

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B741/02

CHEMISTRY B

Unit B741: Chemistry Modules: C1, C2, C3 (Higher Tier)

Candidates answer on the question paper
 A calculator may be used for this paper

OCR Supplied Materials:

None

Duration: 1 hour 15 minutes

Other Materials Required:

- Pencil
- Ruler (cm/mm)

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

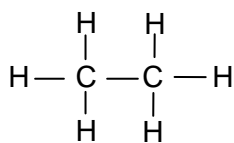
INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table can be found on the back page.
- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **2(** pages. Any blank pages are indicated.

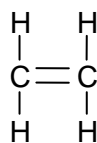
Examiner's Use Only:			
1		8	
2		9	
3		10	
4		11	
5		12	
6			
7			
Total			

Section A – Module C1

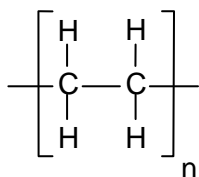
1 Look at the displayed formulas of some carbon compounds.



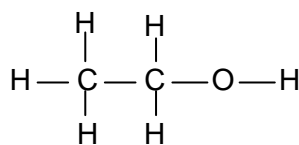
compound A



compound B



compound C



compound D

(a) Which compound is an **alkane**?

answer

[1]

(b) Which compound is **unsaturated**?

answer

[1]

(c) Compound A is a **hydrocarbon**.

Explain why compound A is a hydrocarbon.

.....

..... [1]

(d) Poly(chloroethene) is a polymer.

Look at the table. It shows some information about polymers.

Complete the table.

formula of monomer	name of polymer	repeat unit of polymer
$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$	poly(ethene)	$\left[\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]$
	poly(chloroethene)	$\left[\begin{array}{cc} \text{Cl} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]$
$\begin{array}{c} \text{F} & & \text{F} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{F} & & \text{F} \end{array}$	poly(tetrafluoroethene)	

[2]

[Total: 5]

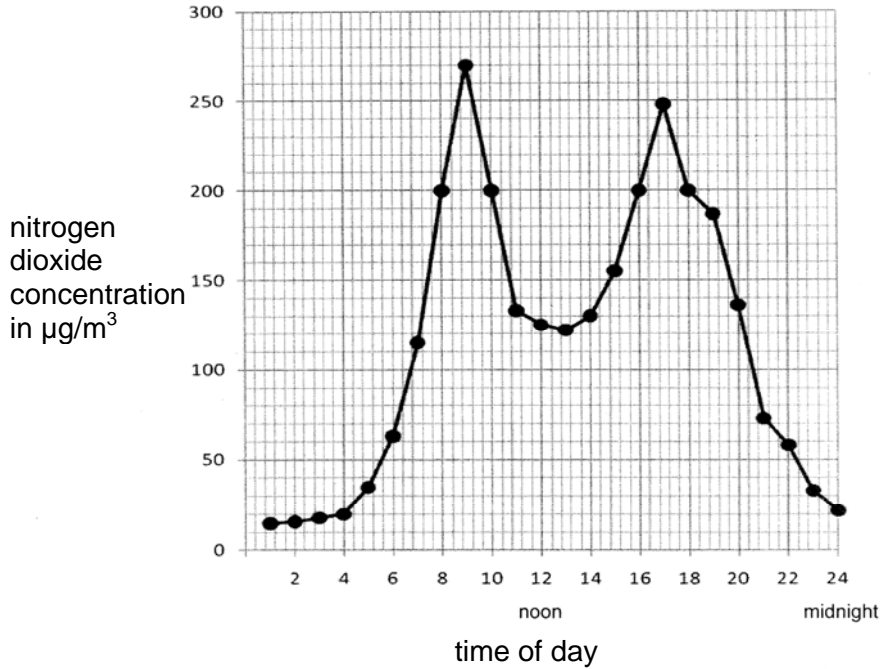
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2 Emily and Sophia investigate the nitrogen dioxide concentration in air on a city road.

Nitrogen dioxide is an oxide of nitrogen.

Look at the graph. It shows their results.



(a) Suggest an explanation for the shape of the graph.

.....

.....

.....

..... [3]

(b) Nitrogen dioxide is made in internal combustion engines.

