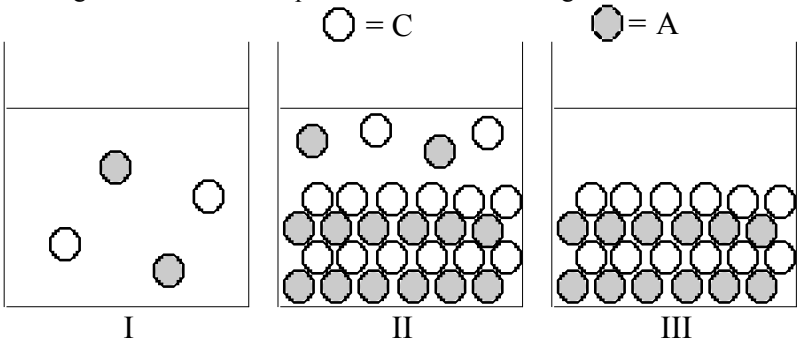
Chapter 17 Pool Questions

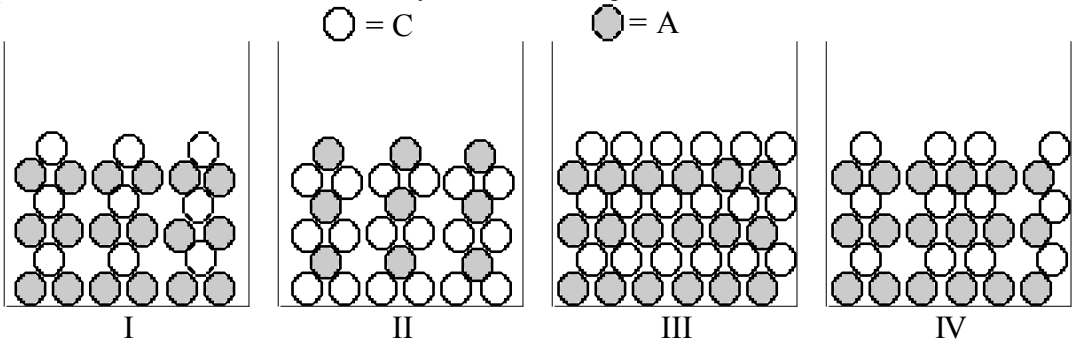
1. Cation C and anion A form an ionic compound for which $K_{sp} = s^2$, where s is the molar solubility of the ionic compound. Which of Figures I–III represent(s) possible results of the mixing of an aqueous solution containing cation C with an aqueous solution containing anion A?



a) only I
b) only II
c) only III
d) both I and II
e) both I and III

2. What is the solubility product expression for $Th(IO_3)_4$?
a) $K_{sp} = [Th^{4+}][4IO_3^-]^4$
b) $K_{sp} = [Th^{4+}][IO_3^-]$
c) $K_{sp} = [Th^{4+}][IO_3^-]^4$
d) $K_{sp} = [Th][IO_3]^4$
e) $K_{sp} = [Th^{4+}][IO_3^-]$

3. Figures I–IV represent ionic compounds formed upon the mixing of an aqueous solution containing cation C with an aqueous solution containing anion A. Identify the figure(s) that represent(s) products for which $K_{sp} = 108s^5$, where s is the molar solubility of the ionic compound.



a) only I
b) only II
c) only III
d) only IV
e) both I and II

4. What is the relationship between molar solubility (s) and K_{sp} for calcium fluoride?
   a) $s = (K_{sp})^{1/2}$
   b) $s = (K_{sp})^{1/3}$
   c) $s = \left(\frac{K_{sp}}{4}\right)^{1/3}$
   d) $s = \left(\frac{K_{sp}}{6}\right)^{1/3}$.
   e) $s = \left(\frac{K_{sp}}{27}\right)^{1/4}$.

