

Chapters 15 & 16 Study Questions
(Use tables in Chapters 14 and 15 as needed.)

1. Compare the following titration curves with respect to i) steepness of curve at equivalence, ii) pH at the start of the titration, iii) pH at equivalence, iv) is there buffer at half-equivalence:
 - a) strong acid titrated with strong base.
 - b) weak acid titrated with strong base.
 - c) weak base titrated with strong acid.
2. Use Figure 15.8, page 749, as needed to answer the following:
 - a) What is the color of bromthymol blue at pH 9?
 - b) At what pH is methyl red orange?
 - c) What is the K_a of an indicator that changes color at pH 3.5?
 - d) What is a good indicator to use when titrating sodium nitrite (NaNO_2) with HCl?
3. How many ml of 2.00 M HNO_3 would be required to neutralize 12.5 ml of 0.0800 M NH_3 ? (optional: What is the pH of the resulting solution?)
4. Amy wants to prepare a buffer with a pH of 5.00.
 - a) What ratio of $\text{CH}_3\text{COO}^-/\text{CH}_3\text{COOH}$ does she need?
 - b) How could she mix 0.100 M CH_3COOH and 0.100 M NaCH_3COO to make this buffer?
 - c) How could she make this buffer using 0.100 M CH_3COOH and 0.100 M NaOH ?
 - d) Name another buffer system she could use.
5. What is the pH of a solution made by mixing
 - a) 750 ml of 0.400 M NaOH and 250 ml of 0.800 M HCl ?
 - b) 100 ml of 0.100 M NaHCO_3 and 200 ml 0.100 M H_2CO_3 ? (K_a for H_2CO_3 is 4.4×10^{-7})
6. The solubility of MgCl_2 at 25°C is approximately 8.0 g $\text{MgCl}_2/100$ g water. Assuming the solution has a density of 1.00 g/cm^3 , calculate the concentration of MgCl_2 in a saturated solution in moles/liter and then calculate K_{sp} for MgCl_2 .
7. The K_{sp} for CuCrO_4 is 3.6×10^{-6} . What is the molarity of a saturated solution of CuCrO_4 ?
8. Silver nitrate (AgNO_3) is added to a solution of 0.020 M sodium carbonate. At what concentration of AgNO_3 does a precipitate start to form?
9. A solution is prepared by mixing 50.0 ml of 0.0100 M lead(II) nitrate with 50.0 ml of 0.0200 M sodium bromide. Will a precipitate form?
10. Write balanced chemical equations for
 - a) the reaction when strong acid is added to $\text{H}_2\text{CO}_3/\text{NaHCO}_3$ buffer.
 - b) the ionization in water of silver phosphate. Write an expression for K_{sp} for this reaction.
11. What is the molar mass of an acid if 0.422 g of the acid are neutralized by 17.5 mL of 0.268 M NaOH ?

Summary of Chapters 15 & 16: Applications of Aqueous Equilibria

acid-base reactions

buffers

how they work

significance of pK_a of buffer

Henderson-Hasselbach equation

calculations relating $[A^-]/[HA]$ to pH

how to prepare buffers

acid-base titrations

equivalence point

shape of titration curves

relation of strength of acid or base to pH

of equivalence point

pH indicators

relevance of pK_a of indicator

K_{sp}

expression for K_{sp}

calculations of equilibrium

concentrations from K_{sp} and vice versa

relationship to extent of solubility

calculations of concentrations of ions that form precipitates

common ion effect