Solubility Homework Booklet Name_____

Complete all the questions. Show work where needed.

1. Which of the following does **not** define solubility?
   A. the maximum mass of solute that can dissolve in a given volume of solution
   B. the minimum moles of solute needed to produce one litre of saturated solution
   C. the moles of solute dissolved in a given volume of solution
   D. the concentration of solute in a saturated solution.

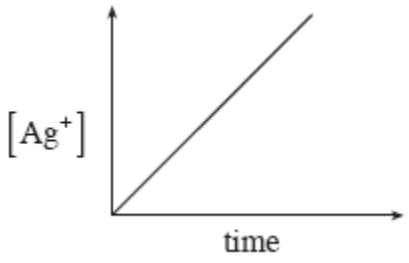
2. Given a saturated solution of $Ca(OH)_2$, which of the following statements is always true?
   A. The $[Ca^{+2}]$ is twice that of $[OH^-]$
   B. The rate of dissolving is greater than the rate of crystallization
   C. The rate of crystallization equals the rate of dissolving
   D. The OH^- precipitates half as fast as the Ca^{+2}

3. Consider the following equilibrium:

$$AgCl_{(s)} \leftrightarrows Ag^+_{(aq)} + Cl^-_{(aq)}$$

Which of the following graphs best describes the $[Ag^+_{(aq)}]$ after equilibrium has been established?

A.



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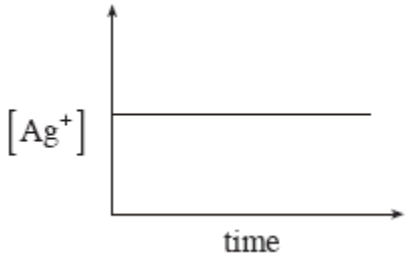

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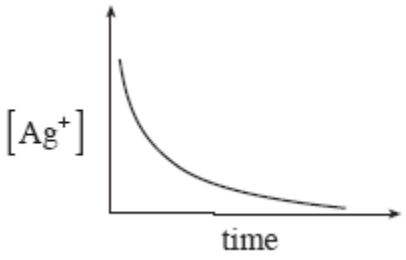

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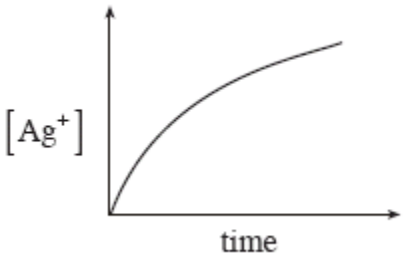


4. Consider the following diagram:

The following three beakers each contain different volumes of a saturated solution of PbI_2 and different masses of solid PbI_2 :

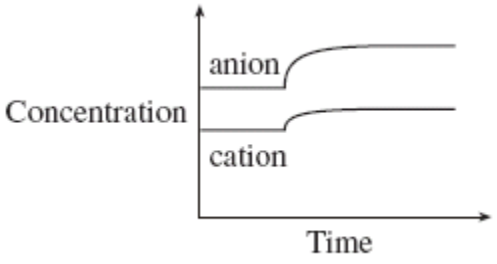
Beaker I Beaker II Beaker III

What is the relationship for the $\left[Pb^{2+}\right]$ in the solution in the three beakers?

A. I < III < II
B. II < III <I
C. I = II = III
D. I > II > III

5. A saturated solution is prepared by dissolving a salt in water. Which of the following graphs could represent the ion concentrations as the temperature is increased?

A.



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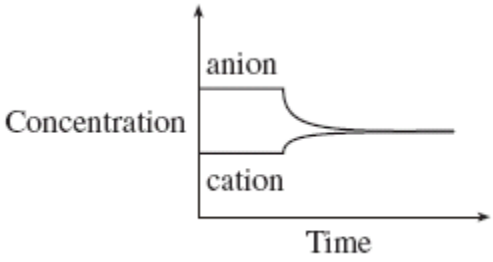

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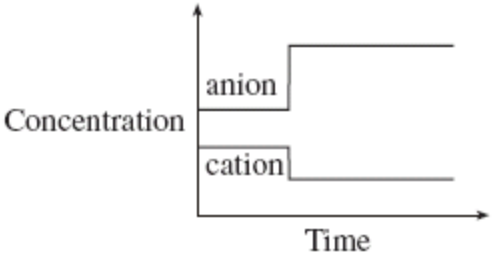

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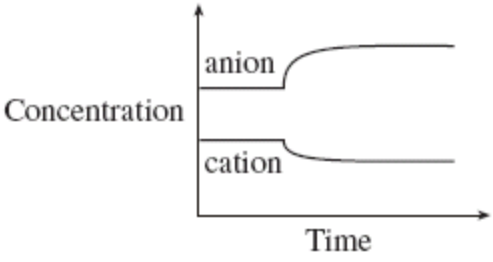


6. The ion concentrations in 3.00 L of a 0.250 M $Al_2(SO_4)_3$ are

	$[Al^{+3}]$	$[SO_4^{-2}]$
A.	1.50 M	2.25 M
B.	0.500 M	0.750 M
C.	0.250 M	0.250 M
D.	0.750 M	0.750 M

7. Which of the following solutions would have $[Fe^{+3}] = 0.020$ M?
   A. 0.50 L of a 0.040 M $FeC_6H_5O_7$ solution
   B. 0.40 L of a 0.050 M $Fe(NO_3)_3$ solution
   C. 0.50 L of a 0.010 M $Fe_2(C_2O_4)_3$ solution
   D. 0.80 L of a 0.020 M $Fe_2(SO_4)_3$ solution

8. The solubility of $SrCO_3$ is 2.4×10^{-5} M. How many moles of dissolved solute are present in 100.0 mL of saturated $SrCO_3$ solution?
   A. 2.4×10^{-6} mole
   B. 2.4×10^{-4} mol
   C. 5.6×10^{-10} mol
   D. 2.4×10^{-5} mol

9. In every solubility equilibrium, the rate of dissolving is
   A. less than the rate of crystallization
   B. greater than the rate of crystallization
   C. equal to zero
   D. equal to the rate of crystallization

10. What are the ion concentrations in 2.5 L of a 0.30 M $CuCl_2$?

	$[Cu^{+2}]$	$[Cl^-]$
A.	0.15 M	0.30 M
B.	1.5 M	0.75 M
C.	0.75 M	1.5 M
D.	0.30 M	0.60 M

11. A 3.0 L solution of $BaCl_2$ has a chloride ion concentration of 0.20 M. The barium ion concentration in this solution is
    A. 0.20 M
    B. 0.10 M
    C. 0.067 M
    D. 0.60 M

