

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## CHAPTER 12

## STUDY GUIDE FOR CONTENT MASTERY

## Section 12.3 Limiting Reactants

In your textbook, read about why reactions stop and how to determine the limiting reactants.

Study the diagram showing a chemical reaction and the chemical equation that represents the reaction. Then complete the table. Show your calculations for questions 15–17 in the space below the table.



$$\text{O}_2 = 32\text{ g} = 32\text{ g}$$

The molar masses of  $\text{Cl}_2$ ,  $\text{NO}_2$ , and  $\text{NO}_3$  are 71.00 g/mol, 63.01 g/mol, and 83.01 g/mol, respectively.

Amount of $\text{Cl}_2$	Amount of $\text{NO}_2$	Amount of $\text{NO}_3$	Identifying Reactant	Amount and Name of Limiting Reactant
1 molecule	1 molecule	1 molecule	none	none
4 molecules	4 molecules	4 molecules	$\text{NO}_2$	4 molecules $\text{NO}_2$
7 molecules	8 molecules	6 molecules	$\text{O}_3$	6 molecules $\text{NO}_2$
1.00 mol	1.00 mol	1.00 mol	$\text{NO}_2$	1.00 mol $\text{NO}_2$
1.00 mol	0.50 mol	1.00 mol	$\text{NO}_2$	0.50 mol $\text{O}_3$
1.00 mol	0.00 mol	1.00 mol	$\text{NO}_2$	1.00 mol $\text{O}_3$
1.00 mol	0.00 mol	1.00 mol	$\text{O}_3$	1.00 mol $\text{NO}_2$
0.000 mol	0.000 mol	1.00 mol	$\text{NO}_2$	0.000 mol $\text{O}_3$
10.00 g	10.00 g	10.00 g	$\text{NO}_2$	10.00 g $\text{NO}_2$
10.00 g	10.00 g	10.00 g	$\text{O}_3$	10.00 g $\text{NO}_2$
10.00 g	10.00 g	20.76 g	$\text{O}_3$	10.00 g $\text{NO}_2$

balanced equation mole ratio = 2 mol  $\text{NO}_2$ /1 mol  $\text{O}_3$

$$10.00 \text{ g } \text{O}_3 \times 1 \text{ mol } \text{O}_3/32.00 \text{ g-} \text{O}_3 = 0.3125 \text{ mol } \text{O}_3$$

$$20.76 \text{ g } \text{NO}_2 \times 1 \text{ mol } \text{NO}_2/46.01 \text{ g-} \text{NO}_2 = 0.4464 \text{ mol } \text{NO}_2$$

actual mole ratio = 0.4464 mol  $\text{NO}_2$ /0.3125 mol  $\text{O}_3$  = 2.132 mol  $\text{NO}_2$ /1.000 mol  $\text{O}_3$

Because the actual mole ratio of  $\text{NO}_2$ : $\text{O}_3$  is larger than the balanced equation mole ratio of  $\text{NO}_2$ : $\text{O}_3$ , there is an excess of  $\text{NO}_2$ ;  $\text{O}_3$  is the limiting reactant.

Mass of  $\text{NO}_2$  used = 0.3125 mol  $\text{O}_3$  × 2 mol  $\text{NO}_2$ /1 mol  $\text{O}_3$  = 0.6250 mol  $\text{NO}_2$

$$0.6250 \text{ mol } \text{NO}_2 \times 46.01 \text{ g } \text{NO}_2/1 \text{ mol } \text{NO}_2 = 28.76 \text{ g } \text{NO}_2$$

Mass of  $\text{NO}_3$  produced = 0.6250 mol  $\text{NO}_2$  × 46.01 g  $\text{NO}_2$ /1 mol  $\text{NO}_2$  = 28.76 g  $\text{NO}_3$

Excess  $\text{NO}_2$  = 20.00 g  $\text{NO}_2$  – 10.00 g  $\text{NO}_2$  = 10.00 g  $\text{NO}_2$

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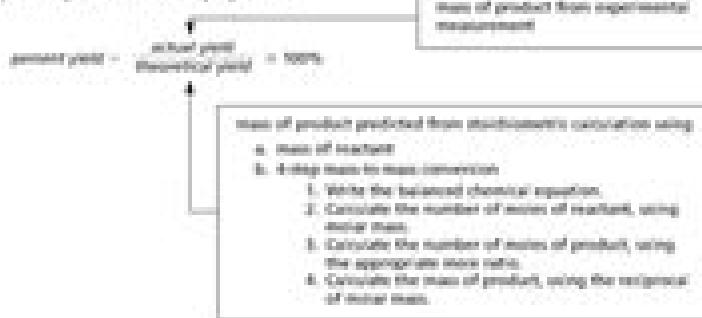
## CHAPTER 12

## STUDY GUIDE FOR CONTENT MASTERY

## Section 12.4 Percent Yield

In your textbook, read about the yields of products.

Study the diagram and the example problem.



**Example Problem:** The following chemical equation represents the production of palladium, a substance used in the manufacturing of some semiconductor devices.



In one experiment, the student yielded 7.47 g of the oxide from a 20.0-g sample of palladium. Determine the percent yield of this reaction. The molar masses of  $\text{KlO}_3$  and  $\text{Na}_2\text{PdCl}_4$  are 108.73 g/mol and 167.44 g/mol, respectively.

Use the information in the diagram and example problem to evaluate each value or expression below. If the value or expression is correct, write correct. If it is incorrect, write the correct value or expression.

- actual yield: **7.47 g  $\text{K}_2\text{PdCl}_6$**
- mass of reactant: **7.00 g  $\text{KlO}_3$  correct**
- number of moles of reactant: **7.00 \text{ g } \text{KlO}\_3 \times \frac{1 \text{ mol } \text{KlO}\_3}{108.73 \text{ g-} \text{KlO}\_3} = 0.0644 \text{ mol } \text{KlO}\_3**
- number of moles of product: **0.0644 \text{ mol } \text{KlO}\_3 \times \frac{1 \text{ mol } \text{K}\_2\text{PdCl}\_6}{1 \text{ mol } \text{KlO}\_3} = 0.0644 \text{ mol } \text{K}\_2\text{PdCl}\_6**
- theoretical yield: **0.0644 \text{ mol } \text{K}\_2\text{PdCl}\_6 \times \frac{167.44 \text{ g } \text{K}\_2\text{PdCl}\_6}{1 \text{ mol } \text{K}\_2\text{PdCl}\_6} = 10.74 \text{ g } \text{K}\_2\text{PdCl}\_6**
- percent yield:  **$\frac{7.47 \text{ g } \text{K}_2\text{PdCl}_6}{10.74 \text{ g } \text{K}_2\text{PdCl}_6} \times 100 = 70\%$**

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