Explain how.

.....

..... [2]

(c) It is important that atmospheric pollution is controlled.

Explain why.

.....

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..... [2]

[Total: 7]

Turn over

3 Ropewise is a company that makes climbing ropes for mountaineers.



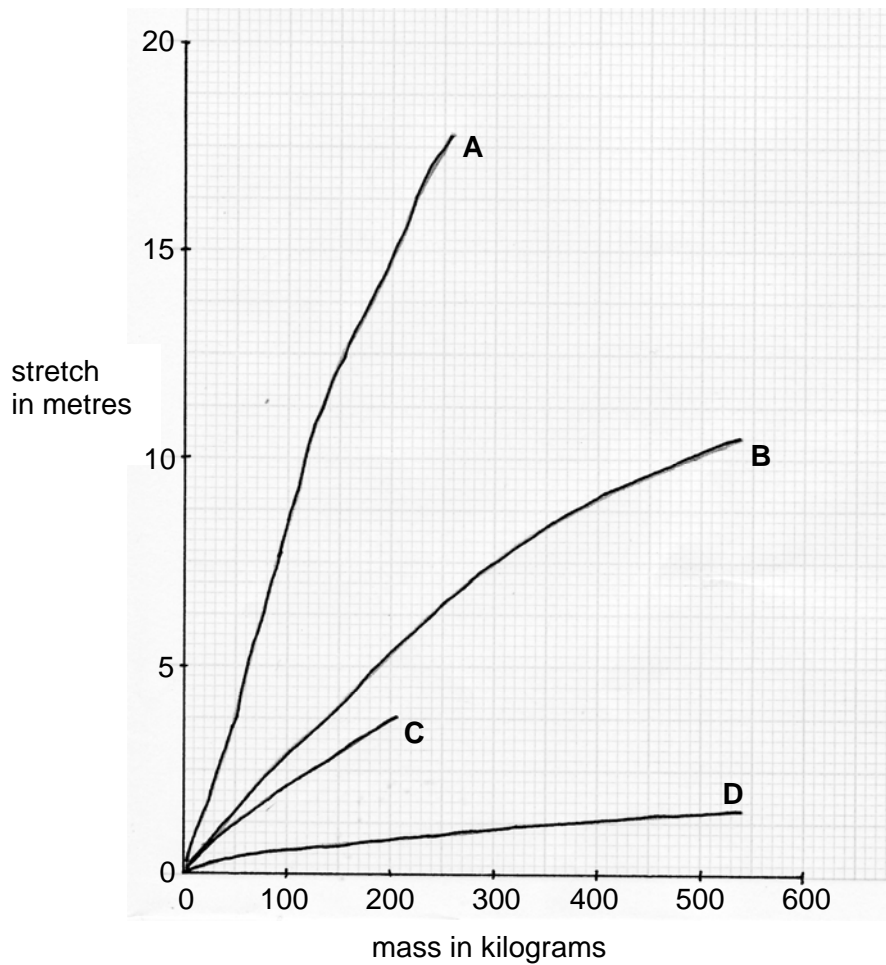
The company tests 50m lengths of rope.

The ropes are made from 4 different polymers **A**, **B**, **C** and **D**.

They add masses to each rope and measure how much each one stretches.

They do this until the rope breaks.

Look at the graph. It shows their results.



A mountaineering club says that a rope must be able to carry a mass of at least 300kg before it breaks.

Evaluate each rope for use as a climbing rope.

Which rope would you choose and why?



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

..... [6]

[Total: 6]

4 Some foods contain salt as a food additive.

Look at the table. It gives the salt content of some foods.

food	salt content in g per 100g food
bacon	3.0
butter	2.0
crisps	1.6
beef	0.2
cheese	1.6
sausage	2.8
bread	0.5
apple	0.01
chicken	0.2
potato	0.01
tomato	0.01

The Department of Health recommends that no more than 6.0g salt should be eaten each day.

Look at the table. It shows what Tom eats in one day.

food	salt content in g
50g bacon	1.5
25g crisps	0.4
100g chicken
200g bread
25g butter
100g potato
100g tomato
total salt content

- (a) Calculate the total amount of salt Tom eats and decide whether he has exceeded the Department of Health guidelines.

