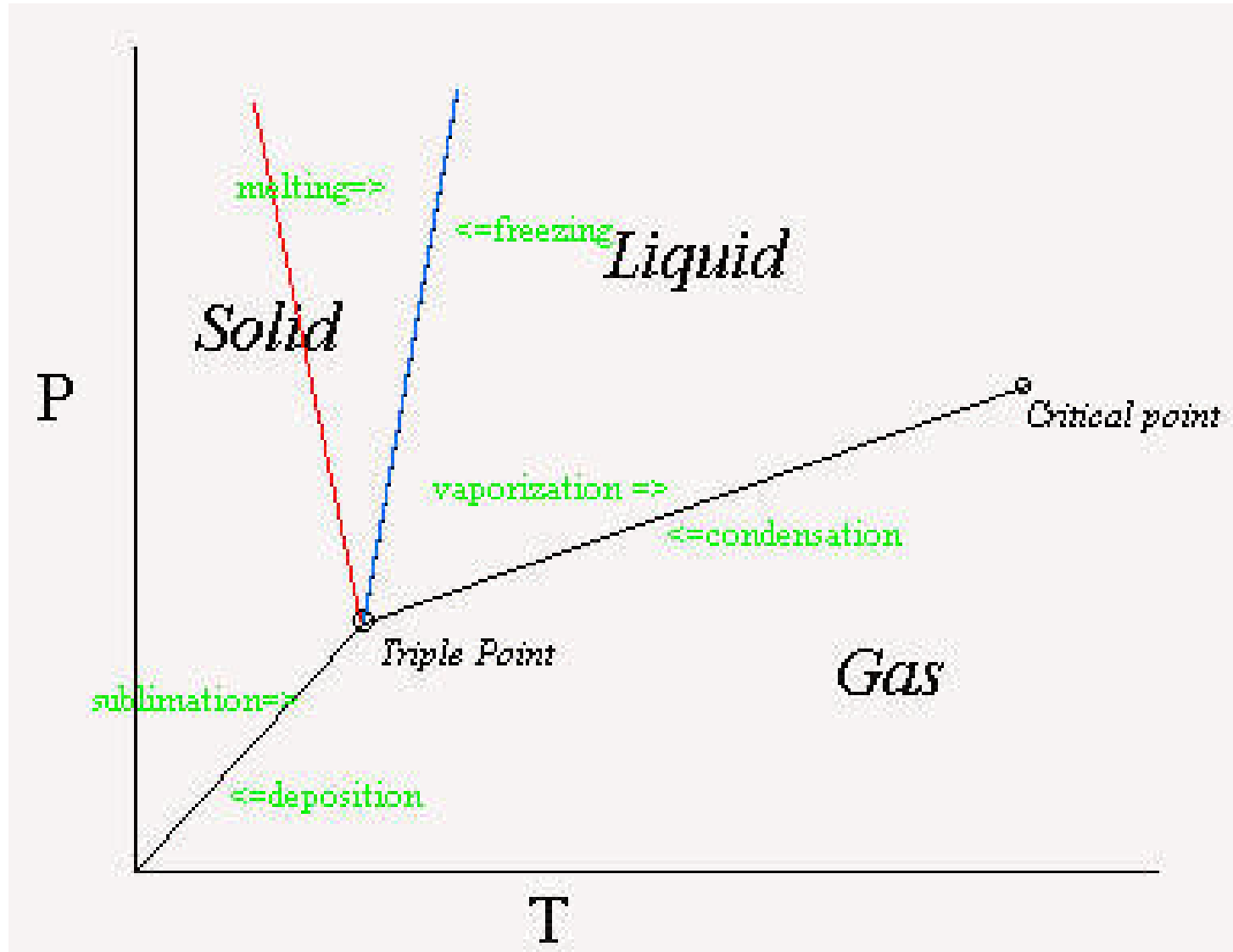


Miscellany

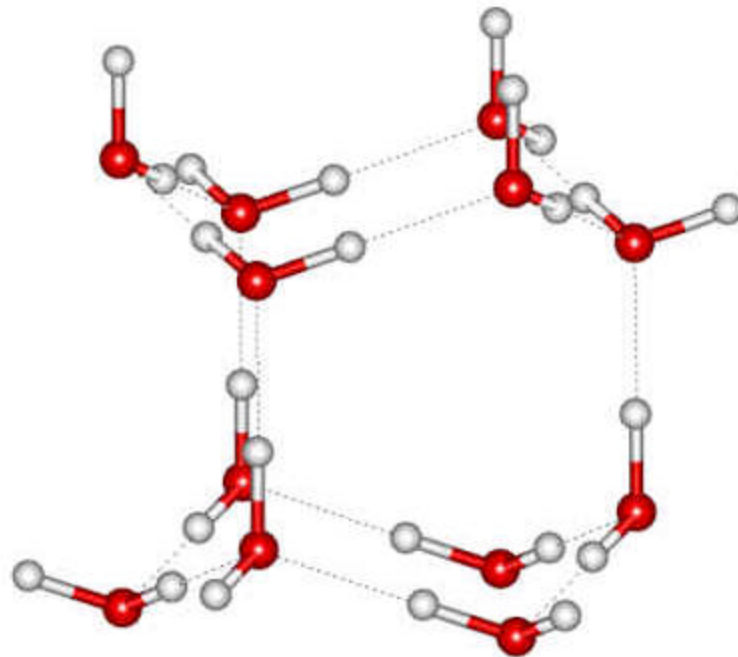
- Homework due date set back to Thurs, Feb 12
- A few thoughts on recognizing intercomponent forces and dipole moments
 - You learn to recognize these by exposure/practice.
 - It should be progressive
 - Ionic? (easy to spot-metal and non metal)
 - If no-Hydrogen bonding?-easy H bound to N,O,F,Cl (Br,I,S)
 - If no-permanent dipole (look for nonsymmetric molecules with elements of differing electronegativities) It takes practice
 - If no-all that's left is van der Waals
 - network solids-not always obvious-you should recognize C(s) but many of the others are oxides of both metals and nonmetals. Why would you expect SiO₂ to be a network solid?
- BH Cycles-that's old news. If you could do it last quarter you should still be able to. If you need help-stop by. An effective strategy would be to open two browsers. With one display the homework problem and with the other find an equivalent question on Web Page 167. Follow the presentation on 167 to solve the problem.

Continuing with the Second Law

- Second try at the second law: "The entropy of an isolated system tends to increase"
- The total thermodynamic description of a change of state must include both the entropy and the enthalpy.
- Thermodynamically entropy can be defined as q_{rev}/T .
Where q_{rev} is the heat change for a reversible process (one whose direction can be changed by an infinitesimal change in the conditions; freezing vs melting is a good example)
- Entropy and Enthalpy are combined in a term called the free energy (ΔG)
- $\Delta G = \Delta H - T\Delta S$ (what are the units of entropy?)
- J/K
- Thought for the day-there are clearly conditions where water freezes. However, this obviously has a negative ΔS . Does this violate the Second Law

