1. A solution of accurately known concentration is the definition of a ....
   a- Buffer solution.
   b- Neutral solution.
   c- Standard solution.
   d- Saturated solution.

2. Consider the following acid-base equilibrium:
   \[ \text{HCO}_3^- + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 + \text{OH}^- \]
   In the reaction above, the Brønsted-Lowry acids are ..... 
   a- H$_2$O and OH$^-$
   b- H$_2$O and H$_2$CO$_3$
   c- HCO$_3^-$ and OH$^-$
   d- HCO$_3^-$ and H$_2$CO$_3$

3. Consider the following reaction:
   \[ \text{H}_3\text{BO}_3 (aq) + \text{HS}^- (aq) \leftrightarrow \text{H}_2\text{BO}_2^- (aq) + \text{H}_2\text{S}(aq) \]
   The order of Brønsted-Lowry acids and bases in this equation is 
   a- Acid, base, acid, base
   b- Acid, base, acid, base
   c- Base, acid, acid, base
   d- Base, acid, base, acid

4. RNH$_2$ is a basic compound according to ....
   a- Arrhenius Ionization Theory.
   b- Brønsted-Lowry Theory.
   c- Lewis Concept (Theory)
   d- a & b
5- Consider the following:

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<tr>
<td>I</td>
<td>$\text{PO}_4^{3-}$</td>
</tr>
<tr>
<td>II</td>
<td>$\text{HPO}_4^{2-}$</td>
</tr>
<tr>
<td>III</td>
<td>$\text{H}_2\text{PO}_4^-$</td>
</tr>
<tr>
<td>IV</td>
<td>$\text{H}_3\text{PO}_4$</td>
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The term amphoteric can be used to describe:

a- I only.
b- II and III only.
c- I, II and III only.
d- II, III and IV only.

6- Consider the following acid-base equilibrium:

$$\text{H}_2\text{C}_6\text{H}_5\text{O}_7^- + \text{HPO}_4^{2-} \rightleftharpoons \text{HC}_6\text{H}_5\text{O}_7^{2-} + \text{H}_2\text{PO}_4^-$$

In the equilibrium above,

a- Reactants are favored because $\text{H}_2\text{C}_6\text{H}_5\text{O}_7^-$ is the weaker acid.
b- Reactants are favored because $\text{HPO}_4^{2-}$ is the weaker acid.
c- Products are favored because $\text{HC}_6\text{H}_5\text{O}_7^{2-}$ is the weaker acid.
d- Products are favored because $\text{H}_2\text{PO}_4^-$ is the weaker acid.

7- As the [H$_3$O$^+$] in a solution decreases, the [OH$^-$] : 

a- Increases and the pH increases.
b- Increases and the pH decreases.
c- Decreases and the pH increases.
d- Decreases and the pH decreases.

8- Consider the following equilibrium:

$$\text{H}_2\text{O} + \text{energy} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^-$$

In pure water at a temperature of 50$^\circ$C,

a- $K_w = 1.0 \times 10^{-14}$
b- pH $< 7$
c- pH $> 7$
d- pH $= 7$

9- What is the pH of a 0.10M NaOH solution?

a- 0.70  b- 1.00  c- 10.00  d- 13.00

10- What does a buffer do?

a- Keeps the salt concentration of a solution constant.
b- Keeps the pH of solution constant.
c- Keeps the cation concentration constant.
d- Keeps the anion concentration constant.

11- What substances are present in a buffer?

a- A weak base or acid only.
b- A hydrolyzing salt only.
c- A weak base or acid and its salt.
d- A salt only.

e- A weak base or acid and its salt.

12- Which of the following could be added to a solution of sodium acetate to prepare a buffer? acetic acid, hydrochloric acid, ammonium acetate, sodium chloride

a- Acetic acid only.
b- Hydrochloric acid only.
c- Ammonium acetate only.
d- Sodium chloride or ammonium acetate.
e- Acetic acid or hydrochloric acid.

N.B.