Do your calculations in the table.

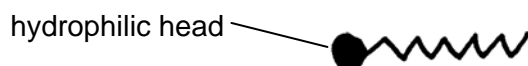
.....

.....

..... [2]

- (b) Emulsifiers help to stop oil and water from separating.

Look at the diagram of an emulsifier molecule



Explain how an emulsifier stops oil and water from separating.

.....

.....

.....

..... [3]

- (c) Baking powder contains sodium hydrogencarbonate, NaHCO_3 .

When sodium hydrogencarbonate is heated, it decomposes into sodium carbonate, carbon dioxide and water.

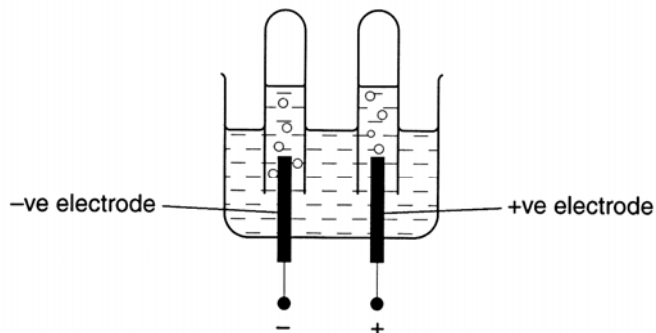
Write a **balanced symbol** equation for this reaction.

..... [2]

[Total: 7]

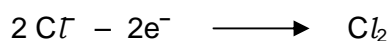
Section B – Module C2

5 Look at the diagram. It shows the electrolysis of concentrated sodium chloride (salt) solution.



Sodium chloride solution contains Na^+ , OH^- , Cl^- and H^+ .

Chlorine is made at the anode.



(a) What is the name of this **type** of reaction?

alloying

neutralisation

oxidation

reduction

answer [1]

(b) Hydrogen and sodium hydroxide are made during the electrolysis.

Explain how. Use an equation to help your answer.

.....

 [3]

[Total: 4]

6 Look at the data about some minerals.

mineral	formula	relative hardness	density in g/cm ³	cost per kg
limestone	CaCO ₃	3	1.5	low
marble	CaCO ₃	5	2.6	high
granite	SiO ₂	7	2.8	high
diamond	C	10	3.2	very high

(a) Which mineral can **only** be scratched by diamond?

Explain your answer.

.....

 [2]

(b) Which mineral would you choose to make tiles for a bathroom floor?

Explain your answer.

.....

 [3]

(c) Granite, marble and limestone have different hardnesses.

Use ideas about rock types to explain why.

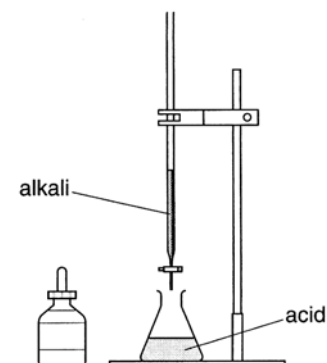
.....

 [3]

[Total: 8]

7 Stuart and Claire are making a fertiliser using neutralisation.

Look at the diagram. It shows the apparatus they use.



(a) They use nitric acid and ammonia.

What is the name of the fertiliser they make?

..... [1]

(b) They want to make ammonium sulfate.

They use ammonia as the alkali.

Which **acid** should they use?

..... [1]

(c) Urea is another fertiliser.



What is the total number of atoms in one molecule of urea?

..... [1]

(d) Urea is made by reacting ammonia, NH_3 , with carbon dioxide.

Urea and water are made.

Write a **balanced symbol** equation for this reaction.

..... [2]

(e) Fertilisers increase crop yield.

Explain how.

.....

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..... [2]

[Total: 7]

Section C – Module C3

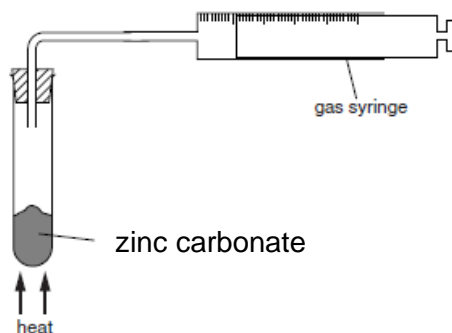
9 Zinc carbonate decomposes when heated.

