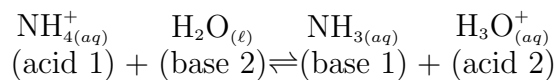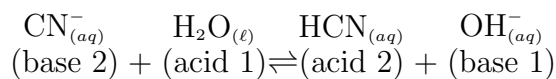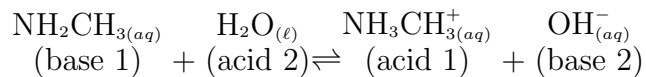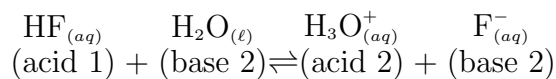# Chemistry 192
Recitation Section Problems
February 5, 2018
Solutions

1. Identify the acid and conjugate base pairs for each of the following acid/base reactions:

$$HF_{(aq)} \quad H_2O_{(\ell)} \quad H_3O^+_{(aq)} \quad F^-_{(aq)}$$
$$(\text{acid 1}) + (\text{base 2}) \rightleftharpoons (\text{acid 2}) + (\text{base 2})$$

$$NH_2CH_{3(aq)} \quad H_2O_{(\ell)} \quad NH_3CH^+_{3(aq)} \quad OH^-_{(aq)}$$
$$(\text{base 1}) \quad + (\text{acid 2}) \rightleftharpoons \quad (\text{acid 1}) \quad + (\text{base 2})$$

$$CN^-_{(aq)} \quad H_2O_{(\ell)} \quad HCN_{(aq)} \quad OH^-_{(aq)}$$
$$(\text{base 2}) + (\text{acid 1}) \rightleftharpoons (\text{acid 2}) + (\text{base 1})$$

$$NH^+_{4(aq)} \quad H_2O_{(\ell)} \quad NH_{3(aq)} \quad H_3O^+_{(aq)}$$
$$(\text{acid 1}) + (\text{base 2}) \rightleftharpoons (\text{base 1}) + (\text{acid 2})$$

2. Calculate the pH and pOH of the following aqueous solutions:

a) 0.12 M NaOH

Answer:

$$[OH^-] = 0.12 \text{ M} \qquad pOH = -\log_{10}(0.12) = 0.92 \qquad pH = 14.00 - pOH = 13.08$$

b) 0.025 M HNO_3

Answer;

$$[H_3O^+] = 0.025 \qquad pH = -\log_{10}(0.025) = 1.60 \qquad pOH = 14 - pH = 12.40$$

c) 1.0 ×10^{-8} M HCl.

Answer:

$$[OH^-] = y \qquad [H_3O^+] = 1.0 \times 10^{-8} + y$$

$$[H_3O^+][OH^-] = y(y + 1.0 \times 10^{-8}) = 1.0 \times 10^{-14}$$

$$y^2 + 1.0 \times 10^{-8}y - 1.0 \times 10^{-14} = 0$$

$$y = \frac{-1.0 \times 10^{-8} \pm [(1.0 \times 10^{-8})^2 + 4.0 \times 10^{-14}]^{1/2}}{2} = 9.5 \times 10^{-8} \quad \text{(ignoring the negative solution)}$$

$$[OH^-] = 9.5 \times 10^{-8} \text{ M} \qquad pOH = -\log_{10}(9.5 \times 10^{-8}) = 7.02 \qquad pH = 14.00 - pOH = 6.98$$

3. Find the final pH when 0.100 L of 0.25 M aqueous NaOH are mixed with 0.050 L of 0.375 M aqueous HCl.

Answer:

$$\text{Initial}: n_{OH^-} = (0.25 \text{ mol L}^{-1})(0.100 \text{ L}) = 2.5 \times 10^{-2} \text{ mol}$$

$$n_{H_3O^+} = (0.375 \text{ mol L}^{-1})(0.050 \text{ L}) = 1.9 \times 10^{-2} \text{ mol}$$

$$\text{After mixing}: n_{OH^-} = 2.5 \times 10^{-2} \text{ mol} - 1.9 \times 10^{-2} \text{ mol} = 6.0 \times 10^{-3} \text{ mol}$$

$$[OH^-] = \frac{6.0 \times 10^{-3} \text{ mol}}{0.100 \text{ L} + 0.050 \text{ L}} = 0.040 \text{ M}$$

$$pOH = -\log_{10}(0.040) = 1.40 \qquad pH = 14.00 - pOH = 12.60$$