Chemical Equilibrium
Chapter ~~14~~ 15

What is true at equilibrium?

What kind of reaction is required for equilibrium?

How do you show this with arrows?

What is the equilibrium expression for $aA + bB \Leftrightarrow cC + dD$?

Why does the way the equation is balanced affect K?

In K_c what is the unit of concentration? mol/L

How do you write it in the expression? $K_c = K_{eq}$ wherein eqm concentrations are expressed in mol/L, whereas in K_p they are expressed in terms of pressure.

What does the size of K tell you about the relationship between the reactants and products?

How can you change from K_c to K_p? $K_p = K_c(0.0821 T)^{\Delta n}$ (R = gas constant)

What does n stand for? Δn = mol(g) prods − mol(g) reactants (n = number of moles)

Under what conditions does $K_c = K_p$? when $\Delta n = 0$

What phases are dropped in a K_c expression? Why?

pure solids & pure liquids

What phases are dropped in a K_p expression? Why?

pure solids & pure liquids

If a reaction happens in a series of steps, how do you find the overall K?

WHAT IS Qc? Q_c = rxn quotient, Q (in Brown et al, page 591)

What does the value of Q_c tell you when it is compared to K_c?

Give all three possibilities. (or K_{eq})

If only the starting concentrations are known, how do you solve for the equilibrium concentrations? ~~(Look over example 14.9 p. 584 to review)~~

IN K PROBLEMS, THE TEMPERATURE IS ALWAYS GIVEN. WHY?

Explain Le Chatelier's Principle.

WHAT DOES SHIFTING TO THE RIGHT MEAN?

WHAT DOES SHIFTING TO THE LEFT MEAN?

How does changes in concentration affect equilibrium?

How do changes in pressure affect equilibriums?

Be specific and include which K is affected.

How do changes in volume affect equilibriums?

Does the presence of an inert gas affect equilibrium?

How does temperature affect equilibrium?

Does it matter if the reaction is exothermic or endothermic?

If a reaction is endothermic in the forward reaction, what is it in the reverse reaction?

How do catalysts affect equilibrium?

CHAPTER ~~15.~~ 16 ACIDS AND BASES

*(means also see outline notes ~~chap 3)~~ Chapt 4

***Arrhenius defined acids and bases by what was in the formula. Acids had _____ and bases had____.**

This was very limiting in definition so we use the **Bronsted** theory. In this theory we look at acids and bases by how they **BEHAVE** in a reaction.

Acids:

Bases:

*What characteristics determines if we say the acid or base is strong or weak:

Since these reactions are often reversible (double arrows ⇔), we find acids and bases in the reverse reaction. These acids and bases, which were products in the forward reaction, are called:

Example: Write the reaction for ammonia plus water and show the acid and base for each direction.

Why can water behave as both an acid and base?

Acid base solutions have both present.

- What number does the multiplication of their concentrations equal?
- What is it called?
- Write the equation.

Write the Equation for pH

- What does the p stand for?

Log questions:

Without a calculator, write each of the following numbers in **SCIENTIFIC NOTATION** and then write the log of each of the following

- 100.0
- 10.0

- 1.00
- 0.100
- 0.0100
- 0.00100
- 0.000100

WHAT IS THE PATTERN?

Why do you think pH's take the –log?

If you have a base, the pH equation won't work.

- Which one will?
- How can you change to a pH scale?

In pH scales:

- ***Low numbers below 7 are***
- ***7 is***
- ***numbers above seven are***

IN OTHER WORDS, a **HIGH pH** is a _____ and a **LOW pH** is a_____.

STRENGTHS:

- If an acid is strong its conjugate base is
- If an acid is weak its conjugate base is
- Give the rules for bases using the same pattern:

Question: If the H^+ concentration gives pH and strong acids totally ionize, so any strong acid with the same Molarity will have the same pH, why are some "stronger" than others? ~~(See table 15.3)~~

So strong acids take _____than weak acids to break into ions.

If HI is stronger than HBr, what does that tell you about the relative bond strength?

Define oxoacids

HOW CAN YOU COMPARE OXOACIDS STRENGTHS?

