

# CHEMISTRY

# COMPUTING FORMULA MASS WORKSHEET

## Directions:

Find the formula mass of the following compounds. Round atomic masses to the tenth of a decimal place. Place your final answer in the FORMULA MASS COLUMN.

Problem Set-up example:	
Find the formula mass of $\text{Ca}(\text{NO}_3)_2$	
Ca:	$1 \times 40.1 = 40.1$
N:	$2 \times 14.0 = 28.0$
O:	$6 \times 16.0 = 96.0$
Formula Mass =	$\underline{\quad 164.1 \quad}$

COMPOUND	FORMULA MASS
$\text{AgNO}_2$	
$\text{NiSO}_3$	
$\text{Ca}_3(\text{PO}_4)_2$	
$\text{HgSO}_4$	
$\text{Fe}(\text{NO}_3)_3$	
$\text{KBr}$	
$\text{BeCr}_2\text{O}_7$	
$\text{Co}(\text{ClO}_3)_2$	
$\text{Cu}_2\text{C}_4\text{H}_4\text{O}_6$	
$\text{CuSO}_4 \cdot 7 \text{H}_2\text{O}$	

COMPOUND	FORMULA MASS
$\text{ZnCl}_2$	
$\text{K}_3\text{PO}_4$	
$\text{Al}_2(\text{SO}_4)_3$	
$\text{MgCrO}_4$	
$\text{CaC}_4\text{H}_4\text{O}_6$	
$\text{NaCl}$	
$\text{K}_2\text{Cr}_2\text{O}_7$	
$\text{H}_2\text{SO}_4$	
$\text{Cu}(\text{OH})_2$	
$\text{MgSO}_4 \cdot 5 \text{H}_2\text{O}$	

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O:	$6 \times 16.0 = 96.0$
Formula Mass =	$\overline{164.1}$

COMPOUND	FORMULA MASS
$\text{AgNO}_2$	<b>153.9</b>
$\text{NiSO}_3$	<b>138.8</b>
$\text{Ca}_3(\text{PO}_4)_2$	<b>310.2</b>
$\text{HgSO}_4$	<b>296.7</b>
$\text{Fe}(\text{NO}_3)_3$	<b>241.9</b>
$\text{KBr}$	<b>119</b>
$\text{BeCr}_2\text{O}_7$	<b>224.9</b>
$\text{Co}(\text{ClO}_3)_2$	<b>225.8</b>
$\text{Cu}_2\text{C}_4\text{H}_4\text{O}_6$	<b>275.2</b>
$\text{CuSO}_4 \cdot 7 \text{H}_2\text{O}$	<b>285.7</b>

COMPOUND	FORMULA MASS
$\text{ZnCl}_2$	<b>136.3</b>
$\text{K}_3\text{PO}_4$	<b>212.3</b>
$\text{Al}_2(\text{SO}_4)_3$	<b>342.2</b>
$\text{MgCrO}_4$	<b>140.3</b>
$\text{CaC}_4\text{H}_4\text{O}_6$	<b>188.2</b>
$\text{NaCl}$	<b>58.4</b>
$\text{K}_2\text{Cr}_2\text{O}_7$	<b>294.2</b>
$\text{H}_2\text{SO}_4$	<b>98.1</b>
$\text{Cu}(\text{OH})_2$	<b>97.6</b>
$\text{MgSO}_4 \cdot 5 \text{H}_2\text{O}$	<b>210.4</b>

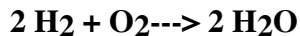
# CHEMISTRY

# MOLAR RATIOS WORKSHEET

## Molar Ratios

The molar ratio is an important concept in solving stoichiometry problems. The sources for these ratios are the coefficients of a balanced equation.

### Example 1:



What is the molar ratio between  $\text{H}_2$  and  $\text{O}_2$ ?

**Answer:**

two to one. So this ratio is written as a fraction is

$$\frac{2}{1}$$

What is the molar ratio between  $\text{O}_2$  and  $\text{H}_2\text{O}$ ?

**Answer:**

one to two. As a fraction, it is:

$$\frac{1}{2}$$

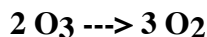
What is the molar ratio between  $\text{H}_2$  and  $\text{H}_2\text{O}$ ?

**Answer:** two to two or:

$$\frac{2}{2}$$

This reduces to one to one, but leave it written as 2 to 2.

### Example 2:



The exact molar ratio you would use depends on how the problem is worded.

