Chem 116 Notes
9/18/08

A clicker question about material we covered in class last lecture
Which statement about the vapor pressure of water is correct?
A. If atmospheric pressure is 600mmHg, water will boil at about 93^{o}C
B. Water cannot boil above 100^{o}C (water can boil above 100^{o}C)
C. At 100^{o}C, the vapor pressure of water is about 50mmHg (these numbers are inverted on the graph)
D. This bears no relevance to my life (ha ha ☺)

Dew Point
*Dew point - temperature that air condenses and produces dew
*Relative humidity - Water vapor in the air (how sticky the air feels)

$$\text{Relative humidity} = \frac{\text{partial pressure of water in the air}}{\text{maximum amount of pressure that could be in the air}}$$

*Water vapor in the air = partial pressure of water
*Relative humidity of 80-90% = "uncomfortable air"
*Relative humidity of 10-20% = "comfortable air"

*The curve on this slide shows the maximum partial pressure of water at a given Temperature (aka saturation vapor pressure)

Heating curve vs. phase diagram vs. vapor pressure curve
1. Heating curve – Part of phase diagram that shows the results of the phase by relating temperature to heat energy added (cooling curve is temperature vs. heat removed)
2. Phase diagram – Shows temperature vs. pressure between all phases. It shows the temperature and pressure at which one phase will turn to another.
3. Vapor pressure curve – Compares pressure to temperature and shows the equilibrium boundary line between liquids and gases.

Compare vapor pressure curves for various materials
*Why does hand sanitizer feel cold?
- Hand sanitizer is composed mostly of ethanol
- Ethanol has a fairly high vapor pressure at 160mmHg
- Body temperature is roughly 37 ^{o}C
- Energy must go into the ethanol to vaporize it (endothermic change from the perspective of the ethanol)
- Exothermic thermodynamic change (from the perspective of your hand) occurs when energy is released from your hand to warm the ethanol, therefore ethanol feels cold.

*See graph for clarification

General phase diagram showing all 3 phases
*Phase diagram shows boundaries between different phases

Compare phase diagrams of H_2O and CO_2
*Curvature between both diagrams is similar

A ⟶ C ⟶ D

Y ⟶ X ⟶ Z

*Triple point – The point at which all phases can co-exist
*Triple point is different between H_2O and CO_2
H_2O = 1 atm at .0098 ^oC
CO_2 = 5.11 atm at 56.4 ^oC

Solid-liquid transition at various pressures
* CO_2 displays "normal behavior"
- at a constant temperature, and increasing pressure, CO_2 changes from liquid to solid
- positive slope
* H_2O displays "unusual behavior"
- at a constant temperature, and increasing pressure, H_2O changes from solid to liquid
- negative slope
*Ice skating is possible because the pressure of the blade on the solid water (ice) causes the ice to melt and allows your skates to glide

CO_2: a typical phase diagram
*Temperature constant, and increase in pressure = liquid to solid
*Triple point – Where all three phases can co-exist

Translating between a phase diagram and a heating curve
*Axis difference in phase diagram
y = dependent = pressure
x = independent = temperature
*Axis differences in heating curve of H_2O
y = dependent = temperature
x = independent = heat added

A clicker question that asks about material we covered in class today
Which of the following graphs represents a cooling curve for CO_2 at P = 3 atm?
-you must use the CO_2 phase diagram as a reference to answer this question
-there is a type-o - x axis should read "heat energy removed" instead of "heat energy added"
*Curve A is a heating curve
*Curve B involves all three phases – at 3 atm can only cross one boundary (gas – solid). At about 6 atm, CO_2 can cross boundaries into all phases.

*Curve C is the correct answer – at 3 atm CO_2 crosses only one boundary (gas – solid), and therefore the "steps" in the graph are fewer

Types of materials

*Like dissolves like
*Unlike materials will separate not dissolve
*Polar molecules can dissolve
*Ionic materials are granular because they composed of a metal and a non-metal
+ ion = metal
- ion = non-metal

Properties that molecular materials exhibit

*Water is a small molecule and is liquid at room temperature (exception to the rule that almost all small molecules are gases at room temperature)
*NH_3 is a gas at room temperature. When it is bubbled through water it is sold as "ammonia cleaning solution" or just "ammonia" in the grocery store