5. The solubility of $CaSO_4$ in pure water at 0°C is 1.08 g/L. What is the value of the solubility product?
   a) 7.94×10^{-3}
   b) 1.08×10^{-3}
   c) 8.91×10^{-2}
   d) 6.30×10^{-5}

6. Rank the following salts in order of increasing molar solubility.

Salt	K_{sp}
$BaSO_4$	1.1×10^{-10}
AgCl	1.8×10^{-10}
$BaCO_3$	9.1×10^{-9}
CdS	8×10^{-27}
$PbSO_4$	1.8×10^{-8}

   a) $CdS < AgCl < BaCO_3 < BaSO_4 < PbSO_4$
   b) $PbSO_4 < BaCO_3 < AgCl < BaSO_4 < CdS$
   c) $CdS < AgCl < BaSO_4 < BaCO_3 < PbSO_4$
   d) $PbSO_4 < BaCO_3 < BaSO_4 < AgCl < CdS$
   e) $CdS < BaSO_4 < AgCl < BaCO_3 < PbSO_4$

7. What is the solubility (in g/L) of silver(I) iodide at 25ºC? The solubility product constant for silver(I) iodide is 8.3×10^{-17} at 25ºC.
   a) 1.9×10^{-14} g/L
   b) 9.7×10^{-15} g/L
   c) 1.1×10^{-2} g/L
   d) 6.5×10^{-4} g/L
   e) 2.1×10^{-6} g/L

8. What is the molar solubility of barium fluoride at 25ºC? The solubility product constant for barium fluoride is 1.0×10^{-6} at 25ºC.
   a) 1.0×10^{-3} *M*
   b) 6.3×10^{-3} *M*
   c) 5.0×10^{-7} *M*
   d) 1.0×10^{-6} *M*
   e) 1.6×10^{-2} *M*

9. Pure water is saturated with slightly soluble calcium fluoride, CaF_2. Which of the following is true concerning the equilibrium concentration of Ca^{2+}?

a) $[Ca^{2+}] = K_{sp}$

b) $[Ca^{2+}] = \sqrt{K_{sp}}$

c) $[Ca^{2+}] = \dfrac{K_{sp}}{2 \times [F^-]}$

d) $[Ca^{2+}] = \sqrt[3]{\dfrac{K_{sp}}{4}}$

e) $[Ca^{2+}] = [F^-]$

10. Which of the following salts has the lowest molar solubility in water?

a) $SrCO_3$ ($K_{sp} = 9.3 \times 10^{-10}$)
b) PbI_2 ($K_{sp} = 6.5 \times 10^{-9}$)
c) AgBr ($K_{sp} = 5.0 \times 10^{-13}$)
d) $Fe(OH)_2$ ($K_{sp} = 8 \times 10^{-16}$)
e) $Ni(OH)_2$ ($K_{sp} = 2.0 \times 10^{-15}$)

11. What is the pH of a saturated solution of $Fe(OH)_2$? For $Fe(OH)_2$, $K_{sp} = 8.0 \times 10^{-16}$.

a) 5.23
b) 4.93
c) 8.77
d) 9.07
e) 7.00

12. Rank the following salts in order of increasing molar solubility.

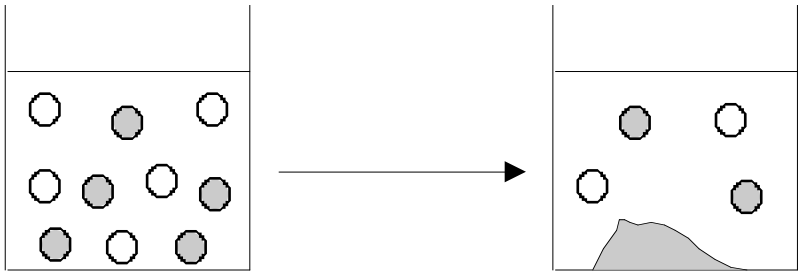
Salt	K_{sp}
AgSCN	1.0×10^{-12}
Ag_2CrO_4	1.1×10^{-12}
Ag_3PO_4	1.0×10^{-16}

a) $Ag_3PO_4 < Ag_2CrO_4 < AgSCN$
b) $AgSCN < Ag_2CrO_4 < Ag_3PO_4$
c) $AgSCN < Ag_3PO_4 < Ag_2CrO_4$
d) $Ag_3PO_4 < AgSCN < Ag_2CrO_4$
e) $Ag_2CrO_4 < AgSCN < Ag_3PO_4$

13. In which of these solutions would silver(I) carbonate have the lowest molar solubility? For silver(I) carbonate, $K_{sp} = 8.5 \times 10^{-12}$.

