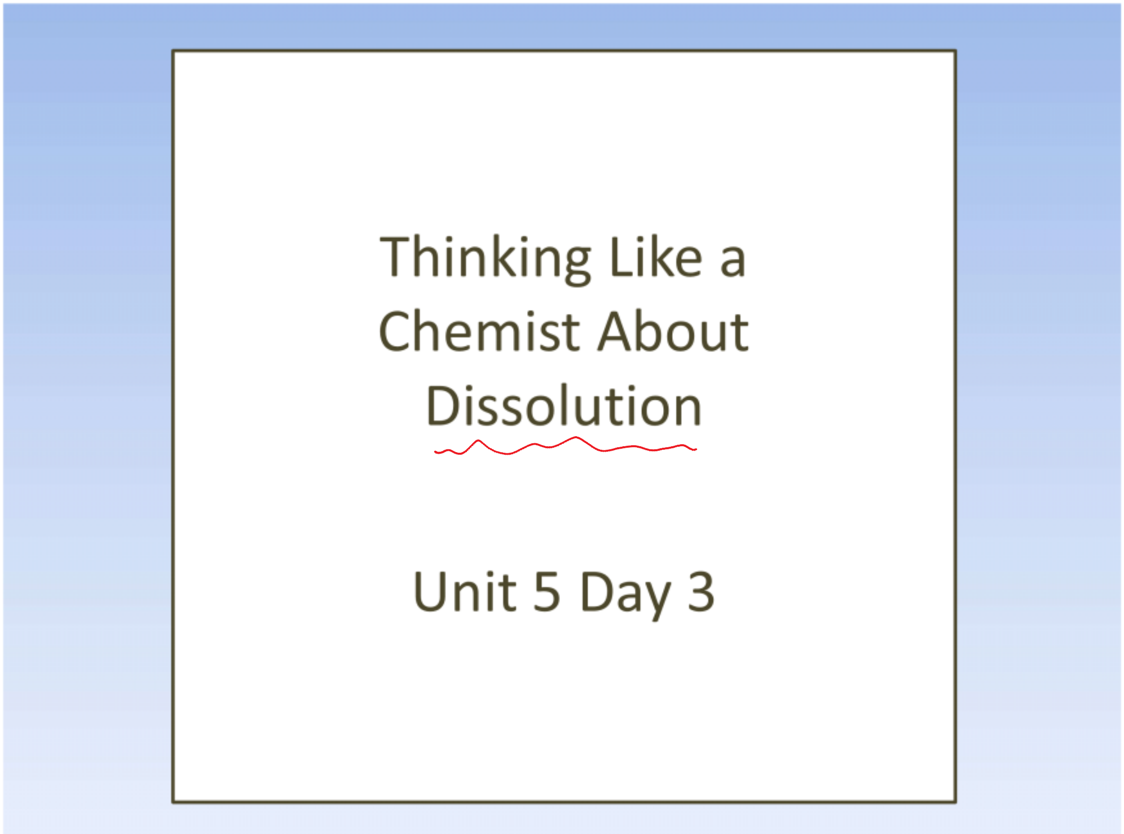
Unit5-Day3-LaB

Tuesday, January 21, 2014
8:42 AM



What are we going to learn today?

Thinking Like a Chemist in the Context of the Dissolution Process.

Macro Modeling
Micro Modeling ← molecular, small particle model, ...
Energy of the change Modeling

IMPORTANT INFORMATION

HW1 due ~~TODAY~~ 9AM Thursday 9AM

LM04 & LM05 due TODAY 9AM

LM06 Solutions due Th 9AM

LM07 Solutions – Concentrations due Th 9AM

LM08 Henry's Law (NEW) due Th 9AM

NOTE: THIS CLASS HAS BEEN DESIGNED TO BE A "HYBRID" OR "BLENDED" STUDENT CENTERED LEARNING EXPERIENCE. THIS MEANS THAT SOME OF THE COURSE INFORMATION WILL BE PRESENTED IN A DIGITAL FORMAT ON THE WWW IN EITHER PRINT OR VIDEO FORMAT. SO LEARNING MODULE INDICATES NEW LEARNING. HOMEWORK INDICATES PRACTICING CONCEPTS/PROBLEM SOLVING THAT HAS BEEN FIRST INTRODUCED EITHER IN CLASS, ON THE WEBSITE OR IN A LEARNING MODULE.

fine print

Learn!

