# CHEM 1C – GENERAL CHEMISTRY

Worksheet 5

1. Hydroxylamine ($HONH_2$) is a weak base with $K_b = 1.1 \times 10^{-8}$.
   (a) Write the formula for the conjugate acid of hydroxylamine.
   (b) What is the value of the acid ionization constant, $K_a$, for the conjugate acid?
   (c) Write the equation for the reaction between hydroxylamine and water.
   (d) Calculate the concentrations of all species in solution, and the pOH and pH of a 1.0 M aqueous solution of hydroxylamine.
   (e) Calculate the percent ionization of the hydroxylamine solution from part (d).

2. Write the reaction equations describing what happens when ammonium chloride is added to water, and calculate the pH of a 0.25 M solution of $NH_4Cl$ in water at 25 °C. For $NH_3$, $K_b = 1.8 \times 10^{-5}$.

3. What is the pH of a buffer solution that is initially 0.75 M $NH_3$ and 0.225 M $NH_4Cl$? For $NH_3$, $K_b = 1.8 \times 10^{-5}$.

4. A buffer is 0.100 M in $NH_4Cl$ and 0.100 M in $NH_3$. When a small amount of $HNO_3(aq)$ is added to this buffer, which buffer component neutralizes the added acid.

5. What is the pH of a buffer solution that is 0.120 M in formic acid ($HCO_2H$) and 0.080 M in potassium formate ($HCO_2K$). For formic acid, $K_a = 1.8 \times 10^{-4}$.

6. A 500.0 mL buffer solution is 0.10 M in benzoic acid and 0.10 M in sodium benzoate and has an initial pH of 4.19. What is the pH of the buffer upon addition of 0.010 mol of NaOH?

7. Calculate the *p*H after 0.015 mole of gaseous HCl is added to 250.0 mL of a buffer that initially is 0.75 M $NH_3$ and 0.225 M $NH_4Cl$. For $NH_3$, $K_b = 1.8 \times 10^{-5}$.

8. Which combination is the best choice to use to prepare a buffer with a pH of 9.0?
   (a) $NH_3$; $NH_4Cl$ ($pK_b$ for $NH_3 = 4.75$)
   (b) $C_5H_5N$; $C_5H_5NHCl$ ($pK_b$ for $C_5H_5N = 8.76$)
   (c) $HNO_2$; $NaNO_2$ ($pK_a$ for $HNO_2 = 3.33$)
   (d) $HCHO_2$; $NaCHO_2$ ($pK_a$ for $C_5H_5N = 3.74$)
   (e) $CH_3NH_2$; $CH_3NH_3Cl$ ($pK_b$ for $CH_3NH_2 = 3.36$)

9. Identify which of the following result in buffer solutions when the two solutions are mixed.
   (a) 100.0 mL 0.10 M $NH_3$ and 100.0 mL 0.10 M $NH_4Cl$
   (b) 50.0 mL 0.10 M $NaNO_2$ and 50.0 mL 0.10 M $HNO_2$
   (c) 50.0 mL 0.10 M HCl and 35.0 mL 0.15 M NaOH
   (d) 175.0 mL 0.10 M $NH_3$ and 150.0 mL 0.12 M NaOH
   (e) 100.0 mL 0.10 M HCl and 100.0 mL 0.20 M $NH_3$