UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

CHEMISTRY **0620/21**

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 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.

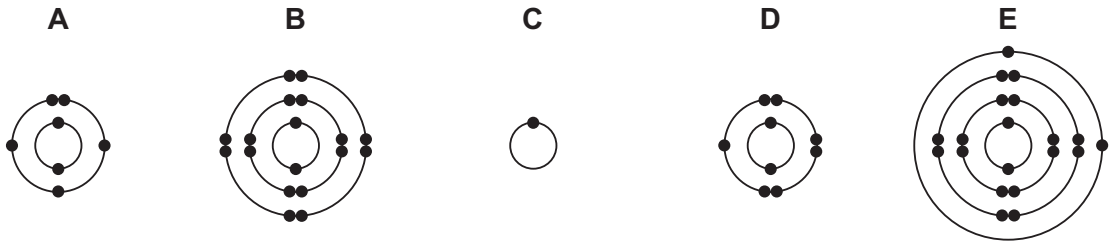
Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

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 **15** printed pages and **1** blank page.

For Examiner's Use

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



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

(a) Which structure

(i) is in Period 4 of the Periodic Table, ☐

(ii) is a noble gas, ☐

(iii) is in Group II of the Periodic Table, ☐

(iv) has five electrons in its outer shell, ☐

(v) has a proton (atomic) number of 7, ☐

(vi) represents a fluorine atom? ☐ [6]

(b) Complete the following sentences about elements using words from the list below.

alkali **atom** **covalent** **ion**

monatomic **three** **transition** **two**

An element is a substance containing only one type of ..... .

The Group VII elements exist as molecules containing ..... atoms.

Carbon has a giant ..... structure with many strong bonds.

Elements such as iron and copper, which form coloured compounds, are called ..... elements. [4]

[Total: 10]

For Examiner's Use

2 The table below shows some properties of the Group I elements.

metal	density in g / cm^3	melting point / °C	boiling point / °C
lithium	0.53	181	1342
sodium	0.97	98	883
potassium	0.86	63	
rubidium	1.53	39	686
caesium	1.88	29	669

(a) Use the information in the table to explain why caesium is a liquid when the temperature is 34 °C.

.....

..... [1]

(b) Suggest a value for the boiling point of potassium.

..... °C [1]

(c) **(i)** Describe the **general** trend in density down the group.

..... [1]

(ii) Which element does **not** follow this trend?

..... [1]

(d) State **three** physical properties of potassium, other than density, melting point and boiling point.

.....

.....

..... [3]

(e) Potassium reacts with water. The products are potassium hydroxide and hydrogen.

(i) Describe **two** observations when potassium reacts with water.

.....

.....

..... [2]

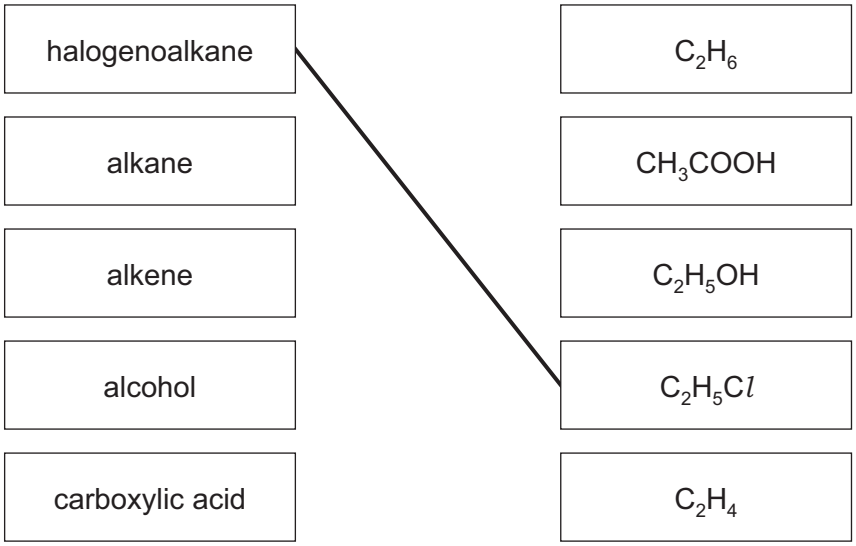
(ii) Complete the symbol equation for this reaction.

$$2K + ...H_2O \rightarrow 2KOH + ...$$ [2]

[Total: 11]

For Examiner's Use

3 **(a)** Match the name of the homologous series on the left with its formula on the right. The first one has been done for you.



