Chemical Reactions

UNIT 3: CHEMICAL REACTIONS

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.
  Include: ***heat of reaction***
- Identify the ***limiting reactant*** and calculate the mass of a product, given the reaction equation and reactant data.
  Include: ***theoretical yield, experimental yield***

Additional KEY Terms

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_2O_3	

CF_4	
Nitrogen dioxide	

Co_2O_3	
H_2S	
Potassium phosphide	
Silicon disulfide	

Carbon tetraiodide	
CaO	
CBr_4	
N_2O_4	

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

OI_2	
Al_2O_3	
Lead(IV) oxide	

Ba_3N_2	
Iron(III) chloride	
Cr_2S_3	
Pb_3N_2	
Lithium sulfide	
CuI	
CuF_2	
$Ca(OH)_2$	

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

NAME	*FORMULA*	*CHARGE*
ACETATE	CH_3COO^-	**-1**
AMMONIUM	NH_4^+	**+1**
HYDROGEN CARBONATE *(BICARBONATE)*	HCO_3^-	**-1**
CARBONATE	CO_3^{-2}	**-2**
CHLORATE	ClO_3^-	**-1**
CHLORITE	ClO_2^-	**-1**
CHROMATE	CrO_4^{-2}	**-2**
DICHROMATE	$Cr_2O_7^{-2}$	**-2**
DIHYDROGEN PHOSPHATE	$H_2PO_4^-$	**-1**
HYDROGEN PHOSPHATE	HPO_4^{-2}	**-2**
PHOSPHATE	PO_4^{-3}	**-3**
HYDROGEN SULFATE *(BISULFATE)*	HSO_4^-	**-1**
SULFATE	SO_4^{-2}	**-2**
HYDROGEN SULFITE *(BISULFITE)*	HSO_3^-	**-1**
SULFITE	SO_3^{-2}	**-2**
HYDRONIUM	H_3O^+	**+1**
HYDROXIDE	OH^-	**-1**
PERCHLORATE	ClO_4^-	**-1**
HYPOCHLORITE	ClO^- *(OCl$^-$)*	**-1**
NITRATE	NO_3^-	**-1**
NITRITE	NO_2^-	**-1**
PERMANGANATE	MnO_4^-	**-1**
THIOCYANATE	SCN^-	**-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_3^-	chlor**ate**	*base* oxygen atoms
ClO_4^-	**per**chlorate	*base* + 1 oxygen atom
ClO_2^-	chlor**ite**	*base* – 1 oxygen atom
ClO^-	**hypo**chlor**ite**	*base* – 2 oxygen atoms

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

1. Name each of the following.

a. $NaC_2H_3O_2$

b. $Ni(NO_3)_2$

c. HgF_2

d. $Sn_3(PO_4)_2$

e. $MgBr_2$

f. $Ca(OH)_2$

g. Cu_3N

h. $Ba(NO_2)_2$

i. MnSe

j. $Ca(ClO)_2$

k. AlP

l. NH_4ClO_3

m. NaH_2PO_4

n. Li_2O

o. MnO

p $FeCO_3$

q. ZnS

r. $CoSO_4$

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 sellenide

l. potassium permangante

m. strontium hydrogen carbonate

n. manganese (VII) oxide

o. boron phosphide

g. chromium (III) sulfate

h. mercury (II) iodide

i. magnesium acetate

p. calcium sulfate

q. rubidium perchlorate

r. cadmium nitrate

3. Name each of the following

a. O_2

b. NO

c. CO_2

d. NO_2

e. PCl_5

f. CCl_4

g. NH_3

h. P_3N_5

i. N_2O

j. NF_3

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

g. chlorine gas

h. nitrogen dioxide

i. diphosphorous decaoxide

j. bromine pentafluoride

k. phosphorous tribromide

l. dinitrogen trichloride

Balance the following chemical reactions:

1. $C_2H_4 + O_2 \rightarrow CO_2 + H_2O$

2. $Al(OH)_3 + Na_2SO_4 \rightarrow Al_2(SO_4)_3 + NaOH$

3. $CaCO_3 + HCl \rightarrow CaCl_2 + H_2O + CO_2$

4. $Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow Al(OH)_3 + CaSO_4$

5. $C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$

6. $Mg + HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

7. $NaOH + H_2SO_4 \rightarrow H_2O + Na_2SO_4$

8. $CaO + HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$

9. $CaO + P_4O_{10} \rightarrow Ca_3(PO_4)_2$

10. $FeS_2 + O_2 + H_2O \rightarrow FeSO_4 + H_2SO_4$

11. $CaCO_3 + H_3PO_4 \rightarrow Ca_3(PO_4)_2 + H_2CO_3$

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

a. $Ca(OH)_{2(aq)} + HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)}$

b. $K_{(s)} + H_2O_{(l)} \rightarrow KOH_{(aq)} + H_{2(g)}$

c. $Cu_{(s)} + AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Ag_{(s)}$

d. $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$

e. $Al(NO_3)_{3(aq)} + H_2SO_{4(aq)} \rightarrow Al_2(SO_4)_{3(aq)} + HNO_{3(aq)}$

f. $PbO_{2(s)} \rightarrow PbO_{(s)} + O_{2(g)}$

g. $Cl_{2(g)} + LiI_{(aq)} \rightarrow LiCl_{(aq)} + I_{2(g)}$

h. $MgCO_{3(s)} \rightarrow MgO_{(s)} + CO_{2(g)}$

i. $Na_2SO_{3(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + SO_{2(g)}$

j. $P_2O_{5(s)} + BaO_{(s)} \rightarrow Ba_3(PO_4)_{2(s)}$

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

a. sodium hydroxide(*aq*) + phosphoric acid, H_3PO_4(*aq*) $\rightarrow$

b. Heating potassium carbonate(*s*) $\rightarrow$ potassium oxide *(s)* and carbon dioxide *(g)*

c. magnesium(*s*) + oxygen(g) $\rightarrow$

d. chlorine(*g*) + magnesium iodide(*aq*) $\rightarrow$

e. electrolysis of water(*l*) $\rightarrow$ *(splitting water into hydrogen and oxygen gas)*

f. aluminum(*s*) + copper(II) sulphate(*aq*) $\rightarrow$

g. ammonium sulphide(*aq*) + iron(II) nitrate(*aq*) $\rightarrow$

h. nitrogen monoxide (*g*) + oxygen (*g*) + water(*l*) $\rightarrow$ hydrogen nitrite *(l)*

i. lithium(*s*) + water(*l*) $\rightarrow$ lithium hydroxide *(aq)* and hydrogen gas

j. strontium bromide(*aq*) + ammonium carbonate(*aq*) $\rightarrow$

k. heating nickel(II) carbonate(*s*) $\rightarrow$ nickel (II) oxide *(s)* and carbon dioxide *(g)*

l. magnesium(*s*) + hydrochloric acid, HCl(*aq*) $\rightarrow$

Even More Naming Ionic Compounds

Name the following ionic compounds and find the molar mass:

1) $CuSO_4$

2) Na_2O

3) $Pb(OH)_2$

4) $LiC_2H_3O_2$

5) $Cu_3(PO_4)_2$

6) NH_4Br

7) $CaCO_3$

8) KCN

9) $FeBr_3$

10) $Co(NO_2)_2$

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.
   a. Calculate the mass of 2.50 moles of sodium hydroxide.
   b. Calculate the mass of 0.0250 moles of barium nitrate.
   c. Calculate the mass of 5.25×10^{-6} moles of aluminum phosphate.
   d. How many moles are in 2.93 g of magnesium hydrogen carbonate?
   e. How many moles are in 27.5 g of lithium sulphate?
   f. How many moles are in 4.629×10^{-2} g of strontium phosphate?

