

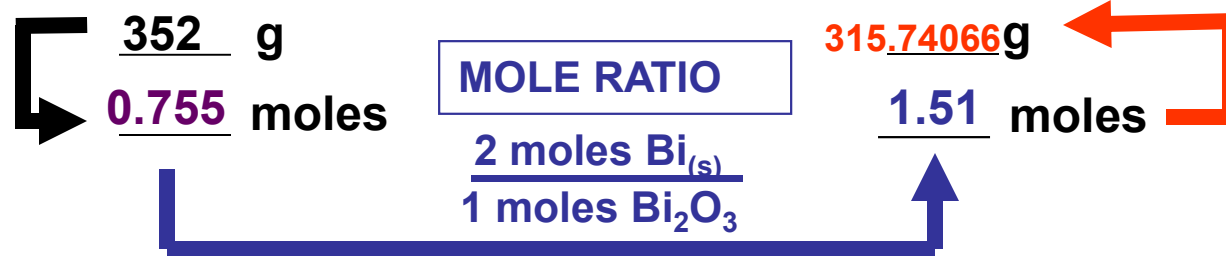
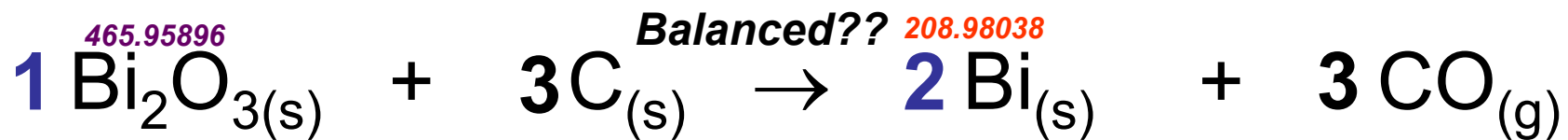
Chemical Equations: Calculations

3.62 Bismuth oxide reacts with carbon to form bismuth metal and carbon monoxide gas:

When 352 g of Bi_2O_3 reacts with excess carbon,

(a) how many moles of Bi_2O_3 react? 0.755 moles Bi_2O_3

(b) How many moles of Bi form? 316 grams Bi



$$\frac{352 \text{ g Bi}_2\text{O}_3}{1} \times \frac{1 \text{ mole Bi}_2\text{O}_3}{465.95896 \text{ g Bi}_2\text{O}_3} \times \frac{2 \text{ moles Bi}_{(s)}}{1 \text{ moles Bi}_2\text{O}_3} \times \frac{208.98038 \text{ g Bi}}{1 \text{ mole Bi}} \quad \text{💡}$$



Chemical Equations: Excess and Limiting reactants

In the Kitchen.... **INGREDIENTS:**

Excess Reactants	5 cups	4 1/2 cups all-purpose flour
	10 teaspoons	2 teaspoons <u>baking</u> soda
	3 cups	2 cups butter, softened
	2 cups	1 1/2 cups packed brown sugar
	3 cups	1/2 cup white sugar
Limiting Reactant	1 <u>package</u>	2 (3.4 ounce) packages instant vanilla pudding mix
Excess Reactants	5 eggs	4 <u>eggs</u>
	10 teaspoons	2 teaspoons vanilla extract
	5 cups	4 cups semisweet chocolate chips
	3 cups	2 cups chopped walnuts (optional)



