UNIT5-DAY1-VDB

Monday, January 14, 2013
1:35 PM

Thinking Like a Chemist

UNIT 5 DAY 1

CH302 Vanden Bout/LaBrake Spring 2013

What are we going to learn today?

Note some important details on the syllabus – LM

Become familiar with the course website

Meet the teaching team

Review the Mechanics of a Learner Centered Course

Review the Concept of Thinking Like a Chemist in the context of a review of some material from last semester –

- Molecular Geometry
- IMFs
- Enthalpy, Entropy, Free Energy

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ANNOUNCEMENTS

CH 302 Exam Dates

Tuesday Exams **Wednesday Exams** **Thursday Exams**

ANNOUNCEMENTS

CH 302 Exam Dates

Tuesday Exams

McCord 302

McCord 302H

Shear 302

2/5, 3/5, 4/9, 4/30

Wednesday Exams

Labrake 302

Vandebout 302

2/6, 3/6, 4/10, 5/1

Thursday Exams

Holcombe 302

2/7, 2/28, 4/4, 5/2

Laude 302

2/21, 3/28, 5/2

ANNOUNCEMENTS

NGLM

LM01 – EXPLORE WEBSITE & SYLLABUS

LM02 – THERMODYNAMICS OF PHASE TRANSITIONS

LM03 – REVIEW HEAT CURVE

Due: 9 AM Thursday

THIS

Polling Question 1

"CD"

What does the phrase "Think Like a Chemist" mean to you?

A. I want to run out of this class now, I'm not a chemistry major, I just need this class for my major.

B. To think like a Chemist

C. Simultaneously make a macroscopic observation, while thinking in terms of the microscopic (molecular) models which can explain said observation.

D. Because you have memorized all the formulas (both chemical and mathematical) that can be used to solve any chemistry problem, you can Think like a General Chemistry teacher type of chemist.

Polling Question 1

"C D"

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D. Because you have memorized all the formulas (both chemical and mathematical) that can be used to solve any chemistry problem, you can Think like a General Chemistry teacher type of chemist.

E.This is a trick question, for those of us who did not have these instructors last semester.

What does the phrase "Think Like a Chemist" mean to you?

http://www.youtube.com/watch?v=ovbn_J-XqQE

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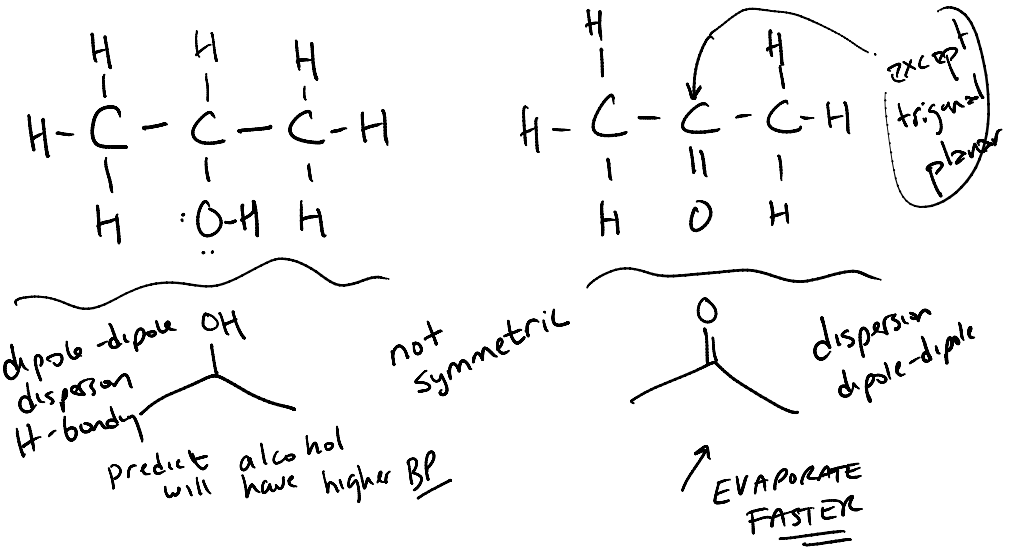
iso propanol

$CH_3CHOHCH_3$

acetone

CH_3COCH_3

All tetrahedral



Polling Question 2

Which has a higher Enthalpy?

A. liquid water
B. gaseous water
C. they are exactly the same
D. it depends on the temperature

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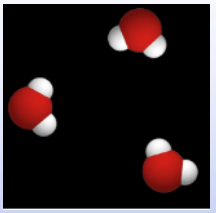
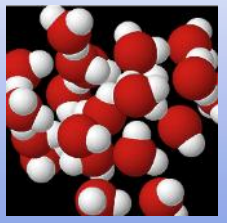
Why do different phases have different Enthalpies?
Intermolecular Forces (IMF)

Liquid

Molecules Close Together
Intermolecular Forces are Attractive
Lower enthalpy (energy) compared to molecules that are separated