[4]

(b) Draw the full structural formula of the compound, C_2H_6, showing all atoms and bonds.

[1]

(c) The compound with the formula C_2H_4 is an unsaturated hydrocarbon.
Describe the difference between a saturated and an unsaturated hydrocarbon in terms of the bonds they contain.

.....

..... [2]

(d) Describe a test to distinguish between a saturated and unsaturated hydrocarbon.

test .....

result with saturated hydrocarbon .....

.....

result with unsaturated hydrocarbon .....

..... [3]

[Total: 10]

For Examiner's Use

4 Farmers spread fertilisers on the soil where crops are to be grown.

(a) Why do farmers use fertilisers? In your answer, include

- the names of the essential elements present in most fertilisers,
- the reasons why farmers use fertilisers.

.....

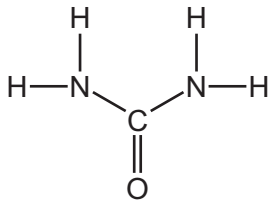
.....

.....

.....

..... [4]

(b) Urea can be used as a fertiliser.
The structure of urea is shown below.



(i) Deduce the molecular formula of urea.

..... [1]

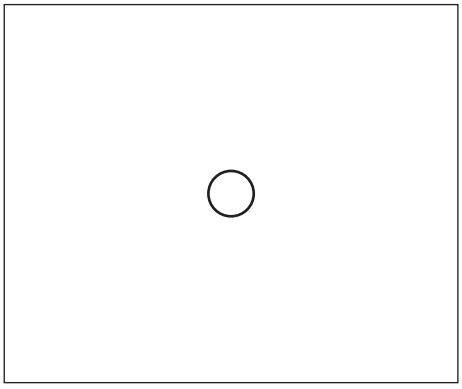
(ii) Calculate the relative molecular mass of urea. You must show all your working.

[2]

For Examiner's Use

(c) Urea is a solid at room temperature. Complete the diagram below to show the arrangement of the molecules in solid urea.

Show a molecule of urea as ◯



[2]

(d) When urea is heated with an alkali, ammonia is given off.
Describe a test for ammonia.

test .....

result ..... [2]

[Total: 11]

For Examiner's Use

5 The table shows some properties of four substances, **A**, **B**, **C** and **D**.

substance	melting point / °C	does the solid conduct electricity?	does a solution of the solid conduct electricity?
A	962	yes	does not dissolve
B	747	no	dissolves and conducts
C	113	no	does not dissolve
D	3550	no	does not dissolve

(a) Which one of these substances has

(i) a giant covalent structure, ☐

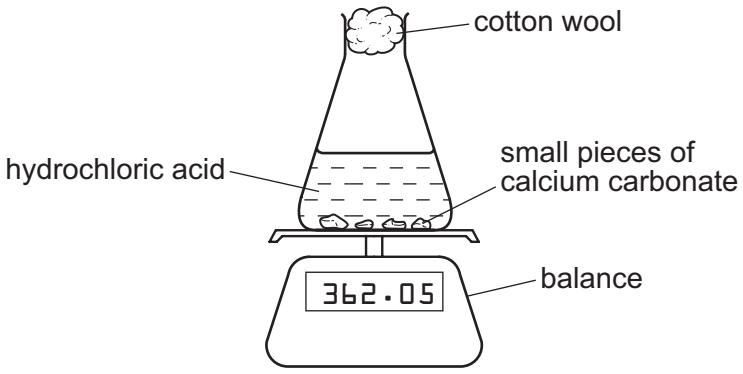
(ii) a simple molecular structure, ☐

(iii) a metallic structure? ☐ [3]

(b) A student carried out an experiment to determine the rate of reaction of calcium carbonate with excess hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

