

Transition guide

This resource is designed to help you make the transition from GCSE to A-level Chemistry.

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You're studying A-level Chemistry, congratulations!

Studying chemistry after your GCSEs really develops your practical and mathematical skills. If you enjoy experimenting in the lab, you'll love it.

At first, you may find the jump in demand from GCSE a little daunting, but if you follow the tips and advice in this guide, you'll soon adapt.

We recommend you keep this somewhere safe, as you may like to refer to the information inside throughout your studies.

Why study A-level Chemistry?

Chemistry students get to investigate a huge range of ideas: the big question you'll ask yourself is 'what is the world made of?' If you choose it as career, **you have the potential to help solve all sorts of problems. You could work on a cure for cancer, or you might develop a new food: the possibilities are endless.**

Even if you don't decide to work in chemistry, studying it still develops useful and transferable skills for other careers. You'll develop research, **problem solving and analytical skills, alongside teamwork and communication. Universities and businesses regard all of these very highly.**

Possible degree options

According to bestcourse4me.com, the top five degree courses taken by students who have A-level Chemistry are:

- Chemistry
- Biology
- Pre-clinical medicine
- Mathematics
- Pharmacology.

For more details, go to the bestcourse4me.com website, or [UCAS](http://ucas.ac.uk).

Which career appeals to you?

Studying Chemistry at A-level or degree opens up plenty of career opportunities, such as:

- analytical chemist
- chemical engineer
- clinical biochemist
- pharmacologist
- doctor
- research scientist (physical sciences)
- toxicologist
- environmental consultant
- higher education lecturer or secondary school teacher
- patent attorney
- science writer

Specification at a glance

Physical chemistry

1. Atomic structure
2. Amount of substance
3. Bonding
4. Energetics
5. Kinetics
6. Chemical equilibria, Le Chatelier's principle and K_c
7. Oxidation, reduction and redox equations
8. Thermodynamics
9. Rate equations
10. Equilibrium constant K_p for homogeneous systems
11. Electrode potentials and electrochemical cells
12. Acids and bases Inorganic chemistry

Inorganic chemistry

1. Periodicity
2. Group 2, the alkaline earth metals
3. Group 7 (17), the halogens
4. Properties of Period 3 elements and oxides
5. Transition metals
6. Reactions of ions in aqueous solution

Organic chemistry

1. Introduction to Organic Chemistry
2. Alkanes
3. Halogenoalkanes
4. Alkenes
5. Alcohols
6. Organic analysis
7. Optical isomerism
8. Aldehydes and ketones
9. Carboxylic acids and derivatives
10. Aromatic chemistry
11. Amines
12. Polymers
13. Amino acids, proteins and DNA
14. Organic synthesis
15. NMR spectroscopy
16. Chromatography

The assessment for the A-level consists of three exams

Paper 1	+	Paper 2	+	Paper 3
What's assessed <ul style="list-style-type: none">• Relevant Physical chemistry topics (sections 3.1.1 to 3.1.4, 3.1.6 to 3.1.8 and 3.1.10 to 3.1.12)• Inorganic chemistry (section 3.2)• Relevant practical skills		What's assessed <ul style="list-style-type: none">• Relevant Physical chemistry topics (sections 3.1.2 to 3.1.6 and 3.1.9)• Organic chemistry (section 3.3)• Relevant practical skills		What's assessed <ul style="list-style-type: none">• Any content• Any practical skills
How it's assessed <ul style="list-style-type: none">• Written exam: 2 hours• 105 marks• 35% of A-level		How it's assessed <ul style="list-style-type: none">• Written exam: 2 hours• 105 marks• 35% of A-level		How it's assessed <ul style="list-style-type: none">• Written exam: 2 hours• 90 marks• 30% of A-level
Questions <ul style="list-style-type: none">• 105 marks of short and long answer questions		Questions <ul style="list-style-type: none">• 105 marks of short and long answer questions		Questions <ul style="list-style-type: none">• 40 marks of questions on practical techniques and data analysis• 20 marks of questions testing across the specification• 30 marks of multiple choice questions

Places to go for help

1. AQA website is a great place to start.

AQA [Chemistry webpages](#) are aimed at teachers, but you may find them useful too. Information includes:

- The [specification](#) – this explains exactly what you need to learn for your exams.
- [Practice exam papers](#).
- Lists of [command words](#) and [subject specific vocabulary](#) – so you understand the words to use in exams.
- [Practical handbooks](#) explain the practical work you need to know.
- Past papers from the [old specification](#). Some questions won't be relevant to **the new A-level** so please check with your teacher.
- [Maths skills support](#).
- [Web resources page](#) with many links to other resources to support study.

