

CHEMISTRY



KS3 SCIENCE EXAM PREPARATION STUDENT BOOK

CHEMICAL ANALYSIS

Please complete all of these questions in this book and store this work in your student revision files.

This will provide a useful resource for revision.

Name	
Class	
Teacher	

Revision Question Book
KS3 Science

This book is suitable for
students carrying out the KS3
Science course



In the following book there are several questions based on KS3 Science. These questions are additional to the work which you do on in your lessons.

To gain the highest grade possible in KS3 Science it is recommended that you complete these questions at home or in revision sessions outside of lessons.

This will both familiarise yourself with both the concepts found in the syllabus and the examination technique found in examinations.

The mark scheme to the questions is integrated in the book for you to use independently.

To improve competency in answering questions on KS3 Science and achieve mastery in this module, answer all of these questions independently.

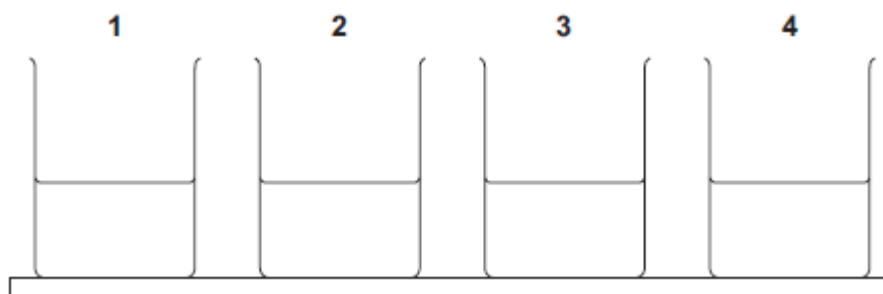
When you have completed your work in this book, please store this work in your student files.

Many thanks for all of your hard work in Science.

Mr. Turnbull

**HIGHER TIER****1.**

A group of students had four different colourless solutions in beakers **1**, **2**, **3** and **4**, shown in the figure below.



The students knew that the solutions were

- sodium chloride
- sodium iodide
- sodium carbonate
- potassium carbonate

but did **not** know which solution was in each beaker.

The teacher asked the class to plan a method that could be used to identify each solution.

She gave the students the following reagents to use:

- dilute nitric acid
- silver nitrate solution.

The teacher suggested using a flame test to identify the positive ions.

Outline a method the students could use to identify the four solutions.

You should include the results of the tests you describe.

[6 Marks]

.....

.....

.....

.....

.....

[illegible]

**Q2.**

The colours of fireworks are produced by chemicals.



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2.1 Information about four chemicals is given in the table.

Complete the table below.

[2 Marks]

Chemical	Colour produced in firework
barium chloride	green
_____ carbonate	crimson
sodium nitrate	_____
calcium sulfate	red

2.2 Describe a test to show that barium chloride solution contains chloride ions.

Give the result of the test.

[2 Marks]

.....

.....

.....

.....



2.3 A student did two tests on a solution of compound **X**.

Test 1

Sodium hydroxide solution was added.

A blue precipitate was formed.

Test 2

Dilute hydrochloric acid was added.

Barium chloride solution was then added.

A white precipitate was formed.

The student concluded that compound **X** is iron (II) sulfate.

Is the student's conclusion correct?

Explain your answer.

[3 Marks]

.....

.....

.....

.....

**Q3.**

Four bottles of chemicals made in the 1880s were found recently in a cupboard during a Health and Safety inspection at Lovell Laboratories.



Sodium carbonate



Sodium chloride



Sodium nitrate



Sodium sulfate

The chemical names are shown below each bottle.

You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid
- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.
- limewater
- red litmus paper

3.1 Describe tests that you could use to show that these chemicals are correctly named.

In each case give the reagent(s) you would use **and** state the result.

[4 Marks]



Test and result for carbonate ions:

.....

.....

Test and result for chloride ions:

.....

.....

Test and result for nitrate ions:

.....

.....

Test and result for sulfate ions:

.....

.....

3.2 Suggest why a flame test would **not** distinguish between these four chemicals.

[1 Mark]

.....

.....

