

CHEM 1413
Chapter 4
Homework Questions

TEXTBOOK HOMEWORK

Chapter 3

3.68 Calculate each of the following quantities:

- (a) Mass (g) of solute in 185.8 mL of 0.267 M calcium acetate
- (b) Molarity of 500. mL of solution containing 21.1 g of potassium iodide
- (c) Amount (mol) of solute in 145.6 L of 0.850 M sodium cyanide

3.70 Calculate each of the following quantities: (a) Molarity of a solution prepared by diluting 37.00 mL of 0.250 M potassium chloride to 150.00 mL (b) Molarity of a solution prepared by diluting 25.71 mL of 0.0706 M ammonium sulfate to 500.00 mL (c) Molarity of sodium ion in a solution made by mixing 3.58 mL of 0.348 M sodium chloride with 500. mL of 6.81×10^{-2} M sodium sulfate (assume volumes are additive)

3.74 How many milliliters of 0.383M HCl are needed to react with 16.2 g of CaCO₃?



3.76 How many grams of solid barium sulfate form when 35.0 mL of 0.160 M barium chloride reacts with 58.0 mL of 0.065 M sodium sulfate? Aqueous sodium chloride forms also.

3.92 Assuming that the volumes are additive, what is the concentration of KBr in a solution prepared by mixing 0.200 L of 0.053 M KBr with 0.550 L of 0.078 M KBr?

Chapter 4

4.14 How many moles and how many ions of each type are present in each of the following?

- (a) 130. mL of 0.45 M aluminum chloride
- (b) 9.80 mL of a solution containing 2.59 g lithium sulfate/L
- (c) 245 mL of a solution containing 3.68×10^{22} formula units of potassium bromide per liter

4.28 If 38.5 mL of lead(II) nitrate solution reacts completely with excess sodium iodide solution to yield 0.628 g of precipitate, what is the molarity of lead(II) ion in the original solution?

4.38(b) Complete the following acid-base reaction with balanced molecular, total ionic, and net ionic equation: (b) Ammonia(aq) + hydrochloric acid(aq) \parallel

4.39(b) Complete the following acid-base reaction with balanced molecular, total ionic, and net ionic equation: (b) Calcium hydroxide(aq) + acetic acid(aq) \parallel

4.43 If 26.25 mL of 0.1850 M NaOH solution reacts with 25.00 mL of H₂SO₄, what is the molarity of the acid solution?

SUPPLEMENTARY HOMEWORK

Solution Concentration

1. A solution is made by mixing 30. mL of 8.00 M HCl, 100 mL of 2.00 M HCl, and enough water to make 200. mL of solution. What is the Molarity of HCl in the final solution?
2. If one mixes 150 mL of 0.30 M KOH with 50 mL of 0.60 M KOH, how many additional mL of water must be added in order for the solution

concentration to be 0.25 M?

3. What are the number of moles and Molar concentrations of $\text{Mg}^{2+}(\text{aq})$ and $\text{PO}_4^{3-}(\text{aq})$ when 30. grams of $\text{Mg}_3(\text{PO}_4)_2$ [$M = 262.9$] are dissolved in 700 mL of aqueous solution?
4. Which of the following has the highest concentration of ions?
(A) 0.1 M CH_3OH (B) 0.1 M NaCl (C) 0.04 M $(\text{NH}_4)_2\text{SO}_4$
(D) 0.03 M $\text{Al}_2(\text{SO}_4)_3$ (E) 0.05 M HBr
5. Barium Fluoride, BaF_2 [$M=175.3$] is a sparingly soluble salt with a solubility of 0.19 g/100 mL H_2O at 25 °C. If you stir 0.95 grams of BaF_2 into 300 mL of water at 25 °C,
 - (a) What is the Molar concentration of BaF_2 ?
 - (b) How many grams of BaF_2 remain undissolved?
 - (c) If, instead, 0.95 grams of BaF_2 are stirred into 600 mL of water, what is the Molar concentration of BaF_2 ?