Carbon dioxide and zinc oxide are made.



Jenna heats a sample of zinc carbonate.

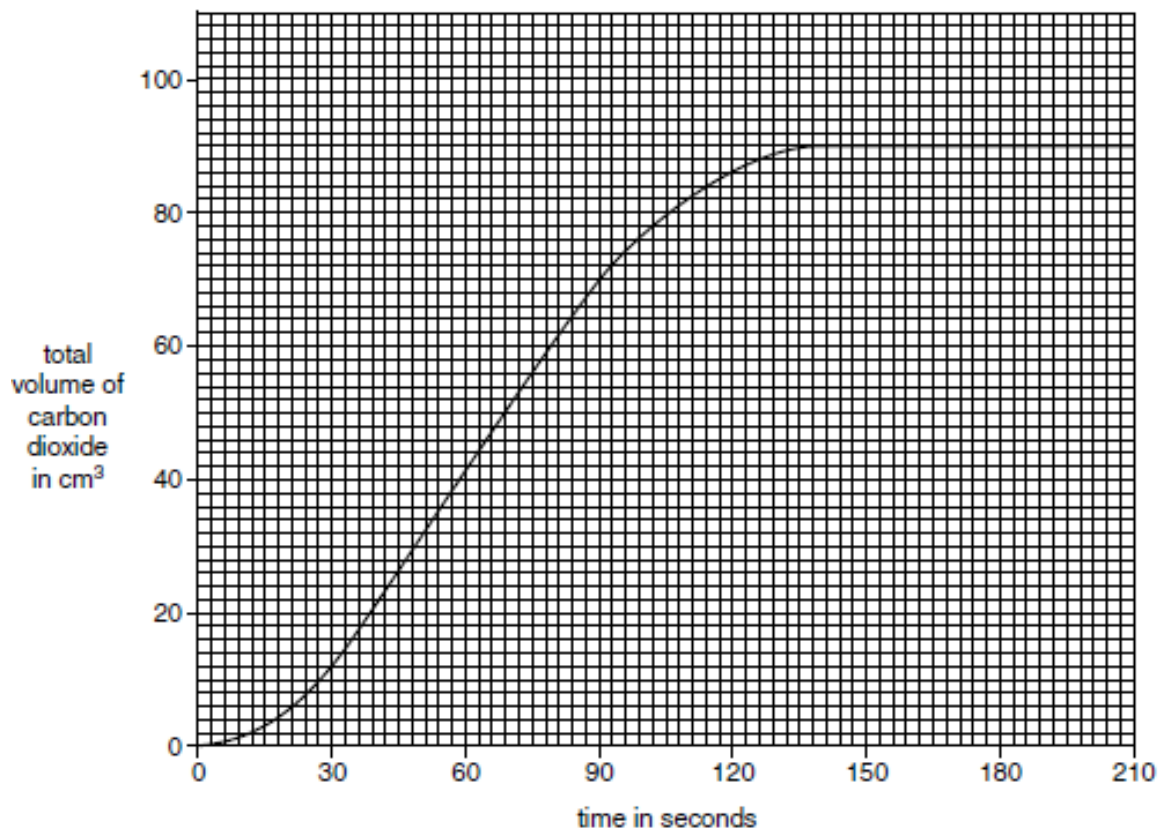
Look at the apparatus she uses.



The carbon dioxide made is collected in a gas syringe.

Every 30 seconds, she measures the total volume of carbon dioxide in the gas syringe.

Look at the graph of Jenna's results.



(a) At which time is the reaction the **fastest**?

Choose from

- 0 – 30 seconds
- 60 – 90 seconds
- 120 – 150 seconds
- 180 – 210 seconds

answer[1]

(b) (i) How long did it take for the reaction to finish?

answer..... seconds [1]

(ii) Jenna repeats the experiment using the same mass of zinc carbonate.

This time she uses a hotter flame to heat the zinc carbonate.

Explain, using the reacting particle model, why the reaction is finished in a shorter time.

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

(c) Jenna repeats the experiment a second time.

This time she uses 1.25 g of zinc carbonate.