3.3 Instrumental methods of analysis linked to computers can be used to identify chemicals.

Give **two** advantages of using instrumental methods of analysis.

[2 Marks]

.....

.....

.....

.....

**Q4.**

A student investigated an egg shell.



The student did some tests on the egg shell.

The student's results are shown in the table below.

Test		Observation
1	Dilute hydrochloric acid was added to the egg shell.	A gas was produced. The egg shell dissolved, forming a colourless solution.
2	A flame test was done on the colourless solution from test 1 .	The flame turned red.
3	Sodium hydroxide solution was added to the colourless solution from test 1 .	A white precipitate formed that did not dissolve in excess sodium hydroxide solution.
4	Silver nitrate solution was added to the colourless solution from test 1 .	A white precipitate formed.

4.1 The student concluded that the egg shell contains carbonate ions.

Describe how the student could identify the gas produced in test **1**.

[2 Marks]

.....

.....

.....

.....



4.2 The student concluded that the egg shell contains aluminium ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

[2 Marks]

.....

.....

.....

.....

4.3 The student concluded that the egg shell contains chloride ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

[2 Marks]

.....

.....

.....

.....

Some scientists wanted to investigate the amount of lead found in egg shells.
They used a modern instrumental method which was *more sensitive* than older methods.

4.4 Name **one** modern instrumental method used to identify elements.

[1 Mark]

.....

.....

4.5 What is the meaning of higher resolution?

[1 Mark]

.....

.....

**FOUNDATION TIER**

1. Chemical tests can be used to identify compounds.

1.1 List **A** gives the names of four compounds in solution. List **B** gives tests and the result of the tests.

Draw a straight line from each compound in List **A** to its test and test result in List **B**.

The first one has been done for you.

[2 Marks]

List A Name of compound in solution	List B Test and result of the test
Calcium chloride	Add barium chloride solution and dilute hydrochloric acid. A white precipitate formed.
Lithium sulphate	Do the flame test. Yellow flame produced.
Potassium carbonate	Add silver nitrate solution and dilute nitric acid. A white precipitate formed.
Sodium nitrate	Add hydrochloric acid. Carbon dioxide gas given off.

1.2 State what you would **see** when sodium hydroxide solution reacts with copper sulphate solution.

[2 Marks]

.....

.....

.....

**Q2.**

Chemical tests can be used to identify ions in solutions.

2.1 List **A** gives the names of two sulfates in solution.
List **B** gives the results of adding sodium hydroxide solution.

Draw a straight line from each sulfate in List **A** to its correct test result in List **B**.

[2 Marks]

List A
Name of sulfate
in solution

Copper sulfate

Iron(II) sulfate

List B
Result of adding
sodium hydroxide solution

A blue precipitate formed

A white precipitate formed

A green precipitate formed

2.2 Suggest why clean test tubes were used for each test.

[1 Mark]

.....

.....

2.3 Draw a ring around the correct colour to complete this sentence.

Sulfate solutions react with barium chloride solution to give a

[1 Mark]

blue
green
white

 precipitate.

**Q3.**

A student investigated an egg shell.



Draw a ring around the correct answer to complete each sentence.

3.1 Test 1

Dilute hydrochloric acid was added to the egg shell.

[2 Marks]

Carbon dioxide gas was produced which turned limewater

milky.
blue.
red.

This test shows that the egg shell must contain

carbonate ions.
chloride ions.
sulfate ions.

3.2 Test 2

The student then did a flame test.

He used the solution remaining after dilute hydrochloric acid was added to the egg shell.

The flame test showed that the egg shell contained calcium ions because

[1 Mark]

the flame was

red.
blue.
lilac.



Some scientists investigated the amount of lead found in egg shells. They used a modern instrumental method which was higher resolution and more accurate than older methods.

3.3 Draw a ring around the correct answer to complete the sentence.

The modern instrumental method has a higher resolution, which means that

[1 Mark]

it can measure

larger
much larger
smaller

 amounts of lead than older methods.

3.4 Tick (✓) the meaning of more accurate.

[1 Mark]

	Tick (✓)
The measurement is given to more decimal places.	
The answer obtained is closer to the true value.	
The equipment used is more expensive.	

