Label the reactants as **acid** or **base** in the box under each.

1. $\text{NH}_3$ + $\text{H}_2\text{O}$ $\Leftrightarrow$ $\text{NH}_4^+$ + $\text{OH}^-$
   
2. $\text{HCO}_3^-$ + $\text{H}_2\text{SO}_4$ $\rightarrow$ $\text{H}_2\text{CO}_3$ + $\text{HSO}_4^-$

1. __________
2. __________
3. __________
4. __________

---

**Question #2**

Which choice identifies a Brønsted-Lowry conjugate acid-base pair and the function of each in the reaction below?

$\text{CO}_3^{2-}(aq) + \text{H}_2\text{O}(l) \Leftrightarrow \text{HCO}_3^-(aq) + \text{OH}^-(aq)$

A. $\text{H}_2\text{O}$, acid; $\text{CO}_3^{2-}$, conjugate base
B. $\text{CO}_3^{2-}$, acid; $\text{H}_2\text{O}$, conjugate base
C. $\text{CO}_3^{2-}$, base; $\text{HCO}_3^-$, conjugate acid
D. $\text{H}_2\text{O}$, base; $\text{OH}^-$, conjugate acid
Question #: 3

A solution has a pOH = 4.25. Calculate the \([H_3O^+]\) and select the two correct answers below.

A. The solution is acidic.
B. The solution is basic.
C. The solution is neutral.
D. \([H_3O^+] = 1.8 \times 10^{-10} \text{ M}\)
E. \([H_3O^+] = 5.6 \times 10^{-5} \text{ M}\)

Question #: 4

What is the pH of pure water at 35 °C given that \(K_w = 3.2 \times 10^{-14}\) at 35 °C?

A. 6.75
B. 7.00
C. 5.05
D. 7.55

Question #: 5

Calculate the pH of 100.0 mL of a 0.0050 M Ba(OH)\(_2\) solution.

\[
pH = \frac{1}{2} \sum \text{concentration of OH}\text{-ions}
\]
Report your answer with two decimal places. Do NOT include units in your answer.

1. __________

Question #: 6

Which equation correctly describes the behavior of the acid or base in water?

A. \(\text{HClO}_4 + \text{H}_2\text{O} \leftrightarrow \text{ClO}_4^- + \text{H}_3\text{O}^+\)
B. \(\text{KOH} \leftrightarrow \text{K}^+ + \text{OH}^-\)
C. \(\text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \leftrightarrow \text{CH}_3\text{NH}_3^+ + \text{OH}^-\)
D. \(\text{HC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_3\text{O}_2^- + \text{H}_3\text{O}^+\)
Question #: 7

Which substance below is a weak acid or a weak base?

A. HNO₃  
B. C₆H₅NH₂  
C. H₂SO₄  
D. Sr(OH)₂

Question #: 8

Select the answer that lists the acids in order of increasing acid strength (weakest to strongest) using the given \( K_a \) values.

<table>
<thead>
<tr>
<th>Acid name</th>
<th>( K_a ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>benzoic acid</td>
</tr>
<tr>
<td>B</td>
<td>chlorous acid</td>
</tr>
<tr>
<td>C</td>
<td>acetic acid</td>
</tr>
</tbody>
</table>

A. A < B < C  
B. C < A < B  
C. B < C < A  
D. B < A < C  
E. A < C < B  
F. C < B < A

Question #: 9

What is the \( K_a \) of pentanoic acid, \( \text{C}_4\text{H}_9\text{COOH} \), given that a 0.100 M solution has a pH of 2.91 at 25 °C?

A. \( 1.3 \times 10^{-10} \)  
B. \( 7.6 \times 10^{-2} \)  
C. \( 2.2 \times 10^{-3} \)  
D. \( 1.5 \times 10^{-5} \)
Question #: 10

What is the percent ionization of a 0.25 M phenol solution given $K_a = 1.3 \times 10^{-10}$?

A. 100%
B. 2.6%
C. 0.013%
D. 0.0023%

Question #: 11

Calculate the pH of a 100.0 mL solution containing 0.0010 M HClO$_4$ and 0.25 M HCOOH. $K_a (HCOOH) = 1.8 \times 10^{-4}$.

