Question #: 1

A cup of orange juice has \([\text{H}_3\text{O}^+] = 2.1 \times 10^{-4} \text{ M}\). What is the pH of the orange juice?

\[
pH = \text{ ________ }
\]

Report your answer to \textbf{two} decimal places.

1. \textbf{ ________ }

Question #: 2

The pH of freshly-squeezed lemon juice is 1.89. What is the concentration of \text{H}_3\text{O}^+ in the juice?

A. \(1.3 \times 10^{-2} \text{ M}\)  
B. \(2.9 \times 10^{-4} \text{ M}\)  
C. \(1.0 \times 10^{-1} \text{ M}\)  
D. \(3.2 \times 10^{-3} \text{ M}\)

Question #: 3

What is the \textbf{pH} of a 0.300 M solution hydrofluoric acid solution with a percent ionization of 3.42%?

A. 0.300  
B. 1.989  
C. 3.138  
D. 4.086
Question #: 4

What is the \textbf{pH} of a solution that is 0.100 M in HClO \((K_a = 2.9 \times 10^{-8})\) and 0.100 M in HCl? Report your answer to \textbf{two} decimal places.

\textbf{pH} = \underline{1\hspace{1cm}}

1. \underline{\hspace{4cm}}

Question #: 5

Which solution requires the use of the quadratic equation to calculate the \([\text{H}_3\text{O}^+])\?

A. 0.150 M benzoic acid (HC\textsubscript{7}H\textsubscript{5}O\textsubscript{2}) solution; \(K_a(\text{HC}_7\text{H}_5\text{O}_2) = 6.5 \times 10^{-5}\)
B. 0.120 M pyruvic acid (HC\textsubscript{3}H\textsubscript{3}O\textsubscript{3}) solution; \(K_a(\text{HC}_3\text{H}_3\text{O}_3) = 4.1 \times 10^{-3}\)
C. 0.110 M nitrous acid (HNO\textsubscript{2}) solution; \(K_a(\text{HNO}_2) = 1.8 \times 10^{-4}\)
D. 0.050 M hydrocyanic acid (HCN) solution; \(K_a(\text{HCN}) = 4.9 \times 10^{-10}\)

Question #: 6

Given that the \(K_a\) of nitrous acid (HNO\textsubscript{2}) at 25°C is \(4.0 \times 10^{-4}\), the \textbf{pK}_b\ of the nitrite ion (NO\textsubscript{2}^-) is \underline{1\hspace{1cm}}. Report your answer to \textbf{two} decimal places.

1. \underline{\hspace{4cm}}
In a mixture of three bases (KOH, CH₃NH₂, and NH₃) of equal concentration, which choice below list(s) the reaction(s) that must be considered in calculating the pH? Choose the single best answer.

A. \[ \text{KOH} \rightarrow \text{K}^+ + \text{OH}^- \]

B. \[ \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^- \quad K_b = 4.4 \times 10^{-4} \]

C. \[ \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \quad K_b = 1.8 \times 10^{-5} \]

D. \[ \text{KOH} \rightarrow \text{K}^+ + \text{OH}^- \]

\[ \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^- \quad K_b = 4.4 \times 10^{-4} \]

\[ \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \quad K_b = 1.8 \times 10^{-5} \]

\[ 2 \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^- \quad K_w = 1.0 \times 10^{-14} \]
**Question #: 8**

Which is the **least basic** solution?

- A. pH = 10
- B. pH = 13
- C. pOH = 2
- D. pOH = 5

**Question #: 9**

Select the **two** salts that have a pH <7 when dissolved in water.

- A. Ca(C₂H₃O₂)₂
- B. CH₃NH₃Br
- C. CrCl₄
- D. LiClO₄
- E. NaNO₂
- F. KI
Question #: 10

For which two 0.010 M polyprotic acid solutions must you consider more than just $K_{a1}$ to accurately calculate the pH?