12. What is the $[OH^-]$ in 250 mL of a 0.20 M $Sr(OH)_2$?
    A. 0.20 M
    B. 0.40 M
    C. 0.050 M
    D. 0.10 M

13. What is the concentration of the ions in 3.0 L of 0.50 M $AgClO_3$?

	$[Ag^+]$	$[ClO_3^-]$
A.	0.50 M	1.5 M
B.	1.5 M	4.5 M
C.	0.17M	0.17M
D.	0.50 M	0.50 M

14. What is the [Cl-] when 1.50 grams of NaCl is dissolved in enough water to make 100.0 mL of solution?
    A. 0.150 M
    B. 0.390 M
    C. 0.256 M
    D. 15.0 M

15. Which of the following compounds could be used to prepare a solution with a $[S^{-2}]$ greater than 0.1 M?
    A. Ag_2S
    B. CaS
    C. CuS
    D. Fe_2S_3

16. Which of the following compounds could be used to prepare a solution with a $[SO_3^{-2}]$ greater than 0.10 M?
    A. Ag_2SO_3
    B. H_2SO_3
    C. $CuSO_3$
    D. $CaSO_3$

17. Which of the following would form a saturated solution when 0.0100 mol of the solid solute is added to 100.0 mL of water?
    A. NaCN
    B. $Pb(NO_3)_2$
    C. $BaCO_3$
    D. $FeSO_4$

18. Which compound will have the greatest solubility in water?
    A. $CaSO_4$
    B. AgCl
    C. $BaCO_3$
    D. $CuCl_2$

19. Which of the following would be true when equal volumes of 0.2 M $(NH_4)_2SO_4$ and 0.2 M BaS are combined?
    A. no precipitate forms
    B. precipitates of both $(NH_4)_2S$ and $BaSO_4$ form
    C. a precipitate of $BaSO_4$ forms
    D. a precipitate of $(NH_4)_2S$ forms

20. What will happen when equal volumes of 0.20 M $(NH_4)_2S$ and 0.20 M $Sr(OH)_2$ are mixed?
    A. Both SrS and NH_4OH precipitate
    B. SrS precipitates.
    C. No precipitate forms
    D. NH_4OH presipitates

21. Which of the following would be true when equal volumes of 0.2 M CaS and 0.2 M $Fe_2(SO_4)_3$ are combined?
    A. precipitates of both Fe_2S_3 and $CaSO_4$ form
    B. a precipitate of $CaSO_4$ forms
    C. no precipitate forms
    D. a precipitate of Fe_2S_3 forms

22. What happens when 10.0 mL of 0.2 M $Sr(OH)_2$ is added to 10.0 mL of 0.2 M Rb_2SO_4?
    A. No precipitate forms
    B. Precipitates of RbOH and $SrSO_4$ form
    C. A precipiate of $SrSO_4$ forms
    D. A precipitate of RbOH forms

23. Which of the following will **not** form a precipitate when mixed with an equal amount of 0.2 M $AgNO_3$?
    A. 0.2 M NaBr
    B. 0.2 M $NaBrO_3$
    C. 0.2 M NaOH
    D. 0.2 M $NaNO_3$

24. Which of the following will **not** form a precipitate when mixed with an equal amount of 0.2 M $Ca(NO_3)_2$?
    A. 0.2 M NaBr
    B. 0.2 M Na_2CO_3
    C. 0.2 M NaOH
    D. 0.2 M Na_2SO_3

25. A solution contains 0.2 M Zn^{+2} and 0.2 M Sr^{+2}. An equal volume of a second solution was added, forming a precipitate with the Zn^{+2} but not the Sr^{+2}. What was present in the second solution?
    A. 0.2 M SO_4^{2-}
    B. 0.2 M SO_3^{-2}
    C. 0.2 M Cl^-
    D. 0.2 M OH^-

26. A solution contains 0.2 M Pb^{+2} and 0.2 M Sr^{+2}. An equal volume of a second solution was added, forming a precipitate with the Pb^{+2} but not the Sr^{+2}. What was present in the second solution?
    A. 0.2 M S^{-2}
    B. 0.2 M SO_4^{2-}
    C. 0.2 M NO_3^-
    D. 0.2 M PO_4^{-3}

27. What is the net ionic equation for the reaction that occurs when equal volumes of 0.20 M BaS and 0.20 M $Fe_2(SO_4)_3$ are mixed?
    A. $3Ba^{+2}_{(aq)} + 3SO_4^{-2}_{(aq)} + 2Fe^{+3}_{(aq)} + 3S^{-2}_{(aq)} \Rightarrow 3BaSO_{4\,(s)} + Fe_2S_{3\,(s)}$
    B. $3BaS_{(aq)} + Fe_2(SO_4)_{3\,(aq)} \Rightarrow 3BaSO_{4\,(s)} + Fe_2S_{3\,(s)}$
    C. $3Ba^{+2}_{(aq)} + 3SO_4^{-2}_{(aq)} \Rightarrow 3BaSO_{4\,(s)}$
    D. $2Fe^{+3}_{(aq)} + 3S^{-2}_{(aq)} \Rightarrow Fe_2S_{3\,(s)}$

28. What is the formula equation for the reaction that occurs when equal volumes of 0.20 M BaS and 0.20 M $Fe_2(SO_4)_3$ are mixed?
    A. $3Ba^{+2}_{(aq)} + 3SO_4^{-2}_{(aq)} \Rightarrow 3BaSO_{4\,(s)}$
    B. $3Ba^{+2}_{(aq)} + 3SO_4^{-2}_{(aq)} + 2Fe^{+3}_{(aq)} + 3S^{-2}_{(aq)} \Rightarrow 3BaSO_{4\,(s)} + Fe_2S_{3\,(s)}$
    C. $3BaS_{(aq)} + Fe_2(SO_4)_{3\,(aq)} \Rightarrow 3BaSO_{4\,(s)} + Fe_2S_{3\,(s)}$
    D. $2Fe^{+3}_{(aq)} + 3S^{-2}_{(aq)} \Rightarrow Fe_2S_{3\,(s)}$

29. What is the complete ionic equation for the reaction that occurs when equal volumes of 0.20 M $Ba(NO_3)_2$ and 0.20 M Na_2SO_4 are mixed?
    A. $Ba(NO_3)_{2\,(aq)} + 2Na_2SO_{4\,(aq)} \Rightarrow BaSO_{4\,(s)} + 2NaNO_{3\,(aq)}$
    B. $Ba^{+2}_{(aq)} + SO_4^{-2}_{(aq)} \Rightarrow BaSO_{4\,(s)}$
    C. $Ba^{+2}_{(aq)} + SO_4^{-2}_{(aq)} + 2Na^+_{(aq)} + 2NO_3^-_{(aq)} \Rightarrow BaSO_{4\,(s)} + 2Na^+_{(aq)} + 2NO_3^-_{(aq)}$
    D. $2Na^+_{(aq)} + 2NO_3^-_{(aq)} \Rightarrow 2NaNO_{3\,(s)}$

30. What is the net ionic equation for the reaction that occurs when equal volumes of 0.20 M K_3PO_4 and 0.20 M $ZnCl_2$ are mixed together?

