

# **Chemical Reactions and Stoichiometry**

### UNIT 3: Chemical Reactions and Quantities in Chemistry

*All important vocabulary is in Italics and bold.*

- Write formulas and names for *polyatomic compounds*.
- Write and classify balanced chemical equations from written descriptions of reactions.  
*Include: polyatomic ions*
- Predict the products of chemical reactions, given the reactants and type of reaction. *Include: polyatomic ions*
- Describe the concept of the *mole* and its importance to measurement in chemistry.
- Calculate the mass of compounds in atomic mass units.
- Calculate the *molar mass* of various substances.
- Calculate the volume of a given mass of a gaseous substance from its density at a given temperature and pressure.  
*Include: molar volume calculation*
- Solve problems requiring interconversions between moles, mass, volume, and number of particles.
- Interpret a balanced equation in terms of moles, mass, and volumes of gases.
- Solve *stoichiometric* problems involving moles, mass, and volume, given a balanced chemical reaction.
- Identify the *limiting reactant* and calculate the mass of a product, given the reaction equation and reactant data.  
*Include: theoretical yield, experimental yield*

	<u>Additional KEY Terms</u>
Avogadro's number	STP
Stoichiometry	Molar ratio
Excess reactant	Actual yield

**For EACH Compound:**

- 1. Label if it is IONIC or COVALENT.**
- 2. Write the appropriate formula or name.**

Manganese(II) bromide	
P <sub>2</sub> O <sub>3</sub>	

CF <sub>4</sub>	
Nitrogen dioxide	

Co <sub>2</sub> O <sub>3</sub>	
H <sub>2</sub> S	
Potassium phosphide	
Silicon disulfide	

Carbon tetraiodide	
CaO	
CBr <sub>4</sub>	
N <sub>2</sub> O <sub>4</sub>	

Magnesium nitride	
Carbon tetrafluoride	
Phosphorus pentasulfide	
Aluminum chloride	
HF	
Tin (IV) nitride	
Bismuth(V) fluoride	

OI <sub>2</sub>	
Al <sub>2</sub> O <sub>3</sub>	
Lead(IV) oxide	

Ba <sub>3</sub> N <sub>2</sub>	
Iron(III) chloride	
Cr <sub>2</sub> S <sub>3</sub>	
Pb <sub>3</sub> N <sub>2</sub>	
Lithium sulfide	
CuI	
CuF <sub>2</sub>	
Ca(OH) <sub>2</sub>	

1. Give one difference between an ionic compound and a covalent compounds.
2. Give one difference in naming ionic versus covalent compounds.
3. When and why do you use the brackets?

## POLYATOMIC IONS

<i>NAME</i>	<i>FORMULA</i>	<i>CHARGE</i>
ACETATE	CH <sub>3</sub> COO <sup>-</sup>	-1
AMMONIUM	NH <sub>4</sub> <sup>+</sup>	+1
HYDROGEN CARBONATE ( <i>BICARBONATE</i> )	HCO <sub>3</sub> <sup>-</sup>	-1
CARBONATE	CO <sub>3</sub> <sup>-2</sup>	-2
CHLORATE	ClO <sub>3</sub> <sup>-</sup>	-1
CHLORITE	ClO <sub>2</sub> <sup>-</sup>	-1
CHROMATE	CrO <sub>4</sub> <sup>-2</sup>	-2
DICHROMATE	Cr <sub>2</sub> O <sub>7</sub> <sup>-2</sup>	-2
DIHYDROGEN PHOSPHATE	H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>	-1
HYDROGEN PHOSPHATE	HPO <sub>4</sub> <sup>-2</sup>	-2
PHOSPHATE	PO <sub>4</sub> <sup>-3</sup>	-3
HYDROGEN SULFATE ( <i>BISULFATE</i> )	HSO <sub>4</sub> <sup>-</sup>	-1
SULFATE	SO <sub>4</sub> <sup>-2</sup>	-2
HYDROGEN SULFITE ( <i>BISULFITE</i> )	HSO <sub>3</sub> <sup>-</sup>	-1
SULFITE	SO <sub>3</sub> <sup>-2</sup>	-2
HYDRONIUM	H <sub>3</sub> O <sup>+</sup>	+1
HYDROXIDE	OH <sup>-</sup>	-1
PERCHLORATE	ClO <sub>4</sub> <sup>-</sup>	-1
HYPOCHLORITE	ClO <sup>-</sup> ( <i>OCl<sup>-</sup></i> )	-1
NITRATE	NO <sub>3</sub> <sup>-</sup>	-1
NITRITE	NO <sub>2</sub> <sup>-</sup>	-1
PERMANGANATE	MnO <sub>4</sub> <sup>-</sup>	-1
THIOCYANATE	SCN <sup>-</sup>	-1

