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F

Tuesday 22 January 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A

A172/01 Modules C4 C5 C6 (Foundation Tier)

A135770113

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

A172012

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.
- The Periodic Table is printed on the back page.
- A list of qualitative tests for ions is printed on page 2.

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Qualitative analysis

Tests for ions with a positive charge

Ion	Test	Observation
calcium Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) Fe^{3+}	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc Zn^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate dissolves in excess sodium hydroxide

Tests for ions with a negative charge

Ion	Test	Observation
carbonate CO_3^{2-}	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride Cl^-	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide Br^-	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide I^-	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate SO_4^{2-}	add dilute acid, then add barium chloride or barium nitrate	a white precipitate forms

Answer **all** the questions.

1 Caesium is an element. Compounds of caesium are found in some minerals.

Ben looks at a table of flame colours for different elements.

Element	Flame colour
caesium	blue
barium	green
calcium	red
copper	blue
potassium	purple
sodium	yellow

(a) Ben does a flame test on a mineral to find out if it contains caesium.

Describe how to do a flame test.

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..... **[2]**

(b) After doing his test, Ben writes this note.

> The flame colour was blue.
>
> I am sure that the mineral does not contain calcium or sodium.
>
> I am not sure whether it contains caesium.

(i) Explain why Ben is sure that the mineral does **not** contain calcium or sodium.

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..... **[2]**

(ii) From his results, Ben cannot be sure whether the mineral contains caesium.

Explain why.

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..... **[2]**

[Total: 6]

2 Jack writes down data about some elements in Group 7.

Element	Formula of molecule	Normal physical state (room temperature 20 °C)	Melting point in °C	Boiling point in °C
fluorine	F_2	gas	–220	–188
chlorine	Cl_2	gas	–101	–35
bromine	Br_2	liquid	–7	–59
iodine	I_2	solid	114	184

Jack has made a mistake. One of the boiling points is wrong.

(a) Which boiling point in the table is wrong?

Explain how you made your choice.

.....

.....

..... **[2]**

(b) Estimate the correct value for the boiling point.

..... °C **[1]**

(c) Astatine is another element in Group 7 of the Periodic Table.

What is the formula for a **molecule** of astatine?

..... **[1]**

[Total: 4]

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Question 3 begins on page 6

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3 Hydrogen and lithium are elements.

Lithium is in Group 1 of the Periodic Table.

The table shows some information about the properties of hydrogen and lithium.

	Hydrogen	**Lithium**
State at room temperature	gas	solid
Type of element	non-metal	metal
Number of electrons in outer shell of an atom	1	1
Ion	H^+	Li^+
Formula of chloride	HCl	$LiCl$
Reactivity	'Pops' when lit. Does not react with water. Reacts with chlorine.	Only burns if heated strongly. Reacts with water. Reacts with chlorine.

(a) Fay and Guy do not agree about where hydrogen fits in the Periodic Table.

Hydrogen is similar to Group 1 elements such as lithium.
Hydrogen fits in Group 1 of the Periodic Table.

Fay

I disagree.
Some of hydrogen's properties are different from the properties of Group 1 elements.

Guy

How does the information in the table support each person's point of view?

The quality of written communication will be assessed in your answer.

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..... **[6]**

(b) Hydrogen gas reacts with lithium at high temperatures to make lithium hydride.

(i) At the temperatures of the reaction:
- lithium is a **liquid**
- lithium hydride is a **solid**.

Draw straight lines to join each **chemical** with its correct **state symbol at high temperature**.

chemical	state symbol at high temperature
	(s)
lithium	
	(l)
hydrogen	
	(g)
lithium hydride	
	(aq)

[2]

(ii) The formula for lithium hydride is LiH.

It is an ionic solid with properties similar to lithium chloride.

What properties is lithium hydride most likely to have?

Put a tick (✓) in the boxes next to the **two** correct answers.