A. $\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightarrow \text{HSO}_4^- + \text{H}_3\text{O}^+$ $K_{a1} = \text{strong}$
   $\text{HSO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{SO}_4^{2-} + \text{H}_3\text{O}^+$ $K_{a2} = 1.2 \times 10^{-2}$

B. $\text{H}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O} \rightleftharpoons \text{HC}_2\text{O}_4^- + \text{H}_3\text{O}^+$ $K_{a1} = 6.0 \times 10^{-2}$
   $\text{HC}_2\text{O}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{C}_2\text{O}_4^{2-} + \text{H}_3\text{O}^+$ $K_{a2} = 6.1 \times 10^{-5}$

C. $\text{H}_2\text{C}_6\text{H}_5\text{O}_6 + \text{H}_2\text{O} \rightleftharpoons \text{HC}_6\text{H}_5\text{O}_6^- + \text{H}_3\text{O}^+$ $K_{a1} = 8.0 \times 10^{-5}$
   $\text{HC}_6\text{H}_5\text{O}_6^- + \text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_5\text{O}_6^- + \text{H}_3\text{O}^+$ $K_{a2} = 1.6 \times 10^{-12}$

D. $\text{H}_3\text{C}_6\text{H}_5\text{O}_7 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{C}_6\text{H}_5\text{O}_7^- + \text{H}_3\text{O}^+$ $K_{a1} = 7.4 \times 10^{-4}$
   $\text{H}_2\text{C}_6\text{H}_5\text{O}_7^- + \text{H}_2\text{O} \rightleftharpoons \text{HC}_6\text{H}_5\text{O}_7^{2-} + \text{H}_3\text{O}^+$ $K_{a2} = 1.7 \times 10^{-5}$
   $\text{HC}_6\text{H}_5\text{O}_7^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_5\text{O}_7^{3-} + \text{H}_3\text{O}^+$ $K_{a3} = 4.0 \times 10^{-7}$

E. $\text{H}_3\text{PO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{PO}_4^- + \text{H}_3\text{O}^+$ $K_{a1} = 7.5 \times 10^{-3}$
   $\text{H}_2\text{PO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{HPO}_4^{2-} + \text{H}_3\text{O}^+$ $K_{a2} = 6.2 \times 10^{-8}$
   $\text{HPO}_4^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{PO}_4^{3-} + \text{H}_3\text{O}^+$ $K_{a3} = 4.2 \times 10^{-13}$

Question #: 11

Which is the strongest acid?

A. $\text{H}_3\text{PO}_4$
B. $\text{H}_3\text{PO}_3$
C. $\text{H}_3\text{AsO}_4$
D. $\text{H}_3\text{AsO}_3$
Question #: 12

Which two of the substances below function as Lewis acids?

\[ \text{Co}^{2+}(aq) + 4 \text{OH}^-(aq) \rightleftharpoons \text{Co(OH)}^2_4^-(aq) \]
\[ \text{Al}^{3+}(aq) + 6 \text{Cl}^-(aq) \rightleftharpoons \text{Al(Cl)}^3_6^-(aq) \]

A. Co^{2+}
B. OH^-
C. Al^{3+}
D. Cl^-

Question #: 13

What is the pH of a 1.0 L buffer solution that is 0.300 M CH₃COOH (pKₐ = 4.76) and 0.300 M CH₃COONa after the addition of 0.050 mol of NaOH? Ignore any volume change from the addition of NaOH. Report pH to two decimal places.

\text{pH} = 

1. 

Question #: 14

Which of the following solutions results in a buffer?

A. 10.0 mL of 0.100 M NaOH + 5.0 mL of 0.100 M HCl
B. 10.0 mL of 0.100 M NaOH + 20.0 mL of 0.100 M HCHO₂
C. 20.0 mL of 0.100 M NaOH + 10.0 mL of 0.200 M HClO₂
D. 10.0 mL of 0.100 M NH₃ + 10.0 mL of 0.100 M HCl
Question #: 15

Calculate the base-to-acid ratio needed to prepare a pH 4.00 propanoic acid, potassium propanoate buffer.

\[ K_a \text{(propanoic acid)} = 1.3 \times 10^{-5} \]

A. 0.13  
B. 0.067  
C. 5.8  
D. 8.7

Question #: 16

Which choice should be the most effective buffer against added acid or base?

