Unit 6 Test Review Sheet

(1) a) KF - neutral
b) NaCl - neutral
c) NH_4F - acidic

$K_a = 5.6 \times 10^{-10}$ $K_b = 2.86 \times 10^{-11}$

$K_a > K_b$

d) NH_4Cl - acidic

(2) a) which is stronger acid

HBr, HI

$HBrO_3$, HIO_3

$HBrO_3$, $HBrO_2$

b) the stronger the bond strength the less acidic the acid is because it will be more difficult to remove the H^+ from the acid

c) the more oxygens attached the stronger the acid

(3) Nonmetal oxides form acids in water
metal oxides form bases in water

(4) a) $HC_2H_3O_2 \rightleftharpoons H^+ + C_2H_3O_2^-$
b) $HF \rightleftharpoons H^+ + F^-$
c) $NH_3 \rightleftharpoons NH_4^+ + OH^-$
d) $CH_3NH_2 \rightleftharpoons CH_3NH_3^+ + OH^-$

d) $K_b = \frac{[CH_3NH_3^+][OH^-]}{[CH_3NH_2]}$

(5) a) $K_a = \frac{[H^+][C_2H_3O_2^-]}{[HC_2H_3O_2]}$

b) $K_a = \frac{[H^+][F^-]}{[HF]}$

c) $K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$

6. a) $1.8\times10^{-5} = \frac{x^2}{.2-x}$ $\quad pH = -\log(.00189) = 2.72$

$x = .00189$ $\quad .00189/.2 \times 100 = .945\%$

b) $K_b = (1\times10^{-14}/5.6\times10^{-10})$ $\quad pOH = -\log(.0023) = 2.64$

$K_b = 1.79\times10^{-5} = \frac{x^2}{.3-x}$ $\quad pH = 11.36$

$x = .0023$ $\quad .0023/.3 \times 100 = .767\%$

c) ∀ care about F^-

$F^- \rightleftharpoons HF + OH^-$ $\quad pOH = -\log(3.95\times10^{-6}) = 5.4$

$K_b = (1.0\times10^{-14}/3.2\times10^{-4}$ $\quad pH = 8.60$

$K_b = 3.125\times10^{-11} = \frac{x^2}{.5-x}$

$x = 3.95\times10^{-6}$ $\quad .5/.5 \times 100 = 7.9\times10^{-4}\%$

7. a) .200 M acetic acid added to 0.100 M sodium acetate

$pH = pK_a + \log(\text{base}/\text{acid})$

$pH = -\log(1.8\times10^{-5}) + \log(.1/.2)$

$pH = 4.44$

$[H^+] = 3.6\times10^{-5}\ M$ $\quad .0000360/.200 \times 100 = .018\%$

* I did 7a on the next page using an ice chart also in case you did it that way *

7. a) .200 M acetic acid added to 0.100 M sodium acetate

$HC_2H_3O_2 \rightleftharpoons H^+ + C_2H_3O_2^-$

I	.2	0	.100
C	$-x$	$+x$	$+x$
E	$.2-x$	x	$.100+x$

$$1.8\times10^{-5} = \frac{(x)(.100+x)}{(.2-x)} \approx \frac{.100x + x^2}{.2-x}$$

$$x = 3.6\times10^{-5}\ M$$

7. b) $pH = -\log(5.6\times10^{-10}) + \log(.300/.100)$

$pH = 9.7$ $\quad [H^+] = 1.87\times10^{-10}/.1 = 1.87\times10^{-7}$

8. The combination of a weak acid/base with its conjugate salt that resists pH change.

9. a) $pH = -\log(1.8\times10^{-5}) + \log(.5/.2)$

$pH = 5.14$

b) $pH = -\log(5.6\times10^{-10}) + \log(.5/.2)$

$pH = 9.65$

10 a) $HC_2H_3O_2 + OH^- \rightleftharpoons H_2O + C_2H_3O_2^-$

b) $NH_3 + H^+ \rightleftharpoons NH_4^+$

(1L) (2L)

11. a) .200 M acetic acid with 0.100 M sodium hydroxide

0.0 mL NaOH

$$1.8 \times 10^{-5} = \frac{x^2}{.2 - x}$$

$x = .0019\ M = [H^+]$

pH = 2.72

1/2 equivalence point

pH = pKa

$pH = -\log(1.8 \times 10^{-5})$

pH = 4.74

equivalence point (moles have to be the same)

