

CHAPTER 9 REVIEW*Stoichiometry***SECTION 1****SHORT ANSWER** Answer the following questions in the space provided.

1. b The coefficients in a chemical equation represent the
- (a) masses in grams of all reactants and products.
 - (b) relative number of moles of reactants and products.
 - (c) number of atoms of each element in each compound in a reaction.
 - (d) number of valence electrons involved in a reaction.
2. d Which of the following would not be studied within the topic of stoichiometry?
- (a) the mole ratio of Al to Cl in the compound aluminum chloride
 - (b) the mass of carbon produced when a known mass of sucrose decomposes
 - (c) the number of moles of hydrogen that will react with a known quantity of oxygen
 - (d) the amount of energy required to break the ionic bonds in CaF_2
3. a A balanced chemical equation allows you to determine the
- (a) mole ratio of any two substances in the reaction.
 - (b) energy released in the reaction.
 - (c) electron configuration of all elements in the reaction.
 - (d) reaction mechanism involved in the reaction.
4. c The relative number of moles of hydrogen to moles of oxygen that react to form water represents a(n)
- (a) reaction sequence.
 - (b) bond energy.
 - (c) mole ratio.
 - (d) element proportion.
5. Given the reaction represented by the following unbalanced equation: $\text{N}_2\text{O}(g) + \text{O}_2(g) \rightarrow \text{NO}_2(g)$
- a. Balance the equation.
- $$\underline{2\text{N}_2\text{O}(g) + 3\text{O}_2(g) \rightarrow 4\text{NO}_2(g)}$$
-
- 4 mol NO₂:3 mol O₂ b. What is the mole ratio of NO₂ to O₂?
- 15.0 mol c. If 20.0 mol of NO₂ form, how many moles of O₂ must have been consumed?
- True d. Twice as many moles of NO₂ form as moles of N₂O are consumed. True or False?
- False e. Twice as many grams of NO₂ form as grams of N₂O are consumed. True or False?

SECTION 1 continued**PROBLEMS** Write the answer on the line to the left. Show all your work in the space provided.

6. Given the following equation:
- $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)$

28.0 g/mol N₂

- a. Determine to one decimal place the molar mass of each substance and express each mass in grams per mole.

2.0 g/mol H₂17.0 g/mol NH₃

- b. There are six different mole ratios in this system. Write out each one.

3 mol H₂:1 mol N₂; 2 mol NH₃:1 mol N₂; 2 mol NH₃:3 mol H₂; or their reciprocals

7. Given the following equation:
- $4\text{NH}_3(g) + 6\text{NO}(g) \rightarrow 5\text{N}_2(g) + 6\text{H}_2\text{O}(g)$

1 mol NO:1 mol H₂O

- a. What is the mole ratio of NO to H
- ₂
- O?

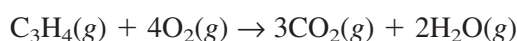
3 mol NO:2 mol NH₃

- b. What is the mole ratio of NO to NH
- ₃
- ?

0.360 mol

- c. If 0.240 mol of NH
- ₃
- react according to the above equation, how many moles of NO will be consumed?

8. Propyne gas can be used as a fuel. The combustion reaction of propyne can be represented by the following equation:



- a. Write all the possible mole ratios in this system.

4 mol O₂:1 mol C₃H₄; 3 mol CO₂:1 mol C₃H₄; 2 mol H₂O:1 mol C₃H₄;3 mol CO₂:4 mol O₂; 2 mol H₂O:4 mol O₂; 2 mol H₂O:3 mol CO₂;or their reciprocals

- b. Suppose that
- x
- moles of water form in the above reaction. The other three mole quantities (
- not*
- in order) are
- $2x$
- ,
- $1.5x$
- , and
- $0.5x$
- . Match these quantities to their respective components in the equation above.

C₃H₄ is 0.5x; O₂ is 2x; and CO₂ is 1.5x

CHAPTER 9 REVIEW*Stoichiometry***SECTION 2**

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

1. 4.5 mol The following equation represents a laboratory preparation for oxygen gas:
$$2\text{KClO}_3(s) \rightarrow 2\text{KCl}(s) + 3\text{O}_2(g)$$

How many moles of O_2 form if 3.0 mol of KClO_3 are totally consumed?
2. 200 g Given the following equation: $\text{H}_2(g) + \text{F}_2(g) \rightarrow 2\text{HF}(g)$
How many grams of HF gas are produced as 5 mol of fluorine react?
3. 0.53 g Water can be made to decompose into its elements by using electricity according to the following equation:
$$2\text{H}_2\text{O}(l) \rightarrow 2\text{H}_2(g) + \text{O}_2(g)$$

How many grams of O_2 are produced when 0.033 mol of water decompose?
4. 34.8 g Sodium metal reacts with water to produce NaOH according to the following equation:
$$2\text{Na}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$$

How many grams of NaOH are produced if 20.0 g of sodium metal react with excess oxygen?

