1. Consider the following experiment:

1.0 mL 0.20 M Ag\(^+\) + an unknown solution \rightarrow precipitate
1.0 mL 020 M Sr\(^{2+}\) + an unknown solution \rightarrow no precipitate

The unknown solution could contain

A 0.20 M OH\(^-\)  C 0.20 M PO\(_4^{3-}\)
B 0.20 M NO\(_3^-\)  D 0.20 M SO\(_4^{2-}\)

2. A compound has a solubility of \(7.1 \times 10^{-5}\) M at 25 °C. The compound is

A CuS  B AgBr  C CaCO\(_3\)  D CaSO\(_4\)

3. A saturated solution of NaCl contains 36.5 g of solute in 0.100 L of solution. The solubility of the compound is

A 0.062 M  C 3.65 M
B 1.60 M  D 6.24 M

4. Calculate the [Li\(^+\)] in 200.0 mL of 1.5 M Li\(_2\)SO\(_4\).

A 0.30 M  B 0.60 M  C 1.5 M  D 3.0 M

5. The Ksp expression for a saturated solution of Mg(OH)\(_2\) is

A \(\text{Ksp} = [\text{Mg}^{2+}][\text{OH}^-]^2/[\text{Mg(OH)}_2]\)  C \(\text{Ksp} = [\text{Mg}^{2+}][\text{OH}^-]\)
B \(\text{Ksp} = [\text{Mg}^{2+}][\text{OH}^-]^2\)  D \(\text{Ksp} = [\text{Mg}^{2+}][2\text{OH}^-]^2\)

6. Consider the following saturated solution solutions

CuSO\(_4\)  BaSO\(_4\)  CaSO\(_4\)

The order of cation concentration, from highest to lowest, is

A [Ba\(^{2+}\)] > [Ca\(^{2+}\)] > [Cu\(^{2+}\)]
B [Ca\(^{2+}\)] > [Cu\(^{2+}\)] > [Ba\(^{2+}\)]
C [Cu\(^{2+}\)] > [Ca\(^{2+}\)] > [Ba\(^{2+}\)]
D [Cu\(^{2+}\)] > [Ba\(^{2+}\)] > [Ca\(^{2+}\)]
7. When \(1.0 \times 10^{-3}\) moles of CuCl\(_2\) are added to 1.0 L of 1.0 \(\times 10^{-3}\) M IO\(_3^−\), the

A) Trial Ksp > Ksp and a precipitate forms  
B) Trial Ksp < Ksp and a precipitate forms  
C) Trial Ksp > Ksp and no precipitate forms  
D) Trial Ksp < Ksp and no precipitate forms  

8. The solubility of CdS = \(2.8 \times 10^{-14}\). The value of the Ksp is

A) \(7.8 \times 10^{-28}\)  
B) \(2.8 \times 10^{-14}\)  
C) \(5.6 \times 10^{-14}\)  
D) \(1.7 \times 10^{-7}\)  

9. The ion concentrations in 0.25 M Al\(_2\)(SO\(_4\))\(_3\) are

<table>
<thead>
<tr>
<th>[Al(^{3+})]</th>
<th>[SO(_4^{2-})]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 0.25 M</td>
<td>0.25 M</td>
</tr>
<tr>
<td>B 0.50 M</td>
<td>0.75 M</td>
</tr>
<tr>
<td>C 0.75 M</td>
<td>0.50 M</td>
</tr>
<tr>
<td>D 0.10 M</td>
<td>0.15 M</td>
</tr>
</tbody>
</table>

10. Which of the following will not produce a precipitate when equal volumes of 0.20 M solutions are combined?

A) KOH and CaCl\(_2\)  
B) Zn(NO\(_3\))\(_2\) and K\(_3\)PO\(_4\)  
C) Sr(OH)\(_2\) and (NH\(_4\))\(_2\)S  
D) Na\(_2\)SO\(_4\) and Pb(NO\(_3\))\(_2\)  

11. Consider the following equilibrium: Mg(OH)\(_2\)(s) \(\rightleftharpoons\) Mg\(^{2+}\)(aq) + 2OH\(^−\)(aq)

A compound that can be added to cause a shift to the right is

A) NaOH  
B) HCl  
C) Sr(OH)\(_2\)  
D) Mg(OH)\(_2\)  

