Name:____Date:____________Block:____

Food Calorimetry Lab

Introduction

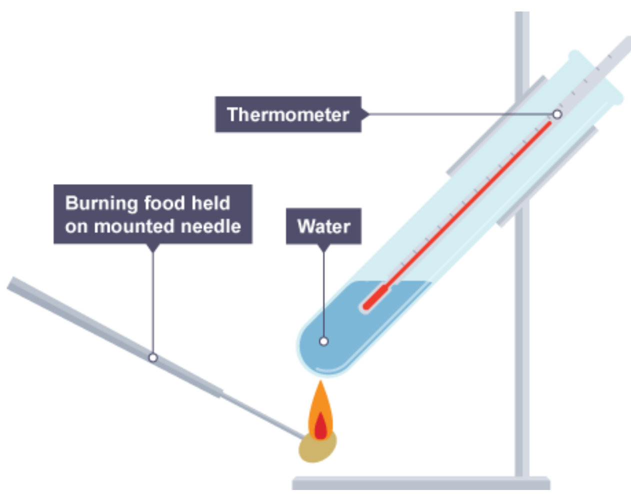
When a substance is heated, the motion of its individual particles increases, resulting in an increase in temperature. The more heat that is added per gram of substance, the greater the temperature change. The relationship between the heat added, the mass of a substance, and the temperature change it undergoes is known as *specific heat*.

$$Specific\ Heat = \frac{Energy\ in\ joules}{Mass\ in\ grams\ \ x\ \ Temperature\ change\ in\ Celsius\ or\ Kelvin}$$

Specific heat is defined as the amount of energy necessary to produce a temperature change of 1°C per gram of substance. The specific heats of different substances vary, and therefore this quantity may be useful in identifying an unknown.

The measurement of heat changes is called *calorimetry*. A calorimeter is a piece of equipment designed to measure the energy released or absorbed during a chemical reaction or phase change. In this lab, calorimetry will be used to determine the amount of heat produced during the combustion of various food samples. A piece of food will be burned and the released energy will be used to heat a known quantity of water. The temperature change of water will then be used to determine the amount of energy in the food.

The diagram below shows the basic setup of the food calorimeter.



It will be assumed that the entire amount of energy released by the burning food is gained by the water. This is based on the Law of Conservation of Energy, which states that energy is neither created nor destroyed. We will assume no heat loss to the calorimeter or the environment outside the calorimeter.

Energy released by burning food = Energy gained by water

The formula below is used to calculate the amount of energy absorbed/released during calorimetry.

$$q = mc\Delta T$$

where **q** = heat (in joules); **m** = mass (in grams); **c** = specific heat (in joules/grams • °C); **ΔT** = change in temperature (i.e. final temp – initial temp) (in °C or K)

Pre-lab

1. How many joules of energy would be needed to increase the temperature of a 5.51 gram sample of iron from 22.0°C to 32.0°C? (The specific heat of iron is 0.45 joules/grams • °C)

2. A sample of sugar is burned in a calorimeter. The heat released from the burning sugar is absorbed by 50.55 grams of water in the calorimeter. Before the sugar is burned, the initial temperature of the water was 25.1°C. After the sugar burned, the final temperature of the water was 42.8°C.

    a. Calculate the amount of energy, in joules, absorbed by the water. (The specific heat of water is 4.184 joules/grams • °C)

    b. Determine the amount of energy, in joules, released by the sugar.

    c. Calculate the amount of energy, in nutritional Calories, released by the sugar. (1 nutritional Calorie = 1 kJ)

    d. The sample of sugar burned had a mass of 0.22 grams. Calculate the amount of energy, in Cal/gram, released by the sugar.

Purpose: To measure and determine the energy, in Calories, released by burning food.

Materials:

- Balance
- Graduated cylinder
- Ring stand
- Ring clamp
- Wire gauze
- Flask
- Thermometer
- Water
- Matches
- Aluminum pan
- Needle inserted into cork stopper wrapped with foil
- Soap
- Food samples

Procedure:

1. Attach the ring clamp to the ring stand.
2. Place wire gauze on top of the ring clamp.
3. Wipe soap on the bottom of the flask.
4. Fill the flask with 100 mL of water.
5. Measure the initial temperature of the water.
6. Place the flask on top of the wire gauze on the ring stand.
7. Record the mass of the food sample.
8. Carefully stick the food sample through the needle attached to the foil covered stopper.
9. Place the stopper with the food sample into the aluminum pan.
10. Place the aluminum pan underneath the flask.
11. Strike a match and ignite the food sample.
12. Once the food begins to burn, blow out the match.
13. Place the match into the water waste container.
14. Let the food sample completely burn then measure the final temperature of the water.
15. Remove the food sample from the needle then throw the food in the trash.
16. Discard the water down the drain.
17. Repeat steps 4-16 using a different food item.

Data:

Food Sample	Mass of Food (g)	Volume of Water (mL)	Initial Temperature of Water (°C)	Final Temperature of Water (°C)

Calculations:

1. Determine the mass of water used for each food sample. (Hint: the density of water is 1 g/mL)
2. Using $q = m\ C\ \Delta T$ equation, calculate the amount of heat, in joules, absorbed by the water for each food sample. The specific heat of water is 4.184 J/g°C.
3. Determine the amount of energy, in nutritional Calories, released by each food sample. (1 nutritional Calorie = 1 kJ)
4. Calculate the amount of energy, in Cal/g, released by each food sample.
5. Using the food label as the accepted value, calculate the percent error for each food sample.

Calculation	**Food Sample #1:__________________**	**Food Sample #2:__________________**
1. Mass of water		
2. Heat absorbed by water (J)		
3. Energy released by food (Calories)		
4. Energy released by food (Cal/g)		
5. % error		

Discussion Questions:

1. Identify and explain possible sources of error? Why is percent error not 0%?

2. Is the burning of food an endothermic or exothermic process? Explain your reasoning.