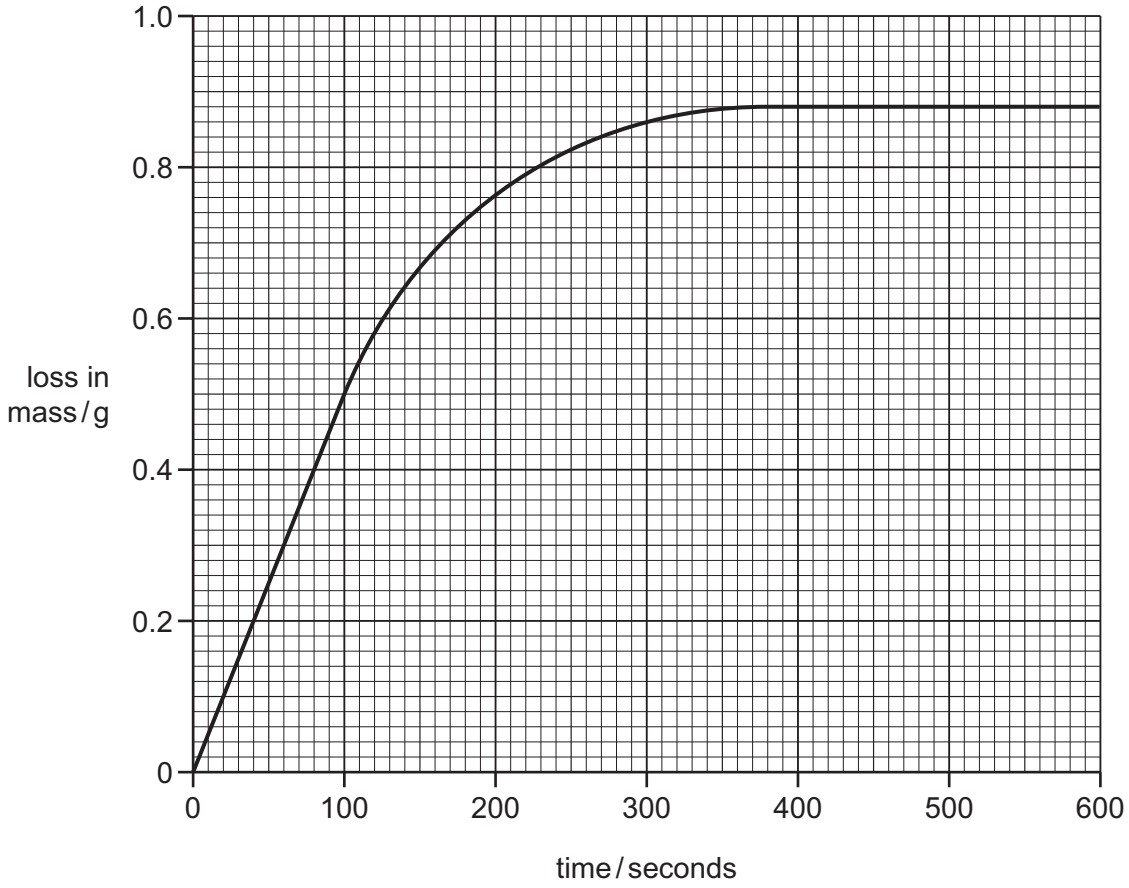
He recorded the loss of mass of the reaction mixture over a period of time.



(i) Explain why the reaction mixture decreases in mass.

..... [1]

He carried out the reaction at constant temperature using 2 g of calcium carbonate in small pieces. The hydrochloric acid was in excess.
He plotted his results on a grid. This is shown below.



(ii) At what time has the reaction just finished?

..... s [1]

(iii) From the graph, deduce the loss in mass in the first 100 seconds.

..... g [1]

(iv) The student repeated the experiment keeping everything the same except for the size of the pieces of calcium carbonate. He used smaller pieces of calcium carbonate but the mass used was the same.

On the grid above, draw a line to show how the loss of mass changes with time when smaller pieces of calcium carbonate are used. [2]

(v) State the effect of increasing the concentration of hydrochloric acid on the rate (speed) of this reaction when all other factors remain constant.

..... [1]

[Total: 9]

For Examiner's Use

6 **(a)** Propanol is a solvent.
Sugar is soluble in propanol. Salt (sodium chloride) is insoluble in propanol.
A student wants to separate a mixture of solid salt and solid sugar.

(i) Describe how she could separate the salt from the sugar.
You may draw a labelled diagram to help you answer this question.

.....

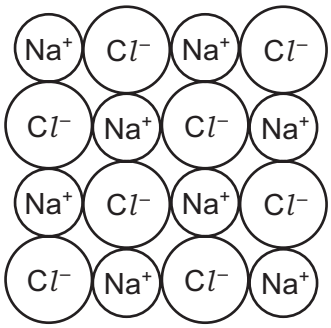
.....

..... [3]

(ii) Describe how the student could obtain solid sodium chloride from a solution of sodium chloride in water.

..... [1]

(b) The diagram shows the structure of sodium chloride.



(i) Deduce the simplest formula for sodium chloride.

