ENERGY

Law of Conservation of Energy - Energy can neither be created or destroyed in a chemical reaction but may be converted from one form to another.

Energy can be assigned to one of the two classes: **potential** or **kinetic** energy.

Potential energy is stored energy or the energy of position. That is, a book 8 feet off the floor has a greater potential energy than a book 2 feet off the floor. Potential energy is important in chemistry because the energy stored in chemical bonds is potential energy.

The energy liberated or absorbed in a chemical reaction is similar in many ways to the energy released or needed when a book is raised or lower.

Kinetic energy is the energy of motion. Particles with high kinetic energy are moving rapidly and those with low kinetic energy of moving slowly. The topic of kinetic energy is often discussed during a lesson on kinetics (rates of reaction).

Some forms of energy are heat, light, sound, electrical, chemical, and mechanical energy.

Exothermic - Energy is released in an exothermic process. Any process in which energy is released is an exothermic process. The burning of paper, an explosion, or the condensation of steam are all exothermic process.

Endothermic - Energy is absorbed in an endothermic process. Any process which requires energy in classified as an endothermic process. The baking of a cake, boiling water, or the of melting ice are all endothermic processes.

UNITS OF ENERGY

The unit of energy used in chemistry is the **"calorie"** or **"kilocalorie"** (1000 calories).

A **calorie** is the amount of energy needed to change the temperature of 1.0 gram of water, 1.0°C.

How do you find the number of calories?

$$\# \text{ calories} = \text{mass} \times \begin{matrix}\text{specific} \\ \text{heat}\end{matrix} \times \begin{matrix}\text{change in} \\ \text{temperature}\end{matrix}$$

Since only water (specific heat = 1.00 calorie /gram @ °C) will be used for energy calculations in Regents chemistry, the equation simplifies to

$$\# \text{ calories} = \text{mass} \times 1.00 \text{ cal/gram}\cdot{}^\circ\text{C} \times \Delta t$$

How much heat is needed to change the temperature of 100. grams of water from 20.°C to 35°C?

$$\# \text{ calories} = \text{mass} \times 1.00 \text{ cal/gram}\cdot{}^\circ\text{C} \times \Delta t$$

$$\# \text{ calories} = 100. \times 1.00 \text{ cal/g}\cdot{}^\circ\text{C} \times 15^\circ\text{C}$$

Amount of energy = 1500 calories

What is the final temperature of 20.0 grams of water at 25°C by the absorption of 100. calories of heat?

calories = mass x 1.00 cal/g@ C x) t

100. calories = 20.0 grams x 1.00 cal/g@ C x) t

) t = 5.0°C

Final temperature = 25°C + 5°C = 30°C

Heat of Fusion,) H_{fus} - The heat of fusion is the energy necessary to change one gram of solid into one gram of liquid at its melting point.

The heat of fusion for ice is 79.72 calories/gram (Chart A on your *Reference Tables for Chemistry*).

$$\# \text{ calories} = \text{mass of solid x })\, H_{fus}$$

Heat of Vaporization,) H_{vap} - The heat of vaporization is the energy necessary to change one gram of liquid into one gram of vapor at its boiling point.

The heat of vaporization for water is 539.4 calories/gram (Chart A on your *Reference Tables for Chemistry)*.

$$\# \text{ calories} = \text{mass of liquid x })\, H_{vap}$$

Calculate the amount of energy needed to melt 200. grams of ice.

calories = mass ice x 80 cal/gram

calories = 200. grams x 80 cal/g

calories = 16,000 calories

How much steam can be prepared by the addition of 2160 calories of heat a sample of water at 100°C?

calories = mass H_2O x 540 cal/g

2160 calories = mass H_2O x 540 cal/g

mass of H_2O = 4 grams H_2O

How many calories of heat energy are absorbed in raising the temperature of 10. grams of water from 5.0°C to 20.°C?

(a) 2.5×10^2

(b) 2.0×10^2

(c) 1.5×10^2

(d) 5.0×10^1

$$\# \text{ calories} = \text{mass} \times \text{specific heat} \times \Delta t$$

$$\#\text{calories.} = 10.\ \text{g.} \times 1.0 \frac{\text{cal}}{\text{g}\cdot°\text{C}} \times (20°\text{C} - 5°\text{C})$$

$$\# \text{ calories} = 150 \text{ cal} = 1.5 \times 10^2 \text{ calories}$$

What is the maximum number of grams of water at 10.°C that can be heated to 30.°C by the addition of 40.0 calories of heat?

(a) 1.0 gram
(b) 2.0 grams
(c) 20. grams
(d) 30. grams

$$\# \text{ calories} = \text{mass} \times \text{specific heat} \times \Delta t$$

$$40.0 \text{ cal.} = \text{mass.} \times 1.0 \frac{\text{cal}}{\text{g} \cdot {}^\circ\text{C}} \times (30^\circ\text{C} - 10.^\circ\text{C})$$

$$40.0 = 20. \times \text{mass}$$

$$\text{mass} = 2.0 \text{ grams}$$

How many grams of ice can be melted at 0°C by the addition of 4800 calories of energy?

(a) 60 grams
(b) 166 grams
(c) 2.1 grams
(d) 600 grams

$$\# \text{ calories} = \text{mass} \times \text{heat of fusion}$$

$$4800 \text{ calories} = \text{mass ice} \times 80 \text{ cal/gram}$$

$$\text{mass ice} = \frac{4800 \text{ calories}}{80 \text{ calories/gram}} = 60 \text{ grams}$$