$\text{pH} =$ \underline{\hspace{2cm}}

Report your answer with two decimal places. Do NOT include units in your answer.

1. \underline{\hspace{2cm}}

Question #: 12

What is the $K_b$ value of dimethylamine (CH$_3$)$_2$NH given that a 0.256 M solution has a pH = 12.07?

A. $1.8 \times 10^{-5}$
B. $6.2 \times 10^{-7}$
C. $8.5 \times 10^{-13}$
D. $5.4 \times 10^{-4}$
Question #: 13

Select the correct statement regarding the $K_a$ values of a triprotic acid, $H_3A$.

A. $K_{a1} < K_{a2} < K_{a3}$ for all triprotic acids.
B. $K_{a1} > K_{a2} > K_{a3}$ for all triprotic acids.
C. $K_{a1} = K_{a2} = K_{a3}$ for all triprotic acids.
D. The magnitude of the successive $K_a$ values cannot be known. It varies depending on the triprotic acid.

Question #: 14

For which polyprotic acid can you calculate the pH using only $K_{a1}$?

A. 0.10 M ascorbic acid, $K_{a1} = 8.0 \times 10^{-5}$, $K_{a2} = 1.6 \times 10^{-12}$
B. 0.10 M citric acid, $K_{a1} = 7.4 \times 10^{-4}$, $K_{a2} = 1.7 \times 10^{-5}$, $K_{a3} = 4.0 \times 10^{-7}$
C. 0.010 M sulfuric acid, $K_{a1} =$ very large, $K_{a2} = 0.012$
D. 0.10 M $m$-tartaric acid, $K_{a1} = 6.8 \times 10^{-4}$, $K_{a2} = 1.2 \times 10^{-5}$

Question #: 15

How would you classify an aqueous solution of NH$_4$ClO? $K_a$(NH$_4^+$) = 5.5 $\times$ 10$^{-10}$ and $K_b$(ClO$^-$) = 2.5 $\times$ 10$^{-7}$.

A. acidic
B. basic
C. nearly neutral

Question #: 16

Select the acid or base ionization reaction that occurs when KNO$_2$ is dissolved in water.

A. There is no ionization reaction because this is a neutral salt.
B. $K^+(aq) + H_2O(l) \Leftrightarrow KOH(aq)$
C. NO$_2^-(aq) + H_2O(l) \Leftrightarrow HNO_2(aq) + OH^-(aq)$
D. NO$_2^-(aq) + H_3O^+(aq) \rightarrow HNO_2(aq) + H_2O(l)$
**Question #: 17**

Given the following $K_a$ and $K_b$ values, select the two correct statements.

<table>
<thead>
<tr>
<th>Substance</th>
<th>$K$ Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNO$_2$</td>
<td>$K_a = 5.6 \times 10^{-4}$</td>
</tr>
<tr>
<td>HClO$_2$</td>
<td>$K_a = 1.1 \times 10^{-2}$</td>
</tr>
<tr>
<td>CH$_3$NH$_2$</td>
<td>$K_b = 5.0 \times 10^{-4}$</td>
</tr>
<tr>
<td>(CH$_3$)$_3$N</td>
<td>$K_b = 5.6 \times 10^{-4}$</td>
</tr>
</tbody>
</table>

A. Cl$^-$ is a stronger base than F$^-$ because HF is a weaker acid than HCl.
B. K$^+$ is a stronger acid than CH$_3$NH$_3^+$ because CH$_3$NH$_2$ is a weaker base than KOH.
C. NO$_2^-$ is a stronger base than ClO$_2^-$ because HNO$_2$ is a weaker acid than HClO$_2$.
D. CH$_3$NH$_3^+$ is a stronger acid than (CH$_3$)$_3$NH$^+$ because CH$_3$NH$_2$ is a weaker base than (CH$_3$)$_3$N.

---

**Question #: 18**

Select the answer that lists the acids in order of increasing acid strength (weakest to strongest).

