UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 7 7 8 3 8 1 7 0 3 6 *

CHEMISTRY **0620/22**

Paper 2 **May/June 2010**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may need to use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 16.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total	

This document consists of **15** printed pages and **1** blank page.

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1 The diagram shows part of the Periodic Table.
Only some of the elements are shown.

Li				
Na	Mg			
K	Ca		Ti	V
			Zr	Nb

(a) Answer the following questions by choosing only from the elements shown in the diagram.
You can use each element once, more than once or not at all.

(i) State the names of **two** transition elements shown in the diagram.

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

(ii) State the name of an element which is in Period 3 of the Periodic Table.

..... [1]

(iii) Which element has the electronic structure 2,8,1?

..... [1]

(iv) Which element has the fastest reaction with water?

..... [1]

(v) Which element has 23 protons in its nucleus?

..... [1]

(b) Sodium reacts with oxygen to form sodium peroxide, Na_2O_2.
Complete the symbol equation for this reaction.

..... Na + ... $\rightarrow$ Na_2O_2

[2]

[Total: 8]

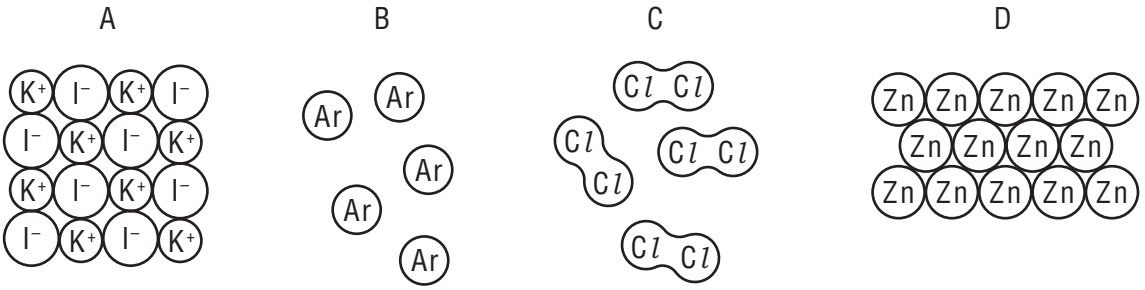
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2 The list describes five types of chemical structures.

giant covalent
giant ionic
metallic
simple atomic
simple molecular

(a) The diagrams below show four types of chemical structures.



(i) Use the list to match these structures with the diagrams.

structure **A** is ..... [1]

structure **B** is ..... [1]

structure **C** is ..... [1]

structure **D** is ..... [1]

(ii) Which **two** of the structures **A**, **B**, **C** or **D** have low melting points?

..... and ..... [1]

(b) Sodium chloride is an ionic solid.
Complete the following sentences using words from the list.

electrons **ionic** **molecular** **molten** **solid**

Sodium chloride does not conduct electricity when it is a .....
because the ions cannot move. When it is ..... sodium chloride does
conduct electricity because the ions are free to move. [2]

[Total: 7]

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3 Water is an important raw material in industry.

(a) State **one** use of water in industry.

..... [1]

(b) Describe a chemical test for water.

test .....

result ..... [2]

(c) A small piece of potassium was placed in a beaker of water.
The equation for the reaction is

$$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$$

(i) Describe a test for the gas given off in this reaction.

test .....

result ..... [2]

(ii) What is the most likely pH of the solution in the beaker when the reaction is complete?
Put a ring around the correct answer.

pH2 pH6 pH7 pH8 pH12

[1]

(d) Water is formed when propane burns.

(i) Complete the equation for this reaction.

$$C_3H_8 + 5O_2 \rightarrow .....CO_2 + ... H_2O$$

[2]

(ii) Which of the following best describes this reaction?
Put a ring around the correct answer.

carbonisation **combustion** **dehydration** **hydrogenation**

[1]

(iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed.
Calculate the mass of water formed when 22 g of propane are burnt.

