Name:_____ Period:_____

K_a and K_b Calculations Worksheet

When a strong acid or base is placed in water, they completely ionize. This means that approximately 100% of the acid or base forms products (or the arrow in the chemical equation points one direction). In the case of a weak acid or base, the substance only partially ionizes. This means equilibrium is established in an aqueous solution of a weak acid or base. Using your understanding of acid/base chemistry, complete the following problems.

1. Write chemical equations which represent the dissociation of each of these acids or bases in aqueous solution. Use a single arrow in the case of a strong acid or base, and a double arrow to represent the equilibrium condition that exists in the solution of a weak acid or base.

a. HCl
b. NaOH
c. H_2SO_4
d. KOH
e. $HC_2H_3O_2$
f. HCN
g. $Cu(OH)_2$
h. NH_4OH

2. Calculate the $[H^+]$ and $[OH^-]$ of a 1.0×10^{-3} M solution of HCl, a strong acid.

3. Calculate the $[OH^-]$ and the $[H^+]$ of a 0.0020 M solution of NaOH, a strong base.

4. Benzoic acid, $HC_6H_5CO_2$, is an organic acid whose sodium salt, $NaC_6H_5CO_2$, has long been used as a safe food additive to protect beverages and many foods against harmful yeasts and bacteria. The acid is monoprotic. Write the equation for its K_a.

5. The $[H^+]$ of a 0.10 M solution of cyanic acid (HCNO) is found to be 0.0010 M. Calculate the K_a for cyanic acid.

$$HCNO \leftrightarrow H^+ + CNO^-$$

6. If 1.22 grams of benzoic acid, $HC_6H_5CO_2$, is dissolved in 1.0 L of water, the $[H^+]$ is found to be 8.0×10^{-4} M. Calculate the K_a for benzoic acid.

$$HC_6H_5CO_2 \leftrightarrow H^+ + C_6H_5CO_2^-$$

7. A 0.0050 M solution of butyric acid, HC_4H_7, has a pH =4.0, calculate K_a.

$$HC_4H_7O \leftrightarrow H^+ + C_4H_7O_2^-$$

8. Determine the $[OH^-]$ and the $[H^+]$ of a 0.20 M solution of formic acid. The $K_a = 1.8 \times 10^{-4}$

$$HCOOH \leftrightarrow H^+ + HCOO^-$$

9. HCN has an initial molarity of 0.50 M, with a K_a value of 3.7×10^{-8}. Calculate its pH at equilibrium. (Hint: This is an ICE problem.)

10. Ethylamine ($C_2H_5NH_3$) is a weak Bonsted-Lowry base. If it has an initial molarity of 0.024 M and a K_b of 5.6×10^{-4}, calculate its pH at equilibrium. (Hint: This is an ICE Problem.)

11. A chemist adds 0.75 moles of NH_3 to enough water to make 0.50 liters of solution. K_b of ammonia is 1.8×10^{-5}. Determine the pH of this solution at equilibrium. (Hint: This is an ICE problem.)

12. Hydrazine, N_2H_4, has been used as a rocket fuel. Like ammonia, it is a Bronsted base. A 0.15 M solution has a pH of 10.70. What is the K_b for hydrazine?