3. Find the number of moles in each of the following.
   a. 9.03×10^{23} molecules of H_2SO_4
   b. 6.84 g of fluorine atoms
   c. 2.41×10^{23} atoms of barium
   d. 33.5 g of iron atoms
   e. 4.40 g of CO_2

4. Calculate the mass of each of the following.
   a. 1.25 moles of NaOH
   b. a single atom of potassium
   c. 0.450 moles of $Mg_3(PO_4)_2$
   d. 3.01×10^{23} molecules of nitrogen gas
   e. 4.75×10^{9} molecules of water

5. Find the number of particles in each of the following.
   a. 1.20×10^{-15} moles of zinc
   b. 4.50×10^{-7} moles of tin atoms
   c. 60.5 g of calcium atoms
   d. 1.10×10^{-10} g of sulphur dioxide
   e. 325.5 g of Al_2O_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 x 10^{25} molc)**

6. How many formula units are in 54 moles of K_2CrO_4? **(3.3 x 10^{25} for.u)**

7. How many formula units are there in 54 g of K_2CrO_4? **(1.7 x 10^{23} for.u)**

8. How many atoms of oxygen are there in 752 g of $NaHCO_3$? **(1.62 x 10^{25} atms)**

9. How many grams are there in 3.70 x 10^{8} formula units of $Zn(OH)_2$? **(6.1 x 10^{-14} g)**

10. How may grams does 1 atom of carbon weight? **(2.0 x 10^{-23} g)**

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

1 mole of CO_2 gas	***22. 4 L at STP***	***44 grams***	***6.02 x 10^{23} molecules***
1 mole of **N_2 gas**			
0.5 mole of **O_2 gas**			
_____ of **NO gas**	44.8 L at STP		
_____ of **CO gas**			2.05 x 10^{18} molecules
_____ of **H_2 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_2 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. 1.00×10^3 L C_2H_6
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. 5.37×10^{-4} L of ammonia

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

a. 3.20×10^{-2} moles of carbon dioxide gas
b. 5.31×10^{24} molecules of SO_2
c. 4.50×10^{23} molecules CH_4
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.

1. Find the number of moles in 6.84 g of fluorine. **(0.18 mol)**

2. Find the number of moles in 3.01×10^{24} atoms of nitrogen. **(5.00 mol)**

3. Find the mass of 0.450 moles of $Mg_3(PO_4)_2$. **(118 g)**

4. Find the number of particles in 1.10×10^{-10} g of sulphur dioxide. **(1.03×10^{12} molc)**

5. Find the mass of 1 atom of potassium. **(6.50×10^{-23} g)**

6. Find the number of atoms of oxygen in 1.5×10^{-5} moles of $Mg_3(PO_4)_2$. **(7.2×10^{19} atoms)**

7. Find the number of moles of oxygen in 10.0 g of $CaCO_3$. **(0.300 mol)**

8. Find the number of atoms of hydrogen in 50.0 g of $Ba(OH)_2$. **(3.51×10^{23})**

9. Calculate the volume, at STP, of each of the following
   a. 3.20×10^{-2} moles of carbon dioxide gas **(0.717 L)**

   b. 32.0 g of oxygen gas **(22.4 L)**

   c. 5.31×10^{24} molecules of SO_2 **(198 L)**

10. Calculate the number of moles in each of the following at STP.
   a. 5.60 L of any gas. **(0.250 mol)**

   b. 0.542 mL of neon gas **(2.42×10^{-5} mol)**

11. Calculate the mass of each of the following at STP.
   a. 1.00×10^{3} L C_2H_6 **(1339 g)**

   b. 10.0 L chlorine gas **(31.7 g)**

12. Calculate the number of particles in each of the following at STP.
   a. 20.0 L of carbon monoxide **(5.38×10^{23})**

b. 224 L of helium gas **(6.02×10^{24})**

ANSWERTHE 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.