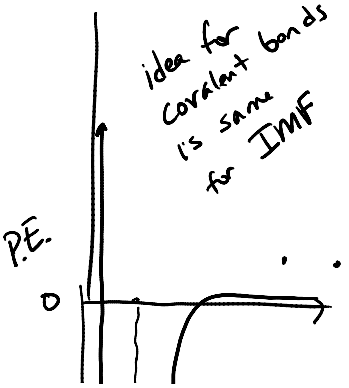


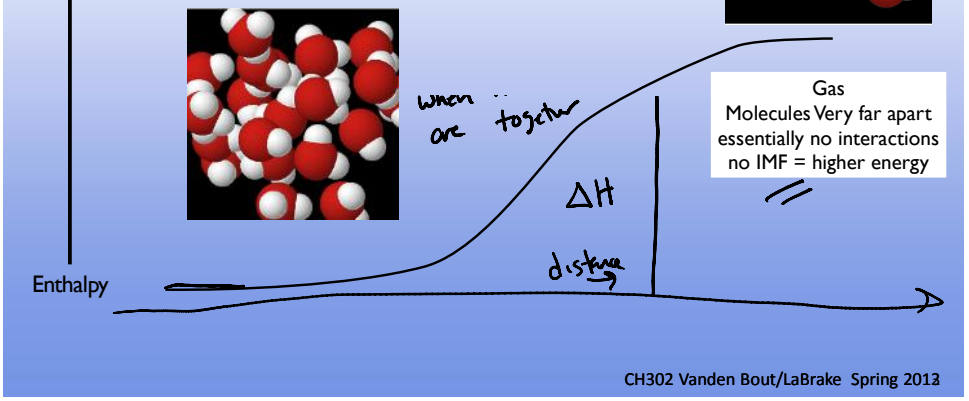


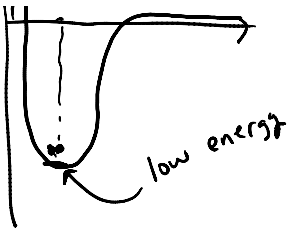
E is lower when molecules are together

Gas
Molecules Very far apart
essentially no interactions
no IMF = higher energy

Enthalpy







Comparing the two

liquid
Attractive IMF
Lower H

gas
~ No IMF
Higher H

We need to put in energy to overcome
the molecules attractions for each other

$\Delta H_{vaporization} = H_{gas} - H_{liquid} > 0$ "+"

remember: positive change in energy is energy into the system

Polling Question 3

Comparing isopropanol and acetone, which has the greater ΔH_{vap}?

A. Impossible to say without some data.
B. isopropanol
C. acetone
D. They are the same.
E. Will vary with temperature

because it has stronger IMF's in particular due to H-bonding!

Good Job!

2. Will vary with temperature

What did we learn just now?

Enthalpy is related to the "energy" of a substance.

Liquids have a lower enthalpy (lower energy = more stable) because they are electrostatically attracted to other molecules and thus have a lower energy when they are close together

The stronger the IMFs, the bigger the difference between the liquid and the gas (which has essentially no potential energy since the "molecules" are so far apart)

Polling Question 4

Which has a higher Entropy?

A. liquid water

B. gaseous water

C. they are exactly the same

D. it depends on the temperature

A Quick Review of Entropy

Dispersal

The entropy technically depends on the number of equivalent microstates of a system

A Quick Review of Entropy

Dispersal of energy

The entropy technically depends on the number of equivalent microstates of a system.

How to deal with this qualitatively today?

- Entropy increases with increasing volume ✓
- Entropy increases with increasing temperature ✓
- Entropy increases with increasing the number of molecules ✓
- Entropy increases with going from a solid to a liquid to a gas

The Universe tends towards higher entropy — 2nd Law!

Polling Question 5

Comparing isopropanol and acetone, which has the greater ΔS_{vap}?

A. Impossible to say without some data.
B. isopropanol
C. acetone
D. They are ~~the same~~. about the same
E. Will vary with temperature

liquid → gas
molecules next to each other — Way far apart

$PV = nRT$
$V = \frac{nRT}{P}$
generate ~ per mole
the same volume
So ΔS is about same

What did we learn just now?

Gases always have a higher entropy than liquids. This is predominately due to the phase change (not the nature of the molecules).

For almost every compound the difference in entropy between the liquid and the gas is the same.

when IMF's are strong ΔS_{vap} is larger than what you would expect

Polling Question 6

Which has a lower Gibb's Free Energy?

A. liquid water
B. gaseous water
C. they are exactly the same
D. it depends on the temperature

most stable state depends on T!

$\Delta G = \Delta H - T\Delta S$

things move to most stable state

Remembering Free Energy

$$\Delta G = \Delta H - T\Delta S$$

$\Delta H^{o}_{vaporizaiton} > 0$

$\Delta S^{o}_{vaporizaiton} > 0$

therefore

$\Delta G^{o}_{vaporizaiton}$ depends on the temperature

Equilibrium

$$\Delta G = 0$$

when the "reactants" and "products" have the same free energy, the change is not spontaneous in either direction.

This is equilibrium

For a phase change when ΔG=0, then ΔH = TΔS!

Polling Question 7

Comparing isopropanol and acetone, which has the higher T when $\Delta G^\circ_{vaporization}=0$?

A. Impossible to say without some data.

B. isopropanol

C. acetone

D. They are the same.

E. Will vary depending on the amount of liquid present

What did we learn today?

Differences in enthalpies of vaporization for different compounds depend on their IMF (and thus their molecule structure).

Stronger IMF = larger enthalpies of vaporization

Entropies of vaporization are very similar for most compounds

At equilibrium $\Delta G = 0$, and $\Delta H = T\Delta S$

Therefore, difference in boiling point result from differences in IMF. Stronger IMF = bigger ΔH = higher T.