Ka of $\text{H}_2\text{C}_6\text{H}_5\text{O}_7^-$ = $1.8 \times 10^{-5}$
Ka of $\text{H}_2\text{PO}_4^-$ = $6.3 \times 10^{-8}$
13. Of the following solutions, which has the greatest buffer capacity?
   a. 0.100 M NH₃ and 0.455 M NH₄Cl
   b. 0.543 M NH₃ and 0.555 M NH₄Cl
   c. 0.087 M NH₃ and 0.088 M NH₄Cl
   d. 0.100 M NH₃ and 0.455 M NH₄Cl

14. Which of the following reactions shows what happens when nitric acid is added to an ammonium ion ammonia buffer?
   a. H⁺ + Cl⁻ → HCl
   b. H⁺ + NH₄⁺ → NH₃
   c. Cl⁻ + NH₃ → NH₄Cl
   d. H⁺ + NH₃ → NH₄⁺

15. Increasing the temperature will greatly affect the pH of the buffer in the former question.
   a. True  
   b. False

16. Consider a buffer solution containing 0.1 N acetic acid & 0.1N sodium acetate. The pH of this solution is ............. (the pKa of acetic acid is 4.74):
   a. 3.55  
   b. 4.74  
   c. 10.45  
   d. 9.26

17. The pH of the solution produced by adding 10.0 ml of 1N HCl to the buffer in the former question is .............
   a. 3.55  
   b. 4.74  
   c. 3.65  
   d. 4.65

18. During an acid-base titration, the point at which the indicator color is changed is known as ................, while the ....................... is point at which stoichiometric amounts of acid and base have been combined.
   a. End point, Transition point.
   b. End point, Equivalence point.
   c. Equivalence point, End point.
   d. Equivalence point, Transition point.
   e. None of the above.

19. Pure potassium hydrogen phthalate is used to standardize a solution of NaOH for use in an acid-base titration. What term is used to describe the potassium hydrogen phthalate?
   a. Titrant base.
   b. Standard buffer.
   c. Equivalent base.
   d. Primary standard.

Examine the following titration curves (T.C) to answer questions 20 to 24:

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26. Which one of the titration curves corresponds to the titration of strong acid (in flask) with strong base (in burette)?
   a. T.C. (a)   b. T.C. (b)   c. T.C. (c)   d. T.C. (d)
21. The pH at the equivalence point in the former titration equals:
   a. 0.00   b. 7   c. 6.5   d. 8.5
22. Titration curve (d) corresponds to titration of
   a. Strong base with strong acid.
   b. Weak base with strong acid.
   c. Strong base with weak acid.
   d. Weak base with weak acid.
23. Which indicator would be best for the titration (d)?
   a. Phenolphthalein (pKa = 9.1).
   b. Thymol blue (pKa = 1.7).
   c. Methyl red (pKa = 5).
   d. Phenol red (pKa = 7.4).
24. In the titration of weak acid against strong base, at the half equivalence point
   a. pH = 1/2 pKa.
   b. pH = pK_b.
   c. pH = 2 pKa.
   d. pH = pK_a.
25. What volume (mL) of 0.5M HNO₃ is necessary to titrate 25 mL of 0.05M KOH solution to the endpoint?
   a. 2.5   b. 5.0   c. 10   d. 25   e. 50
26. A 30.0 mL sample of 0.44M hydrazoic acid, (HN₃ ; Ka = 2.6 x 10⁻³) is titrated with a 0.22M KOH solution.
   What is the pH of the solution at 60% of titration?
   a. 8.87   b. 7.0   c. 5.94   d. 4.77   e. 4.59
27. Titration of a mixture of formic acid (Ka = 1.8 x 10⁻⁷) & acetic acid (Ka = 1.8 x 10⁻⁵), will give two end points.
   a. True   b. False
28. H₂BO₃ (Ka = 10 x 10⁻¹⁰) can be titrated with NaOH after addition of
   a. Dextrin.
   b. Nitrobenzene.
   c. Glycerol.
   d. Neutral formalin.
29. In the titration of Na₂CO₃ / NaOH mixture, total alkalinity can be determined by using standard HCl as a titrant & M.O indicator
   a. True.
   b. False
30. Among the reasons for back or residual acid-base titration:
   a. Volatile substances
   b. Insoluble substances
   c. Substances which require heating with standard reagent.
   d. Substances which require excess reagent for quantitative reaction to proceed rapidly.
   e. All of the above.

Good Luck