

Exam 2 – Chapters 14 & 15**Some K_a Values:**

Acetic acid (CH_3COOH)	1.8×10^{-5}
Nitrous acid (HNO_2)	4.5×10^{-4}
Formic acid (HCO_2H)	1.8×10^{-4}
Hydrocyanic acid (HCN)	4.9×10^{-10}
Hypochlorous acid (HOCl)	3.5×10^{-8}

Some K_b Values:

Ammonia (NH_3)	1.8×10^{-5}
Methylamine (CH_3NH_2)	3.7×10^{-4}

1. (6 pts) Normal rain has a pH of 5.7. The hydroxide ion concentration is $5.0 \times 10^{-9} \text{ M OH}^-$ and the solution is acidic / basic (circle one and show your work!).

2. (6 pts) The pH of a 0.00025 M $\text{Ba}(\text{OH})_2(\text{aq})$ solution is 10.70.

There are 2 OH^- ions so $2 \times 0.00025 \text{ M}$ for $[\text{OH}^-] = 0.00050 \text{ M OH}^-$
 $\text{pOH} = -\log 0.00050 = 3.30$ and $\text{pH} = 14.00 - 3.30 = 10.70$

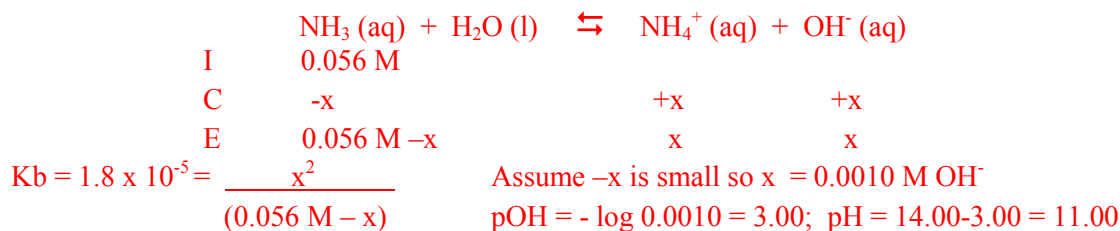
3. (4 pts) Write the conjugate acid and base for hydrogen sulfite ion, HSO_3^-

conjugate acid: H_2SO_3 conjugate base: SO_3^{2-}

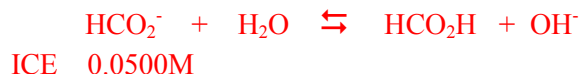
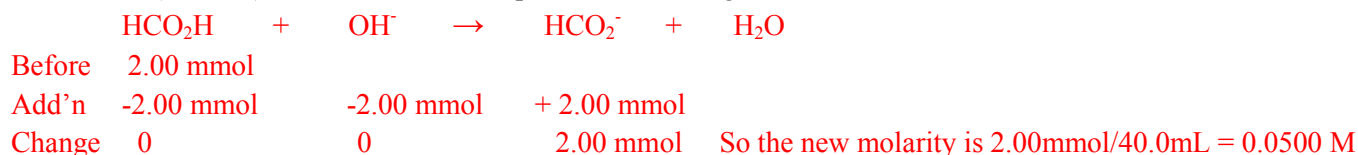
4. (8 pts) Classify the following substances as strong acid, weak acid, strong base, weak base, basic salt, acidic salt:

- a. HNO_2 weak acid _____
 b. CH_3COOK basic salt _____
 c. $\text{CH}_3\text{NH}_3\text{I}$ acidic salt _____
 e. HBr strong acid _____

5. (10 pts) Calculate the pH of $5.6 \times 10^{-2} \text{ M NH}_3$ solution.



6. (10 pts) If 20.0 mL of 0.100M potassium hydroxide was titrated into a beaker containing 20.0 mL of 0.100 M formic acid (HCO_2H) solution, what is the pH of the resulting solution?



Use K_b instead of K_a and Solve ICE table for $x = 1.7 \times 10^{-6} \text{ M}$,
 $\text{pOH} = 5.78$ and $\text{pH} = 8.22$

7. (6 pts) When a weak base is titrated with a strong acid, the pH at the equivalence point is:

Less than 7

8. (8 pts) For the equilibrium reaction of acetic acid in water,

a. Write out the balanced equation for acetic acid in water.



b. When sodium acetate is added to the acetic acid solution,

i) The pH increases and the percent ionization increases.