A. $2\ K_3PO_{4\ (aq)} + 3ZnCl_{2\ (aq)} \rightarrow Zn_3(PO_4)_{2\ (s)} + 6\ KCl_{\ (aq)}$

B. $2\ K_3PO_{4\ (aq)} + 3ZnCl_{2\ (aq)} \rightarrow Zn_3(PO_4)_{2\ (aq)} + 6\ KCl_{\ (s)}$

C. $3Zn^{+2}{}_{(aq)} + 2PO_4{}^{-3}{}_{(aq)} \rightarrow Zn_3(PO_4)_{2\ (s)}$

D. $K^{+}{}_{(aq)} + Cl^{-}{}_{(aq)} \rightarrow KCl_{\ (s)}$

31. When equal volumes of 0.20 M BaS and 0.20 M $FeCl_3$ are mixed, a precipitate forms.

a. Write the formula equation for the above reaction.

b. Write the complete ionic equation for the above reaction.

c. Write the net ionic equation for the above reaction.

32. When equal volumes of 0.20 M K_2SO_3 and 0.20 M $Sr(OH)_2$ are mixed, a precipitate forms.

a. Write the formula equation for the above reaction.

b. Write the complete ionic equation for the above reaction.

c. Write the net ionic equation for the above reaction.

33. When equal volumes of 0.20 M $Na_2C_2O_4$ and 0.20 M $Cr(NO_3)_3$ are mixed a precipitate forms.

a. Write the formula equation for the above reaction.

b. Write the complete ionic equation for the above reaction.

c. Write the net ionic equation for the above reaction.

34. When equal volumes of 0.20 M NH_4SCN and 0.20 M $Fe_2(SO_4)_3$ are mixed, a precipitate forms.

a. Write the formula equation for the above reaction.

b. Write the complete ionic equation for the above reaction.

c. Write the net ionic equation for the above reaction.

35. When equal volumes of 0.20 M $CuSO_4$ and 0.20 M $Pb(NO_3)_4$ are mixed what happens?

a. Write the formula equation for the above reaction.

b. Write the complete ionic equation for the above reaction.

c. Write the net ionic equation for the above reaction.

36. When equal volumes of 0.20 M $Ni_2(SO_4)_3$ and 0.20 M $Sr(OH)_2$ are mixed what happens?

a. Write the formula equation for the above reaction.

b. Write the complete ionic equation for the above reaction.

c. Write the net ionic equation for the above reaction.

37. A solution contains both Ag^+ and Mg^{+2} ions. During selective precipitation, these ions are removed one at a time by adding
A. SO_4^{-2} followed by Cl^-
B. I^- followed by OH^-
C. NO_3^- followed by PO_4^{-3}
D. OH^- followed by S^{-2}

38. A solution contains both Pb^{+2} and Mg^{+2} ions. During selective precipitation, these ions are removed one at a time by adding
A. SO_4^{-2} followed by Cl^-
B. Cl^- followed by PO_4^{-3}
C. S^{-2} followed by SO_4^{-2}
D. OH^- followed by S^{-2}

39. A solution contains both 0.2 M $Mg^{+2}{}_{(aq)}$ and 0.2 M $Sr^{+2}{}_{(aq)}$. These ions can be removed separately through precipitation by adding equal volumes of 0.2 M solutions of
A. CO_3^{-2} and then SO_4^{-2}
B. SO_4^{-2} and then S^{-2}
C. OH^- and then SO_4^{-2}
D. Cl^- and then OH^-

40. Using the solubility table, determine which of the following ions could **not** be used to separate S^{-2} from SO_4^{-2} by precipitation.
A. Cu^{+2}
B. Ca^{+2}
C. NH_4^+
D. Zn^{+2}

41. Using the solubility table, determine which of the following ions could **not** be used to separate OH^{-1} from SO_4^{-2} by precipitation.
    A. Cu^{+2}
    B. Sr^{+2}
    C. Ba^{+2}
    D. Zn^{+2}

42. Using the solubility table, determine which of the following ions could be used to separate OH^{-1} from SO_3^{-2} by precipitation.
    A. Cu^{+2}
    B. Sr^{+2}
    C. Ba^{+2}
    D. Zn^{+2}

43. A solution is prepared containing both 0.2 M S^{2-} and 0.2 M PO_4^{3-} ions. An equal volume of a second solution is added in order to precipitate only one of these two anions. The second solution must contain which of the following?
    A. 0.2 M Pb^{+2}
    B. 0.2 M Cs^{+}
    C. 0.2 Sr^{+2}
    D. 0.2 M Zn^{+2}

44. A solution is found to contain $NaBr_{(aq)}$, $K_2SO_{4\,(aq)}$ and $Li_2SO_{3\,(aq)}$ in solution. Devise a procedure by which each of the anions in the solution can be removed, one at a time. The solutions that are available to use are:

    $Ca(NO_3)_2$ NH_4NO_3 $AgNO_3$ $Mg(NO_3)_2$

    1. First you would add _____. The precipitate formed would be _____ Filter out the precipitate.

    2. To the remaining solution add _____. The precipitate formed would be _____. Filter out the precipitate.

    3. To the remaining solution add _____. The precipitate formed would be _____. FIlter out the precipitate.

45. A solution is found to contain $Ca(NO_3)_{2\,(aq)}$, $AgNO_{3\,(aq)}$, $Fe(NO_3)_{3\,(aq)}$ in solution. Devise a procedure by which each of the cations in the solution can be removed, one at a time. The solutions that are available to use are:

NaI KNO_3 Li_2SO_4 KOH

1. First you would add _____. The precipitate formed would be _____ Filter out the precipitate.

2. To the remaining solution add _____. The precipitate formed would be _____. Filter out the precipitate.

3. To the remaining solution add _____. The precipitate formed would be _____. FIlter out the precipitate.

46. A solution is found to contain $CuSO_{4\,(aq)}$ in solution. Devise a procedure by which each of the cations in the solution can be removed, one at a time. The solutions that are available to use are:

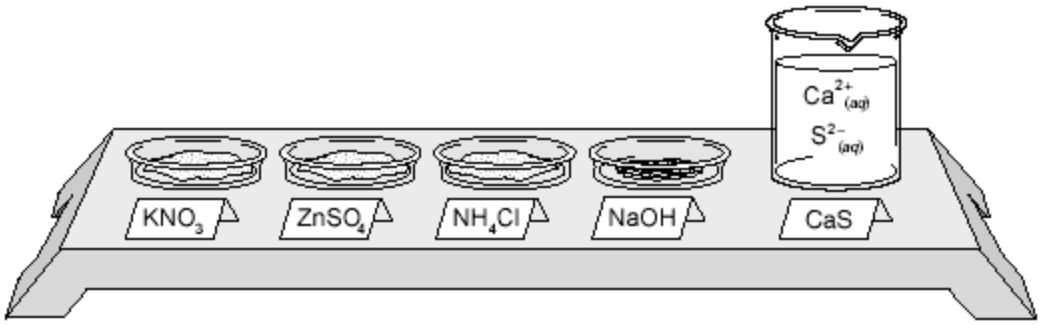
BaI_2 CaS $Pb(NO_3)_4$ NH_4Cl

1. First you would add _____. The precipitate formed would be _____ Filter out the precipitate.

2. To the remaining solution add _____. The precipitate formed would be _____. Filter out the precipitate.

Consider the following:

47.



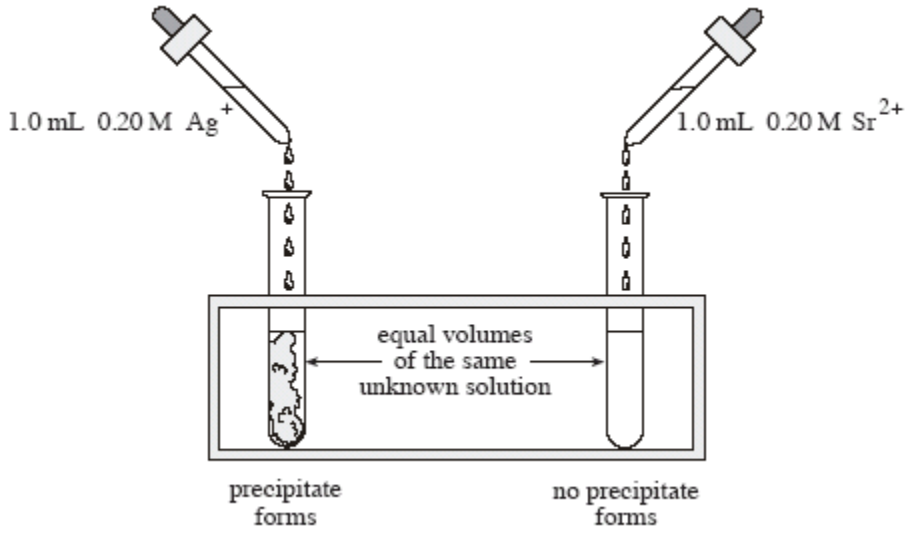
a. Fill in the blanks below that would separate the Ca^{+2} ions from the S^{-2} ions using the solids samples. Indicate which sample you would add first, and the precipitate that would form. Indicate which sample you would add second and the precipitate that would form then.

First, add _____. The precipitate formed would be _____

Second, add _____. The precipitate formed would be _____

b. Write the net ionic equations for one of the precipitation reactions in part (a)

48. Consider the following:

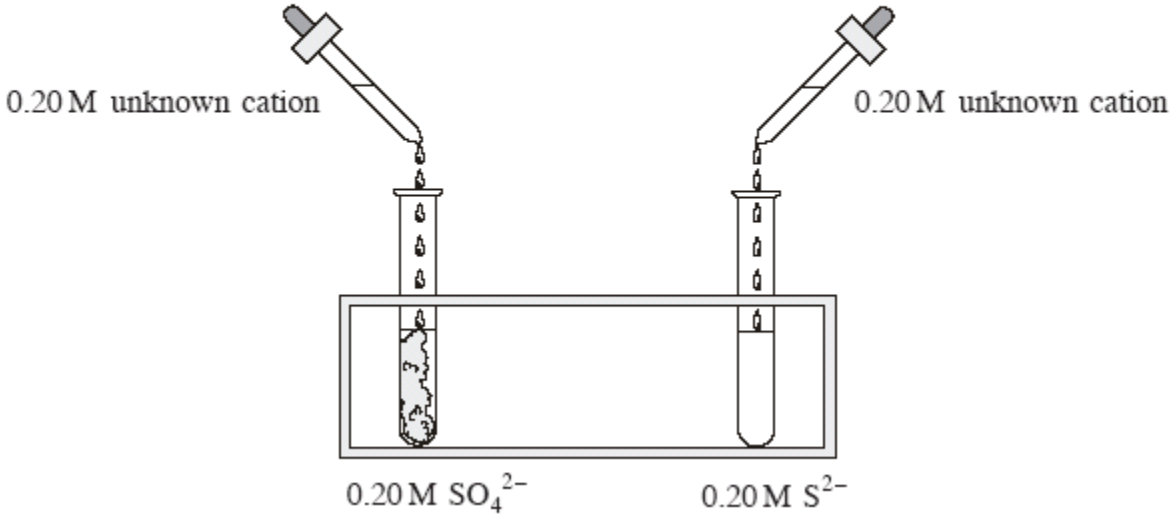


Which of the following could be the unknown solution?

A. 0.20 M K_3PO_4 B. 0.20 M Na_2SO_4 C. 0.20 M $NaNO_3$ D. 0.20 M KOH

49.

