UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTER NUMBER						CANDIDATE NUMBER			

CHEMISTRY (US) **0439/23**

Paper 2 **May/June 2013**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

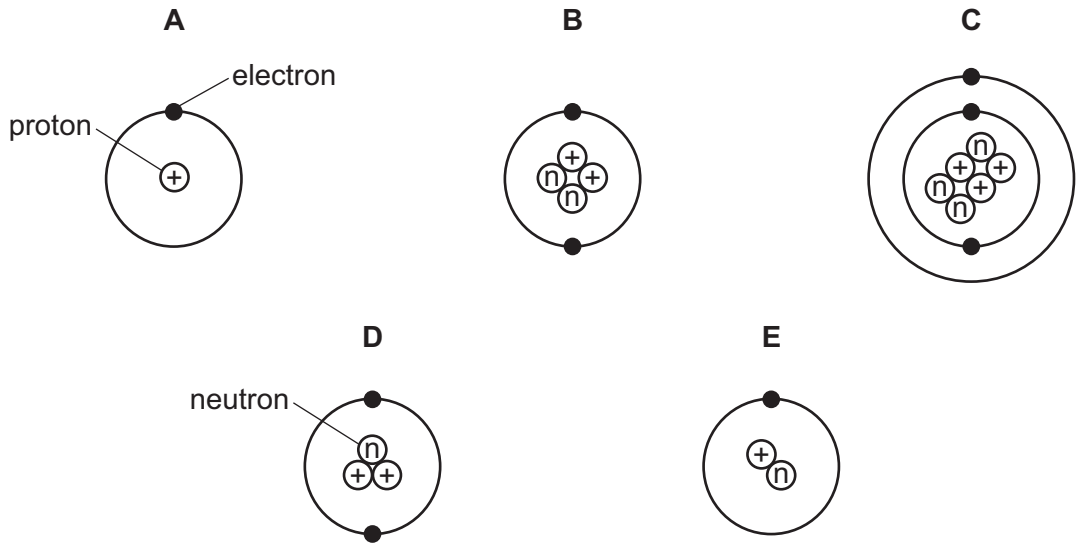
Write your Center number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may need to use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **14** printed pages and **2** blank pages.

1 The structures of five atoms, **A**, **B**, **C**, **D** and **E**, are shown below.



(a) Answer the following questions about these structures. Each structure can be used once, more than once or not at all.

(i) Which **two** structures are hydrogen atoms? ..... and .....

(ii) Which structure represents an atom of a metal? .....

(iii) Which structure has a proton (atomic) number of 3? .....

(iv) Which structure has two neutrons in its nucleus? ..... [5]

(b) The structure of carbon-12 can be written $^{12}_{6}C$.

Write the structure of atom **D** in a similar way.

[1]

(c) Complete the following sentences about isotopes using words from the list below.

atoms	**energy**	**iron**	**molecules**
neutrons	**protons**	**radioactive**	**stable**

Isotopes are atoms of the same element with the same number of ..... and different numbers of ..... . Some isotopes such as uranium-235 are ..... . Uranium-235 can be used as a source of ..... . [4]

[Total: 10]

2 The table shows some physical properties of the Group VII elements.

halogen	melting point / °C	boiling point / °C	atomic radius / nanometers	color
fluorine	–220	–188		pale yellow
chlorine	–101	–35	0.099	
bromine	–7	+59	0.114	red-brown
iodine	+114	+184	0.133	grey-black

(a) Use the information in the table to explain why

(i) chlorine is a gas at room temperature, ...

..... [1]

(ii) bromine is a liquid at room temperature. .....

..... [1]

(b) Describe the trend in atomic radius going down the group from chlorine to iodine.

..... [1]

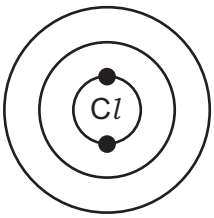
(c) Suggest a value for the atomic radius of fluorine.

..... [1]

(d) Describe the color of chlorine.

..... [1]

(e) A chlorine atom has 17 electrons.
Complete the following structure to show how the electrons are arranged.



[2]

(f) Chlorine reacts with potassium bromide to form potassium chloride and bromine.

(i) Complete the symbol equation for this reaction.

Cl_2 + ...KBr → 2KCl + ... [2]

(ii) Explain why iodine does **not** react with potassium bromide.