It has a very low melting point.	☐
It is insoluble in water.	☐
The solid does not conduct electricity.	☐
The solid is made of crystals.	☐

[2]

[Total: 10]

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Question 4 begins on page 10

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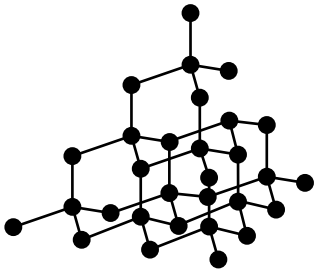
4 Sam does some research about the properties of diamond and graphite.

The table shows what he finds out.

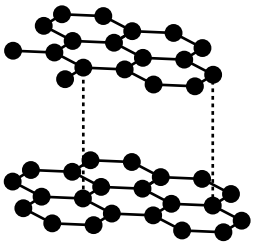
	Diamond	**Graphite**
Melting point in °C	3560	3650
Boiling point in °C	4830	4830
Solubility in water	insoluble	insoluble
Electrical conductivity	does not conduct	good conductor
Hardness	very hard	soft, flakes easily

Sam notices that some of the properties are similar and some are different.

He finds diagrams that show the structures of diamond and graphite.



diamond



graphite

11

The table shows some similarities and differences in the **properties** of diamond and graphite.

Use ideas about their **structures** to explain these similarities and differences.

The quality of written communication will be assessed in your answer.

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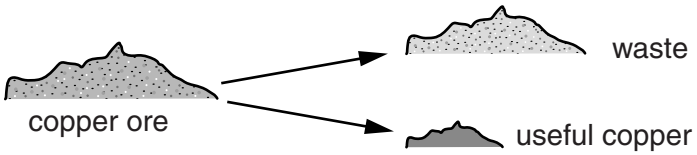
..... **[6]**

[Total: 6]

5 Zoe works for a company that mines copper ores.

She tests different copper ores to find out how much useful copper can be extracted from each one.



The table shows some of her results.

	Mass of ore in g	**Mass of copper extracted from the ore in g**	**Mass of copper extracted per gram of ore**	**Mass of copper extracted per kilogram of ore**
Ore 1	200	10	10 ÷ 200 = 0.05 g	50 g
Ore 2	200	15	15 ÷ 200 = 0.075 g	75 g
Ore 3	200	12		

(a) (i) Calculate the mass of copper extracted per gram for **ore 3**.

answer ..... g **[2]**

(ii) Use your answer to calculate the mass of copper extracted per kilogram for **ore 3**.

answer ..... g **[1]**

(iii) The company wants to make as little waste as possible when it extracts copper.

Which of the ores should the company use?

Explain why.