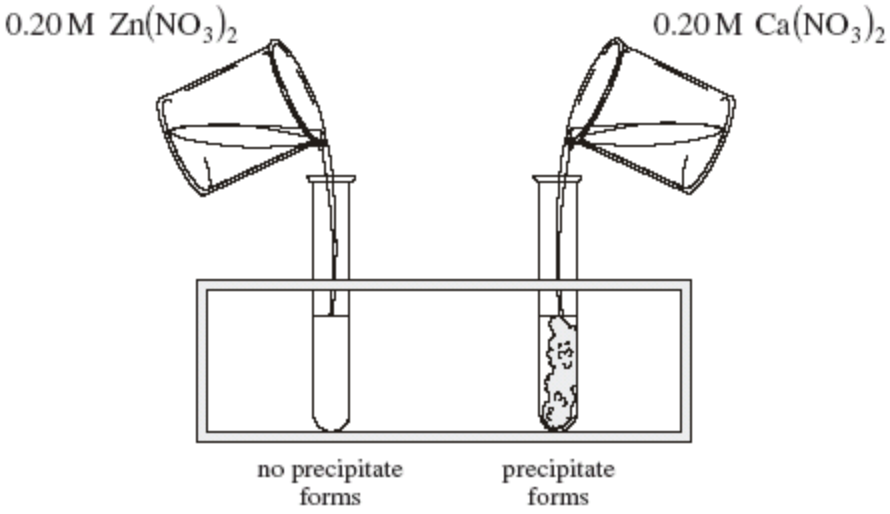
A precipitate forms when a 0.20 M solution containing an unknown cation is added to SO_4^{2-}, but not when an equal volume is added to S^{2-}. **(2 marks)**



The unknown cation is

A. Zn^{+2} B. Mg^{+2} C. Pb^{+2} D. Ba^{+2}

When 10.0 mL of 0.20 M $Zn(NO_3)_2$ is added to a 10.0 mL sample of 0.20 M unknown solution, no precipitate forms. When the same volume of 0.20 M $Ca(NO_3)_2$ is added to a separate 10.0 mL sample of the unknown solution, a precipitate does form. **(2 marks)**



50. The unknown solution could be

A. KOH B. Na_2SO_4 C. Na_2CO_3 D. K_2S

51. Which anion would be most effective in removing the cations responsible for hard water?
A. S^{-2}
B. SO_4^{-2}
C. SO_3^{-2}
D. Cl^-

52. For a saturated solution, the K_{sp} expression does not contain any solid solute term. What is the reason for this?
A. The solid solute does not change in concentration.
B. The solid solute continues to change in amount.
C. The solid solute is a product.
D. The solid solute is a reactant.

53. The Ksp expression for a saturated solution of $Mg(OH)_2$ is
A. $K_{sp} = \frac{[Mg^{+2}][OH^-]^2}{[Mg(OH)_2]}$
B. $K_{sp} = [Mg^{+2}][2OH^-]$
C. $K_{sp} = [Mg^{+2}][OH^-]^2$
D. $K_{sp} = [Mg^{+2}][2OH^-]^2$

54. The K_{sp} expression for a saturated solution of $Ba_3(AsO_4)_2$ would be

A. $Ksp = [Ba^{+2}]^3\ [AsO_4^{-3}]^2$

B. $Ksp = [3Ba^{+2}]\ [2AsO_4^{-3}]$

C. $Ksp = \dfrac{[Ba^{+2}]^3\ [AsO_4^{-3}]^2}{Ba_3(AsO_4)_2}$

D. $Ksp = [3Ba^{+2}]^3\ [2AsO_4^{-3}]^2$

55. The K_{sp} expression for a saturated solution of Ag_2SO_3 is

A. $K_{sp} = [2Ag^+]^2[SO_3^{-2}]$

B. $K_{sp} = [Ag_2^{+2}][SO_3^{-2}]$

C. $K_{sp} = [2Ag^+][SO_3^{-2}]$

D. $K_{sp} = [Ag^+]^2[SO_3^{-2}]$

56. Which of the following expressions represents $[Fe^{+3}]$ in a saturated $Fe(OH)_3$ solution?

A. $[Fe^{+3}] = \dfrac{Ksp}{^3\,[OH^-]}$

B. $[Fe^{+3}] = \dfrac{Ksp}{[OH^-]^{\,3}}$

C. $[Fe^{+3}] = \dfrac{Ksp}{3[OH^-]}$

D. $[Fe^{+3}] = Ksp \times [OH^-]^3$

57. Which of the following is the K_{sp} expression for barium phosphate?

A. $K_{sp} = [3Ba^{+2}][2PO_4^{-3}]$

B. $K_{sp} = [3Ba^{+2}]^3[2PO_4^{-3}]^2$

C. $K_{sp} = [Ba^{+2}][PO_4^{-3}]$

D. $K_{sp} = [Ba^{+2}]^3[PO_4^{-3}]^2$

58. What is the K_{sp} expression for the precipitate formed when solutions of $Fe(NO_3)_3$ and $Sr(OH)_2$ are mixed?

A. $K_{sp} = [Sr^{+2}][NO_3^-]^2$

B. $K_{sp} = [Fe^{+3}][3OH^-]^3$

C. $K_{sp} = [Sr^{+2}][OH^-]^2$

D. $K_{sp} = [Fe^{+3}][OH^-]^3$

59. Which relationship can be used to determine the [Ba+2] in a saturated solution of barium phosphate?

A. $[Ba^{2+}] = \frac{K_{sp}}{[PO_4^{3-}]}$

B. $[Ba^{2+}] = \sqrt[3]{K_{sp}[PO_4^{3-}]^2}$

C. $[Ba^{2+}] = \sqrt[3]{\frac{K_{sp}}{[PO_4^{3-}]^2}}$

D. $[Ba^{2+}] = \sqrt{\frac{K_{sp}}{[PO_4^{3-}]}}$

60. In a saturated solution of $Ag_2C_2O_4$ the $[Ag^+] = 2.2 \times 10^{-4}$ M. What is the K_{sp} of $Ag_2C_2O_4$ in this solution?
A. 4.8×10^{-8}
B. 5.3×10^{-12}
C. 4.3×10^{-11}
D. 1.1×10^{-4}

61. How many moles of solute are dissolved in 200.0 mL of a saturated solution of FeS?
A. 7.7×10^{-10} moles
B. 1.2×10^{-19} moles
C. 1.5×10^{-10} moles
D. 3.9×10^{-9} moles

62. Consider the following saturated solutions:

$CuSO_4$, $BaSO_4$, $CaSO_4$

the order of cation concentration, from highest to lowest is
A. $[Cu^{+2}] > [Ba^{+2}] > [Ca^{+2}]$
B. $[Cu^{+2}] > [Ca^{+2}] > [Ba^{+2}]$
C. $[Ba^{+2}] > [Ca^{+2}] > [Cu^{+2}]$
D. $[Ca^{+2}] > [Cu^{+2}] > [Ba^{+2}]$

63. The solubility of $CdCO_3$ is 2.5×10^{-6} M. Calculate the K_{sp} value for $CdCO_3$.
A. 5.0×10^{-6}
B. 1.6×10^{-3}
C. 2.5×10^{-6}
D. 6.3×10^{-12}

64. What is the value of K_{sp} for $Zn(OH)_2$ if the solubility of $Zn(OH)_2$ is equal to 4.2×10^{-6}M?
A. 1.8×10^{-11}
B. 4.0×10^{-3}
C. 1.0×10^{-2}
D. 3.0×10^{-16}