What is the molar ratio between  $\text{O}_3$  and  $\text{O}_2$ ?

$$\frac{2}{3}$$

What is the molar ratio between  $\text{O}_2$  and  $\text{O}_3$ ?

$$\frac{3}{2}$$

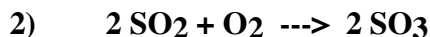
## Practice Problems

Following each equation are two requests for molar ratios from the equation.



Write the molar ratios for:

$\text{N}_2$  to  $\text{H}_2$  and  $\text{NH}_3$  to  $\text{H}_2$



Write the molar ratios for:

$\text{O}_2$  to  $\text{SO}_3$  and  $\text{O}_2$  to  $\text{SO}_2$



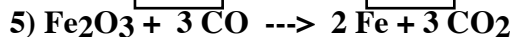
Write the molar ratios for

$\text{PCl}_3$  to  $\text{Cl}_2$  and  $\text{PCl}_3$  to  $\text{PCl}_5$



Write the molar ratios for

$\text{NH}_3$  to  $\text{N}_2$  and  $\text{H}_2\text{O}$  to  $\text{O}_2$



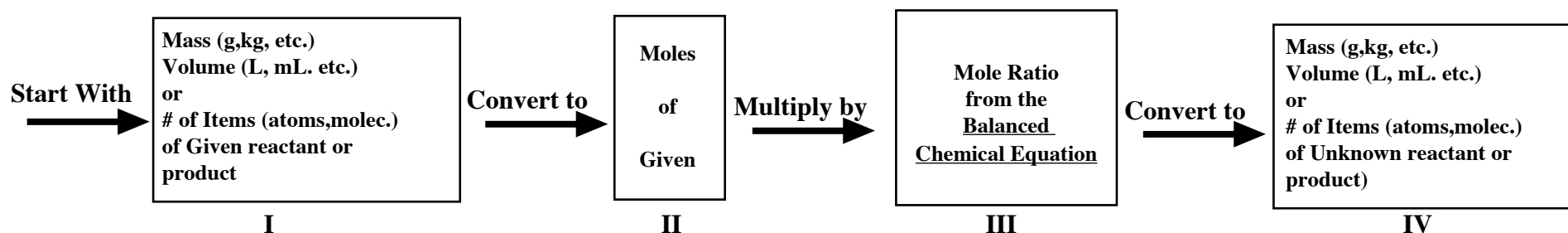
Write the molar ratios for

$\text{CO}$  to  $\text{CO}_2$  and  $\text{Fe}$  to  $\text{CO}$

The Mathematics of Chemical Equations  
(Stoichiometry)

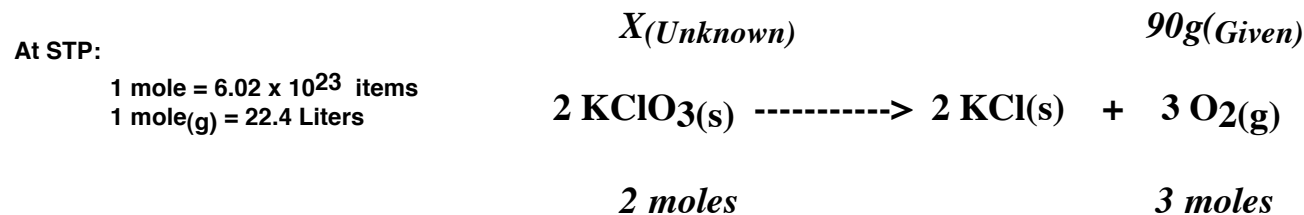
A major task of the chemist is to project how much product can be produced from a certain amount of reactant. The amount of product produced must have more value than the reactants plus the added cost of safely disposing of any waste product produced. The cost of the energy used in the reaction or the cost of disposing of any heat given off by the reaction must also be taken into consideration. A chemical engineer must be able to calculate the amounts of all reactants and products in order to determine if the process is economical. This type of calculation is called **stoichiometry**.

A flow chart for solving stoichiometry problems:



**Sample Problem**

What mass, in grams, of KClO<sub>3</sub> is consumed when 90 grams of O<sub>2</sub> is produced according to the following reaction:

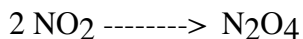


$$X = \frac{90\text{g-O}_2}{32\text{g-O}_2} \times \frac{1\text{ mole-O}_2}{3\text{ moles-O}_2} \times \frac{2\text{ mole-KClO}_3}{2\text{ moles-KClO}_3} \times \frac{122.5\text{ g KClO}_3}{1\text{ mole-KClO}_3} = \boxed{229.7\text{ g KClO}_3}$$

I
II
III
IV

Multiple Choice: Show your set-up in the space provided and circle the answer of your choice.

