

GENERAL CHEMISTRY

STANDARD 2.1

2.1: Compute how heat energy added to a substance will change the substance's temperature

HEAT ENERGY

- Energy is the ability to do work
 - Work is defined as a force applied over a distance
 - Six different types of energy
 - Heat
 - Sound
 - Light
 - Chemical
 - Electrical
 - Mechanical
- Heat energy of a substance is measured by temperature
 - Temperature is directly related to the average kinetic energy of the particles
 - Temperature is measured using one of three main units:
 - Always wash your hands after working with any chemicals
 - NEVER put unused chemicals back into their original container

2.1: Compute how heat energy added to a substance will change the substance's temperature

HEAT ENERGY

- Heat energy of a substance is measured by temperature
 - Temperature is directly related to the average kinetic energy of the particles
 - Temperature is measured using one of three main units:
 - Degrees Fahrenheit
 - Degrees Celsius
 - Kelvin
 - Kelvin is referred to as **Absolute Temperature**
 - The lowest temperature possible in Kelvin is 0 K
 - Referred to as **Absolute Zero**
 - All particle motion stops at Absolute Zero

HEAT ENERGY

Energy is measured in Joules (J)

$$1 \text{ Joule} = 1 \frac{\text{kg m}^2}{\text{s}^2}$$

Other units of energy include

$$1 \text{ Calorie} = 4.184 \text{ J}$$

$$1 \text{ Food Calorie} = 1000 \text{ Calories} = 1 \text{ kilocalorie}$$

$$1 \text{ British Thermal Unit (BTU)} = 1055 \text{ J}$$

1 Calorie = heat
needed to warm 1.0
grams of water 1.0
degrees Celsius

RELATING HEAT ENERGY TO TEMPERATURE

$$Q = mc\Delta T = mc(T_f - T_o)$$

Q = Heat Energy (J)

m = Mass (kg)

c = Specific Heat (J / kg K)

Δ = Delta (change in – final value minus initial value)

T = Temperature (K)

* A temperature change in Kelvin is the same as a temperature change in degrees Celsius

T_o = Initial Temperature

T_f = Final Temperature

RELATING HEAT ENERGY TO TEMPERATURE

Example Problem

Find the heat energy needed to raise the temperature of 75 grams of water 35.2 degrees Celsius.

Use the five step problem solving method to solve this problem.

Step 1

$$Q = ?$$

$$m = 75 \text{ g} = 0.075 \text{ kg}$$

$$c = 4184 \text{ J/kg K (from foldable)}$$

$$\Delta T = 35.2^\circ\text{C} = 35.2 \text{ K}$$

Step 2

$$Q = mc\Delta T$$

Step 3

$$Q = mc\Delta T$$

Step 4

$$Q = 0.075 \times 4184 \times 35.2$$

Step 5

$$Q = 11045.76 = 11000 \text{ J}$$