65. Calculate the solubility of $PbSO_4$

A. 1.3×10^{-4} M
B. 3.6×10^{-8} M
C. 3.2×10^{-16} M
D. 1.8×10^{-8} M

66. The solubility of $ZnCO_3$ is 6.4×10^{-9} M What is the value of K_{sp} for $ZnCO_3$?

A. 1.3×10^{-8}
B. 8.0×10^{-5}
C. 6.4×10^{-9}
D. 4.1×10^{-17}

67. The solubility of $Mg(OH)_2$ is found to be 1.2×10^{-4} M. What is its K_{sp}?

A. 1.4×10^{-8}
B. 1.2 x 10-4
C. 6.9×10^{-12}
D. 1.7×10^{-12}

68. Which of the following saturated solutions will have the lowest $[IO_3^{-1}]$?

A. $NaIO_3$
B. $Cu(IO_3)_2$
C. $Pb(IO_3)_2$
D. $AgIO_3$

69. Calculate the solubility of CaC_2O_4.

A. 8.3×10^{-4} M
B. 4.8×10^{-5} M
C. 2.3×10^{-9} M
D. 1.2×10^{-5} M

70. Which of the following saturated solutions will have the lowest $[S^{-2}]$?

A. CuS
B. ZnS
C. BaS
D. CaS

71. Which of the following saturated solutions will have the lowest $[CO_3^{-2}]$?

A. $CaCO_3$
B. $SrCO_3$
C. Ag_2CO_3
D. $BaCO_3$

72. How many moles of dissolved solute are present in 100.0 mL of a saturated $SrCO_3$ solution?
    A. 2.4×10^{-5} mol
    B. 2.3×10^{-4} mol
    C. 5.6×10^{-11} mol
    D. 2.4×10^{-6} mol

73. What is the solubility of SrF_2?
    A. 4.3×10^{-9} M
    B. 1.0×10^{-3} M
    C. 6.6×10^{-5} M
    D. 1.8×10^{-17} M

74. Which of the following compounds is the least soluble in water?
    A. $PbCl_2$
    B. CsI
    C. CuI_2
    D. PbI_2

75. A saturated solution of nickel carbonate, $NiCO_3$, contains 0.090 g in 2.0 L of solution. Calculate the K_{sp} for $NiCO_3$.

76. After a 50.0 mL sample of a saturated solution of Cu_2SO_3 was heated to dryness, 7.2×10^{-4} g of solid Cu_2SO_3 remained. What is the value of K_{sp} for Cu_2SO_3

77. Calculate the solubility of $SrSO_4$ in grams per litre.

78. Calculate the solubility of $PbSO_4$ in grams per litre.

79. Calculate the iodate ion concentration in a saturated copper(II) iodate solution.

80. What is the maximum $[Ag^{+}]$ that can exist in a solution of 0.010 M $NaIO_3$?
    A. 3.2×10^{-10} M
    B. 1.8×10^{-4} M
    C. 3.2×10^{-6} M
    D. 3.2×10^{-8} M

81. Determine the maximum $[Na_2CO_3]$ that can exist in 5.0 L of a 0.0010 M $Ba(NO_3)_2$ without forming a precipitate.
    A. 2.6×10^{-6} M
    B. 5.1×10^{-5} M
    C. 2.6×10^{-12} M
    D. 2.6×10^{-9} M

82. What is the maximum number of moles of Cl^{-} that can exist in 500.0 mL of 2.0 M $AgNO_3$?
    A. 1.8×10^{-8}
    B. 4.5×10^{-11}
    C. 1.8×10^{-9}
    D. 9.0×10^{-11}

83. Which of the following ions would have the highest concentration in 0.1 M CO_3^{-2}?
    A. Sr^{+2}
    B. Mg^{+2}
    C. Ba^{+2}
    D. Ca^{+2}

84. Which of the following ions would have the highest concentration in 0.1 M Ag^{+}?
    A. CO_3^{-2}
    B. Br^{-}
    C. Cl^{-}
    D. CrO_4^{-2}

85. Which of the following ions could be used in the lowest concentration to remove 0.0010M Ag^{+} ions from a polluted water sample?
    A. IO_3^{-}
    B. CO_3^{-2}
    C. Br^{-}
    D. Cl^{-}

86. Which of the following ions could be used in the lowest concentration to remove 0.0010 M Pb^{+2} ions from a polluted water sample?
    A. Cl^{-}
    B. SO_4^{-2}
    C. I^{-}
    D. Br^{-}

87. Calculate the maximum $[CO_3^{-2}]$ that can exist in a 0.0010 M $Mg(NO_3)_2$

88. Calculate the maximum [CO_3^{-2}] that can exist in a 0.0010 M $AgNO_3$

89. Calculate the mass of NaI necessary to begin precipitation of Cu^+ from a 250.0 mL sample of 0.010 M $CuNO_3$.

90. Calculate the mass of NaCl necessary to begin precipitation of Ag^+ from a 250.0 mL sample of 0.010 M $AgNO_3$.

91. Calculate the maximum mass of $BaCl_2(s)$ that can be added to 250 mL of 0.50 M $Pb(NO_3)_2$ **without** forming a precipitate of $PbCl_2$.

92. Consider the following equilibrium:

$$Fe(OH)_{2(s)} \leftrightarrows Fe^{+2}{}_{(aq)} + 2OH^-{}_{(aq)}$$

Which of the following will cause the equilibrium to shift to the right?

A. adding $Fe(OH)_2$
B. adding $Fe(NO_3)_2$
C. adding KOH
D. adding Na_2S

93. Consider the following equilibrium:

$$AgIO_{3\,(s)} \leftrightarrows Ag^{+}_{(aq)} + IO_3^{-}{}_{(aq)}$$

A few crystals of $NaIO_3$ are added to the above equilibrium. When equilibrium is re-established, how do the new ion concentrations compare with the original equilibrium concentrations?

	$[Ag^+]$	$[IO_3^-]$
A.	increased	increased
B.	increased	decreased
C.	decreased	decreased
D.	decreased	increased

94. Consider the following equilibrium:

$$CaSO_{4(s)} \leftrightarrows Ca^{+2}_{(aq)} + SO_4^{-2}{}_{(aq)}$$

Which of the following would shift the above equilibrium to the left?

A. removing some $Ca^{+2}_{(aq)}$
B. removing some $SO_4^{-2}{}_{(aq)}$
C. adding $MgSO_{4(s)}$
D. adding $CaSO_{4(s)}$

95. Which of the following is true when solid $Cu(NO_3)_2$ is added to a saturated solution of CuS and equilibrium is reestablished?

