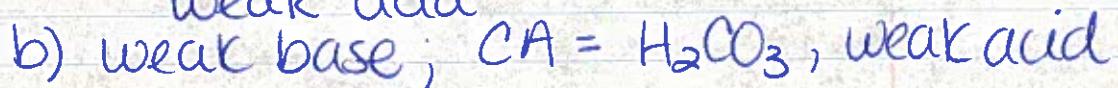
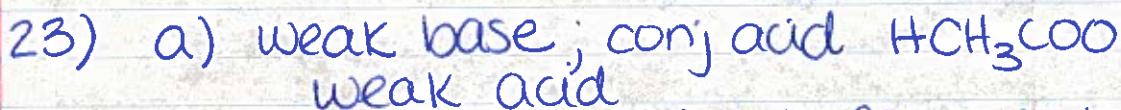
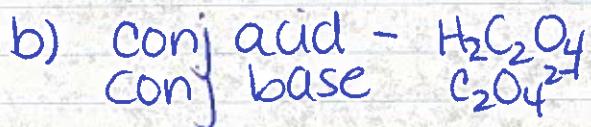
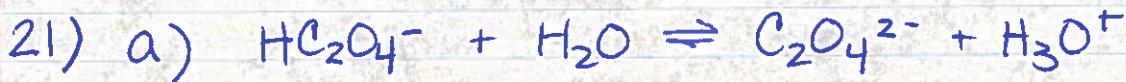
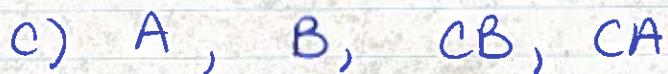
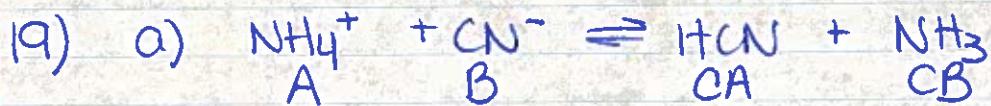
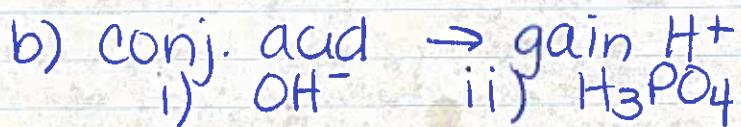
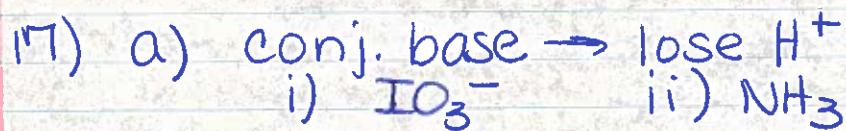


## Chapter 16

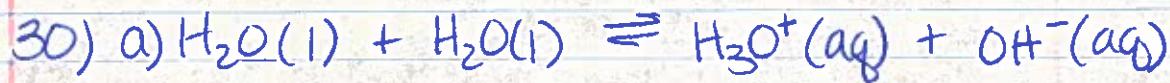
- 2) a) HY ; more dissociated ions  
b)  $X^-$  ; (strong acids have negligible bases)  
c) left HX doesn't like to break apart remains reactant favored

- 3) a) HY Completely dissociated  
b) smallest  $K_a$  = weakest acid HX  
c) highest pH most basic least  $H^+$  HX



## Chapter 16 Continued...

- 23) d)  $\text{Cl}^-$  negligible; CA = HCl strong acid  
 e) weak base, CA =  $\text{NH}_4^+$  weak acid



b)  $K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$

c)  $\text{pH} < 7$   
 $\text{H}_2\text{O}$  is liquid; heterogenous mixtures only list  $\text{aq.}$   
 Solutions contains more  $\text{OH}^-$  than  $\text{H}^+$

31)  $K_w = 1.0 \times 10^{-14} = [\text{H}_3\text{O}^+][\text{OH}^-]$

a)  $1.0 \times 10^{-14} = [\text{H}_3\text{O}^+][0.00045]$

$[\text{H}^+] = 2.2 \times 10^{-11}$  basic

b)  $1.1 \times 10^{-6}$ ; acidic

c)  $1.0 \times 10^{-8}$ ; basic

37) a) decreases  $\text{H}^+$ , increases pH

b)  $6.0 \times 10^{-4} = \text{pH } 4 - 3$  acidic

$\text{pH} = -\log(6.0 \times 10^{-4}) = 3.2$

c)  $5.2 \text{ pH} = 1.0 \times 10^{-5}$

$10^{-5.2} = 6.0 \times 10^{-6} \text{ M} = [\text{H}^+]$

$1.0 \times 10^{-14} / (6.0 \times 10^{-6}) = 2 \times 10^{-9} \text{ M} = [\text{OH}^-]$

	$[\text{H}^+]$	$[\text{OH}^-]$	pH	pOH	A or B
	$7.5 \times 10^{-3} \text{ M}$	$1.3 \times 10^{-12} \text{ M}$	2.12	11.88	A
	$2.8 \times 10^{-5} \text{ M}$	$3.6 \times 10^{-10} \text{ M}$	4.56	9.44	A
	$5.6 \times 10^{-9} \text{ M}$	$1.8 \times 10^{-6} \text{ M}$	8.25	5.75	B
	$5.0 \times 10^{-9} \text{ M}$	$2.0 \times 10^{-6} \text{ M}$	8.30	5.70	B

Chapter 16 conti...

