



De mooiste traktatie is educatie

# Chapter 3 - 5

# Reactions

# TTO 3





SKILL (CHEMIS)TREE







#### **MOLECULAR FORMULAS**

E A molecular formula tells you which types of atoms are present in a molecule and how many of each are present. For the latter we use indexes. These are written down on the lower right-hand side of the type of atom the belong to. The value of the index is equal to the number of atoms (of this type of atom) that a present in the molecule. Sometimes you might see a type of atom that does not have an index. That means there is only one

atom of this type of atom present and to shorten the formula a bit, a one does not have to be written down.

#### EXERCISE 1: MOLECULAR FORMULAS

- A Write down the molecular formula of a substance with two hydrogen atoms and one oxygen atom.
- B Write down the molecular formula of a substance with six hydrogen atoms and two carbon atoms.
- C Write down the molecular formula of a substance with six hydrogen atoms and two carbon atoms and one oxygen atom.
- D Write down the molecular formula of a substance with two oxygen atoms and two carbon atoms.
- E Write down the molecular formula of a substance with eight hydrogen atoms, one oxygen atom and four carbon atoms.
- F Write down the molecular formula of a substance with one carbon atom, one hydrogen atom and one nitrogen atom.

#### EXERCISE 2: MOLECULAR FORMULAS

- A Write down the molecular formula of a substance with one nitrogen atom, one oxygen atom and one hydrogen atom.
- B Write down the molecular formula of a substance with three carbon atoms, one oxygen atom and six hydrogen atoms.
- C Write down the molecular formula of a substance with two carbon atoms and two hydrogen atoms.
- D Write down the molecular formula of a substance with one nitrogen atom, one oxygen atom, six carbon atoms and five hydrogen atoms.
- E Write down the molecular formula of a substance with five carbon atoms, two oxygen atoms, two sulfur atoms and eight hydrogen atoms.
- F Write down the molecular formula of a substance with fourteen hydrogen atoms, eight carbon atoms, four nitrogen atoms and one oxygen atom.









LEVEL 1

EXER	RCISE 3: MO	LECULAR	FORMULAS				LEVEL 2	II 📕
Write each	e for the follow type of atom a	ing molecula re present.	ar formulas dow	vn which ty	pes of atoms a	are present a	nd how many at	coms of
A:	CH₃F	B:	$C_6H_{12}O_6$	C:	$N_2SO_2$	D:	$C_4H_9NO_2$	
EXER	RCISE 4: MO	LECULAR	FORMULAS				LEVEL 3	

Write down the molecular formula of the following substances:











#### WORD EQUATIONS

#### **EXERCISE 5: WORD EQUATIONS**

Write down the word equation of the following reactions:

- The reaction of iodine with chlorine to form iodinetrichloride. А
- В The reaction of hydrogen with oxygen to form water.
- С The reaction of sodium with chlorine to form sodiumchloride.
- LEVEL 2 **EXERCISE 6: WORD EQUATIONS**

Write down the word equation of the following reactions:

- А The decomposition of methane to hydrogen and carbon.
- В The reaction of hydrogen sulfide with oxygen to form water and sulfur dioxide.
- С The reaction of zinc with oxygen to form zinc oxide.

#### **EXERCISE 7: WORD EQUATIONS**

Write down the word equation of the following reactions:

- А The decomposition of trinitrotoluene to carbon dioxide, water, nitrogen and carbon.
- В The reaction of acetone with oxygen to form water and carbon dioxide.
- С The reaction of iron with oxygen to form iron(III)oxide.











#### **BALANCING REACTION EQUATIONS**

A reaction equation tells you the ratio in which substances react. Coefficients are put in front of the molecular formulas and represent how many molecules react or are formed in comparison to the other molecules. It is also important to note that atoms cannot disappear. During chemical reactions they will just covalently bond to other atoms, changing the molecules. So before the reaction and after the reaction we should have the same amount of each type of atom.

Take a look at the example below.

$$2 H_2 + O_2 \rightarrow 2 H_2O$$

On both the left and the right hand side of the arrow you can see that there are two oxygen atoms and four hydrogen atoms present.

#### **EXERCISE 8: MOLECULAR RATIO**

А Have a look at the equation. Imagine that 5 molecules of  $O_2$  react. How many molecules of  $H_2O$  will be produced?

$$2 \text{ H}_2 + \text{O}_2 \rightarrow 2 \text{ H}_2\text{O}$$

В Have a look at the equation. Imagine that 12 molecules of  $H_2$  react. How many molecules of  $N_2$  will be produced?

$$3 \text{ H}_2 + \text{N}_2 \rightarrow 2 \text{ NH}_3$$

С Have a look at the equation. Imagine that 2000 molecules of AI are produced. How many molecules of Al<sub>2</sub>O<sub>3</sub> will have to react?

$$2 \text{ Al}_2\text{O}_3 \rightarrow 4 \text{ Al} + 3 \text{ O}_2$$

D Have a look at the equation. Imagine that 4000000 molecules of  $O_2$  are produced. How many molecules of S<sub>8</sub> will have to react?

$$S_8 + 8 O_2 \rightarrow 8 SO_2$$









EXE	RCISE 9: BAL	ANCING EQUA	TIONS		LEVEL 1	
Write	e the following e	equations in your	exercise book and b	alance them.		
A	2 Ca	+ O <sub>2</sub>	$\rightarrow$ CaO			
В	К	+ O <sub>2</sub>	ightarrow 2 K <sub>2</sub> O			
С	Fe	+ 3 O <sub>2</sub>	$\rightarrow$ Fe <sub>2</sub> O <sub>3</sub>			
D	Pb	+ 02	ightarrow 2 PbO			
EXER	RCISE 10: BA	LANCING EQU	ATIONS		LEVEL 2	
Write	e the following e	equations in your	exercise book and b	alance them.		
A	H <sub>2</sub>	+ Cl <sub>2</sub>	$\rightarrow$ HCl			
В	Mg	+ N <sub>2</sub>	$\rightarrow \dots Mg_3N_2$			
С	N <sub>2</sub>	+ H <sub>2</sub>	$\rightarrow \dots NH_3$			
D	H <sub>2</sub> O <sub>2</sub>		$\rightarrow \ H_2 O$	+ 02		
EXE	RCISE 11: BA	LANCING EQU	ATIONS		LEVEL 2	
Write	e the following e	equations in your	exercise book and b	alance them.		
A	P <sub>4</sub>	+ O <sub>2</sub>	$\rightarrow \dots P_2O_5$			
В	NaN <sub>3</sub>		$\rightarrow$ Na	+ N <sub>2</sub>		
С	CO	+ H <sub>2</sub>	$\rightarrow$ CH <sub>3</sub> OH			
D	KClO₃		$\rightarrow \dots$ KCl	+ O <sub>2</sub>		

#### EXERCISE 12: BALANCING EQUATIONS

Write the following equations in your exercise book and balance them.

А	C <sub>3</sub> H <sub>8</sub>	+ O <sub>2</sub>	$\rightarrow$ $CO_2$	+ H <sub>2</sub> O
В	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		$\rightarrow \dots C_2 H_5 OH$	+ CO <sub>2</sub>
С	H <sub>2</sub> SO <sub>4</sub>	+ Cu	$\rightarrow$ Cu <sub>2</sub> SO <sub>4</sub>	+ H <sub>2</sub>
D	Fe(OH)₃	+ Na	$\rightarrow$ NaOH	+ Fe





LEVEL 2

EXER	RCISE 13: BAL	ANCING EQU	ATIONS	LEVEL 2
Write	the following eq	uations in your e	exercise book and balance them.	
А	NH <sub>3</sub>	+ O <sub>2</sub>	$\rightarrow \dots NO$ + H <sub>2</sub> O	
В	SO <sub>2</sub> + H	$H_2O + \dots Br_2 \rightarrow .$	H <sub>2</sub> SO <sub>4</sub> + HBr	
С	HCl	+ O <sub>2</sub>	$\rightarrow \dots Cl_2 + \dots H_2O$	
D	H <sub>2</sub> SO <sub>4</sub>	+ Fe	$\rightarrow \dots$ Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + $\dots$ H <sub>2</sub>	

#### EXERCISE 14: BALANCING EQUATIONS

Write the following equations in your exercise book and balance them.

