Latent Heat

When a substance changes phase (either between solid and liquid, or liquid and gas), during the phase change there is no increase or decrease in temperature, although there is a flow of heat in these changes. This flow of heat is called ***latent heat***.

The heat required to change a solid to a liquid at the same temperature is called the ***heat of fusion*** (L_F), and is measured as heat per unit mass (i.e. kcal/kg or J/kg).

The heat required to change a liquid to a gas at the same temperature is called the ***heat of vaporization*** (L_V), and is measured as heat per unit mass (i.e. kcal/kg or J/kg).

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The heat required for a phase change therefore is given by the equation

$L_{F_{H_2O}} = 79.7 \frac{cal}{g} = 79.7 \frac{kcal}{kg}$

$Q = mL$

Example: (250 g)

A 50 g ice cube at -5.0°C is placed in 250 mL of water at 10.0°C. What is the equilibrium temperature of the system? - 1) equil ⇒ 0°C (not enough Q to melt all ice)
2) equil > 0°C all cube melts.
3) equil < 0°C

1. Is there enough energy to bring this to a phase change?

$Q_{H_2O} = mc\Delta T$
$= (250\,g)(1.00\,cal/g°C)(0 - 10°)$
$= 2500$ cal

$Q_{ice} = mc\Delta T$
$= (50\,g)(0.50\,\frac{cal}{5°})(0°C - (-5°C))$
$= 125$ cal

yes with 2375 cal left over

2. If so, is there enough energy to fully change phases?

$Q = mL_F$
$= (50\,g)(79.7\,cal/g)$
$= 3985$ cal

$T_{eq} = 0°C$

No not enough to melt all ice

3. If so, what is the final temperature of the water?

0°C

4. How much of the cube melts?

$2375\,cal = m_{ice\ melted}(79.7\,cal/g)$

$m_{ice\ melted} = 29.8\,g$ melts

Example 2:
If equal amounts of ice at -5℃ is placed in water at 5℃ what is the equilibrium temperature of the water (and ice)? If it is 0℃, what percentage of ice remains?

Heat Transfer

1) Conduction – The transfer of heat through a substance.

2) Convection – Heat transferred through the mass movement of molecules

3) Radiation - Heat transfer through the absorption and emission of light.