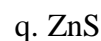
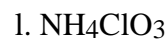
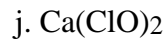
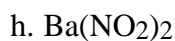
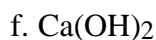
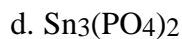
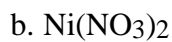
### Patterns for Naming Polyatomic Ions

'-ate' ending is the *general* (base) form. The ending changes depending on the number of oxygen atoms – notice the charge remains the same in these cases.

ClO <sub>3</sub> <sup>-</sup>	<b>chlorate</b>	<i>base</i> oxygen atoms
ClO <sub>4</sub> <sup>-</sup>	<b>perchlorate</b>	<i>base</i> + 1 oxygen atom
ClO <sub>2</sub> <sup>-</sup>	<b>chlorite</b>	<i>base</i> – 1 oxygen atom
ClO <sup>-</sup>	<b>hypochlorite</b>	<i>base</i> – 2 oxygen atoms

**Write the proper chemical names OR write the proper chemical formula for the following compounds:**

**1. Name each of the following.**



**2. Write the chemical formula of the following compounds.**

a. calcium sulfite

b. ammonium dichromate

c. potassium thiocyanate

d. cesium oxalate

e. bismuth (III) hydroxide

f. tin (IV) nitrate

j. iron (II) hydroxide

k. ammonium selenide

l. potassium permanganate

m. strontium hydrogen carbonate

n. manganese (VII) oxide

o. boron phosphide

g. chromium (III) sulfate

h. mercury (II) iodide

i. magnesium acetate

**3. Name each of the following**

a. O<sub>2</sub>

b. NO

c. CO<sub>2</sub>

d. NO<sub>2</sub>

e. PCl<sub>5</sub>

**4. Write the formula for each of the following.**

a. carbon tetrachloride

b. dichlorine monoxide

c. sulfur trioxide

d. ammonia

e. nitrogen gas

f. dinitrogen pentaoxide

p. calcium sulfate

q. rubidium perchlorate

r. cadmium nitrate

f. CCl<sub>4</sub>

g. NH<sub>3</sub>

h. P<sub>3</sub>N<sub>5</sub>

i. N<sub>2</sub>O

j. NF<sub>3</sub>

g. chlorine gas

h. nitrogen dioxide

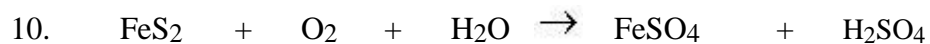
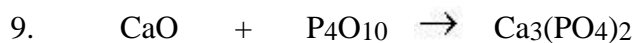
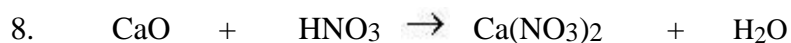
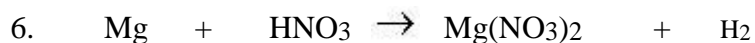
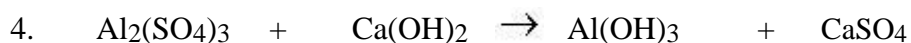
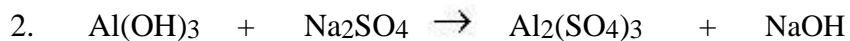
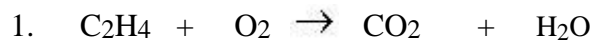
i. diphosphorous decaoxide