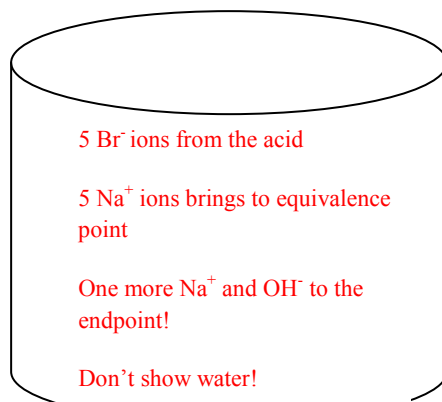
ii) The pH decreases and the percent ionization increases.

iii) The pH decreases and the percent ionization decreases.

iv) The pH increases and the percent ionization decreases. Use Le Chatlier's Principle to the above equation!

v) The pH and percent ionization remain unaffected.

9. (10 pts) Complete a beaker drawing when 5 moles of hydrobromic acid is titrated with sodium hydroxide to the endpoint.



What is the pH at the endpoint?

less than 7

equal to 7

greater than 7 extra OH⁻

10. (10 pts) Calculate the pH of the solution when 10.0 mL of 0.150 M potassium nitrite (KNO₂) is added to 15.0 mL of 0.250 M nitrous acid (HNO₂) solution.

BUFFER! So use H-H Equation!

$$\text{pH} = -\log 4.5 \times 10^{-4} + \log (0.060 \text{ M}/0.150 \text{ M}) = 2.95$$

Note: New volume is 25.0 mL so you need to do some CHM151 math!

$$[10.0 \text{ mL} (0.150 \text{ mmol/mL})]/25.0 \text{ mL} = 0.0600 \text{ M NO}_2^- \text{ the conjugate base!}$$

11. (6 pts) Which of the following is NOT true as an acid gets stronger?

a. The hydronium ion concentration increases

b. The pH decreases

c. Percent ionization increases

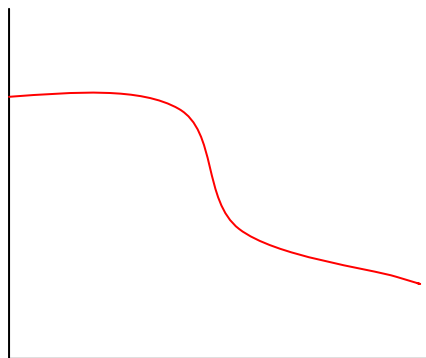
d. The K_a value decreases *Only temperature effects the value of K_a!

e. The hydroxide ion concentration decreases

12. (10 pts) Draw a titration curve for 10.0 mL of 0.100 M NH_3 titrated with 0.100 M NaOH .
- Please make sure you title your graph and label the x and y axis.
 - Label the initial pH.

Use ICE table to get the initial pH!
 $[\text{OH}^-]$ from Ice table = 0.0013M
 $\text{pOH} = 2.87$, $\text{pH} = 11.13$

Labels should be present!



13. (6 pts) Which of the following gives a buffer solution when equal volumes of the two are mixed?
- 0.10 M HF and 0.10 M NaCN
 - 0.10 M HF and 0.10 M NaOH
 - 0.10 M HF and 0.10 M HCl
 - 0.20 M HF and 0.10 M HF
 - 0.10 M HF and 0.10 M NaF The best buffers are weak acids/bases and their conjugates!

Extra Credit: (6 pts) Many home swimming pools are disinfected by adding calcium hypochlorite, $\text{Ca}(\text{OCl})_2$. Calculate the pH of a 0.100 M $\text{Ca}(\text{OCl})_2$ solution. (Hint: What reaction occurs when hypochlorite ion is in water?)

You have 2 OCl^- ions so the molarity of the basic ion is 0.200M



I
C
E

Use K_b instead of K_a and solve for $x = [\text{OH}^-]$, get pOH , then $\text{pH} = 10.38$