Introduction to Laboratory Measurements

All science labs require you to take measurements of mass, volume, temperature, length, etc. The value that you record must reflect the precision of the measurement. Usually, if a measuring device is calibrated to a given decimal place, the measurement can be estimated to the next decimal place. The most common error in taking a measurement is not recording the value to the proper decimal place. This introductory exercise on measuring is intended to provide you with some practice taking and recording common measurements of mass, volume, temperature, and length to the proper decimal place.

Mass

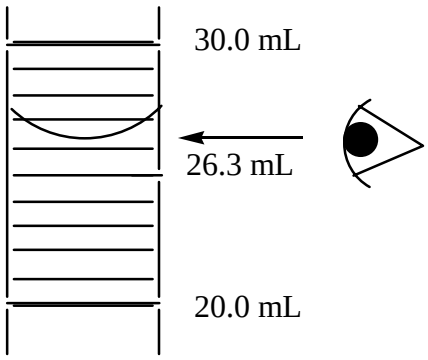
Most all balances are top-loading balances. Top-loading balances are those that weigh an object simply by placing the object on top of a pan. The main differences between different balances are their capacity and their precision. The precision of a balance refers to the last decimal place that can be read. The balances in your lab can read out to the second (hundredth gram position), third (milligram position), or fourth decimal place (0.1 milligram position). Balances that weigh out to the fourth decimal place are referred to as analytical balances. Granular or powdery solids are weighed onto a piece of weighing paper or in a weighing dish or a beaker. Liquids are weighed in beakers or flasks. Very seldom are objects weighed by placing them directly on the pan.

Volume

Precise volume measurements are made with graduated cylinders, burets, or pipets. Beakers have lines painted on them to indicate the APPROXIMATE volume but beakers are NEVER used to make a precise volume measurement.

a) Graduated Cylinders

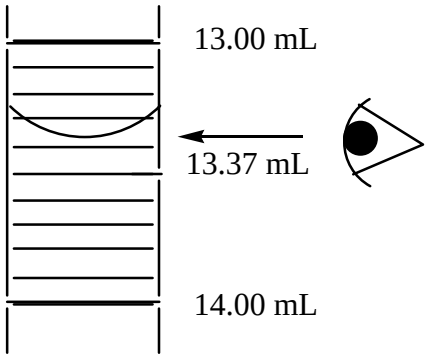
Common sizes of graduated cylinders are 10-mL, 25-mL, 50-mL, and 100-mL. The 10-mL graduated cylinder is calibrated to the tenths place and therefore volumes can be estimated to the second decimal place. The 25-mL, 50-mL, and 100-mL graduated cylinders can be used to measure volumes to the tenths place. The volume is determined by the position of the bottom of the meniscus (the curvature of the liquid**).** The volume of the liquid in the cylinder is recorded and the **graduated cylinder is read from the bottom up.** See the sketch below.



b) Burets

Burets are glass tubes that are calibrated at least to the tenth milliliter position and have a stopcock at the bottom that allows you to deliver a precise volume of liquid up to the capacity of the buret. Since the burets are calibrated to the tenths place, the measured volume can be

estimated to the hundredths place. Two common sizes of burets are 25-mL and 50-mL. It is worth noting here that a 10-mL graduated cylinder, which is also graduated to the tenth milliliter position, isn't as accurate as a buret that is graduated to the same decimal place. The volume of liquid <u>delivered</u> is recorded and the **buret is read from top down.** See the sketch below.



c) Pipets

Pipets are glass tubes that are calibrated to deliver a specific volume, in milliliters, of liquid with precision to the second decimal place. Although the pipets are labeled with the whole number value of the volume, such as "**10**" or "**25**", it is understood that the volume is actually 10.00 mL or 25.00 mL. The liquid is pulled into the pipet using either a pipet bulb or a pipet pump but NEVER by mouth. In this exercise you are to get some practice pulling water into a pipet, draining the water to the calibration line, and delivering. Do not suck water (or any liquid) into the bulb or pump itself. This will ultimately damage the bulb or pump and more importantly contaminate your sample. **Your instructor will demonstrate the proper way to use the pipet.**

<u>Temperature</u>

The temperature of a solid, liquid, or gas (such as air) is measured using a thermometer or temperature probe. Most thermometers are calibrated to the units place on the centigrade scale and therefore the temperature can be estimated to the tenths place. In this exercise place the thermometer into the liquid in one of the graduated cylinders, let it stand for about a minute, and record the temperature to the proper decimal place. You should always record the value and the label (centigrade or Fahrenheit) also, for example, 26.5 ^{o}C.

