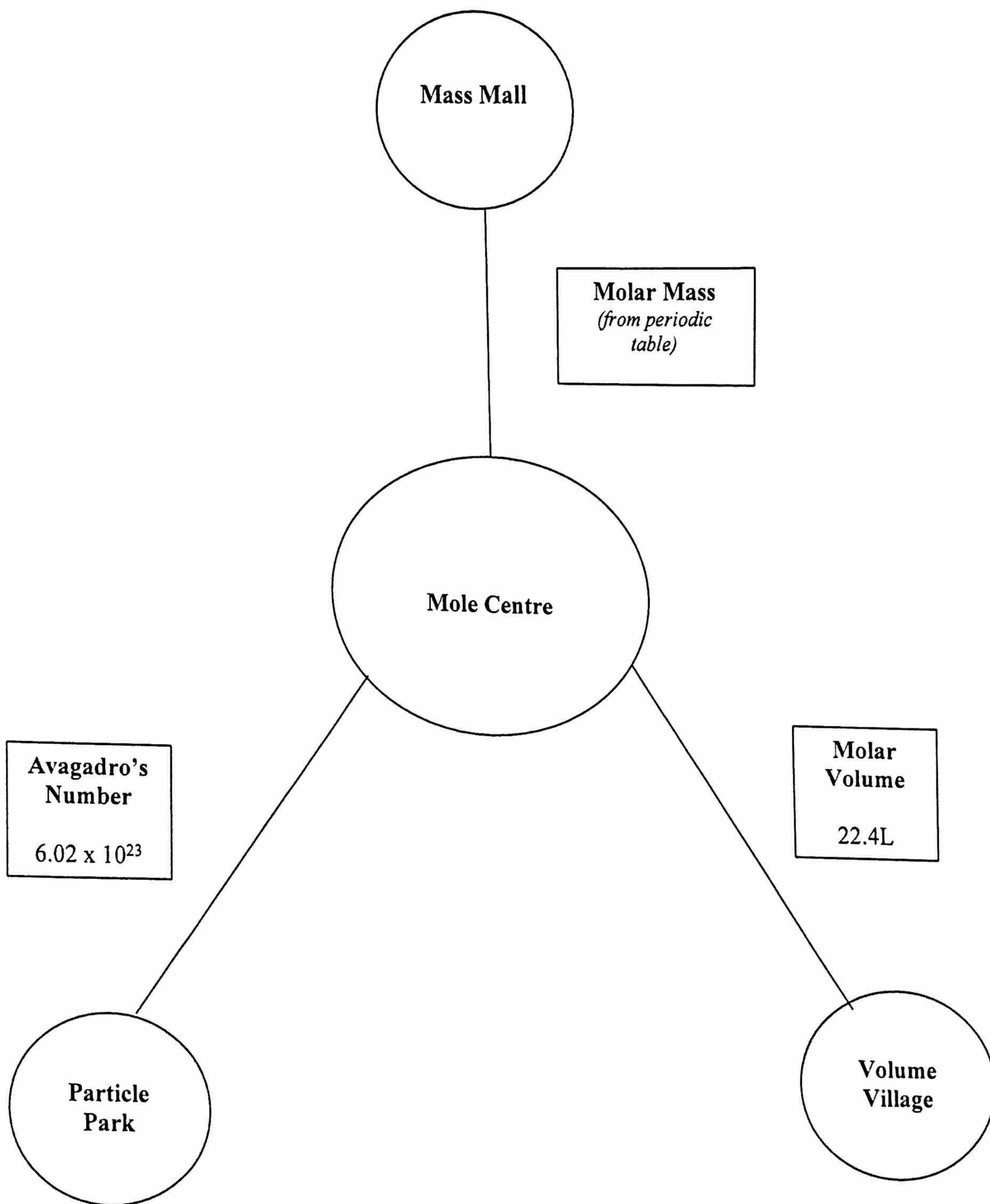


# Welcome to "Mole Town"



# Honors Chemistry: Moles Classwork

## CW: Percent Composition

Calculate the percentage compositions for each of the following compounds.

1. potassium chlorate

2.  $\text{CoSO}_4$

3. A compound that contains 2.16g Al, 3.85g S, and 7.68g O.

Calculate the percentage compositions for the bolded element in each of the following compounds.

