

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

- a) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
- b) $\text{HCl} + \text{OH}^- \rightarrow \text{Cl}^- + \text{H}_2\text{O}$
- c) $\text{HCl} + \text{Na}^+ + \text{OH}^- \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- d) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

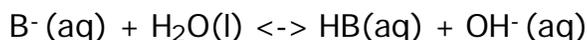
5) In which of the following acid-base systems are the reactants favored?

- a) $\text{HCO}_3^- + \text{SO}_4^{2-} \leftrightarrow \text{HSO}_4^- + \text{CO}_3^{2-}$
- b) $\text{HCl} + \text{SO}_4^{2-} \leftrightarrow \text{HSO}_4^- + \text{Cl}^-$
- c) $\text{HNO}_3 + \text{H}_2\text{O} \leftrightarrow \text{H}_3\text{O}^+ + \text{NO}_3^-$
- d) $\text{H}_3\text{PO}_4 + \text{CH}_3\text{COO}^- \leftrightarrow \text{CH}_3\text{COOH} + \text{H}_2\text{PO}_4^-$

6) Which of the following indicators undergoes a color change from red to yellow at $[\text{H}_3\text{O}^+] = 3.2 \times 10^{-4} \text{ M}$?

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

7) A certain weak base, B^- , has a K_b of 1.0×10^{-9} . What is the pH of a buffer prepared by dissolving equal numbers of moles of B^- and HB in water?

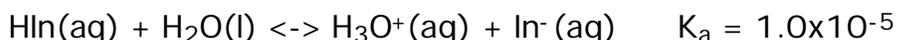


- a) 5.0
- b) 6.0
- c) 7.0
- d) 9.0

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) $[\text{H}^+]$ is less than $1.0 \times 10^{-10} \text{ M}$
- d) $[\text{OH}^-]$ is greater than $1.0 \times 10^{-4} \text{ M}$

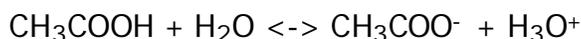
9) The indicator HIn ionizes according to the following equation :



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

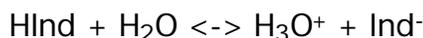
17) Consider the following equilibrium for a buffer solution :



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

- a) $[\text{CH}_3\text{COO}^-]$ and pH have both increased
b) $[\text{CH}_3\text{COOH}]$ and pH have both decreased
c) $[\text{CH}_3\text{COO}^-]$ has decreased and pH changes little
d) $[\text{CH}_3\text{COOH}]$ has decreased and pH changes little

18) Consider the following equilibrium:



At the transition point for an acid-base indicator,

- a) $K_a = [\text{Ind}^-]$ b) $K_a = [\text{HInd}]$
c) $K_a = [\text{H}_3\text{O}^+]$ d) $K_a = [\text{H}_3\text{O}^+][\text{OH}^-]$

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. $K_a = 1.80 \times 10^{-5}$ 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. ($[\text{OH}^-] = [\text{H}_3\text{O}^+]$) 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) $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$, 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.