Name: _____

Skill Sheet 20-B Predicting Product in a Reaction

A balanced chemical equation tells you the *proportional* relationship between the reactants and the products in a reaction. This means that you can use the information provided in a balanced chemical equation to predict how much product will be formed in a reaction, given the mass of the *limiting reactant* (the one that reacts completely).

1. Proportional relationships in balanced, chemical equations

In the Investigations, you discovered an important mathematical relationship that allows you to predict the amount of a product produced in a reaction.

$$\frac{\text{mass of limiting reactant (LR)}}{\text{coefficient of LR} \times \text{formula mass of LR}} = \frac{\text{mass of product (P)}}{\text{coefficient of P} \times \text{formula mass of P}}$$

You can use this relationship to predict the amount of one of the products produced in a reaction, when you know the amount of the limiting reactant that was used up in the reaction.

2. Predicting the amount of product formed: a step-by-step approach

Coal gasification is a process that converts coal into methane gas, the substance that is often used to heat homes and cook food. This process involves a reaction between the carbon found in coal, and water to produce methane gas (CH_4), and carbon dioxide. *If 50.0 g of carbon react completely with water, how many grams of methane gas will be produced*?

Step 1: Write and balance the equation.

Word equation: carbon + water → methane + carbon dioxide.

Unbalanced equation: $C(s) + H_2O(l) \rightarrow CH_4(g) + CO_2(g)$

Balanced equation: $2C(s) + 2H_2O(l) \rightarrow CH_4(g) + CO_2(g)$

Step 2: What do you know? What do you need to find out?

Look at the equation in part 1. Which variables in the equation do you know? Which variable are you solving for?

limiting reactant	product
mass (from problem) = 50.0 g	**mass = need to find out (X)**
coefficient (from bal. equation) = 2	**coefficient = 1**
formula mass of C = 12.0 amu	**formula mass of CH_4 = 16.0 amu**

Step 3: Set up the proportional relationship and solve.

$$\left(\frac{50.0\ g}{2 \times 12.0\ amu} = \frac{X}{1 \times 16.0\ amu}\right) = \left(\frac{50.0\ g}{24.0\ amu} = \frac{X}{16.0\ amu}\right)$$

$$X = \left(\frac{50.0\ g \times 16.0\ amu}{24.0\ amu}\right) = 33.3\ g \text{ of methane gas will be produced}$$

3. Practice

Now try one on your own:

Oxygen gas can be produced by the decomposition of potassium chlorate ($KClO_3$). Another product in this reaction is potassium chloride. How many grams of oxygen gas can be produced by decomposing 150.0 grams of potassium chlorate?

1. Write the balanced equation for the reaction:

2. What do you know? What do you need to find out? Fill out the table below:

limiting reactant	product
mass:	**mass:**
coefficient:	**coefficient:**
formula mass:	**formula mass:**

3. Set up the proportional relationship and solve.

4. More practice on your own

1. When methane gas burns in oxygen gas, carbon dioxide and water are produced. If 85.0 grams of methane burn completely in oxygen gas, how many grams of carbon dioxide will be produced?

---

2. In the space shuttle, the carbon dioxide that the astronauts exhale is removed from the air by a reaction that occurs inside canisters of lithium hydroxide. The products of the reaction are lithium carbonate and water. If the crew on the space shuttle exhales 3,000 grams of carbon dioxide in one day, and all of it reacts with the lithium hydroxide, how many grams of water will be produced?

Use the space below to show your work for the practice problems: