Chem 116 Student Notes November 18, 2008 (EC)

Lecture 19: Acid-Base Equilibrium

Clicker Question:

HPO_4^{2-} (aq) + HCO_3^- (l) ⇔ CO_3^{2-} (aq) + $H_2PO_4^-$ (aq)

(a)	(b)	(c)	(d)
base2	acid 1	base1	acid 2

Question 1: ID the acid/base on the left and their conjugate base/acid on the right

Answer: D

(b) is an acid (gives up H^+)

(c) is its conjugate base

(a) is a base (receives an H^+)

(d) is its conjugate acid

Question 2: Does the equilibrium lie primarily to the left or to the right?

Answer: B

K_a values given are the acid ionization constants

they measure the strength of the acids (so the K_a value for HPO_4^{2-} doesn't need to be considered)

the larger the K_a value the stronger the acid

the stronger the acid, the more the equilibrium will go to the other side

$H_2PO_4^-$ is the stronger of the 2 acids and is on the right

so the equilibrium lies to the left

pH and pOH

1. "p" just stands for "the negative log base-10 of"
    a. so $pH = -\log_{10}[H^+]$
2. pH measures the concentration of $[H^+]$ ions
3. pOH measures the concentration of $[OH^-]$ ions
    a. pH scale of 0 (acidic) to 14 (basic)
        i. pH of 7 (neutral) means $[H^+] = [OH^-]$
    b. there are pH values lower than 0 and higher than 14 but they are so corrosive or caustic they often eat through normal containers, so they're not commonly measured
4. pH + pOH = 14
    a. so once you find either pH or pOH you can find the other by subtracting it from 14

3 types of acid-base problems

1. Predict the pH
    a. Strong acid/base
        i. Completely dissociates so the concentration of $[H^+]$ or $[OH^-]$ will just be the amount of the acid/base you started with
        ii. Strong acids include:
            1. HCl, HBr, HI (but not HF which is weak)
            2. H_2SO_4
            3. HNO_3
            4. $HClO_4$
        iii. Strong bases include:
            1. Most metal cations with OH^- ions
        iv. K_w (1.0×10^{-14}) $= [H^+] \times [OH^-]$ is the water autoionization equilibrium taking the negative log of both sides gives

            $14 = pH + pOH$
    b. Weak acid/base
        i. Solve as you would with I C E charts
        ii. Ka is usually given
2. Equilibrium
    a. Given pH of a solution
    b. Figure out how much acid/base or salt must have been added to water to make the that given pH
3. Titration
    a. Given a solution of unknown acid/base concentration
    b. Neutralize with known amount of base/acid to figure out unknown concentration