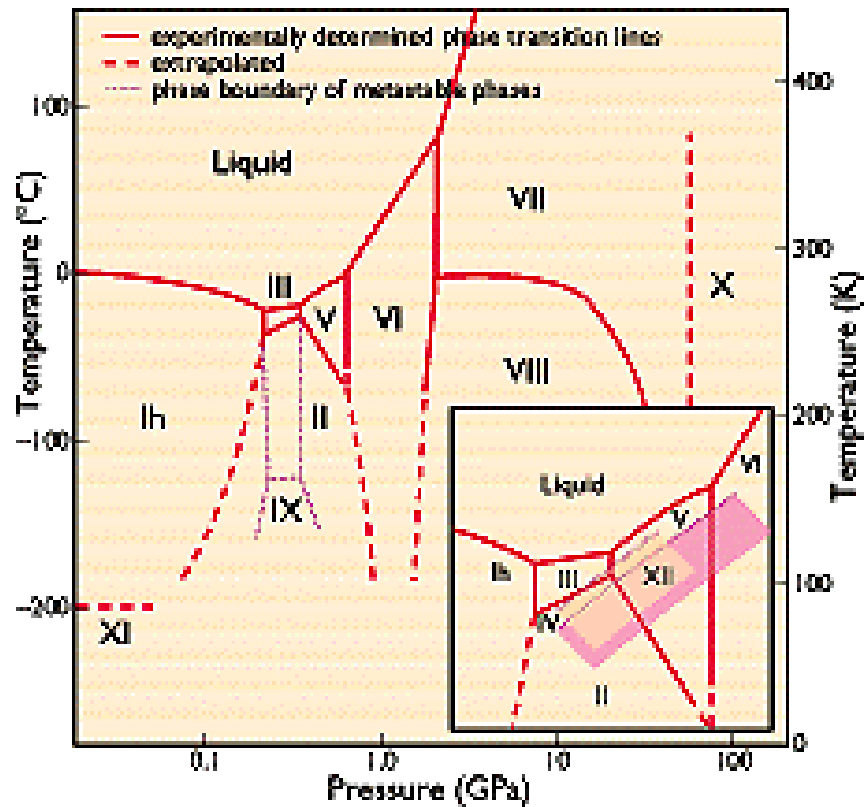


- Structure of Ice



A more detailed phase diagram

- Things are never as simple as they seem-
Kurt Vonnegut had it right



Density and solid structures-Sample Problems

1. $d = C_{\text{geom}} * (M_{\text{atom}}/r^3)$ be certain r is in Cm and M_{atom} in grams
simple cubic: 0.1250
bodycentered: 0.1624
hcp or ccp: 0.1768

Sample problems

A metal with a density of 21.3g/cm³ and a radius 139pm is found to have a ccp structure. Which of the following is the metal? Cs V Mo Pt Ir

Here you are solving for M_{atom} .

$$139\text{pm} = 139 * 10^{-10} \text{ cm} \quad C = 0.1768$$

$$M = 21.3 * (139 * 10^{-10})^3 / 0.1768 = 3.23 * 10^{-22} \text{g}$$

This is the mass of the atom, so you multiply this by Avogadro's number to get the gaw => $3.23 * 10^{-22} * 6.023 * 10^{23} = 195$ which would be Pt

If the density of rubidium is 1.48g/cm³ and its radius is 250pm, which of the following is most likely its structure? simple cubic body centered cubic hcp or ccp

$$\text{assume that it's mass of a Ru atom} = 85.47 / 6.023 * 10^{23} = 1.42 * 10^{-22}$$

$$d = (0.1624 * 1.42 * 10^{-22}) / (250 * 10^{-10})^3 = 1.47 \text{ In agreement with bcc}$$

What would be the density of scandium(radius=161pm), if its solid state structure was cubic?