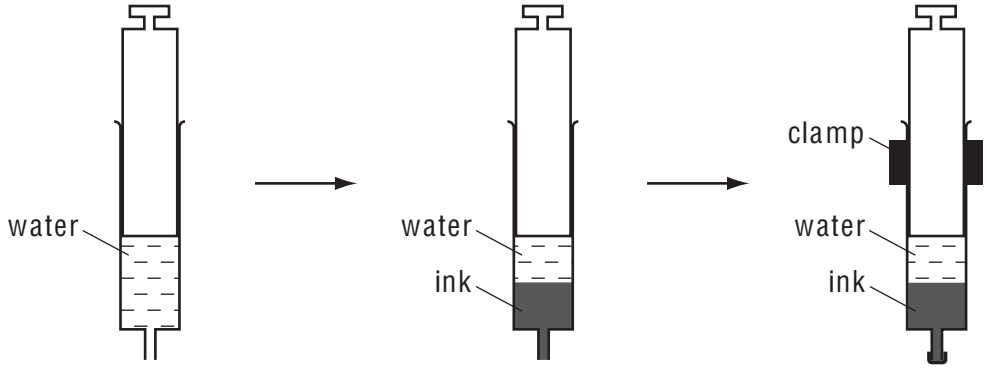
[1]

[Total: 10]

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4 A student half-filled a syringe with water.
She then carefully drew up some blue ink into the syringe so that it formed a separate layer below the water.
She then left the syringe in a clamp for twenty hours.



After twenty hours the blue colour of the ink had spread throughout the water.

(a) Use the kinetic particle theory to explain these observations.

.....

.....

..... [2]

(b) Ink is a mixture of many chemicals.
What do you understand by the term *mixture*?

.....

..... [1]

(c) The list shows some of the substances present in ink.

carboxylic acids
cobalt(II) ions
ethanol
iron(II) ions
nickel(II) ions
tannins
water

(i) Water is a good solvent.
From the list choose **one** other substance that is a good solvent.

..... [1]

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(ii) What is the meaning of the symbol (II) in iron(II)?
Tick **one** box.

the number of outer shell electrons	☐
the difference between the neutron and proton number	☐
the oxidation state	☐
the type of isotope	☐

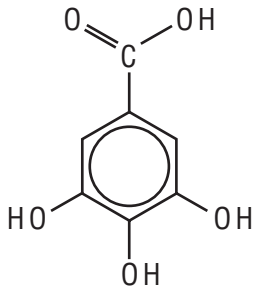
[1]

(iii) Tannins are polymers.
What do you understand by the term *polymer*?

.....

..... [2]

(d) One of the carboxylic acids present in ink is gallic acid.
The structure of gallic acid is shown below.



(i) On the structure above, put a ring around the carboxylic acid functional group. [1]

(ii) Gallic acid is a good reducing agent.
What do you understand by the term *reduction*?

..... [1]

[Total: 9]

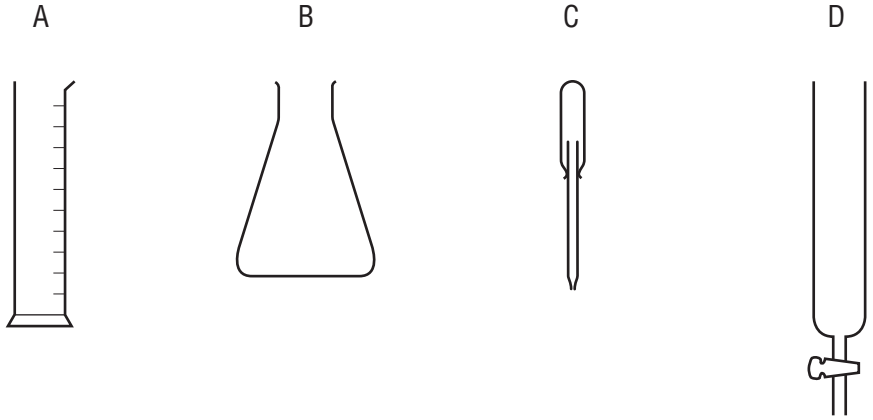
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5 A student wants to separate the coloured pigments in a plant leaf by chromatography. He grinds the plant leaf and separates the solids from the green solution.

(a) What method can he use to separate the solids from the solution?

