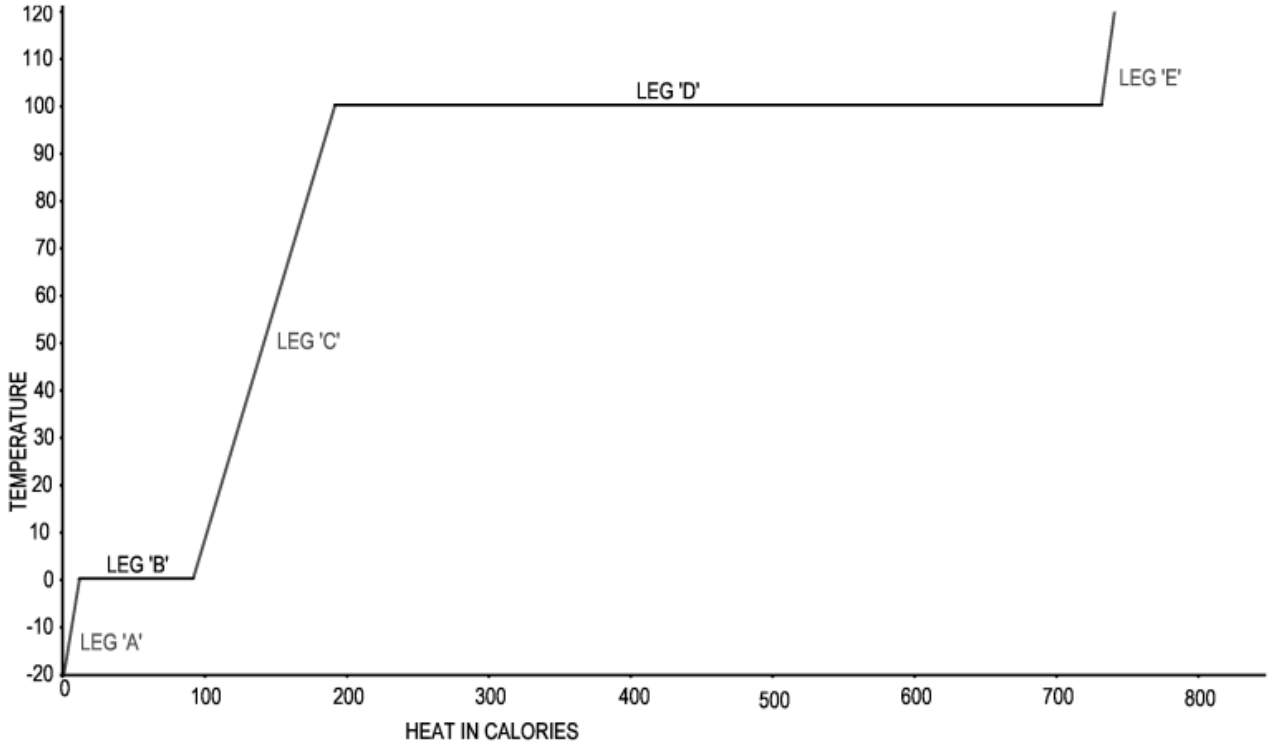
PHASE DIAGRAMS

This is a phase-change diagram for water.