**Q4.**

The colours of fireworks are produced by chemicals.



Three of these chemicals are lithium sulfate, potassium chloride and sodium nitrate.

4.1 A student wants to carry out flame tests on these three chemicals.

Describe how to carry out a flame test.

[2 Marks]

.....

.....

.....

4.2 Draw **one** line from each chemical to the correct flame colour.

The first one has been done for you.

[2 Marks]

Chemical	Flame colour
lithium sulfate	green
potassium chloride	crimson
sodium nitrate	yellow
	lilac



4.3 Dilute nitric acid and silver nitrate solution are added to solutions of the three chemicals.

A white precipitate forms in one of the solutions.

Which chemical produces the white precipitate?

[1 Mark]

.....

.....

The student tests a fourth chemical, **X**.

4.4 The student adds sodium hydroxide solution to a solution of chemical **X**.

A blue precipitate is formed.

Which metal ion is in chemical **X**?

[1 Mark]

.....

.....

4.5 The student adds dilute hydrochloric acid to a solution of chemical **X** and then adds barium chloride solution.

A white precipitate is formed.

Which negative ion is in chemical **X**?

Draw a ring around the correct answer.

[1 Mark]

chloride

nitrate

sulfate

**Q5.**

This question is about mixtures and analysis.

5.1 Which **two** substances are mixtures?

[2 Marks]

Tick **two** boxes.

Air

☐

Carbon dioxide

☐

Graphite

☐

Sodium Chloride

☐

Steel

☐

5.2 Draw **one** line from each context to the correct meaning.

[2 Marks]

Context**Meaning**

Pure
substance in
chemistry

A substance that has had nothing
added to it

A single element or a single
compound

A substance containing only atoms
which have different numbers of
protons

Pure
substance in
everyday life

A substance that can be separated
by filtration

A useful product made by mixing
substances



5.3 What is the test for chlorine gas?

[1 Mark]

Tick **one** box.

A glowing splint relights

☐

A lighted splint gives a pop

☐

Damp litmus paper turns white

☐

Limewater turns milky

☐

5.4 A student tested a metal chloride solution with sodium hydroxide solution.

A brown precipitate formed.

What was the metal ion in the metal chloride solution?

[1 Mark]

Tick **one** box.

Calcium

☐

Copper(II)

☐

Iron(II)

☐

Iron(III)

☐



CHEMISTRY DATA SHEET



The Periodic Table of Elements

1	2	3	4	5	6	7	0
7 Li lithium 3	9 Be beryllium 4	11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12	27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	209 Po polonium 84	210 At astatine 85	222 Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[286] Nh nihonium 113	[289] Fl flerovium 114	[289] Mc moscovium 115	[293] Lv livermorium 116	[293] Ts tennessine 117	[294] Og oganeson 118
		56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	
		101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	
		186 Re rhenium 75	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	
		270 Hs hassium 108	278 Mt meitnerium 109	281 Ds darmstadtium 110	281 Rg roentgenium 111	285 Cn copernicium 112	
		[270] Bh bohrium 107	[269] Sg seaborgium 106	[270] Db dubnium 105	[270] W tungsten 74	[267] Rf rutherfordium 104	
		[270] Os osmium 76	[270] Ir iridium 77	[270] Pt platinum 78	[270] Re rhenium 75	[267] Hf hafnium 72	
		181 Ta tantalum 73	186 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	
		91 Zr zirconium 40	93 Nb niobium 41	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	
		45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	
		89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	97 Tc technetium 43	
		139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	
		[227] Ac* actinium 89	[267] Rf rutherfordium 104	[270] Db dubnium 105	[269] Sg seaborgium 106	[270] Bh bohrium 107	
		[226] Ra radium 88	[227] Ac* actinium 89	[267] Rf rutherfordium 104	[269] Sg seaborgium 106	[270] Bh bohrium 107	

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1
H
hydrogen
1

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted. Relative atomic masses for Cu and Cl have not been rounded to the nearest whole number.