j. bromine pentafluoride

k. phosphorous tribromide

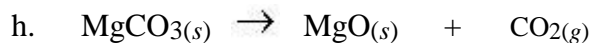
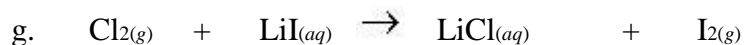
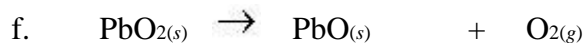
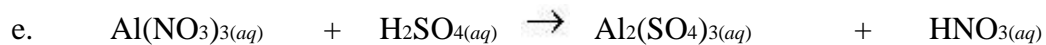
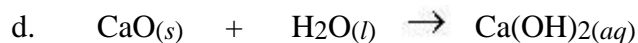
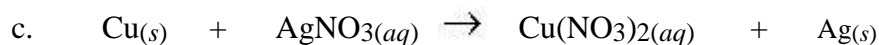
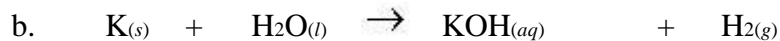
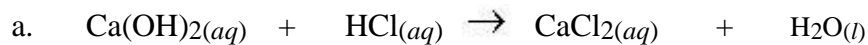
l. dinitrogen trichloride

**Balance the following chemical reactions:**

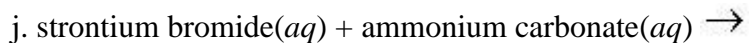
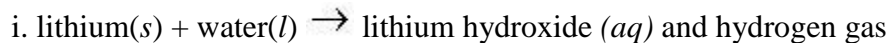
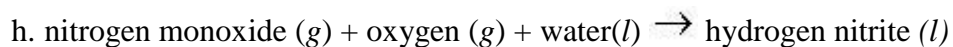
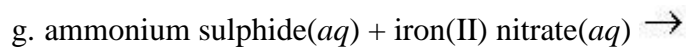
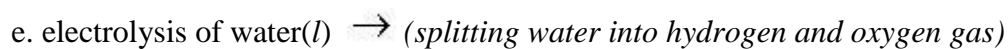
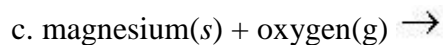
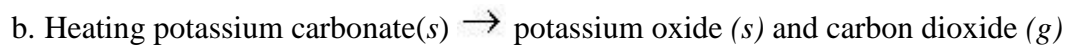




Classify each reaction as synthesis, decomposition, single or double replacement. Balance each equation.



**Predict the type of reaction, then predict the products. Write the balanced chemical equation for each.**



## Even More Naming Ionic Compounds

Name the following ionic compounds and find the molar mass:

- 1)  $\text{CuSO}_4$
- 2)  $\text{Na}_2\text{O}$
- 3)  $\text{Pb}(\text{OH})_2$
- 4)  $\text{LiC}_2\text{H}_3\text{O}_2$
- 5)  $\text{Cu}_3(\text{PO}_4)_2$
- 6)  $\text{NH}_4\text{Br}$
- 7)  $\text{CaCO}_3$
- 8)  $\text{KCN}$
- 9)  $\text{FeBr}_3$
- 10)  $\text{Co}(\text{NO}_2)_2$

Write the formulas of the following compounds and find the molar mass:

- 11) manganese (IV) nitride
- 12) aluminum sulfide
- 13) magnesium selenide
- 14) chromium (III) sulfate
- 15) silver phosphate
- 16) palladium (IV) bromide
- 17) titanium (II) arsenide
- 18) vanadium (V) telluride
- 19) beryllium oxide
- 20) nickel (III) carbonate

Answer the following questions. Remember that showing all your work is good practice.

1. Complete the following table. Use the table to answer question 2 below.

Compound	Formula	Molar Mass
sodium hydroxide		
barium nitrate		
aluminum phosphate		
magnesium hydrogen carbonate		
lithium sulfate		
strontium phosphate		

2.

