1. (3 points) State whether each of the following solutions will be acidic, basic, or neutral. Note that $K_a$ for $\text{HNO}_2$ is $4.5 \times 10^{-4}$ and $K_a$ for $\text{NH}_4^+$ is $5.6 \times 10^{-10}$.

a. $\text{NaNO}_3$ - NEUTRAL
b. $\text{NaNO}_2$ - BASIC

c. $\text{NH}_4\text{NO}_2$ - ACIDIC

\[ \text{NO}_2^- \quad K_a = \frac{1.0 \times 10^{-1}}{4.5 \times 10^{-4}} = 2.2 \times 10^{-5} \]

\[ \text{NH}_4^+ \quad K_a = 5.6 \times 10^{-10} \quad \leftarrow \text{LARGER} \]

2. (5 points) The pH of a 0.14 M solution of a weak base is 10.42. What is $K_b$ for the base?

\[ [\text{OH}^-] = 2.6 \times 10^{-4} \]

\[ \beta^- + \text{H}_2\text{O} \rightleftharpoons \text{H}^- + \text{OH}^- \]

\[ K_b = \frac{(2.6 \times 10^{-4})^2}{1.9 - 2.6 \times 10^{-4}} = 5.0 \times 10^{-7} \]

3. (5 points) A 0.100 L sample of 0.350M NaClO (aq) ($K_b = 2.9 \times 10^{-7}$) is being studied.

a. What atoms, ions or molecules are present in solution?

\[ \text{Na}^+, \text{ClO}^-, \text{HClO} \quad (\text{and} \quad \text{H}^+, \text{OH}^-) \]

b. Calculate the pH of the solution. Show your work.

\[ \text{ClO}^- + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{OH}^- \]

\[ K_b = 2.9 \times 10^{-7} = \frac{x^2}{0.350 - x} \]

\[ x = [\text{OH}^-] = 3.2 \times 10^{-4} \]

\[ \text{pH} = 10.47 \]

4. (5 points) A solution of nitrous acid ($K_a = 4.5 \times 10^{-4}$) has a pH of 2.92. Calculate the amount of $\text{HNO}_2$ originally dissolved per liter, i.e. $[\text{HNO}_2]_{\text{initial}}$.

\[ \text{pH} = 2.92 \quad \Rightarrow \quad [\text{H}^+] = 1.2 \times 10^{-3} = [\text{NO}_2^-] \]

\[ K_a = 4.5 \times 10^{-4} = \frac{[\text{H}^+] [\text{NO}_2^-]}{[\text{HNO}_2]} \quad \Rightarrow \quad [\text{HNO}_2] = 3.2 \times 10^{-3} \]

\[ [\text{HNO}_2] = [\text{HNO}_2]_{\text{initial}} - x \]

\[ [\text{HNO}_2]_{\text{initial}} = [\text{HNO}_2] + x = 3.2 \times 10^{-3} + 1.2 \times 10^{-3} = 4.4 \times 10^{-3} \text{M} \]

5. (2 points) For each of the following pairs of acids, circle the one that will be the STRONGER acid.

a. HClO or HClO$_2$

b. H$_2$S or H$_2$Se