Spring 2010

Experiment 4: Conservation of Mass

Skills/Concepts

- Quantitative comparison of closed and open systems
- Conservation of Mass

Relevant Reading

Hein & Arena 4.2–4.4

Introduction

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Law of Conservation of Mass: The mass of a closed system will remain the same
          regardless of the processing occurring within the system.
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The Law of Conservation of Mass states that mass can neither be created nor destroyed. With regard to chemical reactions, there are two applications of this law:

1. The total mass of the reactants must equal the total mass of the products.
2. The total number of atoms in the reactants must equal the total number of atoms in the products.

A key portion of the Law of Conservation of Mass is the term "closed system." If you boil an open pot of water long enough, the pot becomes empty. What happened to the water? Isn't the mass supposed to be conserved? Boiling water converts to steam, which in this open system, rises up and out of the pot. A closed system would be needed to show that the mass of the steam released is equal to the mass of water lost.

Name: _____

Pre-Lab

Sometimes the mass of a system cannot be directly measured: a dog won't stay still on the scale or certain reactants, if combined, will react immediately. Sometimes masses of substances or systems need to be determined indirectly using relevant known values.

1) A 0.30-kg jar is filled with honey. The filled jar weighs 1.60 kg. What is the mass of the honey collected?

2) A suitcase weighs 0.50 kg. An airline has a 23-kg weigh limit for checked luggage. What is the maximum mass of luggage that a passenger can pack in her suitcase without paying an over-the-limit surcharge?

3) A veterinarian weighs 120. lbs. When she holds Jumping Bean, one of her canine patients, the scale reads 151.5 lbs. How much does the dog weigh?

In this lab, we will also be calculating averages. In particular, we are interested in the arithmetic mean: the sum of the values divided by the number of values summed together. For example:

The values 1, 2, and 6 have the average $\frac{1+2+6}{3}=3$. Calculate the average for the following sets:

4) 120, 10, 130

5) 1.1, 0, -0.1

6) 12.3, 12.6, 12.4

Procedure

Experiment #1

Do each experiment 3 times to ensure reliable data.

1) Add 35 mL of water to a flask.
2) Mass ¼ of an AlkaSeltzer tablet.
3) Add the AlkaSeltzer tablet to the flask.
4) After the reaction, weigh the system.
5) Calculate the masses in the grey row in the table below.

Table 1: Measured and *Calculated* Masses in Grams:
Grey areas denote calculated values

		1	2	3	Average
A	Flask + Water				
B	AlkaSeltzer Tablet				
C	Flask + Water + AlkaSeltzer Tablet Before Reaction				
D	Flask and Contents after Reaction				

Procedure

Experiment #2

Do each experiment 3 times to ensure reliable data.

1) Mass a balloon.
2) Put ¼ of an AlkaSeltzer tablet inside the balloon.
3) Add 35 mL of water to a flask.
4) Secure the balloon on top of the flask without dropping the tablet into the flask.
5) Mass the system.
6) Shake the balloon to release the tablet into the flask. Be careful to keep the balloon secure on the flask.
7) After the reaction, weigh the system.

Table 2: Measured Masses in Grams:
Grey areas denote calculated values

		1	2	3	Average
A	Flask + Water + Balloon + Tablet Before Reaction				
B	System After Reaction				

Name: _____ Lab Partner: _____

Post-Lab

Results:

Table 1: Measured and *Calculated* Masses in Grams:

Grey areas denote calculated values

		1	2	3	Average
A	Flask + Water				
B	AlkaSeltzer Tablet				
C	Flask + Water + AlkaSeltzer Tablet Before Reaction				
D	Flask and Contents after Reaction				

Table 2: Measured Masses in Grams:

Grey areas denote calculated values

		1	2	3	Average
A	Flask + Water + Balloon + Tablet Before Reaction				
B	System After Reaction				

Discussion:

1) Considering the 1st experiment, compare the mass of flask and its contents before and after the reaction.
   a. Average mass before reaction (C): _____
   b. Average mass after reaction (D): _____
   c. Difference (C-D): _____
2) Explain the discrepancy between the masses.

3) Considering the 2nd experiment, compare the mass of the system with the balloon before and after the reaction.

   a. Average mass before reaction (A): _____

   b. Average mass after reaction (B): _____

   c. Difference: _____

4) Compare 1c and 3c. These both show the change in mass of a system before and after a reaction. The first is an open system and the second is a closed system. Why are they different?

5) A camper finds some heavy logs and builds a fire. After the fire burns out, there is a small heap of lightweight ash. Using the Law of Conservation of Mass, explain the change in mass from the heavy logs to the lightweight ash.