12. If the trial ion product for AgBrO\(_3\) is calculated to be \(1.0 \times 10^{-7}\), then

A) a precipitate forms because the trial ion product > Ksp  
B) a precipitate forms because the trial ion product < Ksp  
C) no a precipitate forms because the trial ion product > Ksp  
D) no a precipitate forms because the trial ion product < Ksp  

13. Which of the following will dissolve in water to produce a molecular solution?

A) CaCl\(_2\)  
B) NaOH  
C) CH\(_3\)OH  
D) Sr(OH)\(_2\)  

14. In a solubility equilibrium, the

A) rate of dissolving equals the rate of crystallization  
B) neither dissolving or crystallization occurs  
C) concentration of solute and solvent are equal  
D) mass of dissolved solute is greater than the mass of the solution
15. The maximum \([\text{SO}_4^{2-}]\) that can exist in 1.0 \( \times 10^{-3} \) M \( \text{Ca(NO}_3)_2 \) without a precipitate forming is

- A 7.1 \( \times 10^{-5} \) M
- B 1.0 \( \times 10^{-3} \) M
- C 8.4 \( \times 10^{-3} \) M
- D 7.1 \( \times 10^{-2} \) M

16. When equal volumes of 0.20 M \( \text{CuSO}_4(\text{aq}) \) and 0.20 M \( \text{Li}_2\text{S}(\text{aq}) \) are combined, the complete ionic equation is

- A \( \text{Cu}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{CuS(s)} \)
- B \( \text{CuSO}_4(\text{aq}) + \text{Li}_2\text{S}(\text{aq}) \rightarrow \text{CuS(s)} + \text{Li}_2\text{SO}_4(\text{aq}) \)
- C \( \text{Cu}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + 2\text{Li}^+(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{Li}_2\text{SO}_4(\text{aq}) + \text{CuS(s)} \)
- D \( \text{Cu}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + 2\text{Li}^+(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{Li}_2\text{SO}_4(\text{aq}) + 2\text{Li}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \)

17. Consider the solubility equilibrium: \( \text{CaCO}_3(\text{aq}) \rightleftharpoons \text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \)

An additional piece of solid \( \text{CaCO}_3 \) is added to the equilibrium above. The rate of dissolving and the rate of crystallization have

<table>
<thead>
<tr>
<th>Rate of Dissolving</th>
<th>Rate of Crystallization</th>
</tr>
</thead>
<tbody>
<tr>
<td>A increases</td>
<td>increases</td>
</tr>
<tr>
<td>B increases</td>
<td>not changed</td>
</tr>
<tr>
<td>C not changed</td>
<td>increased</td>
</tr>
<tr>
<td>D not changed</td>
<td>not changed</td>
</tr>
</tbody>
</table>

18. At 25 °C, which of the following compounds would dissolve to form a saturated solution with the greatest \([\text{Pb}^{2+}]\)?

- A \( \text{PbI}_2 \)
- B \( \text{PbCl}_2 \)
- C \( \text{PbBr}_2 \)
- D \( \text{Pb(IO}_3)_2 \)

19. Consider the following anions:

I 10.0 mL of 0.20 M \( \text{Cl}^- \)
II 10.0 mL of 0.20 M \( \text{OH}^- \)
III 10.0 mL of 0.20 M \( \text{SO}_3^{2-} \)

When 10.0 mL of 0.20 M \( \text{Pb(NO}_3)_2 \) are added to each of the above, precipitates form in

- A I and II only
- B I and III only
- C II and III only
- D I, II, and III

20. Which of the following units could be used to describe solubility?

- A g/s
- B g/L
- C M/L
- D mol/s

21. The solubility of \( \text{SnS} \) is 3.2 \( \times 10^{-3} \) M. The value of the Ksp is

- A 1.0 \( \times 10^{-5} \)
- B 3.2 \( \times 10^{-3} \)
- C 6.4 \( \times 10^{-3} \)
- D 5.7 \( \times 10^{-2} \)
22. Silver chloride, AgCl, would be least soluble in
   A  1.0 M HCl  C  1.0 M ZnCl₂
   B  1.0 M NaNO₃  D  1.0 M AgNO₃