$C_2H_3O_2^- + H_2O \rightleftharpoons HC_2H_3O_2 + OH^-$

I	.2 mol/3L = .067	/	0	0
C	$-x$	/	$+x$	$+x$
E	$.067 - x$	/	x	x

$$K_b = \frac{x^2}{.067 - x}$$

$$5.56 \times 10^{-10} = \frac{x^2}{.067 - x}$$

$x = 6.1 \times 10^{-6}\ M = [OH^-]$

pOH = equals 5.21

pH = equals 8.78

after equivalence point

$HC_2H_3O_2 + OH^- \rightleftharpoons C_2H_3O_2^- + H_2O$

I	.2 mol	.3 mol	0	/
C	$-.2$	$-.2$	/	/
E	0	.1 mol	/	/

$\frac{.1\ mol}{4L} = .025\ M = [OH^-] = 1.6$ pH = 12.4

b) .500M NH_3 with 0.500M HCl $K_b = 1.8 \times 10^{-5}$

0.00mL HCl

$$1.8 \times 10^{-5} = \frac{x^2}{.5 - x}$$

$x = .00299\ M = [OH^-]$

$pOH = 2.52$ **pH = 11.48**

1/2 equivalence point

$pH = pK_a = -\log(5.6 \times 10^{-10})$

pH = 9.25