$$NH_3 + O_2 \rightarrow N_2 + H_2O$$

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_2S can be burned by 0.75 moles of oxygen gas?

$$H_2S + O_2 \rightarrow H_2O + SO_2$$

5. How many moles of oxygen can be produced from 1.8 moles of $KClO_3$?

$$KClO_3 \rightarrow KCl + O_2$$

6. How many moles of oxygen are needed to burn 0.40 moles C_8H_{18}?

$$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$$

7. How many moles of oxygen are needed to form 120 moles Fe_2O_3 ?

$$Fe + O_2 \rightarrow Fe_2O_3$$

8. How many moles of carbon dioxide are formed from 0.25 moles CH_4?

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

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

$$CuO + NH_3 \rightarrow H_2O + N_2 + Cu$$

a. How many moles of water are formed?

b. How many moles of N_2 are formed? What is the mass of the N_2 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_2 **(56.7 g)**
   $N_2 + 3\ H_2 \rightarrow 2\ NH_3$

2. How many moles of carbon dioxide are formed when 64 g of CH_4 burn? **(4.0 mol)**
   $CH_4 + O_2 \rightarrow CO_2 + H_2O$

3. What mass of NO is formed when 3.0 moles of HNO_3 react with Cu ? **(22.5 g)**
   $3\ Cu + 8\ HNO_3 \rightarrow 3\ Cu(NO_3)_2 + 4\ H_2O + 2\ NO$

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)**
   $H_2O \rightarrow H_2 + O_2$

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)**
   $Al + O_2 \rightarrow Al_2O_3$

6. What mass of water is needed to react exactly with 2.30 g of NO_2 gas and what mass of HNO_3 will be formed according to the following reaction? **(0.450 g, 1.57 g)**
   $NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

7. What mass of tin (II) nitrate will be formed from 25.2 g of nitric acid (HNO_3) and an excess of tin according to the following reaction? **(38.8 g)**
   $4\ Sn + 10\ HNO_3 \rightarrow 4\ Sn(NO_3)_2 + NH_4NO_3 + 3\ H_2O$

8. What mass of HCl is required to form 14.2 g of Cl_2? **(14.6 g)**
   $HCl + O_2 \rightarrow H_2O + Cl_2$

9. What mass of H_3PO_4 will react with 60.0 g of NaOH ? **(49.0 g)**
   $H_3PO_4 + NaOH \rightarrow Na_3PO_4 + 3\ H_2O$

10. How many grams of hydrogen gas are formed from 18.25 g of HCl ? **(0.500 g)**
    $Zn + HCl \rightarrow ZnCl_2 + H_2$

11. What mass of $KMnO_4$ is needed to produce 35.5 g of chlorine gas. **(31.6 g)**
$2\ KMnO_4 + 16\ HCl \rightarrow 2\ KCl + 2\ MnCl_2 + 8\ H_2O + 5\ Cl_2$

12. What volume of oxygen gas at S.T.P. can be made from 49.0 g of $KClO_3$ using the following reaction? **(13.4 L)**
$KClO_3 \rightarrow KCl + O_2$

13. What mass of Na_2SO_4 and what volume of 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)**
$NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$

14. What mass of glucose ($C_6H_{12}O_6$) would be required to make 5.60 L of CO_2 gas at S.T.P. according to the following reaction? **(22.5 g)**
$C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$

15. What volume of each product could be made from 8.00 g of methane gas (CH_4) at S.T.P. according to the following reaction. **(5.6 L, 16.8 L)**
$CH_4 \rightarrow C_2H_2 + H_2$

16. What volume of CO_2 gas can be made from 11.2 L of CO gas and an excess of iron (III) oxide ? (temperature and pressure kept constant at S.T.P.) **(11.2 L)**
$Fe_2O_3 + CO \rightarrow Fe + CO_2$

