Chem 103

Lecture 1a
Orientation
Chemical Equilibrium

Orientation: basic contact info

- 1. Please initial the attendance roster
- 2. Please pick up a copy of the syllabus
- 3. Web site for my notes:
  - www.calstatela.edu/dept/chem/10summer/103
- 4. Office hrs: M T W F: 11:40am-12:40 pm
  - PS 610; Tel 323-343-2313;
- Email: gsantil@calstatela.edu
  - Please write: "chem 103-your name"

Required materials:

Text book:
Principles of Chemistry: The Molecular Science, *Moore, Stanitski and Jurs*

- eHW must be accessed: OWL Username & password bundled with new textbook or purchased separately at http://www.cengage.com/support/

Other requirements: for Lab

- Experiments for General Chemistry (4^{th}) edition, *Goldwhite and Tikkanen*
- Bound laboratory notebook
- Safety glasses or goggles that meet the Z-87 specification ("Z-87" will be imprinted somewhere on the glasses if they meet it)
- Chemistry Breakage Card ($10 at cashiers office)

Chem 103: What to expect

Chemistry 103 is a rigorous 5-unit course that demands approximately 20 hours of study per week in addition to lecture, recitation and laboratory attendance.

Chemistry 103 is the last of a three quarter sequence that provides a foundation in the chemical sciences suitable for premedical, pre-pharmaceutical, engineering and science majors.

Assignments

- Register for your weekly eHW.
  - First eHW is due Monday next week, 6/28/2010
- Be prepared for weekly human graded homework (submitted at recitation section)

What we expect of students:

- Professional behavior in class: Cell phones, other electronic devices turned off during lecture/exams. Simple calculators used in exams. Absolutely NO CHEATING in exams. No plagiarism in lab reports and homework.
- During class: Late arrivals, side-discussions and other unprofessional behavior will be noted. It can lower your letter grade.
- Attendance to be recorded. Students returning from absences are responsible for missed lectures. No make up exams.

Points distribution

Activity	Points Possible
Two midterms @ 150 points each	300
Laboratory Reports and 30 points for lab technique	230
Recitation) points for the best 8 quizzes issued during recitation (valued at 10 points each), 50 points for assigned homework,	130
e-graded homework	100
Final Examination	240
TOTAL	**1000**

To add the class

Get a permission to add a lab
Get a permission to add a recitation class
Then you can add the lecture
However, note that Extended Education is in charge.
Procedures may have changed

Equilibrium is very important concept!

Used for many calculations:
* Acid - Base
*Thermodynamics
*Redox chemistry
*Precipitation
*Gaseous reactions

Chemical Equilibrium

In Chem 102, you learned about chemical kinetics.
What is the rate equation for A - - > 2 B ?

What is the rate equation for 2B - - > A ?

When are these rate equations valid?

Chemical Equilibrium

Consider:
$NO_2 + NO_2 \rightarrow N_2O_4$ a 1 step rxn. (draw the molecs)
(brown gas) (colorless gas)
$V = k[NO_2]^2$;

but once formed, there is also the reverse rxn:

$N_2O_4 \rightarrow NO_2 + NO_2$; this is the reverse of the above rxn.

After a long time, $v_{forward} = v_{reverse}$ (that's why there's no gross change)

We can write: $NO_2 + NO_2 <==> N_2O_4$ to indicate reversibility.

Graphical Representation:

Chemical Equilibrium is dynamic

Forward and reverse rates equal. So, [reactants] and [products] are constant.
So, ratio is also constant!
Called equilibrium constant.
Symbol: K or K_{eq}

Chemical Equilibrium value

Actual value of K_{eq} experimentally determined.
Measure actual concentrations.
E.g. : at 25°, K = 3.10
(N.b.: Temp-dependent)

Chemical Equilibrium expression

K is a function of [reactant] & [product].
Know how to express it:
If aA + bB <===>cC + dD
Then : $K_{eq} = [C]^c [D]^d / [A]^a [B]^b$
(remember : [prod]/[reactant])

Chemical Equilibrium expression

What is the equilibrium expression for:
a) $2\ NO_2 <==> N_2O_4$?
K =
b) $N_2 + 3\ H_2 <==> 2\ NH_3$?
K =

Chemical Equilibrium *value*

What is the *value* of K for
$N_2 + O_2 <=> 2\ NO$
if $[N_2]=0.20$, $[O_2] = 1.2 \times 10^{-5}$
and [NO] = 0.10 at equil.?
$K=[NO]^2/[N_2][O_2]$
$=.10^2/\{(.20)(1.2x10^{-5})\}=4.2x10^3$

Chemical Equilibrium *properties*

a) K value is independent of initial conditions.
b) The expression is given above.
   It is based on stoichiometric coeffs.
c) It applies only to equilibrium conditions.
   (diff from kinetics discussions)
d) It is dimensionless even though
   we use molarity

Chemical Equilibrium *properties*

Other properties:
If A<-> B K_1
then B<->A has $K=1/K_1$

If A<->B K_1 and B<->C K_2
then: A<-> C has $K=K_1K_2$.

If A<-> B K_1
Then: 2A<->2B $K=K_1^2$.

Pure liquids, solids and solvents
have activity = 1

Let's practice!

Given: K = 3.1 for the following reaction:
$2\ NO_2 <==> N_2O_4$
If conc of NO_2 is 0.10 M , what is the conc of N_2O_4?
Solution:
$K = [N_2O_4] / [NO_2]^2$ or
$K[NO_2]^2 = [N_2O_4] = (3.1)(.10\ M)^2 = 0.031\ M$

Let's practice!

Another problem: Have equations (1) & (2):
(1) $2NO_2 = N_2O_4$ $K_1 = 3.1$
(2) $2NO + O_2 = 2NO_2$ $K_2 = 10$
what is value of K for:
$2NO + O_2 = N_2O_4$ K = ? (31)
(You recognize this as (1) + (2) , yes?)
(1) + (2) so $K = K_1K_2 = 3.1\ (10) = 31$