Lab: Measuring Mass

Introduction:

For laboratory work in any science course three basic types of measurement using the lab balance should be mastered. These are measuring mass directly, "massing out" a specific mass of a substance, and determining mass by difference. These three types of measurement and the techniques for making them are briefly described in the following paragraphs.

- 1. **Measuring mass directly.** Direct measurement is used to determine the mass of a beaker or flask or similar object. This is the simplest type of measurement made with the balance. In a direct measurement, the object with a mass to be measured is placed on the balance pan, and the mass of the object is read directly from the balance.
- 2. "Massing out" a substance. This technique often is used to obtain a desired mass of a solid chemical, such as table salt, that exists in a granular or crystalline state. To do this, the container that is going to hold the chemical is placed on the balance. Once the balance determines the mass of the container, push the tare or zero button. This will reset the balance to zero. The substance being measured out then is added to the container until the desired mass is obtained.
- 3. **Determining mass by difference**. This technique is similar to the "massing out" technique. You follow the same procedures except when placing or adding the substance to the container you are not adding until you reach a predetermined amount. You place all of the substance into the container and determine the mass. This technique is often used to determine changes in mass that occur during a chemical reaction.

<u>Target:</u>

Students are able to determine the mass of various substances using the lab balance and employing the three types of measuring techniques.

<u>Procedure:</u> Be sure to use the same balance for the entire activity.

Part I. Measuring Mass Directly

- 1. Place a penny on the balance pan. Record the mass of the penny.
- 2. Repeat step 2 for the objects listed below. Record the mass of each object.
 - a) A nickel
 - b) A watch glass
 - c) 150 ml beaker

Part II. Measuring Out a substance

- 3. Place a piece of filter paper on the balance pan. Wait a few seconds, and then push the zero button.
- 4. Obtain a sample of NaCl. Using a spoon, add this substance to the filter paper on the balance pan until the balance reads 7.50 g. (If you add too much, remove enough with your spoon to make the balance read 7.50g). Discard the filter paper and NaCl as instructed.
- 5. Place a dry 150ml beaker on the balance pan. Wait a few seconds, and then push the zero button.
- 6. In a 50 ml or 100 ml graduated cylinder, obtain exactly 30.0 ml of tap water. *Slowly* and *carefully* pour the water from the graduated cylinder into the beaker on the balance until it reads 22.0 g. Note and record the volume of water remaining in the graduated cylinder. Discard the water as instructed and dry the beaker.

Part III. Determining Mass by Difference

- 7. Measure and record the mass of a watch glass.
- 8. Using the procedure described by your teacher, obtain a small amount of CaCl₂ crystals on a piece of paper. Carefully transfer the crystals to the watch glass.
- 9. Measure and record the combined mass of the watch glass and $CaCl_2$. Note and record the time you make this measurement.
- 10. Using your spoon spread the crystals out on the watch glass. Study the crystals and record your observations. Set the watch glass aside to be reexamined later.
- 11. Measure and record the mass of a piece of filter paper.
- 12. Obtain a quantity of NaCl on a piece of paper. Using your spoon place on scoop of NaCl on the filter paper. Measure and record the combined mass of the filter paper and NaCl.

- 13. Add a second scoop of NaCl to the sample on the filter paper. Measure and record the combined mass of the filter paper and the two scoops of NaCl.
- 14. Add a third scoop of NaCl to the sample on the filter paper. Measure and record the combined mass of the filter paper and the salt. Discard the salt and the filter paper as instructed.
- 15. Measure and record the mass of a 400 ml beaker.
- 16. In 50 ml or 100 ml graduated cylinder, obtain exactly 30 ml of tap water. Carefully pour this water into the beaker. Measure and record the combined mass of the beaker and water.
- 17. Record the mass of a balloon. Inflate the balloon and tie off the open end so that no gas can escape. Measure and record the mass of the inflated balloon. Discard the balloon.
- 18. Measure and record the combined mass of the watch glass and its contents. Note and record the time of this measurement. Discard the CaCl₂ as instructed. Clean and dry the watch glass.

Observations and Data

Create a table to record all data and information as described in the procedures.

Calculations:

1.	Calculate the volume of water added to the beaker in step 6 (initial volume - volume remaining in graduated cylinder)	ml
2.	Calculate the mass of 1 ml of water. (mass of water / Volume water)	0
		9
3.	Using the mass-by-difference technique, calculate the mass of: a. CaCl2 crystals added to the watch glass (steps 7-9)	9
	b. NaCl (1 scoop)	9
	c. NaCl (2 scoops)	9
	d. NaCl (3 scoops)	9
	e. 30 ml of tap water	9
	f. Moisture absorbed by CaCl ₂	9
4.	Calculate the difference in mass between he inflated balloon and deflated balloon	
		9
5.	Calculate how much time, in minutes, elapsed between the two measurements of ${\sf CaCl}_2$	
		min

Conclusions and Questions:

- 1. In steps 11 14 of the procedure, you measured the combined masses of a piece of filter paper plus one, two and three scoops of NaCl, respectively.
 - a. From calculation 3b, what was the mass of the first scoop of NaCl?
 - b. From your data, calculate the masses of: the second scoop of NaCl and third scoop.

- c. Compare the masses of each individual scoop of NaCl as determined in (a) and (b) above. Are the three values identical? If not, how do your account for the difference?
- 2. What measurements would your make to determine the average mass of a scoop of NaCl? How would your use these measurements to arrive at an average mass?
- 3. Suppose you were asked to measure out 5 grams of calcium chloride. Briefly describe how you would make this measurement.
- 4. Suppose that you wanted to know the mass of a quantity of orange juice that was poured into a drinking glass. Describe how you would determine the mass.
- 5. A beaker contains a quantity of a liquid. You want to know the combined mass of the beaker and the liquid. Describe how you would go about making this determination.
- 6. Suppose you were asked to compare the mass of a nickel and a sample of NaCl crystals.
 - a. Which method would you use to determine the mass of the nickel?
 - b. Which method would you use to determine the mass of the NaCl crystals?
 - c. Which of the two measurements is likely to be the more accurate one? Explain.