A. 0.010 M nitrous acid and 0.010 M sodium nitrite  
B. 0.100 M formic acid and 0.010 M sodium formate  
C. 0.100 M hypochlorous acid and 0.100 M sodium hypochlorite  
D. 0.010 M benzoic acid and 0.100 M sodium benzoate

Question #: 17

Which one of the following pH curves shows the titration of a weak base with a strong acid?

A.
**Question #: 18**

What is the pH after 5.0 mL of 0.500 M LiOH is added to 100.0 mL of 0.200 M hydrofluoric acid (HF, $pK_a = 3.46$)?

A. 2.61  
B. 3.23  
C. 2.07  
D. 4.58

---

**Question #: 19**

Bromcresol green is a good choice as an indicator for the titration of which acid with 0.10 M KOH?

A. hydrazoic acid, $pK_a = 4.60$  
B. nitrous acid, $pK_a = 3.34$  
C. boric acid, $pK_a = 9.27$  
D. hydroiodic acid, $pK_a < 0$

---

**Question #: 20**

A 20.0 mL portion of 0.100 M $C_5H_5N$ ($K_b = 1.7 \times 10^{-9}$) is titrated with 0.400 M HCl. What is the pH at the equivalence point?

A. 2.21  
B. 3.16  
C. 7.00  
D. 8.19
Question #: 21

For which pair of compounds can you directly compare \( K_{sp} \) values as a measure of relative solubility?

A. Al(OH)\(_3\) and ZnS  
B. CaF\(_2\) and Ag\(_2\)CrO\(_4\)  
C. MnC\(_2\)O\(_4\) and Mn(OH)\(_2\)  
D. AgCl and BaCl\(_2\)

---

Question #: 22

What happens when two solutions are mixed together such that the concentration of Ba\(^{2+}\) is \(5.00 \times 10^{-3} \text{ M}\) and the concentration of C\(_2\)O\(_4^{2-}\) is \(1.00 \times 10^{-3} \text{ M}\) in the resulting solution? \(K_{sp}(\text{BaC}_2\text{O}_4) = 1.6 \times 10^{-6}\)

A. \(Q_{sp} < K_{sp}\) and the solution remains unsaturated.  
B. \(Q_{sp} = K_{sp}\) and the solution is saturated, resulting in the precipitation of BaC\(_2\)O\(_4\)(s).  
C. \(Q_{sp} > K_{sp}\), resulting in precipitation of BaC\(_2\)O\(_4\)(s), leaving behind an unsaturated solution.  
D. \(Q_{sp} > K_{sp}\), resulting in precipitation of BaC\(_2\)O\(_4\)(s), leaving behind a saturated solution.

---

Question #: 23

What is the final mercury(II) concentration in a solution that is initially 0.010 M Hg\(^{2+}\) and 0.400 M CN\(^-\)?

\[
\text{Hg}^{2+}(aq) + 4 \text{CN}^-(aq) \rightleftharpoons \text{Hg(CN)}\text{J}^2-(aq) \quad K_f = 1.8 \times 10^{41}
\]

A. \(1.8 \times 10^{21} \text{ M}\)  
B. \(1.8 \times 10^{-19} \text{ M}\)  
C. \(2.8 \times 10^{-51} \text{ M}\)  
D. \(3.3 \times 10^{-42} \text{ M}\)
Question #: 24

For the coordination compound \([\text{Fe}(\text{H}_2\text{O})_4(\text{NH}_3)(\text{OH})]\text{Cl}_2\), the coordination number of Fe is \(_1\) and the oxidation state of Fe is \(_2\). Include a + or – sign in your answer to 2.

1. __________
2. __________

Question #: 25

A solution contains 0.00250 M \(\text{CaCl}_2(aq)\) and 0.00250 M \(\text{Fe(NO}_3)_2(aq)\). KOH(s) is added to precipitate out both \(\text{Ca(OH)}_2(s)\) and \(\text{Fe(OH)}_2(s)\). Determine which compound precipitates first and the pH needed for this compound to be precipitated.

\[
\begin{align*}
K_{sp}[\text{Ca(OH)}_2] &= 4.68 \times 10^{-6} \\
K_{sp}[\text{Fe(OH)}_2] &= 4.87 \times 10^{-17}
\end{align*}
\]

A. \(\text{Ca(OH)}_2\) precipitates first; \(\text{pH} = 12.62\)
B. \(\text{Fe(OH)}_2\) precipitates first; \(\text{pH} = 7.14\)
C. \(\text{Ca(OH)}_2\) precipitates first; \(\text{pH} = 7.14\)
D. \(\text{Fe(OH)}_2\) precipitates first; \(\text{pH} = 12.62\)
Question #: 1

A cup of orange juice has \( [H_3O^+] = 2.1 \times 10^{-4} \) M. What is the pH of the orange juice?

\[ pH = \quad 1 \]

Report your answer to two decimal places.