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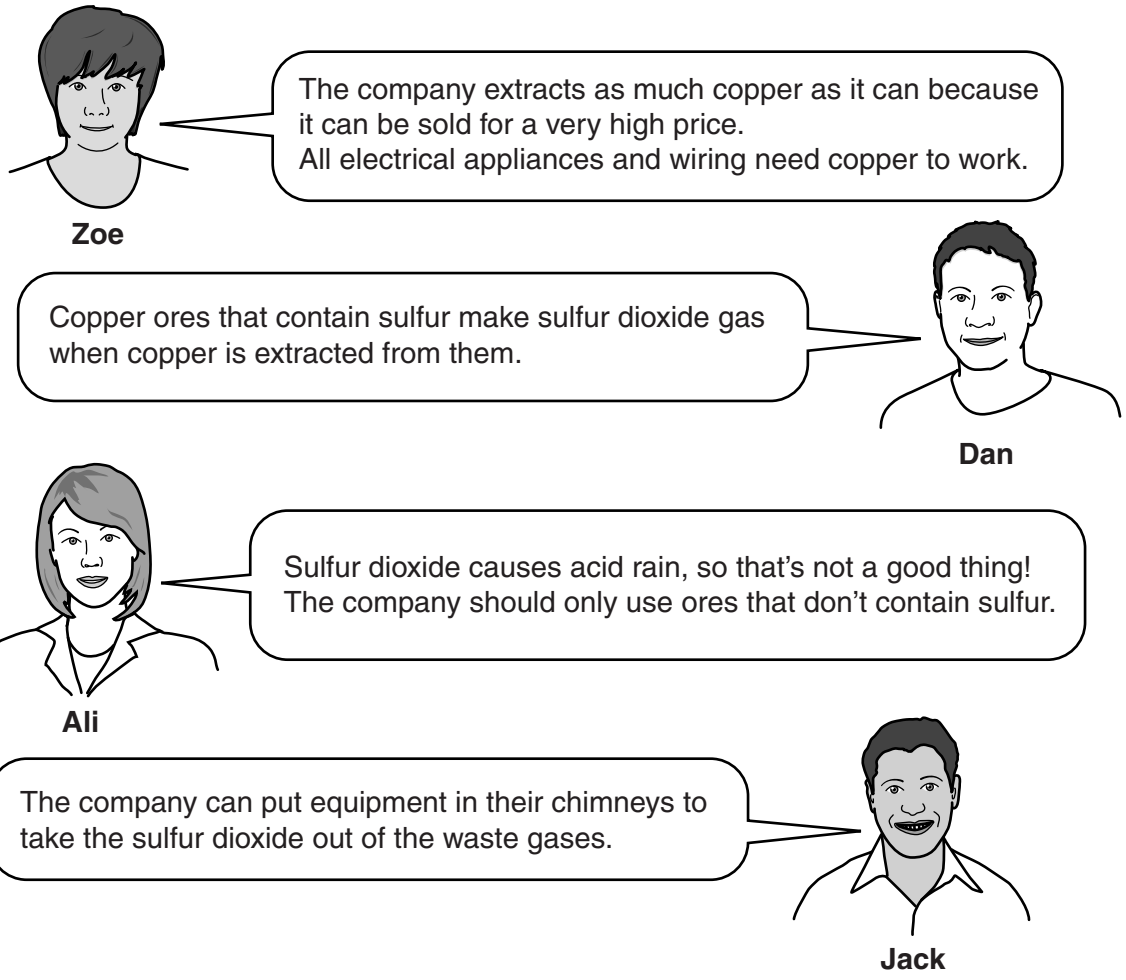
..... **[2]**

(b) Zoe and her friends discuss some issues about extracting copper.



(i) Use the information to describe the advantages and disadvantages of mining copper.

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..... **[3]**

(ii) Use the information to explain **one** way in which the mining company can make the extraction of copper more sustainable.

.....

..... **[1]**

(iii) Dan says that compounds that contain sulfur make sulfur dioxide when copper is extracted from them.

Which compounds make sulfur dioxide when copper is extracted from them?

Put (rings) around the **two** correct answers.

Cu_2O **CuS** **Cu_2S** **$CuCO_3$** **CuO** **[1]**

[Total: 10]

6 Mars is a planet in our solar system.

The table shows the percentage of each gas in the atmosphere on Mars.

Name of gas	Percentage in atmosphere on Mars
carbon dioxide	95.3%
nitrogen	2.7%
argon	1.6%
oxygen	0.13%

(a) Which of the statements about the gases on Mars are true?

Put a tick (✓) in the boxes next to the **two** correct answers.

Most of the atmosphere on Mars is nitrogen. ☐

The gases on Mars are all found on Earth. ☐

All of the gases are elements. ☐

There is more argon than oxygen on Mars. ☐

The percentage of oxygen on Mars is the same as on Earth. ☐

[2]

(b) Draw straight lines to connect each **gas in the atmosphere** with its correct **formula**.

gas in the atmosphere	formula
nitrogen	NO_2
	N_2
argon	Ar
	ArO_2
oxygen	O
	O_2

[2]

[Total: 4]

7 Alex adds dilute hydrochloric acid to solid calcium carbonate.

He sees that the reaction makes bubbles of gas.

(a) Alex writes **word** and **symbol** equations for the reaction between calcium carbonate and hydrochloric acid.

Complete the equations by filling in the boxes.