LM formative

HW summative

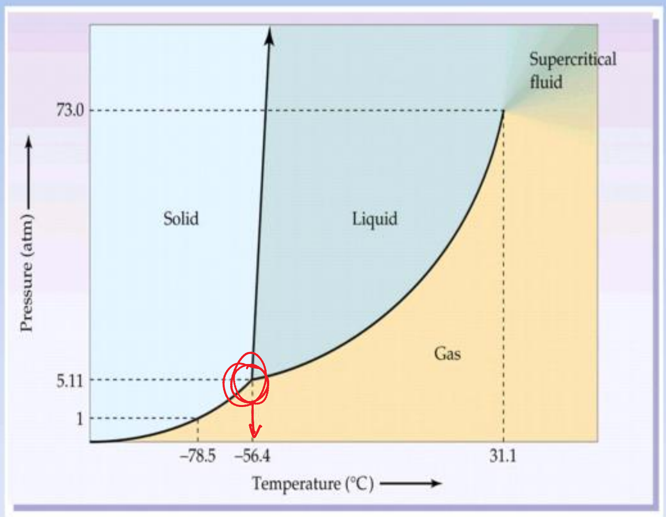
Quiz: CLICKER QUESTION

Which of the following has the highest vapor pressure?

a) CH_3OH
b) CH_3CH_2OH
c) $CH_3CH_2CH_2OH$
d) $CH_3CH_2CH_2CH_2OH$ ← most dispersion Lowest VP

Quiz: CLICKER QUESTION

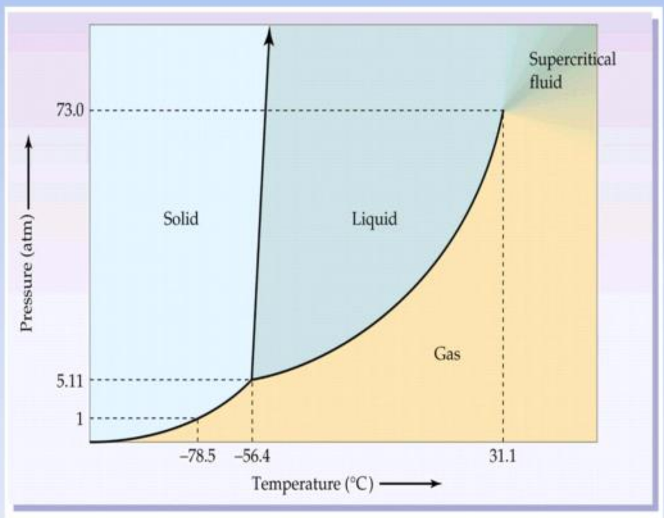
What is the temperature at the triple point?



A. 73.0 ° C
B. -78.5 ° C
C. -56.4 ° C
D. 31.1 ° C
E. 5.11 ° C

Quiz: CLICKER QUESTION 3

At the triple point solid, liquid, and gas all have the same....



A. number of moles
B. free energy
C. volume
D. density
E. entropy

Solutions: Vocabulary Check!

Solution = Solvent + Solute

greater lesser

Solubility – ability to be dissolved

Dissolution –

Homogeneous Solution described by components and concentrations of those components!

LM will instruct concentration units.

Get to work on the worksheet!

