What are we going to learn today?

Thinking Like a Chemist in the
Context of the Solution Equilibrium
Check on your Readiness for Exam

CH302 Vanden Bout/LaBrake Spring 2013

IMPORTANT INFORMATION

HW3 & LM12 due today 9 AM

EXAM 1, Feb 6th 7 – 9 PM

930AM DVB: UTC 2.102A   vs # 1-250
             BEL 328   vs # 251 and higher

11AM LAB: WCH 1.120   vs # 1-275
             PAI 3.02   vs # 276 and higher

1230PM LAB: JGB 2.324   vs # 1-175
             WEL 2.122   vs # 176 and higher

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Version Numbers on Quest
Look for assignment
Exam 5 Version Number
you have a grade
Your grade is your version number

Select the following that best describes your current level of involvement with a study group:

A. Never even thought about meeting with other students to study chemistry.
B. Once, I got together with a group of students from this class to work on chemistry homework and/or discuss chemistry concepts.
C. Occasionally, I get together with a group of students from this class to work on homework and/or discuss chemistry concepts.
D. Regularly, I get together with a group of students from this class to work on chemistry homework, discuss chemistry concepts, and/or call one another when questions arise.

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What is the size of your study group?

A. Only you (1)
B. You plus another person from this class (2)
C. 3 – 5 students
D. 5 – 10 students
E. More than 10 students

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Quiz Clicker Question 3

I have all of these ions in solution, do I get a precipitate?

This is just equilibrium, compare Q to K

$K_{sp} = 1.7 \times 10^{-5}$ for $PbCl_2$
I have a solution in which $[Pb^{2+}] = 10^{-2}$ M and $[Cl^-] = 10^{-2}$ M

A. some $PbCl_2$ will precipitate
B. all the $PbCl_2$ will be solution

$$K_{sp} = [Pb^{2+}][Cl^-]^2$$
$$Q_{sp} = [Pb^{2+}][Cl^-]^2 \quad \text{not at equilibrium}$$
$$Q = (10^{-2})(10^{-2})^2 = 10^{-6}$$
$$K > Q$$

Work through the worksheets. Try your best to understand what is going on!
Platinum Stars on the Line!

Bottle at 0°C did not freeze when opened

Bottle at -5°C DID freeze upon pening

POLL: Clicker Question 4

The molar concentration of the CO_2 gas under 2 atm CO_2 pressure is:
A. Not enough information
B. .117 M
C. .234 M
D. .059 M

$(0.117)(2)$

$C = k_H P_{solute\ gas}$

C = solute gas

$\dfrac{M}{atm}$

(Wikipedia used $\dfrac{atm}{M}$)

POLL: Clicker Question 5

just H_2O and CO_2 (sugar) (no sugar)

The new freezing point of the club soda is:

freezing pt depression
freezing pt must go down

$\Delta T = -i k_f m$

molal

A.	0° C
B.	.44° C
C.	-.44° C
D.	.88° C
E.	-.88° C

assume density of water is the density of solution

$\dfrac{0.234\ moles}{L\ solution} \Bigg| \dfrac{1\ Liter}{1\ kg}$

$\dfrac{0.234\ moles\ solute}{kg\ solution}$

molar mass of CO_2
.214

10.29 g CO_2

1000g − 10.29 =
solution   solute

989 g solvent

$\dfrac{.234}{.989} = \sim 0.236 M$

solution   solute
$98g$ solvent

POLL: Clicker Question 6

> The signs for ΔG, ΔS and ΔH for this solution is:
>
> for solution formation process
>
> A. -, -, -
> B. +, +, +
> C. -, +, -
> D. -, -, +
> E. -, +, +

ΔG is (−) b/c it dissolved! It's spontaneous

ΔS is (+) b/c more micro states

ΔH is (+) b/c solution feels cold

ΔH (−)
gases dissolved in liquids

usually slightly (+)

usually very close to zero

$\Delta H_{soln} = \Delta H_{lattice} + \Delta H_{solvation}$

(+) (+) (+)

holds solid together takes energy to break

energy released when new bonds are formed

POLL: Clicker Question 7

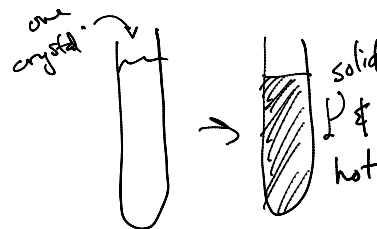> In the 20 molar sodium acetate solution, the value of Q is:
>
> A. 10
> B. 20
> C. 25
> D. 200
> E. 400

↳ Q_{sp}

crystallization is exothermic

one crystal

solid & hot

$Q_{sp} = [Na^+][CH_3COO^-]$
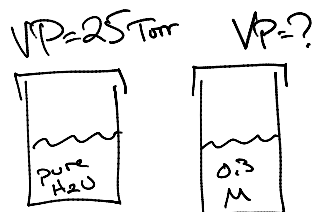
$= (20)(20) = 400$

$Q > K$

POLL: Clicker Question 8

> The vapor pressure of the 0.3 M solution is:

Vapor pressure lowering

> A. 24.86 ~~atm~~ torr
> B. 0.14 ~~atm~~ torr
> C. 25.14 ~~atm~~ torr
> D. 25.0 ~~atm~~ torr

VP = 25 Torr   VP = ?

pure H₂O   0.3 M

lower free energy

Raoult's Law

$P_{solution} = X_{solvent} P^0$

← Vapor pressure

$\Delta P_{solution} = X_{...} P^0$

A. 24.86 atm
B. 0.14 atm
C. 25.14 atm ·····
D. 25.0 atm torr

$$\Delta P_{solution} = X_{solute} P^{\circ}$$

sealed container NO water vapor

H_2O ↑↑ H_2O → H_2O ↓↓ 0.3M

Both evaporate until VP in container goes up to 25 torr (VP of pure water) then Vapor will Condense

Final

H_2O H_2O H_2O 0.15 M

Just like osmosis solute must stay in beaker cannot leave
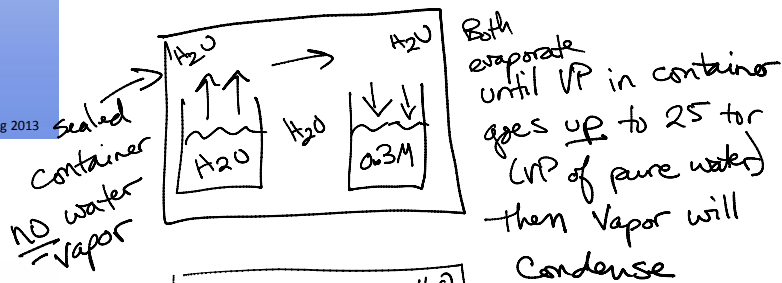
POLL: Clicker Question 9

The molar concentration of the Pb²⁺ ion in the salsa is:

$$K_{sp} = [Pb^{2+}][CO_3^{2-}]$$

A. 0.15 M
B. 7.14×10^{-14}
C. 4.93×10^{-13}
D. 1.11×10^{-14}

$$7.4 \times 10^{-14} = [Pb^{2+}][.15]$$

$$[Pb^{2+}] = ?$$
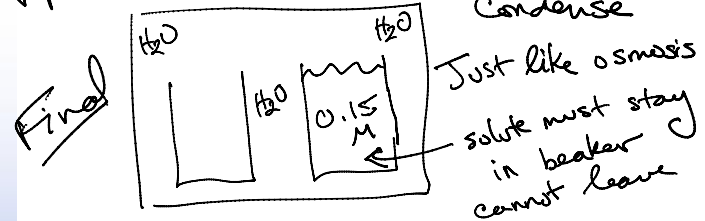
Explanation Space

$$\frac{.015 \times 10^{-3} \, g \, Pb^{2+}}{1 \, L \, sol^{-1}} \Bigg| \frac{1 \, mol \, Pb^{2+}}{207.2 \, g \, Pb^{2+}} = \text{Tolerance}$$

$$7.24 \times 10^{-8} \, M$$

What did we learn today?

Dissolution and solubility can be fully explained:
    macroscopically
    microscopically
    thermodynamically.

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