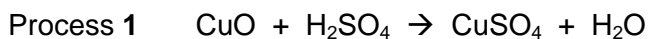
What mass of carbon dioxide is made?

The relative formula mass, Mr, of ZnCO₃ = 125, of CO₂ = 44 and of ZnO = 81.

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

[Total: 6]

10 Stowmarket synthetics manufacture copper sulfate by two different processes.



The water and carbon dioxide made are waste products.

Look at the table of relative formula masses.

compound	formula	relative formula mass, M_r
copper oxide	CuO	80
sulfuric acid	H_2SO_4	98
copper sulfate	CuSO_4	160
water	H_2O	18
copper carbonate	CuCO_3	124
carbon dioxide	CO_2	44

(a) Stowmarket Synthetics know that both atom economy and percentage yield are important.

(i) Show that that atom economy for making copper sulfate by process 1 is 89.9%

.....

 [2]

(ii) Stowmarket Synthetics uses 10.0 tonnes of copper oxide in process 1.

A scientist predicts they should make 20.0 tonnes of copper sulfate.

They actually make 17.2 tonnes.

Show that the percentage yield of copper sulfate is 86.0%.

.....

 [2]

(b) Look at the table.

It gives information about the atom economy and percentage yield for making copper sulfate.

process	atom economy	percentage yield
1	89.9	86.0
2	72.1	94.4

(i) Explain which process wastes the **least** amount of reactants.

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..... [1]

(ii) Explain which process is **more** sustainable.

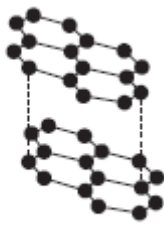
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[Total: 6]

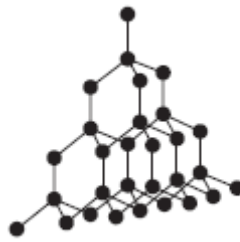
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11 Diamond and graphite are allotropes of carbon.



graphite



diamond

The table shows some of the physical properties of these two allotropes.

diamond	graphite
high melting point	high melting point
does not conduct electricity	conducts electricity

Explain, in terms of structure and bonding, these properties of diamond and graphite.



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

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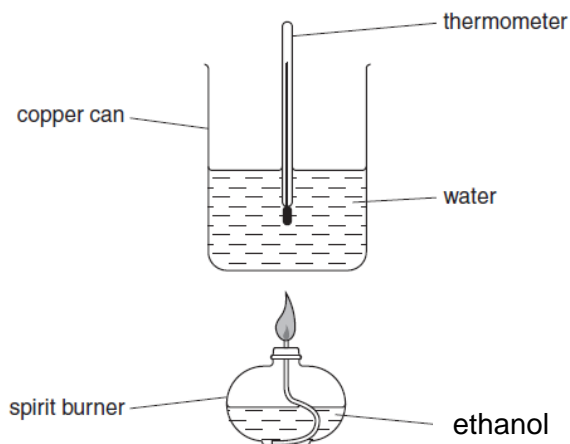
[Total: 6]

12 Ethanol is a liquid fuel.

Alia investigates the energy released when ethanol burns.

She heats 100 g of water using the energy released when ethanol burns.

Look at the apparatus she uses.



She decides to change the mass of ethanol that she uses to heat the 100 g of water.

Look at Alia's results.

mass of ethanol in grams	temperature of water before heating in °C	temperature of water after heating in °C
1.0	20	25
2.0	21	31
3.0	17	32
4.0	21	41
5.0	20	45

Alia knows that the energy released by a fuel can be calculated using this formula.

$$\text{energy released} = \text{mass of water} \times \text{specific heat capacity} \times \text{temperature change}$$

(a) Explain what conclusions Alia can make about the energy transferred from this experiment.

.....

.....

..... [2]

(b) Calculate the energy released per gram of ethanol.

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

(c) Alia decides to use the internet to check to see if her answer is correct.

Explain how publishing results in books and the internet help scientists improve their investigations.

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..... [2]

[Total: 7]

END OF QUESTION PAPER

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PERIODIC TABLE

1	2											3	4	5	6	7	0		
		Key relative atomic mass atomic symbol <small>name</small> atomic (proton) number										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								

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