Chemistry 6A F2007

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11/30/07

Exam 3: Friday 12/7/07 (here in lecture)

What will be covered on the exam?

- Chapter 6: 6.9-6.15
- Chapter 7: All
- Chapter 8: All
- Chapter 9: 9.1 - 9.9
- Any thing from lab as well

What do I need to bring?

Bring a Pencil, Eraser, Calculator and scamtron form 882

YOU NEED TO KNOW YOUR LAB SECTION NUMBER!

What do I need to bring?

Scantron form 882
100 question jobby-doo

chewing optional…

Titration Curves:

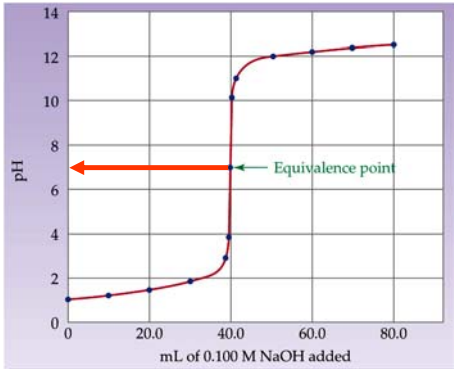
Strong Acid–Strong Base:

$$NaOH(aq) + HCl(aq) \rightarrow H_2O(l) + NaCl(aq)$$

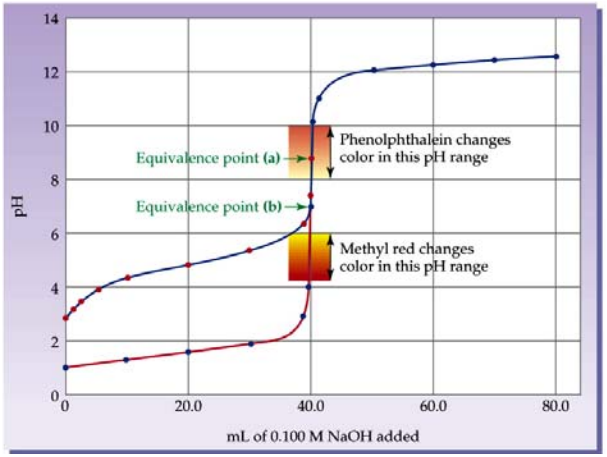
A titration curve plots pH vs. mL of titrant added.

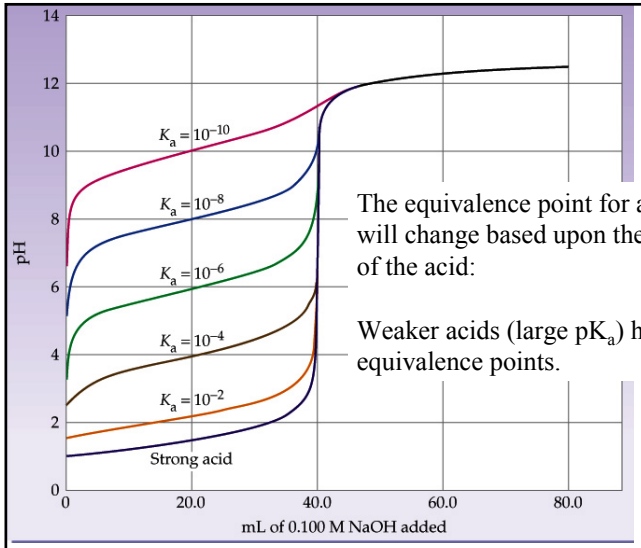
The equivalence point is the point at which equal molar amounts of acid (H_3O^+)and base (OH^-)have reacted.

pH = 7



Indicators are chosen so that they change color over the desired pH range.





The equivalence point for a titration will change based upon the strength of the acid:

Weaker acids (large pK_a) higher pH equivalence points.

HYDROLYSIS REACTIONS OF WEAK ACID SALTS

Salts that contain anion of a weak acid (conjugate base) when dissolved in water will produce the acid.

$$NaA(aq) + H_2O(l) \rightleftarrows HA(aq) + NaOH(aq)$$

This process is know as *"hydrolysis"*.

