1. (3 Pts) Consider the weak acid CH₃COOH (acetic acid). If a 0.048 M CH₃COOH solution is 5.2% ionized, determine the [H₃O⁺] concentration at equilibrium.

\[ 0.048 \times 0.052 = 2.5 \times 10^{-3} \text{M H}_3\text{O}^+ \]

\[ \text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightarrow \text{H}_2\text{O}^+ + \text{CH}_3\text{COO}^- \]

2. (2 Pts) Predict the direction in which the equilibrium will lie for the reaction

\[ \text{H}_2\text{CO}_3 + \text{F}^- \rightarrow \text{HCO}_3^- + \text{HF} \]

\[ K_s(\text{H}_2\text{CO}_3) = 4.2 \times 10^{-7}; K_s(\text{HF}) = 7.1 \times 10^{-4} \]

A) to the left  B) to the right
C) in the middle  D) Favor weaker acid

3. (3 Pts) Which one of these salts will form a neutral solution on dissolving in water?

A) NaCl  B) KNO₂  C) NaCN  D) NH₄NO₃  E) FeCl₃

4. (3 Pts) Which one of these salts will form a basic solution on dissolving in water?

A) NaCl  B) KCN  C) NaNO₃  D) NH₄NO₃  E) FeCl₃

5. (4 Pts) Calculate the pH of a 0.021 M NaCN solution. [Kₐ(HCN) = 4.9 × 10⁻¹⁰]

\[ \text{CN}^- + \text{H}_2\text{O} \rightarrow \text{HCN} + \text{OH}^- \]

\[ x = 6.5 \times 10^{-5} \]

\[ \text{pOH} = 3.18 \]

\[ \text{pH} = 10.82 \]

More questions on back page.
6. Which one of the following is a buffer solution?
(A) 0.40 M HCN and 0.10 M KCN
(B) 0.20 M CH₃COOH
(C) 1.0 M HNO₂ and 1.0 M NaNO₃
(D) 0.10 M KCN
(E) 0.50 M HCl and 0.10 NaCl

7. Calculate the pH of a buffer solution that contains 0.25 M benzoic acid (C₆H₅CO₂H) and 0.15M sodium benzoate (C₆H₅COONa). \(K_a = 6.3 \times 10^{-5}\) for benzoic acid.

\[
\text{pH} = \text{pK}_a + \log \frac{[C₆H₅CO₂⁻]}{[C₆H₅CO₂H]}
\]

\[
\text{pK}_a = 4.19 + \log \frac{0.15}{0.25} = 3.97
\]

\[
\text{pH} = 3.97
\]

8. Calculate the pH of a solution that is 0.20M NH₃(aq) and 0.35 M NH₄Cl(aq). \(K_b(NH₃) = 1.8 \times 10^{-5}\)

\[
\text{pK}_b = \frac{1}{2} \left( -\log K_b \right) = \frac{1}{2} \left( -\log (1.8 \times 10^{-5}) \right) = 9.17
\]

\[
\text{pH} = 9.01
\]