..... [1]

(b) The student takes a drop of the green solution and puts a spot of it onto a piece of chromatography paper.
From the diagrams below choose the letter for the most suitable piece of apparatus for this task.

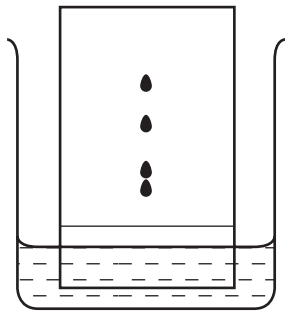


letter ..... [1]

(c) The student sets up the chromatography apparatus as shown.

(i) Label the diagram to show:

- the solvent,
- the original position of the spot of green solution,
- the chromatography paper.



[3]

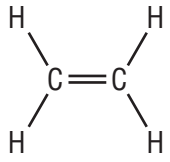
(ii) How many different pigments were present in the plant leaf?

..... [1]

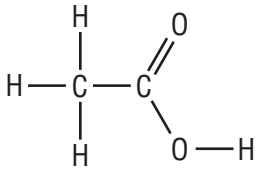
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(d) The structure of some organic compounds found in plant leaves are shown below.

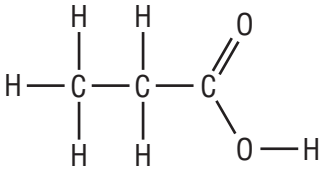
A



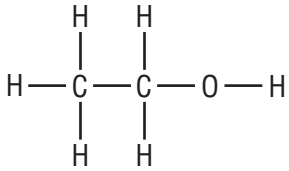
B



C



D



(i) Which one of these compounds is an unsaturated hydrocarbon?

..... [1]

(ii) Describe a chemical test for an unsaturated hydrocarbon.

test .....

result ..... [2]

(iii) What do you understand by the term *hydrocarbon*?

..... [1]

(iv) State the name of compound **B**.

..... [1]

(v) To which homologous series does compound **D** belong?

..... [1]

[Total: 12]

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6 Lead is a grey metal.

(a) State **two** physical properties which are characteristic of metals.

.....

..... [2]

(b) To which Group in the Periodic Table does lead belong?

..... [1]

(c) An isotope of lead has the mass number 208.
Complete the table to show the number of subatomic particles in an atom of this isotope of lead.
Use the Periodic Table to help you.

type of particle	number of particles
electrons	
protons	
neutrons	

[3]

(d) When lead is heated in oxygen, lead(II) oxide is formed.
Write a word equation for this reation.

..... [1]

(e) When lead(II) oxide is heated with carbon, lead and carbon monoxide are formed.

$$PbO + C \rightarrow Pb + CO$$

(i) Which substance becomes oxidised during this reaction?

..... [1]

(ii) Carbon monoxide is a covalent compound.
Which one of these statements about carbon monoxide is correct?
Tick **one** box.

It is a solid with a high melting point. ☐

It conducts electricity when it is a liquid. ☐

It is a gas at room temperature. ☐

It forms about 1 % of the atmosphere. ☐

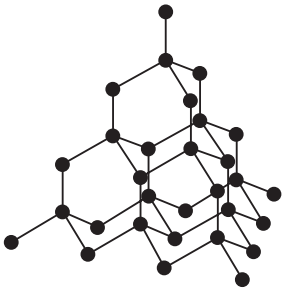
[1]

[Total: 9]

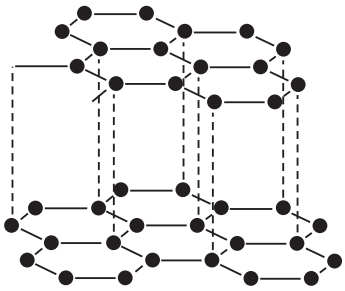
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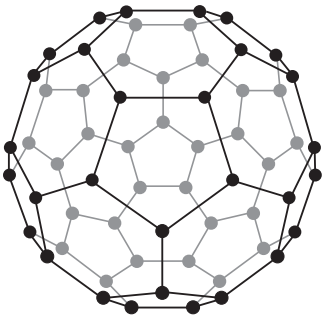
7 Three forms of carbon are diamond, graphite and Buckminsterfullerene.



diamond



graphite



Buckminsterfullerene

● carbon atom

(a) (i) State **one** difference in structure between Buckminsterfullerene and diamond.