<table>
<thead>
<tr>
<th></th>
<th>Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>H$_2$Te</td>
</tr>
<tr>
<td>B</td>
<td>H$_2$Se</td>
</tr>
<tr>
<td>C</td>
<td>H$_2$S</td>
</tr>
</tbody>
</table>

A. A < B < C
B. C < A < B
C. B < C < A
D. B < A < C
E. A < C < B
F. C < B < A
Question #: 19

The reaction above is a \textbf{1} \{Lewis, Arrhenius\} acid-base reaction. Compound \textbf{2} \{1 or 2\} is the acid. Compound \textbf{3} \{1 or 2\} is the base.

1. \underline{__________}
2. \underline{__________}
3. \underline{__________}

Question #: 20

Which statement is \textbf{true}?

A. A buffer consists of a strong base and its conjugate acid.
B. A buffer consists of a weak acid and the conjugate base of a strong acid.
C. A buffer consists of a weak acid and its conjugate base.
D. A buffer consists of a weak base and the conjugate acid of a strong base.

Question #: 21

Calculate the pH of a solution containing 0.40 M sodium periodate (NaIO₄) and 0.20 M periodic acid (HIO₄). \( K_a (\text{HIO}_4) = 7.3 \times 10^{-2} \).

\[
pH = \underline{1}
\]

Report your answer with \textbf{two decimal places}. Do \textbf{NOT} include units in your answer.

1. \underline{__________}
Question #: 22

Calculate the pH of a buffer when 0.010 moles of NaOH is added to 100. mL solution that is 0.20 M sodium pentanoate (C₄H₉COONa) and 0.20 M pentanoic acid (C₄H₉COOH). pKₐ(C₄H₉COOH) = 4.82.

A. 4.82  
B. 5.30  
C. 4.32  
D. 4.93

Question #: 23

For a certain chemical process, the addition of an acid and a base to a buffer must keep the pH in the range of 6.0 - 7.0. Which buffer components would be best for this process? Each buffer below has a pH of 6.5.

A. 1.8 M NaNO₂/0.001 M HNO₂ buffer. pKₐ (HNO₂) = 5.6 ×10⁻⁴  
B. 5.8 M NHCOONa/0.01 M HCOOH buffer. pKₐ (HCOOH) = 1.8 ×10⁻⁴  
C. 0.63 M Na₂HPO₃/ 1.0 M NaH₂PO₃ buffer. pKₐ₂ (H₃PO₃) = 2.0 ×10⁻⁷  
D. 2.0 M C₆H₅COONa/0.01 MC₆H₅COOH buffer. pKₐ(C₆H₅COOH) = 6.3 ×10⁻⁵

Question #: 24

Select the buffer solution that has the best buffering capacity against added strong acid.

A. 0.10 M NaCNO/0.01 M HCNO  
B. 0.01 M NaCNO/0.01 M HCNO  
C. 0.01 M NaCNO/0.10 M HCNO
**Question #**: 25

Select the best indicator for a titration between HCOOH and NaOH.

A. Methyl Orange: (red) 3.2 - 4.4 (yellow)
B. Methyl Red: (red) 4.8 - 6.0 (yellow)
C. Bromothymol Blue: (yellow) 6.0 - 7.6 (blue)
D. Phenolphthalein: (colorless) 8.2 - 10.0 (pink)

**Question #**: 26

Select the description that applies to the following image of a titration curve as the pH of a flask is monitored upon the addition of the standard solution.

A. The flask contains a weak acid. The added standard solution is a strong base.
B. The flask contains a strong acid. The added standard solution is a strong base.
C. The flask contains a weak base. The added standard solution is a strong acid.
D. The flask contains a strong base. The added standard solution is a strong acid.
Question #: 27

Calculate the pH of a titration at the point when 15.0 mL of 0.15 M NaOH is added to 30.0 mL of 0.20 M HNO₃
pH = __1__
Report your answer to two decimal places. Do NOT include units in your answer.

1. __________

Question #: 28

Calculate the pH at the equivalence point when 0.10 M HCl is titrated with 15.0 mL of 0.10 M NH₃. \( K_b (\text{NH}_3) = 1.8 \times 10^{-5} \).