23. The solubility of SrF₂ is
   A  4.3 x 10⁻⁹  B  6.6 x 10⁻⁵  C  1.0 x 10⁻³  D  1.6 x 10⁻³

24. The Ksp expression for a saturated solution of AgCO₃ is
   A  Ksp = [Ag⁺][CO₃²⁻]  C  Ksp = [2Ag⁺][CO₃²⁻]
   B  Ksp = [Ag⁺][CO₃²⁻]  D  Ksp = [2Ag⁺][CO₃²⁻]

25. How many moles of solute are dissolved in 200.0 mL of a saturated solution of FeS?
   A  1.2 x 10⁻¹⁹  B  6.0 x 10⁻¹⁹  C  1.5 x 10⁻¹⁰  D  7.7 x 10⁻¹⁰

26. A solution contains both Ag⁺ and Mg²⁺ ions. During selective precipitation, these ions are removed one at a time by adding
   A  I⁻ followed by OH⁻  C  SO₄²⁻ followed by Cl⁻
   B  OH⁻ followed by S²⁻  D  NO₃⁻ followed by PO₄³⁻

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

28. The ion concentrations in 0.25 M Al₂(SO₄)₃ are
   \[
   [\text{Al}^{3+}] \quad [\text{SO}_4^{2-}]
   \]
   A  0.25 M  0.25 M
   B  0.50 M  0.75 M
   C  0.75 M  0.50 M
   D  0.10 M  0.15 M

29. Which of the following will not produce a precipitate when equal volumes of 0.20 M solutions are combined?
   A  KOH and SrCl₂  C  Zn(OH)₂ and (NH₄)₂S
   B  Zn(OH)₂ and K₃PO₄  D  Na₂SO₄ and Pb(NO₃)₂

30. What is observed when H₂SO₄ is added to a saturated solution of CaSO₄?
   A  CaSO₄(s) dissolves  C  bubbles of H₂ are given off
   B  the [Ca²⁺] increases  D  additional CaSO₄ precipitates
31. The solubility of CdS is $2.8 \times 10^{-14}$ M. The value of the Ksp is

\[
\begin{array}{llll}
A & 7.8 \times 10^{-28} \\
B & 2.8 \times 10^{-14} \\
C & 5.6 \times 10^{-14} \\
D & 1.7 \times 10^{-7} \\
\end{array}
\]

32. Consider the following solutions: 0.10 M Cl$^-$ 0.10 M Br$^-$ 0.10 M IO$_3^-$ 0.10 M BrO$_3^-$

Equal moles of AgNO$_3$ are added to each solution. It is observed that a precipitate forms in all but one solution. Which solution does not form a precipitate?

\[
\begin{array}{llll}
A & \text{Cl}^- \\
B & \text{Br}^- \\
C & \text{IO}_3^- \\
D & \text{BrO}_3^- \\
\end{array}
\]

33. Consider the following equilibrium: $2\text{O}_3(g) \rightleftharpoons 3\text{O}_2(g)$ $K_{eq} = 65$

Initially, 0.10 mole O$_3$ and 0.10 mole of O$_2$ are placed in a 1.0 L container. Which of the following describes the changes in concentrations as the reaction proceeds to equilibrium?

\[
\begin{array}{lll}
\text{[O}_3\text{]} & \text{[O}_2\text{]} \\
A & \text{decreases} & \text{decreases} \\
B & \text{decreases} & \text{increases} \\
C & \text{increases} & \text{decreases} \\
D & \text{increases} & \text{increases} \\
\end{array}
\]

35. Increasing the temperature of a reaction increases the rate by

I increasing frequency of collision  
II increasing the kinetic energy of collision  
III decreasing the potential energy of collision

A I only  
B I and II only  
C II and III only  
D I, II, and III

36. What is the $K_{eq}$ expression for the following equilibrium?

$\text{Fe(s)} + 4\text{H}_2\text{O}(g) \rightleftharpoons \text{Fe}_3\text{O}_4(s) + 4\text{H}_2(g)$

\[
\begin{array}{lll}
A & \text{Keq} = [\text{H}_2]^4 \\
B & \text{Keq} = \frac{[\text{H}_2]^4}{[\text{H}_2\text{O}]} \\
C & \text{Keq} = \frac{[\text{Fe}_3\text{O}_4][\text{H}_2]^4}{[\text{Fe}]^3[\text{H}_2\text{O}]^4} \\
D & \text{Keq} = \frac{[\text{Fe}_3\text{O}_4]}{[\text{H}_2\text{O}]} \\
\end{array}
\]

1. Write the net ionic equation representing the reaction that occurs when 50.0 mL of 0.20 M ZnSO$_4$ and 50.0 mL 0.20 M BaS are combined.
2. A 100.0 mL sample of 0.600M Ca(NO$_3$)$_2$ is diluted by adding 400.0 mL of water. Calculate the concentrations of all of the ions.

