Changes in State: Name _____ Per _____

Heats of Fusion and Vaporization

As a substance cools, energy is given off or released. The amount of energy given off is called the specific heat of the substance. The specific heat of water is 4186 J/kg · ºC (or 4.186 kJ/ kg · ºC). For a solid to melt, the solid must be heated. The amount of energy needed for a substance to melt is called its **heat of fusion**. For water, the heat of fusion is 334,000 J/kg (or 334 kJ/kg). When a liquid freezes, the reverse occurs. Energy is given off. The amount of energy given off is the same as the amount absorbed when the solid melts. Thus, when a kilogram of water freezes, 334 kJ of energy are released.

Similarly, energy is needed for a substance to evaporate or boil. This amount of energy is the **heat of vaporization**. For water, it is 2,260,000 J/kg (or 2260 kJ/kg).

The equations to calculate heat of fusion (H of F) and heat of vaporization (H of V) are:

$Q = m \cdot (H \text{ of } F)$ $Q = m \cdot (H \text{ of } V)$

SHOW ALL WORK!

1. A rain barrel holds about 210 kg of water. How many **kJ** of energy are released when the temperature of the water in the barrel decreases from 25 ºC to 0.0 ºC? Use $Q = m \cdot \Delta T \cdot C_p$.

2. How many **kJ** of energy are released when all the water in the rain barrel freezes?

3. How many **kJ** of energy are needed to change the water in the rain barrel to steam (water vapor)?

4. How much energy would be needed to **melt** a 12-kg block of ice at 0.0 ºC, then **heat** the water to boiling, and then **vaporize** it to steam? Note, you will be doing three different energy transfers!