A. 6.23
B. 5.28
C. 7.96
D. 8.10


Examine the image to select the correct answer.

A. The pH = $pK_a$ of the weak acid when the amount of base added to the titration is 12.5 mL.
B. The pH = $pK_b$ of the weak base when the amount of acid added to the titration is 12.5 mL.
C. The pH = $pK_a$ of the weak acid when the amount of base added to the titration is 25 mL.
D. The pH = $pK_b$ of the weak base when the amount of acid added to the titration is 25 mL.
Calculate the volume of NaOH needed to reach the 1st and 2nd equivalence point when 0.10 M NaOH was titration with 25 mL 0.10 M H₂CO₃. These points are labeled [1] and [2] on the graph.

A. [1] = 50 mL, [2] = 100 mL
B. [1] = 25 mL, [2] = 50 mL
C. [1] = 250 mL, [2] = 500 mL
D. [1] = 12.5 mL, [2] = 25 mL
Label the reactants as **acid** or **base** in the box under each.

1. **base** 
   
2. **acid** 

3. base 

4. acid
Question #: 2

Which choice identifies a Brønsted-Lowry conjugate acid-base pair and the function of each in the reaction below?

\[
\text{CO}_3^{2-}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{HCO}_3^-(aq) + \text{OH}^-(aq)
\]

A. \(\text{H}_2\text{O}\), acid; \(\text{CO}_3^{2-}\), conjugate base
B. \(\text{CO}_3^{2-}\), acid; \(\text{H}_2\text{O}\), conjugate base
C. \(\text{CO}_3^{2-}\), base; \(\text{HCO}_3^-\), conjugate acid
D. \(\text{H}_2\text{O}\), base; \(\text{OH}^-\), conjugate acid

✓ C. \(\text{CO}_3^{2-}\), base; \(\text{HCO}_3^-\), conjugate acid

Question #: 3

A solution has a pOH = 4.25. Calculate the \([\text{H}_3\text{O}^+]\) and select the two correct answers below.

A. The solution is acidic.
B. The solution is basic.
C. The solution is neutral.
D. \([\text{H}_3\text{O}^+] = 1.8 \times 10^{-10} \text{ M}\)
E. \([\text{H}_3\text{O}^+] = 5.6 \times 10^{-5} \text{ M}\)

✓ A. The solution is acidic.
✓ D. \([\text{H}_3\text{O}^+] = 1.8 \times 10^{-10} \text{ M}\)

Question #: 4

What is the pH of pure water at 35 °C given that \(K_w = 3.2 \times 10^{-14}\) at 35 °C?

✓ A. 6.75
B. 7.00
C. 5.05
D. 7.55

Question #: 5
Calculate the pH of 100.0 mL of a 0.0050 M $\text{Ba(OH)}_2$ solution. 

\[ \text{pH = } \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} 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\phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} 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\phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{
Question #: 9

What is the $K_a$ of pentanoic acid, $\text{C}_4\text{H}_9\text{COOH}$, given that a 0.100 M solution has a pH of 2.91 at 25 °C?

A. $1.3 \times 10^{-10}$  
B. $7.6 \times 10^{-2}$  
C. $2.2 \times 10^{-3}$  
D. $1.5 \times 10^{-5}$  
**C. $2.2 \times 10^{-3}$**

Question #: 10

What is the percent ionization of a 0.25 M phenol solution given $K_a = 1.3 \times 10^{-10}$?

A. 100%  
B. 2.6%  
C. 0.013%  
D. 0.0023%  
**C. 0.013%**

Question #: 11

Calculate the pH of a 100.0 mL solution containing 0.0010 M $\text{HClO}_4$ and 0.25 M $\text{HCOOH}$.  
$K_a (\text{HCOOH}) = 1.8 \times 10^{-4}$.

$pH = \underline{\underline{1.300}}$

Report your answer with **two decimal places**. Do **NOT** include units in your answer.
Question #: 12

What is the $K_b$ value of dimethylamine (CH$_3$)$_2$NH given that a 0.256 M solution has a pH = 12.07?