3. When 1.00 L of CaF$_2$ was evaporated to dryness, 2.66 x 10$^{-2}$ g of residue was formed. Calculate the Ksp.

4. A maximum of 0.60 g Pb(NO$_3$)$_2$ can be added to 1.5 L of NaBr$_{(aq)}$ without forming a precipitate. Calculate the [NaBr].

5. Consider the following solutions at 25 $^\circ$C

Saturated AgCl$_{(aq)}$ 
Saturated Ag$_2$CO$_3$(aq)

Using calculations, identify the solution with the greater [Ag$^+$].
ANSWERS to the Practice Test #2

1. Consider the following experiment:

1.0 mL 0.20 M Ag\(^{+}\) + an unknown solution → precipitate
1.0 mL 0.20 M Sr\(^{2+}\) + an unknown solution → no precipitate

The unknown solution could contain

A 0.20 M OH\(^{-}\) low with Ag\(^{+}\) and high with Sr\(^{2+}\)
B 0.20 M NO\(_3\)\(^{-}\)
C 0.20 M PO\(_4\)\(^{3-}\)
D 0.20 M SO\(_4\)\(^{2-}\)

2. A compound has a solubility of 7.1 \(\times\) 10\(^{-5}\) M at 25 °C. The compound is

A CuS
B AgBr
C CaCO\(_3\) square the solubility
D CaSO\(_4\)

3. A saturated solution of NaCl contains 36.5 g of solute in 0.100 L of solution. The solubility of the compound is

A 0.062 M
B 1.60 M
C 3.65 M
D 6.24 M

4. Calculate the [Li\(^{+}\)] in 200.0 mL of 1.5 M Li\(_2\)SO\(_4\).

A 0.30 M
B 0.60 M
C 1.5 M
D 3.0 M Do not divide by L

5. The Ksp expression for a saturated solution of Mg(OH)\(_2\) is

A Ksp = \([\text{Mg}^{2+}][\text{OH}^{-}]^2 / \text{Mg(OH)}_2\]
B Ksp = \([\text{Mg}^{2+}][\text{OH}^{-}]^2\)
C Ksp = \([\text{Mg}^{2+}][\text{OH}^{-}]\)
D Ksp = \([\text{Mg}^{2+}][2\text{OH}^{-}]^2\)
6. Consider the following saturated solution solutions

<table>
<thead>
<tr>
<th></th>
<th>CuSO₄</th>
<th>BaSO₄</th>
<th>CaSO₄</th>
</tr>
</thead>
</table>

The order of cation concentration, from highest to lowest, is

A  [Ba²⁺]  >  [Ca²⁺]  >  [Cu²⁺]
B  [Ca²⁺]  >  [Cu²⁺]  >  [Ba²⁺]
C  [Cu²⁺]  >  [Ca²⁺]  >  [Ba²⁺]  largest to smallest Ksp
D  [Cu²⁺]  >  [Ba²⁺]  >  [Ca²⁺]

7. When 1.0 x 10⁻³ moles of CuCl₂(s) are added to 1.0 L of 1.0 x 10⁻³ M IO₃⁻, the

A  Trial Ksp > Ksp and a precipitate forms
B  Trial Ksp < Ksp and a precipitate forms
C  Trial Ksp > Ksp and no precipitate forms
D  Trial Ksp < Ksp and no precipitate forms

8. The solubility of CdS = 2.8 x 10⁻¹⁴ M. The value of the Ksp is

A  7.8 x 10⁻²⁸  Square the solubility
B  2.8 x 10⁻¹⁴
C  5.6 x 10⁻¹⁴
D  1.7 x 10⁻⁷

9. The ion concentrations in 0.25 M Al₂(SO₄)₃ are

<table>
<thead>
<tr>
<th></th>
<th>Al³⁺</th>
<th>SO₄²⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.25 M</td>
<td>0.25 M</td>
</tr>
<tr>
<td>B</td>
<td>0.50 M</td>
<td>0.75 M</td>
</tr>
<tr>
<td>C</td>
<td>0.75 M</td>
<td>0.50 M</td>
</tr>
<tr>
<td>D</td>
<td>0.10 M</td>
<td>0.15 M</td>
</tr>
</tbody>
</table>