- Calculate the mass of 2.50 moles of sodium hydroxide.
- Calculate the mass of 0.0250 moles of barium nitrate.
- Calculate the mass of  $5.25 \times 10^{-6}$  moles of aluminum phosphate.
- How many moles are in 2.93 g of magnesium hydrogen carbonate?
- How many moles are in 27.5 g of lithium sulphate?
- How many moles are in  $4.629 \times 10^{-2}$  g of strontium phosphate?

3. Find the number of moles in each of the following.

- $9.03 \times 10^{23}$  molecules of  $\text{H}_2\text{SO}_4$
- 6.84 g of fluorine atoms
- $2.41 \times 10^{23}$  atoms of barium
- 33.5 g of iron atoms
- 4.40 g of  $\text{CO}_2$

4. Calculate the mass of each of the following.

- 1.25 moles of  $\text{NaOH}$
- a single atom of potassium
- 0.450 moles of  $\text{Mg}_3(\text{PO}_4)_2$
- $3.01 \times 10^{23}$  molecules of nitrogen gas
- $4.75 \times 10^9$  molecules of water

5. Find the number of particles in each of the following.

- $1.20 \times 10^{-15}$  moles of zinc
- $4.50 \times 10^{-7}$  moles of tin atoms
- 60.5 g of calcium atoms
- $1.10 \times 10^{-10}$  g of sulphur dioxide
- 325.5 g of  $\text{Al}_2\text{O}_3$

**Answer the following questions. Remember that showing all your work is good practice.**

1. What is the mass of 4.5 moles of sugar ( $C_6H_{12}O_6$ )? **(810 g)**
2. What is the mass of 3.75 moles of NaCl? **(218 g)**
3. How many moles are there in 752 g of  $AlCl_3$ ? **(5.6 mol)**
4. How many moles are there in 752 g of  $CuSO_4$ ? **(4.7 mol)**
5. How many molecules are in 103 moles of  $H_2O$ ? **( $6.20 \times 10^{25}$  molc)**
6. How many formula units are in 54 moles of  $K_2CrO_4$ ? **( $3.3 \times 10^{25}$  for.u)**
7. How many formula units are there in 54 g of  $K_2CrO_4$ ? **( $1.7 \times 10^{23}$  for.u)**
8. How many atoms of oxygen are there in 752 g of  $NaHCO_3$ ? **( $1.62 \times 10^{25}$  atoms)**
9. How many grams are there in  $3.70 \times 10^8$  formula units of  $Zn(OH)_2$ ? **( $6.1 \times 10^{-14}$  g)**
10. How many grams does 1 atom of carbon weight? **( $2.0 \times 10^{-23}$  g)**

Use the information given to fill in the missing conversions for each gas:

<i>1 mole of CO<sub>2</sub> gas</i>	<i>22.4 L at STP</i>	<i>44 grams</i>	<i>6.02 x 10<sup>23</sup> molecules</i>
1 mole of <b>N<sub>2</sub></b> gas			
0.5 mole of <b>O<sub>2</sub></b> gas			
_____ of <b>NO</b> gas	44.8 L at STP		
_____ of <b>CO</b> gas			2.05 x 10 <sup>18</sup> molecules
_____ of <b>H<sub>2</sub></b> gas		20 grams	

**Answer the following questions. Be sure to show your work.**

1. Calculate the number of moles in each of the following at STP.

- a. 5.60 L of any gas.
- b. 112 L of a gas.
- c. 8.96 L of fluorine gas
- d. 28.0 L of CO<sub>2</sub> gas
- e. 0.542 mL of neon gas

2. Calculate the mass of each of the following at STP.

- a. 89.6 L sulfur dioxide
- b.  $1.00 \times 10^3$  L C<sub>2</sub>H<sub>6</sub>
- c. 10.0 L chlorine gas
- d. 50.0 L argon gas
- e. 12.0 L neon gas

