Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4078960309

CHEMISTRY **0620/22**

Paper 2 **October/November 2014**

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 use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

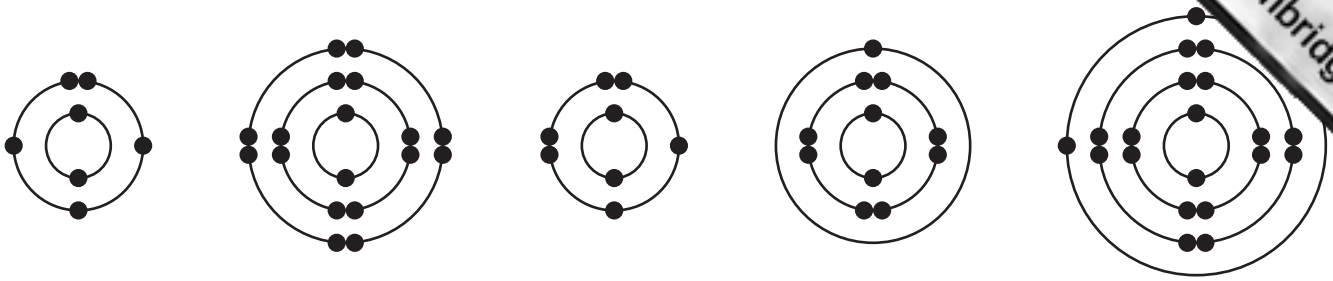
Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 20.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **17** printed pages and **3** blank pages.

1 **(a)** The electronic structure of five atoms, **A**, **B**, **C**, **D** and **E**, are shown below.



A **B** **C** **D** **E**

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

Which structure:

(i) represents an atom of an element in Group V of the Periodic Table, ... [1]

(ii) has a complete outer shell of electrons, ... [1]

(iii) represents an oxygen atom, ... [1]

(iv) has a proton number of 20, ... [1]

(v) is an atom of an element in Period 4 of the Periodic Table, ... [1]

(vi) has a single valency electron? ..... [1]

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

atoms **ions** **molecules** **neutrons** **nuclei** **protons**

Isotopes are ..... of the same element with the same number of .....

but different numbers of ..... . [3]

[Total: 9]

2 The table below shows some nutritional information on a bottle of apple juice.

contents	mass present in g / 100 cm^3
protein	0.10
sugars	10.40
unsaturated fat	0.10
saturated fat	0.06
chloride ions, Cl^-	0.04
magnesium ions, Mg^{2+}	0.01
nitrate ions, NO_3^-	0.01
potassium ions, K^+	0.02
sodium ions, Na^+	0.05
X, SO_4^{2-}	0.01

(a) Answer these questions using information from the table.

(i) Which negatively charged ion is present in the highest concentration?

..... [1]

(ii) State the name of the ion, **X**, whose formula is SO_4^{2-}.

..... [1]

(iii) The formulae for some chlorides are shown below.

aluminium chloride, $AlCl_3$
calcium chloride, $CaCl_2$
lead(IV) chloride, $PbCl_4$
potassium chloride, KCl

Deduce the formula for magnesium chloride.

..... [1]

(iv) Calculate the mass of sugars in 250 cm^3 of this apple juice.

..... g [1]

(b) The fats in the apple juice are both saturated and unsaturated.
Describe a test to distinguish between saturated and unsaturated compounds.

test .....

result with saturated compound .....

result with unsaturated compound .....

[3]

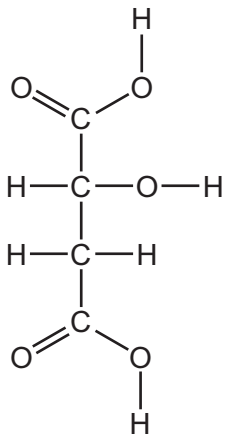
(c) Apple juice is slightly acidic.

(i) Which **one** of the following pH values is slightly acidic?
Put a ring around the correct answer.

pH 1 **pH 5** **pH 7** **pH 9** **pH 14**

[1]

(ii) One of the acids found in apple juice is malic acid.
The structure of malic acid is shown below.



On the structure of malic acid above, put a ring around a carboxylic acid functional group. [1]

[Total: 9]

3 Hydrogen chloride gas can be prepared by the action of concentrated sulfuric acid on sodium chloride.

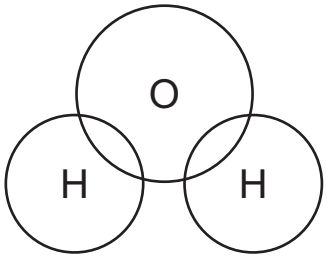
$$H_2SO_4 + 2NaCl \rightarrow Na_2SO_4 + 2HCl$$

(a) Write the word equation for this reaction.

