Name: _____   Date: _____

Chemistry 30 Unit Exam

Acids & Bases   **70 total**

I. Multiple Choice   *20 marks*

You will need to refer to a table of Relative Strengths of Acids & Bases for some questions.

1. Among the following, the weakest acid is:

    A. hydrochloric acid   B. sulfuric acid

    C. nitric acid   D. acetic acid

2. A Brønsted-Lowry base can be defined as:

    A. a hydroxide ion (OH^-) donor

    B. a proton (H^+) donor

    C. a proton (H^+) acceptor

    D. a hydroxide ion (OH^-) acceptor

3. The hydronium ion is best represented as:

    A. H^- B. H^+

    C. H_3O^- D. H_3O^+

4. A certain solution has a pH of 8. How is this solution best described?

    A. strongly basic   B. weakly basic

    C. strongly acidic   D. weakly acidic

5. Mixtures of chemicals that make a solution resistant to a change in pH are known as:

    A. amphoteric   B. indicators

    C. electrolytes   D. buffers

6. The conjugate base of H_2CO_3 is:

    A. H_2O B. CO_3^{2-}

    C. HCO_3^- D. CO_2

7. Which of the following statements is TRUE concerning a 0.10 M HCl solution and a 0.10 M CH_3COOH (acetic acid) solution?

    A. The concentration of $H^+_{(aq)}$ in both solutions is 1.0×10^{-1}.

    B. The HCl solution almost totally ionizes while the CH_3COOH does not.

    C. They are both considered to be strong acids.

    D. The HCl solution will turn litmus red, while the CH_3COOH solution will not.

8. The hydronium ion concentration, $[H_3O^+]$, of a 0.015 M aqueous HNO_3 solution is:

    A. 0.015 M   B. 0.030 M

    C. 3.3×10^{-13} M   D. 1.5

9. Consider the following acid-base reaction:

    $HF_{(aq)} + HCO_3^-{}_{(aq)} \rightleftharpoons F^-{}_{(aq)} + H_2CO_3{}_{(aq)}$

    The substances acting like bases are:

    A. HF and F^-

    B. HCO_3^- and F^-

    C. HF and H_2CO_3

    D. HCO_3^- and H_2CO_3

10. The pH of a solution in which $[H^+] = 1.5 \times 10^{-5}$ is:

    A. 1.5   B. 10

    C. 4.8   D. 9.2

11. HCN is a weak acid, with a $K_a = 4.0 \times 10^{-10}$. In a 1.0 M solution, which of the following species will be present in the greatest concentration?

    A. H^+

    B. CN^-

    C. HCN

    D. both H^+ and CN^-

12. If a solution has a pH of 3, then the concentration of hydrogen ions, H^+ is:

    A. 1.0×10^{-3} M

    B. 1.0×10^{-11} M

    C. 1.0×10^{3} M

    D. 1.0×10^{-14} M

13. Which of the following acids is the strongest? All are 1.0 M.

    A. HF $K_a = 6.7 \times 10^{-4}$

    B. H_3PO_4 $K_a = 7.1 \times 10^{-3}$

    C. CH_3CO_2H $K_a = 1.8 \times 10^{-5}$

    D. H_2CO_3 $K_a = 4.4 \times 10^{-7}$

14. What substances are acting as acids in this equilibrium reaction:
$CN^- + H_2O \rightleftharpoons HCN + OH^-$

    A. CN^-, H_2O

    B. H_2O, HCN

    C. CN^-, OH^-

    D. H_2O, OH^-

15. A solution in which the hydroxide ion concentration is 1.0×10^{-4} is:

    A. acidic

    B. basic

    C. neutral

    D. amphoteric

16. If $[H^+]$ in a solution is 1.0×10^{-1} M, then $[OH^-]$ is:

    A. 1.0×10^{-1} M

    B. 1.0×10^{-15} M

    C. 1.0×10^{-13} M

    D. 1.0×10^{-7} M

17. A 0.001 M solution of an acid that ionizes only slightly in solution would be termed:

    A. concentrated and weak

    B. strong and dilute

    C. dilute and weak

    D. concentrated and strong

18. Which of the following statements is **TRUE**?

    A. Bases turn litmus red and taste sour.

    B. Acids form electrolytic solutions, but bases do not.

    C. Bases are proton donors and react with active metals to produce hydrogen gas.

    D. A strong acid almost totally ionizes, while a weak acid only partially ionizes.

19. Normal rain water is slightly acidic. If a sample of rain water has a hydroxide ion concentration $[OH^-]$ of 1.6×10^{-8} M, the $[H^+]$ in that sample is:

    A. 1.6×10^{-8}

    B. 8.4×10^{-6}

    C. 4.5×10^{-7}

    D. 6.3×10^{-7}

20. In the neutralization reaction involving reactants $H^+_{(aq)} + Cl^-_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)}$, the spectator ions are:

    A. H^+ and Cl^-

    B. H^+ and Na^+

    C. Na^+ and Cl^-

    D. Cl^- and OH^-

II. Short Answer   50

Be sure to complete all parts to each question and to clearly identify the final answer .
Do not lose significant figures part-way through a calculation.

1. Determine $[H^+]$ in a 0.02 M solution of perchloric acid, $HClO_4$. Perchloric acid is a very strong acid.

                                                                                        2

2. Write the K_a expressions for each of these acids. Assume that only one hydrogen is ionized.   **2**

    a) hydrofluoric acid, HF   b) formic acid, $HCHO_2$

3. Calculate the pH for the following solutions. Read the information provided carefully.
    Identify each as acidic, basic, or neutral.   **8**

	pH	**acid, base, or neutral**
a) $[H^+] = 1.0 \times 10^{-10}$		
b) $[OH^-] = 1.0 \times 10^{-10}$		
c) $[OH^-] = 1.0 \times 10^{-1}$		
d) $[H^+] = 1.0 \times 10^{-5}$		

4. a) Calculate the hydrogen-ion concentration $[H^+]$ for an aqueous solution in which
        $[OH^-]$ is 1.0×10^{-11} M.

    b) Is the solution acid, basic, or neutral?   **3**

5. Calculate $[H^+]$ in a 0.005 M solution of $NaOH_{(aq)}$.   **3**

6. A student dissolves 250 g of hydrofluoric acid, HF, in enough water to make one litre of solution.

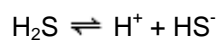   a) Calculate the concentration of this solution in $mol \cdot L^{-1}$.   *2*

    b) Calculate $[H^+]$ for this solution, given that K_a for hydrofluoric acid is 6.7×10^{-4}.   *3*

        Begin by writing a balanced equation.

    c) Determine $[OH^-]$ for this solution.   *2*

   d) Determine the pH of this solution.   *1*

7. Hydrosulfuric acid, H_2S, is a weak acid with $K_a = 9.5 \times 10^{-8}$. This acid ionizes as follows:

    $$H_2S \rightleftharpoons H^+ + HS^-$$

    Determine the pH of a 0.25 M solution of this acid.   (Hint: $[H_2S]$ = 0.25 M. Find $[H^+]$)   *4*

8. Ca(OH)$_2$ is a strong base. Determine the pH of a 0.11 M solution of Ca(OH)$_2$.   *4*

    (Hints: [Ca(OH)$_2$] = 0.11. Begin by finding [OH$^-$])

9. Determine each of the following: *3*

    a) Find [H$^+$] of a solution whose pH is 8.3

    b) Find [H$^+$] in a solution with a pOH of 3.75

    c) Calculate [OH$^-$] in a solution with a pH of 9.2

10. Determine the concentration of a solution of KOH for which the pH is 11.89.
    KOH is a strong base.   *3*

11. A 0.24 M solution of the weak acid H_2CO_3 has a pH of 3.49. Determine K_a for H_2CO_3.
    H_2CO_3 dissociates according to:

    4

$$H_2CO_{3\,(aq)} \rightleftharpoons H^+_{\,(aq)} + HCO_3^-{}_{(aq)}$$
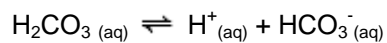
12. A neutral solution is produced when 41.32 mL of a 0.1077 M HCl solution was used to titrate 50.00 mL of a NaOH solution. Calculate the concentration of the sodium hydroxide solution before titration.

    3

13. A 30.0 mL sample of sulfuric acid, H_2SO_4, is titrated to an end point with 90.0 mL of 0.40 M NaOH. What is the concentration of the sulfuric acid? *3*