A	Al	+ Fe <sub>2</sub> O <sub>3</sub>	$\rightarrow$ Al <sub>2</sub> O <sub>3</sub>	+ Fe
В	FeS	+ O <sub>2</sub>	$\rightarrow$ Fe <sub>2</sub> O <sub>3</sub>	+ SO <sub>2</sub>
С	Fe(OH)₃	+ H <sub>2</sub>	$\rightarrow$ H <sub>2</sub> O	+ Fe

#### EXERCISE 15: BALANCING EQUATIONS

Write the following equations in your exercise book and balance them.

А	PCl₅	+ H <sub>2</sub> O	$\rightarrow H_3PO_4$	+ HCl
В	As	+ NaOH	$\rightarrow$ Na <sub>3</sub> AsO <sub>3</sub>	+ H <sub>2</sub>
С	Fe <sub>2</sub> O <sub>3</sub>	+ CO	→ Fe + CO;	2

You can also practice balancing equations on the website listed below.

Write the balanced equations in your exercise book. You can also find the links in the description of the ScheikundeFrits clip about reaction equations.

https://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiome/balancing-chemicalequations/e/balancing\_chemical\_equations

http://education.jlab.org/elementbalancing/ (choose advanced)

http://www.sciencegeek.net/Chemistry/taters/EquationBalancing.htm





LEVEL 3



#### **EXERCISE 18: REACTION EQUATIONS WITH GROUPS**

Write the following equations in your exercise book and balance them.

А	CaCl <sub>2</sub>	+ Na <sub>3</sub> PO <sub>4</sub>	$\rightarrow$ Ca <sub>3</sub> P <sub>2</sub> O <sub>8</sub>	+ NaCl
В	Fe <sub>2</sub> (CO <sub>3</sub> ) <sub>3</sub>	+ Pb <sub>3</sub> (PO <sub>4</sub> ) <sub>4</sub>	$\rightarrow$ FePO <sub>4</sub>	+ Pb(CO <sub>3</sub> ) <sub>2</sub>
С	Fe(OH)₃	+ Cl <sub>2</sub>	$\rightarrow$ H <sub>2</sub> O <sub>2</sub>	+ FeCl₃





**COMBUSTION REACTIONS** 

#### A combustion reaction is a reacting of a fuel with oxygen. So when making a reaction equation both of them will be the reactants. The reaction products can either be found in the text related to the reaction or, if the combustion reaction is a complete combustion, are predictable. The list below this

paragraph denotes which reaction products are to be expected (if the combustion reaction is a complete combustion) if the fuel contains certain types of atoms.

**Fuel contains** C-atoms H-atoms S-atoms

Product Carbon dioxide (CO<sub>2</sub>) Water (H<sub>2</sub>O) Sulfur dioxide (SO<sub>2</sub>)

#### **EXERCISE 19: COMBUSTION REACTIONS**

Which reaction products are formed during the complete combustion of the following substances?

- $CS_2$ А
- В  $C_2H_6O$
- С  $H_2S$
- D  $C_2H_2SO$

#### **EXERCISE 20: COMBUSTION REACTIONS**

Write the following equations in your exercise book and balance them.

A	CS <sub>2</sub>	+ O <sub>2</sub>	$\rightarrow$ CO <sub>2</sub>	+ SO <sub>2</sub>
В	C <sub>2</sub> H <sub>6</sub>	+ O <sub>2</sub>	$\rightarrow$ $CO_2$	+ H <sub>2</sub> O
С	C <sub>4</sub> H <sub>10</sub> O	+ O <sub>2</sub>	$\rightarrow$ $CO_2$	+ H <sub>2</sub> O

#### **EXERCISE 21: COMBUSTION REACTIONS**

Write the following equations in your exercise book and complete and balance them.