.....

..... [1]

(ii) State **two** differences in structure between graphite and diamond.

.....

.....

..... [2]

(b) State the type of bonding between the carbon atoms in diamond.

..... [1]

(c) Suggest why graphite is used as a lubricant.
Refer to the layers in your answer.

.....

..... [1]

(d) State **one** use for diamond.

..... [1]

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(e) Coal is a fuel containing carbon.
When coal is burnt, carbon dioxide is produced.
Explain how the increase in carbon dioxide concentration in the atmopshere affects the world's climate.

.....

.....

..... [2]

(f) Coal also contains small amounts of sulfur.
Explain how burning coal leads to acid rain.

.....

.....

..... [2]

(g) Methane is a fuel.

(i) Which one of the following is a natural source of methane?
Tick **one** box.

waste gases from respiration in plants	☐
waste gases from digestion in animals	☐
gases from photosynthesis in plants	☐
gases from forest fires	☐

[1]

For Examiner's Use

(ii) Draw a diagram to show the arrangement of the electrons in a molecule of methane, CH_4.

Use
● for an electron from a carbon atom
× for an electron from a hydrogen atom

[1]

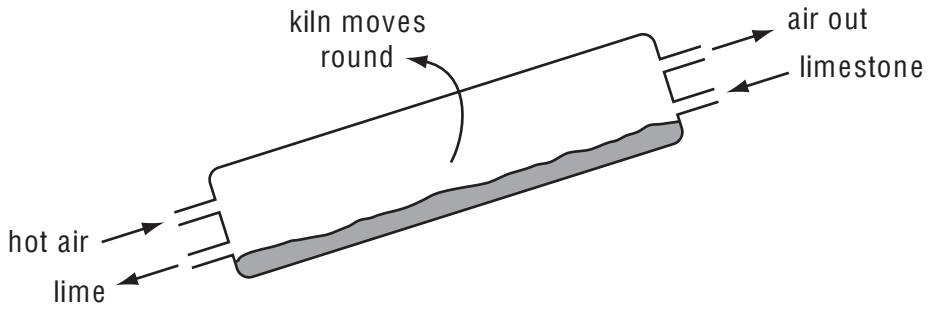
(iii) Methane belongs to the alkane homologous series.
Name **one** other alkane.

..... [1]

[Total: 13]

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8 The diagram shows a rotary kiln used to make lime from limestone.
Limestone is fed in at the top of the kiln and lime comes out at the bottom.



(a) What is the chemical name for lime?

..... [1]

(b) State the name of the type of chemical reaction that takes place in the rotary lime kiln.

..... [1]

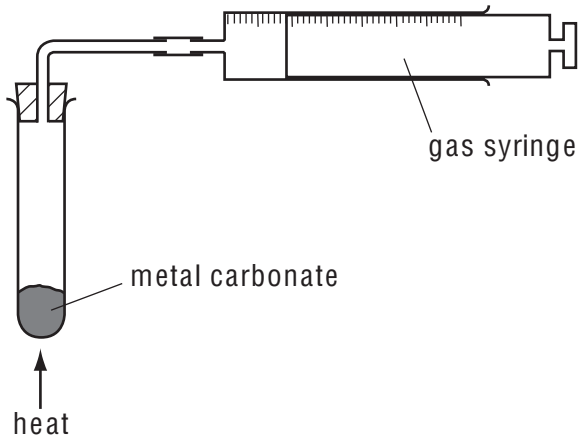
(c) Suggest why the air coming out of the rotary kiln has a greater percentage of carbon dioxide than the air entering the kiln.

..... [1]

(d) State **one** use for lime.

..... [1]

(e) A student compared the speed of reaction of three metal carbonates.
She measured the volume of gas released using the apparatus shown.