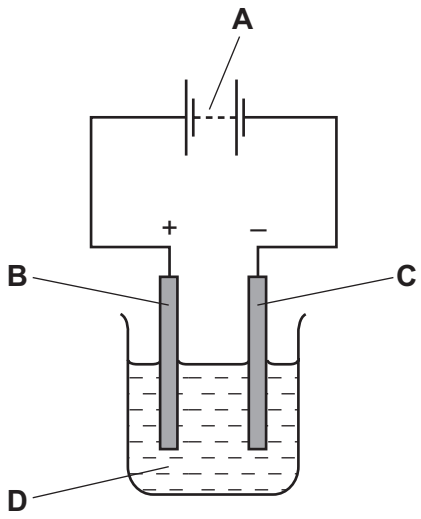
..... [1]

(ii) What type of bonding is present in sodium chloride?
Put a ring around the correct answer.

covalent **ionic** **metallic** **weak** [1]

For Examiner's Use

(c) The diagram shows the apparatus used to electrolyse a concentrated aqueous solution of sodium chloride.



(i) Which letter on the diagram, **A**, **B**, **C** or **D**, represents the electrolyte?

..... [1]

(ii) Name the product formed at

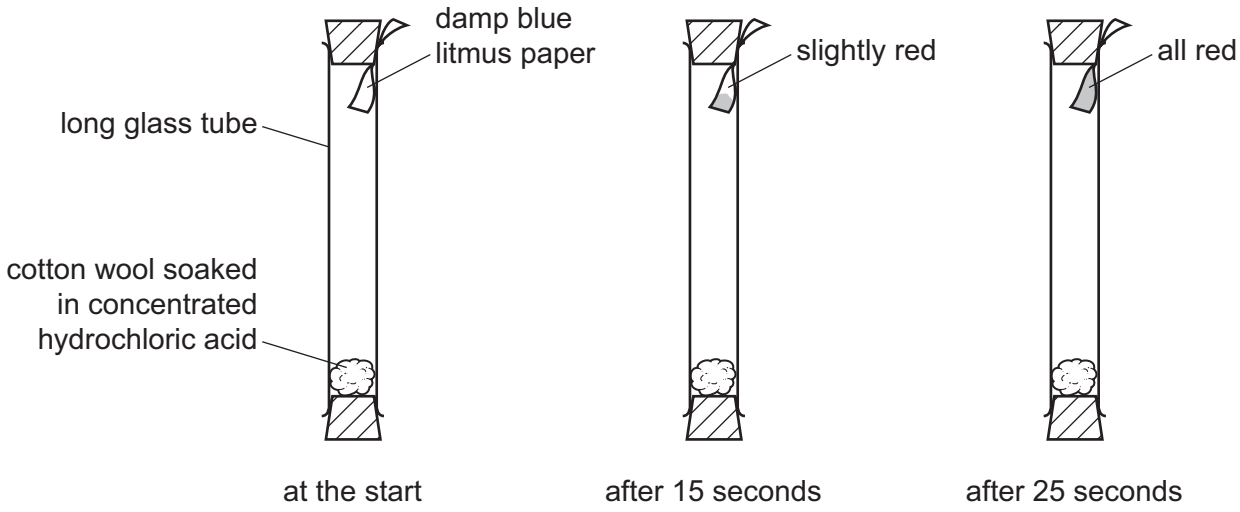
the positive electrode, ...

the negative electrode. ..... [2]

[Total: 9]

For Examiner's Use

7 **(a)** A student set up the apparatus shown below.
The concentrated hydrochloric acid gives off hydrogen chloride gas.
After 15 seconds, the damp blue litmus paper begins to turn red.
After 25 seconds, the litmus paper has turned completely red.



Use ideas about moving particles to explain these observations.

.....

.....

.....

.....

..... [4]

(b) Hydrogen chloride reacts with ammonia to form a salt which has the formula NH_4Cl.
State the name of this salt.

..... [1]

(c) **(i)** Hydrochloric acid reacts with iron to form iron(II) chloride and hydrogen.
Write a word equation for this reaction.