10. Which of the following will not produce a precipitate when equal volumes of 0.20 M solutions are combined?

A  KOH and CaCl₂
B  Zn(NO₃)₂ and K₃PO₄
C  Sr(OH)₂ and (NH₄)₂S  Both have high solubility
D  Na₂SO₄ and Pb(NO₃)₂

11. Consider the following equilibrium: Mg(OH)₂(s)  ⇌  Mg²⁺(aq) + 2OH⁻(aq)

A compound that can be added to cause a shift to the right is

A  NaOH
B  HCl  Acids react with OH⁻
C Sr(OH)$_2$
D Mg(OH)$_2$

12. If the trial ion product for AgBrO$_3$ is calculated to be $1.0 \times 10^{-7}$, then

A a precipitate forms because the trial ion product > Ksp
B a precipitate forms because the trial ion product < Ksp
C no a precipitate forms because the trial ion product > Ksp
D no a precipitate forms because the trial ion product < Ksp

13. Which of the following will dissolve in water to produce a molecular solution?

A CaCl$_2$
B NaOH
C CH$_3$OH One of these things is not kike the other
D Sr(OH)$_2$

14. In a solubility equilibrium, the

A rate of dissolving equals the rate of crystallization
B neither dissolving or crystallization occurs
C concentration of solute and solvent are equal
D mass of dissolved solute is greater than the mass of the solution

15. The maximum [SO$_4^{2-}$] that can exist in $1.0 \times 10^{-3}$ M Ca(NO$_3$)$_2$ without a precipitate forming is

A $7.1 \times 10^{-5}$ M
B $1.0 \times 10^{-3}$ M
C $8.4 \times 10^{-3}$ M
D $7.1 \times 10^{-2}$ M

16. When equal volumes of 0.20 M CuSO$_4$(aq) and 0.20 M Li$_2$S(aq) are combined, the complete ionic equation is

A Cu$^{2+}$(aq) + SO$_4^{2-}$(aq) → CuS(s)
B CuSO$_4$(aq) + Li$_2$S(aq) → CuS(s) + Li$_2$SO$_4$(aq)
C Cu$^{2+}$(aq) + SO$_4^{2-}$(aq) + 2Li$^+$(aq) + S$^{2-}$(aq) → Li$_2$SO$_4$(aq) + CuS(s)
D Cu$^{2+}$(aq) + SO$_4^{2-}$(aq) + 2Li$^+$(aq) + S$^{2-}$(aq) → CuS(s) + 2Li$^+$(aq) + SO$_4^{2-}$(aq)

17. Consider the solubility equilibrium: 

$$CaCO_3(aq) \rightleftharpoons Ca^{2+}(aq) + CO_3^{2-}(aq)$$

An additional piece of solid CaCO$_3$ is added to the equilibrium above. The rate of dissolving and the rate of crystallization have

Rate of Dissolving Rate of crystallization
A increases increases
B increases not changed
C not changed increased
D not changed not changed
18. At 25 °C, which of the following compounds would dissolve to form a saturated solution with the greatest [Pb²⁺]?

A  PbI₂  
B  PbCl₂  **largest Ksp**  
C  PbBr₂  
D  Pb(IO₃)₂

19. Consider the following anions:

I  10.0 mL of 0.20 M Cl⁻  
II  10.0 mL of 0.20 M OH⁻  
III  10.0 mL of 0.20 M SO₃²⁻  

When 10.0 mL of 0.20 M Pb(NO₃)₂ are added to each of the above, precipitates form in

A  I and II only  
B  I and III only  
C  II and III only  
D  I, II, and III

20. Which of the following units could be used to describe solubility?

A  g/s  
B  g/L  
C  M/L  
D  mol/s

21. The solubility of SnS is 3.2 x 10⁻³ M. The value of the Ksp is

A  1.0 x 10⁻⁵  **square the solubility**  
B  3.2 x 10⁻³  
C  6.4 x 10⁻³  
D  5.7 x 10⁻²

