Thermochemistry Strain Your Brain Name_______________________

Date__________Period________

Virtually every chemical reaction is accompanied by a change in energy. Chemical reactions usually absorb or release heat. ***Thermochemistry*** is the study of the transfers of energy as heat that accompany chemical reactions and physical changes.

Temperature is a measure of the average kinetic energy of the particles in a sample of matter. The greater the kinetic energy of the particles, the higher the temperature it has. For calculations in thermochemistry we use the Celsius and Kelvin scales. The ability to measure temperature is thus based on heat transfer. The amount of energy transferred as heat is usually measured in joules. A ***joule*** is the SI unit of heat as well as other forms of energy. The joule, abbreviated (J) is derived from the units for force and length. Because the joule is a rather small unit compared with other units for heat, the ***kilojoule, kJ***, is also commonly used as a unit for heat.

Heat can be thought of as the energy transferred between samples of matter because of a difference in their temperatures. Energy transferred as heat always moves spontaneously from matter at a higher temperature to matter at a lower temperature. Ice left out in a glass at room temperature melts due to the heat in the room. Heat transfer always goes from "hot" to "cold".

The quantity of energy transferred as heat during a temperature change depends on the nature of the material changing temperature, and the size of the temperature change. One gram of iron heated to 100.0 °C and cooled to 50.0 °C transfers 22.5 J of energy. But one grams of silver transfers 11.8 J of energy under the same conditions. The difference results from the metal's differing capacities for absorbing this energy. A quantity called specific heat can be used to compare heat absorption capacities for different materials. ***Specific heat*** *is the amount of energy required to raise the temperature of one gram of a substance by one Celsius degree (1°C) or one Kelvin (1 K) (because the sizes of the degree divisions on both scales are equal).* Values of specific heat can be given in units of joules per gram per Celsius degree, J/(g·°C), joules per gram per Kelvin, J/(g·K), or calories per gram per Celsius degree, cal/(g·°C). Specific heat is given the symbol (c). An equation then can be given to find the quantity of energy gained or lost with a change in temperature. Conversions – 1 calorie = 4.186 joules

$$q = c \times m \times \Delta T$$

q = quantity of heat transferred c = specific heat of the substance

m = mass of the substance ΔT = the temperature change

Sample Problem- A 4.0 g sample of glass was heated from 274 K to 314 K and was found to have absorbed 32 J of energy as heat. What is the specific heat of this type of glass?

Given: *m* = 4.0 g ΔT = 40 K q = 32 J Unknown: c

$$c = \frac{32\text{ J}}{(4.0\text{ g})(40\text{ K})} = 0.20\text{ J/(g·K)}$$

Problems-

1. 2,000 calories is a good number for a human to consume in a day. How many joules does this equal?

2. Convert 10°C, 30°C, 32°F, and 75°F to Kelvins

3. How much heat energy is needed to raise the temperature of a 55 g sample of aluminum from 22.4 °C to 94.6 °C? c_{Al}=0.897 J/(gK)

4. Determine the specific heat of a material if a 35 g sample absorbed 48 J as it was heated from 293 K to 313 K.

5. 980 kJ of energy are added to 6.2 L of water at 291 K, what will the final temperature of the water be? The specific heat of water is 4.186 J/(gK).

6. 3.5 kJ of heat are added to a 28.2 g sample of iron at 20°C. What is the final temperature of iron in Kelvins? c_{Fe} = 0.45 J/(gK)