MARK SCHEME HIGHER

1.1

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1 – 2 marks)

Any description of a method used and / or a result given

Level 2 (3 – 4 marks)

Description of workable methods used, with results to identify positive **or** negative ions

Level 3 (5 – 6 marks)

Description of methods used to identify both positive **and** negative ions, with relevant results

examples of the points made in the response

extra information

Test: add (platinum / nichrome) wire (for the flame test)

accept any method of introducing the solution into the flame, eg a splint soaked in the solution or sprayed from a bottle

Result: the sodium compounds result in a yellow / orange / gold flame **or** the potassium compound results in a lilac / purple / mauve flame

student could state that potassium carbonate gives a different colour to the three sodium compounds as long as it is clear that the flame test colour comes from Na^+ or K^+

Test: add dilute nitric acid to all four solutions

allow any acid

Result: sodium carbonate and potassium carbonate will effervesce **or** sodium chloride and sodium iodide will not effervesce

Test: add dilute nitric acid followed by silver nitrate

Result: sodium chloride and sodium iodide produce a precipitate **or** sodium chloride produces a white precipitate and sodium iodide produces a yellow precipitate

accept sodium carbonate and potassium carbonate do not produce a precipitate

[6]



2.1	
lithium	
<i>allow Li^+ / Li</i>	1
yellow	
<i>allow orange</i>	1
2.2 silver nitrate (solution)	
<i>incorrect test = 0 marks</i>	
<i>ignore (nitric) acid</i>	
<i>do not allow other named acids</i>	1
white precipitate	1
2.3 blue precipitate (with sodium hydroxide) indicates copper ions	
<i>allow Cu^{2+}</i>	1
and white precipitate (with barium chloride) indicates sulfate ions	
<i>allow SO_4^{2-}</i>	
<i>accept compound X is copper sulfate / CuSO_4 for 1 mark</i>	1
but iron(II) ions produce a green precipitate (with sodium hydroxide)	1
	[7]



3.1 Na_2CO_3 : $\text{HCl} \rightarrow$ gas / effervescence / bubbles (1)
 CO_2 / carbon dioxide / turns lime water milky (1)

1

NaCl : $\text{AgNO}_3 \rightarrow$ white ppt (1)
 silver chloride (1)

1

NaNO_3 : $\text{Al} + \text{NaOH} \rightarrow$ pungent / sharp smell / choking gas (1)
 NH_3 / ammonia / turns (red) litmus blue(1)

1

Na_2SO_4 : $\text{BaCl}_2 \rightarrow$ white ppt (1)
 barium sulfate (1)

1

each correct test and one result = 1 mark

one other result for any test = 1 mark this mark can only be awarded once

3.2 all would give a yellow / yellow-orange (flame) / same coloured (flame) / same results
 allow orange (flame) 1

or

they all contain sodium

1

3.3 any **two** from:

ignore cost/errors

- fast / quick or comment about speed

allow precise

- small amounts/sensitive

allow can be left to run/continuous analysis

- accurate

- ease of automation

accept operators do not need chemical skills

- sample not used up

- reliable / efficient

2

[7]

**4.1** (bubble gas produced through) limewater*incorrect tests = zero***1**

(limewater) goes cloudy / milky

1**4.2** *ignore yes or no*

red flame indicates that calcium / lithium ions present

*allow aluminium has no flame colour***or**

Ca/Mg also produce a (white) precipitate with NaOH

1the (white) precipitate formed in test 3 **or** by adding sodium hydroxide solution would dissolve (in excess) if aluminium ions were present**1****4.3** *ignore yes or no*because a white precipitate is formed in test 4 **or** by adding silver nitrate**1**