22. Silver chloride, AgCl, would be least soluble in

A  1.0 M HCl  
B  1.0 M NaNO₃  
C  1.0 M ZnCl₂  **1.0 M ZnCl₂**  
D  1.0 M AgNO₃

23. The solubility of SrF₂ is

A  4.3 x 10⁻⁹  
B  6.6 x 10⁻⁵
24. The Ksp expression for a saturated solution of AgCO$_3$ is

A $\text{Ksp} = [\text{Ag}^+][\text{CO}_3^{2-}]$
B $\text{Ksp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}]$
C $\text{Ksp} = [2\text{Ag}^+][\text{CO}_3^{2-}]$
D $\text{Ksp} = [2\text{Ag}^+]^2[\text{CO}_3^{2-}]$

25. How many moles of solute are dissolved in 200.0 mL of a saturated solution of FeS?

A $1.2 \times 10^{-19}$
B $6.0 \times 10^{-19}$
C $1.5 \times 10^{-10}$
D $7.7 \times 10^{-10}$

26. A solution contains both Ag$^+$ and Mg$^{2+}$ ions. During selective precipitation, these ions are removed one at a time by adding

A I$^-$/followed by OH$^-$
B OH$^-$/followed by S$^{2-}$
C SO$_4^{2-}$/followed by Cl$^-$
D NO$_3^-$/followed by PO$_4^{3-}$

27. Which of the following does not define solubility?

A the concentration of solute in a saturated solution
B the moles of solute dissolved in a given amount of solution
C the maximum mass of solute that can dissolve in a given amount of solution
D the minimum amount of solute required to produce one litre of saturated solution

28. The ion concentrations in 0.25 M Al$_2$(SO$_4$)$_3$ are

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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.25 M</td>
<td>0.25 M</td>
</tr>
<tr>
<td>B</td>
<td><strong>0.50 M</strong></td>
<td><strong>0.75 M</strong></td>
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<tr>
<td>C</td>
<td>0.75 M</td>
<td>0.50 M</td>
</tr>
<tr>
<td>D</td>
<td>0.10 M</td>
<td>0.15 M</td>
</tr>
</tbody>
</table>

29. Which of the following will not produce a precipitate when equal volumes of 0.20 M solutions are combined?

A KOH and SrCl$_2$
B Zn(OH)$_2$ and K$_3$PO$_4$
C Zn(OH)$_2$ and (NH$_4$)$_2$S
D Na₂SO₄ and Pb(NO₃)₂

30. What is observed when H₂SO₄ is added to a saturated solution of CaSO₄?

A CaSO₄(s) dissolves
B the [Ca²⁺] increases
C bubbles of H₂ are given off
D additional CaSO₄ precipitates

31. The solubility of CdS is 2.8 × 10⁻¹⁴ M. The value of the Ksp is

A 7.8 × 10⁻²⁸
B 2.8 × 10⁻¹⁴
C 5.6 × 10⁻¹⁴
D 1.7 × 10⁻⁷

32. Consider the following solutions: 0.10 M Cl⁻ 0.10 M Br⁻ 0.10 M IO₃⁻ 0.10 M BrO₃⁻

Equal moles of AgNO₃ are added to each solution. It is observed that a precipitate forms in all but one solution. Which solution does not form a precipitate?

A Cl⁻
B Br⁻
C IO₃⁻
D BrO₃⁻ highest Ksp

33. Consider the following equilibrium: 2O₃(g) ⇄ 3O₂(g)  Keq = 65

Initially, 0.10 mole O₃ and 0.10 mole of O₂ are placed in a 1.0 L container. Which of the following describes the changes in concentrations as the reaction proceeds to equilibrium?

[O₃]  [O₂]
A decreases  decreases
B decreases  increases
C increases  decreases
D increases  increases

34. Consider the following potential energy diagram for the reversible reaction.
<table>
<thead>
<tr>
<th>Activation Energy (kJ)</th>
<th>ΔH (kJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 10</td>
<td>-20</td>
</tr>
<tr>
<td>B 10</td>
<td>-30</td>
</tr>
<tr>
<td>C 30</td>
<td>+10</td>
</tr>
<tr>
<td>D 20</td>
<td>+30</td>
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</tbody>
</table>

35. Increasing the temperature of a reaction increases the rate by
   I increasing frequency of collision
   II increasing the kinetic energy of collision
   III decreasing the potential energy of collision

A I only
B **I and II only**
C II and III only
D I, II, and III

36. What is the Keq expression for the following equilibrium?

   \[ \text{Fe}_{(s)} + 4\text{H}_2\text{O}_{(g)} \rightleftharpoons \text{Fe}_3\text{O}_4_{(s)} + 4\text{H}_2(g) \]