Chemical Equations: Excess and Limiting reactants

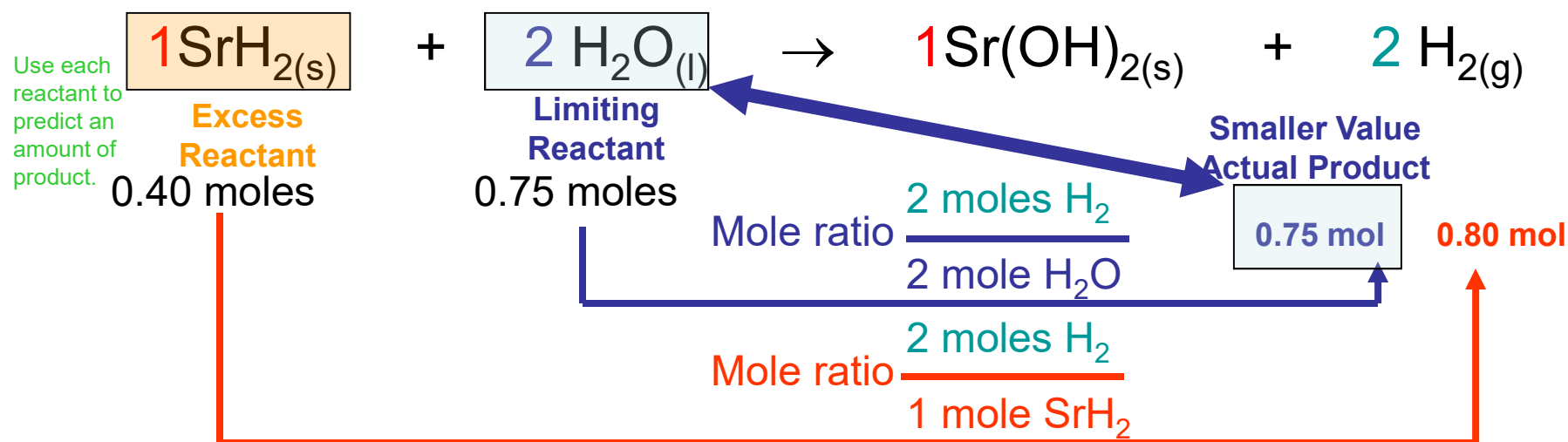
- **Excess Reactants:**
 - Reactants that are not used up during the chemical reaction
 - At the end of the reaction, there is leftover Excess Reactant
- **Limiting Reactants:**
 - Reactants that are used up completely during the chemical reaction.
 - Limiting reactants determine the amount of product that can form.



Chemical Equations:

Identifying Excess and Limiting reactants

Problem 3.72: SrH_2 reacts with water according to the following *balanced* chemical equation. How many moles of H_2 will be formed when **0.40 moles of SrH_2** react with **0.75 moles of H_2O** ?



Calculate Product using SrH_2

$$\frac{0.40 \text{ moles SrH}_2}{1} \times \frac{2 \text{ moles H}_2}{1 \text{ mole SrH}_2} = 0.80 \text{ moles H}_2$$

Calculate Product using H_2O

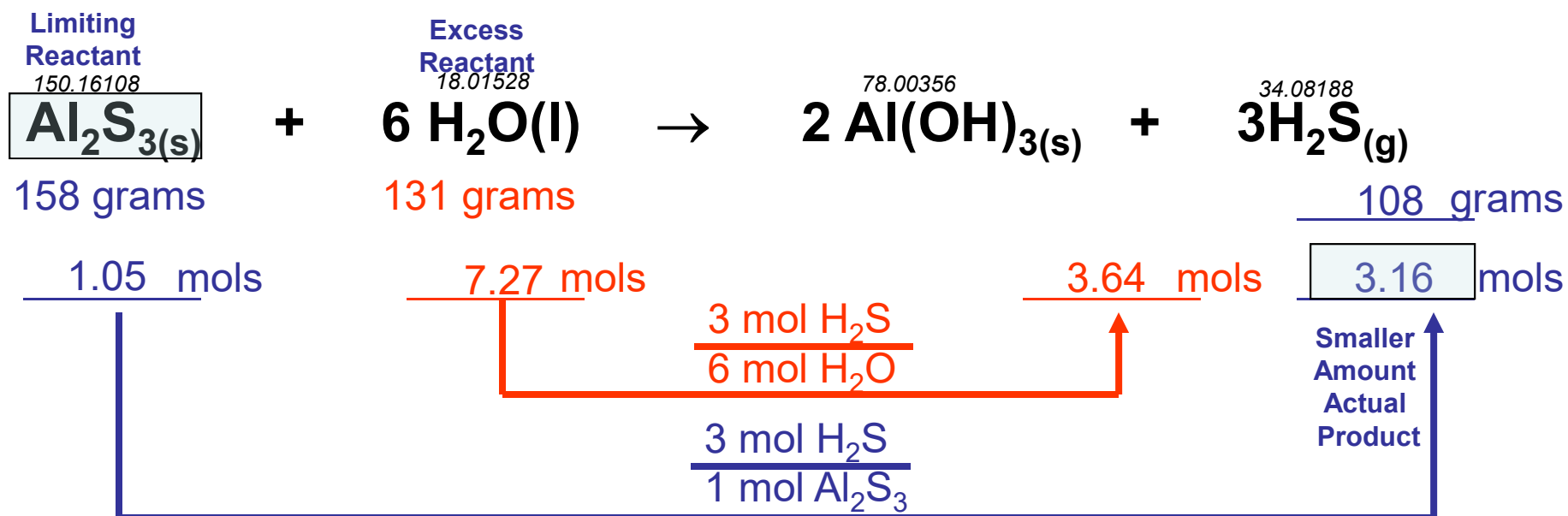
$$\frac{0.75 \text{ moles H}_2\text{O}}{2} \times \frac{2 \text{ moles H}_2}{1 \text{ mole SrH}_2} = 0.75 \text{ moles H}_2$$



Chemical Equations:

Calculations with Excess and Limiting reactants

3.74 Given the following balanced chemical equation determine how many grams of di-hydrogen sulfide can be formed from 158 grams of aluminum sulfide and 131 grams of liquid water.



$$\frac{158 \text{ g Al}_2\text{S}_3}{1} \times \frac{1 \text{ mol Al}_2\text{S}_3}{150.16108 \text{ g Al}_2\text{S}_3} \times \frac{3 \text{ mol H}_2\text{S}}{1 \text{ mol Al}_2\text{S}_3} \times \frac{34.08188 \text{ g H}_2\text{S}}{1 \text{ mol H}_2\text{S}} = 107.5832108 \text{ g}$$

$$\frac{131 \text{ g H}_2\text{O}}{1} \times \frac{1 \text{ mol H}_2\text{O}}{18.01528 \text{ g H}_2\text{O}} \times \frac{3 \text{ mol H}_2\text{S}}{6 \text{ mol H}_2\text{O}}$$



Chemical Yields

Theoretical Yield: Predicted via limiting reactant

Actual Yield: The mass of product produced in an experiment
Is usually lower than the theoretical yield

$$\textbf{\underline{Percent Yield}} = \frac{\textbf{Actual Yield}}{\textbf{Theoretical Yield}} \times 100$$

If in the previous example, 101 grams of product were actually collected, calculate the percent yield:

$$\textbf{Percent Yield} = \frac{\textbf{101. grams}}{\textbf{107.5832108 g}} \times 100 = \textbf{93.9 \%}$$

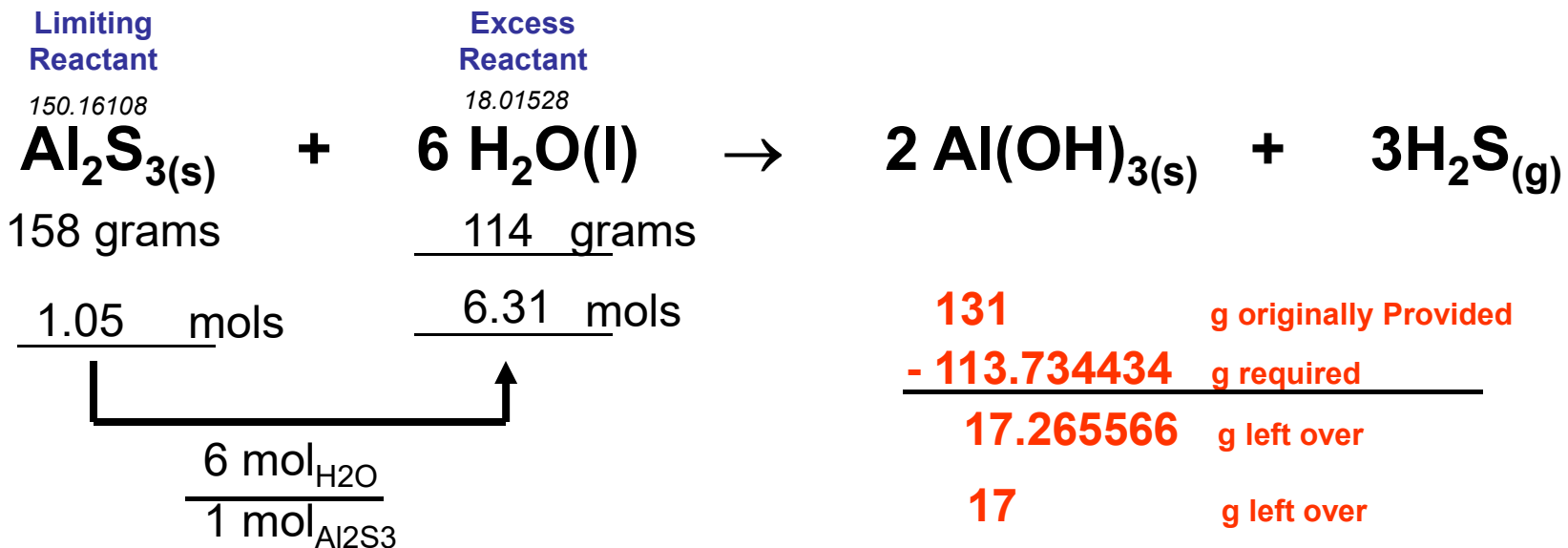


Chemical Equations:

Calculations with Excess and Limiting reactants

3.74 How many grams of excess reactant is left?

1. Identify limiting and excess reactants
2. Use limiting reactant to predict how much excess reactant is required.
3. Subtract the required excess reactant from the amount originally provided



$$\frac{158 \text{ grams}}{1} \times \frac{1 \text{ mol Al}_2\text{S}_3}{150.16108 \text{ g Al}_2\text{S}_3} \times \frac{6 \text{ mol H}_2\text{O}}{1 \text{ mol Al}_2\text{S}_3} \times \frac{18.01528 \text{ H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 113.734434 \text{ g}$$



Example Problem

3.72 Metal hydrides react with water to form hydrogen gas and the metal hydroxide. For example:



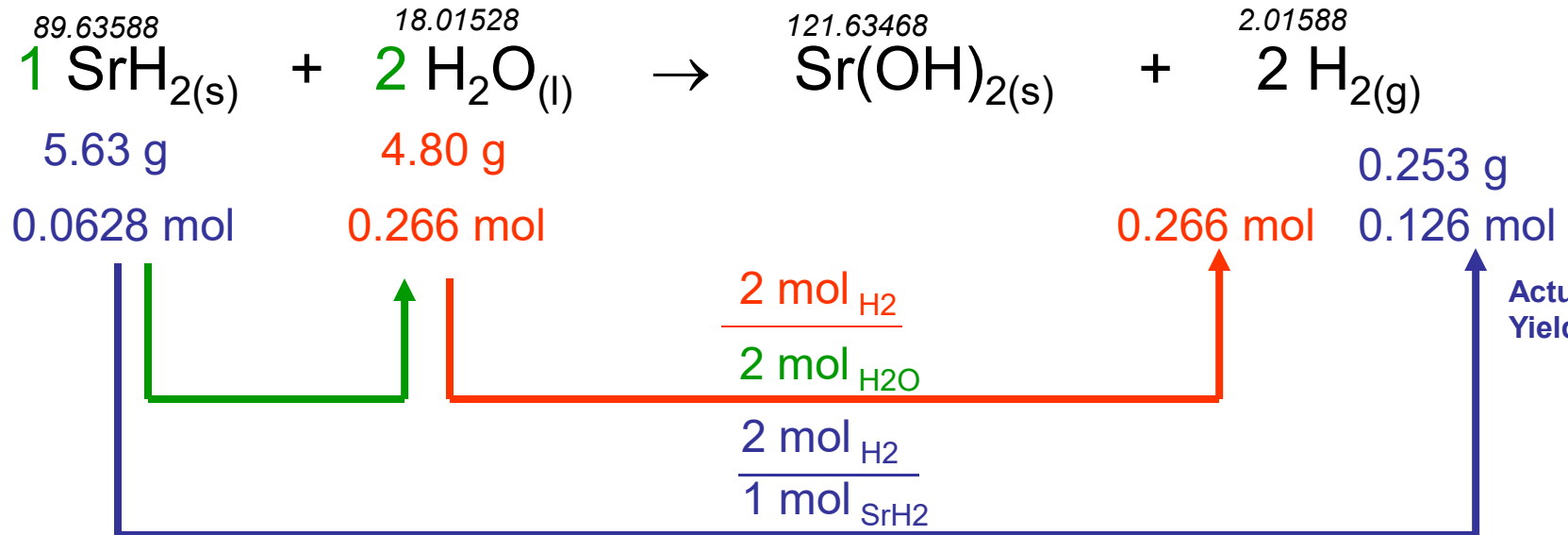
You wish to calculate the mass of hydrogen gas that can be prepared from 5.63 g of SrH₂ and 4.80 g of H₂O.

1. Identify the limiting and excess reactants.
2. Calculate the mass of H_{2(g)} that can be produced.
3. How many grams of excess reactant is left over at the end of the reaction.



Example Problem

Limiting
Reactant



Leftovers...

$$\frac{5.63 \text{ g SrH}_2}{1} \times \frac{1 \text{ mol SrH}_2}{89.63588 \text{ g SrH}_2} \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol SrH}_2} \times \frac{18.01528 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 2.2630676 \text{ g H}_2\text{O}$$

$$4.80 \text{ g H}_2\text{O (given)} - 2.2630676 \text{ g H}_2\text{O (required)} = 2.54 \text{ g left over H}_2\text{O}$$