3. Calculate the number of molecules in each of the following at STP.

- a. 20.0 L of carbon monoxide
- b. 5.00 L of hydrogen gas
- c. 42.0 L of water vapour
- d. 224 L of helium gas
- e.  $5.37 \times 10^{-4}$  L of ammonia

4. Calculate the volume, at STP, of each of the following

- a.  $3.20 \times 10^{-2}$  moles of carbon dioxide gas
- b.  $5.31 \times 10^{24}$  molecules of SO<sub>2</sub>
- c.  $4.50 \times 10^{23}$  molecules CH<sub>4</sub>
- d. 50.0 g of ammonia gas
- e. 12.0 g of fluorine gas

**Answer the following questions. Remember that showing all your work is good practice.**

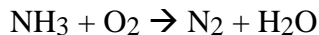
- Find the number of moles in 6.84 g of fluorine. **(0.18 mol)**
- Find the number of moles in  $3.01 \times 10^{24}$  atoms of nitrogen. **(5.00 mol)**
- Find the mass of 0.450 moles of  $\text{Mg}_3(\text{PO}_4)_2$ . **(118 g)**
- Find the number of particles in  $1.10 \times 10^{-10}$  g of sulphur dioxide. **( $1.03 \times 10^{12}$  mole)**
- Find the mass of 1 atom of potassium. **( $6.50 \times 10^{-23}$  g)**
- Find the number of atoms of oxygen in  $1.5 \times 10^{-5}$  moles of  $\text{Mg}_3(\text{PO}_4)_2$ . **( $7.2 \times 10^{19}$  atoms)**
- Find the number of moles of oxygen in 10.0 g of  $\text{CaCO}_3$ . **(0.300 mol)**
- Find the number of atoms of hydrogen in 50.0 g of  $\text{Ba}(\text{OH})_2$ . **( $3.51 \times 10^{23}$ )**
- Calculate the volume, at STP, of each of the following
  - $3.20 \times 10^{-2}$  moles of carbon dioxide gas **(0.717 L)**
  - 32.0 g of oxygen gas **(22.4 L)**
  - $5.31 \times 10^{24}$  molecules of  $\text{SO}_2$  **(198 L)**
- Calculate the number of moles in each of the following at STP.
  - 5.60 L of any gas. **(0.250 mol)**
  - 0.542 mL of neon gas **( $2.42 \times 10^{-5}$  mol)**
- Calculate the mass of each of the following at STP.
  - $1.00 \times 10^3$  L  $\text{C}_2\text{H}_6$  **(1339 g)**
  - 10.0 L chlorine gas **(31.7 g)**
- Calculate the number of particles in each of the following at STP.
  - 20.0 L of carbon monoxide **( $5.38 \times 10^{23}$ )**
  - 224 L of helium gas **( $6.02 \times 10^{24}$ )**



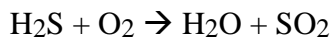
**ANSWER THE FOLLOWING QUESTIONS OF STOICHIOMETRY:**

*Make sure each reaction is balanced FIRST before answer the questions.*

Use the following unbalanced reaction to answer questions 1-3.



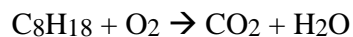
1.
  - a. What are the molar coefficients of the balanced reaction?
  - b. How many moles of oxygen gas will react exactly with 1.6 mol of ammonia?
  - c. How many moles of each product will be generated by the amount in (b)?
  
2.
  - a. How many moles of oxygen gas will react with 0.75 mol of ammonia gas?
  - b. How many moles of each product will be produced from the 0.75 mol of ammonia?
  
3. Determine the number of moles of water that would be produced from 2.50 mol of ammonia reacting with an excess of oxygen gas.
  
4. How many moles of H<sub>2</sub>S can be burned by 0.75 moles of oxygen gas?



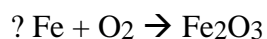
5. How many moles of oxygen can be produced from 1.8 moles of KClO<sub>3</sub>



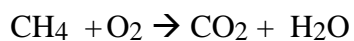
6. How many moles of oxygen are needed to burn 0.40 moles C<sub>8</sub>H<sub>18</sub>?