A \[ \text{Keq} = [\text{H}_2]^4 \]
B \[ \text{Keq} = \frac{[\text{H}_2]}{[\text{H}_2\text{O}]} \]
C \[ \text{Keq} = \frac{[\text{H}_2]^4}{[\text{H}_2\text{O}]^4} \]
D \[ \text{Keq} = \frac{[\text{Fe}_3\text{O}_4][\text{H}_2]^4}{[\text{Fe}]^3[\text{H}_2\text{O}]^4} \]
Subjective

1. Write the net ionic equation representing the reaction that occurs when 50.0 mL of 0.20 M ZnSO₄ and 50.0 mL 0.20 M BaS are combined.

$$\text{ZnSO}_4(aq) + \text{BaS}(aq) \rightarrow \text{BaSO}_4(s) + \text{ZnS}(s)$$

$$\text{Zn}^{2+} + \text{SO}_4^{2-} + \text{Ba}^{2+} + \text{S}^{2-} \rightarrow \text{BaSO}_4(s) + \text{ZnS}(s)$$

2. A 100.0 mL sample of 0.600 M Ca(NO₃)₂ is diluted by adding 400.0 mL of water. Calculate the concentrations of all of the ions.

$$\text{Ca(NO}_3)_2 \rightleftharpoons \text{Ca}^{2+} + 2\text{NO}_3^-$$

\[
\begin{array}{c|c|c|c}
(100) & 0.600 \text{ M} & 0.120 \text{ M} & 0.240 \text{ M} \\
(500) & & & \\
\end{array}
\]
3. When 1.00 L of CaF$_2$ was evaporated to dryness, 2.66 x $10^{-2}$ g of residue was formed. Calculate the Ksp.

\[
\text{Molarity} = \frac{2.66 \times 10^{-2} \text{ g} \times 1 \text{ mole}}{78.1 \text{ g}} = 3.406 \times 10^{-4} \text{ M}
\]

\[
\begin{align*}
\text{CaF}_2 & \rightleftharpoons \text{Ca}^{2+} + 2\text{F}^- \\
3.406 \times 10^{-4} \text{ M} & \quad 3.406 \times 10^{-4} \text{ M} \quad 6.812 \times 10^{-4} \text{ M}
\end{align*}
\]

\[
\text{Ksp} = (3.406 \times 10^{-4})(6.812 \times 10^{-4})^2 = 1.58 \times 10^{-10}
\]

4. A maximum of 0.60 g Pb(NO$_3$)$_2$ can be added to 1.5 L of NaBr$_{(aq)}$ without forming a precipitate. Calculate the [NaBr].

\[
\text{Molarity} = \frac{0.60 \text{ g} \times 1 \text{ mole}}{331.2 \text{ g}} = 0.001208 \text{ M}
\]
\[ \text{PbBr}_2 \rightleftharpoons \text{Pb}^{2+} + 2\text{Br}^- \]

\[
K_{\text{sp}} = [\text{Pb}^{2+}][\text{Br}^-]^2
\]

\[
6.6 \times 10^{-6} = [0.001208][\text{Br}^-]^2
\]

\[
[\text{Br}^-] = 7.4 \times 10^{-2} \text{M}
\]

5. Consider the following solutions at 25 °C

Using calculations, identify the solution with the greater \([\text{Ag}^+]\).

\[
\text{AgCl(s)} \rightleftharpoons \text{Ag}^+ + \text{Cl}^-
\]

\[
K_{\text{sp}} = x^2
\]

\[
1.8 \times 10^{-10} = x^2
\]

\[
x = 1.3 \times 10^{-5} \text{M}
\]

\[
[\text{Ag}^+] = 1.3 \times 10^{-5} \text{M}
\]

\[
\text{Ag}_2\text{CO}_3(\text{s}) \rightleftharpoons 2\text{Ag}^+ + \text{CO}_3^{2-}
\]

\[
K_{\text{sp}} = 4x^3
\]

\[
8.5 \times 10^{-12} = 4x^3
\]

\[
x = 1.286 \times 10^{-4} \text{M}
\]

\[
[\text{Ag}^+] = 2x = 2.6 \times 10^{-4} \text{M}
\]

Greater