$$\text{mass of Sc atom} = 44.9 / 6.023 * 10^{23} = 7.45 * 10^{-23}$$

$$d = (0.125 * 7.45 * 10^{-23}) / (161 * 10^{-10})^3 = 2.23 \text{g/cm}^3$$

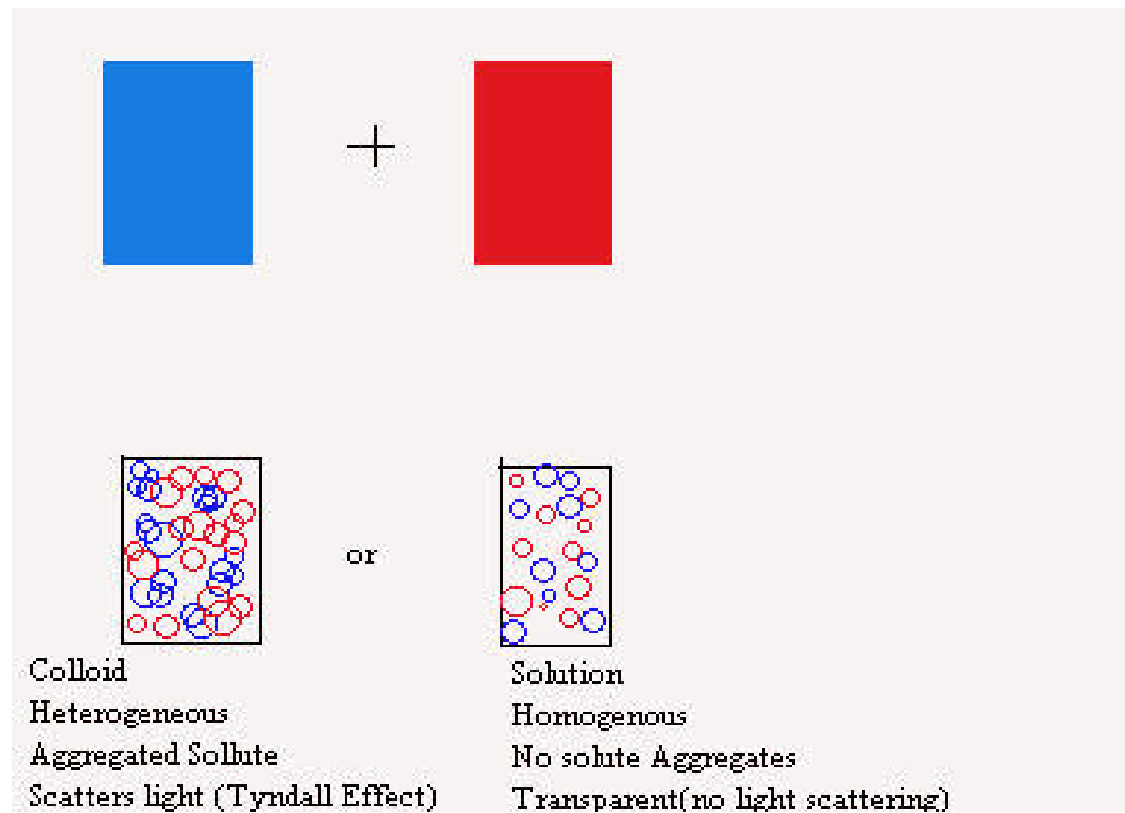
Web page now gives detailed solutions

Like dissolves like

- Any mixture which is homogeneous at the microscopic level is a solution. These are by no means limited to the traditional “dissolve a solid in a liquid” scenario (text Table 11.1 p 430)
- Several aspects of solutions are well known
 - not all combinations form solutions (water and gasoline don’t mix)
 - some combinations mix in all proportions-such combinations are termed “miscible”. Thus, two which don’t mix are termed “immiscible”
 - some combinations have limits (sugar and water). When that limit is reached the solution is said to be **saturated**. How is it recognized?
 - temperature has an effect on the solubility (you can dissolve much more sugar in hot coffee than ice tea)
 - We use words like “solvent” and “solute(s)” to identify the components due to either
 - relative amounts, or
 - logic (can’t accept the idea of a liquid dissolving in a solid)

The mixing process

- What's involved, qualitatively, in producing a homogeneous mixture from two pure substances?



- Using the terms solute and solid-how does one explain the properties described earlier?
- Why wouldn't two substances mix?
- Why would there be limits?
- Why would temperature matter (and why would the behavior not be constant-some materials have decreasing solubility with increasing temperature)?

Describing the mixture quantitatively-concentration

- There are numerous ways of describing a mixture. You are already familiar with the more common ones: molarity, mole fraction and % by mass. (Table 11.3 p 437). The fourth shown-molality will be discussed shortly.
- Molarity is the most common, but suffers from being temperature dependent. How critical is that issue?
- at 22°C $d_{\text{H}_2\text{O}}=0.99780$. At 50°C $d_{\text{H}_2\text{O}}=.98807$, a change of slightly less than 1%. If one realizes that the actual temperature difference you're likely to encounter in a working lab environment is much less than this(probably only a few degrees), it does not seem likely that a significant error will be introduced.

Thermodynamics of dissolution

- Making a mixture is clearly a change of state and should therefore have changes in the thermodynamic functions: ΔG , ΔH and ΔS ?
- Can anything be said, *a priori*, about the expected signs of these changes? What is your experience?
- ΔH ?
- ΔS ?
- ΔG ?

The properties of solutions

- In what ways does a solution of water differ in its physical properties from the “neat” liquid.