

Title: Training Lab 1
Chemistry 11100, Fall 2012

Introduction

The purpose of this lab is to introduce you to a series of techniques that you will use in chemistry lab. For this lab, you will be using the glassware in your laboratory drawers as well as analytical glassware and instruments that you will regularly need. The techniques you will learn are:

1. *Use of a balance* – a balance is used to measure the mass of solids in the chemistry lab.
2. *Use of volumetric glassware* – pipettes, burets and volumetric flasks are used to measure or contain a specific volume. Volumetric glassware, such as the volumetric flasks, burets and pipettes, are laboratory instruments that deliver very accurate volumes of liquids. The volumes contained or dispensed by such glassware are accurate to several significant figures. We use these pieces of glassware to perform dilutions and dispense samples for analysis.
3. *Filtration* – Filtration is a technique used to separate a solid from a liquid. Today you will practice gravity filtration using hot coffee. The making of a cup of coffee is an example of solid - liquid extraction. Hot water and ground coffee are mixed then filtered to remove the grounds from the beverage.

Errors in Chemical Analysis

In this lab you will also be introduced to a series of calculations regularly used in chemistry lab. One of the most common calculations is percent error.

$$\% \text{ Error} = \frac{|\text{Actual} - \text{Theoretical}|}{\text{Theoretical}} \times 100\%$$

Percent error allows you to find the difference between the calculated values (theoretical) and the values that you actually found experimentally (actual). This is a useful calculation because it can show you how precisely you have performed analytical techniques.

$$\% \text{ Recovery} = \frac{\text{mass of material recovered}}{\text{mass of material started with}} \times 100\%$$

Percent recovery allows you to calculate how much of a compound or solution was lost through a process. Like percent error this is a useful calculation to determine the effectiveness of a process or technique.

Accuracy is very important in the chemistry lab. Because of this we use instruments that allow us to have the greatest certainty of how much of a substance we have used or what concentration that substance is. If a certain substance weighs 40.552 g, it is said to have 5 significant figures, meaning that 5 of the numbers carry meaning. Any numbers that would follow the 2 are not accurate and therefore not considered.

Units and Conversions

You will also be regularly converting from one unit to another. In this lab you will convert from mass (grams, g) to volume (liters or milliliters, L or mL). For converting units, you need a conversion factor, in our case density, commonly expressed as mass per unit volume (g/mL). Conversion factors like density are values that link different types of units so we can use them in calculations. You perform unit conversions on a daily basis, though you may not know it. When you are told that something is 4 yards long, you convert in your head that the distance measured is 12 feet, and you may go as far as to realize that is 144 inches. Another example of this taking place is when you buy fresh food at a grocery store. If steaks are \$7.50 per pound and you buy a steak that weighs a pound and a half, you can convert and determine what the steak will cost you.

Prelab

Answer the following questions before going to lab. Write your answers in your lab notebook in your own style and words. Your answers are due at the beginning of lab.

- 1) Identify each of the following as a mass, volume, temperature, a length (distance).
 - A. 543 mL
 - B. 85.0 °F
 - C. 5 cc
 - D. 3 cm³
 - E. 1.2 L
 - F. 62 kg
 - G. 5 mg
 - H. -40°C
 - I. 1.2m
 - J. 55 cm

K. 1,245 mm

2) Identify the number of significant figures in the following

A. 543 mL

B. 85.0 °F

C. 9000 g

D. 9.03×10^3 g

E. 0.0045 Kg

3) Convert the following measurements

A. 8 in. to ft.

B. 1.5 cups to oz.

C. 723 g to kg

D. 1.63 L to mL

E. 32 cm to in (Note: 2.54 in /1 cm)

4) You have 10.25 mL of a liquid solution with a density of 1.5 g/mL. What is the mass of the liquid in grams?

5) You plan to filter a solution to separate a solid from a liquid. You determine that there should be 50.42 g of a solid remaining after filtering. You carry out the filtration and allow the solid to dry. You weigh the solid and determine its mass to be 49.177 g. What is the percent recovery?

6) Read the appendices explaining the use of analytical balances and pipettes.

Procedure

Perform all parts of the experiment as a group of two. You and your lab partner should share the tasks but keep an individual record of all data in your lab notebook. Turn in one lab report at the end of the lab period. Don't forget to include both partners' names on the report.

Safety - You must wear safety goggles over your eyes during the entire lab, even while writing your lab report.

