Chem12 Relative Acid Strengths-30

Suppose we have the following acid-base equilibrium :

$$HA(aq) + B^-(aq) <-> HB(aq) + A^-(aq)$$

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

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.

$HC_2O_4^-(aq) + CO_3^{2-}(aq) <-> C_2O_4^{2-}(aq) + HCO_3^-(aq)$

a) Name the two acids. Which is strongest?

b) Name the two bases. Which is strongest?

c) Are the products or reactants favored?

Exercise 2) Which acid produces the greater $[H_3O^+]$, HF or H_2CO_3. Assume the concentrations of both are equal.

Exercise 3) Given : $CH_3COO^-(aq) + H_2O(l) <-> CH_3COOH(aq) + OH^-(aq)$

a) Name the two bases. Which is stronger?

b) Are the products or reactants favored?

Exercise 4) H_2S is a stronger acid than H_2O.

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) $HCO_3^- + HS^- <-> CO_3^{2-} + H_2S$, 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^-.