А	C <sub>4</sub> H <sub>8</sub>	+ O <sub>2</sub>	$\rightarrow$
В	H <sub>2</sub> S	+ O <sub>2</sub>	$\rightarrow$

+...02

```
Sc heikunde
     its.nl
```

... C4H8O

С











#### **EXERCISE 22: COMBUSTION REACTIONS**

Write the following equations in your exercise book and complete and balance them.

 $A \qquad \dots C_4 H_4 O \qquad \longrightarrow \qquad$ 

 $B \qquad \dots C_4 H_{10} \qquad \longrightarrow \qquad$ 

 $\mathsf{C} \qquad \dots \mathsf{C}_3\mathsf{H}_6\mathsf{S} \qquad \longrightarrow \qquad$ 







#### MAKING REACTION EQUATIONS

#### **EXERCISE 23: MAKING REACTION EQUATIONS**

Give the word equation and reaction equation of the following reactions. Take in mind that some reactions are combustion reactions in which you will have to determine what the products of the reaction. Note that some elements consist of multiple atoms.

- A The decomposition of sodium chloride (NaCl) to sodium en chlorine.
- B The complete combustion of methane (CH<sub>4</sub>).
- C The complete combustion of carbon.

#### EXERCISE 24: MAKING REACTION EQUATIONS

Give the word equation and reaction equation of the following reactions. Take in mind that some reactions are combustion reactions in which you will have to determine what the products of the reaction. Note that some elements consist of multiple atoms.

- A The reaction between iodine and chlorine to iodine trichloride (ICl<sub>3</sub>).
- B The complete combustion of ethane  $(C_2H_6)$ .
- C The complete combustion of hydrogen.

#### EXERCISE 25: MAKING REACTION EQUATIONS

Give the word equation and reaction equation of the following reactions. Take in mind that some reactions are combustion reactions in which you will have to determine what the products of the reaction. Note that some elements consist of multiple atoms.

- A The reaction between hydrogen and carbon dioxide to water and methane (CH<sub>4</sub>).
- B The complete combustion of dodecane (C<sub>12</sub>H<sub>26</sub>).
- C The complete combustion of sulfur.













#### EXERCISE 26: MAKING REACTION EQUATIONS

Give the word equation and reaction equation of the following reactions. Take in mind that some reactions are combustion reactions in which you will have to determine what the products of the reaction. Note that some elements consist of multiple atoms.

- A The decomposition of aluminium oxide (Al<sub>2</sub>O<sub>3</sub>) to aluminium and oxygen.
- B The complete combustion of octane ( $C_8H_{18}$ ).
- C The complete combustion of ethanethiol ( $C_2H_6S$ ).

#### EXERCISE 27: MAKING REACTION EQUATIONS

Give the word equation and reaction equation of the following reactions. Take in mind that some reactions are combustion reactions in which you will have to determine what the products of the reaction. Note that some elements consist of multiple atoms.

- A The reaction between water and carbon to hydrogen and carbon monoxide (CO).
- $B \qquad \qquad \text{The complete combustion of hexane (C_6H_{14}).}$
- C The complete combustion of carbondifulfide (CS<sub>2</sub>).

### EXERCISE 28: MAKING REACTION EQUATIONS LEVEL 3

Give the word equation and reaction equation of the following reactions.

- A The reaction of nitric acid (HNO<sub>3</sub>) and iron to iron(III)nitrate (Fe(NO<sub>3</sub>)<sub>3</sub>) and hydrogen.
- $B \qquad \qquad \text{The complete combustion of acetone (C}_3H_6O).$
- $C \qquad \qquad \mbox{The complete combustion of 2,2-disulfanylethane-1,1-diol} \ (C_2H_6S_2O_2).$

#### EXERCISE 29: MAKING REACTION EQUATIONS

Give the word equation and reaction equation of the following reactions.

