Lab: Marshmallow Energy

Background: By burning pieces of food, the chemical energy stored in molecular bonds is released as heat and light. The heat can be measured in units called calories, or in units called joules. A calorie is the amount of heat (energy) required to increase the temperature of one gram of water by 1°C. This process is the basis of the technique of calorimetry. The more calories a food contains, the more heat it gives off when burned.

Objective: You will burn a marshmallow to determine the amount of energy that is stored in it, and then you will compare your results to the amounts listed on the package.

Safety: Open flames will be used. Tie back all loose hair and clothing. Stay in front of the flame at all times. Wear goggles. Be careful with sharp objects.

Materials: marshmallow, aluminum can, ring stand, ring, wire screen, index card, small ball of clay, paper clip, thermometer, graduated cylinder, stirring rod, matches or burner.

Procedure:

1. Set up your ring stand and ring, placing the wire screen on top. Then gently place the can on top of the wire screen.
2. Measure 100 mL of water in a graduated cylinder, then gently pour the water into the can.
3. Place a small ball of clay on an index card. Unfold the paper clip and stick one end into the clay, with the other end pointing up. (Your teacher will demonstrate) Stick your marshmallow onto the end of the paper clip so it is held securely.
4. Insert a thermometer into the can. Record the starting temperature of the water in your data table.
5. Ignite the marshmallow and allow it to burn to completion.
6. When the marshmallow won't burn any more, record the final temperature of the water in your data table.

Data:

Starting Temp. of Water (°C)	
Final Temp of Water (°C)	

Analysis:

1. Using the density of water to be 1g/mL, determine the mass of water you used: _____g

2. Calculate the change in temperature of the water (△T): _____ °C

3. Look up the specific heat value (C) for water in Table B and record it here: _____
4. Calculate the heat energy absorbed by the water, in joules. Use Table T. Show your work:

5. We will assume for the remaining calculations that *the amount of heat gained by the water is equal to the total amount of heat released by the marshmallow*. With this assumption, how much heat was released by one marshmallow? _____ joules

6. If *4.18 joules = 1 heat calorie*, calculate many heat calories were released by one marshmallow. Show your work:

7. A dietary Calorie (capital C) like we're used to seeing on nutritional labels, is equal to 1000 heat calories. Calculate how many dietary Calories were released by one marshmallow. This is your *measured value*. Show your work:

8. Read the Nutrition Facts label on the package of marshmallows and record the following: # of marshmallows per serving = _____ dietary Calories per serving = _____ Now calculate how many dietary Calories are in one marshmallow, according to the package. This is the *accepted value.* Show your work:

9. Calculate your percent error for dietary Calories in one marshmallow. Show your work:

10. Complete the following chart to explain 2 sources of error in this experiment. You may want to look at the "Thermal Images" of the marshmallow lab on the moodle to help you.

Source of EXPERIMENTAL Error	How did this error affect your heat calculation?	What could you do to limit this error?

Be sure to complete your lab credit sheet!