

## Chem12 Relative Acid Strengths-30

Suppose we have the following acid-base equilibrium :

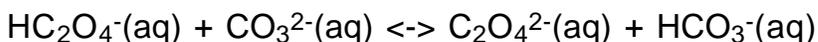


HA and HB are acids and B<sup>-</sup> and A<sup>-</sup> are bases. If HA is the stronger acid then the products are favored. K<sub>a</sub> for HA is greater than K<sub>a</sub> for HB (note : the K<sub>a</sub> value is the equilibrium constant of the reaction. Large K<sub>a</sub> values indicate stronger acids). Also A<sup>-</sup> is a weaker base than B<sup>-</sup>.

**Note** : In any acid-base reaction, the **weaker** acid and base are favored at equilibrium.

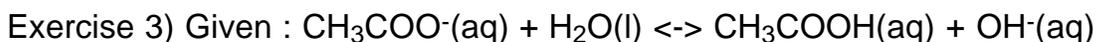
**Note** : In the acid strength table it can be seen that the stronger the acid, the weaker its conjugate base and vice versa.

Exercise 1) Given the acid-base reaction that occurs between the hydrogen oxalate ion and carbonate ion.



- Name the two acids. Which is strongest?
- Name the two bases. Which is strongest?
- Are the products or reactants favored?

Exercise 2) Which acid produces the greater [H<sub>3</sub>O<sup>+</sup>], HF or H<sub>2</sub>CO<sub>3</sub>. Assume the concentrations of both are equal.



- Name the two bases. Which is stronger?
- Are the products or reactants favored?

Exercise 4) H<sub>2</sub>S is a stronger acid than H<sub>2</sub>O.

Give the two conjugate bases of the above acids.

Which of the above bases is stronger?

Exercise 5) Which acid will have a greater  $[H_3O^+]$ ,  $HNO_2$  or  $C_6H_5COOH$ ? Assume concentrations are equal.

Exercise 6) Which base will have the greater  $[OH^-]$ ,  $NH_3$  or  $CO_3^{2-}$ ? Assume concentrations are equal.

Exercise 7)a) Write the equation for the acid-base equilibrium that occurs between hydrogen carbonate ions  $HCO_3^-$  and hydrogen sulfide ions  $HS^-$ .

b) Identify the acids and bases in the above reaction.

c) State whether products or reactants are favored at equilibrium.

Exercise 8) Which of the following pairs is the stronger acid?

a)  $H_2S$  or  $CH_3COOH$       b)  $H_2O_2$  or  $HSO_3^-$       c)  $H_2S$  or  $H_2PO_4^-$

Exercise 9) Which of the following pairs is the stronger base?

a)  $HCO_3^-$  or  $O^{2-}$       b)  $HPO_4^{2-}$  or  $HS^-$   
c)  $OH^-$  or  $NH_3$       d)  $HS^-$  or  $HSO_3^-$

Answers : 1)a)  $HC_2O_4^-$  (strongest),  $HCO_3^-$ ; b)  $CO_3^{2-}$  (strongest),  $C_2O_4^{2-}$   
c) products, 2)  $HF$ , 3)a)  $CH_3COO^-$ ,  $OH^-$  (strongest), b) reactants, 4)  $HS^-$ ,  $OH^-$  (strongest), 5)  $HNO_2$ , 6)  $CO_3^{2-}$ , 7)a)  $HCO_3^- + HS^- \rightleftharpoons CO_3^{2-} + H_2S$ ,  
b) acids are  $HCO_3^-$  and  $H_2S$ , bases are  $HS^-$  and  $CO_3^{2-}$ , c) reactants, 8)a)  $CH_3COOH$ , b)  $HSO_3^-$ , c)  $H_2S$ , 9)a)  $O^{2-}$ , b)  $HPO_4^{2-}$ , c)  $OH^-$ , d)  $HS^-$ .