**Problem Set 5**  (**Due April 24th 8:00 AM**)

Answers to the problems in **RED** need to be submitted through the course website before class begins on the due date.

**Acids and Bases**

[**Follow this link for a table of pKa values**](http://chem.winthrop.edu/faculty/grossoehme/link_to_webpages/courses/chem105/supp/pka.jpg)

1. For each of the following salts, predict if a 100 mM solution would be acidic, basic, or neutral.

NaCl NaNO3 KNO2 KH2PO4 sodium acetate ammonium chloride

1. For each pair, identify which will be a more acidic solution:
   1. 10 mM HCl or 10 mM HF
   2. 10 mM HNO2 or 10 mM HNO3
   3. 10 mM H2SO4 or 10 mM HCl
   4. 10 mM H3PO4 or 10 mM HF
   5. 10 mM HNO2 or 20 M HNO2
   6. 10 mM H2SO4 or 0.2 M H2SO4
2. For each of the following, calculate Ka
3. HClO (pKa = 7.53)
4. HF (pKa = 3.2)
5. For each acid in problem 3, determine the conjugate base.
6. For each base in problem 3, determine the Kb and pKb.
7. Determine the pH of each of the following solutions:
8. [H3O+] = 1.5 M
9. [OH-] = 1.5 M
10. pOH = 5
11. [H3O+] = 4.89 mM
12. [OH-] = 18.6 M
13. pOH = 11
14. Calculate the pH of each of the following solutions (note pKa values are available [here](http://chem.winthrop.edu/faculty/grossoehme/link_to_webpages/courses/chem105/supp/pka.jpg)):
15. 650 M HF
16. 175 M HClO
17. 650 M HCl
18. 175 M HClO4
19. 1 mM Mg(OH)2
20. 10 M Mg(OH)2
21. 650 mM MgF2
22. 175 mM Ca(ClO)2
23. Calculate the pOH of:
24. 650 mM NaF
25. 175 mM NaClO
26. For each of the following acids, determine what concentration is needed to have a pH of 5.5. Please answer in **micromolar**.
    1. Hydrochloric acid
    2. Nitric acid
    3. Ammonium chloride
    4. Chloroacetic acid

**Buffers and Titrations**

1. For each buffer, determine the buffering range.

|  |  |  |
| --- | --- | --- |
| **Buffer** | **Maximum buffered pH** | **Minimum buffered pH** |
| Hypochlorous Acid |  |  |
| Boric Acid |  |  |
| Formic Acid |  |  |

1. For each of the following, determine which form of the buffer (HA or A-) will be present at higher concentration.
   1. pKa = 5.75 pH = 4.5
   2. pKa = 3.75 pH = 4.5
   3. pKa = 8.8 pH = 8.8
   4. pKa = 7.1 pH = 7.2
2. Calculate the pH of a 500 mL solution that is:
3. 0.15 M CH3CO2H and 0.25 M CH3CO2-.
4. 1.25 M F- and 1.38 M HF
5. Calculate the mass of the indicated ionic compound that is needed for each of the following solutions
   1. How much potassium hypochlorite is needed to create a 250 mL buffer at pH 7.0 with 100 mM hypochlorous acid?
   2. How much sodium nitrite is needed to create a 500 mL buffer at pH 3.8 with 75 mM nitrous acid?
6. Calculate the resulting pH when 10 mL of 0.5 M NaOH is added to:
   1. 1.8 L solution of 50 mM hypochlorite buffered at a pH of 7.0
   2. 3.6 L of 200 mM solution of nitrite buffered at pH 3.8.
7. What mass of sodium acetate needs to be added to each of the following solutions of acetic acid to create a buffer at pH 5.3?
8. 500 mL of 1.00 M acetic acid
9. 250 mL of 385 mM acetic acid.

|  |  |
| --- | --- |
| 1. NaCl = Neutral (HCl is a strong acid)  KNO2 = basic sodium acetate = basic  3. a. Ka = 2.95 x 10-8  5. a. pKb = 6.47 Kb = 3.38 x 10-7  7. a. pH = 3.4 c. pH = 3.19 e. pH = 11.3 g. pH = 8.66  9. a. 3.16 M c. 17,800 M  11. a. HA b. A-  13. a. 0.901 g | 2. a. HCl c. H2SO4 e. 10 mM HNO2  4. ClO-  6. a. pH = 5.82 b. pH = 8.18 c. pH = 9  8. a. pOH = 5.49  10. Minimum = 6.4 Maximum = 8.4  12. pH = 4.97  14. a. 6.873 |