

Chemistry 12

Solubility Equilibrium Review Package

Name:

Date:

Block:

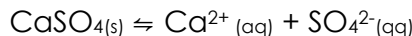
I. Multiple Choice

- Which one of the following would form an ionic solution when dissolved in water?
A. I_2
B. CH_3OH
C. $Ca(NO_3)_2$
D. $C_{12}H_{22}O_{11}$
- The **complete** ionic equation for the reaction between $MgCl_2$ and $AgNO_3$ is
A. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$
B. $2AgNO_{3(aq)} + MgCl_{2(aq)} \rightarrow 2AgCl_{(s)} + Mg(NO_3)_{2(aq)}$
C. $2Ag^+_{(aq)} + Mg^{2+}_{(aq)} + 2NO_3^-_{(aq)} + 2Cl^-_{(aq)} \rightarrow MgCl_{2(s)} + 2Ag^+_{(aq)} + 2NO_3^-_{(aq)}$
D. $2Ag^+_{(aq)} + Mg^{2+}_{(aq)} + 2NO_3^-_{(aq)} + 2Cl^-_{(aq)} \rightarrow 2AgCl_{(s)} + Mg^{2+}_{(aq)} + 2NO_3^-_{(aq)}$
- Which of the following would precipitate out both Ca^{2+} and Mg^{2+} ?
A. S^{2-}
B. PO_4^{3-}
C. SO_4^{2-}
D. CH_3COO^-
- The $[SO_4^{2-}]$ in a saturated solution of $PbSO_4$ is:
A. $1.2 \times 10^{-16} M$
B. $5.0 \times 10^{-9} M$
C. $1.1 \times 10^{-8} M$
D. $1.3 \times 10^{-4} M$
- Which one of the following salts is soluble?
A. $BaSO_4$
B. $CaCO_3$
C. K_3PO_4
D. $Fe(OH)_2$
- The compound Ag_2S has a solubility of $1.3 \times 10^{-4} M$ at $25^\circ C$. The K_{sp} for this compound is:
A. 2.2×10^{-12}
B. 8.8×10^{-12}
C. 1.7×10^{-8}
D. 3.4×10^{-8}
- Which of the following could be used to express solubility?
A. mol
B. M/s
C. g/mL
D. mL/min
- When 100.0 mL of a saturated solution of BaF_2 is heated and all the water is evaporated, $3.6 \times 10^{-4} mol$ of solute remains. The solubility of BaF_2 is:
A. $1.9 \times 10^{-10} M$
B. $1.3 \times 10^{-5} M$
C. $3.6 \times 10^{-4} M$
D. $3.6 \times 10^{-3} M$

10. A solution contains both 0.2M Mg^{2+} and 0.2M Sr^{2+} . These ions can be removed separately through precipitation by adding equal volumes of 0.2M solutions of:

- A. OH^- , and then S^{2-}
B. Cl^- , and then OH^-
C. CO_3^{2-} and then SO_3^{2-}
D. SO_4^{2-} and then PO_4^{2-}

11. Consider the following equilibrium:



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

- A. adding $CaSO_4(s)$
B. adding $MgSO_4(s)$
C. removing some $Ca^{2+}(aq)$
D. removing some $SO_4^{2-}(aq)$

12. Calculate the solubility of CaC_2O_4 .

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

13. How many moles of dissolved solute are present in 100.0mL of a saturated $SrCO_3$ solution?

- A. $5.6 \times 10^{-11} \text{ mol}$
B. $2.4 \times 10^{-6} \text{ mol}$
C. $2.4 \times 10^{-5} \text{ mol}$
D. $2.4 \times 10^{-4} \text{ mol}$

14. What happens when equal volumes of 0.2M $AgNO_3$ and 0.2M $NaCl$ are combined?

- A. A precipitate forms because the trial ion product $>K_{sp}$
B. A precipitate forms because the trial ion product $<K_{sp}$
C. No precipitate forms because the trial ion product $>K_{sp}$
D. No precipitate forms because the trial ion product $<K_{sp}$

15. Determine the maximum $[Na_2CO_3]$ that can exist in 1.0L of 0.0010M $Ba(NO_3)_2$ without forming a precipitate.

- A. $2.6 \times 10^{-12} M$
B. $2.6 \times 10^{-9} M$
C. $2.6 \times 10^{-6} M$
D. $5.1 \times 10^{-5} M$

16. When a student mixes equal volumes of 0.20 M Na_2S and 0.20 M $Sr(OH)_2$,

- A. no precipitate forms.
B. a precipitate of only SrS forms.
C. a precipitate of only $NaOH$ forms.
D. precipitates of both $NaOH$ and SrS form.

17. A student wishes to identify an unknown cation in a solution. A precipitate does not form with the addition of SO_4^{2-} , but does form with the addition of S^{2-} . Which of the following is the unknown cation?

- A. Ag^+
B. Mg^{2+}
C. Ca^{2+}
D. Cu^{2+}

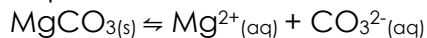
18. The solubility of MnS is $4.8 \times 10^{-7}M$, at 25C. The K_{sp} value is

- A. 2.3×10^{-13}
B. 4.8×10^{-7}
C. 9.6×10^{-7}
D. 6.9×10^{-4}

19. A 200.0mL solution contains 0.050 mol of $\text{Ba}(\text{NO}_3)_2$. The $[\text{NO}_3^-]$ is:

- A. 0.050 M
B. 0.10 M
C. 0.25M
D. 0.50 M

20. Consider the following solubility equilibrium:



The addition of which of the following substances would decrease the solubility of MgCO_3 ?