- A The reaction of sulfuric acid  $(H_2SO_4)$  and aluminium to aluminium sulphate  $(Al_2(SO_4)_3)$  and hydrogen.
- $B \qquad \qquad \text{The complete combustion of ethanol (C_2H_5OH).}$
- $C \qquad \qquad \mbox{The complete combustion of 1-sulfanylpropane-2-ol} \ (C_3H_8SO).$













UNIT	S		
EXER	CISE 30: UNITS	LEVEL 1	
Conve	ert the following units:		
А	3.0 g = kg		
В	2.0 dm <sup>3</sup> = L		
С	5.4 kg = g		
D	7.2 mL = L		
EXER	CISE 31: UNITS	LEVEL 2	
Conve	ert the following units:		
А	2.0 mg = kg		
В	2.0 cm <sup>3</sup> = L		
С	8.2 kg = g		
D	9.1 mL = dm <sup>3</sup>		

#### EXERCISE 32: UNITS

Convert the following units:

- A  $4.0 \text{ g/L} = ... \text{ kg/m}^3$
- B  $2.4 \text{ g/cm}^3 = \dots \text{g/L}$
- C 5.7 ton = ... g
- D 6.2 mL = ... m<sup>3</sup>

You can find more exercises here: <u>http://vaklokaal-nlt.nl/wp-content/uploads/2009/01/eenheden.xls</u>





## EXERCISE 33: LAVOISIER'S LAW

- A Water is formed from the reaction between hydrogen and oxygen. Calculate the mass in grams of hydrogen and oxygen combined that is required to form 72 grams of water.
- B Explain why the total mass of the substances on the left-hand side of the arrow have to be equal to the total mass of the substances on the right-hand side of the arrow.

EXERCISE 34: LAVOISIER'S LAW

Water is formed from the reaction between hydrogen and oxygen. Calculate the mass in grams of water that is formed when 16 grams of hydrogen reacts with 128 grams of oxygen.

## LAVOISIER'S LAW

You have learned about Lavoisier' law or the law of conservation of mass. The law dictates that mass can't disappear, it can only move from one place to another, because it is bound to each of the atoms. This means that the total mass of the substances that have reacted is always equal to the total mass of the reaction products.

## Scheikunde Francium







#### **MOLECULAR MASS**

Each type of atom has its own specific mass. Imagine having a bag of marbles with all marbles being exactly the same. If you know the mass of one marble and know how many marbles are in the bag, you could calculate the combined mass of the marbles by multiplying the mass of a marble by the amount of marbles, because all marbles are exactly the same and therefor have the same mass.

The same thing applies to atoms and the molecules the atoms form. Oxygen, O<sub>2</sub>, consists of two oxygen atoms. Since these atoms are identical, you will just have to know the mass of one atom (the atomic mass) in order to calculate the total mass of the molecule. This is called the molecular mass.

The atomic (and molecular) mass has its own unit: u. We don't use grams because the atomic and molecular mass are very small and it is easier to calculate the mass in u. In your textbook, you can find a table with the atomic mass of each type of atom.

EXERCISE 35: MOLECULAR MASS	LEVEL 1				
Calculate the molecular mass of these molecules. Use the	appendix in your textbook.				
A O <sub>2</sub> B S <sub>8</sub>	C Br <sub>2</sub> D O <sub>3</sub>				
EXERCISE 36: MOLECULAR MASS	LEVEL 2				
Calculate the molecular mass of these molecules. Use the	appendix in your textbook.				
$\begin{array}{llllllllllllllllllllllllllllllllllll$	C NO <sub>2</sub> D C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>				
EXERCISE 37: MOLECULAR MASS	LEVEL 3				
Calculate the molecular mass of these molecules. Use the appendix in your textbook.					

A CF<sub>4</sub> C CH<sub>2</sub>Cl<sub>2</sub>

B SiO<sub>2</sub> D Al(OH)<sub>3</sub>









## Scheikunde Fi its.nl

### CHEMISTRY - YEAR 3 - REACTIONS

#### **MASS RATIO**

**EXERCISE 38: MASS RATIO** 

#### А Frits has a fruit salade with 30 grams of apples and 60 grams of pears. What is the mass ratio between the apples and the pears in the fruit salade? Frits has a fruit salade with 60 grams of grapes and 40 grams of bananas. What is the mass ratio

В between the grapes and the bananas in the fruit salade?