..... [1]

(b) Hydrogen chloride dissolves in water to form hydrochloric acid.

(i) Complete the dot-and-cross diagram to show the arrangement of the outer shell electrons in water.

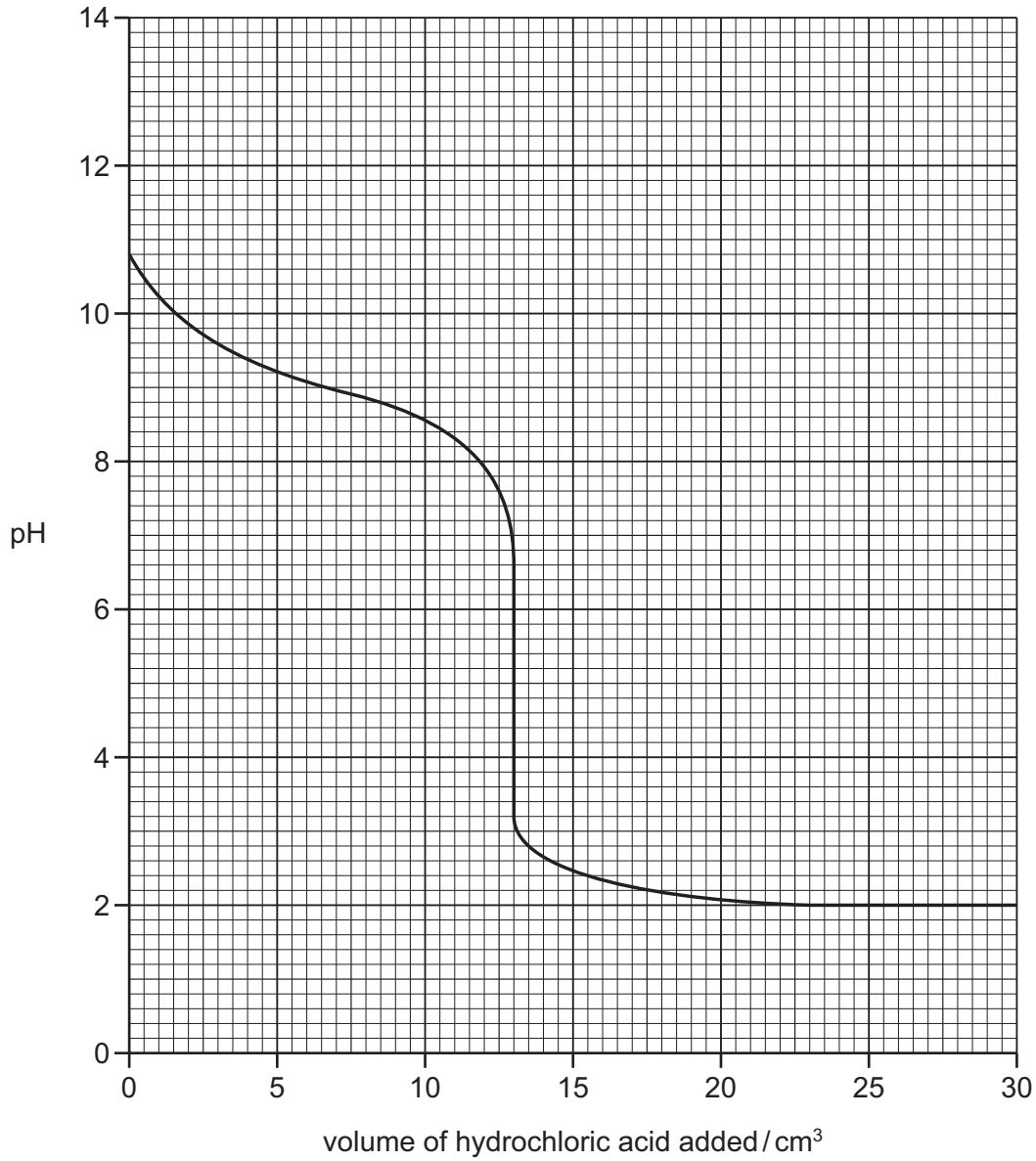


[2]

(ii) Describe what you would observe when a few drops of silver nitrate solution are added to hydrochloric acid.

..... [2]

(c) The graph below shows how pH changes when aqueous ammonia is neutralised by [illegible]ic acid.



(i) What is the pH of the aqueous ammonia at the start of the experiment?

..... [1]

(ii) What volume of hydrochloric acid has been added when the pH is 10?