When you heat things, they become hot even though they do not appear hot. Be cautious when removing hot glassware from the hotplate. Pick up hot glassware using layers of paper towels around the glassware (DO NOT USE YOUR CRUCIBLE TONGS!). Allow the glassware to cool on a heat resistant pad. Placing hot glassware on a cold surface can crack the glass.

Waste Collection - All solutions used in this experiment are to be discarded down the drain followed with plenty of water.

Part 1: Use of a Balance

NOTE: Use the same balance for the entirety of this section

From
drawer

100 mL beaker (clean and dry)
spatula

From the reagent bench

Sodium chloride (NaCl)
paper weigh cup

your lab

There are two types of balances found in the chemistry labs. The balances in the laboratory proper are milligram balances. They will measure mass to three places beyond the decimal, 0.001 g. In the balance rooms, between labs, there are analytical balances. The analytical balances will read to four places beyond the decimal point, 0.0001 g. You may use either a milligram or analytical balance for this experiment but for Part 1 you must use the same balance for all measurements.

Place a paper weighing cup on the balance and zero (tare) the balance so that the balance reads zero grams. Add approximately 1 gram of salt (NaCl) into this paper cup. Record the exact mass of salt in your notebook using the correct number of significant digits.

Note – Clean all spills in and around the balance immediately. For solids, use the brush attached to the balance to sweep the material onto a piece of paper so that you can properly dispose of it. In this case, discard the salt in a trash can.

Remove the weighing cup from the balance and place a clean beaker on the balance. Tare the beaker. Transfer the salt from the weighing cup into the beaker and determine the mass of the salt in the beaker. Record the mass of the salt in your notebook.

Part 2: Pipettes, volumetric flasks, and dilutions

From your lab drawer

100 mL beakers (clean and dry)

From the front of the room

Parafilm

Kimwipes

From your graduate instructor

10 mL pipet

From the back of the lab room

100 mL volumetric flasks

pipet bulb

From the reagent bench

Dye solution, 0.001%

Place approximately 30 mL of the dye solution into a clean dry beaker and record the concentration of the dye solution found on the label of the bottle. This solution will be your “stock” solution.

Rinse your pipette using 3-5 mL of the stock dye solution. Discard the solution down the drain followed with plenty of water.

Before using the volumetric flask, take a few seconds to notice where the *full mark* is located on the flask’s neck. This is usually a dark colored ring (could be white in color) that goes completely around the neck.

Procedure to prepare a diluted dye solution:

Pipette 10.00 mL of the stock dye solution into one of the volumetric flasks. Using your 100mL beaker, add about 50mL of de-ionized water to the flask. Carefully and gently swirl the flask to mix the solution. Add more water to the flask until the level of the solution reaches about half way between the bottom of the flask’s neck and the *full mark*. Obtain a piece of Parafilm and use it to securely cover the opening of the flask. With the covered opening of the flask in the palm of one hand, grasp the base of the flask with your other hand and invert the flask several times (7 or 8). Set the flask on your bench top and remove the Parafilm from the flask. Using the water in your squirt bottle, carefully and slowly add water until the bottom of the meniscus is

at the full mark of the flask. Obtain a fresh piece of Parafilm, cover the opening of the flask, and invert the flask several times to mix the liquid. You now have 100.0mL of a diluted dye solution. Label this solution as solution “2”.

Calculate the concentration of the solution in flask 2.

Repeat the previous procedure, but this time use solution 2 instead of the stock solution. Label the freshly prepared solution as solution “3”. Record any observations about the differences between the solutions in your lab notebook. Calculate the concentration of the solution “3”.

Part 3: Accuracy of Glassware: Beakers, Pipettes and Graduated Cylinders

From your lab drawer

4-125mL Erlenmeyer flasks (clean and dry)

100mL beaker (clean and dry)

10mL and 50mL graduated cylinder

medicine dropper

From your graduate instructor

10mL pipet

From the back of the lab room

pipet bulb

Procedure:

Obtain four clean and dry 125-mL Erlenmeyer flasks, a 100mL beaker, both a 10 mL and 50 mL graduated cylinder from your drawer as well as a pipette.

Flask 1

Tare a balance. Weigh one of the flasks and record its mass. Remove the flask from the balance and add as closely as possible 10 mL of water to the flask. (Use the graduation marks on the side of the flask to measure the 10mL.) Tare a balance and weigh the flask with the water. Record the combined mass (flask + water). Use this general idea for flasks 2, 3 and 4 in the following steps.

