Chapter 19 WS

A/B Strength, Neutralization, & Salts

Name: ______________________________

Period: _______ **Date:** ____________________

1) When talking about solutions, what do the words "strong" and "weak" actually represent?
Strong = Completely Ionizes Weak = Partially Ionizes

2) What is the generic formula for the acid dissociation constant (K_a) for the generic acid HA?

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

3) Acids with a large K_a are considered STRONG acids because they are COMPLETELY ionized,

and acids with a small K_a are WEAK acids because they are PARTIALLY ionized.

4) What is the generic formula for the base dissociation constant (K_b) for the generic base XOH?

$$K_b = \frac{[X^+][OH^-]}{[XOH]}$$

5) Bases with a LARGE K_b are considered STRONG bases because they are highly

ionized, and bases with a SMALL K_b are WEAK bases because they are slightly ionized.

6) What would be the K_a or K_b for the following acids if the following are equilibrium concentrations?

a. $H_2CO_3 \rightarrow H^+ + HCO_3^-$
$[H_2CO_3] = 2.00M, [H^+] = 9.80 \times 10^{-6}, [HCO_3^-] = 9.80 \times 10^{-6}$

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{(9.8 \times 10^{-6})^2}{2.00} = 4.80 \times 10^{-11}$$

b. $H_2S \rightarrow H^+ + HS^-$
$[H_2S] = 8.25M, [H^+] = 9.08 \times 10^{-4}M, [HS^-] = 9.08 \times 10^{-4}M$

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{(9.08 \times 10^{-4})^2}{8.25} = 9.99 \times 10^{-8}$$

c. $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$
$[NH_3] = 0.250M, [NH_4^+] = 2.12 \times 10^{-3}M, [H^+] = 2.12 \times 10^{-3}M$

$$K_b = \frac{[X^+][OH^-]}{[XOH]} = \frac{(2.12 \times 10^{-3})^2}{0.250} = 1.80 \times 10^{-5}$$

d. $H_2NNH_2 + H_2O \rightarrow H_2NNH_3^+ + OH^-$
$[H_2NNH_2] = 0.120M, [H_2NNH_3^+] = 8.76 \times 10^{-4}M, [OH^-] = 8.76 \times 10^{-4}M$

$$K_b = \frac{[X^+][OH^-]}{[XOH]} = \frac{(8.76 \times 10^{-4})^2}{0.120} = 6.39 \times 10^{-6}$$

7) What are the products of acid/base reactions?

$$Acid + Base \rightarrow SALT + WATER$$

8) What is the equivalence point of a titration?
The point at which the amount (mol) of acid (H+) is equal to the amount (mol) of base (OH-)

9) What is the end point of a titration?
The point at which the solution changes color

10) What is the formula for calculating titrations?
$M_aV_ai_a = M_bV_bi_b$ or $N_aV_a = N_bV_b$

11) What is the normality of the following acids and bases?

a. 2.0 M NaOH

$$2.0\ M\ NaOH \left|\frac{1\ mol\ OH^-}{1\ mol\ NaOH}\right| = 2.0\ N\ NaOH$$

b. 1.0 M H_3PO_4

$$1.0\ M\ H_3PO_4 \left|\frac{3\ mol\ H^+}{1\ mol\ H_3PO_4}\right| = 3.0\ N\ H_3PO_4$$

c. .5 M $Ca(OH)_2$

$$0.5\ M\ Ca(OH)_2 \left|\frac{2\ mol\ OH^-}{1\ mol\ Ca(OH)_2}\right| = 1.0\ N\ Ca(OH)_2$$

d. 1.5 M H_2SO_4

$$1.5\ M\ H_2SO_4 \left|\frac{2\ mol\ H^+}{1\ mol\ H_2SO_4}\right| = 3.0\ N\ H_2SO_4$$

12) Calculate the missing part of each of the following titrations:

a. 25 mL of 1.0 M H_2SO_4 is titrated with 40 mL of NaOH. What is the concentration of the NaOH?