1. **potassium** chlorate

5.  $\text{CoSO}_4$

2.  $\text{C}_2\text{H}_5\text{OH}$

6. **lithium** carbide.

3. tetraphosphorus decoxide

7.  $\text{H}_2\text{O}_2$

4.  $\text{Fe}_3\text{O}_4$

8. **barium** chloride

**CW: One and Two Step Mole Problems**  
**One Step Mole Problems**

1. Calculate the molar mass for each of the following compounds.
  - a. sodium sulfate
  
  
  
  
  
  
  
  - b. aluminum phosphate
  
  
  
  
  
  
  
  - c. ammonium hydroxide
  
2. What is the mass of 1.75 moles of zinc atoms?
  
  
  
  
  
  
  
3. How many moles are there in 42.0g of aluminum?
  
  
  
  
  
  
  
4. How many atoms are there in 1.50 moles carbon?
  
  
  
  
  
  
  
5. How many moles are there in  $7.50 \times 10^{23}$  atoms of iron?
  
  
  
  
  
  
  
6. How many molecules are in 0.254 moles of carbon dioxide?
  
  
  
  
  
  
  
7. How many moles are in 42.24 g of nickel(II) sulfite?

8. How many grams are in 0.049 moles of silver nitrate?

9. How many liters are in 12.42 moles of chlorine gas?

10. How many grams are in 0.0425 moles of potassium chloride?

11. How many grams are in 6.21 mole of carbon tetrachloride?

12. How many moles are in 4.16 L of dinitrogen pentoxide?

**Moles 2 Step Problems** Perform the following conversions.

13. 6g of S to atoms

14.  $6.02 \times 10^{14}$  atoms of Zn to grams

15.  $5.5 \times 10^{25}$  molecules copper (I) sulfate to grams

16.  $5.5 \times 10^4$  grams calcium carbonate to molecules

17. 244.2 g calcium hydroxide to liters

18. 6.89 liters of bromine gas to grams

## The MOLE Practice!

### Moles to Atoms/ Atoms to Moles

1. How many moles of Magnesium is  $1.25 \times 10^{23}$  atoms of Magnesium?
2. How many atoms are in 2.64 moles of Aluminum?
3. How many molecules are in 2.12 moles of propane ( $C_3H_8$ )?
4. How many atoms are in 4.2 moles of Carbon tetrachloride ( $CCl_4$ )?
5. How many molecules are in 12.00 mol of sucrose ( $C_{12}H_{22}O_{11}$ )?
6. How many moles of Mercury is  $9.03 \times 10^{24}$  atoms?
7. How many atoms are in 4.50 moles of Copper?
8. How many molecules are in 100.0 mol of carbon dioxide ( $CO_2$ )?

### Moles to Mass/Mass to Moles

1. The molecular formula for hydrogen peroxide is  $H_2O_2$ . What is the molar mass?
2. What is the molar mass of nitrogen dioxide ( $NO_2$ )?