but chloride ions are in hydrochloric acid

1**4.4** mass spectrometry*allow MS***or**

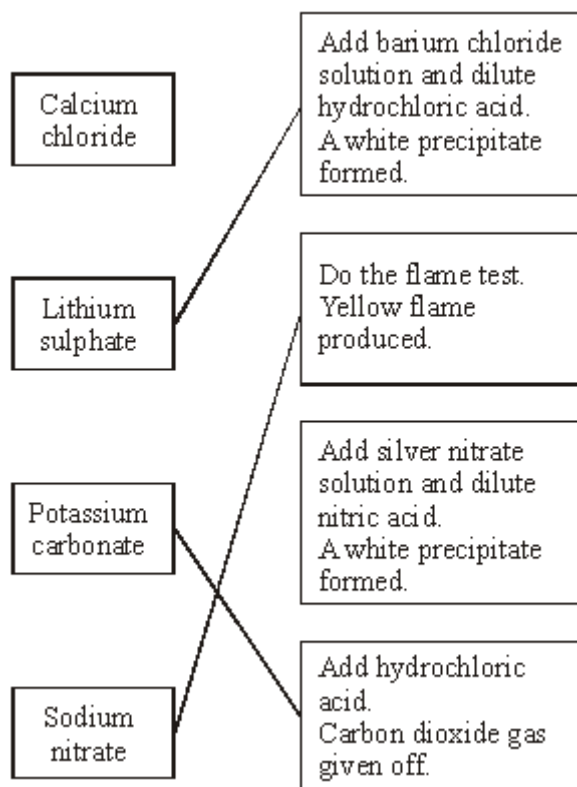
atomic absorption spectroscopy

*allow AAS**spectrometry / spectroscopy alone is insufficient***1****4.4** can detect a small(er) amount of the substance*allow can detect small(er) changes**allow small(er) sample sizes**ignore references to precision / accuracy***1**



FOUNDATION

1.1



all three correct = 2

one or two correct = 1

1.2 blue

precipitate

solid

2

1

1

[4]



2.1 copper sulfate → blue precipitate

1

iron (II) sulfate → green precipitate

1

2.2 e.g. some idea of contamination

allow so you can see the colour change clearly / easily

or

give misleading / incorrect results / lead to wrong conclusion

allow to get accurate / reliable results

ignore fair test

1

2.3 white

1

[4]



3.1 milky

1

carbonate ions

1

3.2 red

1

3.3 smaller

1

3.4 The answer obtained is closer to the true value

1

[5]



4.1 *method of introducing sample into flame*

e.g. wire / splint / spray

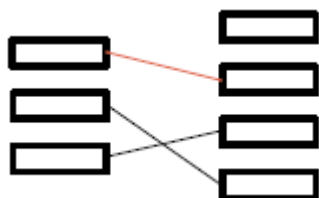
1

clean wire or colourless flame

allow blue / roaring flame

1

4.2



1

1

4.3 (potassium) chloride

*allow KCl **or** Cl⁻*

1

4.4 copper

allow Cu²⁺

1

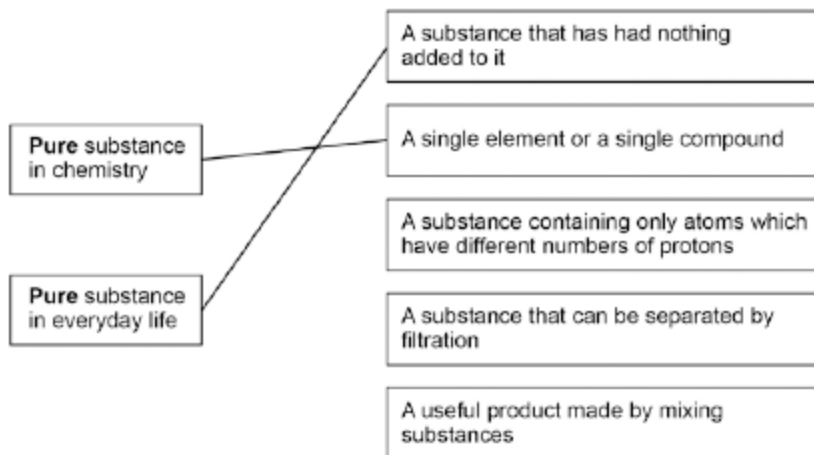
4.5 sulfate

1

[7]

**5.1 Air****2**

Steel

1**5.2**Allow **1** mark for the correct meanings linked to context but incorrect way around**1****5.3** Damp litmus paper turns white**1****5.4** Iron (III)**1****[6]**



Acknowledgements

This document has been produced by Mr J Turnbull.

All relevant information has been credited in the document.

This document has been produced for educational purposes only.

This document has been produced for the KS3 Science Specification.