..... [1]

(iii) What volume of hydrochloric acid has been added when the pH is changing most quickly?

..... [1]

(d) Concentrated hydrochloric acid reduces manganese(IV) oxide, MnO_2, to manganese(II) chloride.

$$4HCl + MnO_2 \rightarrow MnCl_2 + Cl_2 + 2H_2O$$

How does this equation show that manganese(IV) oxide gets reduced?

..... [1]

(e) The table shows some properties of four metals, **A**, **B**, **C** and **D**, and their oxides.

metal	density in g / cm^3	boiling point / °C	colour of oxide	charge on the metal ion
A	2.99	2831	white	3+
B	0.53	1342	white	1+
C	7.86	2750	black or red-brown	2+ or 3+
D	7.14	907	white	2+

Which **one** of these metals is a transition metal?
Use the information in the table to explain your answer.

.....

.....

..... [2]

[Total: 11]

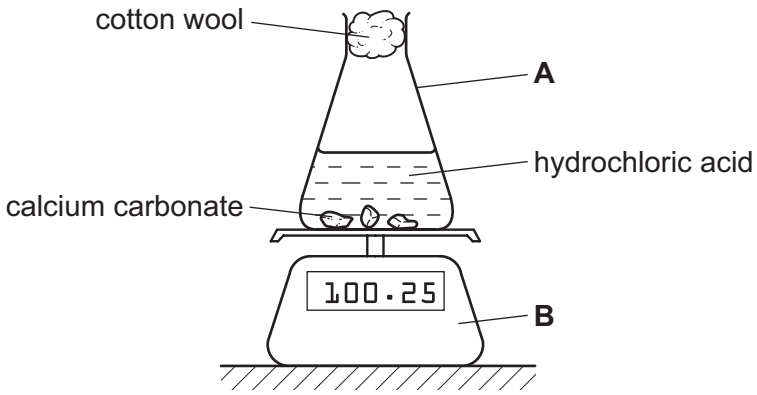
4 Calcium carbonate reacts with dilute hydrochloric acid.

(a) Complete the symbol equation for this reaction.

$$CaCO_3 + ...HCl \rightarrow CaCl_2 + CO_2 + ...$$

[2]

(b) The rate of this reaction can be followed using the apparatus shown below.



(i) State the names of the pieces of apparatus labelled **A** and **B**.

A .....

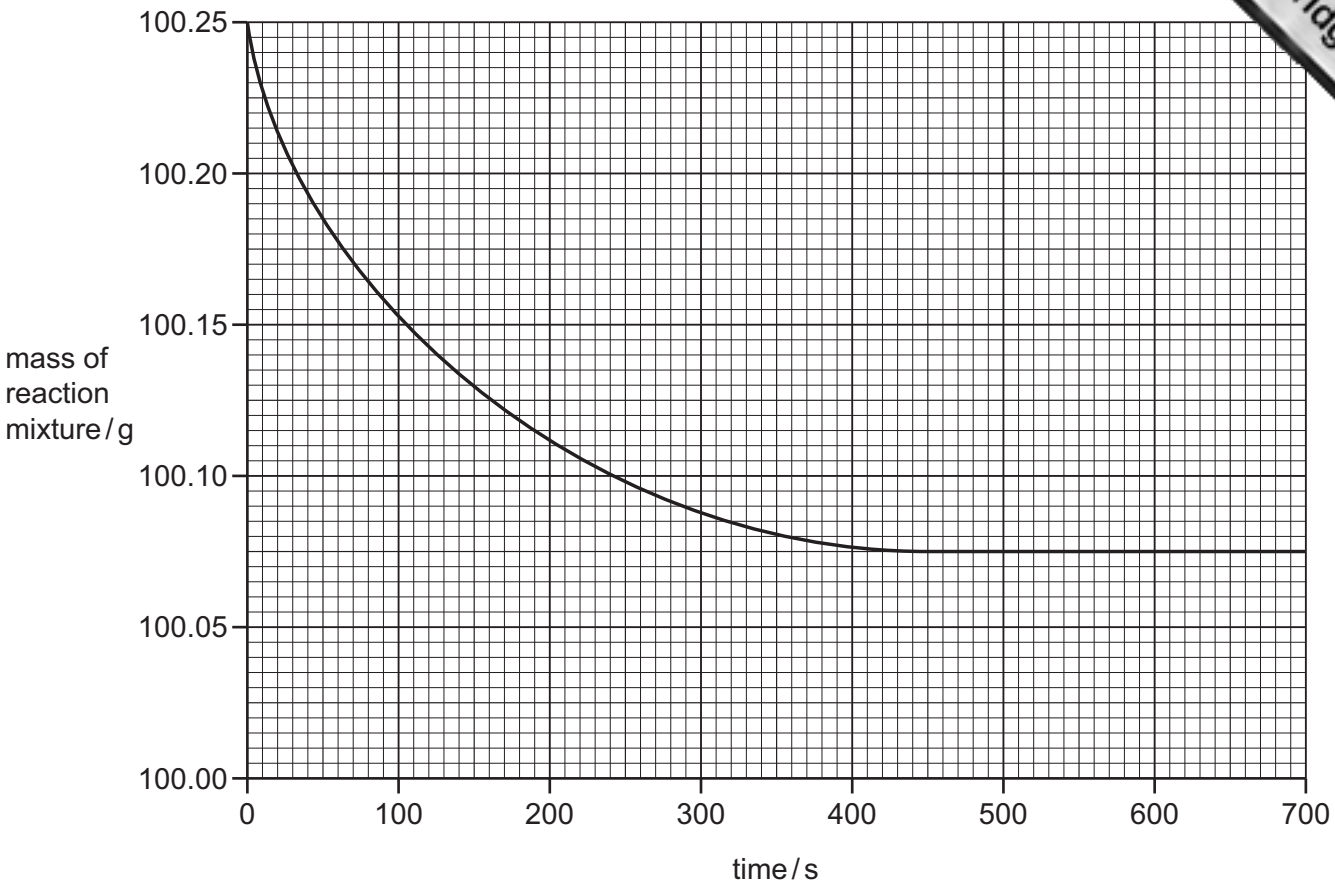
B .....