..... [1]

[Total: 10]

3 Aluminum and gallium are in Group III of the Periodic Table.

(a) The heat from your hand is sufficient to melt gallium.
Describe the change in state from solid to liquid in terms of the kinetic particle theory.
In your answer include

- the difference in arrangement and closeness of the particles in a solid and a liquid,
- the difference in the motion of the particles in a solid and a liquid.

.....

.....

.....

.....

..... [5]

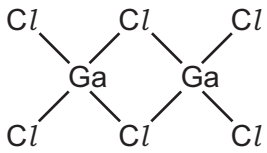
(b) Gallium is a metal. Describe **three** physical properties of gallium which are typical of most metals.

1. .....

2. .....

3. ..... [3]

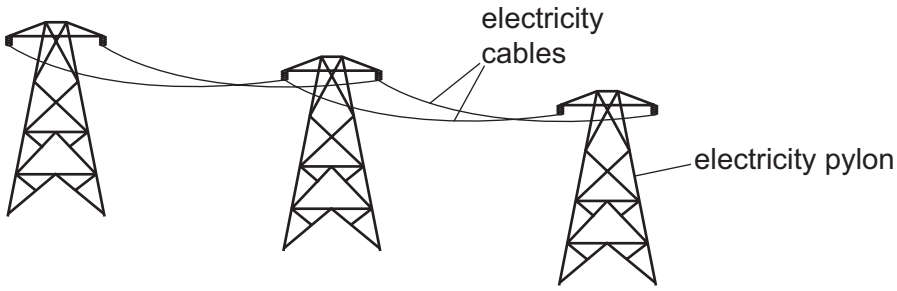
(c) When it is a gas, gallium(III) chloride has the structure shown below.



Write the molecular formula for gallium(III) chloride.

..... [1]

(d) Aluminum is used to make high voltage electricity cables.



The table shows some properties of four metals which could be used for overhead power cables.

metal	relative strength	density in g / cm^3	relative electrical conductivity	price $ per tonne
aluminum	9	2.70	0.4	2120
copper	30	8.92	0.7	9600
tungsten	100	19.35	0.2	450
steel	50	7.86	0.1	700

(i) Suggest why aluminum, rather than tungsten, is used in overhead power cables?

..... [1]

(ii) Suggest why steel, rather than copper, is used as a core for overhead power cables.

..... [1]

(iii) Give **two** reasons why aluminum is used for overhead power cables rather than copper.

1. .....

2. ..... [2]

(e) State **one** use of aluminum other than as an electrical conductor.

..... [1]

[Total: 14]

4 Impure water needs to be treated if it is to be used in the home.

(a) (i) Explain why filtration and chlorination are used in the water treatment process.

.....

.....

..... [2]

(ii) State **one** use of water in the home.

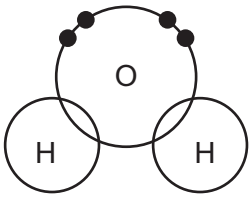
..... [1]

(b) Describe a chemical test for water.

test .....

result ..... [2]

(c) (i) Complete the diagram below to show the electron arrangement in a water molecule.



[1]

(ii) Is the bonding in water covalent or ionic?
Give a reason for your answer.

..... [1]

(d) Pure water is neutral. Which one of these pH values is neutral?
Put a ring around the correct answer.

pH 0 **pH 6** **pH 7** **pH 9** **pH 13**

[1]

(e) Water reacts with sodium. The products are sodium hydroxide and hydrogen.
Write a word equation for this reaction.

[1]

[Total: 9]

5 Energy is given out when fuels burn.

(a) State the name given to a chemical reaction which releases energy.

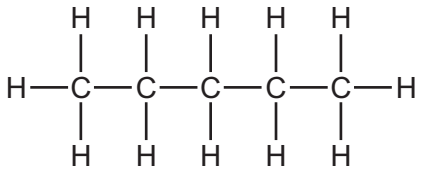
..... [1]

(b) Hydrogen can be used as a fuel.
Complete the symbol equation for the burning of hydrogen in oxygen.

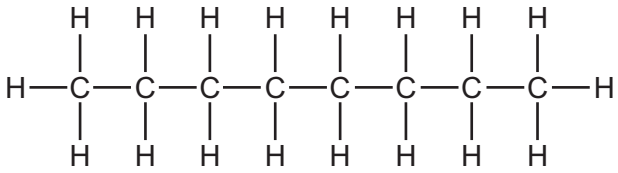
$$.....H_2 + ... \rightarrow 2H_2O$$ [2]

(c) Gasoline is a mixture of hydrocarbons containing between 5 and 10 carbon atoms.
Four of these hydrocarbons are shown below.

