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Chemistry 30

Unit 5: Acids & Bases

Assignment 2 – K_a, K_b, K_w and pH

1. Given the following balanced ionization reactions for the following weak acids and bases, write the K_a or K_b expressions for each.

   a. ascorbic acid: $HC_6H_7O_{6\,(aq)} \rightleftharpoons H^+_{(aq)} + C_6H_7O_6^-{}_{(aq)}$ $K_a =$

   b. boric acid: $H_3BO_{3\,(aq)} \rightleftharpoons H^+_{(aq)} + H_2BO_3^-{}_{(aq)}$ $K_a =$

   c. methyl amine: $CH_3NH_{2\,(aq)} + H_2O_{(l)} \rightleftharpoons CH_3NH_3^+{}_{(aq)} + OH^-{}_{(aq)}$ $K_b =$

2. Calculate $[OH^-]$ is a solution containing 100.0 g of potassium hydroxide in 2.50 L solution. Potassium hydroxide is a strong base.

3. A solution is prepared in which 0.600 mole of hydrogen chloride is dissolved in enough water to make 5.80 L. Calculate the concentration of hydrogen ions in this solution.

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4. A solution is prepared the contains 0.0445 mole of sulfuric acid in a total solution volume of 12.1 L. Sulfuric acid typically undergoes complete ionization according to the equation:

$$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$$

Calculate $[H^+]$. Sulfuric acid is a strong acid.

5. Phosphoric acid is a **weak** acid that undergoes the following ionization reaction:

$$H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$$

If there are 1.32×10^{-2} mole of phosphoric acid present in 875 mL of solution, calculate the concentration of hydrogen ions, H^+, in solution. K_a for phosphoric acid is 7.0×10^{-3}.

Begin by calculating $[H_3PO_4]$. Then use K_a to determine $[H^+]$.

6 Determine the pH of each of the following solutions, and tell whether the solution is acidic or basic.

		Acid or Base?
a) $[H^+] = 1.0 \times 10^{-3}$ M	pH = _____	_____
b) $[H^+] = 2.5 \times 10^{-5}$M	pH = _____	_____
c) $[OH^-] = 0.01$ M	pH = _____	_____

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7. Calculate both $[H^+]$ and $[OH^-]$ for the following solutions. All are either strong acids or strong bases. Be sure to clearly identify all answers.

   a) 2.5 M NaOH

   b) 0.045 M HCl

8 Calculate the pH of a 0.1 M solution of sodium hydroxide, NaOH, a strong base.

   Hint: First find $[OH^-]$. Use this to find $[H^+]$ which you then convert to pH

9 a) Determine the concentration of hydrogen ions, $[H^+]$ in a solution whose pH is 5.17.

   b) Calculate the hydroxide ion concentration, $[OH^-]$, for this solution.

10. Determine $[H_3O^+]$ in a solution whose pH = 9.22. (Hint: $[H_3O^+] = [H^+]$)

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11. A 2.67 g sample of hydrogen fluoride gas (HF) is dissolved in sufficient water to make 1.05 L of solution at 25°C to form an acidic solution. Hydrogen fluoride is a weak acid with $K_a = 6.6 \times 10^{-4}$.

    Calculate the pH of this solution.

    Begin by calculating [HF]. Then use K_a to determine $[H^+]$. Finally convert $[H^+]$ to pH.

12. The formula for ascorbic acid, better known as Vitamin C, is $HC_6H_7O_6$. K_a for ascorbic acid is 8.00×10^{-5}. Determine the pH of a solution prepared by dissolving a 500.0 mg vitamin C tablet in enough water to make 200.0 mL of solution.