Name: $\qquad$

## 26. Buffers

Show your work for all calculations.

1. What is the effect on the concentration of acetic acid, hydronium ion, and acetate ion when the following are added to an acidic buffer solution of equal concentrations of acetic acid and sodium acetate?

|  | $\mathbf{C H}_{3} \mathbf{C O}_{2} \mathbf{H}$ | $\mathbf{H}^{+}$ | $\mathbf{C H}_{3} \mathbf{C O}_{2}{ }^{-}$ |
| :--- | :--- | :--- | :--- |
| a. HCl |  |  |  |
| b. $\mathrm{KCH}_{3} \mathrm{CO}_{2}$ |  |  |  |
| c. NaCl |  |  |  |
| d. KOH |  |  |  |
| e. $\mathrm{CH}_{3} \mathrm{CO}_{2} \mathrm{H}$ |  |  |  |

2. What is the effect on the concentration of ammonia, hydroxide ion, and ammonium ion when the following are added to a basic buffer solution of equal concentrations of ammonia and ammonium nitrate?

|  | $\mathbf{N H}_{3}$ | ( $\mathbf{O H}^{-}$ | $\mathbf{N H}_{\mathbf{4}}{ }^{+}$ |
| :--- | :--- | :--- | :--- |
| a. KI |  |  |  |
| b. $\mathrm{NH}_{3}$ |  |  |  |
| c. HI |  |  |  |
| d. NaOH |  |  |  |
| e. $\mathrm{NH}_{4} \mathrm{Cl}$ |  |  |  |

3. What is $\left[\mathrm{H}^{+}\right]$in a solution of $0.075 M \mathrm{HNO}_{2}$ and $0.030 M \mathrm{NaNO}_{2}$ ?

$$
\mathrm{HNO}_{2}(\mathrm{aq}) \rightleftharpoons \mathrm{H}^{+}(\mathrm{aq})+\mathrm{NO}_{2}^{-}(\mathrm{aq}) K_{\mathrm{a}}=4.5 \times 10^{-5}
$$

4. What is $\left[\mathrm{OH}^{-}\right]$in a solution of $1.25 \mathrm{M} \mathrm{H}_{3}$ and $0.78 \mathrm{M} \mathrm{H}_{4} \mathrm{NO}_{3}$ ?

$$
\mathrm{NH}_{3}(\mathrm{aq})+\mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \rightleftharpoons \mathrm{NH}_{4}^{+}(\mathrm{aq})+\mathrm{OH}^{-}(\mathrm{aq}) K_{\mathrm{b}}=1.8 \times 10^{-5}
$$

5. What mass of $\mathrm{NH}_{4} \mathrm{Cl}$ must be added to 0.750 L of a $0.100-\mathrm{M}$ solution of $\mathrm{NH}_{3}$ to give a buffer solution with a pH of 9.26 ? (Hint: Assume a negligible change in volume as the solid is added.)

$$
\mathrm{NH}_{3}(\mathrm{aq})+\mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \rightleftharpoons \mathrm{NH}_{4}^{+}(\mathrm{aq})+\mathrm{OH}^{-}(\mathrm{aq}) K_{\mathrm{b}}=1.8 \times 10^{-5}
$$

6. A $5.36-\mathrm{g}$ sample of $\mathrm{NH}_{4} \mathrm{Cl}$ was added to 25.0 mL of 1.00 M NaOH and the resulting solution diluted to 0.100 L .
a. What is the pH of this buffer solution?
b. Is the solution acidic or basic?
c. What is the pH of a solution that results when 3.00 mL of 0.034 M HCl is added to the solution?
