LESSON MAKER PRO

Reaction Math Lab

Use balanced equations to predict products and check yields.

HIGH SCHOOL · CHE.6

CHE.6 "Students will demonstrate an understanding of the types, causes, and effects of chemical reactions. Develop and use models to predict the products of chemical reactions (e.g., synthesis reactions; single replacement; double displacement..."

NAME _____ **DATE** _____

FOLLOW THE RATIO

The coefficients in a balanced equation show the ratio of particles or moles that react. If one reactant runs out first, it limits how much product can form. Percent yield = actual yield / theoretical yield × 100%.

WORKED EXAMPLE

For $2\ H_2 + O_2 \rightarrow 2\ H_2O$, you have 11 mol H_2 and 8 mol O_2. Which reactant limits the reaction, and how many moles of water can form?

1. 8 mol O_2 could react with 16 mol H_2.
2. Only 11 mol H_2 is available, so H_2 runs out first.
3. The H_2-to-H_2O ratio is 2:2, so 11 mol H_2 forms 11 mol H_2O.

Answer: H_2 is limiting; 11 mol H_2O can form.

PRACTICE 6 problems

1 For $2\ H_2 + O_2 \rightarrow 2\ H_2O$, how many moles of water can form from 4 mol H_2 and 3 mol O_2?

ANSWER _____

2 For $N_2 + 3\ H_2 \rightarrow 2\ NH_3$, you have 2 mol N_2 and 3 mol H_2. Which reactant limits the reaction, and how many moles of NH_3 can form?

ANSWER _____

3 For $2\ Mg + O_2 \rightarrow 2\ MgO$, you have 6 mol Mg and 2 mol O_2. How many moles of MgO can form, and how many moles of Mg remain?

ANSWER _____

4 For $2\ CO + O_2 \rightarrow 2\ CO_2$, 10 molecules of CO react with 3 molecules of O_2. How many molecules of CO_2 form, and how many molecules of CO remain?

ANSWER _____

5 For $2\ Mg + O_2 \rightarrow 2\ MgO$, 48 g Mg reacts completely with 32 g O_2. What mass of MgO forms?

ANSWER _____

6 A reaction could produce 40 g of a product, but only 30 g is collected. What is the percent yield?

ANSWER _____

APPLY IT Show your work

1 A hydrogen-powered racing drone uses $2\ H_2 + O_2 \rightarrow 2\ H_2O$. Its fuel system starts with 14 mol H_2 and 10 mol O_2. How many moles of water can form, and how many moles of O_2 remain?

WORK SPACE

ANSWER _____

2 A baker heats 0.20 mol of baking soda. The reaction is $2\ NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$. If the baker collects 0.08 mol CO_2, what is the percent yield of collected CO_2?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A company makes an aluminum oxide coating using $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$. It starts with 12 mol Al and 6 mol O_2, then collects 3 mol Al_2O_3. Which reactant is limiting? Find the theoretical yield of Al_2O_3, the percent yield of collected product, and the moles of Al left if all the O_2 reacts.

WORK SPACE AND ANSWER

Reaction Math Lab

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	For $2\ H_2 + O_2 \rightarrow 2\ H_2O$, how many moles of water can form from 4 mol H_2 and 3 mol O_2?	**4 mol H_2O**
2	For $N_2 + 3\ H_2 \rightarrow 2\ NH_3$, you have 2 mol N_2 and 3 mol H_2. Which reactant limits the reaction, and how many moles of NH_3 can form?	**H_2 is limiting; 2 mol NH_3 can form.**
3	For $2\ Mg + O_2 \rightarrow 2\ MgO$, you have 6 mol Mg and 2 mol O_2. How many moles of MgO can form, and how many moles of Mg remain?	**4 mol MgO can form; 2 mol Mg remain.**
4	For $2\ CO + O_2 \rightarrow 2\ CO_2$, 10 molecules of CO react with 3 molecules of O_2. How many molecules of CO_2 form, and how many molecules of CO remain?	**6 molecules of CO_2 form; 4 molecules of CO remain.**
5	For $2\ Mg + O_2 \rightarrow 2\ MgO$, 48 g Mg reacts completely with 32 g O_2. What mass of MgO forms?	**80 g MgO**
6	A reaction could produce 40 g of a product, but only 30 g is collected. What is the percent yield?	**75%**

PART 2 · APPLY IT

1. **14 mol H_2O can form; 3 mol O_2 remain.** The 14 mol H_2 requires 7 mol O_2 and produces 14 mol H_2O. Subtract 7 mol from the 10 mol O_2 available.
2. **80%** The theoretical yield is 0.10 mol CO_2. Divide 0.08 by 0.10 and multiply by 100%.

CHALLENGE

O_2 is limiting. The theoretical yield is 4 mol Al_2O_3; the percent yield is 75%; 4 mol Al remain.

Accept equivalent ratio calculations. In the challenge, the percent yield compares product collected with the theoretical yield, while the remaining aluminum assumes all oxygen reacts.