Name: _____ **CHEMISTRY** ___/___/___

Specific Heat Capacity

Specific heat capacity (Cp) is defined as the amount of energy required to raise the temperature of one gram of a substance one degree Celsius. The unit for specific heat capacity is J/g°C. Specific heat capacity is sometimes referred to as just specific heat. Specific heat capacity values vary for different substances. It is a substance's specific heat that makes some substances feel cooler than others, even though both are at the same temperature. This phenomenon is due to the fact that some substances require little heat in order for their temperature to rise 1°C. Thus, substances with low specific heat values are said to be good conductors of heat. Most metals are considered to be good conductors because of their low Cp values. Substances with high Cp values are called insulators because they require large amounts of heat in order to warm up just a little. It is because of this, large bodies of water take a long time to warm in the summer and a long time to freeze in the winter. The chart below lists the specific heat capacities for some various substances.

Substance	Specific Heat Capacity (J/g°C)
Water (l)	4.184
Water (s)	2.09
Water (g)	2.01
Aluminum (s)	0.89
Iron (s)	0.45
Mercury (l)	0.14
Carbon (s)	0.71
Silver (s)	0.24
Gold (s)	0.13
Copper (s)	0.385

The specific heat capacity of a substance is needed when determining how much energy is absorbed or released when heat flows from one substance to another. The formula used is:

$\Delta H = \Delta T$ x mass x Cp

The Δ is the delta symbol and means "change in".
ΔH – the change in heat, measured in joules
ΔT – the change in temperature (final temperature – initial temperature), measured in °C
mass – the mass of a substance, measured in grams
Cp – the specific heat capacity of the substance that is being heated or cooled, measured in J/g°C

Since you will either be give the initial and final temperatures or asked to find one of them, it may be better to express the formula as:

$$\Delta H = (T_{final} - T_{initial}) \text{ x mass x Cp}$$

Which Cp of water should you use?
Water boils at 100°C and freezes at 0°C. If a temperature range is below 0°C, use the Cp for solid water. If the temperature range is above 100°C use the Cp for water vapor (g). If the temperature range is between 0°C and 100°C, use the Cp for liquid water.

If ΔH is **positive**, it is an **endothermic change**, if ΔH is **negative**, it is an **exothermic change**.

Homework: Solve each problem in kilojoules and Calories (kilocalories) or degrees Celsius. Indicate if an endothermic or exothermic change takes place.

1. If you fill a bathtub with 200 kg of water at 44°C, how much heat energy is lost as the water cools to a temperature of 21°C?

2. On a cold winter day with a temperature of 4°C, you pick up a penny from the ground and put it in your pocket. If the penny has a mass of 1.85 grams, how much heat energy must be transferred to the coin to warm it to your body temperature, 37°C?

3. A nutritional chemist burns a saltine cracker in a calorimeter containing 250. grams of water. The temperature increases from 25.0°C to 29.8°C. What is the energy content of the cracker?

4. Predict the final temperature of 2.50 kg of water in a calorimeter if the water is at 25.0°C before 0.5 oz. of noodles, which contain 54 Calories, are burned?

5. How much heat is lost by 4.0 L of water that is cooled from 87°C to 21°C?

6. If 980 kJ of energy are added to 6.2 L of water at 18°C, what is the final temperature of the water?

7. How much heat energy is released to your body when a cup of hot tea containing 200.0 grams of water is cooled from 65°C to body temperature, 37°C?

8. How much heat energy is needed to raise the temperature of a 425.0 gram aluminum baking sheet from room temperature, 25°C, to a baking temperature of 200.°C?

9. Calculate the amount of energy needed to raise the temperature of 100. grams of gold from 30°C to 40°C.

10. Calculate the amount of energy released as 225 grams of mercury cools from 100.°C to 27°C.

11. Which of the following would be the best choice as an insulator, gold, iron, aluminum or water? Explain

12. Which of the following is the best conductor of heat, carbon, water, copper, or mercury? Explain.

13. If a ΔH value is positive, is a reaction endothermic or exothermic?