Solution Stoichiometry

6. When NaOH is added to a solution of $\text{Cu}(\text{NO}_3)_2(\text{aq})$, solid $\text{Cu}(\text{OH})_2(\text{s})$ precipitates.
 - (a) How many grams of NaOH ($M=40.$) are required to precipitate all of the copper (as CuSO_4) from 500 mL of 0.60 M $\text{Cu}(\text{NO}_3)_2(\text{aq})$?
 - (b) How many grams of $\text{Cu}(\text{OH})_2(\text{s})$ ($M=97.5$) precipitates from the solution?
7. When aqueous solutions of $\text{K}_3\text{PO}_4(\text{aq})$ and $\text{Ca}(\text{NO}_3)_2(\text{aq})$ are mixed together, solid $\text{Ca}_3(\text{PO}_4)_2(\text{s})$ [$M=310.3$] precipitates from solution.
 - (a) What mass of $\text{Ca}_3(\text{PO}_4)_2(\text{s})$ will precipitate when 600 mL of 0.40 M $\text{K}_3\text{PO}_4(\text{aq})$ and 600 mL of 0.40 M $\text{Ca}(\text{NO}_3)_2(\text{aq})$ are mixed together?
 - (b) Which reactant is in excess?
 - (c) What will be the concentration of the excess reactant after the $\text{Ca}_3(\text{PO}_4)_2$ has precipitated?

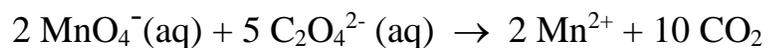
Titration

8. Dolomite is a mineral found in soil and has the formula, $\text{CaMg}(\text{CO}_3)_2$ [M=184.4]. It reacts with hydrochloric acid, HCl, for form $\text{H}_2\text{CO}_3 + \text{CaCl}_2 + \text{MgCl}_2$. If a 120 gram sample of soil requires 348 mL of 0.35 M HCl to react completely with the dolomite, what is the mass percent of dolomite in the soil sample?
9. To analyze an iron containing compound [Fe, M=55.8], you can convert all of the iron to Fe^{2+} in aqueous solution, and then titrate the solution with standardized KMnO_4 . The balanced net ionic equation for this titration is:
 $\text{MnO}_4^-(\text{aq}) + 5\text{Fe}^{2+}(\text{aq}) + 8\text{H}^+(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + 5\text{Fe}^{3+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$
A 0.58 gram sample of an iron-containing compound requires 26.40 mL of 0.0125 M KMnO_4 to react completely with the Fe^{2+} . What is the mass percent of iron in the compound?
10. You are given 0.95 g of an unknown diprotic acid, H_2A . If 45.0 mL of 0.40 M NaOH are required to neutralize the acid completely, what is the Molar Mass of the acid?
11. Assume that 1.65 g of impure $\text{Ca}(\text{OH})_2$ [M = 74.1] is dissolved in 100. mL of aqueous solution. When this solution is titrated with 0.45 M HCl, it is found that 86.0 mL of the acid solution are required to completely neutralize the base. What is the percent impurity in the $\text{Ca}(\text{OH})_2$ sample?

Redox Reactions

12. Regarding the following reaction, which of the following statements is/are correct?
- $$\text{Mg}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{Cu}(\text{s})$$
- (i) Mg is oxidized; (ii) Cu^{2+} is oxidized; (iii) Mg is reduced, (iv) Cu^{2+} is reduced
- (A) i and iii (B) i and ii (C) i and iv
(D) iii and iv (E) ii and iii

13. Regarding the following reaction, which of the statements below is/are true?



- (i) MnO_4^- is the reducing agent (ii) MnO_4^- is reduced
(iii) $\text{C}_2\text{O}_4^{2-}$ is the reducing agent (iv) $\text{C}_2\text{O}_4^{2-}$ is oxidized

(A) i & iii (B) ii & iv (C) ii & iii & iv (D) None of the statements

14. In the oxidation-reduction reaction, $\text{Fe}_2\text{O}_3(\text{s}) + 3 \text{CO}(\text{g}) \rightarrow 2 \text{Fe}(\text{s}) + 3 \text{CO}_2(\text{g})$, _____ is oxidized and _____ electrons are transferred.