2. The Royal Society of Chemistry (RSC)

The RSC do everything from naming new elements and lobbying MPs, to improving funding for research sciences in the UK. You'll find lots of handy resources on their [website](#).

3. The student room

Join the A-level Chemistry forums and share thoughts and ideas with other students if you're stuck with your homework. Just be very careful not to share any details about your assessments, there are serious consequences if you're caught cheating. Visit thestudentroom.co.uk

4. Textbooks

AQA [approved textbooks](#) are published by Collins, Hodder and Oxford University Press. Textbooks from other publishers will also be suitable, but you'll need to double check that the content and formula symbols they use match the AQA specification.

5. Revision guides

These are great if you want a quick overview of the course when you're revising for your exams. Remember to use other tools as well, as these aren't detailed enough on their own.

6. YouTube

YouTube has thousands of Chemistry videos. Just be careful to look at who produced the video and why, because some videos distort the facts. Check the author, date and comments – these help indicate whether the clip is reliable. If in doubt, ask your teacher.

7. Magazines

Focus, New Scientist or Philip Allan updates can help you put the chemistry you're learning in context.

Useful information and activities

Greek letters

Greek letters are used often in science. They can be used as symbols for numbers (such as $\pi = 3.14\dots$), as prefixes for units to make them smaller (eg $\mu\text{m} = 0.000\,000\,001\text{ m}$) or as symbols for particular quantities (such as λ which is used for wavelength). The Greek alphabet is shown below.

A	α	alpha
B	β	beta
Γ	γ	gamma
Δ	δ	delta
E	ϵ	epsilon
Z	ζ	zeta
H	η	eta
Θ	θ	theta
I	ι	iota
K	κ	kappa
Λ	λ	lambda
M	μ	mu

N	ν	nu
Ξ	ξ	ksi
O	\omicron	omicron
Π	π	pi
P	ρ	rho
Σ	ς or σ	sigma
T	τ	tau
Υ	υ	upsilon
Φ	ϕ	phi
X	χ	chi
Ψ	ψ	psi
Ω	ω	omega

Activity 1

A lot of English words are derived from Greek ones, but it's difficult to see as the **alphabet is so different**.

Many of the Greek letters are pronounced like the start of their name. For example, omega is pronounced "o", sigma is pronounced "s" and lambda is pronounced "l".

See if you can work out what the following Greek words mean by comparing the phonetic spelling with similar English words.

Πυθαγόρας
Ωκεανος
μόνος
Τηλε
Τρωγλοδύτης

Name of a mathematician
Atlantic, Pacific or Arctic...
Single
Far or distant
Cave dweller

SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or °C). Sometimes there are different units available for the same type of measurement, for example ounces, pounds, kilograms and tonnes are all used as units for mass.

To reduce confusion and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	N	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units.

For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km.

The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^9	1 000 000 000	
Mega	M	10^6	1 000 000	
kilo	k	10^3	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 2

Which SI unit and prefix would you use for the following quantities?

- The mass of water in a test tube.
- The time taken for a solution to change colour.
- The radius of a gold atom.
- The volume of water in a burette.
- The amount of substance in a beaker of sugar.
- The temperature of the blue flame from a Bunsen burner.

Sometimes, there are units that are used that are not combinations of SI units and prefixes. These are often multiples of units that are helpful to use. For example, one litre is 0.001 m^3 .

Activity 3

Rewrite the following in SI units.

1. 5 minutes
2. 2 days
3. 5.5 tonnes

Activity 4

Rewrite the following quantities.

1. 0.00122 metres in millimetres
2. 104 micrograms in grams
3. 1.1202 kilometres in metres
4. 70 decilitres in millilitres
5. 70 decilitres in litres
6. 10 cm^3 in litres

Important vocabulary for practical work

There are many words used in practical work. You will have come across most of these words in your GCSE studies. It is important you are using the right definition for each word.

Activity 5

Join the boxes to link the word to its definition.

