Chem12 Buffer/Titration : Test - 230

1) Give definitions for the following :

a) equivalence point

b) endpoint (or transition point)

2) What is the purpose of a buffer ?

3) What is the usual purpose of doing a titration ?

4) What is the purpose of using a primary standard ?

5) Answer the following multiple choice questions :

1) The process of removing hydrogen ions from a solution by adding hydroxide ions is called

a) hydrolysis b) ionization c) neutralization
d) precipitation

2) An acid-base indicator is generally defined as a substance which

a) changes color when moles of H^+ equals moles of OH^-
b) changes color when the pH of the solution is 7
c) is used to detect whether the test solution contains an excess of positive or negative ions
d) changes color within a definite pH range

3) What volume of 0.0200 M $Ca(OH)_2$ solution is required to neutralize 25.0 mL of 0.0100 M HCl solution? (in mL)

a) 6.25 b) 12.5 c) 25.0 d) 50.0

4) The net ionic equation for the titration of NaOH(aq) with HCl(aq) is

a) $H^+ + OH^- \rightarrow H_2O$
b) $HCl + OH^- \rightarrow Cl^- + H_2O$
c) $HCl + Na^+ + OH^- \rightarrow NaCl + H_2O$
d) $HCl + NaOH \rightarrow NaCl + H_2O$

5) In which of the following acid-base systems are the reactants favored?

a) $HCO_3^- + SO_4^{2-} \leftrightarrow HSO_4^- + CO_3^{2-}$
b) $HCl + SO_4^{2-} \leftrightarrow HSO_4^- + Cl^-$
c) $HNO_3 + H_2O \leftrightarrow H_3O^+ + NO_3^-$
d) $H_3PO_4 + CH_3COO^- \leftrightarrow CH_3COOH + H_2PO_4^-$

6) Which of the following indicators undergoes a color change from red to yellow at $[H_3O^+] = 3.2x10^{-4}$ M?

a) Thymol blue b) Orange IV c) Methyl orange
d) Alizarin yellow

7) A certain weak base, B^-, has a K_b of $1.0x10^{-9}$. What is the pH of a buffer prepared by dissolving equal numbers of moles of B^- and HB in water?

$$B^-(aq) + H_2O(l) \leftrightarrow HB(aq) + OH^-(aq)$$

a) 5.0 b) 6.0 c) 7.0 d) 9.0

8) The indicator phenolphthalein is colorless in a particular solution. This means that the :

a) pH is less than 8.2
b) pH is greater than 8.2
c) $[H^+]$ is less than $1.0x10^{-10}$ M
d) $[OH^-]$ is greater than $1.0x10^{-4}$ M

9) The indicator HIn ionizes according to the following equation :

$$HIn(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + In^-(aq) \qquad K_a = 1.0x10^{-5}$$

At the transition point (endpoint) of HIn, which relationship is true?

a) $[In^-] = [OH^-]$
b) $[HIn] = [In^-]$
c) $[HIn] = [H_3O^+]$
d) $[H_3O^+] = [OH^-]$

10) Which of the following indicators is the **BEST** choice for determining the equivalence point in a titration between $NH_3(aq)$ and HBr(aq)?

a) Methyl Violet
b) Methyl orange
c) Alizarin yellow
d) Phenolphthalein

11) A buffer solution is prepared and found to contain 1.0 M $CH_3COO^-(aq)$ and 1.0 M $CH_3COOH(aq)$. Which of the following best describes the $[CH_3COO^-]$ of the solution after a small amount of a strong acid is added to the buffer?

a) exactly 2.0 M
b) slightly less than 1.0 M
c) slightly greater than 2.0 M
d) slightly greater than 1.0 M

12) Which of the following could be used to form a buffer solution?

a) HBr and NaOH
b) HCl and NH_4Cl
c) HNO_3 and $NaNO_3$
d) H_2CO_3 and $NaHCO_3$

13) Normal rain has a pH of 6 as result of dissolved

a) oxygen
b) carbon dioxide
c) sulfur dioxide
d) nitrogen dioxide

14) Which of the following oxides will dissolve in water to form an acidic solution?

a) SO_2
b) TiO
c) K_2O
d) MgO

15) Which one of the following dissolves in water to form a basic solution?

a) NO
b) SO_3
c) CO_2
d) K_2O

16) A solution is amber (yellow) when the indicator Neutral red is added. It is colorless when phenolphthalein is added.
The approximate pH of the solution is

a) 4 b) 6 c) 8 d)10

17) Consider the following equilibrium for a buffer solution :

$$CH_3COOH + H_2O <-> CH_3COO^- + H_3O^+$$

When a small amount of acid is added to this system, and the equilibrium is reestablished,

a) $[CH_3COO^-]$ and pH have both increased
b) $[CH_3COOH]$ and pH have both decreased
c) $[CH_3COO^-]$ has decreased and pH changes little
d) $[CH_3COOH]$ has decreased and pH changes little

18) Consider the following equilibrium:

$$HInd + H_2O <-> H_3O^+ + Ind^-$$

At the transition point for an acid-base indicator,

a) $K_a = [Ind^-]$ b) $K_a = [HInd]$
c) $K_a = [H_3O^+]$ d) $K_a = [H_3O^+][OH^-]$

6) A buffer is made by adding 2.00 mol of acetic acid and 1.00 mol of the salt KCH_3COO to 1.00 L of water. $K_a = 1.80x10^{-5}$ for acetic acid.

a) Write the equilibrium reaction

b) Find the pH

c) Find the new pH if 0.100 mol of H_3O^+ is added.

7) Acid rain has decreased the pH of a lake affecting life there. What would you do to fix this problem ?

Answers : 1)a) This is the point in a titration where the stoichiometry of the reaction is exactly satisfied. ($[OH^-] = [H_3O^+]$) b) This is the point

in a titration at which the indicator is half-way through a color change. (it should be close to the equivalence point in a titration), 2) A buffer prevents changes in the pH of a solution when a small amount of an acid or base is added. 3) The purpose of doing a titration is to find the concentration of an unknown solution using a solution of known concentration. 4) A primary standard is used to prepare a solution of known concentration (called a standard solution) to a high degree of accuracy and precision. This solution can then be used in a titration. 5) 1) c, 2) d, 3) a, 4) a, 5) a, 6) c, 7) a, 8) a, 9) b, 10) b, 11) b, 12) d, 13) b, 14)a, 15) d, 16) c, 17) c, 18) c, 6)a) $CH_3COOH + H_2O <-> CH_3COO^- + H_3O^+$, b) pH = 4.44, c) pH = 4.38, 7) Add a base to the lake, such as $CaCO_3$ (limestone, it's inexpensive) or CaO (lime) to raise the pH. Or, reduce emissions of non-metal (S, N) oxides that form acid rain.