7. How many moles of oxygen are needed to form 120 moles Fe<sub>2</sub>O<sub>3</sub>



8. How many moles of carbon dioxide are formed from 0.25 moles CH<sub>4</sub>?



9. If 0.90 moles of CuO is reduced according to the equation:



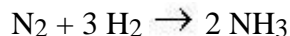
a. How many moles of water are formed?

b. How many moles of N<sub>2</sub> are formed? What is the mass of the N<sub>2</sub> formed?

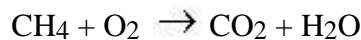
**Answer the questions below. Make sure each reaction is BALANCED first.**

*Remember that showing all your work is good practice.*

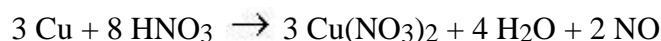
1. What mass of ammonia can be produced from 5.0 moles of H<sub>2</sub> (**56.7 g**)



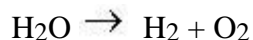
2. How many moles of carbon dioxide are formed when 64 g of CH<sub>4</sub> burn? (**4.0 mol**)



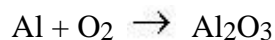
3. What mass of NO is formed when 3.0 moles of HNO<sub>3</sub> react with Cu ? (**22.5 g**)



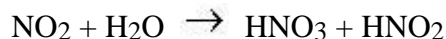
4. Calculate what mass of oxygen and hydrogen that will be formed by the decomposition of 4.50 g of water according to the following reaction. (**4.00 g, 0.50 g**)



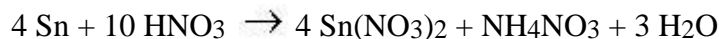
5. Calculate the mass of aluminum oxide produced from 8.00 g of oxygen gas reaction with an excess of metal according to the following reaction. (**17.0 g**)



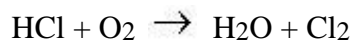
6. What mass of water is needed to react exactly with 2.30 g of NO<sub>2</sub> gas and what mass of HNO<sub>3</sub> will be formed according to the following reaction? (**0.450 g, 1.57 g**)



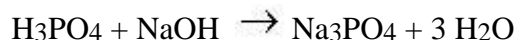
7. What mass of tin (II) nitrate will be formed from 25.2 g of nitric acid (HNO<sub>3</sub>) and an excess of tin according to the following reaction? (**38.8 g**)



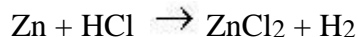
8. What mass of HCl is required to form 14.2 g of Cl<sub>2</sub>? (**14.6 g**)



9. What mass of H<sub>3</sub>PO<sub>4</sub> will react with 60.0 g of NaOH ? (**49.0 g**)



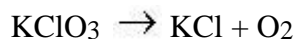
10. How many grams of hydrogen gas are formed from 18.25 g of HCl ? (**0.500 g**)



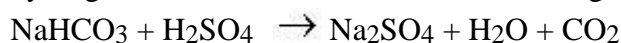
11. What mass of  $\text{KMnO}_4$  is needed to produce 35.5 g of chlorine gas. **(31.6 g)**



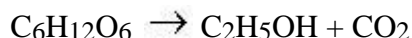
12. What volume of oxygen gas at S.T.P. can be made from 49.0 g of  $\text{KClO}_3$  using the following reaction?  
**(13.4 L)**



13. What mass of  $\text{Na}_2\text{SO}_4$  and what volume of  $\text{CO}_2$  at S.T.P. can be made from 67.2 g of sodium hydrogen carbonate and excess acid according to the following reaction? **(56.8 g, 17.9 L)**



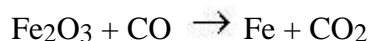
14. What mass of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) would be required to make 5.60 L of  $\text{CO}_2$  gas at S.T.P. according to the following reaction? **(22.5 g)**



15. What volume of each product could be made from 8.00 g of methane gas ( $\text{CH}_4$ ) at S.T.P. according to the following reaction. **(5.6 L, 16.8 L)**