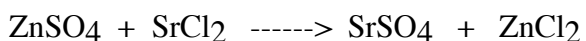
(1) Given the balanced equation:



What mass, in grams, of  $\text{N}_2\text{O}_4$  is produced when 10 moles of  $\text{NO}_2$  is consumed?

- a) 153      b) 690      c) 368      d) 460      e) 1150

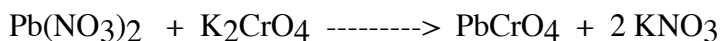
(2) Given the balanced equation:



What number of moles of  $\text{SrCl}_2$  is consumed when 54 g of  $\text{ZnCl}_2$  is produced?

- a) 0.16      b) 0.3      c) 0.79      d) 1.58      e) 0.4

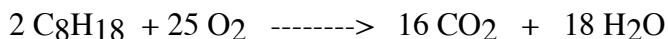
(3) Given the balanced equation:



What number of moles of  $\text{Pb}(\text{NO}_3)_2$  is consumed when 54 g of  $\text{KNO}_3$  is produced?

- a) 0.13      b) 0.18      c) 0.27      d) 1.34      e) 0.67

(4) Given the balanced equation:



What number of moles of  $\text{CO}_2$  is produced when 60 grams of  $\text{C}_8\text{H}_{18}$  is consumed?

- a) 3.37      b) 7.02      c) 5.26      d) 2.11      e) 4.21

# CHEMISTRY

## Stoichiometry Practice [Mole-Mass]

Answers:

(1) 460

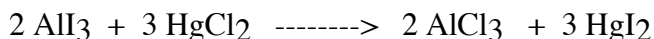
(2) 0.4

(3) 0.27

(4) 4.21

Multiple Choice: Show your set-up in the space provided and circle the answer of your choice.

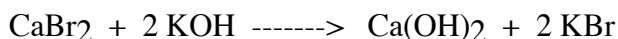
(1) Given the following reaction:



What mass, in grams, of  $\text{AlI}_3$  is consumed when 46 grams of  $\text{HgI}_2$  is produced?

- a) 27.5      b) 6.9      c) 137.6      d) 82.5      e) 68.8

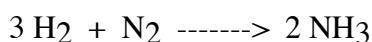
(2) Given the following reaction:



What mass, in grams, of  $\text{CaBr}_2$  is consumed when 96 g of  $\text{Ca(OH)}_2$  is produced?

- a) 173      b) 52      c) 86      d) 155      e) 259

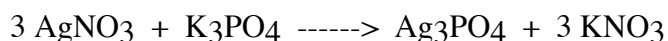
(3) Given the following reaction:



What mass, in grams, of  $\text{NH}_3$  is produced when 77 g of  $\text{N}_2$  is consumed?

- a) 187      b) 31.2      c) 18.7      d) 46.8      e) 93.5

(4) Given the following reaction:



What mass, in grams, of  $\text{Ag}_3\text{PO}_4$  is produced when 19 g of  $\text{K}_3\text{PO}_4$  is consumed?

- a) 46.8      b) 15      c) 37.5      d) 18.7      e) 112.4

# CHEMISTRY

## Stoichiometry Practice(Mass-Mass)

Answers:

1) 27.5

2) 259

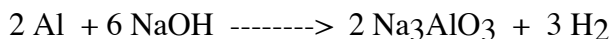
3) 93.5

4) 37.5



Multiple Choice: Show your set-up in the space provided and circle the answer of your choice.

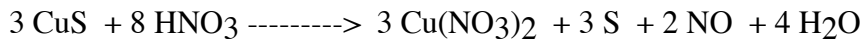
(1) Given the balanced equation:



What mass, in grams, of  $\text{Na}_3\text{AlO}_3$  is produced when  $6 \times 10^{23}$  molecules of  $\text{NaOH}$  is consumed?

- a) 240      b) 80      c) 64      d) 9.6      e) 48

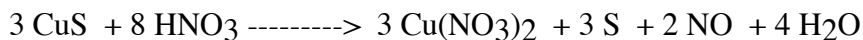
(2) Given the balanced equation:



What number of molecules of  $\text{Cu}(\text{NO}_3)_2$  is produced when 67 g of  $\text{HNO}_3$  is consumed?

- a) 7.18      b) 3.19      c) 5.98      d) 1.44      e) 2.39      [all  $\times 10^{23}$ ]

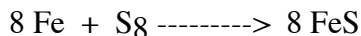
3. Given the balanced equation:



What number of molecules of  $\text{NO}$  is produced when 8 grams of  $\text{S}$  is produced?

