CH 223 – Worksheet 2

1. A buffer contains 0.1 mol acetic acid and 0.13 mol potassium acetate in 1.00 L. a) What is the pH of this buffer. b) What is the pH of the buffer after the addition 0.02 mol of KOH? (CH_3COOH, $K_a = 1.8 \times 10^{-5}$).

a) $pH = pK_a + \log\frac{[A^-]}{[HA]} = 4.74 + \log\frac{0.13}{0.10} = 4.85$

b)

	$CH_3COOH_{(aq)} \rightleftharpoons$	$H^+(aq)$ +	$CH_3COO^-(aq)$ ↑
	0.10 M	OH^- 0.02 mol	0.13 M
	− 0.2	−0.02 mol	+0.02
	0.08 M	0	0.15

$pH = 4.74 + \log\frac{[0.15]}{0.08} = 5.01$

2. The K_{sp} for LaF_3 is 2×10^{-19}. What is the solubility of LaF_3 in water in grams per liter?

$LaF_3(s) \rightleftharpoons La^{3+}(aq) + 3\,F(aq)$

	0	0
	+x	+3x
	x	3x

$K_{sp} = [La^{3+}][F^-]^3 = x\,(3x)^3 = 27x^4 = 2.0 \times 10^{-19}$

$27x^4 = 2.0 \times 10^{-19}$

$x = \left(\frac{2.0 \times 10^{-19}}{27}\right)^{1/4}$

$x = 9.28 \times 10^{-6}\ \frac{mol}{L}\ LaF_3$

$MM = 195.9\ \frac{g}{mol}$

$(9.28 \times 10^{-6}\ \frac{mol}{L})(195.9\ \frac{g}{mol}) = 1.8 \times 10^{-3}\ \frac{g}{L}$

3. Will Ag_2SO_4 (Ksp = 1.5×10^{-5}) precipitate when 100 mL of 0.050 M $AgNO_3$ is mixed with 10 mL of 5.0×10^{-2} M Na_2SO_4 solution?

$(0.100\ L\ AgNO_3)(0.050\ \frac{mol}{L}\ AgNO_3) = 0.005\ mol\ Ag^+$

$\frac{0.005\ mol}{0.110\ L} = 0.04545\ \frac{mol}{L}\ Ag^+$

$(0.010\ L\ Na_2SO_4)(0.050\ \frac{mol}{L}\ Na_2SO_4) = 0.0005\ mol\ SO_4^{2-}$

$\frac{0.0005\ mol}{0.110\ L} = 0.004545$

$Ag_2SO_4(s) \rightleftharpoons 2\,Ag^+(aq) + SO_4^{2-}(aq)$

	0	0
	2x	x

$Q = [Ag^+]^2[SO_4^{2-}] = (0.04545)^2(0.004545) = 9.39 \times 10^{-6}\ \frac{mol}{L}$

$Q = 9.39 \times 10^{-6} < K_{sp} = 1.5 \times 10^{-5}$ ∴ No precipatate

4. If it takes 42.53 mL of NaOH to react with 1.00 g of potassium hydrogen phthalate (KHP; $KHC_8H_4O_4$), what is the concentration of NaOH?

$(1.00\ g\ KHP)\left(\frac{1\ mol\ KHP}{204\ g}\right)\left(\frac{1\ mol\ NaOH}{1\ mol\ KHP}\right)\left(\frac{1\ NaOH}{0.4253\ L}\right) = 0.1152\ \frac{mol}{L}\ NaOH$

$KHC_8H_4O_4(s) \rightarrow K^+(aq) + HC_8H_4O_4^- + NaOH \rightarrow NaC_8H_4O_4(aq) + H_2O(l)$