1. 3.68

Question #: 2

The pH of freshly-squeezed lemon juice is 1.89. What is the concentration of \( H_3O^+ \) in the juice?

✓ A. \( 1.3 \times 10^{-2} \) M  

B. \( 2.9 \times 10^{-4} \) M
Question #: 3

What is the pH of a 0.300 M solution hydrofluoric acid solution with a percent ionization of 3.42%?

A. 0.300
✓B. 1.989
C. 3.138
D. 4.086

Question #: 4

What is the pH of a solution that is 0.100 M in HClO \( (K_a = 2.9 \times 10^{-8}) \) and 0.100 M in HCl? Report your answer to two decimal places.

\[ \text{pH} = \phantom{0}1 \]

1. 1.00

Question #: 5

Which solution requires the use of the quadratic equation to calculate the \([H_3O^+]\)?

A. 0.150 M benzoic acid (\( HC_7H_5O_2 \)) solution; \( K_a(\text{HC}_7\text{H}_5\text{O}_2) = 6.5 \times 10^{-5} \)
✓B. 0.120 M pyruvic acid (\( \text{HC}_3\text{H}_3\text{O}_3 \)) solution; \( K_a(\text{HC}_3\text{H}_3\text{O}_3) = 4.1 \times 10^{-3} \)
C. 0.110 M nitrous acid (\( \text{HNO}_2 \)) solution; \( K_a(\text{HNO}_2) = 1.8 \times 10^{-4} \)
D. 0.050 M hydrocyanic acid (HCN) solution; \( K_a(\text{HCN}) = 4.9 \times 10^{-10} \)

Question #: 6

Given that the \( K_a \) of nitrous acid (\( \text{HNO}_2 \)) at 25°C is \( 4.0 \times 10^{-4} \), the \( pK_b \) of the nitrite ion (\( \text{NO}_2^- \)) is \phantom{0}1. Report your answer to two decimal places.
Question #: 7

In a mixture of three bases (KOH, CH₃NH₂, and NH₃) of equal concentration, which choice below list(s) the reaction(s) that must be considered in calculating the pH? Choose the single best answer.

✓ A.  
   \[ \text{KOH} \rightarrow K^+ + \text{OH}^- \]

B.  
   \[ \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^- \quad K_b = 4.4 \times 10^{-4} \]
   \[ \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \quad K_b = 1.8 \times 10^{-5} \]

C.  
   \[ \text{KOH} \rightarrow K^+ + \text{OH}^- \]
   \[ \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^- \quad K_b = 4.4 \times 10^{-4} \]
   \[ \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \quad K_b = 1.8 \times 10^{-5} \]

D.  
   \[ \text{KOH} \rightarrow K^+ + \text{OH}^- \]
   \[ \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^- \quad K_b = 4.4 \times 10^{-4} \]
   \[ \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \quad K_b = 1.8 \times 10^{-5} \]
   \[ 2 \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^- \quad K_w = 1.0 \times 10^{-14} \]

Question #: 8

Which is the least basic solution?
Question #: 9

Select the two salts that have a pH <7 when dissolved in water.

A. Ca(C₂H₃O₂)₂
✓ B. CH₃NH₃Br
✓ C. CrCl₃
D. LiClO₄
E. NaNO₂
F. KI

Question #: 10

For which two 0.010 M polyprotic acid solutions must you consider more than just $K_{a1}$ to accurately calculate the pH?

✓ A.

$\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightarrow \text{HSO}_4^- + \text{H}_3\text{O}^+ \quad K_{a1} = \text{strong}$

$\text{HSO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{SO}_4^{2-} + \text{H}_3\text{O}^+ \quad K_{a2} = 1.2 \times 10^{-2}$

B.