Accurate

A statement suggesting what may happen in the future.

Data

An experiment that gives the same results when a different person carries it out, or a different technique or set of equipment is used.

Precise

A measurement that is close to the true value.

Prediction

An experiment that gives the same results when the same experimenter uses the same method and equipment.

Range

Physical, chemical or biological quantities or characteristics.

Repeatable

A variable that is kept constant during an experiment.

Reproducible

A variable that is measured as the outcome of an experiment.

Resolution

This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.

Uncertainty

The interval within the true value can be expected to lie.

Variable

The spread of data, showing the maximum and minimum values of the data.

Control variable

Measurements where repeated measurements show very little spread.

Dependent variable

Information, in any form, that has been collected.

Precise language

It is essential at AS and A-level to use precise language when you write reports and when you answer examination questions. You must always demonstrate that you understand a topic by using the correct and appropriate terms.

For example, you should take care when discussing bonding to refer to the correct particles and interactions between them.

Also, when discussing the interaction between particles in an ionic solid, you would demonstrate a lack of understanding if you referred to the particles as atoms or molecules instead of ions or the interaction between these ions as intermolecular forces rather than electrostatic forces. In this case, use of the incorrect terms would result in the loss of all the marks available for that part of a question.

Take care also to use the word 'chloride' and not 'chlorine' when referring to the ions in a compound such as sodium chloride. The word 'chlorine' should only be used for atoms or molecules of the element.

The periodic table

The periodic table of elements is shown on the back page of this booklet. The A-level course will build on what you've learned in your GCSE studies.

Activity 6

On the periodic table on the following page:

- Draw a line showing the metals and non-metals.
- Colour the transition metals blue.
- Colour the halogens yellow.
- Colour the alkali metals red.
- Colour the noble gases green.
- Draw a blue arrow showing the direction of periods.
- Draw a red arrow showing the direction of groups.
- Draw a blue ring around the symbols for all gases.
- Draw a red ring around the symbols for all liquids.

1 2 3 4 5 6 7 0

(18)

1.0
H
hydrogen
1

Key

relative atomic mass
symbol
name
atomic (proton) number

(1) (2)

6.9
Li
lithium
3

9.0
Be
beryllium
4

23.0
Na
sodium
11

24.3
Mg
magnesium
12

(13)

10.8
B
boron
5

27.0
Al
aluminium
13

(14)

12.0
C
carbon
6

28.1
Si
silicon
14

(15)

14.0
N
nitrogen
7

31.0
P
phosphorus
15

(16)

16.0
O
oxygen
8

32.1
S
sulfur
16

(17)

19.0
F
fluorine
9

35.5
Cl
chlorine
17

(18)

4.0
He
helium
2

20.2
Ne
neon
10

39.9
Ar
argon
18

(3)

45.0
Sc
scandium
21

88.9
Y
yttrium
39

138.9
La *
lanthanum
57

(4)

47.9
Ti
titanium
22

91.2
Zr
zirconium
40

178.5
Hf
hafnium
72

(5)

50.9
V
vanadium
23

92.9
Nb
niobium
41

180.9
Ta
tantalum
73

(6)

52.0
Cr
chromium
24

96.0
Mo
molybdenum
42

183.8
W
tungsten
74

(7)

54.9
Mn
manganese
25

[98]
Tc
technetium
43

186.2
Re
rhenium
75

(8)

55.8
Fe
iron
26

101.1
Ru
ruthenium
44

190.2
Os
osmium
76

(9)

58.9
Co
cobalt
27

102.9
Rh
rhodium
45

192.2
Ir
iridium
77

(10)

58.7
Ni
nickel
28

106.4
Pd
palladium
46

195.1
Pt
platinum
78

(11)

63.5
Cu
copper
29

107.9
Ag
silver
47

197.0
Au
gold
79

(12)

65.4
Zn
zinc
30

112.4
Cd
cadmium
48

200.6
Hg
mercury
80

(13)

69.7
Ga
gallium
31

114.8
In
indium
49

204.4
Tl
thallium
81

(14)

72.6
Ge
germanium
32

118.7
Sn
tin
50

207.2
Pb
lead
82

(15)

74.9
As
arsenic
33

121.8
Sb
antimony
51

209.0
Bi
bismuth
83

(16)

