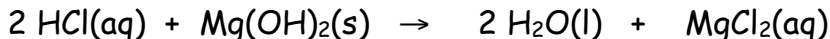


CHM 150/151: SOLUTION STOICHIOMETRY KEY

1. The active ingredient in *Milk of Magnesia*, a commonly used laxative, is magnesium hydroxide. A 2.0-teaspoon (10.0 mL) sample of *Milk of Magnesia* was analyzed and required 18.26 mL of a 1.50M hydrochloric acid for complete neutralization.

a. Write the balanced chemical equation for the reaction between hydrochloric acid and magnesium hydroxide.



b. Calculate the mass (in mg) of magnesium hydroxide present in the sample of *Milk of Magnesia*.

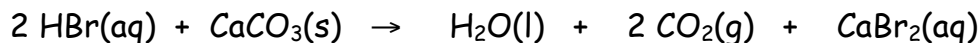
$$18.26 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1.50 \text{ mol HCl}}{1 \text{ L}} \times \frac{1 \text{ mol Mg(OH)}_2}{2 \text{ mol HCl}} \times \frac{58.326 \text{ g Mg(OH)}_2}{\text{mol Mg(OH)}_2} = 0.799 \text{ g Mg(OH)}_2$$

c. Calculate the mass percent concentration of magnesium hydroxide in *Milk of Magnesia* given that the density of *Milk of Magnesia* is 1.1 g/mL.

$$\frac{0.799 \text{ g Mg(OH)}_2}{10.0 \text{ mL Milk of Magnesia}} \times \frac{1 \text{ mL of Milk of Magnesia}}{1.1 \text{ g Milk of Magnesia}} \times 100\% = 7.26\% \text{ Mg(OH)}_2$$

2. Limestone is a mixture of calcium carbonate and other substances. A 1.356 g sample of limestone rock is pulverized then analyzed with a standard solution of hydrobromic acid. The sample required 25.87 mL of a 0.750M hydrobromic acid solution for complete neutralization to a phenolphthalein endpoint.

a. Write the balanced chemical equation for the reaction between hydrobromic acid and calcium carbonate.

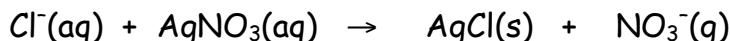


b. Calculate the mass percent concentration of calcium carbonate in the limestone.

$$\frac{25.87 \text{ mL HBr}}{1.356 \text{ g limestone}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.750 \text{ mol HBr}}{1 \text{ L}} \times \frac{1 \text{ mol CaCO}_3}{2 \text{ mol HBr}} \times \frac{100.09 \text{ g CaCO}_3}{\text{mol CaCO}_3} \times 100\% = 71.6\% \text{ CaCO}_3$$

3. The mass percentage of chloride ion in a sample of sea water can be determined by titrating the sample with silver nitrate, which produces a precipitate. In one test, a 25.0 mL sample of sea water was titrated with 39.47 mL of a 0.3029M silver nitrate solution to reach the equivalence point,

a. Write the balanced chemical equation for the reaction between silver nitrate and chloride ion.



b. Calculate the mass percentage of chloride ion in the sea water if the density of sea water is 1.03 g/mL.

$$\frac{39.47 \text{ mL AgNO}_3}{25.0 \text{ mL sea H}_2\text{O}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.3029 \text{ mol AgNO}_3}{1 \text{ L}} \times \frac{1 \text{ mol Cl}^-}{1 \text{ mol AgNO}_3} \times \frac{35.45 \text{ g Cl}^-}{\text{mol Cl}^-} \times \frac{1 \text{ mL sea H}_2\text{O}}{1.03 \text{ g sea H}_2\text{O}} \times 100\% = 1.65\% \text{ Cl}^-$$

4. Oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$ (aq), is present in many plants and vegetables. If 24.0 mL of 0.0100M potassium permanganate solution is needed to titrate a 1.00 g sample that contains oxalic acid, what is the mass percent concentration of oxalic acid in the sample?



$$\frac{24.0 \text{ mL KMnO}_4}{1.00 \text{ g sample}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.0100 \text{ mol KMnO}_4}{1 \text{ L}} \times \frac{5 \text{ mol H}_2\text{C}_2\text{O}_4}{2 \text{ mol KMnO}_4} \times \frac{90.036 \text{ g H}_2\text{C}_2\text{O}_4}{\text{mol H}_2\text{C}_2\text{O}_4} \times 100\% = 5.40\% \text{ H}_2\text{C}_2\text{O}_4$$