

Chem 36

General Chemistry (II)

Professor Joel Goldberg
Spring 2002

January 16, 2002

■ **Syllabus**

■ **Assignment!**

-send me an email message (by *Friday*) with the following information:

- academic level (1st-year, sophomore, etc.)
- major or potential major
- previous coursework in chemistry (Chem 31? Chem 35? Semester? Year?)
- conflicts with three evening exams?
- Course schedule indicating days/times when you are NOT AVAILABLE for the weekly problem session

Intermolecular Forces

■ What happens to gas phase molecules when subjected to *increased pressure*?

- Volume occupied by gas *decreases (IGL)*
- At higher pressures: get *negative deviations from IGL*
 - due to intermolecular attraction (*Van deWaals Equation*)
- At a high enough pressure:

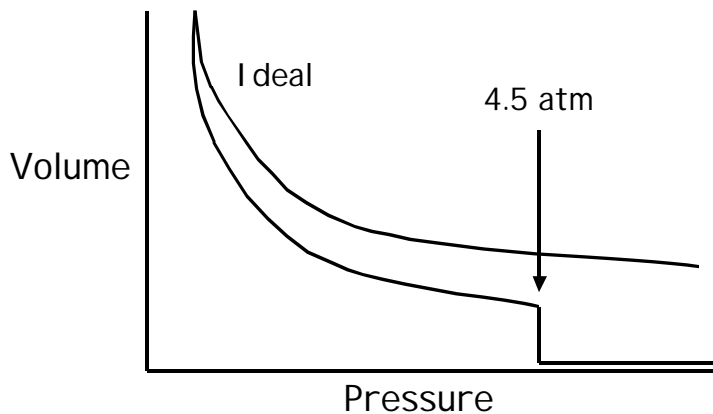
ABRUPT decrease (100x or more) in volume

Phase Transition: Gas @ Liquid

-due to *intermolecular attractive forces*

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Example: 1 mol SO₂ @ 30°C



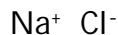
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Intermolecular Forces

- All based on *electrostatic* attraction, but not strong enough to be considered a **chemical bond**

- Recall: **Ionic Bonds**

- electrostatic attraction between two ions:



- Bond strength varies with: -charge on ions

- distance (r) separating ions

- force varies with $1/r^2$

- bond energy (force acting over a distance r) then varies with $1/r$

- ionic bond energies:** very large (300 - 600 kJ/mol)

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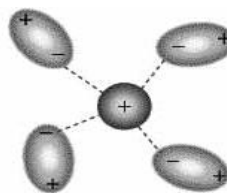
Ion-Dipole Interactions

- Ions can have electrostatic interactions with *polar molecules*:

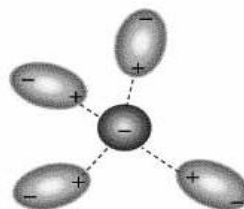
- both *attractive* and **repulsive** forces

- lower energy interaction**
(10 - 20 kJ/mol)

- energy drops off as $1/r^2$



(a)



(b)

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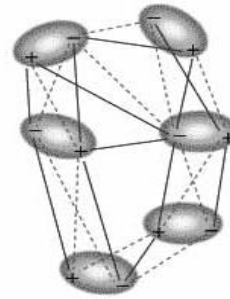
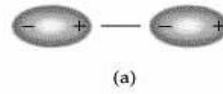
Dipole-Dipole Interactions

- Polar molecules can have *electrostatic interactions* with other polar molecules:

-both *attractive* and **repulsive** forces

-even **lower energy interaction**
(1 - 5 kJ/mol)

-energy drops off as $1/r^3$



Attraction ———
Repulsion - - - - -

(b)

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