a) pure water
b) 0.1 *M* $AgNO_3$
c) 0.01 *M* $AgNO_3$
d) 0.1 *M* Na_2CO_3
e) 0.03 *M* H_2CO_3

14. The figure below represents the result of adding which of the following aqueous solutions to a filtered, saturated solution of AgCl?



a) only HCl(*aq*)
b) only HNO_3(*aq*)
c) only NaCl(*aq*)
d) HCl(*aq*) or HNO_3(*aq*)
e) HCl(*aq*) or NaCl(*aq*)

15. What is the concentration of silver(I) ion in a saturated solution of silver(I) carbonate containing 0.0070 *M* Na_2CO_3? For Ag_2CO_3, $K_{sp} = 8.6 \times 10^{-12}$.
a) 8.0×10^{-9} *M*
b) 2.0×10^{-9} *M*
c) 3.5×10^{-5} *M*
d) 6.0×10^{-4} *M*
e) 8.0×10^{-4} *M*

16. What is the molar solubility of MgF_2 in a 0.42 *M* NaF solution? For MgF_2, $K_{sp} = 8.4 \times 10^{-8}$.
a) 1.0×10^{-7}
b) 2.0×10^{-7}
c) 4.8×10^{-7}
d) 1.4×10^{-4}
e) 7.1×10^{-4}

17. Which of the following will apply to a saturated solution of an ionic compound?
a) $Q_c > K_{sp}$
b) $Q_c < K_{sp}$
c) $Q_c = K_{sp}$
d) $Q_c = 1$
e) $K_{sp} = 1$

18. Suppose 50.00 mL of 2.0×10^{-5} *M* $Fe(NO_3)_3$ is added to 50.00 mL of 2.0×10^{-4} *M* KIO_3. Which of the following statements is true? For $Fe(IO_3)_3$, $K_{sp} = 1.0 \times 10^{-14}$.
a) A precipitate forms because $Q_c > K_{sp}$.
b) A precipitate forms because $Q_c < K_{sp}$.
c) No precipitate forms because $Q_c > K_{sp}$.
d) No precipitate forms because $Q_c < K_{sp}$.
e) Nothing happens.

19. What will happen if 0.1 mol of solid silver(I) nitrate is added to 1.0 L of a saturated solution of silver(I) chromate? For Ag_2CrO_4, $K_{sp} = 2.4 \times 10^{-12}$.
    a) The $AgNO_3$ will settle to the bottom without dissolving.
    b) The concentration of Ag^+ in solution will not change.
    c) The concentration of CrO_4^{2-} will increase.
    d) Some Ag_2CrO_4 will precipitate.
    e) Nothing will happen.

20. Suppose 50.00 mL of a 1×10^{-8} *M* solution of lead(II) nitrate is mixed with 50.00 mL of a 1×10^{-6} solution of sodium phosphate. Which of the following statements is true? For lead(II) phosphate, $K_{sp} = 1 \times 10^{-44}$.
    a) A precipitate forms because $Q_c < K_{sp}$.
    b) A precipitate forms because $Q_c > K_{sp}$.
    c) No precipitate forms because $Q_c = K_{sp}$.
    d) No precipitate forms because $Q_c < K_{sp}$.
    e) No precipitate forms because $Q_c > K_{sp}$.

21. If 450 mL of 1×10^{-7} *M* $AgNO_3$ is mixed with 450 mL of 1×10^{-8} *M* NaI, what will occur? For AgI, $K_{sp} = 8.3 \times 10^{-17}$.
    a) Silver(I) iodide will precipitate.
    b) No precipitate will form.
    c) Sodium nitrate will precipitate.
    d) Silver(I) nitrate will precipitate.
    e) Sodium iodide will precipitate.

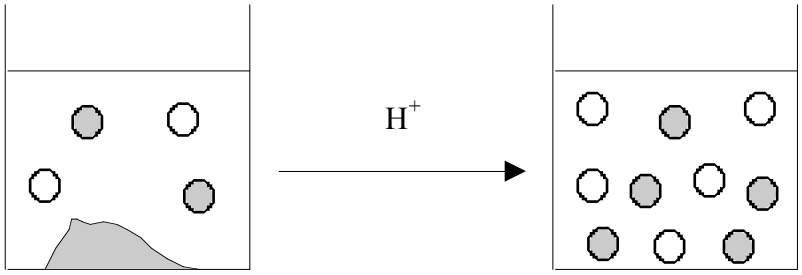
22. Sodium chloride is added slowly to a solution that is 0.010 *M* in Cu^+, Ag^+, and Au^+. The K_{sp} values for the chloride salts are 1.9×10^{-7}, 1.6×10^{-10}, and 2.0×10^{-13}, respectively. Which compound will precipitate first?
    a) CuCl(*s*)
    b) AgCl(*s*)
    c) AuCl(*s*)
    d) All will precipitate at the same time.
    e) It cannot be determined.