A. $1.8 \times 10^{-5}$
B. $6.2 \times 10^{-7}$
C. $8.5 \times 10^{-13}$
✓ D. $5.4 \times 10^{-4}$

Question #: 13

Select the correct statement regarding the $K_a$ values of a triprotic acid, H$_3$A.

A. $K_{a1} < K_{a2} < K_{a3}$ for all triprotic acids.
✓ B. $K_{a1} > K_{a2} > K_{a3}$ for all triprotic acids.
C. $K_{a1} = K_{a2} = K_{a3}$ for all triprotic acids.
D. The magnitude of the successive $K_a$ values cannot be known. It varies depending on the triprotic acid.

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For which polyprotic acid can you calculate the pH using only $K_{a1}$?

✓ A. 0.10 M ascorbic acid, $K_{a1} = 8.0 \times 10^{-5}, K_{a2} = 1.6 \times 10^{-12}$
B. 0.10 M citric acid, $K_{a1} = 7.4 \times 10^{-4}, K_{a2} = 1.7 \times 10^{-5}, K_{a3} = 4.0 \times 10^{-7}$
C. 0.010 M sulfuric acid, $K_{a1} =$ very large, $K_{a2} = 0.012$
D. 0.10 M $m$-tartaric acid, $K_{a1} = 6.8 \times 10^{-4}, K_{a2} = 1.2 \times 10^{-5}$

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How would you classify an aqueous solution of NH₄ClO? \( K_a(NH_4^+) = 5.5 \times 10^{-10} \) and \( K_b(ClO^-) = 2.5 \times 10^{-7} \).

A. acidic  
✓ B. basic  
C. nearly neutral

**Question #**: 16

Select the acid or base ionization reaction that occurs when KNO₂ is dissolved in water.

A. There is no ionization reaction because this is a neutral salt.  
B. \( K^+(aq) + H_2O(l) \leftrightarrow KOH(aq) \)  
✓ C. \( NO_2^-(aq) + H_2O(l) \leftrightarrow HNO_2(aq) + OH^-(aq) \)  
D. \( NO_2^-(aq) + H_3O^+(aq) \rightarrow HNO_2(aq) + H_2O(l) \)

**Question #**: 17

Given the following \( K_a \) and \( K_b \) values, select the two correct statements.

<table>
<thead>
<tr>
<th>Substance</th>
<th>( K_a )</th>
<th>( K_b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNO₂</td>
<td>( 5.6 \times 10^{-4} )</td>
<td></td>
</tr>
<tr>
<td>HClO₂</td>
<td>( 1.1 \times 10^{-2} )</td>
<td></td>
</tr>
<tr>
<td>CH₃NH₂</td>
<td></td>
<td>( 5.0 \times 10^{-4} )</td>
</tr>
<tr>
<td>(CH₃)₃N</td>
<td></td>
<td>( 5.6 \times 10^{-4} )</td>
</tr>
</tbody>
</table>

A. \( Cl^- \) is a stronger base than \( F^- \) because HF is a weaker acid than HCl.  
B. \( K^+ \) is a stronger acid than \( CH_3NH_3^+ \) because \( CH_3NH_2 \) is a weaker base than KOH.  
✓ C. \( NO_2^- \) is a stronger base than \( ClO_2^- \) because \( HNO_2 \) is a weaker acid than \( HClO_2 \).  
✓ D. \( CH_3NH_3^+ \) is a stronger acid than \( (CH_3)_3NH^+ \) because \( CH_3NH_2 \) is a weaker base than \( (CH_3)_3N \).
Select the answer that lists the acids in order of increasing acid strength (weakest to strongest).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>H₂Te</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>H₂Se</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>H₂S</td>
</tr>
</tbody>
</table>

A. A <B <C  
B. C <A <B  
C. B <C <A  
D. B <A <C  
E. A <C <B  
✓ F. C <B <A  

The reaction above is a _1_ [Lewis, Arrhenius] acid-base reaction.  
Compound _2_ [1 or 2] is the acid.  
Compound _3_ [1 or 2] is the base.

