mallinckrodt Baker: Phillipsburg, NJ, November 12, 2003.
    - **MSDS obtained from an Internet search**
        - *Titanium Dioxide*; MSDS No. T3627; Mallinckrodt Baker: Phillipsburg, NJ, November 12, 2003. http://www.jtbaker.com/msds/englishhtml/t3627.htm (accessed 4/15/04).
        - If there is not a MSDS No., *Titanium Dioxide*; MSDS; Mallinckrodt Baker: Phillipsburg, NJ, November 12, 2003. http://www.jtbaker.com/msds/englishhtml/t3627.htm (accessed 4/15/04).

Safety Precautions:

- Wear your safety goggles at all times.
- Balances are especially sensitive, expensive devices. **Never weigh chemicals directly on the pan**. Use a container such as a beaker or flask. Remove the container from the balance, add the chemical and then replace the container. If you spill anything onto the balance, please notify the instructor immediately

Cooperative Project I Summary Graded Assignments:

- Prelab Assignment
- Weekly Summary
- Notebook
- Lab Report
    - Results and Discussion
        - Is data reported in tables?
        - Is data reported in the proper scientific format (correct units, significant figures?)
        - Analysis of data included in report? Mean? Standard deviation? Graphs?
        - Literature search results
    - Experimental Section
        - Experimental section comes after the results and discussion
        - This section should include your procedures with sufficient detail to duplicate your experiment
        - No results in experimental section

Background Reading and Practice Problems:

Cooperative Chemistry Laboratory Manual

- Safety Rules, Laboratory Etiquette (12-14)
- NFPA Hazard Codes, Waste, MSDS's (15-16)
- Recording and Reporting Results (17-19)
- Writing Lab Reports (19-23)
- Reporting Numerical Results, Significant Figures, Graphs (35-40)
- Measuring Devices (47-49)
- Reading a Meniscus (67-68)

Chemistry: An Atoms-Focused Approach, by Gilbert, Kirss, Foster

- Section 1.3, Density; Sections 1.7 and 1.8
- Complete the following problems:
- End of Chapter Problems 54, 58, 64, 77, 79
- Considering problem 98 on page 44, complete the following table.

	Cylinder A	Cylinder B
Mass (g)	15.560	35.536
Initial volume water (mL)	25.0	25.0
Final volume of water (mL)		
Volume of Cylinder (mL)		
Density (g/mL)		
Identify of Metal		