3 *COMPUTE*

a. Use the periodic table to determine the molar masses of H_2O, Fe, and Fe_3O_4. Then, determine how many mol Fe_3O_4 can be produced from each reactant.

1 mol H_2O = 18.02 g
1 mol Fe = 55.85 g
1 mol Fe_3O_4 = 231.55 g

$$67.0 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} \times \frac{1 \text{ mol Fe}_3\text{O}_4}{3 \text{ mol Fe}} = 0.400 \text{ mol Fe}_3\text{O}_4$$

$$36.0 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol Fe}_3\text{O}_4}{4 \text{ mol H}_2\text{O}} = 0.499 \text{ mol Fe}_3\text{O}_4$$

Fe is the limiting reactant because the given amount of Fe can make only 0.400 mol Fe_3O_4, which is less than the 0.499 mol Fe_3O_4 that the given amount of H_2O would produce.

b. $0.400 \text{ mol Fe}_3\text{O}_4 \times \dfrac{231.55 \text{ g Fe}_3\text{O}_4}{1 \text{ mol Fe}_3\text{O}_4} = 92.6 \text{ g Fe}_3\text{O}_4$

c. $0.400 \text{ mol Fe}_3\text{O}_4 \times \dfrac{4 \text{ mol H}_2\text{O}}{1 \text{ mol Fe}_3\text{O}_4} \times \dfrac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 28.8 \text{ g H}_2\text{O consumed}$

36.0 g H_2O – 28.8 g H_2O consumed = 7.2 g H_2O remaining

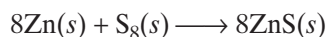**4** *EVALUATE*

The mass of original reactants is 67.0 + 36.0 = 103.0 g; the mass of Fe_3O_4 + unreacted water is 92.6 g + 7.2 g = 99.8 g. The difference of 3.2 g is the mass of hydrogen that is produced with the Fe_3O_4.

PRACTICE

Answers in Appendix E

1. Zinc and sulfur react to form zinc sulfide according to the following equation.

$$8Zn(s) + S_8(s) \longrightarrow 8ZnS(s)$$

   a. If 2.00 mol of Zn are heated with 1.00 mol of S_8, identify the limiting reactant.

   b. How many moles of excess reactant remain?

   c. How many moles of the product are formed?

2. Carbon reacts with steam, H_2O, at high temperatures to produce hydrogen and carbon monoxide.

   a. If 2.40 mol of carbon are exposed to 3.10 mol of steam, identify the limiting reactant.

   b. How many moles of each product are formed?

   c. What mass of each product is formed?

CHEMISTRY INTERACTIVE TUTOR

Module 5: Equations and Stoichiometry

extension
Go to **go.hrw.com** for more practice problems that ask you to calculate the amount of excess reactant and the amount of product formed.

Keyword: HC6STCX