MACROSCOPIC DESCRIPTION OF DISSOLUTION

Thinking About Solutions

Polling: Clicker Question

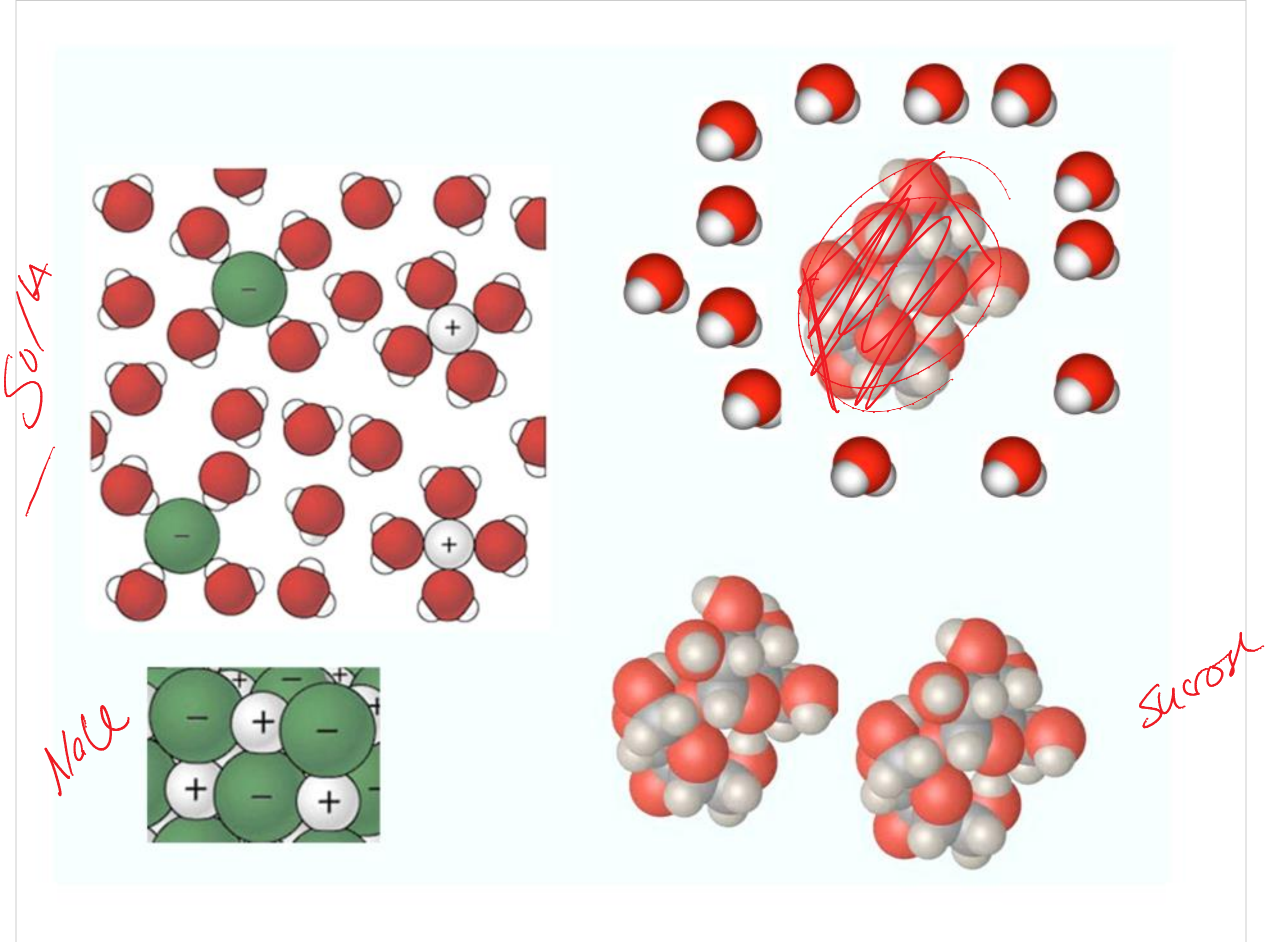
A nice micro view of the dissolution of a(n):

A. ionic solid

B. molecular solid

C. metallic solid

D. covalent solid


NaCl
Sucrose

Dissolution Demonstration Observations

Sodium chloride in water

Sucrose in water

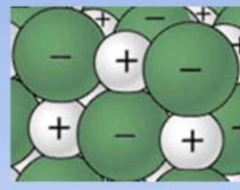
Ammonium nitrate in water

Endothermic

T ↓

"Breaking Bonds"

How do we think about this in terms of energy? $\Delta H_{solution}$

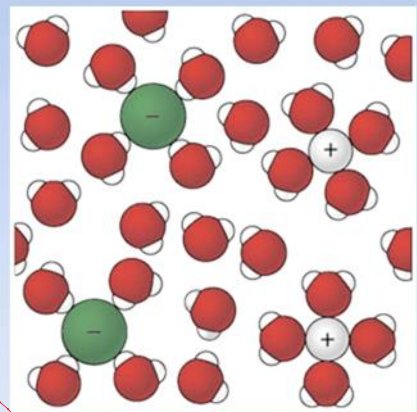


1. break solute
   – costs energy – Lattice Energy

   ΔH "+"

2. form new solute-solvent interactions
   - give off energy – Solvation Energy

   ΔH "–"



+

Bigger

$$\Delta H_{solution} = \Delta H_{Lattice\ Energy} + \Delta H_{solvation}$$

What did we learn just now?

$\Delta H_{solution}$ is hard to predict. Depends on energy needed to separate solute-solute and energy release when new solute-solvent attractions are formed.

$\Delta H_{solution} > 0$

Typical Situation Solute-solvent interactions are weaker than solute-solute (and solvent-solvent)

$\Delta H_{solution} < 0$

Unusual, but possible

Solute-solvent interactions are stronger than solute-solute and solvent-solvent

Polling: Clicker Question

What is going on with the entropy of dissolution for our example solutions?

A. The entropy always increases.
B. The entropy always decreases.
C. It depends on the type of solid solute.
D. It depends on the phase of the solute.

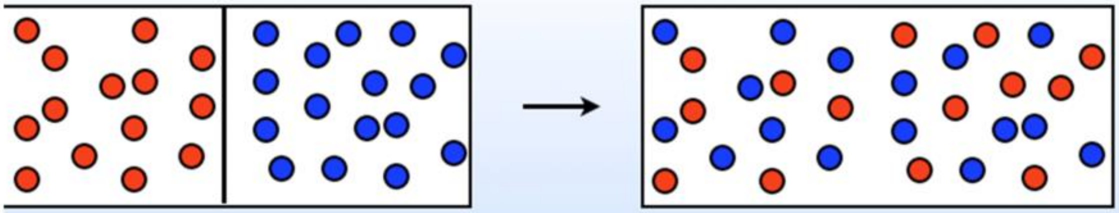
Entropy of Solution $\Delta S_{solution}$ usually easy to predict

Solutions typically have a higher entropy than the unmixed compounds
Therefore $\Delta S_{solution} > 0$
For most cases

Since entropy almost always favors mixing, the reason some substance dissolve and other do not is generally the result of enthalpy (intermolecular forces)

Mixtures

What is different than pure substances?