The strength of a conjugate base depends upon the strength of the acid from which it came.

The stronger an acid is, the weaker is its conjugate base, and *vise versa.*

As a result, conjugate bases of very weak acids will produce higher concentrations of hydroxide in solution.

HYDROLYSIS REACTIONS OF WEAK ACID SALTS

The conjugate base of a strong acid will not undergo hydrolysis:

$$NaCl(aq) + H_2O(l) \rightarrow \text{no reaction}$$

When a salt such as sodium acetate is added to water, acetic acid forms:

weak acid

$$NaC_2H_2O_3(aq) + H_2O(l) \rightleftarrows HC_2H_2O_3(aq) + NaOH(aq)$$

strong base

BUFFER SOLUTIONS:

When both a weak acid and a conjugate base are both present in solution the solution resists change to pH.

These solutions are called "Buffer Solutions"

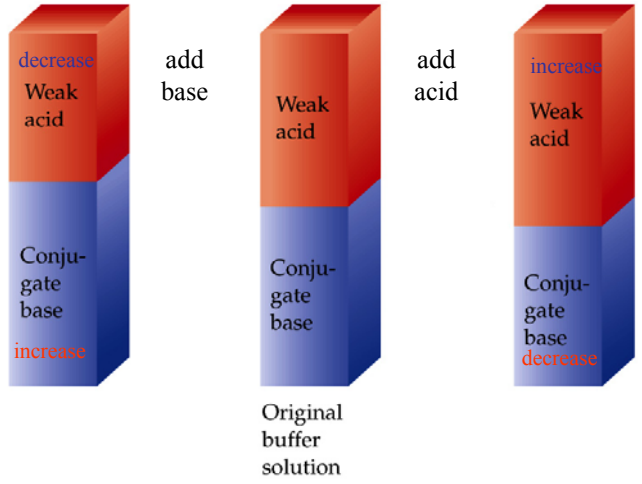
Buffers are useful for maintaining a certain pH range during a chemical reaction.

Any added acid (H^+ ions) react with the conjugate base of the weak acid.

$$A^-(aq) + H^+(aq) \rightleftarrows HA(aq)$$

Any added base (OH^- ions) react with the non-ionized weak acid.

$$OH^-(aq) + HA(aq) \rightleftarrows A^-(aq) + H_2O(l)$$

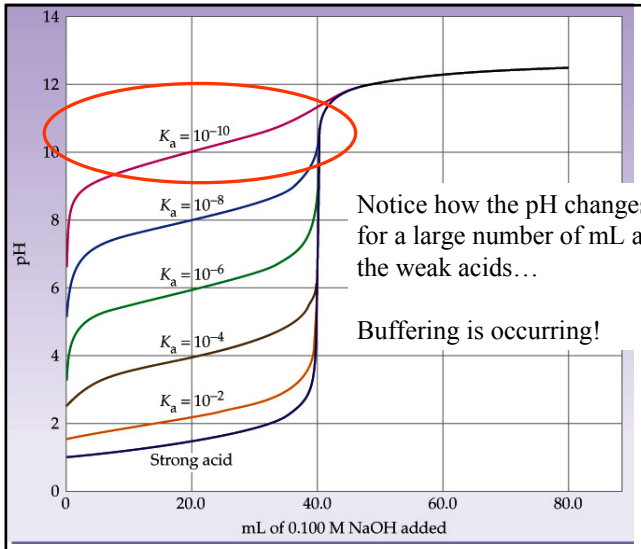


UNBUFFERED vs. BUFFERED SOLUTIONS

The solution on the left is not buffered, the one on the right is.
Universal indicator was added to each solution.

When NaOH(aq) is added to each solution, the buffered solution does not change!

When HCl(aq) is added to two fresh samples, once again the buffer does not change its pH.



Notice how the pH changes very little for a large number of mL added in the weak acids…

Buffering is occurring!

The pH of a Buffer solution is governed by the ***"Henderson-Hasselbalch"*** equation:

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

$pH = -\log[H^+]$

$pK_a = -\log[K_a]$

K_a = acid dissociation equilibrium constant

$[A^-]$ = conjugate base concentration (usually in the form of a salt)

$[HA]$ = weak acid concentration

When preparing a buffer solution, begin by choosing a weak acid with pK_a close to required pH.