3. How many grams are in 9.45 mol of dinitrogen trioxide ( $\text{N}_2\text{O}_3$ )?

4. Find the number of moles in 92.2g of Iron (III) oxide ( $\text{Fe}_2\text{O}_3$ ).

5. Find the mass in grams of 3.32 mol K.

6. Calculate the number of moles in 847g of  $\text{NH}_4$ .

7. Calculate the mass of 2.50 mol of sodium sulfate ( $\text{Na}_2\text{SO}_4$ ).

8. Calculate the number of moles of 75g of sodium oxide ( $\text{Na}_2\text{O}$ ).

#### Mole to Volume/Volume to Mole

1. Convert 2.02 mol  $\text{N}_2$  to liters.

2. Convert 12.4 L of  $\text{O}_2$  to moles.

#### Multistep Problems

1. Convert 10.0g of sulfur dioxide ( $\text{SO}_2$ ) to molecules.

2. What volume, in liters, does 200.1g of nitrogen dioxide ( $\text{NO}_2$ ) occupy?

3. Calculate the mass of 16.3 liters of oxygen gas.

4. Calculate the number of molecules present in 43.7 g  $\text{BH}_3$ .

5. Calculate the number of molecules present in 0.982 mol of methane ( $\text{CH}_4$ ).

## CW: Empirical & Molecular Formulas

### Empirical formulas

1. If 4.02g of N reacts with 11.48g of O, what is the empirical formula of this compound?

2. Calculate the empirical formulas of the compounds with the following percentage compositions:

a) 40.2% K, 26.9% Cr, 32.9% O

b) 21.8% Mg, 27.9% P, 50.3% O

3. Determine the empirical formula for the following two compounds.

a) 0.89g K, 1.18g Cr, 1.27g O



b) 1.03g K, 0.69g Cr, 0.84g O

4. Calculate the empirical formulas of the compounds with the following percentage compositions:

a) 65.7% Sr, 10.4% Si, 23.9% O

b) 34.58% Na, 23.3%P, 42.12% O

### Molecular formulas

Determine the molecular formulas for the following:

1. empirical formula is CH; molecular mass is 26g

2. empirical formula is  $C_2H_5$ ; molecular mass is 58g

3. A compound of phosphorus and oxygen contains 56.36% phosphorus. If the molecular mass is 2204 g, what is the molecular formula?

Determine the molecular formulas for the following:

4. empirical formula is  $C_3H_2O$ ; molecular mass is 216g

5. compound contains 0.240 g C and 0.020 g H; molecular mass is 78g

CW: Hydrates

1. What is the formula and name of a hydrate that is 85.3% barium chloride and 14.7% water?

2. A 4.89 grams sample of a hydrate was heated, and after the water was driven off, 3.87 g of anhydrous calcium sulfate remained. Determine the formula of this hydrate and name the compound.

3. A 1.628 grams sample of a hydrate of magnesium iodide is heated until its mass is reduced to 1.072 g and all water has been removed. What is the formula of the hydrate?

4. A hydrate of  $\text{Na}_2\text{CO}_3$  has a mass of 4.31 g before heating. After heating, the mass of the anhydrous compound is found to be 3.22 g. Determine the formula of the hydrate and then write out the name of the hydrate.

5. Given that the molar mass of  $\text{Na}_2\text{SO}_4 \cdot n\text{H}_2\text{O}$  is 322.1 g/mol, calculate the value of  $n$ .

6. Anhydrous lithium perchlorate (4.78 g) was dissolved in water and re-crystallized. Care was taken to isolate all the lithium perchlorate as its hydrate. The mass of the hydrated salt obtained was 7.21 g. What hydrate is it?

7. A substance was found to have the following percentages by mass: 23% zinc; 11% sulfur; 11% oxygen; 44% water. What is the empirical formula?

8. A 5.00 g sample of hydrated barium chloride,  $\text{BaCl}_2 \cdot n\text{H}_2\text{O}$ , is heated to drive off the water. After heating, 4.26 g of anhydrous barium chloride,  $\text{BaCl}_2$ , remains. What is the value of  $n$  in the hydrate's formula?

9. A 1.98 g sample of a cobalt(II) chloride hydrate is heated over a burner. When cooled, the mass of the remaining dehydrated compound is found to be 1.55 g. What is the formula for the original hydrate? How can you make sure that all of the water of hydration has been removed?

## Stoichiometry Class Work

### Part 1: Moles → Moles & Grams → Moles

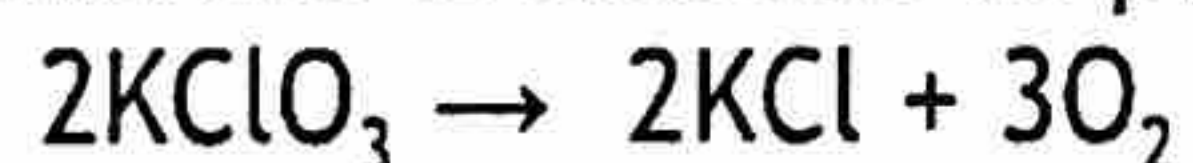
1. According to the equation:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , how many moles of ammonia will be produced if 14.0 mol of hydrogen react with excess nitrogen?