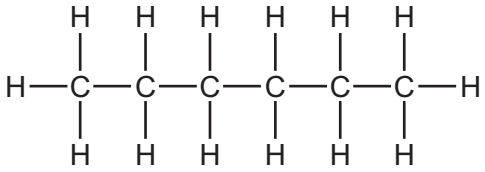
A



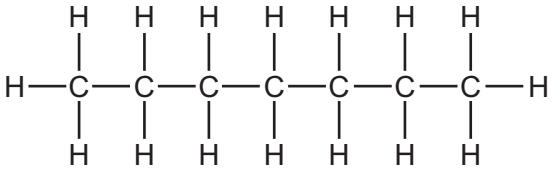
B



C



D



(i) Which **one** of these structures, **A**, **B**, **C** or **D**, has the highest relative molecular mass?
You are not expected to do any calculations.

..... [1]

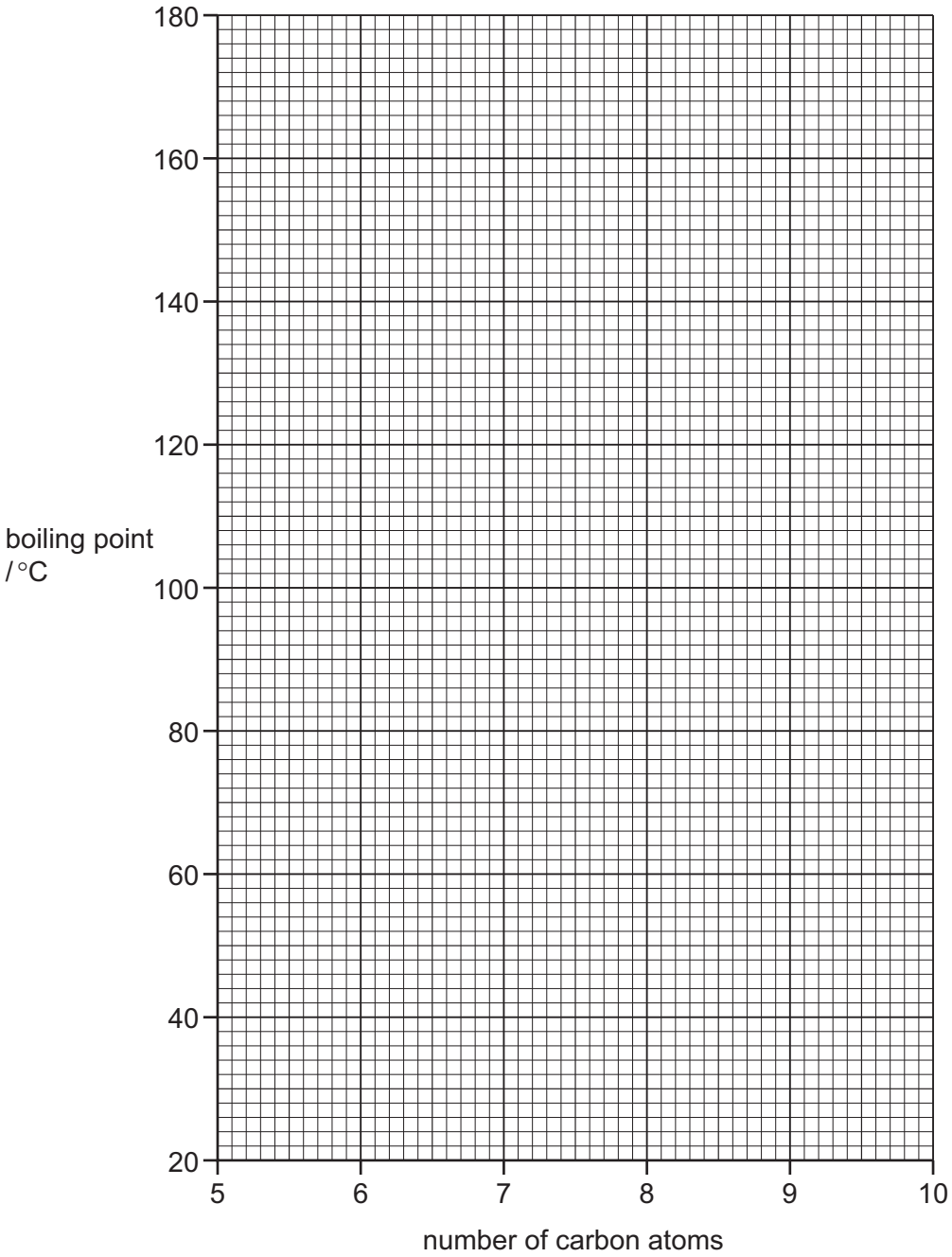
(ii) Give **one** use of gasoline.