<u>Dimensions</u>

The length, width, and height of a sample are measured with a ruler or a caliper that is calibrated on the metric scale. In chemistry or physics labs, dimensions are seldom measured on the English scale. Most rulers and calipers are calibrated to the tenth centimeter position (also called the millimeter position). Thus, the dimension can be measured to the second decimal place (hundredth centimeter or tenth millimeter).

Name _____ Section _____ Date _____

Throughout this exercise known samples will be marked with a number followed by the letter K and unknowns will be marked with a number followed by the letter U. The correct values for the known samples are listed on the answer card at your bench. Make sure that you can measure your sample correctly by checking your value against the known value on the card. When you are satisfied that you can take the measurement properly, proceed to measure the unknown sample. Record you values on this data sheet and hand this into your instructor after all measurements have been taken. **The objective of this exercise is for you to record the correct measurements to the proper decimal place.**

Mass and Dimensions

Measure the mass, diameter, and length of the known and unknown metal cylinders at your bench. Check the correct values of the known before you continue with the unknown.

Known metal cylinder number	_____	Unknown metal cylinder number	____
Mass (g)	_____	Mass (g)	_____
Diameter (cm)	_____	Diameter (cm)	_____
Length (cm)	_____	Length (cm)	_____

Volume – Graduated Cylinder

Record the volume of water that is in the graduated cylinders marked known and unknown. Check the correct value of the known before you continue with the unknown.

Known graduated cylinder number	_____	Volume (mL)	_____
Unknown graduated cylinder number	_____	Volume (mL)	_____

Volume - Buret

Record the volume of water that has been delivered from the burets marked known and unknown. Check the correct value of the known before you continue with the unknown.

Known buret number	_____	Unknown buret number	_____
Volume (mL)	_____	Volume (mL)	_____

Volume – Pipet

Have your instructor observe you while you pipet a sample of water into a beaker. Have your instructor place a check mark here ____ when you have shown that you can pipet properly.

Temperature

Place a thermometer into a beaker of water and let stand for 1-2 minutes and then record the temperature of the water.

Temperature of the water (^{o}C) _____

Name:_____ ***CHE 120L***

Section: _____

Use of Logger Pro / Graphical Analysis Software

Doxorubicin is an anti-cancer drug commonly used in chemotherapy. It makes a red solution when dissolved in water. The higher the amount of doxorubicin in the solution the darker red the solution is and the darker the solution is the more it absorbs light (this is referred to as "Absorbance").

The table below gives the amount of Doxorubicin (column X, units: g/L) and the absorbance value (column Y, units: a.u.).

Column X: Amount of Doxorubicin (g/L)	Column Y: Absorbance (a.u)
0	0
0.134	0.0058
0.272	0.0116
0.399	0.0174
0.535	0.0232
0.671	0.029
0.799	0.0348
0.922	0.0406
1.054	0.0464
1.157	0.0522
1.240	0.058

- Using Logger Pro or Graphical Analysis software, **make a graph of the Absorbance values (Y axis) versus the amount of Doxorubicin (X axis). Attach the graph to this sheet.**
- Label the graph and the axes
- What is the value of the slope? _____
- What is the value of the y-intercept? _____
- What is the value of the correlation coefficient? _____
- From the value of the correlation coefficient, is a linear fit a good fit? Justify your answer.

Note: you can download Logger Pro / Graphical Analysis (GA) from the General Chemistry Website (www.nku.edu/~chemistry/general_chem/), using the username: "chemistry" and the password: "silicon".