Calculate the pH of a buffer solution that is made by adding 0.100 g of sodium carbonate to 500.0 mL of a 0.100 M sodium bicarbonate.

weak acid

$$HCO_3^-(aq) + H_2O(l) \rightleftarrows CO_2^{2-}(aq) + H_3O^+(aq)$$

conjugate base

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

$[A^-] = [CO_3^{2-}]$ $[HA] = [HCO_3^-]$

$pK_a = 10.25$

Calculate the pH of a buffer solution that is made by adding 0.100 g of sodium carbonate to 500.0 mL of a 0.100 M sodium bicarbonate.

$$pH = pK_a + \log\frac{[A^-]}{[HA]} \qquad [A^-] = [CO_3^{2-}] \qquad [HA] = [HCO_3^-]$$

$pK_a = 10.25$

$$pH = 10.25 + \log\frac{0.100\text{g } Na_2CO_3 \times \frac{\text{mol}}{104.99\text{g}} \times \frac{1}{0.500\text{L}}}{0.100\text{ M}}$$

$$= 8.54$$

It's time to play….

Answer that question about chapter 9 time!!!

In the Brønsted theory of acids and bases, both acids and bases are defined in terms of how substances lose or gain…

a. OH^- b. H_3O^+ c. H^+ d. Cl^-

A water solution is found to have a molar OH^- concentration of 3.2×10^{-5}.

The solution would be classified as:

a. acidic
b. basic
c. neutral
d. can't be classified

A solution for which $[H^+] = 1.0\times10^{-3}$ will have a pH of…

a) 5.00 b) 3.00 c) -5.00 d) -9.00

When an acid is analyzed by adding a measured quantity of base, the point at which all the acid has reacted is correctly called:

a. the equivalence point
b. the neutral point
c. the endpoint
d. the analysis point

Which of the following is a weak acid?

a. HNO_3
b. HCl
c. H_2CO_3
d. H_2SO_4

Which of the following salts would produce a basic solution (pH higher than 7) upon being dissolved in pure, distilled water?

a. NaCl
b. Na_2CO_3
c. $Mg(NO_3)_2$
d. NH_4Cl

CO_3^{2-} is the only conjugate base of a week acid

Which of the following mixtures would represent a buffer?

a. sodium chloride / hydrochloric acid
b. sodium sulfate / sulfuric acid
c. sodium acetate / acetic acid
d. none of these

acetic acid is the only weak acid, therefore it is the only choice that can make a buffer solution.

The term, strong acid, refers to:

a. the number of hydrogen atoms attached to the acid molecule
b. the speed at which it will dissolve metal
c. if it will cause burns to the skin
d. the ability for the acid to completely dissociate in solution

True/False

Sodium nitrate in water will produce a basic solution.

False!

NO_3^- is the conjugate base of a strong acid

$NO_3^-(aq) + H_2O(l) \rightarrow$ No reaction!

Which of the conditions given is necessary for a chemical reaction to occur?

a. The molecules of the reacting chemicals must be in motion.

b. The molecules of the reacting chemicals must collide with one another.

c. The molecules of the reacting chemicals must be of opposite charges.

d. The molecules of the reacting chemicals must be at different charges.

Which of the following is most closely related to the term "reaction rate"?

a. the temperature needed to initiate a reaction

b. the position of equilibrium when a reaction stops

c. the speed of a reaction

d. more than one response is correct

The energy required to start some spontaneous processes is called

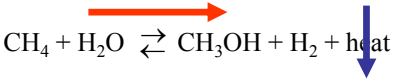
a. internal energy

b. collision energy

c. free energy

d. activation energy

The following question refers to the following equilibrium in which all reactants and products are gases:



Indicate the effect of the changing condition on the position of equilibrium.

Referring to an equilibrium, What would happen if one were to cool the mixture?

Equilibrium…

a. shifts left
b. shifts right
c. no effect
d. can shift to right or left