$\text{H}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O} \rightleftharpoons \text{HC}_2\text{O}_4^- + \text{H}_3\text{O}^+ \quad K_{a1} = 6.0 \times 10^{-2}$

$\text{HC}_2\text{O}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{C}_2\text{O}_4^{2-} + \text{H}_3\text{O}^+ \quad K_{a2} = 6.1 \times 10^{-5}$

C.

$\text{H}_2\text{C}_6\text{H}_5\text{O}_6 + \text{H}_2\text{O} \rightleftharpoons \text{HC}_6\text{H}_5\text{O}_6^- + \text{H}_3\text{O}^+ \quad K_{a1} = 8.0 \times 10^{-5}$

$\text{HC}_6\text{H}_5\text{O}_6^- + \text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_5\text{O}_6^{3-} + \text{H}_3\text{O}^+ \quad K_{a2} = 1.6 \times 10^{-12}$

✓ D.

$\text{H}_3\text{C}_6\text{H}_5\text{O}_7 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{C}_6\text{H}_5\text{O}_7^- + \text{H}_3\text{O}^+ \quad K_{a1} = 7.4 \times 10^{-4}$

$\text{H}_2\text{C}_6\text{H}_5\text{O}_7^- + \text{H}_2\text{O} \rightleftharpoons \text{HC}_6\text{H}_5\text{O}_7^{2-} + \text{H}_3\text{O}^+ \quad K_{a2} = 1.7 \times 10^{-5}$

$\text{HC}_6\text{H}_5\text{O}_7^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_5\text{O}_7^{3-} + \text{H}_3\text{O}^+ \quad K_{a3} = 4.0 \times 10^{-7}$
E.

\[
\begin{align*}
  \text{H}_3\text{PO}_4 + \text{H}_2\text{O} & \rightleftharpoons \text{H}_2\text{PO}_4^- + \text{H}_3\text{O}^+ \quad K_{a1} = 7.5 \times 10^{-3} \\
  \text{H}_2\text{PO}_4^- + \text{H}_2\text{O} & \rightleftharpoons \text{HPO}_4^{2-} + \text{H}_3\text{O}^+ \quad K_{a2} = 6.2 \times 10^{-8} \\
  \text{HPO}_4^{2-} + \text{H}_2\text{O} & \rightleftharpoons \text{PO}_4^{3-} + \text{H}_3\text{O}^+ \quad K_{a3} = 4.2 \times 10^{-13}
\end{align*}
\]

Question #: 11

Which is the strongest acid?

✓ A. \( \text{H}_3\text{PO}_4 \)

B. \( \text{H}_3\text{PO}_3 \)

C. \( \text{H}_3\text{AsO}_4 \)

D. \( \text{H}_3\text{AsO}_3 \)

Question #: 12

Which two of the substances below function as Lewis acids?

✓ A. \( \text{Co}^{2+} \)

B. \( \text{OH}^- \)

✓ C. \( \text{Al}^{3+} \)

D. \( \text{Cl}^- \)

Question #: 13

What is the pH of a 1.0 L buffer solution that is 0.300 M \( \text{CH}_3\text{COOH} \) (\( pK_a = 4.76 \)) and 0.300 M \( \text{CH}_3\text{COONa} \) after the addition of 0.050 mol of NaOH? Ignore any volume change from the addition of NaOH. Report pH to two decimal places.
pH = 1

1. 4.91|4.90|4.92|

---

**Question #**: 14

Which of the following solutions results in a **buffer**?

A. 10.0 mL of 0.100 M NaOH + 5.0 mL of 0.100 M HCl
B. 10.0 mL of 0.100 M NaOH + 20.0 mL of 0.100 M HCHO₂
C. 20.0 mL of 0.100 M NaOH + 10.0 mL of 0.200 M HClO₂
D. 10.0 mL of 0.100 M NH₃ + 10.0 mL of 0.100 M HCl

---

**Question #**: 15

Calculate the base-to-acid ratio needed to prepare a pH 4.00 propanoic acid, potassium propanoate buffer.

\[ K_a \text{(propanoic acid)} = 1.3 \times 10^{-5} \]

✓A. 0.13
B. 0.067
C. 5.8
D. 8.7

---

**Question #**: 16

Which choice should be the **most effective** buffer against added acid or base?

