

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 reactant.

Study the diagram showing a chemical reaction and the chemical equation that represents the reaction. Then complete the table. Show your calculations for questions 25–27 in the space below the table.



The molar masses of O_2 , NO , and NO_2 are 32.00 g/mol, 30.01 g/mol, and 46.01 g/mol, respectively.

Amount of O_2	Amount of NO	Amount of NO_2	Limiting Reactant	Amount and State of Excess Reactant
1 molecule	2 molecules	2 molecules	none	none
4 molecules	4 molecules	4 molecules	NO	2 molecules O_2
2 molecules	8 molecules	4 molecules	2. O_2	3. 4 molecules NO
1.00 mol	2.00 mol	4. 2.00 mol	5. none	6. none
4.00 mol	4.00 mol	7. 4.00 mol	8. NO	9. 2.00 mol O_2
1.00 mol	7.00 mol	10. 7.00 mol	11. NO	12. 1.50 mol O_2
1.00 mol	4.00 mol	13. 2.00 mol	14. O_2	15. 2.00 mol NO
0.500 mol	0.200 mol	16. 0.200 mol	17. NO	18. 0.400 mol O_2
32.00 g	60.02 g	19. 92.02 g	20. none	21. none
16.00 g	60.02 g	22. 46.01 g	23. O_2	24. 58.12 g NO
16.00 g	20.00 g	25. 28.76 g	26. O_2	27. 1.24 g NO

balanced equation mole ratio = 2 mol NO /1 mol O_2

$16.00 \text{ g } O_2 \times 1 \text{ mol } O_2 / 32.00 \text{ g } O_2 = 0.5125 \text{ mol } O_2$

$20.00 \text{ g } NO \times 1 \text{ mol } NO / 30.01 \text{ g } NO = 0.6664 \text{ mol } NO$

actual mole ratio = $0.6664 \text{ mol } NO / 0.5125 \text{ mol } O_2 = 2.132 \text{ mol } NO / 1.000 \text{ mol } O_2$

Because the actual mole ratio of NO : O_2 is larger than the balanced equation mole ratio of NO : O_2 , there is an excess of NO ; O_2 is the limiting reactant.

Mass of NO used = $0.5125 \text{ mol } O_2 \times 2 \text{ mol } NO / 1 \text{ mol } O_2 = 0.4250 \text{ mol } NO$

$0.4250 \text{ mol } NO \times 30.01 \text{ g } NO / 1 \text{ mol } NO = 12.76 \text{ g } NO$

Mass of NO_2 produced = $0.4250 \text{ mol } NO \times 46.01 \text{ g } NO_2 / 30.01 \text{ g } NO = 6.51 \text{ g } NO_2$

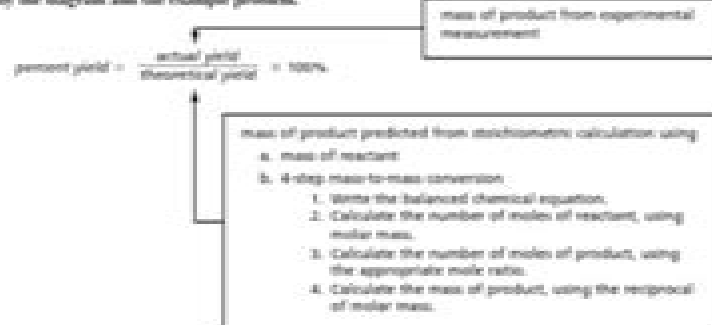
Excess $NO = 20.00 \text{ g } NO - 12.76 \text{ g } NO = 7.24 \text{ g } NO$

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Section 12.4 Percent Yield

In your textbook, read about the yield of products.

Study the diagram and the example problem.



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



In one experiment, the reaction yielded 7.42 g of the oxide from a 7.00-g sample of gallium. Determine the percent yield of this reaction. The molar masses of Ga and Ga_2O_3 are 69.72 g/mol and 187.44 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: unknown 7.42 g Ga_2O_3
- mass of reactant: 7.00 g Ga , correct
- number of moles of reactant: $7.00 \text{ g } Ga \times \frac{69.72 \text{ g } Ga}{1 \text{ mol } Ga}$ $7.00 \text{ g } Ga \times 1 \text{ mol } Ga / 69.72 \text{ g } Ga$
- number of moles of product: $0.100 \text{ mol } Ga \times \frac{2 \text{ mol } Ga_2O_3}{1 \text{ mol } Ga}$ $0.100 \text{ mol } Ga \times \frac{2 \text{ mol } Ga_2O_3}{4 \text{ mol } Ga}$
- theoretical yield: $0.100 \text{ mol } Ga_2O_3 \times \frac{187.44 \text{ g } Ga_2O_3}{1 \text{ mol } Ga_2O_3}$ correct
- percent yield: $\frac{9.37 \text{ g } Ga_2O_3}{7.42 \text{ g } Ga_2O_3} \times 100$ $7.42 \text{ g } Ga_2O_3 / 9.37 \text{ g } Ga_2O_3 \times 100$

Limiting Reactants Study Guide

Leo J. Malone, Theodore O. Dolter



Limiting Reactants Study Guide:

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