A. $[S^{-2}]$ does not change
B. $[Cu^{+2}]$ increases
C. $[S^{-2}]$ increases
D. $[Cu^{+2}]$ does not change

96. Which of the following is true when solid NaOH is added to a saturated solution of CuS and equilibrium is reestablished?

A. $[S^{-2}]$ does not change
B. $[Cu^{+2}]$ does not change
C. $[Cu^{+2}]$ increases
D. $[S^{-2}]$ increases

97. Solid NaI is added to a saturated AgCl solution. How have $[Ag^+]$ and $[Cl^-]$ changed when equilibrium has been reestablished?

	$[Ag^+]$	$[Cl^-]$
A.	increased	increased
B.	decreased	increased
C.	increased	decreased
D.	stayed the same	stayed the same

98. Consider the following equilibrium:

$$CaSO_{4\,(s)} \leftrightarrows Ca^{2+\,(aq)} + SO_4^{2-}{}_{(aq)}$$

When $Ba(NO_3)_2$ is added to this solution, which of the following will occur in regards to the equilibrium and $[Ca^{2+}]$?

	Equilibrium	$[Ca^{2+}]$
A.	shifts left	increases
B.	shifts left	decreases
C.	shifts right	increases
D.	shifts right	decreases

99. Consider the following equilibrium:

$$\text{energy} + AgCl_{(s)} \leftrightarrows Ag^{+}{}_{(aq)} + Cl^{-}{}_{(aq)}$$

Addition of which of the following will increase the solubility of AgCl?

A. $AgNO_3$
B. a catalyst
C. HCl
D. heat

100. Consider the following equilibrium:

$$\text{energy} + AgCl_{(s)} \leftrightarrows Ag^{+}{}_{(aq)} + Cl^{-}{}_{(aq)}$$

Addition of which of the following will increase the solubility of AgCl?

A. $AgNO_3$
B. decrease the volume
C. HCl
D. NaBr

101. In which of the following would $PbCl_{2(s)}$ be the **<u>least</u>** soluble?

A. 1 M K_2SO_4
B. 1 M $BaCl_2$
C. 1 M HCl
D. 1 M $Pb(NO_3)_2$

102. What will be the effect of adding some solid $AgNO_3$ to a saturated solution of AgCl?

A. More AgCl will be produced.
B. The $AgNO_3$ will not affect the AgCl equilibrium.
C. The $AgNO_3$ will not dissolve.
D. More AgCl will dissolve.

103. What will be the effect of adding some solid K_2SO_4 to a saturated solution of AgCl?
A. More AgCl will be produced.
B. The K_2SO_4 will not affect the AgCl equilibrium.
C. More AgCl will dissolve.
D. The K_2SO_4 will not dissolve.

104. What will be the effect of adding some solid $Cu(NO_3)_2$ to a saturated solution of AgCl?
A. More AgCl will be produced.
B. The $Cu(NO_3)_2$ will not affect the AgCl equilibrium.
C. The $Cu(NO_3)_2$ will not dissolve.
D. More AgCl will dissolve.

105. Solid $BaSO_4$ is added to water to prepare a saturated solution. Which of the following is true for this equilibrium?
A. the rate of dissolving = rate of crystallization
B. $[BaSO_4] = [Ba^{+2}]^2$
C. solubility = 1.1×10^{-10} M
D. trial K_{sp} is less than K_{sp}

106. The following data was collected to determine the solubility of a substance:

Mass of solute dissolved	5.00 g
Volume of solvent	250.0 mL
Molar mass of solute	100.0 g/mol
Molar mass of solvent	20.0 g/mol

Which of the following best describes its solubility?
A. 2.00×10^{-2} g/mL
B. 1.00 mol/L
C. 0.250 mol
D. 5.00×10^{-2} mol

107. When equal volumes of 0.2 M solutions are mixed, which of the following combinations will form a single precipitate?
A. $CuSO_4$ and $CaCl_2$
B. $(NH_4)_2SO_4$ and $Al(CH_3COO)_3$
C. BaS and NaI
D. $ZnSO_4$ and SrS

108. What is the concentration of the ions in 3.0 L of 0.50 M $Fe_2(SO_4)_3$?

	$[Fe^{+3}]$	$[SO_4^{-2}]$
A.	1.5 M	1.5 M
B.	3.0 M	4.5 M
C.	0.33M	0.50M
D.	1.0 M	1.5 M

109. Which compound will have the lowest solubility?

A. $AgIO_3$

B. $Fe(NO_3)_3$

C. $Fe(OH)_2$

D. $CaSO_4$

110. A solution contains 0.2 M Cu^{+2} and 0.2 M Sr^{+2}. An equal volume of a second solution was added, forming a precipitate with the Cu^{+2} but not the Sr^{+2}. What was present in the second solution?

A. 0.2 M S^{-2} B. 0.2 M SO_4^{2-} C. 0.2 M Cl^- D. 0.2 M NO_3^-

111. A solution of $(NH_4)_2SO_{3\,(aq)}$ is mixed with a solution of $CaCl_{2\,(aq)}$.

a. Write the formula equation for the reaction.

b. Write the complete ionic equation for the reaction.

c. Write the net ionic equation for the reaction.

b. Explain what happens when some $CaS_{(s)}$ is added to the contents.

112. A solution is found to contain $Sr(NO_3)_{2\,(aq)}$, $CuNO_{3\,(aq)}$, $Ba(NO_3)_{2\,(aq)}$ in solution. Devise a procedure by which each of the cations in the solution can be removed, one at a time. The solutions that are available to use are:

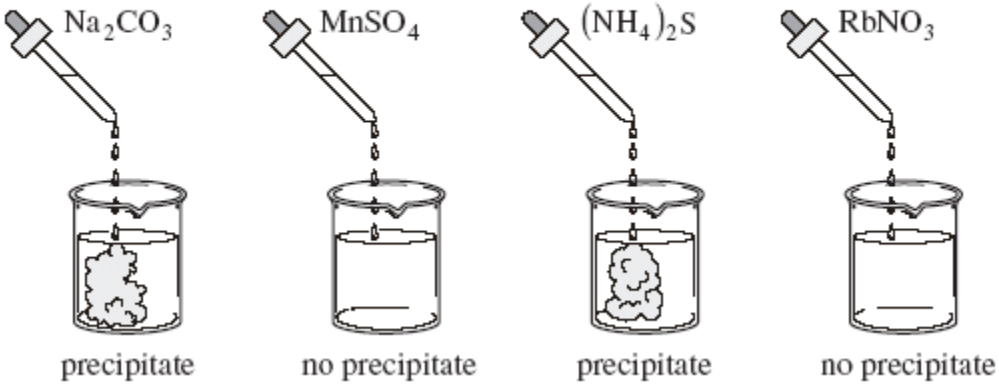
NaI KNO_3 Li_2SO_4 KOH

1. First you would add _____. The precipitate formed would be _____ Filter out the precipitate.

2. To the remaining solution add _____. The precipitate formed would be _____. Filter out the precipitate.

3. To the remaining solution add _____. The precipitate formed would be _____. FIlter out the precipitate.

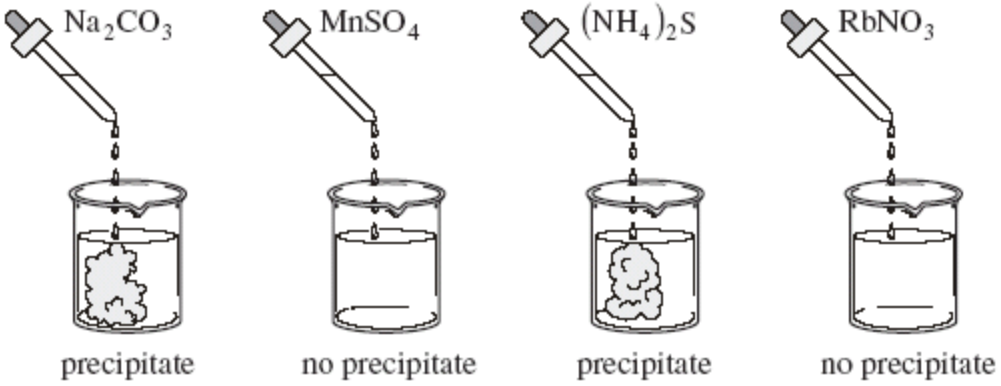
An experiment is conducted to identify an unknown cation that is present in each of four beakers.



113. Which of the following is the unknown cation?

A. Ba^{+2}
B. Be^{+2}
C. Fe^{+3}
D. Ag^{+1}

An experiment is conducted to identify an unknown cation that is present in each of four beakers.



114. Which of the following is the unknown cation?

A. Sr^{+2}
B. Be^{+2}
C. Cr^{+2}
D. Rb^{+1}

115. A solution is prepared containing both 0.2 M SO_4^{2-} and 0.2 M PO_4^{3-} ions. An equal volume of a second solution is added in order to precipitate only one of these two anions. The second solution must contain which of the following?

A. 0.2 M Pb^{+2}
B. 0.2 Sr^{+2}
C. 0.2 M Cs^{+}
D. 0.2 M Zn^{+2}

116. The solubility of $NiCO_3$ is 4.4×10^{-2} g/L. Determine the K_{sp} value for $NiCO_3$.

A. 1.9×10^{-3}
B. 1.4×10^{-7}
C. 2.1×10^{-1}
D. 3.7×10^{-4}

117. A compound has a solubility of 7.1×10^{-5} M at 25°C. The compound is

A. AgBr
B. $CaSO_4$
C. CuS
D. $CaCO_3$

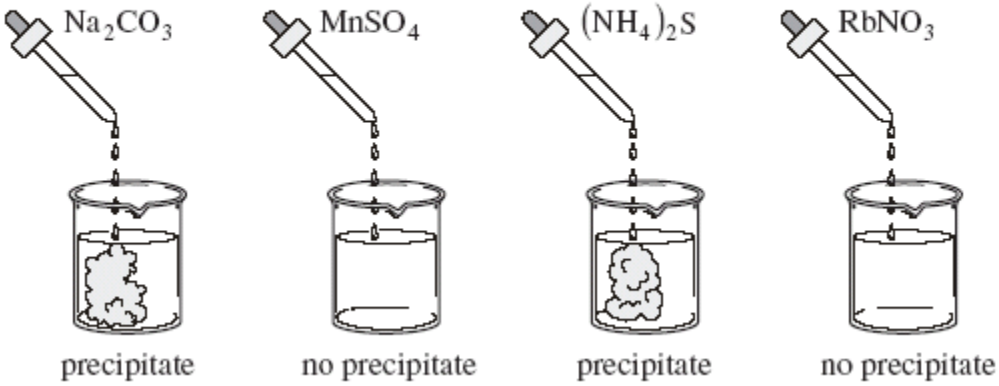
118. At 25°C, what is the $[Cl^-]$ in a saturated solution of $PbCl_2$?

A. 2.3×10^{-2} M
B. 4.6×10^{-2} M
C. 1.4×10^{-2} M
D. 2.9×10^{-2} M

119. Which of the following compounds is the least soluble in water?
A. CsOH
B. $AgBrO_3$
C. CuI
D. BeS

120. In a saturated solution of $Ag_2C_2O_4$ the $[Ag^+] = 2.2 \times 10^{-4}$ M. What is the solubility of $Ag_2C_2O_4$ in this solution?
A. 2.2×10^{-4} M
B. 4.4×10^{-4} M
C. 5.2×10^{-12} M
D. 1.1×10^{-4} M

An experiment is conducted to identify an unknown cation that is present in each of four beakers.



121. Which of the following is the unknown cation?

A. Ca^{+2}
B. Be^{+2}
C. Sn^{+2}
D. K^{+1}

122. An equal number of moles of Na_2CO_3 is added to four different 10.0 mL testtubes.

Sample 1	Sample 2	Sample 3	Sample 4
0.50 M $Ba^{2+}_{(aq)}$	0.50 M $Ca^{2+}_{(aq)}$	0.50 M $Mg^{2+}_{(aq)}$	0.50 M $Sr^{2+}_{(aq)}$

A precipitate forms in only one of the samples. Identify the cation which is present in the precipitate.
A. Sr^{+2}
B. Mg^{+2}
C. Ca^{+2}
D. Ba^{+2}

123. The solubility of CaF_2 is 3.3×10^{-4} M. Determine the K_{sp} for CaF_2.

A. 1.4×10^{-10}
B. 3.3×10^{-4}
C. 3.6×10^{-11}
D. 1.1×10^{-7}

124. Calculate the mass of NaCl necessary to begin precipitation of Pb^{+2} from a 250.0 mL sample of 0.010 M $Pb(NO_3)_2$.

125. Consider the following equilibrium:

$$Fe(OH)_{2(s)} \leftrightarrows Fe^{+2}{}_{(aq)} + 2OH^-{}_{(aq)}$$

Which of the following will cause the equilibrium to shift to the left?

A. adding KOH
B. adding $Cu(NO_3)_2$
C. adding $Fe(OH)_2$
D. adding Na_2S