Chemistry BC2001x: General Chemistry I

Lecture 8: Thursday October 1, 2009
Topics: Partial pressures, Real Gases. Phase Equilibria

Hand in Problem Set 3

Pick up:

- **Intermolecular Forces**
- **Problem set 4**

General Chemistry I

About Tuesday's exam

Sample exam from 2008 and answers on the course web site.

I recommend that you first review thoroughly, then take the exam under timed conditions, without distractions. Look at the answers only after you have taken then exam.

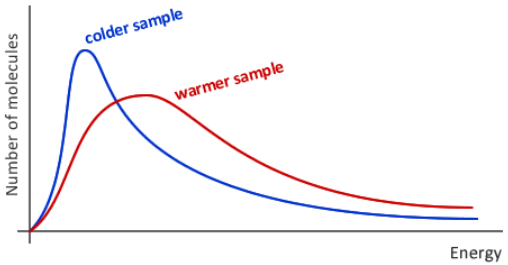
The exam starts at 9:00 (not 9:10) and ends at 10:25 AM. No extensions for lateness, so get here on time.

Pen or pencil ok; just write LEGIBLY.

Regular office hours (problem solving workshop) Monday 6-8.

Maxwell-Boltzmann Distribution

In a gas at temperature T, there is a range of energies (and, since $E = \frac{1}{2} mv^2$, of velocities)



Selected Van der Waals parameters

equation

$$(P + n^2a/V^2)(V-nb) = nRT$$

a=0 and b=0 is ideal gas

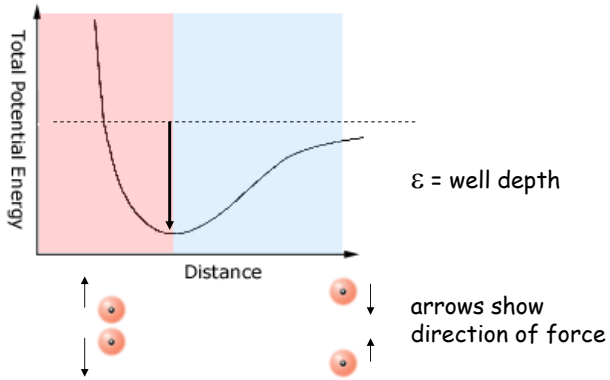
gas	a (L^2-atm/mole)	b (L/mole)
H_2	0.034	0.023
O_2	1.360	0.031
SO_2	6.714	0.050

Intermolecular forces

(forces between *molecules*)

Generally much weaker than intramolecular forces

(forces between *atoms* inside molecules)



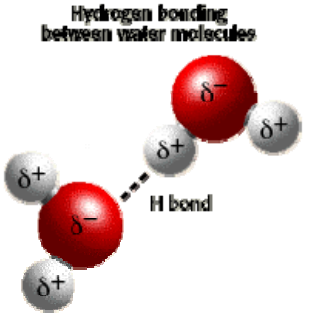
Hydrogen bonding:

The strongest intermolecular interaction

When an H atom is attached directly to a very electronegative atom (**F, O, or N**), that bond is strongly polarized:

the H atom has a weak partial positive charge (δ+), the other a weak partial negative charge (δ-).

The charges on adjacent molecules attract each other.



Liquid-vapor equilibria

H_2O (liquid) ⇄ H_2O (gas)		$CHCl_3$ (liquid) ⇄ $CHCl_3$ (gas)	
Temperature (°C)	Vapor pressure (mmHg)	Temperature (°C)	Vapor pressure (mmHg)
0	4.58	0	61.0
10	9.21	10	100.5
20	17.54	20	159.5
25	23.76	25	199.1
30	31.82	30	246.0
40	55.32	40	366.4
50	92.51	50	526.0
61.2	157.8	* 61.2 (T_{bp})	760.0
70	233.7	70	1019
75	289.1		
80	355.1	80	1403
* 100 (T_{bp})	760.0	100	2244
110	1074.6		

vapor pressure as a function of temperature (equivalently, boiling point as a function of pressure) for water and chloroform

Vapor pressure = pressure of a gas in equilibrium with a liquid

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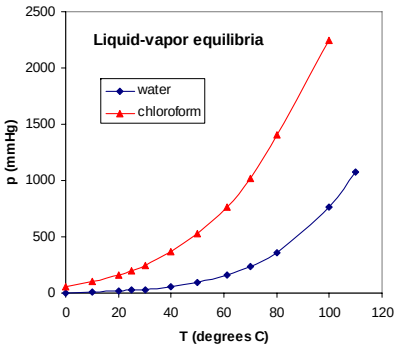

Vapor pressure as a function of temperature for water and chloroform: data plotted using the Excel spreadsheet program.

Chloroform is more volatile than water.

Phase diagrams
Water, H_2O and Carbon dioxide CO_2