Weak Acid and Weak Base Questions and Problems-Set I

Because the answers are on this sheet, I expect to see all of your work if you want credit for completing this assignment.

1. Formic acid, HCOOH, is a monoprotic acid. In a 0.100 M solution of formic acid, the pH is 2.38 at 25°C. Calculate the K_a for formic acid at this temperature. (answer: 1.8×10^{-4})

2. Calculate the pH and [H+] of a 0.100 M solution of acetic acid, CH_3COOH, Ka = 1.8×10^{-5}. (answer: 2.87, 0.00134 M)

3. Which of the following solutions has the highest pH ?
   (a) 0.40 M HNO_2 (b) 0.40 M $HClO_4$ (c) 0.40 M CH_3COOH

4. The K_a for benzoic acid is 6.5×10^{-5}. Calculate the concentrations of all the species (C_6H_5COOH, $C_6H_5COO^-$, and H^+) in a 0.10 M benzoic acid solution. What is the [OH-] in this solution? (answer: 0.10 M, 0.0025 M, 0.0025 M; 4×10^{-12})

5. Calculate the percent ionization in a 0.20 M solution of hydrofluoric acid, HF. $K_a = 6.7 \times 10^{-4}$. (answer: 5.7 %)

6. The pH of an 0.10 M HCN solution is found to be 5.2. What is the K_a of HCN? (answer: 4×10^{-10})

7. Calculate the pH of a 15.0 M NH_3 solution. The K_b of ammonia is 1.8×10^{-5}. (answer: 12.2)

8. The pH of a 1.0 M CH_3NH_2 solution is 12.32. What is the K_b of methylamine? (answer: 4.5×10^{-4})

9. What is the initial molarity of formic acid (HCOOH; $K_a = 6.9 \times 10^{-4}$) whose pH is 3.26 at equilibrium? (see question 1 for the K_a)

(answer: 0.0023 M)

10. Calculate the percent ionization of a weak acid (HA, $K_a = 6.5 \times 10^{-5}$) solution at the following concentrations:
(a) 0.20 M (b) 0.00020 M (answer: 1.80 %; 43%)

11. A 0.04 M solution of a weak acid, HA, in water is 14 % ionized. Calculate the K_a of this acid.

(answer: 9.1×10^{-4})

12. What is the pH of a 1.0 M NH_3 solution? Start by writing the appropriate ionization reaction and a K_b expression. The K_b of ammonia is 1.8×10^{-5}. (answer 11.6)

13. What is the H+ ion concentration in a 0.82 M HOCl solution? $K_a = 3.2 \times 10^{-8}$. (answer: 1.6×10^{-4} M)

14. A 1.0 M HF solution is only ionized 2.6%. What is the K_a value for HF? (answer: 6.9×10^{-4})

15. Calculate the pH and the % ionization in a 1.0 M HNO_2 solution. $K_a = 5.1 \times 10^{-4}$ (answer: 1.6; 2.3%)