EXERC	ISE 39: MASS RATIO	LEVEL 2	
A	Oxygen and hydrogen react to form water. 8.0 Grams of oxygen will react with What is the mass ratio in which oxygen and hydrogen react?	h 1.0 grams of hy	drogen.
В	Nitrogen and hydrogen react to form ammonia. 28.0 Grams of nitrogen will re	eact with 6.0 gram	ns of

hydrogen. What is the mass ratio in which nitrogen and hydrogen react?

#### **EXERCISE 40: MASS RATIO**

- Methane and oxygen react to form carbon dioxide and water. 8.0 Grams of methane reacts with 32.0 А grams of oxygen. During the reaction 22.0 grams of carbon dioxide and 18.0 grams of water are formed. What is the mass ratio in which oxygen reacts and carbon dioxide is formed?
- В Nitrogen and oxygen react to form dinitrogen monoxide. 14.0 Grams of nitrogen reacts with 8.0 grams of oxygen. What is the mass ratio in which oxygen reacts and dinitrogen monoxide is formed?











#### CALCULATE MASS RATIO

The reaction equation tells you the ratio in which the molecules react.

$$2 H_2 + O_2 \rightarrow 2 H_2O$$

In the example above, you can see that two hydrogen molecules react with one oxygen molecule. The molecular ratio in which hydrogen and oxygen react is 2 : 1. You can also see that the molecular ratio in which oxygen reacts and water is formed 1 : 2 is.

However, we can't just measure the number of molecules if we want to perform a reaction. What we can do is measure a certain mass of a substance. Therefore, it would be useful to know the mass ratio in which molecules react. Then we could make sure we have enough of both substances to perform the reaction with a little waste as possible or to make sure we get a certain amount of product.

You can calculate the mass ratio of a reaction by multiplying the molecular mass of the substances with the coefficients of the molecules, which is found in the reaction equation.

#### EXERCISE 41: CALCULATE MASS RATIO

A Calculate the mass ratio in which O<sub>2</sub> en H<sub>2</sub> react.

 $2 \text{ H}_2 + \text{O}_2 \rightarrow 2 \text{ H}_2\text{O}$ 

B Calculate the mass ratio in which H<sub>2</sub> en N<sub>2</sub> react.

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

C Calculate the mass ratio in which Al en  $O_2$  are formed.

 $2 \text{ Al}_2\text{O}_3 \rightarrow 4 \text{ Al} + 3 \text{ O}_2$ 

 $D \qquad \quad Calculate the mass ratio in which O_2 en S_8 react.$ 

 $S_8 + 8 \text{ O}_2 \rightarrow 8 \text{ SO}_2$ 









#### EXERCISE 42: CALCULATE MASS RATIO

A Calculate the mass ratio in which H<sub>2</sub> and O<sub>2</sub> react.

 $2 H_2 + O_2 \rightarrow 2 H_2O$ 

 $B \qquad \ \ Calculate the mass ratio in which H_2 and N_2 react.$ 

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

 $C \qquad \ \ Calculate the mass ratio in which Al_2O_3 \ reacts and Al \ is formed.$ 

$$2 \text{ Al}_2\text{O}_3 \rightarrow 4 \text{ Al} + 3 \text{ O}_2$$

 $D \qquad \ \ Calculate the mass ratio in which S_8 and O_2 react.$ 

 $S_8 + 8 \text{ O}_2 \rightarrow 8 \text{ SO}_2$ 

#### EXERCISE 43: CALCULATE MASS RATIO

A Calculate the mass ratio in which H<sub>2</sub> reacts and H<sub>2</sub>O is formed.

 $2 \text{ H}_2 + \text{O}_2 \rightarrow 2 \text{ H}_2\text{O}$ 

B Calculate the mass ratio in which  $H_2$  reacts and  $NH_3$  is formed.

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

C Calculate the mass ratio in which  $AI_2O_3$  reacts and  $O_2$  is formed.