[2]

(ii) Explain why the mass of the reaction mixture decreases with time.

..... [1]

(c) The graph below shows how the mass of the reaction mixture changes with time
The calcium carbonate was in excess and large pieces of calcium carbonate were



(i) At what time was the reaction just complete?

..... [1]

(ii) Calculate the total loss in mass of the reaction mixture in this experiment.

..... [1]

(iii) How does the rate of reaction change when:

smaller pieces of calcium carbonate are used,

.....

the temperature is decreased,

.....

the concentration of hydrochloric acid is decreased?

.....

[3]

(d) When heated, calcium carbonate breaks down to form calcium oxide and carbon

Which **two** words from the list below describe this reaction?
Tick **two** boxes.

combustion	☐
decomposition	☐
endothermic	☐
exothermic	☐
oxidation	☐

[2]

(e) Calcium oxide is used in flue-gas desulfurisation.

(i) Explain how flue-gas desulfurisation works.

.....

.....

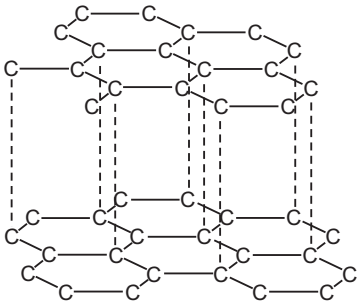
..... [2]

(ii) Give **one** other use of calcium oxide.

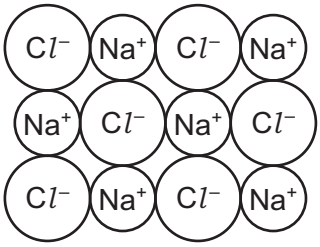
..... [1]

[Total: 15]

5 The structures of graphite and sodium chloride are shown below.



graphite



sodium chloride

(a) Describe the similarity and differences in these structures.

.....

.....

.....

.....

.....

..... [4]

(b) Graphite is a form of carbon.
Carbon is an element.

(i) What is meant by the term *element*?

.....

..... [1]

(ii) Write a symbol equation for the complete combustion of carbon.

[2]

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

substance	melting point / °C	boiling point / °C	electrical conductivity
A	–7	+59	does not conduct
B	–157	–152	does not conduct
C	+769	+1930	conducts when molten but not when solid
D	+1410	+2355	does not conduct

Which **one** of these substances, **A**, **B**, **C** or **D**,

(i) is a liquid at room temperature, ... [1]

(ii) is a giant ionic structure, ... [1]

(iii) is a noble gas, ... [1]

(iv) is a giant covalent structure? ..... [1]

[Total: 11]

6 The table below shows some properties of the first five members of the alkane homol[illegible]s.

alkane	molecular formula	boiling point / °C	density of the liquid alkane in g / cm^3
methane	CH_4	–164	0.47
ethane	C_2H_6	–88	
propane	C_3H_8	–42	0.59
butane	C_4H_{10}	0	0.60
pentane		+36	0.63

(a) (i) What do you understand by the term *homologous series*?

.....

