***Experiment 2***

***Laboratory Techniques and Measurements***

***OBJECTIVES***

The objectives of this experiment are: (a) to demonstrate the ability to use lab. equipment properly, (b) to demonstrate skills of performing scientific measurements in the lab., (c) to demonstrate knowledge of applying significant figures to measurements, (d) to apply metric and English units to measurements, and (e) to cut, bend, and fire polish a glass tube.

***INTRODUCTION***

The metric system is widely used by scientists around the world and in all fields. It is based on the multiple of 10 and uses prefixes such as, *kilo, centi,* and *milli,* to illustrate large and small measurements.

Any measured quantity is recorded with uncertainty. The uncertainty is in the last recorded digit; therefore, the number of significant figures in a recorded measurement contains all certain digits plus one uncertain digit. For example, an analytical scale weighing to three decimal places has 0.001 g uncertainty. Therefore, a measurement such as 2.356 g has 2.35 as certain digits and 0.006 as the uncertain digit, making the total number of significant figures 4. A metric ruler that has 0.1 cm (1 mm) subdivisions, has 0.1 cm certainty, thus it is possible to estimate and record measurements to 0.01 cm (one digit more than the marked digit). Similarly, the uncertainty of a Celsius thermometer is 0.1 ºC. For example, a 95 degrees Celsius temperature should be recorded as 95.0 ºC or 95.1 ºC but not 95 ºC.

Precision and accuracy are two terms that are often used interchangeably; however, during measurement, they serve different meanings. Accuracy is a measure of the agreement between a measurement and the true value. High accuracy is often achieved using a well-calibrated instrument. Precision, on the other hand, is a measure of the agreement between several measurements of the same object. Measurements can be precise but not necessarily accurate.

EXPERIMENTAL PROCEDURE

1. ***Laboratory Techniques and Scientific Measurements:***
2. ***Weighing with the Analytical Balance:*** The instructor will demonstrate the use of the analytical balances available in the Laboratory.

Obtain different types of coins and measure their masses. Record the mass below.

Mass of one-cent coin \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g  \_\_\_\_\_\_\_ g

Mass of five-cent coin \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g  \_\_\_\_\_\_\_ g

Mass of twenty five-cent coin \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g  \_\_\_\_\_\_\_ g

*Question 1:* Obtain four more mass measurements for a one-cent coin from other groups and determine the average mass of a penny.

\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_

Average mass = \_\_\_\_\_\_\_\_\_\_\_\_ g

*Question 2: Perform the following arithmetic and record your answer with the proper significant figures.*

1. 23.1973 mg + 2.225 mg + 15.26 mg =
2. 87 cm x 2.4 cm =
3. 245.6 mi ÷ 3.4 hr =

*Question 3: Provide the numerical equivalent to each prefix.*

*kilo \_\_\_\_\_\_\_\_\_\_\_, milli \_\_\_\_\_\_\_\_\_\_\_, centi \_\_\_\_\_\_\_\_\_\_\_\_*

1. ***Using the Burner and Measuring Temperature:*** The instructor will demonstrate the use of a Bunsen burner.

Obtain a thermometer and hold it in the air for few seconds, then record the room temperature.

Room temperature \_\_\_\_\_\_\_\_\_\_\_\_\_ °C

Half fill a 250 mL beaker with tap water, and then record the water temperature. Heat the water on a hot plate until it boils, then turn off the heater and measure the temperature of the water in the beaker.

Tap water temperature \_\_\_\_\_\_\_\_\_\_\_\_\_ °C

Boiling water temperature \_\_\_\_\_\_\_\_\_\_\_\_\_ °C

To measure the freezing point of water, half fill a 250 mL beaker with ice then add to it tap water to bring the total volume of ice and water to about ¾ of the volume of the beaker. Place the thermometer in the ice-water mixture, stir for few seconds, then record the lowest temperature reached.

Freezing point of water \_\_\_\_\_\_\_\_\_\_\_\_\_ °C

*Question 1: How does the temperature of the tap water compare to the temperature of air?*

*Question 2: How does the boiling point of water in Cedar City compare to the boiling point of water at sea level?*

*Question 3: How does the freezing point of water in Cedar City compare to the freezing point of water at sea level?*

*Question 4: Does the factor which gives rise to the difference in the boiling point of water at sea level and the boiling point of water at Cedar City altitude have much of an effect on the freezing point of water at both elevations?*

1. ***Measuring Length:***

Obtain a large test tube and a pencil and measure their lengths in centimeter and in inches. Also measure the height of the work bench and record the results below.

Length of a large test tube \_\_\_\_\_\_\_\_\_\_\_ cm \_\_\_\_\_\_\_\_\_\_\_ in

Length of a pencil \_\_\_\_\_\_\_\_\_\_\_ cm \_\_\_\_\_\_\_\_\_\_\_ in

Height of the working bench \_\_\_\_\_\_\_\_\_\_\_ cm \_\_\_\_\_\_\_\_\_\_\_ in

*Question 1: Use your measurements to find the ratio of * \_\_\_\_\_\_\_\_\_\_\_

*Question 2: A student’s height in centimeters is 176 cm. What is the student’s height in inches?*

1. ***Measuring Volume:***

Fill a large test tube with tap water, then pour the water in a graduated cylinder to measure the capacity of the test tube. Repeat the same procedure using a 50 mL beaker.

Volume of a large test tube \_\_\_\_\_\_\_\_\_\_\_\_\_ mL

Volume of a 50 mL beaker \_\_\_\_\_\_\_\_\_\_\_\_\_ mL

1. ***Glass working:*** The instructor will demonstrate cutting a glass tube and bending it using the gas burner.

Cut off a piece of glass tube 20 cm long using the technique demonstrated by the instructor. Hold the end of the tube in the hottest part of the flame until the heat rounds off the sharp edge of the tube. This is called fire polishing. Do the same to the other end of the tube. **(Be sure not to touch the polished end until it is cool)**. After it is cool, hold the tube over the flame and heat the middle of it until it is soft and wobbly. Remove from the flame and bend the ends gently upward until you obtain a right angle bend in the middle of the tube. Obtain your instructor approval on your work.

Instructor approval: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Question 1: What is the purpose of wetting the scratch on the glass tube?*

*Question 2: What is the purpose of fire-polishing the glass tube?*