 $2 \text{ Al}_2\text{O}_3 \rightarrow 4 \text{ Al} + 3 \text{ O}_2$ 

D Calculate the mass ratio in which  $S_8$  reacts and  $SO_2$  is formed.

 $S_8 + 8 \text{ O}_2 \rightarrow 8 \text{ SO}_2$ 







LEVEL 2



EXERCISE 45: CALCULATE MASS	LEVEL 1	
Sodium and chlorine react in a mass ratio of 23.0 : 35.5 to form sodium chloride that has to react when 1.5 grams of sodium reacts.	e. Calculate the mass o	of chlorine
EXERCISE 46: CALCULATE MASS	LEVEL 2	
Iron and oxygen react in a mass ratio of 55.8 : 16.0 to form iron(II)oxide. Calcula is formed when 2.5 grams of iron react.	ate the mass of iron(II)	oxide that
EXERCISE 47: CALCULATE MASS	LEVEL 2	
Copper and oxygen react in a mass ratio of 127.0 : 16.0 to form copper(I)oxide. copper(I)oxide that is formed when 3.0 grams of oxygen react.	Calculate the mass of	
EXERCISE 48: CALCULATE MASS	LEVEL 2	
Aluminium and oxygen react in a mass ratio of 27.0 : 24.0 to form aluminium ox aluminium oxide that is formed when 7.0 grams of aluminium react.	xide. Calculate the ma	ss of
EXERCISE 49: CALCULATE MASS	LEVEL 3	
Calcium and chlorine react to form calcium chloride. The mass ratio in which ch chloride is formed is 71.0 : 111.0. Calculate the mass of calcium that reacts whe is formed.	lorine reacts and calci en 3.0 grams of calciun	um n chloride





#### EXERCISE 50: CALCULATE MASS

Calcium and oxygen react to form calcium oxide. The mass ratio in which calcium reacts and calcium oxide is formed is 5.0 : 7.0. Calculate the mass of oxygen that reacts with 5.0 grams of calcium.











#### EXERCISE 57: CALCULATE MASS

Calculate the mass of PCI<sub>5</sub> that has to react to form 3.5 grams of HCl. Balance the reaction equation first.

 $PCI_5 + H_2O \rightarrow H_3PO_4 + HCI$ 







SURPLUS

Excess is an amount of substance that, according to the reaction equation, is in excess in the reaction mixture. This excess can't be used in the chemical reaction because there is not enough of the other reactant(s) to react with. By calculating the maximum mass that can react of each reactant, you can calculate which substance has an excess present.

#### EXERCISE 58: EXCESS

25.0 grams  $SnO_2$  and 3.0 grams of  $H_2$  are combined in a closed off space and react according to the reaction equation below. Try to calculate the mass ratio between  $SnO_2$  and  $H_2$ . If you can't calculate the mass ratio, assume that it is 66.0 : 1.0.

 $SnO_2 + 2 H_2 \rightarrow Sn + 2 H_2O$ 

- A Calculate the mass of  $SnO_2$  that reacts with 3.0 grams of  $H_2$ .
- B Calculate the mass of H<sub>2</sub> that reacts with 25.0 grams of SnO<sub>2</sub>.
- C Calculate which of the substances is in excess and this amount of the excess.

#### EXERCISE 59: EXCESS

4.5 grams of KOH and 11.0 grams of  $H_3PO_4$  are combined in a closed off space and react according to the reaction equation below. Calculate which substance is in excess and the amount of the excess.

 $3 \text{ KOH} + \text{H}_3\text{PO}_4 \rightarrow \text{K}_3\text{PO}_4 + 3 \text{ H}_2\text{O}$ 

#### EXERCISE 60: EXCESS

12.0 grams of  $KNO_3$  and 12. 0 grams of  $H_2CO_3$  are combined in a closed off space and react according to the reaction equation below.

$$2\ \text{KNO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{K}_2\text{CO}_3 + 2\ \text{HNO}_3$$

A Calculate which substance is in excess and the amount of the excess.

B Calculate the mass of  $K_2CO_3$  and the mass of  $HNO_3$  that is formed.