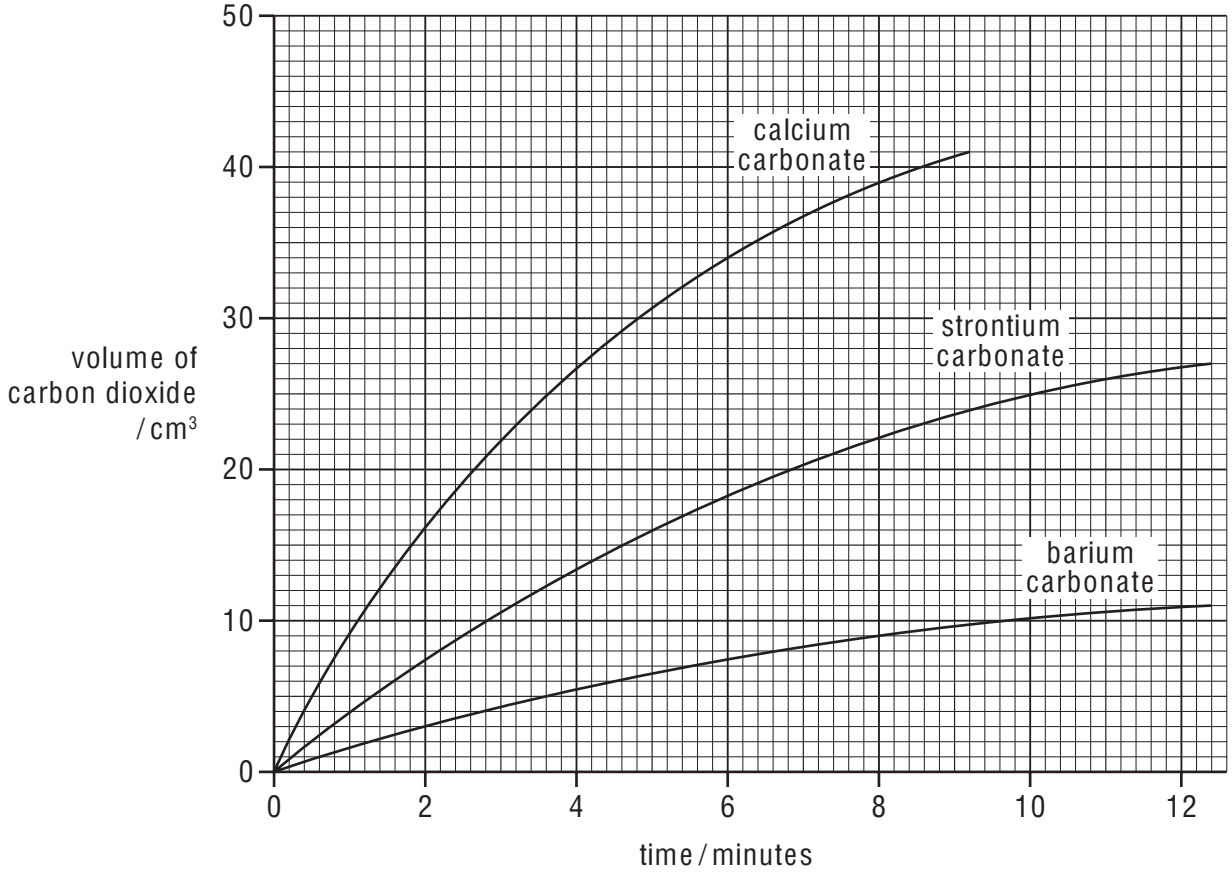


State **one** thing that must be kept constant if the speeds of these reactions are to be compared in a fair way.

..... [1]

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(f) The graph shows the volume of carbon dioxide released when the three metal carbonates are heated.



(i) Which carbonate produced carbon dioxide the fastest?

..... [1]

(ii) What volume of carbon dioxide was produced by strontium carbonate in ten minutes?

..... [1]

(iii) How does the speed of the reaction of these three metal carbonates relate to the position of calcium, strontium and barium in the Periodic Table?

.....

..... [2]

(g) Describe how hydrochloric acid and limewater can be used to show that carbonate ions are present in calcium carbonate.

.....

.....

..... [3]

[Total: 12]

DATA SHEET

The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
																4 He Helium 2
					1 H Hydrogen 1											
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	64 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	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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series

†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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