CH 102 Take Home Quiz 8

Name _____ **Day/Section** _____
Points will be taken off for the following mistakes:
Work not shown; Wrong significant figures; Units not shown

1. (1point) The number of moles of a solid that dissolves in 1 liter of water is called the molar solubility. For **$Mn_3(PO_4)_2$**, the molar solubility is **4.0×10^{-5} M**. What is the **K_{sp}** for this compound?

   $$Mn_3(PO_4)_2 \text{ (s)} \rightleftarrows 3Mn^{2+} \text{ (aq)} + 2PO_4^{3-} \text{ (aq)}$$

   $$K_{sp} = (3 \cdot s)^3 \cdot (2 \cdot s)^2 = 108 \cdot s^5 = 110592 \cdot 10^{-25} = 1.1 \cdot 10^{-20}$$

2. (2 points) 0.25 moles of $MgCl_2$ and 1.0 mole of NaOH are dissolved in water with a final volume of 1 L. The K_{sp} of $Mg(OH)_2$ is 5.6×10^{-12}. What is the final concentration of OH^- and Mg^{2+} at the equilibrium?

		$Mg(OH)_2$ (s)	⇆	$2OH^-$	+	Mg^{2+}
	I	excess		1mol		0.25mol(L.R) $Q_{sp} > K_{sp}$
	C			-0.5		-0.25
Revised	I			0.5		0 Q=0
	C			+2s		+s (s is very small))
	Eq			0.5		s

$$K_{sp} = 5.6 \times 10^{-12} = [OH^-]^2 \cdot [Mg^{2+}] = 0.5^2 \cdot s;$$

$$s = [Mg^{2+}] = 2.244 \cdot 10^{-11} M$$

$$[OH^-] = 0.5M$$

3. (1point) What is the molar solubility of $Mg(OH)_2$ in an aqueous solution ?

   $$K_{sp} = 5.6 \times 10^{-12} = (2s)^2 \cdot s$$

   $$s = 1.1 \cdot 10^{-4} \text{ mol/L}$$

4. (1point) What is the final concentration of the OH^- of $Mg(OH)_2$ in an aqueous solution of 0.10 M $MgCl_2$?

   $$K_{sp} = 5.6 \cdot 10^{-12} = (2s + 10^{-7})^2 \cdot 0.1$$

   $$(2s + 10^{-7}) = [OH^-] = 7.6 \cdot 10^{-6} \text{ mol/L}$$

4. (4 poits) A solution is made by adding 1 mmol of NaCl and 1 mmol of $AgNO_3$ to 1 L of water. $K_{sp}(AgCl)=1.6\cdot10^{-10}$

a. What will be the Q_{sp} reaction: $Q_{sp}= 10^{-3}\cdot10^{-3}=10^{-6} >>K_{sp}$

b. With regards to the AgCl, circle the correct choice:

$Q_{sp} < K_{sp}$ **$Q_{sp} = K_{sp}$**   **$\boxed{Q_{sp} > K_{sp}}$**

c. With regards to AgCl, circle the correct choice
   - **Precipitation will occur   _1point_**
   - **Precipitation will not occur**
   - **More information needed**

d. How many moles of AgCl will precipitate if any?

precipitate =__1 mmol

5. A buffer is prepared by combining 0.24mol of HA, $K_a = 1.3 \times 10^{-5}$, and 0.35 mol of NaA in a total volume of 415 mL at 25 °C.

a. (1point) 200.0 mL of 1.5 M HCl solution is added to the buffer above, and the resulting solution is allowed to come to equilibrium. Calculate the equilibrium pH of the solution.
0.30mols of HCl added so after limiting reaction:

$$HCl\ (aq)\quad +\quad A^-(aq) \rightarrow\quad HA(aq)\ +\quad Cl^-(aq)$$
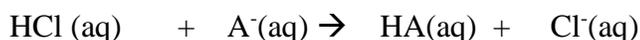
Initial: 0.3 mol(L.R.)   0.35mol   0.24mols
End: 0mol   0.05mol   0.54mol

Equilibrium: **HA(aq)**   +   **$H_2O(l)$** ⇌ **H_3O^+ (aq)**   + **A^-(aq)**
Q<K   I   0.54mol/0.615L 10^{-7} M   0.05mol/0.615L
             C   -x   +x   +x
             EQ   0.54mol/0.615L   x   0.05mol/0.615L

$$[H_3O^+]= K_a\frac{[HA]}{[\ A^-]} = 1.3\times10^{-5} \times \frac{0.54}{0.05}$$

pH=3.85