2. How many moles of sodium will react with water to produce 8.0 mol of hydrogen in the following reaction?  $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$

3. How many mole of lithium chloride will be formed by the reaction of chlorine with 3.60 mol of lithium bromide in the following reaction?  $2\text{LiBr} + \text{Cl}_2 \rightarrow 2\text{LiCl} + \text{Br}_2$

4. How many moles of  $\text{CO}_2$  are formed from 7.26 mol of propane?  $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

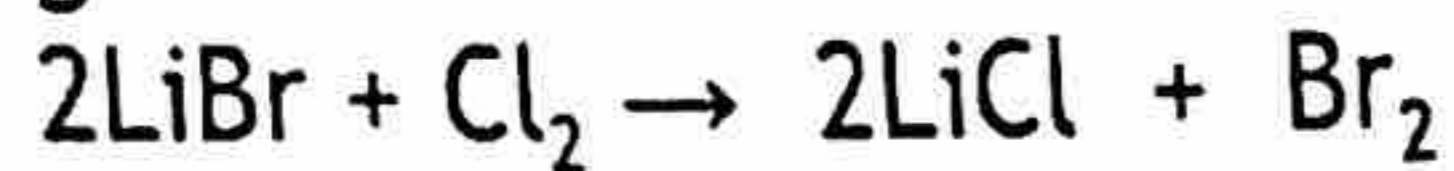
5. What mass of potassium chlorate is needed to produce 8.50 mol of oxygen?



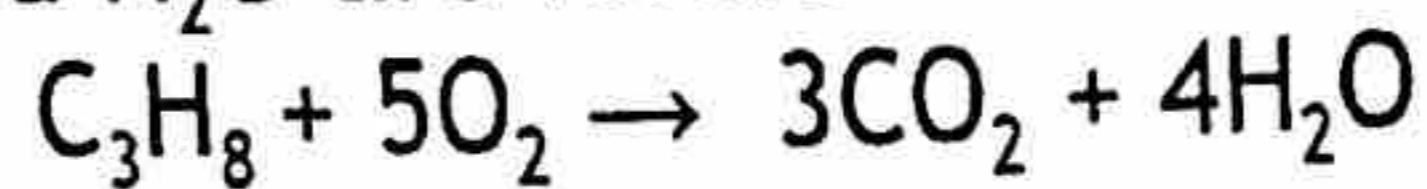
6. According to the equation:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , how many grams of ammonia will be produced if 14.0 mol of hydrogen react with excess nitrogen?

7. How many grams of sodium will react with water to produce 8.0 mol of hydrogen in the following reaction?  $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$

8. How many mole of lithium chloride will be formed by the reaction of chlorine with 36.0 grams of lithium bromide in the following reaction?



9. How many grams of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are formed from 7.26 mol of propane?



**Part 2: grams  $\rightarrow$  grams and all other two step Stoichiometry**

1. a. Write the balanced equation. Lithium and fluorine react to form...

b. Calculate the mass of lithium required to produce 59.5 g of lithium fluoride.

c. How many grams of lithium fluoride can be produced from 300.0 g of fluorine?

2. a. Write the balanced equation for the reaction of Calcium with gold (I) bromide.

b. How many grams of calcium are required to produce 200.0 g of gold?

c. How many grams of calcium bromide can be produced when 350.0 g of gold (I) bromide react?

3. a. Write the balanced reaction for the combustion of propane ( $C_3H_8$ ).

b. Calculate the mass of each product produced when 180.0 g of propane react.

c. How many liters of oxygen are required to react with 99.0 g of propane?



Name \_\_\_\_\_  
Period \_\_\_\_\_ Date \_\_\_\_\_

### Mixed Stoichiometry and Mole Conversions

You must show work with correct conversion factors.

1. For the reaction  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , how many moles of nitrogen are required to produce 12 mol of ammonia,  $\text{NH}_3$ ?
2. A 15.0 gram sample of  $\text{NaCl}$  contains how many formula units of  $\text{NaCl}$ ?
3. What is the mass of 5.2 liters of nitrogen gas,  $\text{N}_2$ , at STP?
4. For the reaction  $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$ , how many moles of potassium chloride can be produced from 125 g of chlorine?
5. How many grams of  $\text{CaCO}_3(s)$  would need to decompose to produce 30.0 liters of  $\text{CO}_2(g)$  at STP according to the following equation?  
$$\text{CaCO}_3(s) \rightarrow \text{CaO}(s) + \text{CO}_2(g)$$
6. For the reaction  $2\text{Fe} + \text{O}_2 \rightarrow 2\text{FeO}$ , how many grams of iron(II) oxide are produced from 6.00 mol of iron reacting with excess oxygen?
7. How many grams of  $\text{H}_2\text{O}$  are present in 0.20 mol  $\text{H}_2\text{O}$ ?