43) a) An acid that completely dissociates in an aqueous solution

b)  $[H^+] = 0.500M$



44) a) A base that completely dissociates in an aqueous solution

b)  $[OH^-] = 2 \times 0.035 = 0.070M$

45) a)  $pH = -\log(8.5 \times 10^{-3} M) = 2.07$

b)  $\frac{1.52g}{\text{molar mass HNO}_3} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 1 \text{ g} \end{array} \right| \frac{1.575L}{\text{ }} = \frac{\text{conc } H^+ = 0.0419M}{-\log(H^+) = 1.377}$

c)  $M_1V_1 = M_2V_2$        $\frac{5}{1000} \times .250 = \frac{50}{1000} \times M_2$   
 $[H^+] = .0250M$        $-\log(H^+) = 1.402$

d)  $\frac{0.100 \text{ mol}}{L} \left| \begin{array}{c} .010L \\ \hline \end{array} \right| = \frac{.001 \text{ moles } H^+}{+}$

$\frac{0.200 \text{ mol}}{L} \left| \begin{array}{c} 0.020L \\ \hline \end{array} \right| = \frac{.004 \text{ moles } H^+}{=}$

$\frac{.005 \text{ moles } H^+}{.03 L} = .167 M$        $-\log(.167) =$   
 $pH = 0.778$

## Chapter 16e continued..

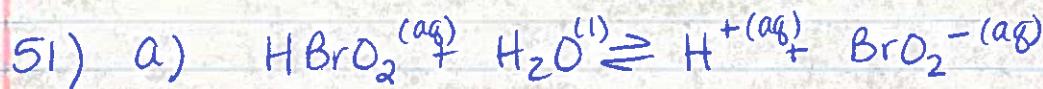
47) a)  $[\text{OH}^-] = 1.5 \times 10^{-3} \times 2 = 0.003 \text{ M}$   
 $\text{pOH} = -\log(0.003) = 2.52 \quad 14 - 2.52 = 11.5 = \text{pH}$

b)  $2.250 \text{ g LiOH} \left| \begin{array}{c} 1 \text{ mol} \\ \text{molar mass LiOH} \end{array} \right| .250 \text{ L} = [\text{OH}^-] = 0.3758 \text{ M}$   
 $-\log(0.3758) = \text{pOH}$   
 $14 - \text{pOH} = 13.5750$

c)  $.175 \text{ mol} \left| \begin{array}{c} .001 \text{ L} \\ \text{L} \end{array} \right| \frac{1}{2} \text{ L} = [\text{OH}^-] = 8.75 \times 10^{-5} \text{ M}$   
 $-\log(8.75 \times 10^{-5}) = \text{pOH}$   
 $14 - \text{pOH} = 9.942$

d)  $0.105 \text{ mol} \left| \begin{array}{c} .005 \text{ L} \\ \text{L} \end{array} \right| = 5.25 \times 10^{-4}$   
 $+ = 0.003375 / .020$   
 $[\text{OH}^-]$   
 $9.5 \times 10^{-2} \text{ mol} \left| \begin{array}{c} 2 \text{ OH}^- \text{ in } \text{Ca}(\text{OH})_2 \\ 2 \text{ L} \end{array} \right| .015 \text{ L} = 0.00285$   
 $: 0.17 \text{ M}$   
 $-\log(\text{OH}^-) = \text{pOH} \quad 14 - \text{pOH} = 13.23$

49)  $10^{-11.5} = 3.16 \times 10^{-12} \text{ M} = [\text{H}^+]$   
 $1.0 \times 10^{-14} = (3.16 \times 10^{-12})(\text{OH}^-) =$   
 $[\text{OH}^-] = 3.2 \times 10^{-3} \text{ M} \text{ NaOH}$



$$K_a = \frac{[\text{H}^+][\text{BrO}_2^-]}{[\text{HBrO}_2]}$$

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{BrO}_2^-]}{[\text{HBrO}_2]}$$

b)  $K_a = \frac{[\text{H}^+][\text{C}_2\text{H}_5\text{COO}^-]}{[\text{C}_2\text{H}_5\text{COOH}]}$        $K_a = \frac{[\text{H}_3\text{O}^+][\text{C}_2\text{H}_5\text{COO}^-]}{[\text{C}_2\text{H}_5\text{COOH}]}$