17. $C_3H_8O_2 + O_2 \rightarrow CO_2 + H_2O$
In the reaction above, the heat of combustion is 420 kJ/mole of $C_3H_8O_2$. When 125 L of $C_3H_8O_2$, at STP, react how much energy would be released? **(2344 kJ)**

18. Given: $C_3H_8 + O_2 \rightarrow CO_2 + H_2O + 650$ kJ/mole
If 650 kJ/mole is produced burning C_3H_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, $2\ H_{2\,(g)} + O_{2\,(g)} \rightarrow 2\ H_2O_{\,(g)}$

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

   a. 10 molecules of H_2 and 4 molecules of O_2
   b. 50 molecules of H_2 and 20 molecules of O_2
   c. 100 molecules of H_2 and 100 molecules of O_2.
   d. 0.50 moles of H_2 and 0.75 moles of O_2.
   e. 0.80 moles H_2 and 0.75 moles O_2.
   f. 5.00 g H_2 and 56.00 g O_2.
   g. 2.00 L H_2 and 2.00 L O_2 at STP.
   h. 7.00 L H_2 and 3.00 L 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)**

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$$

3. Given 5.0 mol of acetylene and 11.0 mol of oxygen gas, calculate the moles of CO_2 gas produced. Calculate the moles of excess reactant that remains. **(8.8, 0.6)**

$$2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$$

4. Given 5.0 mol of sulphur and 8.4 mol of oxygen gas calculate the mass of SO_3 gas produced. Calculate the moles of excess reactant that remains. **(400.0 g, 0.9 mol)**

$$2\ S + 3\ O_2 \rightarrow 2\ SO_3$$

5. Given 0.16 g of hydrogen gas and 5.6 g of nitrogen gas, calculate the mass of NH_3 produced. Calculate the mass of excess reactant that remains. **(0.90 g, 4.86 g)**

$$N_2 + 3\ H_2 \rightarrow 2\ NH_3$$

6. According to the reaction below,

$$AlBr_3 + Cl_2 \rightarrow Br_2 + AlCl_3$$

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, $Al_{(s)} + Br_{2\,(g)} \rightarrow AlBr_{3\,(s)}$

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, $Fe_2O_{3\,(s)} + CO_{(g)} \rightarrow Fe_{(s)} + CO_{2\,(g)}$

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.

1. $LiOH + KCl \rightarrow LiCl + KOH$

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

2. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

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

3. $Be + 2\ HCl \rightarrow BeCl_2 + H_2$

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

4. $NaCl + CaO \rightarrow CaCl_2 + Na_2O$

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

5. $FeBr_2 + KCl \rightarrow FeCl_2 + KBr$

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

6. $TiS + H_2O \rightarrow H_2S + TiO$

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.

7. $U + 3\ Br_2 \rightarrow UBr_6$

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

8. $H_2SO_4 \rightarrow H_2O + SO_3$

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 5.97×10^{22} formula units of sodium hydrogen sulphate? (**0.0992 mol)**

3. How many litres are in 1.72×10^{22} formula units of potassium nitrate? The density of postassium nitrate is 2.109 g/ml. **(0.00134 L)**