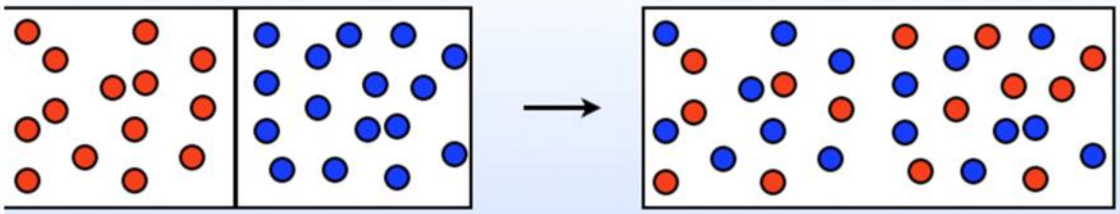
What is the free energy change for gases mixing?

$\Delta G < 0$

POLLING CLICKER QUESTION

Mixtures

What is different than pure substances?



Why does the free energy decrease? ($\Delta G = \Delta H - T\Delta S$)

A. ΔH is positive, ΔS is zero
B. ΔH is zero, ΔS is positive
C. ΔH is negative, ΔS is positive
D. ΔH is negative, ΔS is zero

POLLING CLICKER QUESTION 7

How can you explain the spontaneous dissolution of the endothermic solution?

A. It must be entropically driven

B. It must not really be endothermic

C. It must only occur at very low temperatures, because the solution does get cold

D. It must be driven by the change in enthalpy

E. It must not be as soluble as endothermic solutions

$|\Delta H| < |T\Delta S|$

POLLING CLICKER QUESTION

What is the sign for the change in Free Energy for the dissolution process in which polystyrene peanuts were placed in water?

A. Positive

B. Negative

C. $\Delta G = 0$

D. Need values for ΔH and ΔS to determine.

POLLING CLICKER QUESTION

What is the sign for the change in Entropy for the dissolution process in which polystyrene peanuts were placed in acetone?

A. Positive
B. Negative
C. $\Delta G = 0$
D. Need values for ΔH and ΔS to determine.

POLLING CLICKER QUESTION

What is the sign for the change in Enthalpy for the dissolution process in which biodegradable peanuts were placed in acetone?

A. Positive

B. Negative

C. $\Delta G = 0$

D. Need values for ΔH and ΔS to determine.

POLLING CLICKER QUESTION

What is the sign of change in free energy for mixing olive oil with water?

A. Negative
B. Positive
C. 0
D. None of the above

Talk about like dissolves like..

What did we learn just now?

When a solute dissolves spontaneously in a solvent, the process is considered spontaneous.

For a spontaneous dissolution process, $\Delta G < 0$

In some cases non-spontaneous dissolution process can become spontaneous upon increasing the temperature.

What did we learn today?

Micro modeling of the dissolution process – noted the difference between molecular solids and ionic solids.

Energy modeling of the dissolution process – noted the changes in enthalpy (solute-solute interactions vs solute-solvent interactions).

Energy modeling of the dissolution process - noted changes in entropy – typically depends on the phase of the solute (solid dissolving in liquid vs gas dissolving in liquid).

Energy modeling of the dissolution process – predict based on sign of ΔG.

Learning Outcomes

Describe the factors that favor the dissolution process in terms of the intermolecular forces and thermodynamics (enthalpies of solution, solvation, lattice energy, entropies of solution, free energy of solution)

Describe how P (Henry's Law) affects solubility of a gas.

Define and perform calculations for common concentration units molarity, molality, and mole fraction.

POLLING CLICKER QUESTION

Is the value ΔG ever = 0 when a solute is added to a solvent?

A. Yes, when solution is saturated

B. No, dissolution is either spontaneous or not spontaneous

C. Yes, before the solution is saturated with solute

D. No, this would indicate equilibrium and that concept is meaningless here

Talk about T dependence of solvent dissolving..

- Henry's Law – the solubility of a gas is directly proportional to its partial pressure, P.
- $P = k_H X$
- At the elevation, 2900 m, of Bear Lake in Rocky Mountain National Park, the partial pressure of oxygen is 0.14 atm. What is the mole fraction of oxygen in Bear Lake at 20 ºC?