

Solubility Equilibrium

- Practice Problems for Assignment 7

- $\text{PbCl}_2(\text{s})$ is precipitated from a solution containing $\text{Pb}^{2+}(\text{aq})$ and $\text{Cl}^{-}(\text{aq})$. Which one of the following describes the concentrations of the ions remaining in solution?
 - $[\text{Pb}^{2+}]^2[\text{Cl}^{-}] = K_{\text{sp}}$ of $\text{PbCl}_2(\text{s})$
 - $[\text{Pb}^{2+}]^2[\text{Cl}^{-}]^2 = K_{\text{sp}}$ of $\text{PbCl}_2(\text{s})$
 - $[\text{Pb}^{2+}][\text{Cl}^{-}] = K_{\text{sp}}$ of $\text{PbCl}_2(\text{s})$
 - $[\text{Pb}^{2+}][\text{Cl}^{-}]^2 = K_{\text{sp}}$ of $\text{PbCl}_2(\text{s})$
- Silver acetate, $\text{AgCH}_3\text{COO}(\text{s})$, crystals are in equilibrium with a saturated solution. Which of the following could cause more silver acetate to dissolve?
 - The addition of a few crystals of silver nitrate.
 - The addition of a few drops of concentrated nitric acid.
 - The addition of a few crystals of sodium acetate.
 - The evaporation of some water from the solution with no temperature change.
- In which of the following would solid AgCl be most soluble?
 - 1 M HCl
 - 1 M MgCl_2
 - 1 M AgNO_3
 - 1 M NH_4NO_3
- Consider the following equilibrium system.
$$\text{PbI}_2(\text{s}) + \text{heat} \rightleftharpoons \text{Pb}^{2+}(\text{aq}) + 2\text{I}^{-}(\text{aq})$$

Which of the following changes would result in more PbI_2 dissolving?
 - Add more PbI_2
 - Increase the pressure
 - Add $\text{Pb}(\text{NO}_3)_2$
 - Increase the temperature
- A soluble magnesium salt is
 - MgSO_3
 - MgCO_3
 - $\text{Mg}(\text{NO}_3)_2$
 - $\text{Mg}_3(\text{PO}_4)_2$
- Write the equation for the equilibrium involved in the solubility of barium phosphate.
- Write the equilibrium law corresponding to K_{sp} .
- The solubility of thallium (I) iodide in water at 20°C is $5.9 \times 10^{-3} \text{ g/L}$. What is the K_{sp} for this compound?

9. The molar solubility of Ag_2SO_4 in a solution containing 28.4 g Na_2SO_4 per liter is 4.3×10^{-3} M. What is the K_{sp} for Ag_2SO_4 ?
10. Calculate the molar solubility of Ag_3PO_4 in water.
11. Calculate the molar solubility of AgI in pure water.
12. Calculate the molar solubility of AgI in 0.20 M CaI_2 solution.
13. Will a precipitate of CaSO_4 form in a solution if the Ca^{2+} concentration is 0.0025 M and the SO_4^{2-} concentration is 0.030 M?
14. When 100.0 mL of 1.0×10^{-3} M $\text{Pb}(\text{NO}_3)_2$ and 100.0 mL of 2.0×10^{-3} M MgSO_4 are mixed, what precipitate might be expected? Will some of the precipitate form?
15. Two aqueous solutions of $\text{Fe}_2(\text{SO}_4)_3$ and $\text{Pb}(\text{NO}_3)_2$ are mixed. Will a reaction occur? If so, write:
 - (a) the formula equation
 - (b) the complete ionic equation
 - (c) the net ionic equation.
 - (d) Identify the spectator ions.
16. Two aqueous solutions of potassium nitrate and ammonium chloride are mixed. Will a reaction occur? If so, write:
 - (a) the formula equation
 - (b) the complete ionic equation
 - (c) the net ionic equation.
 - (d) Identify the spectator ions.

Answers:

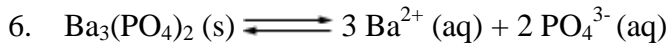
1. d

2. b

3. d

4. d

5. c



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

8. 3.2×10^{-10}

9. 1.5×10^{-5}

10. $1.8 \times 10^{-5} \text{ M}$

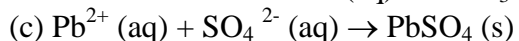
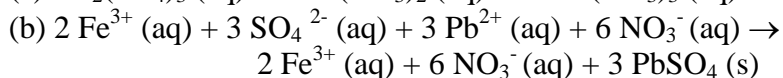
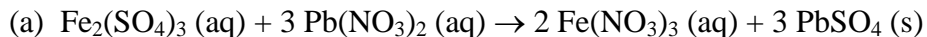
11. $9.1 \times 10^{-9} \text{ M}$

12. $2.1 \times 10^{-16} \text{ M}$

13. yes

14. $\text{PbSO}_4 (\text{s})$. A precipitate will form.

15. Yes, a reaction will occur. $\text{PbSO}_4 (\text{s})$ forms.



(d) The spectator ions are Fe^{3+} and NO_3^- .

16. The reaction produces soluble ions. All the ions that are in the solution when the solutions are mixed remain in solution. There is no reaction.