79.0
Se
selenium
34

127.6
Te
tellurium
52

[209]
Po
polonium
84

(17)

79.9
Br
bromine
35

126.9
I
iodine
53

[210]
At
astatine
85

(18)

83.8
Kr
krypton
36

131.3
Xe
xenon
54

[222]
Rn
radon
86

Elements with atomic numbers 112-116 have been reported but not fully authenticated

[280]
Rg
roentgenium
111

[281]
Ds
darmstadtium
110

[276]
Mt
meitnerium
109

[270]
Hs
hassium
108

[272]
Bh
bohrium
107

[271]
Sg
seaborgium
106

[268]
Db
dubnium
105

[267]
Rf
rutherfordium
104

[227]
Ac †
actinium
89

[226]
Ra
radium
88

[223]
Fr
francium
87

* 58 – 71 Lanthanides

† 90 – 103 Actinides

140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	[145] Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.3 Gd gadolinium 64	158.9 Tb terbium 65	162.5 Dy dysprosium 66	164.9 Ho holmium 67	167.3 Er erbium 68	168.9 Tm thulium 69	173.1 Yb ytterbium 70	175.0 Lu lutetium 71
232.0 Th thorium 90	231.0 Pa protactinium 91	238.0 U uranium 92	[237] Np neptunium 93	[244] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[247] Bk berkelium 97	[251] Cf californium 98	[252] Es einsteinium 99	[257] Fm fermium 100	[258] Md mendelevium 101	[259] No nobelium 102	[262] Lr lawrencium 103

Activity 7

Use the periodic table to find the following:

1. The atomic number of: osmium, sodium, lead, chlorine.
2. The relative atomic mass of: helium, barium, europium, oxygen.
3. The number of protons in: mercury, iodine, calcium.
4. The symbol for: gold, lead, copper, iron.
5. The name of: Sr, Na, Ag, Hg.
6. THInK can be written using a combination of the symbols for Thorium, Indium and Potassium (ThInK). Which combinations of element symbols could be used to make the following words?

AMERICA, FUN, PIRATE, LIFESPAN, FRACTION, EROSION, DYNAMO

Activity 8: research activity

Research either:

The history of the periodic table

OR

The history of models of atomic structure.

Present your findings as a timeline. You should include the work of at least four people. For each, explain what evidence or experiments they used and how this changed the understanding of chemistry.

Relative atomic mass (A_r)

If there are several isotopes of an element, the relative atomic mass will take into account the proportion of atoms in a sample of each isotope.

For example, chlorine gas is made up of 75% of chlorine-35 $^{35}_{17}\text{Cl}$ and 25% of chlorine-37 $^{37}_{17}\text{Cl}$.

The relative atomic mass of chlorine is therefore the mean atomic mass of the atoms in a sample, and is calculated by:

$$A_r = \left(\frac{75.0}{100} \times 35\right) + \left(\frac{25.0}{100} \times 37\right) = 26.25 + 9.25 = 35.5$$

Activity 9

1. What is the relative atomic mass of Bromine, if the two isotopes, ^{79}Br and ^{81}Br , exist in equal amounts?
2. Neon has three isotopes. ^{20}Ne accounts for 90.9%, ^{21}Ne accounts for 0.3% and the last 8.8% of a sample is ^{22}Ne . What is the relative atomic mass of neon?
3. Magnesium has the following isotope abundances: ^{24}Mg : 79.0%; ^{25}Mg : 10.0% and ^{26}Mg : 11.0%. What is the relative atomic mass of magnesium?

Harder:

4. Boron has two isotopes, ^{10}B and ^{11}B . The relative atomic mass of boron is 10.8. What are the percentage abundances of the two isotopes?
5. Copper's isotopes are ^{63}Cu and ^{65}Cu . If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

Relative formula mass (M_r)

Carbon dioxide, CO_2 has 1 carbon atom ($A_r = 12.0$) and two oxygen atoms ($A_r = 16.0$). The relative formula mass is therefore

$$M_r = (12.0 \times 1) + (16.0 \times 2) = 44.0$$

Magnesium hydroxide $\text{Mg}(\text{OH})_2$ has one magnesium ion ($A_r = 24.3$) and two hydroxide ions, each with one oxygen ($A_r = 16.0$) and one hydrogen ($A_r = 1.0$).

