Multiple Choice.

1. Which term does the following statement best describe? A mixture of a weak acid and its conjugate base, each with distinguishing colours.
   A. Buffer
   B. Titration
   C. Indicator
   D. Primary standard

2. Which of the following properties is true for a solution of KNO₃?
   A. It is neutral
   B. It is basic
   C. It is slightly basic
   D. It is slightly acidic

3. Which of the following salts will be basic?
   A. KCl
   B. NH₄Cl
   C. KHSO₄
   D. K₂HPO₄

4. A weak acid is titrated with a strong base using the indicator phenolphthalein to detect the end point. What is the approximate pH at the transition point?
   A. 7.0
   B. 8.0
   C. 9.0
   D. 10.0

5. What volume of 0.100M H₂SO₄ is needed to titrate 25.0 mL of 0.200M NaOH?
   A. 12.5 mL
   B. 25.0 mL
   C. 50.0 mL
   D. 100.0 mL

6. Which of the following titrations always results in pH = 7.0 at the equivalence point?
   A. A weak acid is titrated with a weak base
   B. A weak acid is titrated with a strong base
   C. A strong acid is titrated with a weak base
   D. A strong acid is titrated with a strong base

______ 7. Which of the following pairs of chemicals could be used to make a buffer solution?
   A. NH₃ and H₂O
   B. HCl and NaCl
   C. NH₃ and NH₄Cl
   D. CH₃COOH and HCl

______ 8. When performing a titration experiment, the indicator must always have
   A. A distinct colour change at pH = 7.0
   B. The ability to change from colourless to pink
   C. A transition point that is close to the equivalence point
   D. An equivalence point that is close to the stoichiometric point

______ 9. What is one of the Ka values for thymol blue?
   A. 1.6 x 10⁻⁹
   B. 2.0 x 10⁻⁷
   C. 1.0 x 10⁻⁷
   D. 6.0 x 10⁻⁵

______ 11. Which of the following describes the net ionic equation for the hydrolysis of a NaNO₂ solution?
   A. NaNO₂ ⇌ Na⁺ + NO₂⁻
   B. NO₂⁻ + H₂O ⇌ HNO₂ + OH⁻
   C. Na⁺ + 2 H₂O ⇌ H₂O⁺ + NaOH
   D. NaNO₂ + H₂O ⇌ NaOH + HNO₂

______ 12. What do a chemical indicator and a buffer solution typically both contain?
   A. A strong acid and its conjugate acid
   B. A strong acid and its conjugate base
   C. A weak acid and its conjugate acid
   D. A weak acid and its conjugate base

______ 13. What is the approximate pH and Kₐ at the transition point for phenol red?

<table>
<thead>
<tr>
<th>pH</th>
<th>Kₐ</th>
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<tbody>
<tr>
<td>A</td>
<td>6.6</td>
</tr>
<tr>
<td>B</td>
<td>7.3</td>
</tr>
<tr>
<td>C</td>
<td>7.3</td>
</tr>
<tr>
<td>D</td>
<td>8.0</td>
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Problems:
1. Calculate the pH of 0.60 M NH₄F.

2. You are given two buffer solutions:
   Buffer #1: 1.0 M NH₃ mixed with 1.0 M NH₄Cl
   Buffer #2: 0.1 M NH₃ mixed with 0.1 M NH₄Cl.

   a) Will the pH of the buffers differ from each other? Why?

   b) Calculate the pH of an undisturbed buffer solution.

   c) Which buffer solution would be more effective? Explain your answer.
3. 40.0 mL of 0.10 M NH₃ is titrated with 0.20 M HClO₄. Calculate the pH of the solution produced in the reaction flask at the following points:
   a) At 2.00 mL before midpoint.
b) 5.00 mL past equivalence point.
c) What indicator would be most appropriate for this titration? Explain your answer.