8. Determine the mass in grams of sodium needed to produce 20.0 g of sodium hydroxide according to the chemical equation :  $2\text{Na}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$
9. For the reaction  $\text{CS}_2 + 3\text{O}_2 \rightarrow \text{CO}_2 + 2\text{SO}_2$ , how many liters of oxygen are needed to produce 2.8 moles of  $\text{SO}_2$  at STP?
10. If a sample contains  $4.33 \times 10^{22}$  molecules of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , how many moles of sucrose does it contain?
11.  $2\text{Al} + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2$   
If 4.5 liters of  $\text{H}_2$  are formed at STP in the above reaction, how many moles of  $\text{HCl}$  reacted?
12. For the reaction  $2\text{HNO}_3 + \text{Mg}(\text{OH})_2 \rightarrow \text{Mg}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$ , how many grams of magnesium nitrate are produced from 32.5 grams of nitric acid,  $\text{HNO}_3$ ?
13. Given the reaction:  $4\text{NH}_3(g) + 5\text{O}_2(g) \rightarrow 4\text{NO}(g) + 6\text{H}_2\text{O}(l)$  ; How many liters of nitrogen monoxide will form when 10.5 liters of oxygen react with excess  $\text{NH}_3$  at STP?
14. A scientist collects a sample that contains  $4.20 \times 10^{24}$  molecules of carbon dioxide gas. What is the mass of carbon dioxide in the sample?
15. How many moles of  $\text{Fe}(\text{ClO}_2)_3$  are in 27.2 grams of  $\text{Fe}(\text{ClO}_2)_3$ ?

## CW: Limiting & Excess Reactants

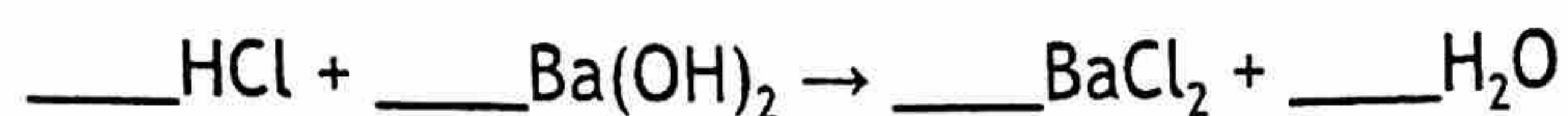
Define -

Limiting reactant - \_\_\_\_\_

Excess reactant - \_\_\_\_\_

### Question 1)

Balance:



If 2.0 mol of HCl reacts with 2.5 mol of  $\text{Ba(OH)}_2$  ....

1. How many moles of each product can be made?

$\text{BaCl}_2 = \text{_____}$        $\text{H}_2\text{O} = \text{_____}$

2. Which is the limiting reactant?

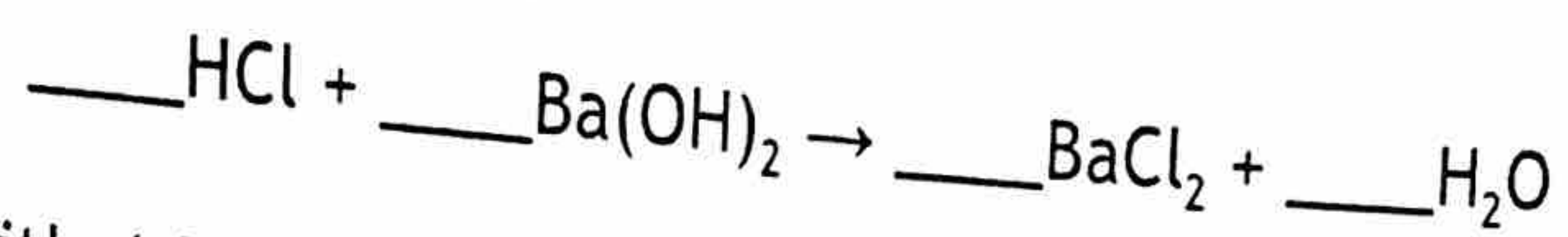
3. Which is the excess reactant?