16. What volume of  $\text{CO}_2$  gas can be made from 11.2 L of  $\text{CO}$  gas and an excess of iron (III) oxide ? (temperature and pressure kept constant at S.T.P.) **(11.2 L)**



17.  $\text{C}_3\text{H}_8\text{O}_2 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

In the reaction above, the heat of combustion is 420 kJ/mole of  $\text{C}_3\text{H}_8\text{O}_2$ . When 125 L of  $\text{C}_3\text{H}_8\text{O}_2$ , at STP, react how much energy would be released? **(2344 kJ)**

18. Given:  $\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + 650 \text{ kJ/mole}$

If 650 kJ/mole is produced burning  $\text{C}_3\text{H}_8$ , how much energy is produced when 11.0 g of oxygen gas is used? **(44.7 kJ)**

**ANSWER THE FOLLOWING QUESTIONS ABOUT LIMITING REACTANTS:**

1. For the reaction,  $2 \text{H}_2(g) + \text{O}_2(g) \rightarrow 2 \text{H}_2\text{O}(g)$

Identify the limiting factor (reactant) in each of the following reaction mixtures:

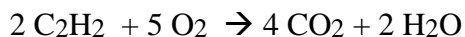
- 10 molecules of  $\text{H}_2$  and 4 molecules of  $\text{O}_2$
- 50 molecules of  $\text{H}_2$  and 20 molecules of  $\text{O}_2$
- 100 molecules of  $\text{H}_2$  and 100 molecules of  $\text{O}_2$ .
- 0.50 moles of  $\text{H}_2$  and 0.75 moles of  $\text{O}_2$ .
- 0.80 moles  $\text{H}_2$  and 0.75 moles  $\text{O}_2$ .
- 5.00 g  $\text{H}_2$  and 56.00 g  $\text{O}_2$ .
- 2.00 L  $\text{H}_2$  and 2.00 L  $\text{O}_2$  at STP.
- 7.00 L  $\text{H}_2$  and 3.00 L  $\text{O}_2$  at STP.

In each of the following questions, identify the **limiting factor**, the **excess reactant**, and then calculate the **amount of product formed**, and the **amount and excess reactant** that remains.

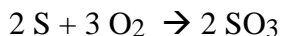
2. Given 3.0 moles of methane and 4.0 moles of oxygen gas, calculate the moles of carbon dioxide gas produced. Calculate the moles of excess reactant that remains. **(2.0, 1.0)**



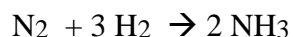
3. Given 5.0 mol of acetylene and 11.0 mol of oxygen gas, calculate the moles of  $\text{CO}_2$  gas produced. Calculate the moles of excess reactant that remains. **(8.8, 0.6)**



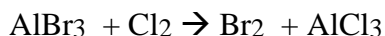
4. Given 5.0 mol of sulphur and 8.4 mol of oxygen gas calculate the mass of  $\text{SO}_3$  gas produced. Calculate the moles of excess reactant that remains. **(400.0 g, 0.9 mol)**



5. Given 0.16 g of hydrogen gas and 5.6 g of nitrogen gas, calculate the mass of  $\text{NH}_3$  produced. Calculate the mass of excess reactant that remains. **(0.90 g, 4.86 g)**



6. According to the reaction below,



How many grams of aluminum chloride are produced from 82.0 g of chlorine and 175.0 g of aluminum bromide? How many grams of the excess reactant remains? **(87.6g, 12.1 g)**

7. For the reaction,  $\text{Al (s)} + \text{Br}_2 \text{ (g)} \rightarrow \text{AlBr}_3 \text{ (s)}$

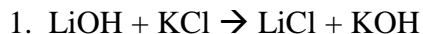
What mass of aluminum bromide can be made from 70.0 g of aluminum and 50.0 L of bromine at STP? **(397 g, 29.8 g)**

8. For the reaction,  $\text{Fe}_2\text{O}_3 \text{ (s)} + \text{CO (g)} \rightarrow \text{Fe (s)} + \text{CO}_2 \text{ (g)}$