The relative formula mass is therefore:

$$(24.3 \times 1) + (2 \times (16.0 + 1.0)) = 58.3$$

Activity 10

Calculate the relative formula mass of the following compounds:

1. Magnesium oxide MgO
2. Sodium hydroxide NaOH
3. Copper sulfate CuSO_4
4. Ammonium chloride NH_4Cl
5. Ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$

Common ions

Positive ions (cations)		Negative ions (anions)	
Name	Symbol	Name	Symbol
Hydrogen	H ⁺	Hydroxide	OH ⁻
Sodium	Na ⁺	Chloride	Cl ⁻
Lithium	Li ⁺	Bromide	Br ⁻
Silver	Ag ⁺	Oxide	O ²⁻
Magnesium	Mg ²⁺	Hydrogencarbonate	HCO ₃ ⁻
Calcium	Ca ²⁺	Nitrate	NO ₃ ⁻
Zinc	Zn ²⁺	Sulfate	SO ₄ ²⁻
Aluminium	Al ³⁺	Carbonate	CO ₃ ²⁻
Ammonium	NH ₄ ⁺	Phosphate	PO ₄ ³⁻

Some elements have more than one charge. For example, iron can form ions with a charge of +2 or +3. Compounds containing these are named Iron(II) and Iron(III) respectively.

Other common elements with more than one charge include:

Chromium(II) and chromium(III)

Copper(I) and copper(II)

Lead(II) and lead(IV)

Activity 11

On the periodic table on the following page, colour elements that form one atom ions (eg Na⁺ or O²⁻) according to the following key:

Charge	Colour
+1	red
+2	yellow
+3	green
-1	blue
-2	brown

Ionic compounds must have an overall neutral charge. The ratio of cations to anions must mean that there is as many positives as negatives.

For example:

NaCl	
Na ⁺	Cl ⁻
+1	-1

MgO	
Mg ²⁺	O ²⁻
+2	-2

MgCl ₂	
Mg ²⁺	Cl ⁻
	Cl ⁻
+2	-2

Activity 12

Work out what the formulas for the following ionic compounds should be:

1. Magnesium bromide
2. Barium oxide
3. Zinc chloride
4. Ammonium chloride
5. Ammonium carbonate
6. Aluminium bromide
7. Iron(II) sulfate
8. Iron(III) sulfate

Diatomic molecules

A number of atoms exist in pairs as diatomic (two atom) molecules.

The common ones that you should remember are:

Hydrogen H₂, Oxygen O₂, Fluorine F₂, Chlorine Cl₂, Bromine Br₂, Nitrogen N₂ and Iodine I₂

Common compounds

There are several common compounds from your GCSE studies that have names that do not help to work out their formulas. For example, water is H₂O.

Activity 13: Research activity

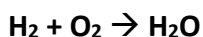
What are the formulas of the following compounds?

1. Methane
2. Ammonia
3. Hydrochloric acid
4. Sulfuric acid
5. Sodium hydroxide
6. Potassium manganate(VII)
7. Hydrogen peroxide

Balancing equations

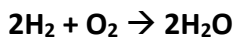
Chemical reactions never create or destroy atoms. They are only rearranged or joined in different ways.

When hydrogen and oxygen react to make water: hydrogen + oxygen → water



There are two hydrogen atoms on both sides of this equation, but two oxygen atoms on the left and only one on the right. This is not balanced.

This can be balanced by writing:



The reactants and products in this reaction are known and you can't change them. The compounds can't be changed and neither can the subscripts because **that would change the compounds. So, to balance the equation, a number must be added in front of the compound or element in the equation. This is a coefficient. Coefficients show how many atoms or molecules there are.**

Activity 14

Write balanced symbol equations for the following reactions. You'll need to use the **information on the previous pages to work out the formulas of the compounds. Remember some of the elements may be diatomic molecules.**

1. Aluminium + oxygen → aluminium oxide
2. Methane + oxygen → carbon dioxide + water
3. Aluminium + bromine → aluminium bromide
4. Calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide
5. Aluminium sulfate + calcium hydroxide → aluminium hydroxide + calcium sulfate

Harder:

6. Silver nitrate + potassium phosphate → silver phosphate + potassium nitrate

More challenging:

7. Potassium manganate(VII) + hydrochloric acid → potassium chloride + manganese(II) chloride + water + chlorine

Moles

A mole is the amount of a substance that contains 6.02×10^{23} particles.