4. Which reactant do you use to determine the amount of product? \_\_\_\_\_

5. How many grams of water are ACTUALLY produced?

6. How many grams of  $\text{BaCl}_2$  are ACTUALLY produced?

Question #2)



If 4.0 mol of HCl reacts with 4.5 mol of Ba(OH)<sub>2</sub> ....

1. Which is the limiting reactant?
2. Which is the excess reactant?
3. Which reactant do you use to determine the amount of product?
4. How many grams of water are produced?
5. How many grams of BaCl<sub>2</sub> are produced?

Question 3)

Given:  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$  If 1.00 g Mg reacts with 0.500 L O<sub>2</sub> at STP, how many g MgO will be produced? (Remember to identify the limiting reactant.)

Question 4) If 10.0 g NO reacts with 7.0 g O<sub>2</sub>, how many g NO<sub>2</sub> are produced? (Write a balanced equation & Identify your limiting reactant!!)

Question 5) Given: Sodium reacts with water to produce sodium hydroxide and hydrogen gas.

a) If 90.0 grams Na is dropped into 80.0 g H<sub>2</sub>O, how many liters of H<sub>2</sub>(g) will be produced at STP by the given reaction?

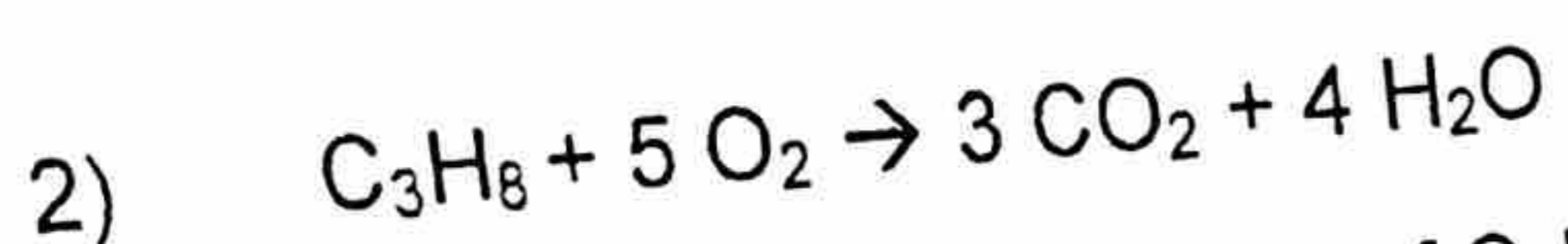
b) How much of the excess reactant is left over?

## Percent, Actual, and Theoretical Yield



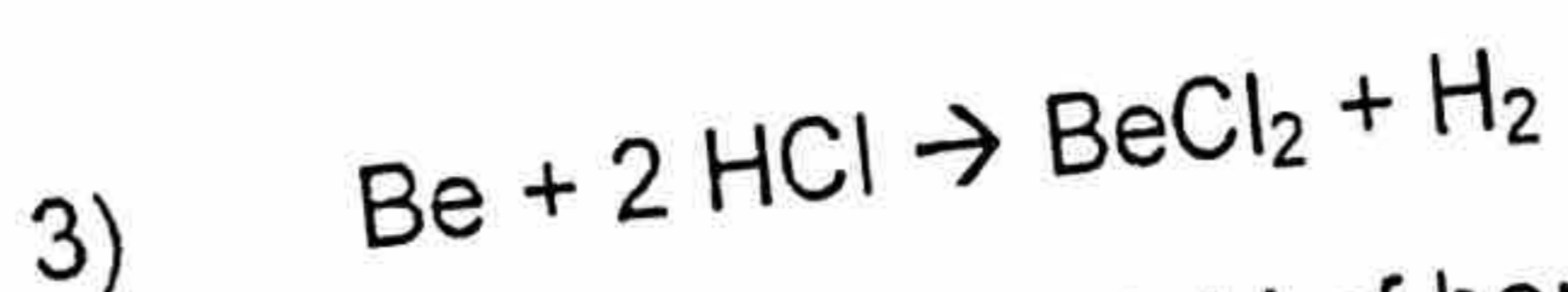
a) I began this reaction with 20 grams of lithium hydroxide. What is my theoretical yield of lithium chloride?

b) I actually produced 6 grams of lithium chloride. What is my percent yield?

