ENERGY IN CHEMICAL REACTIONS

Purpose: To determine the heat of a chemical reaction using calorimetry.

PART I INTRODUCTION

1. What is a calorie?
   A Calorie is a unit of heat. It is the amount of heat needed to raise the temperature of 1 gram water 1 degree Celsius. You will actually measure the calories of a food product and compare this to the calories on the container. Food Calories usually have an upper case C. 1 Calorie = 1000 calories. Today you will measure calories and then convert them to Calories.
2. How are heat and temperature different?
   Temperature is the average amount of kinetic energy contained in the molecules of a substance. It is measured with a thermometer and the units are degrees Celsius. Heat is the total amount of energy in a sample of substance. It is measured indirectly and the units are calories.
3. How is heat measured?
   To measure calories in food, for example, the food is burned in a combustion chamber. The heat from the combustion reaction of the food is used to raise the temperature of a sample of water. Knowing the mass of the water and the temperature change of the water the heat gained by the water can be calculated using the following equation:

   $$M \times C \times \Delta T = \text{Heat change in the water } (q)$$

   M is the mass of the water. Δ T is the final temperature of the water – the initial temperature of the water (Δ T means change in temperature). C is a constant called specific heat. It tells how a particular substance absorbs heat. All substances absorb heat differently. It takes one calorie of heat to raise the temperature of one gram water one degree Celsius. C for water is 1 cal/g ^{o}C.

PART II PROCEDURE

Procedure and Observations and Data:

A. How much energy is in a peanut

1. Measure the mass of the apparatus which is a stickpin that is attached to a cork
2. Place 1/2 of a peanut on the apparatus and find the mass. **Be careful. Do not let the pin go into your finger. Your instructor will show you how to do this safely.**
3. Put exactly 25 ml of water in a 100 ml beaker . Measure and record the temperature of the water.
4. Light the peanut on fire with a match and once the nut is lit, quickly hold the beaker of water over the nut. The goal is to get as much heat into the water as possible (Is it possible to get all of the heat into the water?)
5. Do not let the water boil! Blow out the flame before this happens.
6. After the nut has burned, make sure the water is mixed so that the hot water is evenly dispersed in the beaker, and measure the temperature of the water and record
7. Record the mass of the apparatus and nut after it was burned. Be sure to pick up any crumbs that fell off of the pin.
8. Repeat this experiment until you have burned 3 nuts.

Table 1: Mass and Temperature Changes in a Chemical Reaction

Mass of apparatus	Mass of apparatus and nut (initial)	Mass of apparatus and nut (final)	Temperature of water (initial)	Temperature of water (final)	Mass of water used

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EXPERIMENT 13

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Part III Calculations (do this for each nut)

Show all of the calculations for one nut in your lab book but show the results of all calculations in a table in your book

1. What is the initial mass of the nut? (Show subtraction calculation)

2. What is the final mass of the nut ?

3. What is the change in mass of the nut?

4. What is the change in temperature of the water?

5. What is the heat gain of the water in calories ?

6. What is the heat gain of the water in Calories ?

7. What is the experimental heat loss of the nut in Calories?

8. What is the heat loss per gam of the nut?

9. What is the average heat loss per gram of the nut?

10. What is the theoretical heat loss per gram of the nut in Calories? (from the average)

11. What is the efficiency of this experiment? (from the average)

Table 2: Calculating Heat Changes in a Chemical Reaction

Initial mass of nut	Final mass of nut	Change in mass of nut	Change in temp. of water	Heat gain of water cal.	Heat gain of water Cal.	Experimental heat loss of nut in Cal.	Experimental heat loss per gram of nut in Cal.	Ave. heat loss of nut	Theo. heat loss of nut	% Eff.

Questions

1. **How could you make it so that more of the heat from the burning nut goes into the water**

2. **The mass of the nut went down and the temperature of the water went up. Did you change matter into energy? Make sure you explain your answer with evidence.**

3. **What happened to the matter of the nut that was burned?**

4. **How did the energy get into the nut in the first place?**

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5. **A 12.5 gram walnut is burned under 100 ml of water. How many calories did the water absorb if its temperature went from 22.5 ^oC to 95.5 ^oC?**

Answer____________________________________