The mass of 1 mole of any substance is the relative formula mass (M_r) in grams.

Examples:

One mole of carbon contains 6.02×10^{23} particles and has a mass of 12.0 g

Two moles of copper contains 12.04×10^{23} particles, and has a mass of 127 g 1 mole of water contains 6.02×10^{23} particles and has a mass of 18 g

The amount in moles of a substance can be found by using the formula:

$$\text{Amount in moles of a substance} = \frac{\text{mass of substance}}{\text{relative formula mass}}$$

Activity 15

Fill in the table.

Substance	Mass of substance	Amount/moles	Number of particles
Helium			18.12×10^{23}
Chlorine	14.2		
Methane		4	
Sulfuric acid	4.905		

Empirical formula

If you measure the mass of each reactant used in a reaction, you can work out the ratio of atoms of each reactant in the product. This is known as the empirical formula. This may give you the actual chemical formula, as the actual formula may be a multiple of this. For example, hydrogen peroxide is H_2O_2 but would have the empirical formula HO .

Use the following to find an empirical formula:

1. Write down reacting masses
2. Find the amount in moles of each element
3. Find the ratio of moles of each element

Example:

A compound contains 2.232 g of iron, 1.284 g of sulfur and 1.920 g of oxygen. What is the empirical formula?

Element	Iron	Sulfur	Oxygen
mass/relative atomic mass	2.232/55.8	1.284/32.1	1.920/16.0
Amount in moles	0.040	0.040	0.120
Divide by smallest value	0.040/0.040	0.040/0.040	0.120/0.040
Ratio	1	1	3

So the empirical formula is FeSO_3 .

If the question gives the percentage of each element instead of the mass, replace mass with the percentage of an element present and follow the same process.

Activity 16

Work out the following empirical formulas:

1. The smell of a pineapple is caused by ethyl butanoate. A sample is known to contain only 0.180 g of carbon, 0.030 g of hydrogen and 0.080 g of oxygen. What is the empirical formula of ethyl butanoate?
2. Find the empirical formula of a compound containing 0.0578 g of titanium, 0.288 g of carbon, 0.012 g of hydrogen and 0.384 g of oxygen.
3. 300 g of a substance are analysed and found to contain only carbon, hydrogen and oxygen. The sample contains 145.9 g of carbon and 24.32 g of hydrogen. What is the empirical formula of the compound?
4. Another 300 g sample is known to contain only carbon, hydrogen and oxygen. The percentage of carbon is found to be exactly the same as the percentage of oxygen. The percentage of hydrogen is known to be 5.99%. What is the empirical formula of the compound?

The Periodic Table of the Elements

1	2	3	4	5	6	7	0																																						
(1) 6.9 Li lithium 3	(2) 9.0 Be beryllium 4	(3) 45.0 Sc scandium 21	(4) 47.9 Ti titanium 22	(5) 50.9 V vanadium 23	(6) 52.0 Cr chromium 24	(7) 54.9 Mn manganese 25	(8) 55.8 Fe iron 26	(9) 58.9 Co cobalt 27	(10) 58.7 Ni nickel 28	(11) 63.5 Cu copper 29	(12) 65.4 Zn zinc 30	(13) 10.8 B boron 5	(14) 12.0 C carbon 6	(15) 14.0 N nitrogen 7	(16) 16.0 O oxygen 8	(17) 19.0 F fluorine 9	(18) 4.0 He helium 2																												
23.0 Na sodium 11	24.3 Mg magnesium 12	39.1 K potassium 19	87.6 Sr strontium 38	88.9 Y yttrium 39	92.9 Nb niobium 41	96.0 Mo molybdenum 42	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18																												
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54																												
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86																												
[223] Fr francium 87	[226] Ra radium 88	[227] Ac† actinium 89	[267] Rf rutherfordium 104	[268] Db dubnium 105	[271] Sg seaborgium 106	[272] Bh bohrium 107	[270] Hs hassium 108	[276] Mt meitnerium 109	[281] Ds darmstadtium 110	[280] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated																																		
* 58 – 71 Lanthanides																																													
† 90 – 103 Actinides																																													
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