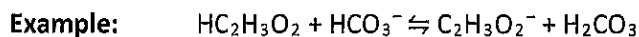


**Using  $K_a$ 's to determine  $K_{eq}$  for a given reaction:** You can compare the  $K_a$  values of two acids to determine if a given acid/base reaction is reactant or product favored!



$K_a$  of  $\text{HC}_2\text{H}_3\text{O}_2 = 1.8 \times 10^{-5} \Rightarrow$  Stronger acid

$K_a$  of  $\text{H}_2\text{CO}_3 = 4.3 \times 10^{-7}$

1. What are the **two** conjugate acid-base pairs in this reaction?  $\text{HC}_2\text{H}_3\text{O}_2$  and  $\text{C}_2\text{H}_3\text{O}_2^-$   
 $\text{HCO}_3^-$  and  $\text{H}_2\text{CO}_3$
2. What are the two acids in this reaction?  $\text{HC}_2\text{H}_3\text{O}_2$  and  $\text{H}_2\text{CO}_3$
3. Which acid is stronger,  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{H}_2\text{CO}_3$ ?  $\text{HC}_2\text{H}_3\text{O}_2$
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:  $\text{HA}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{A}^-(\text{aq})$

a. If  $\text{A}^-$  is a stronger base than  $\text{H}_2\text{O}$ , is the value of K greater or less than 1?  $K < 1$

b. If  $\text{A}^-$  is a stronger base than  $\text{H}_2\text{O}$ , is HA a weak acid or a strong acid? weak acid

2. Given the following acid/base reaction:  $\text{NO}_2^- + \text{NH}_4^+ \rightleftharpoons \text{NH}_3 + \text{HNO}_2$

$K_a$  of  $\text{NH}_4^+ = 5.6 \times 10^{-10}$

$K_a$  of  $\text{HNO}_2 = 4.5 \times 10^{-4} \Rightarrow$  Stronger acid

1. What are the **two** conjugate acid-base pairs in this reaction?  $\text{NO}_2^-$  and  $\text{HNO}_2$   
 $\text{NH}_4^+$  and  $\text{NH}_3$

2. What are the two acids in this reaction?  $\text{NH}_4^+$  and  $\text{HNO}_2$

3. Which acid is stronger?  $\text{HNO}_2$

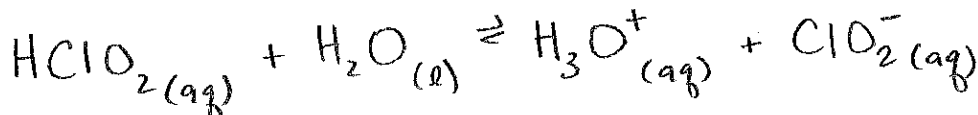
4. Is the example reaction reactant or product favored? reactant-favored

5. Is the K value of this reaction less than 1, equal to 1, or greater than 1?  $K < 1$

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

$\text{HClO}$ , b/c weaker base  $\Rightarrow$  stronger conjugate acid!

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



## 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  $\Rightarrow$  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.  $H_2O$       b.  $NH_3$       c.  $H_3PO_4$  } no room to accept an  $H^+$       d.  $HCO_3^-$
7. You prepare a 2.0 M solution of acid. For which of the following acids will  $[H_3O^+] \ll 2.0 M$ ?  $\ll 100\%$  dissociation  $\Rightarrow$  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.  $H_3PO_4$
- $\hookrightarrow H_2SO_4$
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  $[OH^-] \ll 0.5 M$ ? 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:
- $$H - \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} - \overset{\cdot\cdot}{\underset{\cdot\cdot}{Cl}} \quad H - \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} - \overset{\cdot\cdot}{\underset{\cdot\cdot}{F}}$$
- 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?  $\Rightarrow$  strong acid
- a.  $H_2CO_3$       b.  $H_2S$       c.  $HF$       d.  $HNO_3$