Flask 2

Record the mass of flask 2. This time, use your 10-mL graduated cylinder to pour 10 mL of water into the flask and record the combined mass.

Flask 3

Record the mass of flask 3. Using your 10-mL graduated cylinder, pour 50 mL of water into the flask and record the combined mass.

Flask 4

Record the mass of flask 4. Measure 10 mL of water using a 10-mL pipette and allow it to drain into the flask and record the mass.

Part 4: Filtration

From your lab drawer

1-250mL Erlenmeyer flasks (clean and dry)
1-250mL beaker (clean and dry)
long stem glass funnel
spatula

From your graduate instructor

filter paper

From your lab bench

ring stand

From the back of the lab room

ring clamp

hot plate

From the reagent bench

coffee

heat resistant white fiber pad

Procedure:

Using your 250mL beaker, bring 120 mL of deionized water to a boil on a hot plate set at medium heat.

Preparing the coffee filter - see picture below.

Place a funnel in a ring stand above a 250mL Erlenmeyer flask. Make sure that the bottom of the funnel is inside the flask, but is not so low that it will touch the filtrate (liquid that has passed through the filter). Fold a piece of filter paper in half, then in half again (it should be in quarters now). Pull apart the filter paper so that one layer of filter paper is on one side and 3 are on the other. This should make a cone shape. Slide your cone into your glass funnel, and wet slightly with de-ionized water from your squirt bottle.

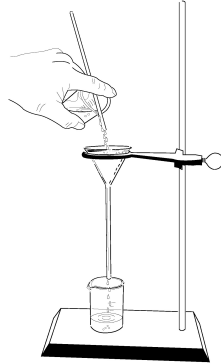
Preparing the coffee

When the water begins to boil, turn off the hotplate. Obtain a white fiber pad from the reagent shelf and set it next to the hot plate. Using several layers of paper towels (**DO NOT USE CRUCIBLE TONGS**) remove the beaker from the hot plate and set it on the pad. Doing so will help keep the beaker from breaking. Hot glass placed on cool surfaces, as in your bench top, don't mix.

Scoop 5 spatulas of coffee into the hot water. Allow the coffee to brew for 5 minutes.

Filtering the coffee

Wrapping several layers of paper towels around the beaker, slowly pour your mixture into the paper filter cone using the technique illustrated.



DO NOT, UNDER ANY CIRCUMSTANCES, DRINK ANY OF THE SOLUTIONS!

Once cooled, the coffee can be poured down the drain and the filter paper and grounds disposed in the trash.

LABORATORY REPORT FORM

With your lab partner, complete this report form. Attach duplicate pages from each person's lab notebook where you recorded the data and observations. Note, each person must turn in pages from his or her laboratory notebook.

Title: _____

Group members: _____

111 Section number ___ ___ ___

Date Work Done: _____

Goals (in your own words)

Part 1: Using an analytical balance

Mass of salt in weigh cup: _____

Mass of salt in beaker after transfer: _____

Did the mass of NaCl change? Why might the mass of the salt change during the transfer?

Calculate the percent recovery for the transfer:

Which technique would be best if you needed 1.00 g of NaCl in the beaker?

Part 2: Pipettes, volumetric flasks, and dilutions

Concentration of stock solution: _____

Calculated concentration of solution 2: _____

Show calculations

Calculated concentration of solution 3: _____

Show calculations

Explain what is meant by the term dilution:

If you did not thoroughly mix solution 2 before removing 10 mL to prepare solution 3, what effect would that have on the concentration of solution 3? Explain.

Part 3: Accuracy of Glassware: Beakers, Pipettes and Graduated Cylinders

	Measuring Device			
	Beaker	10 mL Grad. Cylinder	50 mL Grad. Cylinder	Pipette
Mass of flask (g)				
Mass of flask + water (g)				
mL of water				
mass of water				

Assuming the density of water is 1.000 g/mL, what is the expected mass of 10.0 mL of water? (Show work)

Percent error (based on above calculation):

Beaker: _____

10 mL Graduated cylinder: _____

50 mL Graduated cylinder: _____

Pipet: _____

Calculation of percent error (Show calculations for all four parts):

Which of these pieces of glassware gives the most accurate value for the mass of water? Why?

Part 4: Gravity Filtration

What is meant by solid-liquid extraction?

What was left in the filter?