1. Which acid, together with its sodium salt, would be best for preparing a buffer with a pH = 4.5?
   (A) HCN \( (K_a = 4.9 \times 10^{-10}) \)
   (B) C\(_3\)H\(_5\)O\(_2\)H \( (K_a = 1.3 \times 10^{-5}) \)
   (C) HF \( (K_a = 6.8 \times 10^{-4}) \)
   (D) ClC\(_2\)H\(_2\)O\(_2\)H \( (K_a = 1.4 \times 10^{-3}) \)

2. What is the pH of a solution that contains 0.50 M sodium benzoate and 0.75 M benzoic acid? \( (K_a = 6.8 \times 10^{-5}) \)
   (A) 3.99
   (B) 4.34
   (C) 4.57
   (D) 5.22

3. Which of these solutions, appropriately combined, could be used to produce a buffer?
   (A) HCl and NaOH
   (B) HNO\(_2\) and NaNO\(_3\)
   (C) KI and KOH
   (D) HF and NaOH

4. Which pair of chemicals would produce a buffer solution when equal numbers of moles of each are mixed?
   (A) HF and NaF
   (B) HF and HC\(_2\)H\(_3\)O\(_2\)
   (C) HCl and NH\(_3\)
   (D) HNO\(_2\) and NaNO\(_3\)

5. Which titration will have an equivalence point at the lowest pH?
   (A) HCl and KOH
   (B) HF and NaOH
   (C) HF and NH\(_3\)
   (D) HCl and NH\(_3\)

6. A 0.100 M solution of acetic acid \( (K_a = 1.8 \times 10^{-5}) \) is titrated with a 0.1000 M solution of NaOH. What is the pH when 50% of the acid has been neutralized?
   (A) 2.38
   (B) 4.74
   (C) 5.70
   (D) 7.00

7. Which indicator is most appropriate for titrating a 0.100 M solution of NH\(_3\) with 0.100 M HNO\(_3\)? The equilibrium constant, \( K_a \), for NH\(_3\) equals \( 1.8 \times 10^{-5} \)
<table>
<thead>
<tr>
<th>Indicator</th>
<th>pH color transition range</th>
</tr>
</thead>
<tbody>
<tr>
<td>cresol red</td>
<td>1-2</td>
</tr>
<tr>
<td>methyl red</td>
<td>4-6</td>
</tr>
<tr>
<td>phenolphthalein</td>
<td>8-10</td>
</tr>
<tr>
<td>alizarin yellow</td>
<td>10-12</td>
</tr>
</tbody>
</table>

8. When a particular aqueous solution is diluted by a factor of ten with H\(_2\)O, the pH increases by one pH unit. This solution most likely contains a
   (A) weak acid
   (B) strong base
   (C) strong acid
   (D) buffer

9. When 50.0 mL of 0.200 M HCl is mixed with 150.0 mL of 0.100 M NaOH, the reaction is as shown.
   \[ \text{NaOH(aq)} + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)} \]
   What is the concentration of the resulting solution?
   (A) 0.0500 M NaCl
   (B) 0.100 M NaCl
   (C) 0.0500 M NaCl and 0.0250 M NaOH
   (D) 0.0500 M NaCl and 0.0500 M NaOH

10. Which pair constitutes a buffer?
    (A) HCl and KCl
        (B) NaOH and NaCl
        (C) HNO\(_2\) and NaNO\(_2\)
        (D) HNO\(_3\) and NH\(_4\)NO\(_3\)

11. The best acid for preparing a buffer of pH = 3.2 has a \( K_a \) near
    (A) \( 2.0 \times 10^{-5} \)
        (B) \( 6.0 \times 10^{-4} \)
        (C) \( 3.2 \times 10^{-2} \)
        (D) \( 4.0 \times 10^{-6} \)
12. How many moles of HCOONa must be added to 1.0 L of 0.10 M HCOOH to prepare a buffer solution with a pH of 3.4? (HCOOH $K_a = 2 \times 10^{-4}$)
(A) 0.01 (C) 0.1
(B) 0.05 (D) 0.2

13. The acid-base indicator methyl red has a $K_a$ of $1 \times 10^{-4}$. Its acidic form is red while its alkaline form is yellow. If methyl red is added to a colorless solution with a pH = 7, the color will be
(A) pink (C) orange
(B) red (D) yellow

14. Which mixture forms a buffer when dissolved in 1.0 L of water?
(A) 0.2 mol NaOH + 0.2 mol HBr
(B) 0.2 mol NaCl + 0.3 mol HCl
(C) 0.4 mol HNO₂ + 0.2 mol NaOH
(D) 0.5 mol NH₃ + 0.5 mol HCl

15. A buffer solution is prepared in which the concentration of NH₃ is 0.30 M and the concentration of NH₄ is 0.20 M. What is the pH of this solution? The equilibrium constant, $K_b$ for NH₃ equals $1.8 \times 10^{-5}$. (A) 8.73 (C) 9.43
(B) 9.08 (D) 11.72

16. For which titration would the use of phenolphthalein introduce a significant error?
$K_{indicator}$ for phenolphthalein = $1 \times 10^{-9}$(A)

17. The titration curves labeled 1 and 2 were obtained by titrating equal volumes of two different acid samples with portions of the same sodium hydroxide solution.

What conclusions can be drawn about the relative concentrations and strengths of acids 1 and 2 from these curves?
(A) The concentrations are the same but acid 1 is weaker than acid 2.
(B) The concentrations are the same but acid 1 is stronger than acid 2.
(C) Acid 1 is the same strength as acid 2, but it is less concentrated.
(D) Acid 1 is the same strength as acid 2, but it is more concentrated.

18. A 0.100 M solution of acetic acid ($K_a = 1.8 \times 10^{-5}$) is titrated with a 0.1000 M solution of NaOH. What is the pH when 50% of the acid has been neutralized?
(A) 2.38 (C) 5.70
(B) 4.74 (D) 7.00

19. The $pK_a$ values for several acid-base indicators are given in the table. Which indicator should be used in the titration of a weak base with a strong acid?

<table>
<thead>
<tr>
<th>Indicator, $pK_a$</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-dintrophenol</td>
<td>3.5</td>
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<tr>
<td>bromthymol blue</td>
<td>7.0</td>
</tr>
<tr>
<td>cresol red</td>
<td>8.0</td>
</tr>
<tr>
<td>alizarin yellow R</td>
<td>11.0</td>
</tr>
</tbody>
</table>

(A) 2,4-dintrophenol
(B) bromthymol blue
(C) cresol red
(D) alizarin yellow R
## Practice Test 17.1  Chapter 17

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
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<tr>
<td>19</td>
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