

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 (4th) 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 (3 points for the best 8 quizzes issued during recitation (valued at 10 points each), 50 points for assigned homework,	130
c-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

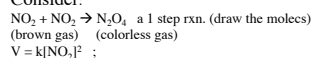
In Chem 102, you learned about chemical kinetics.
 What is the rate equation for $A \rightarrow 2B$?

What is the rate equation for $2B \rightarrow A$?

When are these rate equations valid?

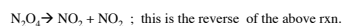
Chemical Equilibrium

Consider:



$$V = k[\text{NO}_2]^2$$

but once formed, there is also the reverse rxn:



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

We can write: $\text{NO}_2 + \text{NO}_2 \rightleftharpoons \text{N}_2\text{O}_4$ 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

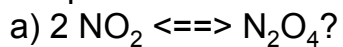
Actual value of K_{eq} experimentally determined.
Measure actual concentrations.
E.g. : at 25° , $K = 3.10$
(N.b.: Temp-dependent)

Chemical Equilibrium expression

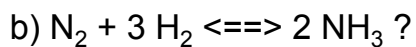
K is a function of [reactant] & [product].
Know how to express it:
If $aA + bB \rightleftharpoons cC + dD$
Then : $K_{eq} = \frac{[C]^c [D]^d}{[A]^a [B]^b}$
(remember : [prod]/[reactant])

Chemical Equilibrium expression

What is the equilibrium expression for:



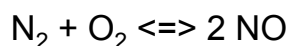
$K =$



$K =$

Chemical Equilibrium *value*

What is the *value* of K for



if $[\text{N}_2]=0.20$, $[\text{O}_2] = 1.2 \times 10^{-5}$

and $[\text{NO}] = 0.10$ at equil.?

$$K = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]}$$

$$= \frac{.10^2}{(.20)(1.2 \times 10^{-5})} = 4.2 \times 10^3$$

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 $A \leftrightarrow B$ K_1
then $B \leftrightarrow A$ has $K=1/K_1$

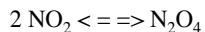
If $A \leftrightarrow B$ K_1 and $B \leftrightarrow C$ K_2
then: $A \leftrightarrow C$ has $K=K_1K_2$.

If $A \leftrightarrow B$ K_1
Then: $2A \leftrightarrow 2B$ $K=K_1^2$.

Pure liquids, solids and solvents
have activity = 1

Let's practice!

Given: $K = 3.1$ for the following reaction:



If conc of NO_2 is 0.10 M , what is the conc
of N_2O_4 ?

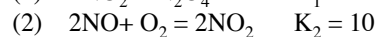
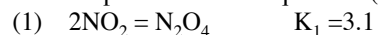
Solution:

$$K = [\text{N}_2\text{O}_4] / [\text{NO}_2]^2 \text{ or}$$

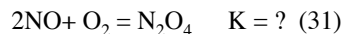
$$K[\text{NO}_2]^2 = [\text{N}_2\text{O}_4] = (3.1)(.10 \text{ M})^2 = 0.031 \text{ M}$$

Let's practice!

Another problem: Have equations (1) & (2):



what is value of K for:



(You recognize this as (1) + (2), yes?)

(1) + (2) so $K = K_1K_2 = 3.1(10) = 31$