- a) 1.99      b) 2.99      c) 0.33      d) 1.5      e) 1      [all  $\times 10^{23}$ ]

4. Given the balanced equation:



What mass, in grams, of  $\text{S}_8$  is consumed when  $5 \times 10^{23}$  molecules of  $\text{Fe}$  is consumed?

- a) 1.67      b) 3.34      c) 16.72      d) 5.57      e) 6.69

Answers:

1) 48

2)  $2.39 \times 10^{23}$

3)  $1 \times 10^{23}$

4) 3.34

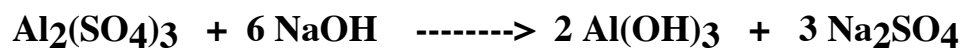
## A. MASS - MASS PROBLEMS

\_\_\_\_\_ 1. What mass of oxygen reacts when 84.9 g of iron is consumed in the following reaction:



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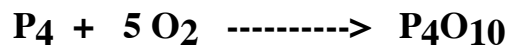
Given the following reaction:



\_\_\_\_\_ 2. What mass of  $\text{Al}(\text{OH})_3$  is produced if 22.7 g of  $\text{NaOH}$  is consumed?

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Given the following reaction:



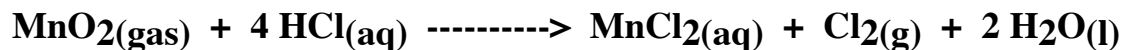
\_\_\_\_\_ 3. What mass of oxygen will react with 7.75 g of  $\text{P}_4$ ?

**B. MASS - VOLUME and VOLUME - VOLUME PROBLEMS**

Since chemical equations for chemical reactions state the relative numbers of moles for each reactant and product, these numbers can tell us the volumes at STP for those substances that are gases. Recall that the volume occupied by 1 mole of any gas at STP is 22.4 Liters. This relationship between moles (and hence, mass) and volumes can be used to solve problems of the types often called mass - volume and volume - volume.

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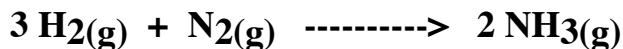
For the reaction



\_\_\_\_\_ 1. what volume of  $\text{Cl}_2(\text{g})$  measured at STP is produced when 7.65 g of  $\text{HCl}(\text{aq})$  reacts?

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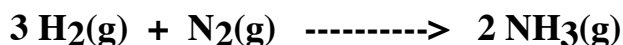
For the reaction



\_\_\_\_\_ 2. what mass of  $\text{NH}_3(\text{g})$  is produced when 2.15 L of  $\text{H}_2(\text{g})$  measured at STP reacts?

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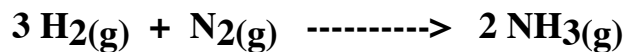
For the reaction



\_\_\_\_\_ 3. what volume of  $\text{NH}_3(\text{g})$  measured at STP is produced when 2.15 L of  $\text{H}_2(\text{g})$  reacts?

## C. MASS - MOLECULE and MOLECULE - MOLECULE PROBLEMS

For the reaction, at STP



\_\_\_\_\_ 1. what mass of  $\text{NH}_3(\text{g})$  is produced when  $2 \times 10^{23}$  molecules of  $\text{N}_2$  reacts?

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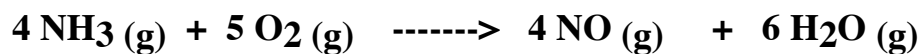
For the reaction, at STP



\_\_\_\_\_ 2. what number of molecules of  $\text{CO}_2(\text{g})$  will be produced if  $3 \times 10^{24}$  molecules of  $\text{O}_2(\text{g})$  reacts.

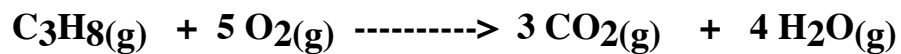
**D.VOLUME - MOLECULE PROBLEMS**

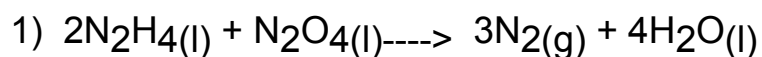
\_\_\_\_\_ 1. What number of molecules of O<sub>2</sub> is consumed when 33.6 liters of STP H<sub>2</sub>O is produced according to the following reaction:



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\_\_\_\_\_ 2. What number of liters of STP CO<sub>2</sub> is produced when  $7 \times 10^{23}$  molecules of O<sub>2</sub> is consumed?





If 10.81 g of  $\text{N}_2\text{H}_4$  is used, what mass of nitrogen is produced?

2) 10.6 g of magnesium react with excess hydrochloric acid.

