

Change of State Calculations Homework Assignment

J. Flint Baumwirt ~ Granada Hills Charter High School, CSUN Math Science and Technology Magnet ~ Jan/Feb 2009-CST aligned

$$Q = m C_p \Delta T \quad Q = m \Delta H_{\text{fus}} \quad Q = m \Delta H_{\text{vap}}$$

FOR WATER:

$$\Delta H_{\text{vap}} = 2260 \text{ J/g}$$

$$\Delta H_{\text{fus}} = 334 \text{ J/g}$$

$$C_{p \text{ gas}} = 2.03 \text{ J/g}^\circ\text{C}$$

$$C_{p \text{ liquid}} = 4.18 \text{ J/g}^\circ\text{C}$$

$$C_{p \text{ solid}} = 2.06 \text{ J/g}^\circ\text{C}$$

$$\text{H}_2\text{O} = 18.0 \text{ g/mol}$$

1. Calculate the number of kJ it would take to convert 85.0 grams of water to steam. The Latent Heat of Vaporization, ΔH_{vap} is 2260 J/g.
2. Calculate the number of kJ it would take to convert 55.0 grams of liquid water to solid ice at 0°C . The Latent Heat of Fusion, ΔH_{fus} , is 334 J/g.
3. Calculate the amount of heat energy that it would take to turn 15.0 grams of water at 22°C into steam and raise the temperature of the steam to 180°C . The Latent Heat of Vaporization, ΔH_{vap} , is 2260 J/g and the Specific Heat of gaseous water, $C_{p \text{ gas}}$, is 2.03 J/g $^\circ\text{C}$.
4. Calculate the amount of heat energy needed to take 35.0 grams of ice at 0°C from the freezer, put it in a saucepan over a burner on the stove and bring the resulting liquid water to a boil until all was all boiled away. **Show a heating/cooling diagram of this process with all significant temperatures and phase changes labeled along with your calculations.** The Latent Heat of Fusion, ΔH_{fus} , is 334 J/g, the Latent Heat of Vaporization, ΔH_{vap} , is 2260 J/g and the Specific Heat of water, $C_{p \text{ liquid}}$, is 4.18 J/g $^\circ\text{C}$.
5. Calculate the amount of heat energy it would take to bring an old bathtub full of frozen water sitting out in a snow-covered field at (minus) -10°C to a point where it was just *starting* to boil at 100°C . Consider the volume of the tub to be approximately 130 cm x 70 cm x 70 cm. The density of ice is 0.931 g/cm³. The molar mass of water is 18.0 grams/mol. **Show a heating/cooling diagram of this process with all significant temperatures and phase changes labeled along with your calculations.** The Latent Heat of Fusion, ΔH_{fus} , is 334 J/g. The Specific Heat of ice, $C_{p \text{ solid}}$, is 2.06 J/g $^\circ\text{C}$ and the Specific Heat of water is 4.18 J/g $^\circ\text{C}$.

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