- Rule 1
- Rule 2

*Review the four types of acid base reactions and give an example for each.

-
-
-
-

*What is a **basic oxide**? Give an example.

*What is an **acidic oxide**? Give an example.

What is an **AMPHOTERIC** oxide? Give an example.

What is an amphoteric hydroxide?

- ***What happens when $Al(OH)_3$ has more OH^- added?*** (This reaction has been on the AP test)

What is the **lewis** definition of an acid and base?

- Draw the example for $BF_3 + NH_3$ and explain who is the acid and explain why. (This reaction has been on the AP test)

Chapter 16 Outline (cont'd)

ACID BASE EQUILIBRIA

To understand this chapter, you **MUST** understand chapter 15 on acids and bases and pH calculations.

Why do we have to use Ka and Kb to find the pH's of weak acids and bases?

Define Ka and Kb:

What is the relationship between Ka of an acid and the Kb of its conjugate?

What does the size of Ka and Kb tell us? Why?

Write the equation and equilibrium expression for HF.

Write the equation for ammonia added to water and the equilibrium expression.

- What is "ice" and how is it used to figure out how to plug into the Ka and Kb expression?

What is percent ionization?

- If given a starting Molarity and % ionization, be able to calculate the H^+ or OH^- concentrations.
- If given Ka and a starting Molarity, be able to calculate % ionization as well as pH.

Using phosphoric acid, show why there would be three Ka values.

Using Sulfuric acid, explain why there is only one Ka value. Write the two equations in your explanation.

SALT HYDROLYSIS:

- **What is it?**
- What salts undergo hydrolysis?
- How can you tell if a salt will be neutral, acidic or basic? Give examples with equations.

Henderson-Hasselbalch equation:

- What kind of problems can it solve?
- How would you rewrite the equation for a base?

What is a buffer?

- What is the capacity of a buffer?
- If you add acid to a buffer, how do you calculate the new pH?
- If you add base to a buffer, how do you calculate the new pH?

Titrations!

- **Does neutralization mean the pH is 7?**
- What is a titration curve?
- *How do you find the equivalence point or end point on the curve?*
- How can you find a Ka or Kb on a curve?
- **If you titrate a monoprotic acid, diprotic acid, and triprotic acid, how will the graphs of the curves be different? (Draw them)**
- What are indicators?
- **HOW ARE THEY USED IN A TITRATION?**
- How do you know which one to pick? (Explain the different types of titrations...SA v SB etc)
- How can you make sure the known Molarity is correct in a titration?

Okay time for some review!

- What is the equation to solve for a Molarity in a titration?
- **Why can we use this equation? (what is true at the end point?)**

- What does Molarity x Volume equal?

- If given grams of an acid or base and the volume, how would you solve the problem?

Solubility and K_{sp}

Chapter 17 Outline

DEFINE SOLUBILITY PRODUCT:

What types of reactions have Ksp values?

When solving a problem, how can you tell if the reaction is unsaturated, saturated or supersaturated?

When the K_{sp} is large, this indicates the s compound is _____soluble and when the numbers are small this indicates the compound is _____soluble.

WHAT IS THE DIFFERENCE BETWEEN MOLAR SOLUBILITY AND SOLUBILITY?

How do you convert from one to the other?

Be able to predict if a precipitate is formed: ~~see example 17.5 on page 685.~~

What is fractional crystallization? isolation of individual salts from a soln mixture based on indiv K_{sp} s

What is fractional crystallization used for?

What is the common ion effect?

Does adding a common ion increase or decrease solubility?

Explain why from Le Chatelier.

USING LE CHATELIER, EXPLAIN WHY ADDING AN ACID TO A BASIC SOLUTION INCREASES THE SOLUBILITY OF A BASE.

Using Le Chatelier, explain why adding a base to an acidic solution increases the solubility of an acid.

What is a complex ion?

What metals tend to form complex ions?

What is a general rule to predict a complex ion?

What is the stability constant?

Define: Qualitative Analysis

EXPLAIN THE GENERAL PROCESS.

What is this process similar to?