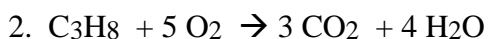
What volume of carbon dioxide is formed from 50.0 g of iron (III) oxide and 6.50 L of carbon monoxide. **(6.50 L, 34.5 g)**

## Percent, Actual and Theoretical Yield

*Make sure the equations are balanced first.*



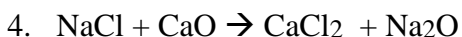
- I began this reaction with 20 grams of lithium hydroxide. What is my theoretical yield of lithium chloride?
- I actually produced 6 grams of lithium chloride. What is my percent yield?



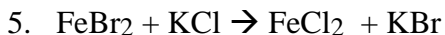
- If I start with 5 g of propane, what is my theoretical yield of water?
- I got a percent yield of 75%. How many grams of water did I make?



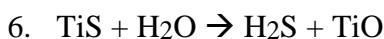
My theoretical yield of beryllium chloride was 10.7 grams. If my actual yield was 4.5 g, what was my percent yield?



What is my theoretical yield of sodium oxide if I start with 20 grams of calcium oxide?



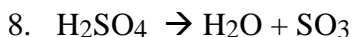
- What is my theoretical yield of iron (III) chloride if I start with 34 grams of iron (III) bromide?
- What is my percent yield of iron (III) chloride if my actual yield is 4 grams?



Use the percent yield to explain why it is impossible to get an actual yield of 22 grams of titanium (II) oxide from 20 grams of titanium (II) sulphide.



What is my actual yield of uranium hexabromide if I start with 100 grams of uranium and get a percent yield of 83%?



If I start with 89 g of sulphuric acid and produce 7.1 g of water, what is my percent yield?

1. 35.5, 16.9

2. 8.2, 6.1

3. 42.1

4. 22.1

5. 20.0, 20

6. 137.5

7. 301.4

8. 250.2

## CHEMICAL REACTION UNIT REVIEW

1. How many litres are there in 7.21 moles of dihydrogen monoxide gas at STP? (**162 L**)
2. How many moles are there in  $5.97 \times 10^{22}$  formula units of sodium hydrogen sulphate? (**0.0992 mol**)
3. How many litres are in  $1.72 \times 10^{22}$  formula units of potassium nitrate? The density of potassium nitrate is 2.109 g/ml. (**0.00134 L**)
4. How many particles are in 7.21 grams of tin (IV) oxide? ( **$2.89 \times 10^{22}$** )
5. Find the mass of 4.50 moles of copper (II) chlorate. ( **$1.04 \times 10^3$  g**)
6. How many litres are in 285 grams of tricarbon octahydride gas at STP? (**145 L**)
7. Find the mass of  $9.36 \times 10^{23}$  formula units of calcium hydroxide. (**115 g**)
8. Lead (II) nitrate and sodium iodide react in a closed container. Write a complete balanced equation and state the reaction type.
9. Aluminum metal and oxygen gas combine. Write a complete balanced equation for this reaction and state the reaction type.
10. A piece of copper wire reacts in silver (I) nitrate solution. Write a complete balanced equation and state the reaction type.



11. Write a complete balanced equation for the combustion of ethane ( $C_2H_6$ ).
12. Sodium carbonate and calcium hydroxide react to form sodium hydroxide and calcium carbonate.  
Calculate the mass of each product formed if you are given 20.5 g of sodium carbonate. (**15.5 g, 19.3 g**)
13. 15.0 g of barium bromide react with 35.0 g of sodium carbonate.
- What type of reaction is this?
  - Write a balanced equation for the reaction.
  - Which is the limiting reactant?
  - Find the mass of each product. (**9.94 g, 10.4 g**)
  - What mass of excess reactant is left? (**29.7 g**)
14. 7.5 g of potassium chloride is mixed with 11.7 g of calcium hydroxide. Determine the limiting reactant.  
If 4.7 g of calcium chloride is produced in this experiment, what is the percent yield?