	+	hydrochloric acid	→	calcium chloride	+	carbon dioxide	+	

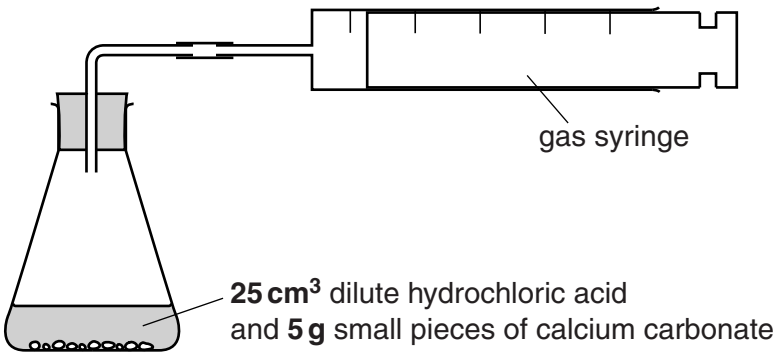
$CaCO_3$ + $2HCl$ → $CaCl_2$ + + H_2O

[3]

(b) Alex reacts small pieces of calcium carbonate with dilute hydrochloric acid.

He measures the time taken for the reaction to make 20 cm^3 of gas.

He uses this equipment.



Results

Mass of calcium carbonate	Time taken to make 20 cm^3 gas
5 g small pieces	50 s

Alex predicts that the reaction will be **slower** if he uses **large lumps** of **calcium carbonate**.

Alex does another experiment to find out if his prediction is right.

Write a plan for his experiment.

Your answer should include:
- the quantities he should use
- how he can make it a fair test
- how he will know if his prediction is right.

The quality of written communication will be assessed in your answer.

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..... **[6]**

(c) What other conditions could be changed to give a slower reaction?

Put ticks (✓) in the boxes next to the **two** correct answers.

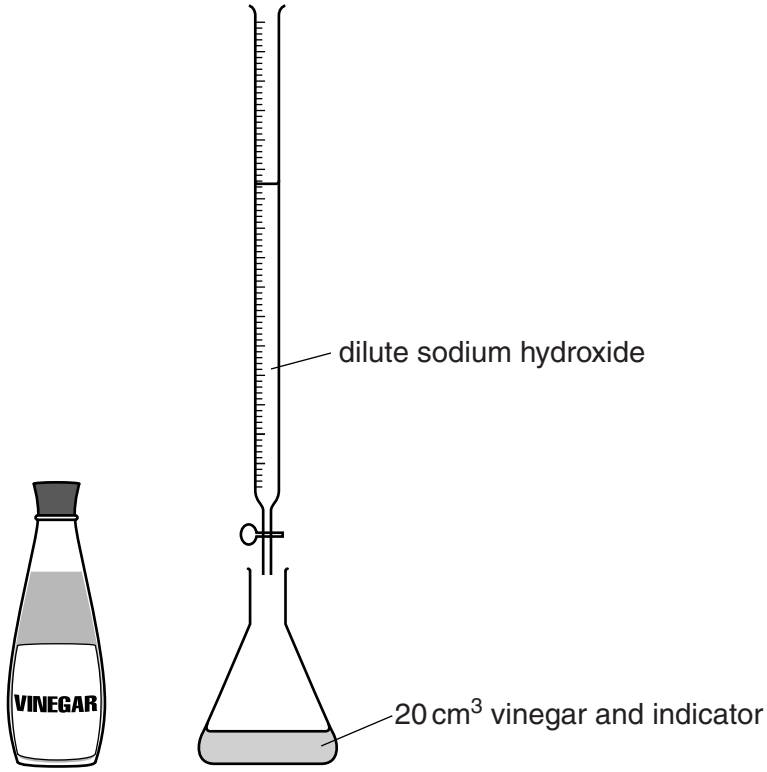
use a more concentrated acid	☐
use a catalyst	☐
shake the flask	☐
use a lower temperature	☐
add water to the acid	☐

[2]

[Total: 11]

8 Some students do titrations to find out the concentration of acid in vinegar.

The diagram shows the equipment they use.



Each student does a first titration then repeats the titration several times.

(a) Each student calculates an average result from their repeats.

The first titration result is **not** used to calculate the average.

Which statement best explains why?

Put a tick (✓) in the box next to the **best** answer.