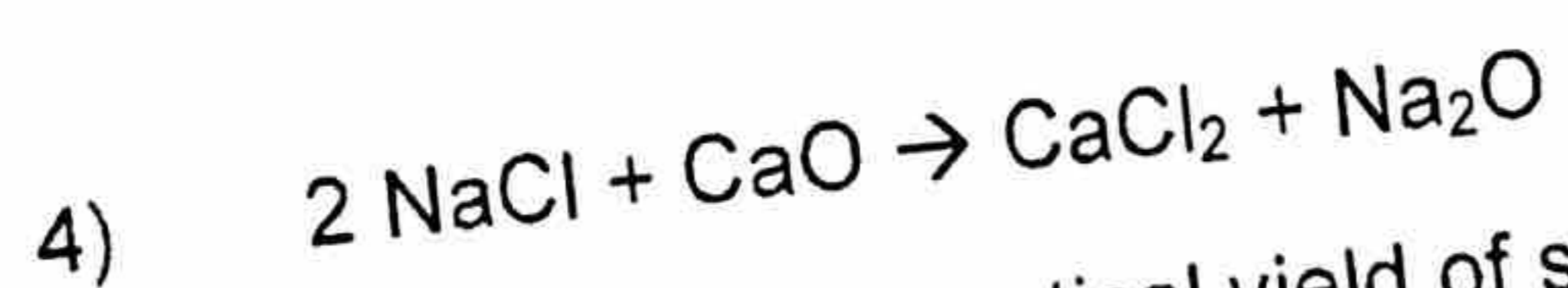


a) If I start with 5 grams of  $\text{C}_3\text{H}_8$ , what is my theoretical yield of water?

b) 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 grams, what was my percent yield?

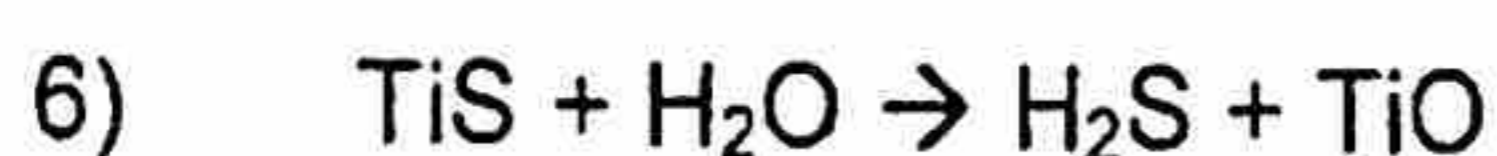


What is my theoretical yield of sodium oxide if I start with 20 grams of calcium oxide?



a) What is my theoretical yield of iron (II) chloride if I start with 34 grams of iron (II) bromide?

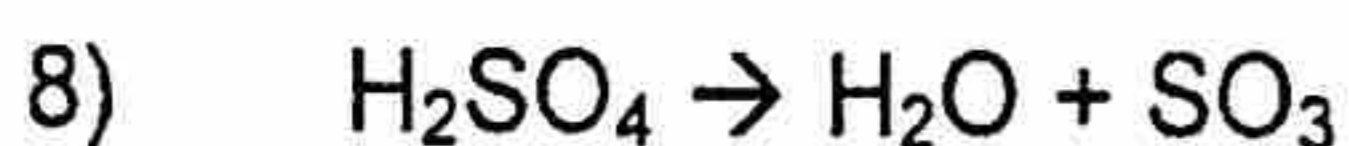
b) What is my percent yield of iron (II) chloride if my actual yield is 4 grams?



What is my percent yield of titanium (II) oxide if I start with 20 grams of titanium (II) sulfide and my actual yield of titanium (II) oxide is 22 grams?



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 grams of sulfuric acid and produce 7.1 grams of water, what is my percent yield?