equivalence point

$NH_4^+ \rightleftharpoons H^+ + NH_3$

	NH_4^+	H^+	NH_3
I	.5/2.00 = .25	0	0
C	−x	+x	+y
E	.25 − x	x	x

$5.6 \times 10^{-10} = \frac{x^2}{.25 - x}$

$x = 1.18 \times 10^{-5}$

pH = 4.93

after equivalence point

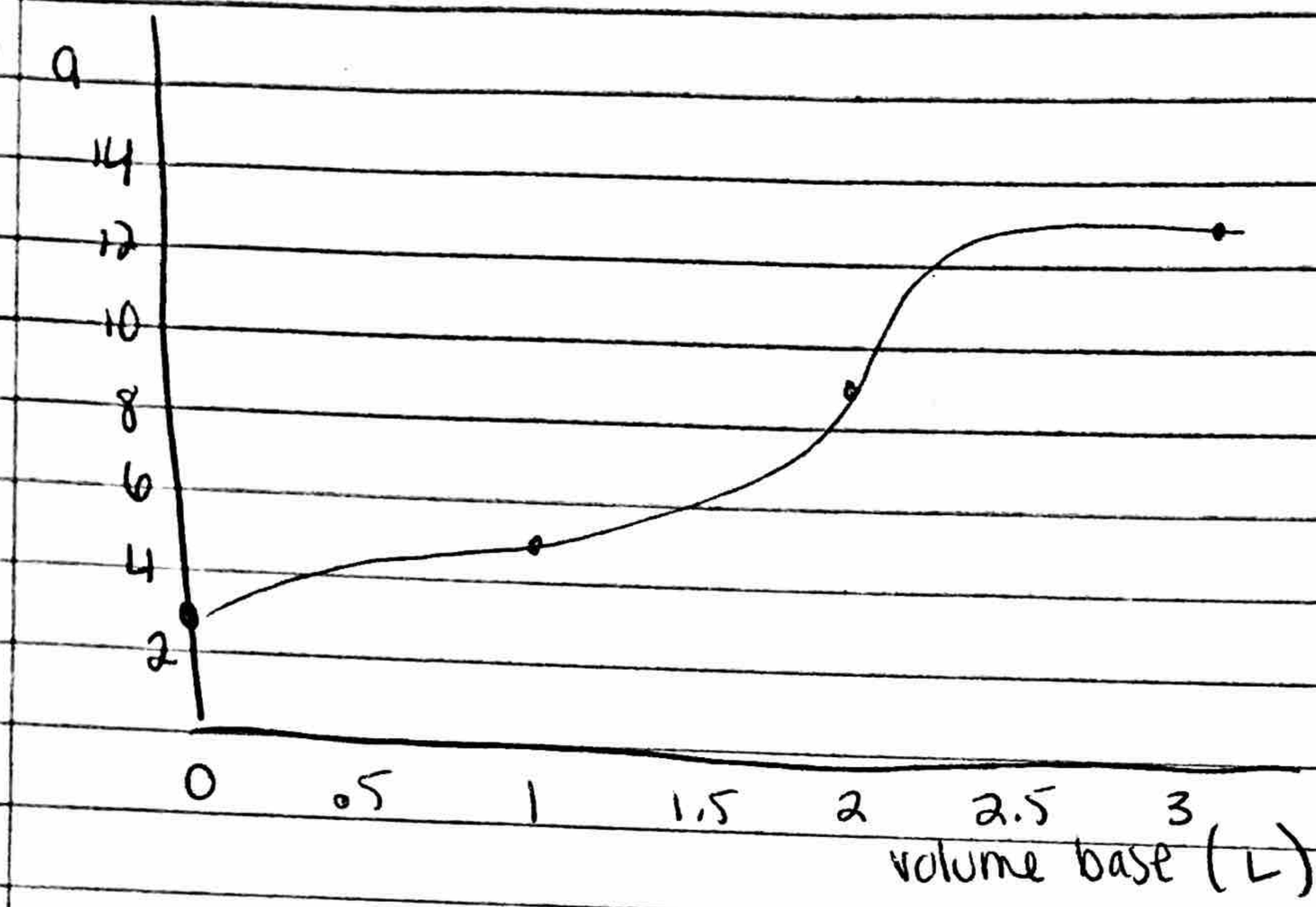
$NH_3 + H^+ \rightleftharpoons NH_4^+$

	NH_3	H^+	NH_4^+
I	.5	1	0
C	−.5	−.5	+.5
E	0	.5	.5

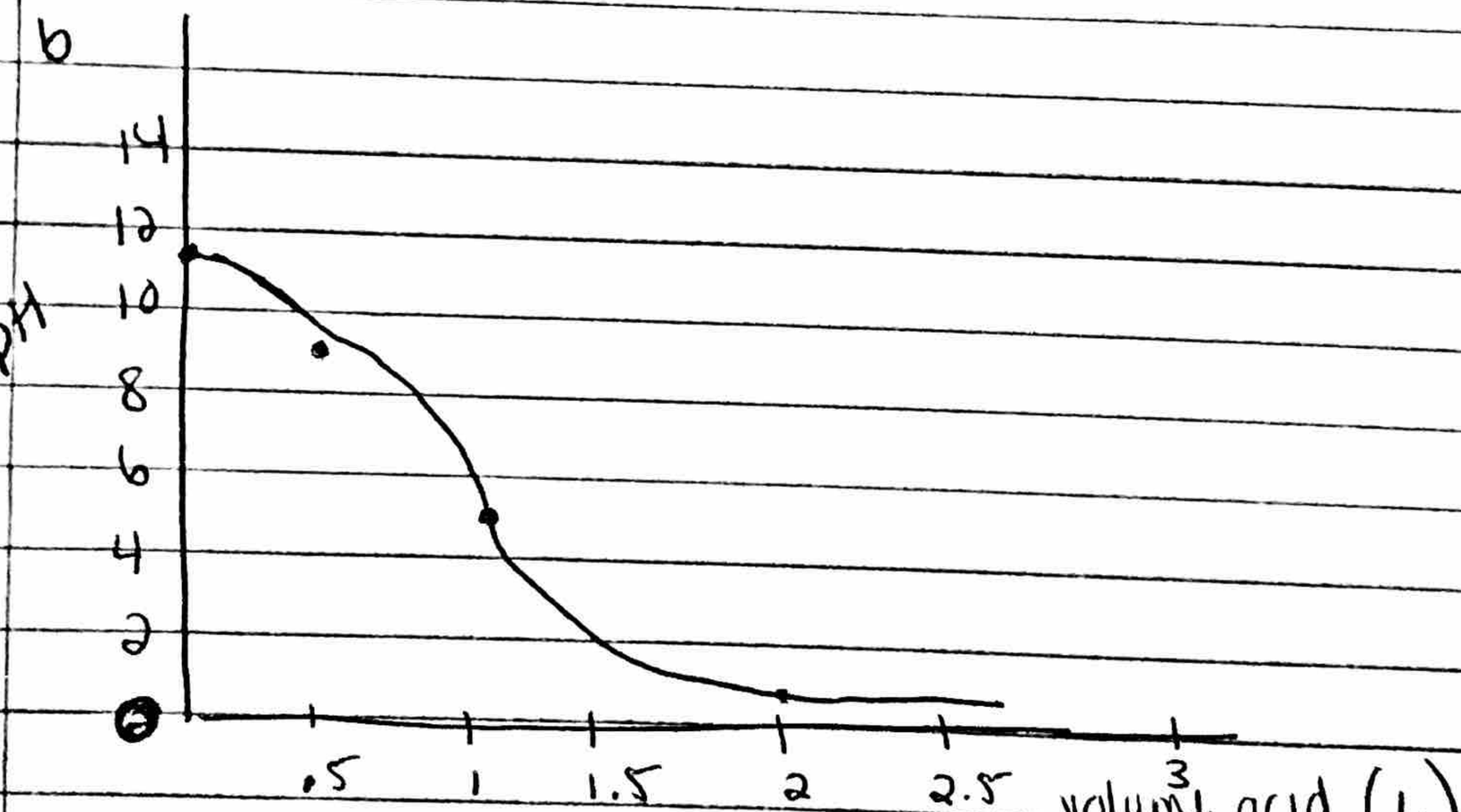
$pH = -\log(.5/3)$

pH = .78

12 a



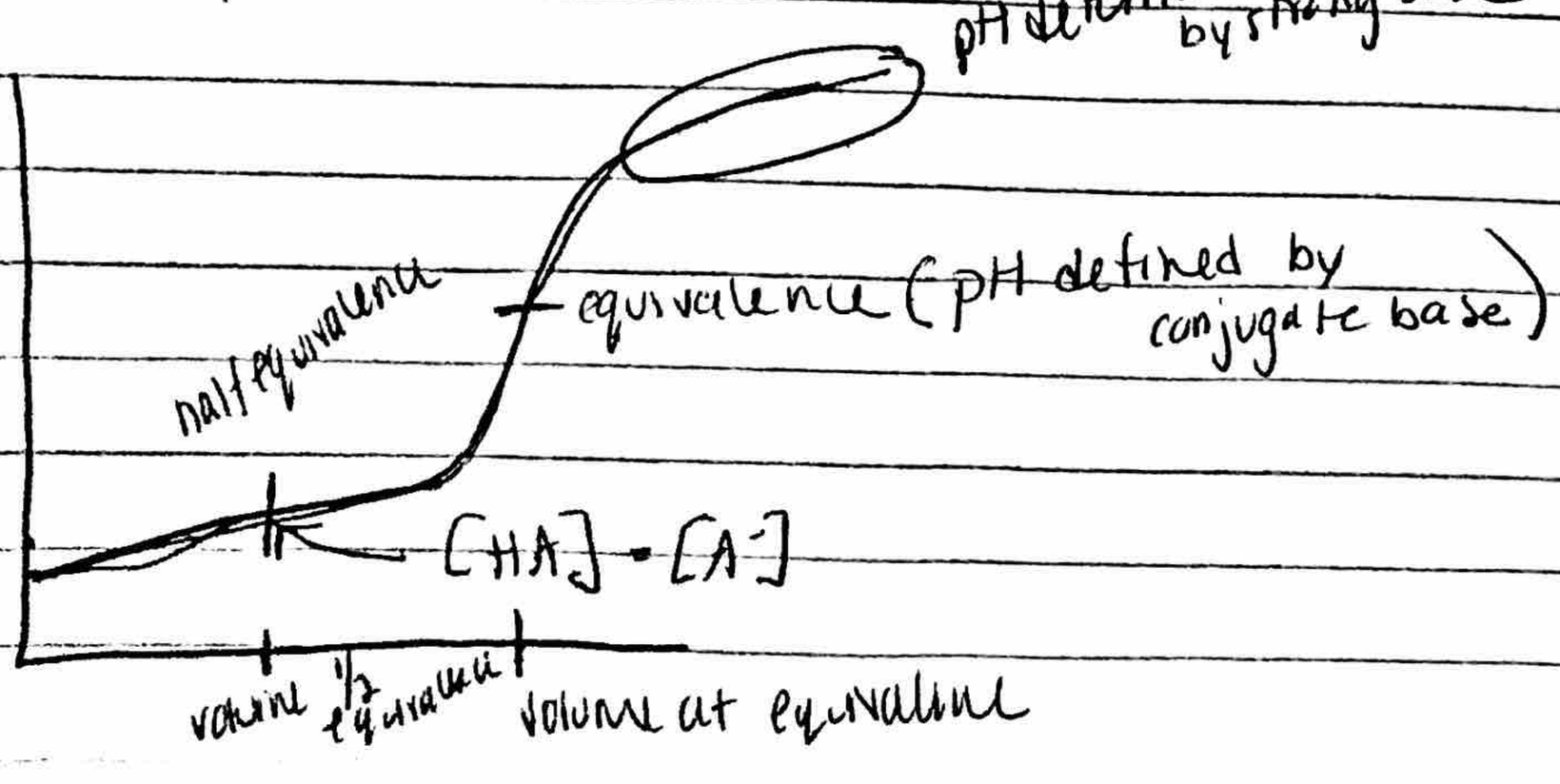
b



13 a - thymol blue

b - methyl red

14



15 a) $BaCO_3(s) \rightleftharpoons Ba^{+2}(aq) + CO_3^{-2}(aq)$

b) $Ag_2SO_4(s) \rightleftharpoons 2Ag^{+}(aq) + SO_4^{-2}(aq)$

16 a) $K_{sp} = [Ba^{+2}][CO_3^{-2}]$

