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## Solubility Equilibrium Practice Test

1. (a) calcium hydroxide has low solubility, ( $\Rightarrow$ )  
       calcium chloride is more soluble ( $\rightarrow$ )  
       (b) calcium hydroxide will have a lower concentration

2. saturated has the max amount of solute dissolved in it; solid is in equilibrium with its ions

3. (a) low sol.       $\text{Cu}(\text{OH})_2(s) \rightleftharpoons \text{Cu}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq})$   
       (b) sol.           $\text{Sn}(\text{NO}_3)_2(s) \rightleftharpoons \text{Sn}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq})$   
       (c) sol.           $\text{NaCl}(s) \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$   
       (d) low sol.       $\text{Ag}_2\text{CO}_3(s) \rightleftharpoons 2\text{Ag}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$

4. (a)  $\text{Cu}(\text{NO}_3)_2(\text{aq}) + \text{HCl}(\text{aq}) \rightleftharpoons \text{CuCl}(\text{s}) + \text{HNO}_3(\text{aq})$   
 $\text{Cu}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightleftharpoons \text{CuCl}(\text{s}) + \text{H}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$   
       (b)  $\text{Cu}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightleftharpoons \text{CuCl}(\text{s})$   
 $(\text{NH}_4)_2\text{CO}_3(\text{aq}) + \text{MgBr}_2(\text{aq}) \rightleftharpoons \text{MgCO}_3(\text{s}) + 2\text{NH}_4\text{Br}(\text{aq})$   
 $2\text{NH}_4^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) + \text{Mg}^{2+}(\text{aq}) + 2\text{Br}^-(\text{aq}) \rightleftharpoons \text{MgCO}_3(\text{s}) + 2\text{NH}_4^+(\text{aq}) + 2\text{Br}^-(\text{aq})$   
 $\text{Mg}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightleftharpoons \text{MgCO}_3(\text{s})$

5. (a)  $\text{Ba}(\text{OH})_2$        $\text{BaSO}_4$        $\text{Ba}_3(\text{PO}_4)_2$   
       most  $\longrightarrow$  least

(b)  $\text{Ba}(\text{OH})_2(\text{s}) \rightleftharpoons \text{Ba}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq})$   
 $K_{sp} = 5.0 \times 10^{-3} = [\text{Ba}^{2+}][\text{OH}^-]^2$   
 $= 4x^3$

$$x = 0.108$$

$$[\text{Ba}(\text{OH})_2] = 0.108 \text{ mol/L}$$

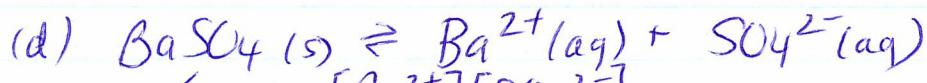
(c)  $\text{Ba}_3(\text{PO}_4)_2(\text{s}) \rightleftharpoons 3\text{Ba}^{2+}(\text{aq}) + 2\text{PO}_4^{3-}(\text{aq})$

$$K_{sp} = [\text{Ba}^{2+}]^3 [\text{PO}_4^{3-}]^2$$

$$3 \times 10^{-23} = 108x^5$$

$$x = 1.2 \times 10^{-5}$$

$$[\text{Ba}^{2+}] = 3.6 \times 10^{-5} \text{ mol/L}$$



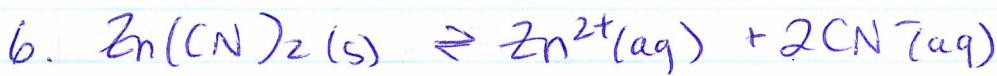
$$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$$

$$1.1 \times 10^{-10} = x^2$$

$$x = 1.0 \times 10^{-5} = [\text{BaSO}_4]$$

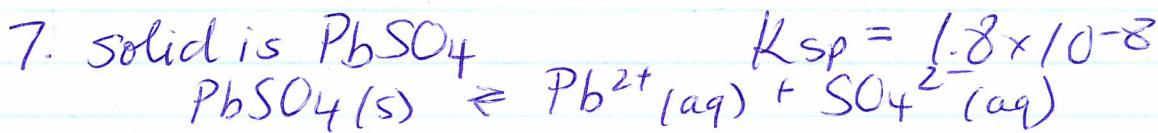
$$m = MCV = \frac{233.40 \text{ g}}{\text{mol}} \times \frac{1.0 \times 10^{-5} \text{ mol}}{\text{L}} \times 0.250 \text{ L}$$

$$= 5.8 \times 10^{-4} \text{ g}$$



$$K_{sp} = \frac{x}{(1.26 \times 10^{-4})(2 \cdot 1.26 \times 10^{-4})^2}{=} 8.0 \times 10^{-12}$$

$$x = 1.26 \times 10^{-4} \text{ mol/L}$$



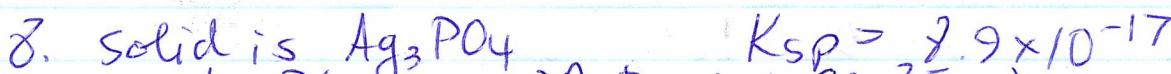
$$[\text{Pb}^{2+}] = 0.000185 \left( \frac{500.0}{625.0} \right) = 0.000148 \text{ mol/L}$$

$$[\text{SO}_4^{2-}] = 0.00760 \left( \frac{125.0}{625.0} \right) = 0.00152 \text{ mol/L}$$

$$Q_{sp} = [\text{Pb}^{2+}][\text{SO}_4^{2-}]$$

$$= 2.24 \times 10^{-7}$$

$Q_{sp} > K_{sp}$ , so precipitate!



$$\text{Ag}_3\text{PO}_4(s) \rightleftharpoons 3\text{Ag}^+(aq) + \text{PO}_4^{3-}(aq)$$

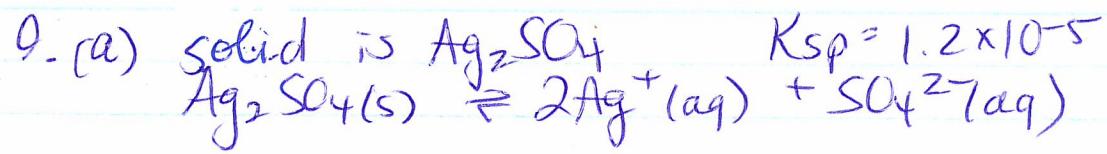
$$[\text{Ag}^+] = 0.00500 \left( \frac{1}{2} \right)^3 = 0.00250 \text{ mol/L}$$

$$[\text{PO}_4^{3-}] = 0.00135 \left( \frac{1}{2} \right)^3 = 0.000675 \text{ mol/L}$$

$$Q_{sp} = [\text{Ag}^+]^3 [\text{PO}_4^{3-}]$$

$$= 1.05 \times 10^{-11}$$

$Q_{sp} > K_{sp}$ , so precipitate!



$$[\text{Ag}^+] = 0.55 \left( \frac{25}{313} \right) = 0.044 \text{ mol/L}$$

$$[\text{SO}_4^{2-}] = 0.050 \left( \frac{183}{313} \right) = 0.0300 \text{ mol/L}$$

$$\begin{aligned} K_{sp} &= [\text{Ag}^+]^2 [\text{SO}_4^{2-}] \\ &= (0.044)^2 (0.0300) \\ &= 5.8 \times 10^{-5} \end{aligned}$$

(b) have to add more solution to be able to detect the solid with your weak human eyes