## Chapter 16 continued...

53)  $K_a = \frac{[H^+][CH_3CH(OH)COO^-]}{[CH_3CH(OH)COOH]}$

 $pH = -\log(H^+)$ 
 $2.44 = -\log(H^+)$ 
 $10^{-2.44} = 0.00363 = H^+$ 
 $K_a = \frac{(0.00363)(.00363)}{0.10}$

$K_a = 1.32 \times 10^{-4}$

54)  $K_a = \frac{[H^+][CB]}{[A]}$ ,  $10^{-2.68} = 0.00209 M = H^+$

 $K_a = \frac{(0.00209)(.00209)}{.085} = 5.14 \times 10^{-5}$

57)  $10^{-2.90} = 0.00126 M = [H^+]$

$1.8 \times 10^{-5} = \frac{(.00126)(.00126)}{[\text{acetic acid}]}$

$[CH_3COOH] = 0.088 M$

59)  $6.3 \times 10^{-5} = \frac{x^2}{.050}$        $[CH_3O^+] = 1.8 \times 10^{-3} M$   
 $[C_6H_5COO^-] = 1.8 \times 10^{-3} M$   
 $[C_6H_5COOH] = 0.050$

63)  $pK_a = 2.32$        $10^{-2.32} = K_a = 0.00479$

$K_a = \frac{[H^+][CB]}{0.10} = 0.00479$

$[H^+] = 0.0219 M$

$pH = -\log(0.0219) = 1.666$

$$(65) \text{ Percent ionization} = \frac{[\text{H}^+]}{[\text{HA}]} \times 100\%$$

$$\text{a) } K_a = 1.9 \times 10^{-5} = \frac{[\text{H}^+][\text{N}_3^-]}{0.400}$$

$$[\text{H}^+] = 0.00276 \text{ M}$$

$$\% = \frac{0.00276}{0.400} \times 100 = 6.89\%$$

$$\text{b) } 1.9 \times 10^{-5} = \frac{x^2}{.1} \quad \frac{.00138}{.1} \times 100 = 1.38\%$$

$$\text{c) } 1.9 \times 10^{-5} = \frac{x^2}{.04} \quad \frac{8.72 \times 10^{-4}}{.04} \times 100 = 2.18\%$$



$$\text{b) } K_b = \frac{[\text{HCO}_3^-][\text{OH}^-]}{[\text{CO}_3^{2-}]}$$

$$\text{c) } K_b = \frac{[\text{HCHO}_2^+][\text{OH}^-]}{[\text{CHO}_2^-]}$$

$$75) K_b = 6.4 \times 10^{-4} = \frac{[\text{CA}][\text{OH}^-]}{0.075}$$

$$[\text{OH}^-] = 6.93 \times 10^{-3}$$

$$-\log(\text{OH}^-) = 2.16$$

$$14 - 2.16 = 11.84 = \text{pH}$$

$$76) \quad 4.0 \times 10^{-6} = \frac{x^2}{0.550} \quad [\text{OH}^-] = 1.48 \times 10^{-3} \text{ M}$$

$$-\log(\text{OH}^-) = 2.83$$

$$14 - 2.83 = 11.17$$

$$78) \quad 10^{-9.95} = \text{H}^+ = 1.12 \times 10^{-10}$$

$$[\text{OH}^-] = 8.91 \times 10^{-5}$$

$$K_b = \frac{(8.91 \times 10^{-5})(8.91 \times 10^{-5})}{(5.0 \times 10^{-3})}$$

$$K_b = 1.59 \times 10^{-6}$$

$$pK_b = -\log(1.59 \times 10^{-6})$$

$$pK_b \approx 5.80$$

81) a) ↑  $K_a$  ↑ acidity  
acetic acid = stronger acid

b) hypochlorite ion

$$\text{c) } 10^{-14} = K_b \times K_a$$

$$\text{CH}_3\text{COO}^- \quad K_b = 5.56 \times 10^{-10}$$

$$\text{ClO}^- \quad K_b = 3.33 \times 10^{-7}$$

82) a) ammonia

b) hydroxylamine

$$\text{c) } K_a \text{ NH}_4^+ = 5.56 \times 10^{-10}$$

$$K_a \text{ H}_3\text{NOH}^+ = 9.09 \times 10^{-7}$$

85) a)  $\text{NH}_4\text{Br}$  dissociates     $\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3 + \text{H}_3\text{O}^+$   
acidic

b)  $\text{FeCl}_3 + \text{H}_2\text{O} \rightleftharpoons \text{HCl} + \text{Fe(OH)}_3$     acidic  
strong acid  
dissociates  $\text{H}^+$

c)  $\text{Na}_2\text{CO}_3$  dissociates     $\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{OH}^-$   
basic

d)  ~~$\text{KClO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{HClO}_4 + \text{OH}^-$~~   
dissociates    strong acid  $\text{H}^+ + \text{ClO}_4^- + \text{OH}^-$   
neutral