Name _____ Date _____ Period _____

Calorimetry with Cheese Puffs C405R Chemistry

Objective - use calorimetry to calculate the heat of a chemical process

Introduction

Heat is something that can be difficult to measure directly. In this lab, we will use a method called calorimetry to determine the heat evolved in the burning of a cheese puff. Calorimetry is the quantitative measurement of the heat required or evolved during a process which is chemical in nature. A Calorimeter is an instrument for measuring the heat of a reaction during a well defined process. In this lab, an aluminum can and heat shield will be used.

Assume that a measured mass of water (***m***, in grams) contained in an aluminum soda can is heated, specific heat capacity (c_p) is known, and the change in temperature (ΔT, in **°C**) is calculated. The quantity of heat transferred ***"Q"*** can be calculated, in either joules or calories:

$$Q = m\, c_p\, \Delta T$$

(c_p for water is 1.0 cal/g °C or 4.184 J/g °C)

There are some limitations in this experimental approach. First, the aluminum can itself will absorb some of the heat from the burning cheese puff. While this amount can be approximated (using the mass of the empty can and its specific heat capacity and assuming that the heat is dissipated uniformly throughout the aluminum), this will account for only a portion of the heat released that never makes it to the water. Because the burning takes place in air, heat is also released to the surrounding area. The specific heat capacity (c_p) for aluminum is 0.215 cal/g °C or 0.900 J/g °C).

Finally, then, complete the experiment for the burning of two cheese puffs, minimizing the limitations, and complete the following calculation to determine the calories of heat released:

$$Q_{total} = Q_{water} + Q_{can} = [m\, c_p\, \Delta T]_{water} + [m\, c_p\, \Delta T]_{can}$$

<u>Safety Notice:</u> Eating or drinking is not permitted during labs!

Materials

100mL graduated cylinder	thermometer	aluminum can	100mL water
large paper clip	matches	aluminum foil	ring stand
triple beam balance	metal rod	thermometer holder	

Methods

1. Determine the mass of the can on a balance.
2. Measure 100mL water and pour into the aluminum can.
3. Determine the mass of the can and water. Record this data in the data table.
4. Record the mass of a cheese puff in the data table.
5. Assemble the calorimeter. Place a small sheet of aluminum foil underneath the calorimeter to direct the heat into the can and catch any residue that may fall during combustion.
6. Record the initial temperature of the water in the calorimeter.
7. Ignite the cheese puff with a match, and allow it to burn completely (<3 minutes).

8. Record the maximum temperature of the water in the can.
9. Find the mass of the cheese puff residue.

Results

Data Table

	Value
1. mass of can in grams	
2. mass of can + water in grams	
3. mass of water in grams ***(#2 - #1)***	
4. initial temperature in ***°C***	
5. final temperature in ***°C***	
6. change in temperature, ***ΔT*** ***(#5 - #4)***	
7. initial mass of cheese puff in grams	
8. final mass of cheese puff in grams	
9. amount of cheese puff consumed in grams ***(#7 - #8)***	

Questions

1. Solve for the heat transferred, Q_{water}, into the water.

2. Solve for the heat transferred, Q_{can}, into the can.

3. Determine the $\mathbf{Q_{total}} = \boldsymbol{Q_{water}} + \boldsymbol{Q_{can}}$

4. **Observed:** Calculate the calories per gram of cheese puff consumed in the lab.

5. **Expected:** Calculate the calories per gram of cheese puffs based on the product label.

6. Is the Observed caloric value more, less or about the same as the Expected (bag) caloric value? If you found a difference, then explain why.