23. The best explanation for the dissolution of ZnS in dilute HCl is that
    a) the zinc ion is amphoteric.
    b) the sulfide-ion concentration is decreased by the formation of H_2S.
    c) the sulfide-ion concentration is decreased by oxidation to sulfur.
    d) the zinc-ion concentration is decreased by the formation of a chloro complex.
    e) the solubility product of $ZnCl_2$ is less than that of ZnS.

24. You have two salts, AgX and AgY, with very similar K_{sp} values. You know that K_a for HX is much greater than K_a for HY. Which statement will be true?
    a) AgX is more soluble than AgY in acidic solution.
    b) AgY is more soluble than AgX in acidic solution.
    c) AgX and AgY are equally soluble in acidic solution.
    d) AgX and AgY are less soluble in acidic solution than in pure water.
    e) none of these

25. In which of the following solutions would CaC_2O_4 have the highest molar solubility?
    a) 0.01 *M* $Na_2C_2O_4$
    b) 0.01 *M* $NaHC_2O_4$
    c) 0.01 *M* $H_2C_2O_4$
    d) 0.01 *M* NaCl
    e) 0.01 *M* HCl

26. The figure below represents the results of adding a strong acid to a saturated solution of an ionic compound. Which of the following could be the ionic compound?



    a) AgF
    b) AgCl
    c) AgBr
    d) AgI
    e) $AgClO_4$

27. What is the value of the dissociation constant, K_d, for the complex ion $Cd(NH_3)_4^{2+}$? For $Cd(NH_3)_4^{2+}$, $K_f = 1.0 \times 10^7$.
    a) 1.0×10^{-3}
    b) 1.0×10^{7}
    c) 5.6×10^{1}
    d) 2.5×10^{6}
    e) 1.0×10^{-7}

28. Calculate the molar concentration of uncomplexed Zn^{2+} in a solution that contains 0.20 mol of $Zn(NH_3)_4^{2+}$ per liter and 0.0116 *M* NH_3 at equilibrium? The overall K_f for $Zn(NH_3)_4^{2+}$ is 3.8×10^9.
    a) 2.9×10^{-3} *M*
    b) 8.8×10^{-3} *M*
    c) 6.7×10^{-4} *M*
    d) 2.0×10^{-13} *M*
    e) none of these

29. From the two equilibria below,

$Ag(NH_3)_2^+(aq) \rightleftharpoons Ag^+(aq) + 2NH_3(aq)$; $K_d = 5.9 \times 10^{-8}$

$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$; $K_{sp} = 1.8 \times 10^{-10}$

what is K_c for the following equilibrium?

$AgCl(s) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)_2^+(aq) + Cl^-(aq)$

a) 1.1×10^{-17}
b) 3.1×10^{-3}
c) 9.4×10^{16}
d) 3.3×10^{2}
e) 1.0×10^{-14}

30. In the qualitative analysis scheme for metal ions, how are the Analytical Group I cations separated from the other cations?

a) by addition of HCl, forming insoluble metal chlorides
b) by addition of H_2SO_4, forming insoluble metal sulfates
c) by addition of H_2S in acidic solution, forming insoluble metal sulfides
d) by addition of H_2S in basic solution, forming insoluble metal sulfides or hydroxides
e) by addition of $(NH_4)_2CO_3$ or $(NH_4)_3PO_4$, forming insoluble metal carbonates or phosphates

ANSWERS

Question	Answer
1	d
2	c
3	d
4	c
5	d
6	e
7	e
8	b
9	d
10	c
11	d
12	c
13	b
14	e
15	c
16	c
17	c
18	d
19	d
20	b
21	a
22	c
23	b
24	b
25	e
26	a
27	e
28	a
29	b
30	a