1. Lewis  
2. 1  
3. 2  

Question #: 20
Which statement is true?

A. A buffer consists of a strong base and its conjugate acid.
B. A buffer consists of a weak acid and the conjugate base of a strong acid.
✓C. A buffer consists of a weak acid and its conjugate base.
D. A buffer consists of a weak base and the conjugate acid of a strong base.

Question #: 21

Calculate the pH of a solution containing 0.40 M sodium periodate (NaIO₄) and 0.20 M periodic acid (HIO₄). Kₐ (HIO₄) = 7.3 ×10⁻².

\[ \text{pH} = \_\_\_\_\_ \]

Report your answer with two decimal places. Do NOT include units in your answer.

1. 1.44

Question #: 22

Calculate the pH of a buffer when 0.010 moles of NaOH is added to 100. mL solution that is 0.20 M sodium pentanoate (C₄H₉COONa) and 0.20 M pentanoic acid (C₄H₉COOH). pKₐ (C₄H₉COOH) = 4.82.

A. 4.82
✓B. 5.30
C. 4.32
D. 4.93

Question #: 23

For a certain chemical process, the addition of an acid and a base to a buffer must keep the pH in the range of 6.0 - 7.0. Which buffer components would be best for this process?

Each buffer below has a pH of 6.5.

A. 1.8 M NaNO₂/0.001 M HNO₂ buffer. pKₐ (HNO₂) = 5.6 ×10⁻⁴
B. 5.8 M NHCOONa/0.01 M HCOOH buffer. pKa (HCOOH) = 1.8 ×10⁻⁴
Select the buffer solution that has the best buffering capacity against added strong acid.

✓ A. 0.10 M NaCNO/0.01 M HCNO
   B. 0.01 M NaCNO/0.01 M HCNO
   C. 0.01 M NaCNO/0.10 M HCNO

Select the best indicator for a titration between HCOOH and NaOH.

A. Methyl Orange: (red) 3.2-4.4 (yellow)
B. Methyl Red: (red) 4.8 - 6.0 (yellow)
C. Bromothymol Blue: (yellow) 6.0 - 7.6 (blue)
✓ D. Phenolphthalein: (colorless) 8.2 - 10.0 (pink)

Select the description that applies to the following image of a titration curve as the pH of a flask is monitored upon the addition of the standard solution.
A. The flask contains a weak acid. The added standard solution is a strong base.
✓ B. The flask contains a strong acid. The added standard solution is a strong base.
C. The flask contains a weak base. The added standard solution is a strong acid.
D. The flask contains a strong base. The added standard is a strong acid.

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**Question #**: 27

Calculate the pH of a titration at the point when 15.0 mL of 0.15 M NaOH is added to 30.0 mL of 0.20 M HNO₃

pH = 1

Report your answer to **two decimal places**. Do **NOT** include units in your answer.

1. 1.08

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**Question #**: 28

Calculate the pH at the equivalence point when 0.10 M HCl is titrated with 15.0 mL of 0.10 M NH₃. $K_b (\text{NH}_3) = 1.8 \times 10^{-5}$.


Question #: 29

Examine the image to select the correct answer.

✓ A. The pH = pKₐ of the weak acid when the amount of base added to the titration is 12.5 mL.
B. The pH = pKₐ of the weak base when the amount of acid added to the titration is 12.5 mL.
C. The pH = pKₐ of the weak acid when the amount of base added to the titration is 25 mL.
D. The pH = pKₐ of the weak base when the amount of acid added to the titration is 25 mL.

Question #: 30

Calculate the volume of NaOH needed to reach the 1st and 2nd equivalence point when 0.10 M NaOH was titration with 25 mL 0.10 M H₂CO₃. These points are labeled [1] and [2] on the graph.
A. \([1] = 50 \text{ mL}, \ [2] = 100 \text{ mL}\)
✓B. \([1] = 25 \text{ mL}, \ [2] = 50 \text{ mL}\)
C. \([1] = 250 \text{ mL}, \ [2] = 500 \text{ mL}\)
D. \([1] = 12.5 \text{ mL}, \ [2] = 25 \text{ mL}\)