The first result is usually lower than the others. ☐

The first titration is done without an indicator. ☐

The students do not follow the method carefully the first time. ☐

The first result is used to give a rough idea of the volume needed. ☐

[1]

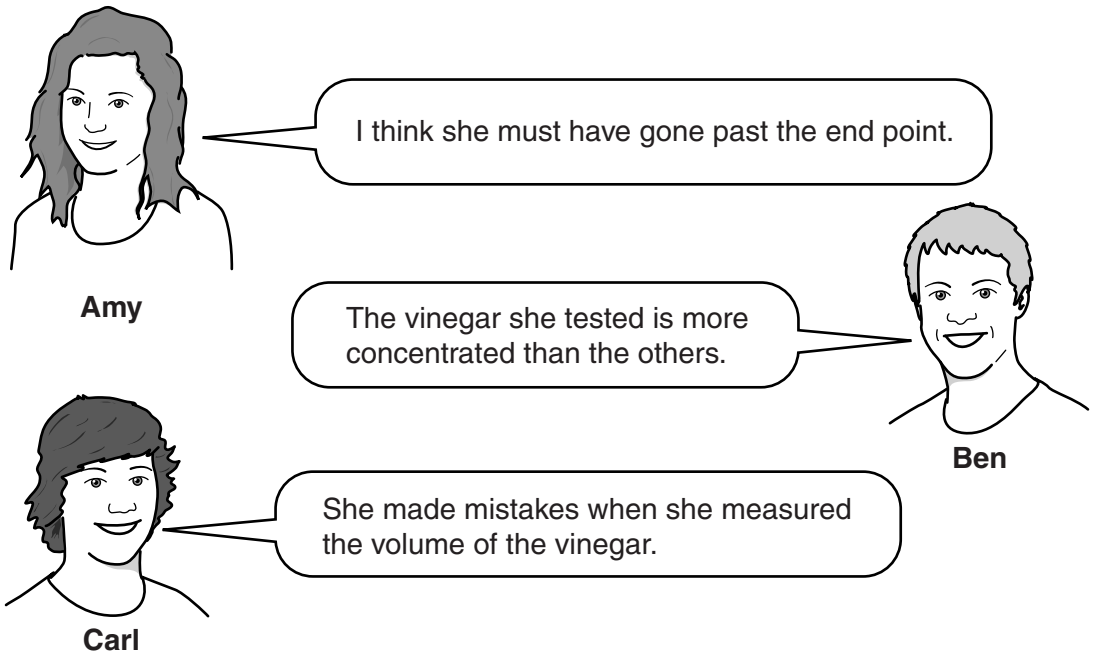
(b) All students test vinegar from the same bottle and use the same concentration of sodium hydroxide.

The students record their average results in a table.

Name of student	Average volume of sodium hydroxide used in cm^3
Amy	23.4
Ben	24.1
Carl	23.8
Dee	18.2

The students notice that Dee's result is very different from the others.

They suggest explanations for this.



Which student has the best explanation for Dee's result?

Explain why you **agree** or **disagree** with the ideas suggested by each student.

Best explanation .....

Reasoning .....

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..... **[3]**

(c) What is the word for the type of reaction that happens during this titration?

Put a (ring) around the correct answer.

crystallisation **evaporation** **filtration** **neutralisation** **[1]**

[Total: 5]

9 Magnesium sulfate is used to make medicines.

(a) Elly makes some magnesium sulfate by reacting magnesium oxide with sulfuric acid.

She uses this formula to work out her theoretical yield of magnesium sulfate.

theoretical yield = 3 × mass of magnesium oxide used

In her experiment, she uses **5 g of magnesium oxide**.

Use Elly's formula to work out her **theoretical yield**.

..... g **[1]**

(b) Elly makes some more magnesium sulfate crystals using a different amount of magnesium oxide.

She weighs an empty dish.

She puts her crystals into the dish and weighs it again.

weight of dish and crystals	206.5 g
weight of empty dish	201.0 g

(i) What mass of crystals has Elly made?

..... g **[1]**

(ii) For this experiment, Elly works out that her theoretical yield is 10.0 g.

Work out Elly's percentage yield.

Use this formula.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

..... % **[2]**

[Total: 4]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 H hydrogen 1										4 He helium 2
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	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	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	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	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	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	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	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.