..... [1]

(d) The table shows the boiling points of the straight-chain hydrocarbons in the g
fraction.

number of carbon atoms	5	6	7	8	9	10
boiling point / °C	36	69		126	151	174

(i) On the grid below, plot a graph to show how the boiling point changes with the number of carbon atoms in these hydrocarbons. Draw a smooth curve through the points.



[3]

(ii) Use your graph to deduce the boiling point of the hydrocarbon with 7 carbon atoms.

boiling point ..... °C [1]

(e) The alkanes are a homologous series of hydrocarbons.

(i) What is meant by the term *homologous series*?

.....

..... [2]

(ii) Alkanes can be cracked to form alkenes and smaller alkanes.
State the conditions needed for cracking.

.....

..... [2]

[Total: 13]

6 Inks are mixtures of different dyes.

(a) A student used paper chromatography to separate the dyes in a particular ink.
Describe how paper chromatography is carried out. You may draw a diagram to help explain your answer.
In your description include

- the apparatus you would use,
- how chromatography is carried out.

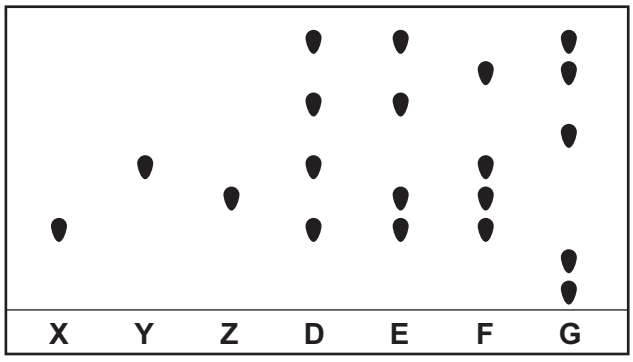
.....

.....

.....

..... [4]

(b) The chromatogram below shows the results of a chromatography experiment.
X, **Y** and **Z** are pure dyes containing only one compound.
The dyes present in four different inks, **D**, **E**, **F** and **G** are also shown.



(i) Which ink, **D**, **E**, **F** or **G**, contains all the dyes **X**, **Y** and **Z**?

..... [1]

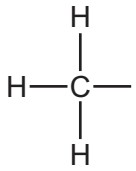
(ii) Which ink, **D**, **E**, **F** or **G**, does **not** contain any of the dyes **X**, **Y** and **Z**?

..... [1]

(iii) Which ink contains the greatest number of different dyes?

..... [1]

(c) Some inks contain ethanoic acid.
Complete the structure of ethanoic acid.

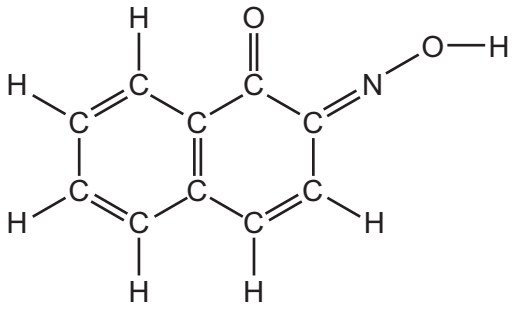


[1]

(d) Ethanoic acid can be used as a solvent.
What is the meaning of the term *solvent*?

..... [1]

(e) The structure of a dye called Gambine R is shown below.



(i) How many different types of atom are there in one molecule of Gambine R?

..... [1]

(ii) How many carbon atoms are there in one molecule of Gambine R?

..... [1]

[Total: 11]

7 Hydrogen peroxide, H_2O_2, decomposes in the presence of an enzyme called peroxida
products of this reaction are water and oxygen.

(a) (i) What is meant by the term *enzyme*?

