Appendix D Exercises

Use the following molar masses to do the following problems:

C_4H_8 : 56.10 g/mol	C_4H_9OH : 74.12 g/mol
Fe_2O_3 : 159.70 g/mol	Al_2O_3 : 101.96 g/mol
V_2O_5 : 181.88 g/mol	NH_4VO_3 : 116.98 g/mol
NH_3 : 17.03 g/mol	V_2O_3 : 149.88 g/mol
Cu_2S : 159.17 g/mol	CuO : 79.55 g/mol
Cu_2O : 95.55 g/mol	AgCl : 143.4 g/mol

1. In the presence of acids, water can react with alkenes to form alcohols:

$$C_4H_8 + H_2O \rightarrow C_4H_9OH$$

If 250 g of C_4H_8 reacts with excess H_2O, how many grams of C_4H_9OH can be produced?

2. Aluminum reacts with iron(III) oxide in the "thermite reaction":

$$2Al(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + Al_2O_3(s)$$

a) If 10.0 g of Al reacts with excess Fe_2O_3, how many grams of Al_2O_3 can be produced?

b) If 25.0 g of Al reacts with 10.0 g of Fe_2O_3, how many grams of Al_2O_3 can be produced?

c) In the experiment in part b, what is the mass of the excess reactant remaining after complete reaction?

3. Vanadium(V) oxide reacts with ammonia and water as follows:

$$V_2O_5 + 2NH_3 + H_2O \rightarrow 2NH_4VO_3$$

a) If 50.0 g of V_2O_5 is reacted with excess ammonia and water, how many grams of NH_4VO_3 can be produced?

b) How many grams of NH_3 are required to completely react with 50.0 g of V_2O_5?

4. Vanadium(III) oxide can be made by reduction of vanadium(V) oxide with hydrogen:

$$V_2O_5(s) + 2H_2(g) \rightarrow V_2O_3(s) + 2H_2O(l)$$

a) How many liters of H_2, measured at 1.00 atm and 30 ^oC, are required to completely react with 75.0 g of V_2O_5?

b) If 10.0 g of V_2O_5 reacts with 1.65 L of H_2, measured at 1.00 atm and 30 ^oC, how many grams of V_2O_3 can be produced?

5. Copper(I) sulfide is prepared by heating copper and sulfur in the absence of air:

$$2Cu(s) + S(s) \rightarrow Cu_2S(s)$$

a) How many grams of Cu_2S can be produced from the reaction of 25.0 g of Cu with excess S?

b) How many grams of sulfur are required to form 75.0 g of Cu_2S?

c) If a mixture of 135 g of Cu and 45 g of S is allowed to react, how many grams of Cu_2S could be produced?

d) How many grams of the excess reactant remain in the experiment in part c?

6. Copper(I) oxide can be prepared by thermal decomposition of copper(II) oxide:

$$4CuO(s) \rightarrow 2Cu_2O(s) + O_2(g)$$

a) How many grams of Cu_2O can be produced upon the decomposition of 450 g of CuO?

b) How many liters of O_2, collected at 1.00 atm and 27 ^oC, can be produced by the decomposition of 450 g of CuO?

7. The silver ions in aqueous silver sulfate can be precipitated by addition of excess chloride:

$$Ag_2SO_4(aq) + 2NaCl(aq) \rightarrow 2AgCl(s) + Na_2SO_4(aq)$$

a) How many grams of silver chloride can be formed when 35.0 mL of a 0.100 M Ag_2SO_4 solution is reacted with excess sodium chloride solution?

b) If 22.7 mL of a silver sulfate solution of unknown concentration yields 0.985 g of AgCl upon reaction with excess sodium chloride solution, what is the concentration of the silver sulfate solution?

8. Zn metal reacts with hydrochloric acid to produce hydrogen gas and zinc(II) chloride:

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

a) If 15.0 g of Zn are added to excess HCl(aq), how many liters of $H_2(g)$, collected at 27 ^oC and 725 mm Hg, are produced?

b) If excess Zn is added to 25.0 mL of 0.025 M HCl(aq), how many liters $H_2(g)$, collected at 27 ^oC and 725 mm Hg, can be produced?

9. Potassium permanganate and iron(II) chloride undergo an electron transfer reaction in acid solution:

$KMnO_4(aq) + 5FeCl_2(aq) + 8HCl \rightarrow MnCl_2(aq) + 5FeCl_3(aq) + KCl(aq) + 4\ H_2O(l)$

How many mL of 0.150 M $FeCl_2(aq)$ are needed to completely react with

13.7 mL of 0.110 M $KMnO_4$?

10. Citric acid reacts with sodium hydroxide in a proton transfer reaction:

$H_3C_6H_5O_7(aq) + 3NaOH(aq) \rightarrow 3H_2O(l) + Na_3C_6H_5O_7(aq)$

a) How many mL of 0.125 M NaOH(aq) are required to completely react with 25.0 mL of 0.0695 M citric acid?

b) If 37.5 mL of 1.25 M NaOH(aq**)** is needed to completely react with 22.5 mL of a citric acid solution, what is the concentration of the citric acid solution?

ANSWERS:

1. 330 g

2. **a)** 18.9 g **b)** 6.38 g **c)** 21.6 g

3. **a)** 64.3 g **b)** 9.34 g

4. **a)** 20.5 L **b)** 4.97 g

5. **a)** 31.3 g **b)** 15.1 g **c)** 169 g **d)** 11 g

6. **a)** 405 g **b)** 34.8 L

7. **a)** 1.00 g **b)** 0.151 M

8. **a)** 5.92 L **b)** 8.07 mL

9. 50.2 mL

10. **a)** 41.7 mL **b)** 0.694 M