1) Which one of the following pairs cannot be mixed together to form a buffer solution?
A) HONH₂, HONH₃Cl  B) NaCl, HCl  C) RbOH, HF  D) KOH, HNO₂  E) H₂SO₃, KHSO₃

2) Of the following solutions, which has the greatest buffering capacity?
A) 0.821 M HF and 0.217 M NaF  B) 0.821 M HF and 0.909 M NaF  C) 0.100 M HF and 0.217 M NaF  D) 0.121 M HF and 0.667 M NaF

3) The addition of hydrochloric acid and _________ to water can produce a buffer solution.
A) HC₆H₅O  B) NaOH  C) NH₃  D) HNO₃  E) NaNO₃

4) The addition of sodium hydroxide and _________ to water produces a buffer solution.
A) HCl  B) NaC₂H₃O₂  C) NaF  D) NH₃  E) none of the above

5) A 25.0 mL sample of a solution of an unknown compound is titrated with a 0.115 M NaOH solution. The titration curve above was obtained. The unknown compound is
A) a strong acid  B) a strong base  C) a weak acid  D) a weak base  E) neither an acid nor a base
Consider the following table of K_{sp} values.

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
<th>K_{sp}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium carbonate</td>
<td>CdCO₃</td>
<td>5.2 × 10⁻¹²</td>
</tr>
<tr>
<td>Cadmium hydroxide</td>
<td>Cd(OH)₂</td>
<td>2.5 × 10⁻¹⁴</td>
</tr>
<tr>
<td>Calcium fluoride</td>
<td>CaF₂</td>
<td>3.9 × 10⁻¹¹</td>
</tr>
<tr>
<td>Silver iodide</td>
<td>AgI</td>
<td>8.3 × 10⁻¹⁷</td>
</tr>
<tr>
<td>Zinc carbonate</td>
<td>ZnCO₃</td>
<td>1.4 × 10⁻¹¹</td>
</tr>
</tbody>
</table>

6) Which compound listed below has the greatest molar solubility in water?
A) CdCO₃  B) Cd(OH)₂  C) AgI  D) CaF₂  E) ZnCO₃
7) In which of the following aqueous solutions would you expect AgCl to have the lowest solubility?
A) pure water  B) 0.020 M BaCl₂  C) 0.015 NaCl  D) 0.020 AgNO₃  E) 0.020 KCl

8) The $K_a$ of benzoic acid is $6.30 \times 10^{-5}$. The pH of a buffer prepared by combining 50.0 mL of 1.00 M potassium benzoate and 50.0 mL of 1.00 M benzoic acid is __________.
A) 1.705  B) 0.851  C) 3.406  D) 4.201  E) 2.383

9) Calculate the pH of a solution prepared by dissolving 0.150 mol of acetic acid and 0.300 mol of sodium acetate in water sufficient to yield 1.00 L of solution. The $K_a$ of acetic acid is $1.76 \times 10^{-5}$.
A) 2.516  B) 3.892  C) 4.502  D) 10.158  E) 5.056

10) The pH of a solution prepared by dissolving 0.350 mol of solid methylamine hydrochloride (CH₃NH₃Cl) in 1.00 L of 1.10 M methylamine (CH₃NH₂) is __________. The $K_b$ for methylamine is $4.40 \times 10^{-4}$.
A) 1.66  B) 2.86  C) 10.28  D) 11.14  E) 10.61

11) A 25.0 mL sample of 0.723 M HClO₄ is titrated with a 0.27 M KOH solution. The $\text{H}_3\text{O}^+$ concentration after the addition of 80.0 mL of KOH is __________ M.
A) 0.4  B) $1 \times 10^{-7}$  C) 0.7  D) $3 \times 10^{-13}$  E) $4 \times 10^{-2}$

12) The pH of a solution prepared by mixing 50.0 mL of 0.125 M KOH and 50.0 mL of 0.125 M HCl is __________. A) 6.29  B) 7.00  C) 8.11  D) 5.78  E) 0.00