SECTION 2 continued

5. 60.2 g a. What mass of oxygen gas is produced if 100. g of lithium perchlorate are heated and allowed to decompose according to the following equation?



- 42.1 L b. The oxygen gas produced in part a has a density of 1.43 g/L. Calculate the volume of this gas.

6. A car air bag requires 70. L of nitrogen gas to inflate properly. The following equation represents the production of nitrogen gas:



- 81 g a. The density of nitrogen gas is typically 1.16 g/L at room temperature. Calculate the number of grams of N_2 that are needed to inflate the air bag.

- 2.9 mol b. Calculate the number of moles of N_2 that are needed.

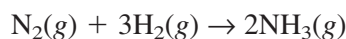
- 1.3×10^2 g c. Calculate the number of grams of NaN_3 that must be used to generate the amount of N_2 necessary to properly inflate the air bag.

CHAPTER 9 REVIEW*Stoichiometry***SECTION 3**

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

1. 88% The actual yield of a reaction is 22 g and the theoretical yield is 25 g. Calculate the percentage yield.

2. 6.0 mol of N₂ are mixed with 12.0 mol of H₂ according to the following equation:

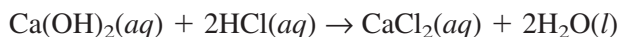


- N₂; 2.0 mol a. Which chemical is in excess? What is the excess in moles?

- 8.0 mol b. Theoretically, how many moles of NH₃ will be produced?

- 6.4 mol c. If the percentage yield of NH₃ is 80%, how many moles of NH₃ are actually produced?

3. 0.050 mol of Ca(OH)₂ are combined with 0.080 mol of HCl according to the following equation:



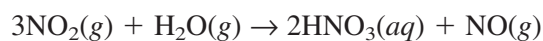
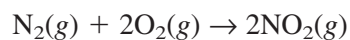
- 0.10 mol a. How many moles of HCl are required to neutralize all 0.050 mol of Ca(OH)₂?

SECTION 3 continued

_____ **HCl** _____ **b.** What is the limiting reactant in this neutralization reaction?

_____ **1.4 g** _____ **c.** How many grams of water will form in this reaction?

- 4.** Acid rain can form in a two-step process, producing $\text{HNO}_3(aq)$.



_____ **1.26×10^3 g** _____ **a.** A car burns 420. g of N_2 according to the above equations. How many grams of HNO_3 will be produced?

_____ **960. g** _____ **b.** For the above reactions to occur, O_2 must be in excess in the first step. What is the minimum amount of O_2 needed in grams?

_____ **6.9×10^2 L** _____ **c.** What volume does the amount of O_2 in part **b** occupy if its density is 1.4 g/L?

CHAPTER 9 REVIEW*Stoichiometry***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. Given the following equation:
- $C_3H_4(g) + xO_2(g) \rightarrow 3CO_2(g) + 2H_2O(g)$

4 a. What is the value of the coefficient x in this equation?40.07 g/mol b. What is the molar mass of C_3H_4 ?2 mol O_2 :1 mol H_2O c. What is the mole ratio of O_2 to H_2O in the above equation?0.20 mol d. How many moles are in an 8.0 g sample of C_3H_4 ?3z e. If z mol of C_3H_4 react, how many moles of CO_2 are produced, in terms of z ?

2. a. What is meant by
- ideal conditions*
- relative to stoichiometric calculations?

The limiting reactant is completely converted to product with no losses, as dictated by the ratio of coefficients.

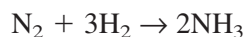
- b. What function do ideal stoichiometric calculations serve?

They determine the theoretical yield of the products of the reaction.

- c. Are actual yields typically larger or smaller than theoretical yields?

smaller**PROBLEMS** Write the answer on the line to the left. Show all your work in the space provided.

3. Assume the reaction represented by the following equation goes all the way to completion:

4 mol a. If 6 mol of H_2 are consumed, how many moles of NH_3 are produced?8.5 g b. How many grams are in a sample of NH_3 that contains 3.0×10^{23} molecules?

MIXED REVIEW continued

- c. If 0.1 mol of N₂ combine with H₂, what must be true about the quantity of H₂ for N₂ to be the limiting reactant?

At least 0.3 mol of H₂ must be provided.

4. 75% If a reaction's theoretical yield is 8.0 g and the actual yield is 6.0 g, what is the percentage yield?

5. Joseph Priestley generated oxygen gas by strongly heating mercury(II) oxide according to the following equation:



0.0693 mol

- a. If 15.0 g HgO decompose, how many moles of HgO does this represent?

0.0346 mol

- b. How many moles of O₂ are theoretically produced?

1.11 g

- c. How many grams of O₂ is this?

0.786 L

- d. If the density of O₂ gas is 1.41 g/L, how many liters of O₂ are produced?

1.05 g

- e. If the percentage yield is 95.0%, how many grams of O₂ are actually collected?