Specific Heat and Temperature Change: Day 1

Specific heat is the amount of heat energy needed to raise the temperature of a substance, without changing phase. It is usually expressed in joules or calories. It is generally given as the amount of energy (calories or joules) needed to raise 1 gram of a substance, 1 degree (Celsius or Kelvin).

The amount heat necessary is a reflection of the atomic/molecular structure of the substance. For example, water has a large specific heat. Expressed in joules it is 4.18 J/gC, or expressed in calories it is 1 c/gC. Remember the water molecule is polar, therefore, the molecules hang onto each other, and it takes a comparatively large amount of energy to raise its temperature. Remember also that temperature is a reflection of the speed of molecular motion.

To calculate the amount of heat necessary to raise the temperature of a substance you use the formula for heat energy; H = (change in temperature) (mass, the number of molecules changing speed) and finally the (specific heat for that substance).

Examples:

How much heat energy is needed to raise the temperature of 21 grams of water, 15 degrees? Express your answer in calories and joules.

How much heat energy is needed to raise the temperature of 21 grams of copper, 15 degrees?

If that same amount of heat energy is applied to 21 grams of bromine, and the temperature starts at 23 C, what is the final temperature?

Work with a partner, find two substances with significantly different specific heats, how do their final temperatures differ if you have 50 grams of each, start at 50 C, and add 50 calories?

Specific Heat and Temperature Change: Day 2

Determine the amount of thermal energy it would take to change the temperature of your element from ten degrees below its melting point to ten degrees above boiling point. Use the Labquest to find the necessary information.

Element: _____

Specific Heat: _____

Melting Point: _____

Boiling Point: _____

Heat of Fusion: _____

Heat of Vaporization: _____

Process

a. Subtract ten degrees from your melting point, and add ten degrees to your boiling point, then subtract the two numbers. Next. multiply your answer times your specific heat. This is the amount of thermal energy necessary to <u>just change the temperature of one gram</u> of your element.

b. Then add the heat of fusion (this accounts for the amount of energy needed to change phase from a solid to a liquid) and then add the heat of vaporization (this accounts for the amount of energy needed to change phase from a liquid to a gas).

c. If you had more than one gram, multiply your answer from 'b' times the number of grams.

XC: Convert the value for heat of fusion/heat of vaporization from kj/mol to j/gC. A mole is a value that reflects a definite number of particles per unit mass. The number of particles is Avogadro's Number, 6.02×10^{23} and the unit of mass is the atomic weight for that element. The process of converting would involve two steps. First, reduce the value to reflect the heat of fusion/vaporization for one gram. In practical terms you are dividing the heat of f/v by the atomic weight. Second, then change from kilojoules to joules. Then note how it compares to the value for water.