- A. H_2O B. NaCl C. NaOH D. Na_2CO_3

21. In a solubility equilibrium, the:

- A. rate of dissolving equals the rate of crystallization.
B. neither dissolving nor crystallization are occurring.
C. concentration of solute and solvent are always equal.
D. mass of dissolved solute is greater than the mass of the solution.

22. Which of the following solutions would have $[\text{Fe}^{3+}]$ 0.020M?

- A. 0.40 L of 0.050M $\text{Fe}(\text{NO}_3)_3$ C. 0.50 L of 0.040M $\text{FeC}_6\text{H}_5\text{O}_7$
B. 0.80 L of 0.020M $\text{Fe}_2(\text{SO}_4)_3$ D. 0.50L of 0.010M $\text{Fe}_2(\text{C}_2\text{O}_4)_3$

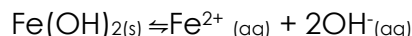
23. Which of the following substances has the lowest solubility?

- A. BaS B. CuS C. FeS D. ZnS

24. The complete ionic equation for the reaction between MgS and $\text{Sr}(\text{OH})_2$ is:

- A. $\text{MgS}(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s}) + \text{SrS}(\text{s})$
B. $\text{MgS}(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s}) + \text{SrS}(\text{aq})$
C. $\text{Mg}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) + \text{Sr}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) + \text{SrS}(\text{s})$
D. $\text{Mg}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) + \text{Sr}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s}) + \text{Sr}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq})$

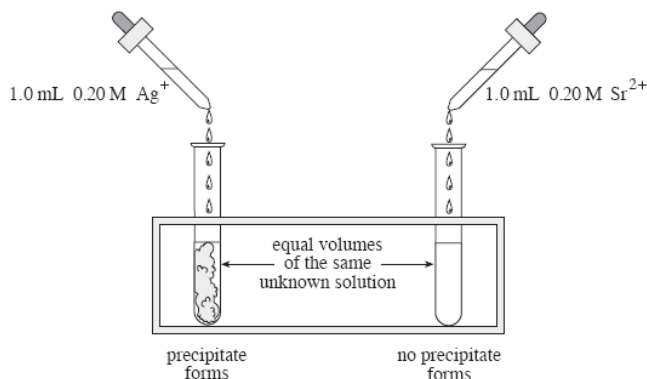
25. Consider the following equilibrium:



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

- A. adding KOH C. adding $\text{Fe}(\text{OH})_2$
B. adding Na_2S D. adding $\text{Fe}(\text{NO}_3)_2$

26. Consider the following experiment:

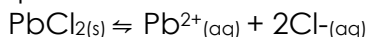


The unknown solution could contain

- A. 0.20M OH^-
B. 0.20M NO_3^-
C. 0.20M PO_4^{3-}
D. 0.20M SO_4^{2-}

27. A compound has a solubility of $7.1 \times 10^{-5} \text{M}$ at 25°C . The compound is:
 A. CuS B. AgBr C. CaCO_3 D. CaSO_4
28. In a saturated solution of KNO_3 , the rate of crystallization is:
 A. equal to zero. C. less than the rate of dissolving.
 B. equal to the rate of dissolving. D. greater than the rate of dissolving.
29. At a certain temperature, the solubility of BaF_2 is $7.4 \times 10^{-3} \text{M}$. The K_{sp} of BaF_2 is:
 A. 1.6×10^{-6} B. 5.5×10^{-5} C. 1.1×10^{-4} D. 7.4×10^{-3}
30. What is the maximum $[\text{Sr}^{2+}]$ that can exist in a solution of $0.10 \text{M Na}_2\text{SO}_4$?
 A. $3.4 \times 10^{-7} \text{M}$ C. $1.7 \times 10^{-6} \text{M}$
 B. $3.4 \times 10^{-6} \text{M}$ D. $5.8 \times 10^{-4} \text{M}$
31. A student could precipitate silver chloride from a saturated solution of silver chloride by adding
 A. water. C. sodium nitrate.
 B. sodium iodide. D. sodium chloride.
32. When equal volumes of 0.20M SrBr_2 and 0.20M AgNO_3 are combined,
 A. no precipitate forms.
 B. a precipitate of only AgBr forms.
 C. a precipitate of only $\text{Sr}(\text{NO}_3)_2$ forms.
 D. precipitates of both AgBr and $\text{Sr}(\text{NO}_3)_2$ form.

33. Consider the following solubility equilibrium:



A student adds NaCl to a saturated solution of PbCl_2 . When equilibrium is reestablished, how have the concentrations changed from the original equilibrium?

- A. $[\text{Pb}^{2+}]$ and $[\text{Cl}^{-}]$ both increased.
 B. $[\text{Pb}^{2+}]$ and $[\text{Cl}^{-}]$ both decreased.
 C. $[\text{Pb}^{2+}]$ decreased and $[\text{Cl}^{-}]$ increased.
 D. $[\text{Pb}^{2+}]$ decreased and $[\text{Cl}^{-}]$ decreased.
34. Solid Ag_2CrO_4 is added to water to form a saturated solution. The K_{sp} value can be calculated by

A. $K_{\text{sp}} = [\text{CrO}_4^{2-}]^2$

B. $K_{\text{sp}} = [\text{CrO}_4^{2-}]^3$

C. $K_{\text{sp}} = \frac{[\text{CrO}_4^{2-}]^3}{2}$

D. $K_{\text{sp}} = 4[\text{CrO}_4^{2-}]^3$

5. Calculate the molar solubility of the following solutions:

a. BaCO_3

b. Mg(OH)_2

6. Will a precipitate form if 100 mL of 1.0×10^{-3} M $\text{Pb(NO}_3)_2$ solution is added to 100.0 mL of 2.0×10^{-3} M MgSO_4 solution? Show all calculations and include the K_{sp} .