A. 0.010 M nitrous acid and 0.010 M sodium nitrite
B. 0.100 M formic acid and 0.010 M sodium formate
C. 0.100 M hypochlorous acid and 0.100 M sodium hypochlorite
✓D. 0.010 M benzoic acid and 0.100 M sodium benzoate

---

**Question #**: 17
Which one of the following pH curves shows the titration of a weak base with a strong acid?

A.

B.

C.

✓D.
Question #: 18

What is the pH after 5.0 mL of 0.500 M LiOH is added to 100.0 mL of 0.200 M hydrofluoric acid (HF, $pK_a = 3.46$)?

✓ A. 2.61
   B. 3.23
   C. 2.07
   D. 4.58

Question #: 19

Bromcresol green is a good choice as an indicator for the titration of which acid with 0.10 M KOH?

✓ A. hydrazoic acid, $pK_a = 4.60$
   B. nitrous acid, $pK_a = 3.34$
   C. boric acid, $pK_a = 9.27$
   D. hydroiodic acid, $pK_a < 0$
Question #: 20

A 20.0 mL portion of 0.100 M C₅H₅N (Kₐ = 1.7 × 10⁻⁹) is titrated with 0.400 M HCl. What is the pH at the equivalence point?

A. 2.21 ✓
B. 3.16
C. 7.00
D. 8.19

Question #: 21

For which pair of compounds can you **directly** compare $K_{sp}$ values as a measure of relative solubility?

A. Al(OH)₃ and ZnS ✓
B. CaF₂ and Ag₂CrO₄
C. MnC₂O₄ and Mn(OH)₂
D. AgCl and BaCl₂

Question #: 22

What happens when two solutions are mixed together such that the concentration of Ba²⁺ is 5.00 × 10⁻³ M and the concentration of C₂O₄²⁻ is 1.00 × 10⁻³ M in the resulting solution? $K_{sp}(\text{BaC}_2\text{O}_4) = 1.6 \times 10^{-6}$

A. $Q_{sp} < K_{sp}$ and the solution remains unsaturated.
B. $Q_{sp} = K_{sp}$ and the solution is saturated, resulting in the precipitation of BaC₂O₄(s).
C. $Q_{sp} > K_{sp}$, resulting in precipitation of BaC₂O₄(s), leaving behind an unsaturated solution. ✓
D. $Q_{sp} > K_{sp}$, resulting in precipitation of BaC₂O₄(s), leaving behind a saturated solution.

Question #: 23

What is the final mercury(II) concentration in a solution that is initially 0.010 M Hg²⁺ and 0.400 M CN⁻?
Hg^{2+}(aq) + 4 CN^-(aq) ⇌ Hg(CN)_2^{2-}(aq) \quad K_f = 1.8 \times 10^{41}

A. \ 1.8 \times 10^{-21} \text{M}
B. \ 1.8 \times 10^{-19} \text{M}
C. \ 2.8 \times 10^{-51} \text{M}
✓D. \ 3.3 \times 10^{-42} \text{M}

Question #: 24

For the coordination compound [Fe(H_2O)_4(NH_3)(OH)]Cl_2,
the coordination number of Fe is 1 and the oxidation state of Fe is 2.
Include a + or – sign in your answer to 2.

1. 6|six|
2. +3|3+|+three|three+|+ 3|3 +|

Question #: 25

A solution contains 0.00250 M CaCl_2(aq) and 0.00250 M Fe(NO_3)_2(aq). KOH(s) is added to precipitate out both Ca(OH)_2(s) and Fe(OH)_2(s). Determine which compound precipitates first and the pH needed for this compound to be precipitated.

\[ K_{sp}[\text{Ca(OH)}_2] = 4.68 \times 10^{-6} \]
\[ K_{sp}[\text{Fe(OH)}_2] = 4.87 \times 10^{-17} \]

A. Ca(OH)_2 precipitates first; pH = 12.62
✓B. Fe(OH)_2 precipitates first; pH = 7.14
C. Ca(OH)_2 precipitates first; pH = 7.14
D. Fe(OH)_2 precipitates first; pH = 12.62