b) $K_{sp} = [Ag^{+}]^2[SO_4^{-2}]$

17. a)

	$BaCO_3$	$\rightleftharpoons$	Ba^{+2}	+	CO_3^{-2}
I	3.4×10^{-5}		0		0
C	-3.4×10^{-5}		$+3.4\times10^{-5}$		$+3.4\times10^{-5}$
E	0		3.4×10^{-5}		3.4×10^{-5}

$K_{sp} = [3.4\times10^{-5}]^2 = \boxed{1.2\times10^{-9}}$

b)

	Ag_2SO_4	$\rightleftharpoons$	$2Ag^{+}$	+	SO_4^{-2}
I	7.4×10^{-6}		0		0
C	-7.4×10^{-6}		$+2(7.4\times10^{-6})$		$+7.4\times10^{-6}$
E	0		1.5×10^{-5}		7.4×10^{-6}

$2.3\times10^{-3}\ g \left| \frac{1\ mol}{311.87\ g} \right. = 7.4\times10^{-6}\ M$

$K_{sp} = (1.5\times10^{-5})^2(7.4\times10^{-6})$

$\boxed{K_{sp} = 1.6\times10^{-15}}$

18. a)

	$PbCl_2$	$\rightleftharpoons$	Pb^{+2}	+	$2Cl^{-}$
I	X		0		0
C	$-X$		$+X$		$+2X$
E	0		X		$2X$

$1.6\times10^{-5} = (x)(2x)^2$

$1.6\times10^{-5} = 4x^3$

$x = .016\ M$

b) $AgCl_{(s)} \rightleftharpoons Ag^+ + Cl^-$

I	X	0	0.30 M
C	-X	+X	+X
E	0	X	.3 + X

$$1.8 \times 10^{-10} = (x)(.3 + x)$$

$$1.8 \times 10^{-10} = .3x + x^2$$

$$x = 5.9 \times 10^{-10} M$$

19. a) $Q > K_{sp}$ precipitation will occur

$Q < K_{sp}$ precipitation will not occur

20 a) $K_2SO_4 = \frac{(300.0mL)(.300M)}{500.0mL} = .18 M$

$AgNO_3 = \frac{(200.0mL)(.200M)}{500.0mL} = .08 M$

Ag_2SO_4

$$Q = [.08]^2[.18]$$

$$Q = .0012$$

$K_{sp} = 1.2 \times 10^{-5} < Q$ will precipitate

b) $Pb(NO_3)_2 = \frac{(150mL)(.10)}{250mL} = .06 M$

$NaCl = \frac{(100mL)(.20)}{250} = .08 M$

$$Q = (.06)(.08)^2$$

$Q = 3.84 \times 10^{-4} > K_{sp}$

will precipitate