1. Along LEG 'A' water exists as a solid (ice), and the temperature increases as HEAT energy is absorbed.

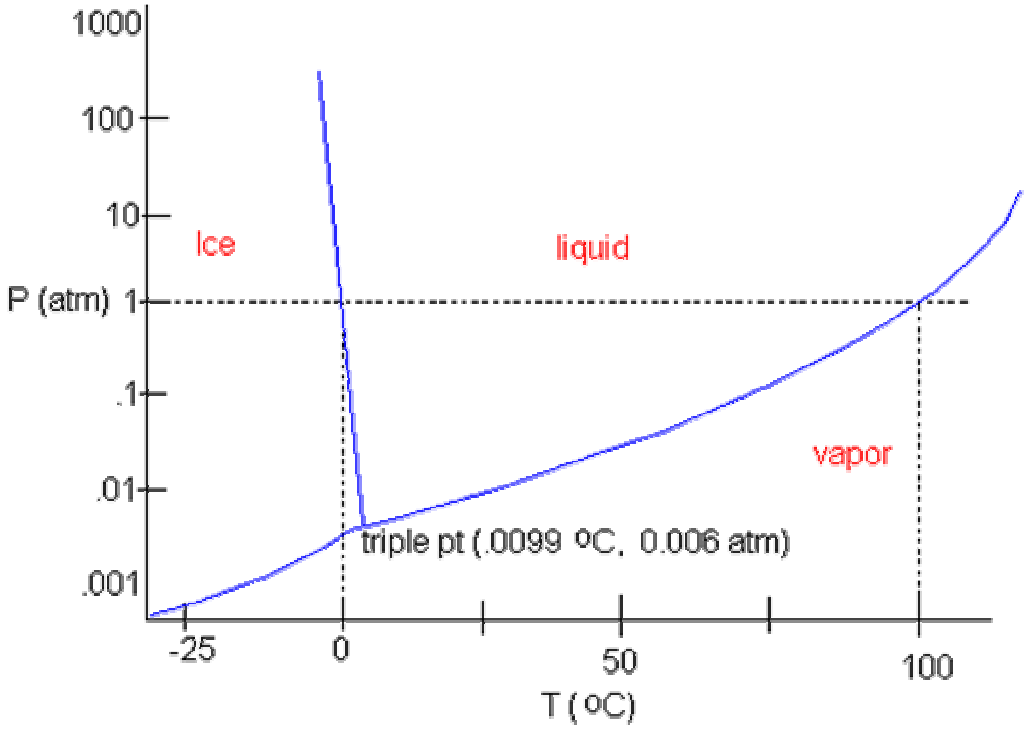
2. At 0 °C a phase change begins:
   a) Moving from left to right along LEG 'B', ice is *melting* to form liquid water
   b) Moving from right to left along LEG 'B', liquid water is *freezing* to form ice
   c) The distance of LEG 'B' along the Heat axis (x-axis) is known as the *Heat of Fusion*
   d) *Note that temperature remains constant during a phase change*!

3. Once ice has completely melted, the temperature begins to increase again (LEG 'C'), as the heat absorbed by water is no longer going toward changing the phase of the substance.

4. At 100 °C, a second phase change begins:
   a) Moving from left to right along LEG 'D', water is *boiling* to form water vapor
   b) Moving from right to left along LEG 'D', water vapor is undergoing *condensation* to form liquid water
   c) The distance of LEG 'D' along the Heat axis (x-axis) is known as the *Heat of Vaporization*
   d) *Note that temperature remains constant during a phase change*!

5. Once all of the liquid water has vaporized, the temperature begins to increase again (LEG 'E'), as the heat absorbed by water is no longer going toward changing the phase of the substance.

This a phase diagram for water, showing all three phases. The lines represent conditions of equilibrium between phases.



Phase Changes			
From….	**To….**	**…is called**	**…and energy is…**
Solid	Liquid	Melting	Absorbed
Liquid	Solid	Freezing	Released
Liquid	Vapor	Boiling or vaporization	Absorbed
Vapor	Liquid	Condensation	Released
Solid	Vapor	Sublimation	Absorbed
Vapor	Solid	Deposition	Released

1. The temperature at which a substance melts/freezes at standard pressure (1 atm) is known as the *Normal melting point* or *Normal freezing point*. For water, this is 0 °C.
2. The temperature at which a substance boils/condenses at standard pressure is known as the *Normal boiling point* or *Normal condensation point*. For water, this is 100 °C.
3. The *Triple point* is the condition of temperature and pressure in at which all three phases exist together at equilibrium. For water, this is 0.0099 °C and 0.006 atmospheres.
4. The *Critical Temperature, T_c* is the temperature beyond which the solid and liquid phases of the substance cannot exist. Put another way, above the critical temperature, the substance can only be found as a gas. For water, this temperature is 373.99 °C.
5. The *Critical Pressure, P_c* is the pressure above which the substance cannot exist as a gas. For water, this pressure is 217.75 atmospheres.
6. The *Critical Point* is the point defined by the critical temperature and the critical pressure.
7. The slope of the line between the solid and liquid phase provides important information about the substance:
    a) If the slope is negative (as it is for water), then the substance is more dense as a liquid than it is as a solid.
    b) If the slope is positive (as it is for most substances), then the substance is more dense as a solid than it is as a liquid.