13) The concentration of iodide ions in a saturated solution of lead (II) iodide is __________ M. The solubility product constant of PbI₂ is $1.4 \times 10^{-8}$.
A) $3.8 \times 10^{-4}$  B) $3.0 \times 10^{-3}$  C) $1.5 \times 10^{-3}$  D) $3.5 \times 10^{-9}$  E) $1.4 \times 10^{-8}$

14) The solubility of lead (II) chloride (PbCl₂) is $1.6 \times 10^{-2}$ M. What is the $K_{sp}$ of PbCl₂?  A) $5.0 \times 10^{-4}$  B) $4.1 \times 10^{-6}$  C) $3.1 \times 10^{-7}$  D) $1.6 \times 10^{-5}$  E) $1.6 \times 10^{-2}$

15 Calculate the maximum concentration (in M) of silver ions (Ag⁺) in a solution that contains 0.025 M of CO₃²⁻. The $K_{sp}$ of Ag₂CO₃ is $8.1 \times 10^{-12}$.
A) $1.8 \times 10^{-5}$  B) $1.4 \times 10^{-6}$  C) $2.8 \times 10^{-6}$  D) $3.2 \times 10^{-10}$  E) $8.1 \times 10^{-12}$

16) Calculate the percent ionization of formic acid (HCO₂H) in a solution that is 0.219 M in formic acid. The $K_a$ of formic acid is $1.77 \times 10^{-4}$.
A) $3.94 \times 10^{-5}$  B) 0.0180  C) 2.84  D) 0.280  E) 12.2
17) Calculate the pH of a solution that is 0.210 M in nitrous acid (HNO₂) and 0.290 M in potassium nitrite (KNO₂). The acid dissociation constant of nitrous acid is $4.50 \times 10^{-4}$.
A) 3.487 B) 3.210 C) 13.86 D) 10.51 E) 4.562

18) Consider a solution containing 0.100 M fluoride ions and 0.126 M hydrogen fluoride. The concentration of fluoride ions after the addition of 4.00 mL of 0.0100 M HCl to 25.0 mL of this solution is _______ M. (DIFFICULT!)
A) 0.0862 B) 0.0876 C) 0.0980 D) 0.0848 E) 0.00253

19) Calculate the pH of a solution prepared by dissolving 0.850 mol of NH₃ and 0.350 mol of NH₄Cl in water sufficient to yield 1.00 L of solution. The $K_b$ of ammonia is $1.77 \times 10^{-5}$.
A) 5.137 B) 4.367 C) 9.633 D) 8.781 E) 8.863

20) A 25.0 mL sample of 0.150 M hydrazoic acid is titrated with a 0.150 M NaOH solution. What is the pH at the equivalence point? The $K_a$ of hydrazoic acid is $4.50 \times 10^{-4}$.
A) 11.72 B) 9.28 C) 4.72 D) 7.00 E) 8.80

21) A 25.0-mL sample of 0.150 M butanoic acid is titrated with a 0.150 M NaOH solution. What is the pH before any base is added? The $K_a$ of butanoic acid is $1.5 \times 10^{-5}$.
A) 2.83 B) $1.5 \times 10^{-3}$
C) 4.82 D) 4.00
E) $1.0 \times 10^4$

22) A 25.0 mL sample of 0.150 M hypochlorous acid is titrated with a 0.150 M NaOH solution. What is the pH after 26.0 mL of base is added? The $K_a$ of hypochlorous acid is $3.0 \times 10^{-8}$.
A) 2.54 B) 11.47
C) 7.00 D) 7.51
E) 7.54

23) A 25.0-mL sample of 0.150 M hydrazoic acid is titrated with a 0.150 M NaOH solution. What is the pH after 13.3 mL of base is added? The $K_a$ of hydrazoic acid is $1.9 \times 10^{-5}$.
A) 4.45 B) 1.34
C) 3.03 D) 4.78
E) 4.66

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