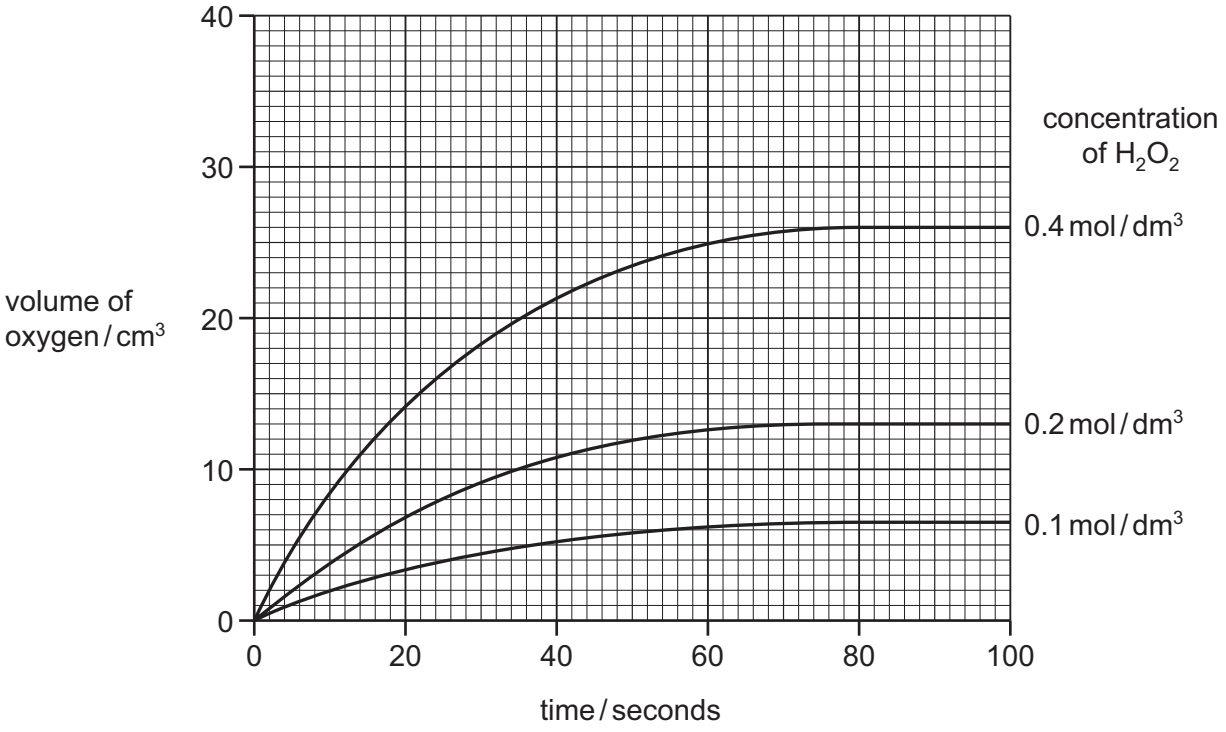
.....

..... [2]

(ii) Complete the symbol equation for this reaction.

$$.....H_2O_2 \rightarrow 2H_2O + O_2$$ [1]

(b) A student followed the course of this reaction by measuring the volume of oxygen released over a period of time.
The diagram below shows some results that he obtained using hydrogen peroxide at three different concentrations.



(i) Describe how the concentration of hydrogen peroxide affects the rate of this reaction.

..... [1]

(ii) On the graph above, draw a line to show the course of the reaction when the starting concentration of hydrogen peroxide is 0.3 mol / dm^3. [2]

(iii) For the concentration of hydrogen peroxide of 0.4 mol / dm^3, deduce

- the volume of oxygen given off when the reaction is complete,

..... cm^3

- the time it takes to produce 14 cm^3 of oxygen.

..... seconds [2]

(c) In the presence of sulfuric acid, hydrogen peroxide reacts with iodide ions to form
and water. This involves the reduction of hydrogen peroxide.

(i) What is the meaning of the term *reduction*?

..... [1]

(ii) Complete the word equation for the reaction of sulfuric acid with calcium hydroxide.

sulfuric acid + calcium hydroxide → ..... + ...

..... [2]

(iii) Describe a test for iodide ions.

test .....

result ..... [2]

[Total: 13]

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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	101 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	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	a = relative atomic mass
X	X = atomic symbol
b	b = proton (atomic) number

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