- Write the balanced equation for the reaction.
- What mass of hydrogen gas is produced?
- Classify this reaction as single or double displacement, decomposition, synthesis, or combustion.

3) Potassium hydroxide decomposes into potassium oxide and water.

- Write the balanced equation for the reaction.
- What is the amount of water formed if 34.9 g of potassium hydroxide are used?

4) Barium hydroxide reacts with sulfuric acid.

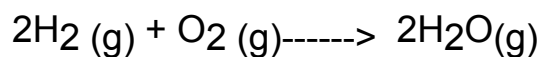
a) Write the balanced equation for the reaction.

b) What mass of barium hydroxide is needed to completely react with 9.58 g of sulfuric acid?

c) Classify this reaction as single or double displacement, decomposition, synthesis, or combustion.

5) The actual amount of product produced in a reaction is 33.13 g, although a mass-mass calculation predicted 46.87 g. What is the percentage yield of this product?

6) Hydrogen burns in oxygen according to the following reaction:



What is the percentage yield if 9.28 g of oxygen react with hydrogen to produce 8.81 g of water?



7) 28.0 g of magnesium carbonate reacts with sulfuric acid. What mass of water is produced?

8)  $\text{Na}_2\text{SiO}_3(\text{s}) + 8\text{HF}(\text{aq}) \rightarrow \text{H}_2\text{SiF}_6(\text{aq}) + 2\text{NaF}(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$   
If 17.4 g of HF is used, what mass of  $\text{H}_2\text{SiF}_6$  is produced?

9) 17.1 g of  $\text{C}_2\text{H}_6$  is burned in oxygen. What mass of oxygen was consumed?  
(Assume complete combustion.)

**KEY**

1) 14.2 g

2)

a)  $\text{Mg} + 2\text{HCl} \rightarrow \text{H}_2 + \text{MgCl}_2$

b) 0.881 g

c) Single displacement

3)

a)  $2\text{KOH} \rightarrow \text{K}_2\text{O} + \text{H}_2\text{O}$

b) 5.60 g

4)

a)  $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow 2\text{H}_2\text{O} + \text{BaSO}_4$

b) 16.7 g

c) double displacement

5) 70.68%

6) 84.4%

7) 5.98g

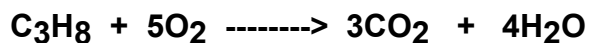
8) 15.7g

9) 63.8g

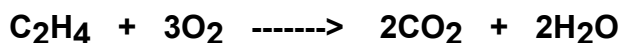
1. How many grams of  $C_2H_2$  will be produced, if 7.00g of  $Ca(OH)_2$  are also produced in the following reaction?



2. How many grams of  $H_2O$  will be produced, if 26.31g of  $CO_2$  are also produced in the following reaction?



3. How many grams of  $H_2O$  will be produced by the combustion of 73.56 grams of  $C_2H_4$ ?



4. How many moles of  $HCl$  will react with 18.13g of  $SrO$ ?



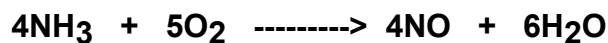
5. How many grams of  $\text{NH}_3$  will be produced, if 97.77g of  $\text{CaCO}_3$  are also produced in the reaction below?



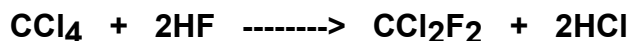
6. How many grams of  $\text{H}_2\text{O}$  are needed if 41.85g of  $\text{O}_2$  are to be produced from the reaction below?



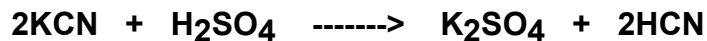
7. How many grams of  $\text{NO}$  will be produced, if 1.93g of  $\text{H}_2\text{O}$  are also produced in the reaction below?



8. In the chemical reaction below, how many grams of  $\text{HCl}$  will be produced by the reaction of 2343.42g of  $\text{CCl}_4$ ?



9. In the chemical reaction below, how many grams of KCN will react with 81.55g of H<sub>2</sub>SO<sub>4</sub>?



10. How many grams of Fe<sub>2</sub>O<sub>3</sub> will react with 18.97 grams of C in the REDOX reaction below?



11. In the following **unbalanced** combustion reaction, how many grams of C<sub>8</sub>H<sub>18</sub> will react with 4.78g of O<sub>2</sub>?



12. In this **unbalanced** chemical reaction



How many grams of H<sub>2</sub>O will be produced, if 41.95g of Fe<sub>3</sub>O<sub>4</sub> are reacted completely with hydrogen?