$$M_aV_ai_a = M_bV_bi_b$$
$$(1.0)(25)(2) = M_b(40)(1)$$
$$1.2\ M\ NaOH = M_b$$

b. 3.0 L of sulfuric acid titrates with 1.0 L of 1.0 M $Al(OH)_3$. What is the concentration of the acid?

$$M_aV_ai_a = M_bV_bi_b$$
$$M_a(3.0)(2) = (1.0)(1.0)(3.0)$$
$$M_a = 2.0\ M\ H_2SO_4$$

c. 10. mL of 0.50 M HCl titrates 50. mL of an $Al(OH)_3$ solution. What molarity is the base?

$$M_aV_ai_a = M_bV_bi_b$$
$$(0.5)(10)(1) = (M_b)(50)(3)$$
$$M_b = 0.03\ M\ Al(OH)_3$$

d. 7.5 L of 1.0 M tetra-protic acid is titrated with a 3.0 M KOH solution. What volume is needed?

$$M_aV_ai_a = M_bV_bi_b$$
$$(1.0)(7.5)(4) = (3.0)V_b(1)$$
$$10.\ L\ NaOH = V_b$$

13) In some instances, adding a salt to water will turn the solution into an acid or a base. There are 4 basic rules for predicting the acidity, basicity, or neutrality of a solution when a salt is added… what are they?

a. Strong Acid + Strong Base = Neutral Solution

b. Weak Acid + Weak Base = Neutral Solution

c. Strong Acid + Weak Base = Acidic Solution

d. Weak Acid + Strong Base = Basic Solution

14) If the K_a of ethanoic acid (CH_3COOH) is $6.40x10^{-5}$, what would be the concentration of hydrogen ion in a 0.300 M solution of ethanoic acid?

a. Write the equation for the dissociation of ethanoic acid:

$$CH_3COOH \leftrightarrow CH_3COO^- + H^+$$

b. Calculate the initial concentration, change in concentration, and final concentration of all three parts of the dissociation equation:

Reaction	Ethanoic Acid	Ethanoate	Hydrogen Ion
Initial	0.300	0	0
Change	-x	+x	+x
Final	0.300 – x	x	x

c. Write the formula for K_a, substitute in your final concentrations from part b, and then solve for your unknown amount… You are gonna need the quadratic formula for this one!

$$K_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$$

$$6.40 \times 10^{-5} = \frac{[x][x]}{[0.300 - x]}$$

$$6.40 \times 10^{-5} = \frac{[x][x]}{[0.300 - x]}$$

$$1.92 \times 10^{-6} - 6.4 \times 10^{-5}x = x^2$$

$$0 = -1.92 \times 10^{-6} + 6.4 \times 10^{-5}x + x^2$$

Quadratic Equation
$x = 1.35x10^{-3}$

[Ethanoic Acid] = 0.299 M
[Ethanoate] = $1.35x10^{-3}$ M
$[H^+] = 1.35x10^{-3}$ M

15) Determine which acids and bases the following salts hydrolyze into and then determine whether the resulting solution will be acidic, basic, or neutral:

a. NaCl

$$NaCl + H_2O \leftrightarrow NaOH + HCl$$

$$Neutral = Strong\ B + Strong\ A$$

b. $(NH_4)_3PO_4$

$$(NH_4)_3PO_4 + H_2O \leftrightarrow NH_4OH + H_3PO_4$$

$$Neutral = Weak\ B + Weak\ A$$

c. $Mg(C_2H_3O_2)_2$

$$Mg(C_2H_3O_2)_2 + H_2O \leftrightarrow Mg(OH)_2 + HC_2H_3O_2$$

$$Neutral = Weak\ B + Weak\ A$$

d. K_2CO_3

$$K_2CO_3 + H_2O \leftrightarrow KOH + H_2CO_3$$

$$Basic = Strong\ B + Weak\ A$$