Name _____ AP Chem ___/___/___

**Chapter 14 HW - #1 (Due 11/11/2015)**
**Complete both free response questions. One will be graded. Show all work. Box and clearly label all final answers**

1. Monochloroacetic acid, $HC_2H_2ClO_2$, is a skin irritant that is used in "chemical peels" intended to remove the top layer of dead skin from the face and improve complexion. The value of $K_a$ for monochloroacetic acid is $1.35 \times 10^{-3}$.
   (a) Calculate the pH for a 0.30 M solution of monochloroacetic acid.
   (b) Calculate the percent dissociation 0.30 M solution of monochloroacetic acid.
   (c) Calculate the pH for a 0.025 M solution of monochloroacetic acid.
   (d) Calculate the percent dissociation 0.025 M solution of monochloroacetic acid.
   (e) Even though percent dissociation increases as the concentration of a weak acid decreases, the $[H^+]$ decreases. Explain.

a. $1.35 \times 10^{-3} = \frac{x^2}{0.30}$ $x = 0.0201$ $pH = -\log 0.0201$

$pH = 1.70$

b. $\frac{0.0201}{0.30} \times 100 = 6.7\%$

c. $1.35 \times 10^{-3} = \frac{x^2}{0.025}$ $x = 0.0058$ $pH = -\log 0.0058$

$pH = 2.24$

d. $\frac{0.0058}{0.025} \times 100 = 23.2\%$

e. Dilution shifts the reaction to the side with more particles so % dissociation increases, pH also rises as $[H^+]$ decreases when more water is added.

2. $HF(aq)$ is a weak acid. It reacts with $NaOH(aq)$ according to the reaction represented below.

$$HF(aq) + OH^-(aq) \rightleftharpoons H_2O(l) + F^-(aq)$$

A volume of 35 mL of 0.39 *M* $NaOH(aq)$ is added to 45 mL of 0.40 *M* $HF(aq)$ solution. Assume that volumes are additive.

(a) Calculate the number of moles of $HF(aq)$ remaining in the solution.

(b) Calculate the molar concentration of $F^-(aq)$ in the solution.

In a reaction vessel, 0.900 mol of $Ba(NO_3)_2(s)$ and 0.400 mol of $H_3PO_4(aq)$ are combined with deionized water to a final volume of 2.00 L. The reaction represented below occurs.

$$3Ba(NO_3)_2(aq) + 2H_3PO_4(aq) \rightarrow Ba_3(PO_4)_2(s) + 6HNO_3(aq)$$

(c) Calculate the mass of $Ba_3(PO_4)_2(s)$ formed.

(d) What is the concentration, in mol $L^{-1}$, of the nitrate ion, $NO_3^-(aq)$, after the reaction reaches completion?

(e) What is the concentration, in mol $L^{-1}$, of the barium ion, $Ba^{2+}(aq)$, after the reaction reaches completion?

a.

NaOH: $\frac{0.39}{0.035} = \frac{x}{}$ $x = 0.01365$ moles NaOH

HF: $\frac{0.40}{0.045} = \frac{x}{}$ $x = 0.018$ moles HF

0.018 moles HF − 0.01365 = 0.00435 moles HF remain

b. Mol $F^-$ = moles NaOH = $\frac{0.01365 \text{ mol } F^-}{0.080} = 0.171 \text{ M } F^-$

c. $3Ba(NO_3)_2 + 2H_3PO_4 \rightleftharpoons Ba_3(PO_4)_2 + 6HNO_3$

0.900 0.400

$H_3PO_4$ is L.R.

$$0.400 \text{ mol } H_3PO_4 \left| \frac{1 \text{ mol } Ba_3(PO_4)_2}{2 \text{ mol } H_3PO_4} \right| \frac{601.93 \text{ g}}{1 \text{ mol } Ba_3(PO_4)_2} = 120.4 \text{ g } Ba_3(PO_4)_2$$

d. $0.900 \times 2 = \frac{1.80 \text{ mol}}{2 \text{ L}} = 0.900 \text{ M } NO_3^-$

e. $$0.400 \text{ mol } H_3PO_4 \left| \frac{3 \text{ mol } Ba(NO_3)_2}{2 \text{ mol } H_3PO_4} \right. = 0.600 \text{ mol } Ba^{2+} \text{ needed}$$

0.900 − 0.600 = 0.300 ÷ 2.0 = 0.150 M