..... [1]

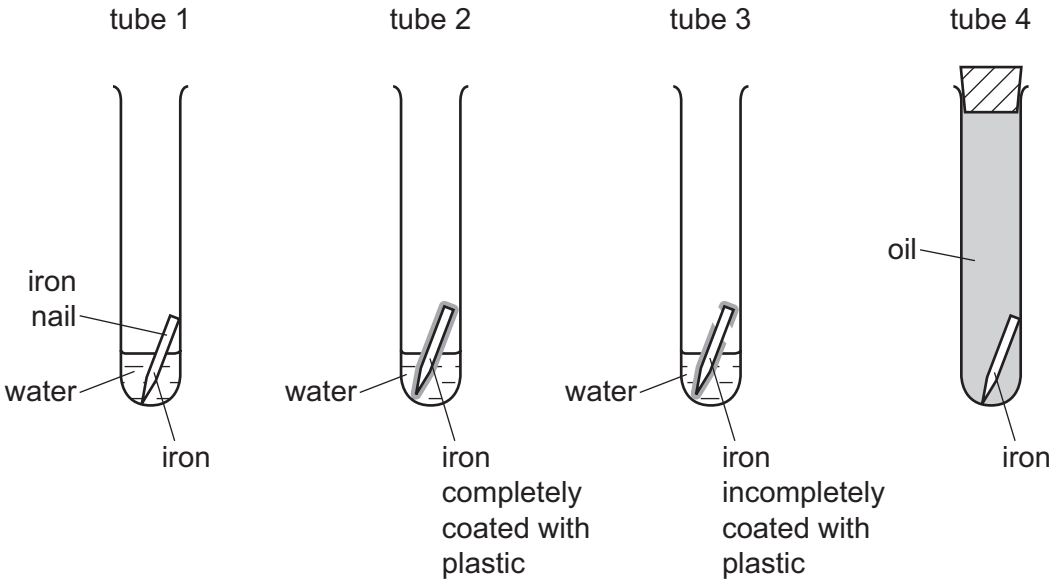
(ii) Describe a test for iron(II) ions.

test .....

result ..... [2]

For Examiner's Use

(d) A student investigates various methods of protecting iron from rusting. She sets up four tubes as shown in the diagram below.



(i) Tube 1 contains unprotected iron. What is the purpose of this experiment?

..... [1]

(ii) State the names of the **two** substances needed for iron to rust.

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

(iii) Explain why the iron in tube 4 does **not** rust.

.....

..... [1]

(iv) Explain why the iron in tube 3 eventually rusts.

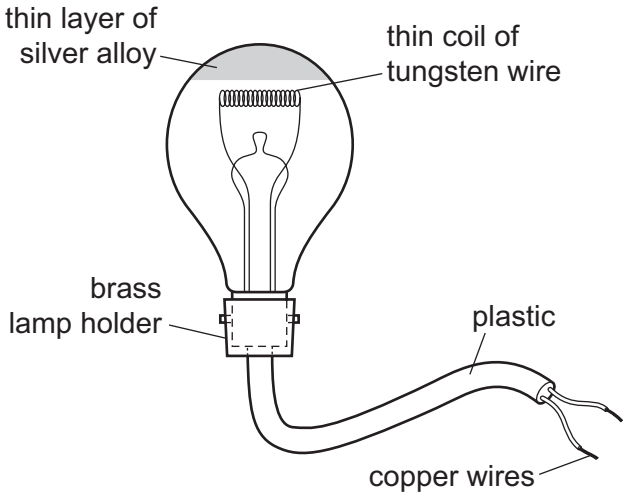
.....

..... [1]

[Total: 13]

For Examiner's Use

8 The diagram shows a silvered light bulb.



Some properties of metals used in the light bulb are shown in the table below.

metal	hardness	electrical conductivity	melting point / °C	price / $ per tonne
brass	hard	good	about 1000	7 000
copper	fairly soft	very good	1083	9 600
silver	fairly soft	very good	962	1 300 000
tungsten	hard	good	3410	450

(a) (i) Suggest why copper rather than tungsten is used for electrical wiring?

..... [1]

(ii) Suggest why silver is **not** used for electrical wiring.

..... [1]

(iii) Suggest **two** reasons why tungsten rather than copper is used to make the bulb filament.

reason 1 .....

reason 2 ..... [2]

(iv) Explain why the copper wires are covered with plastic.

.....

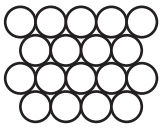
..... [2]

[Turn over

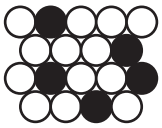
For Examiner's Use

(b) Brass is an alloy.
Which one of the following diagrams, **A**, **B**, **C** or **D**, best represents an alloy?

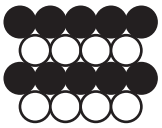
A



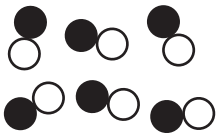
B



C



D



..... [1]

[Total: 7]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	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	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.).