4. How many particles are in 7.21 grams of tin (IV) oxide? **(2.89×10^{22})**

5. Find the mass of 4.50 moles of copper (II) chlorate. **(1.04×10^{3} g)**

6. How many litres are in 285 grams of tricarbon octahydride gas at STP? **(145 L)**

7. Find the mass of 9.36×10^{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.

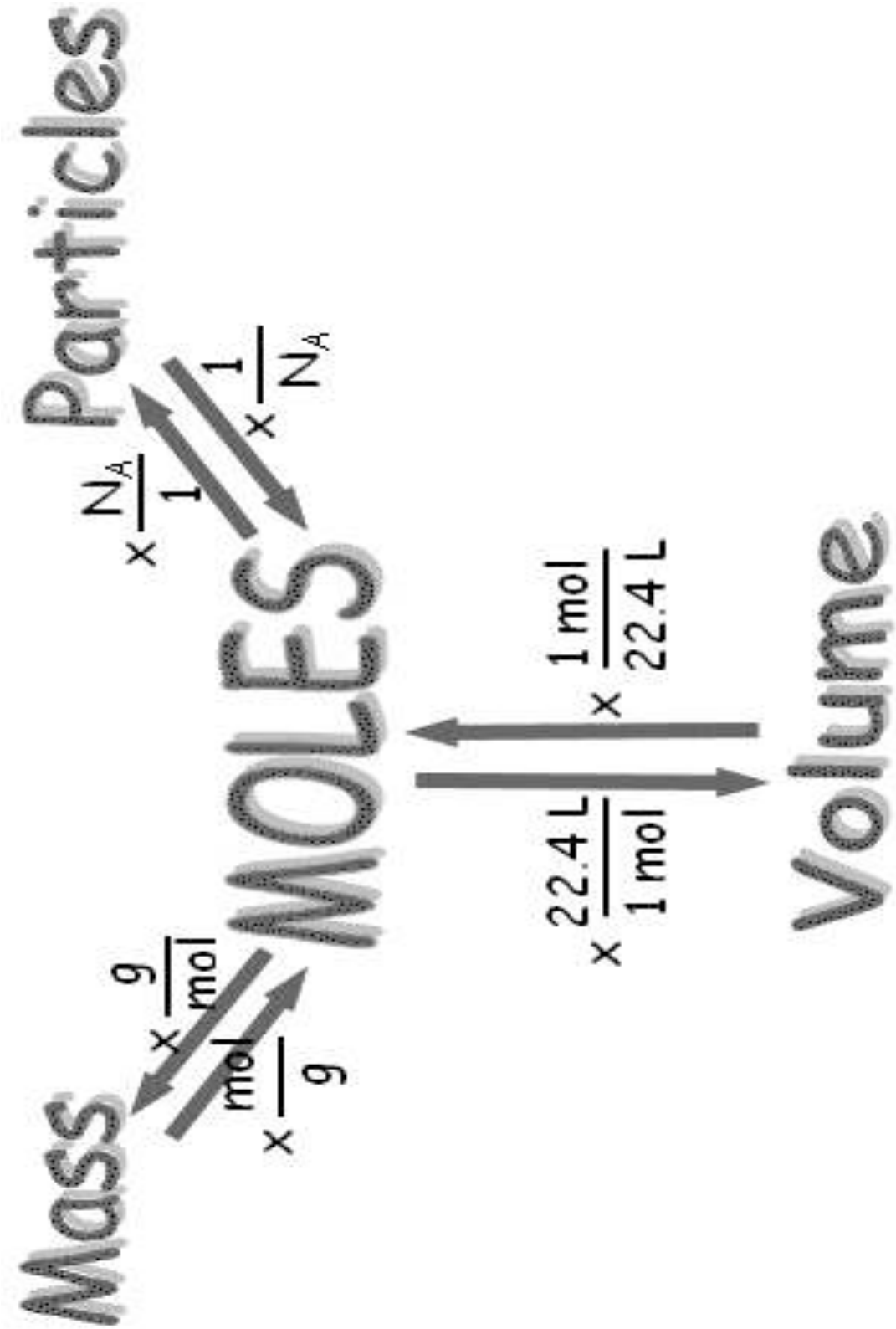
11. Write a complete balanced equation for the combustion of ethane (C_2H_6).

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.

    a. What type of reaction is this?
    b. Write a balanced equation for the reaction.
    c. Which is the limiting reactant?
    d. Find the mass of each product. (**9.94 g , 10.4 g)**
    e. 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?


Mass
Particles
MOLES
Volume
x 9/mol
x mol/9
x N_A/1
x 1/N_A
x 1 mol/22.4 L
x 22.4 L/1 mol