**Using $K_a$'s to determine $K_{eq}$ for a given reaction:** You can compare the $K_a$ values of two acids to determine if a given acid/base reaction is reactant or product favored!

**Example:** $HC_2H_3O_2 + HCO_3^- \leftrightharpoons C_2H_3O_2^- + H_2CO_3$

$K_a$ of $HC_2H_3O_2 = 1.8 \times 10^{-5}$ ⇒ Stronger acid

$K_a$ of $H_2CO_3 = 4.3 \times 10^{-7}$

1. What are the **two** conjugate acid-base pairs in this reaction? $HC_2H_3O_2$ and $C_2H_3O_2^-$; $HCO_3^-$ and $H_2CO_3$
2. What are the two acids in this reaction? $HC_2H_3O_2$ and $H_2CO_3$
3. Which acid is stronger, $HC_2H_3O_2$ or $H_2CO_3$? $HC_2H_3O_2$
4. Is the example reaction reactant or product favored? product-favored
5. Is the K value of this reaction less than 1, equal to 1, or greater than 1? $K > 1$

**Practice Problems!**

**1.** Consider the reaction of an acid in water: $HA(aq) + H_2O(l) \leftrightharpoons H_3O^+(aq) + A^-(aq)$

a. If $A^-$ is a stronger base than $H_2O$, is the value of K greater or less than 1? $K < 1$

b. If $A^-$ is a stronger base than $H_2O$, is HA a weak acid or a strong acid? weak acid

**2.** Given the following acid/base reaction: $NO_2^- + NH_4^+ \leftrightharpoons NH_3 + HNO_2$

$K_a$ of $NH_4^+ = 5.6 \times 10^{-10}$

$K_a$ of $HNO_2 = 4.5 \times 10^{-4}$ ⇒ Stronger acid

1. What are the **two** conjugate acid-base pairs in this reaction? $NO_2^-$ and $HNO_2$; $NH_4^+$ and $NH_3$
2. What are the two acids in this reaction? $NH_4^+$ and $HNO_2$
3. Which acid is stronger? $HNO_2$
4. Is the example reaction reactant or product favored? reactant-favored
5. Is the K value of this reaction less than 1, equal to 1, or greater than 1? $K < 1$

**3.** The hypochlorite ion, $ClO^-$, is a weaker base than the cyanide ion, $CN^-$. Which is a stronger acid, HClO or HCN, and why?

HClO, b/c weaker base ⇒ stronger conjugate acid!

**4.** The term "$K_a$ for chlorous acid" refers to what chemical reaction?

$HClO_{2(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + ClO_2^-{}_{(aq)}$

**Multiple Choice Practice!**

**5.** You prepare a 0.100 M solution of acid. For which of the following acids will $[H_3O^+] = 0.100$ M? 100% dissociation ⇒ strong acid!

a. $HC_2H_3O_2$ b. $H_2SO_3$ (c.) $HNO_3$ d. $HIO_3$

**6.** All of the following can function as Brønsted-Lowry bases in solution EXCEPT:

a. $H_2O$ (c.) $H_3PO_4$ ] no room to accept an $H^+$

b. $NH_3$ d. $HCO_3^-$

**7.** You prepare a 2.0 M solution of acid. For which of the following acids will $[H_3O^+] << 2.0$ M? << 100% dissociation ⇒ weak acid!

a. HBr (b.) HF c. HI d. HCl

**8.** Which of the following acids can be oxidized to form a stronger acid?

a. $H_2CO_3$ (b.) $H_2SO_3$ c. $HNO_3$ d. $H_3PO_4$

↳ $H_2SO_4$

**9.** Which of the following is true for all bases?

a. All bases donate $OH^-$ ions into solution.

b. Only strong bases create solutions in which $OH^-$ ions are present.

(c.) Only strong bases are good conductors when dissolved in solution.

d. For weak bases, the concentration of the $OH^-$ ions equals to concentration of the base in solution.

**10.** A 0.5–molar solution of which of the following bases will have $[OH^-] << 0.5$ M? weak base!

a. $Mg(OH)_2$ b. LiOH (c.) $Al(OH)_3$ d. $Sr(OH)_2$

**11.** The structure of two oxyacids is shown below:

Which would be a stronger acid and why?

~~a.~~ HOCl, because the H–O bond is stronger than in HOF as chlorine is larger than fluorine.

b. HOCl, because the H–O bond is weaker than in HOF as chlorine has a higher electronegativity than fluorine.

(c.) HOF, because the H–O bond is weaker than in HOCl as fluorine has a higher electronegativity than chlorine.

~~d.~~ HOF, because the H–O bond is stronger than in HOCl as fluorine is smaller than chlorine.

**12.** A 0.5–molar solution of which of the following acids will be the best conductor of electricity? ⇒ strong acid

a. $H_2CO_3$ b. $H_2S$ c. HF (d.) $HNO_3$