..... [2]

(ii) Deduce the molecular formula for pentane.

..... [1]

(iii) Describe how the boiling points of these alkanes change as the number of carbon atoms increases.

..... [1]

(iv) Deduce the density of liquid ethane.

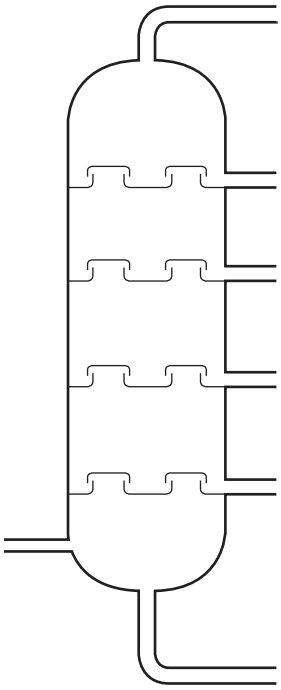
..... [1]

(b) Methane is a fuel which is a gas at room temperature.
State the name of a fuel which is:

a solid at room temperature, ...

a liquid at room temperature. .....
[2]

(c) The diagram below shows a distillation column used to separate petroleum into fractions.



(i) On the diagram above:

- put a letter **X** to show where the temperature in the column is lowest,
- put a letter **F** to show where the fraction containing the largest molecules is collected,
- put a letter **M** to show where petroleum enters the distillation column.

[3]

(ii) The refinery gas fraction contains ethane.
Hydrogen is one of the products formed when ethane is cracked.
Complete the symbol equation for the cracking of ethane.

$$C_2H_6 \rightarrow \text{.....} + \text{.....}$$

[2]

(iii) State the conditions needed for cracking.

..... [2]

[Total: 14]

7 Gallium and aluminium are in Group III of the Periodic Table.

(a) The melting point of gallium is 30 °C.
Use the kinetic particle theory to explain what happens when a spoon made of gallium is placed into a cup of tea at 40 °C.

In your answer, refer to:

- the change of state which occurs,
- the change in the arrangement of the particles,
- the change in the motion of the particles.

.....

.....

.....

.....

..... [4]

(b) Gallium burns in air at a high temperature to form gallium(III) oxide.
Complete the symbol equation for this reaction.

$$\text{.....Ga} + 3O_2 \rightarrow \text{.....}Ga_2O_3$$

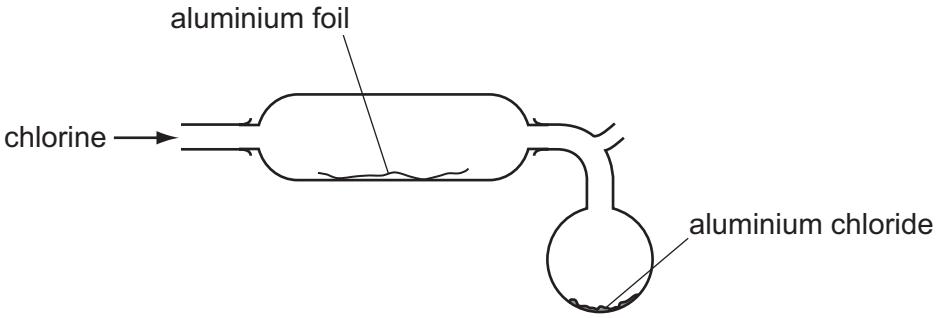
[2]

(c) Explain why aluminium is often used in containers for food and drinks.

.....

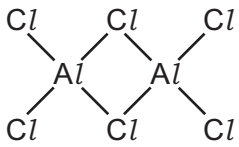
..... [2]

(d) Aluminium chloride can be made by heating aluminium foil in a stream of chlorine.



(i) On the diagram above, draw an arrow to show where heat should be applied. [1]

(ii) At temperatures between 178 °C and 400 °C, aluminium chloride has the structure shown below.



Deduce the molecular formula of this structure.

..... [1]

(iii) Some properties of aluminium and silver are shown in the table below.

	cost	density in g / cm^3	electrical conductivity	melting point / °C
aluminium	high	2.7	good	660
silver	very high	10.5	very good	962

Use the information in the table to suggest why aluminium rather than silver is used in overhead power cables.

..... [1]

[Total: 11]

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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							11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
	7 Li Lithium 3	9 Be Beryllium 4									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
	23 Na Sodium 11	24 Mg Magnesium 12									70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
	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	65 Zn Zinc 30	112 Cd Cadmium 48	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
	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 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	119 Sn Tin 50	209 Bi Bismuth 83			
	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	209 At Astatine 85	209 Rn Radon 86
	226 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.).