Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

CHEMISTRY **0620/22**

Paper 2 **May/June 2015**

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 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

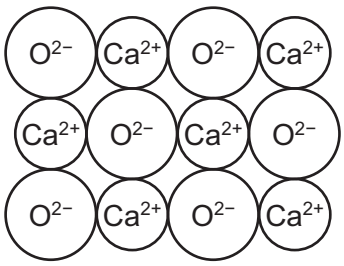
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

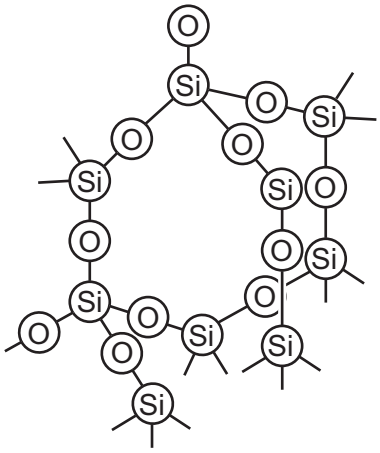
This document consists of **16** printed pages.

1 The structures of six compounds containing oxygen are shown below.

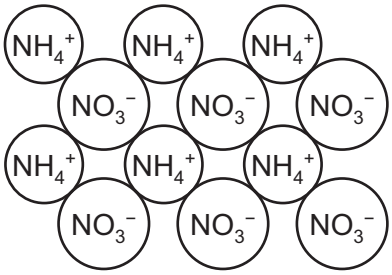
A



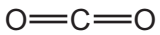
B



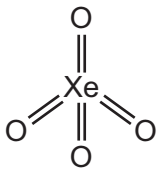
C



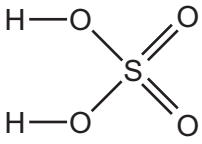
D



E



F



(a) Answer the following questions about these compounds. Each compound, **A**, **B**, **C**, **D**, **E** or **F**, may be used once, more than once or not at all.

(i) Which compound is a compound of a noble gas? .....[1]

(ii) Which compound can be used as a fertiliser? .....[1]

(iii) Which compound can be used to neutralise acidic soil? .....[1]

(iv) Which compound is a greenhouse gas? .....[1]

(v) Which **two** compounds are ionic? ..... and .....[1]

(vi) Which **two** compounds react to form calcium sulfate? ..... and .....[1]

(b) Complete the symbol equation for the reaction of compound **A** with hydrochloric acid.

$$CaO + ...HCl \longrightarrow CaCl_2 + ...$$ [2]

(c) Complete the following sentence about compounds using words from the list below.

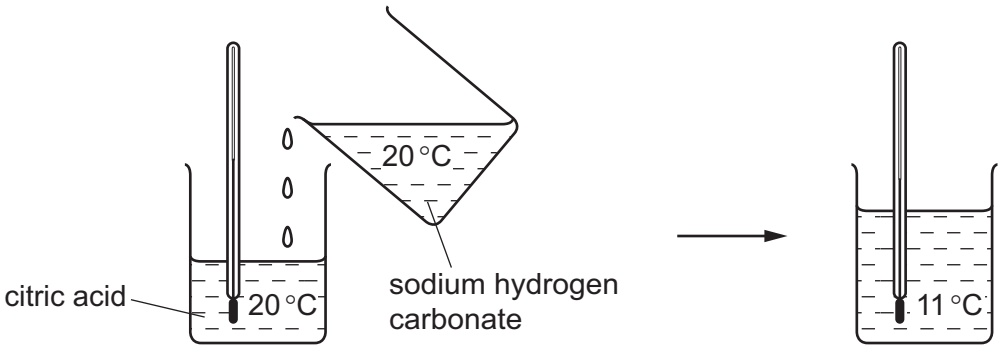
atoms **combined** **mixtures**

molecules **separated** **unreactive**

A compound is a substance containing two or more different ..... which are chemically ..... . [2]

[Total: 10]

2 An aqueous solution of sodium hydrogen carbonate is added to an aqueous solution of citric acid. The mixture is stirred. The temperature is measured before and after the addition.



(a) Explain how this experiment shows that the reaction is endothermic.

.....[1]

(b) Citric acid reacts with sodium hydroxide to form the soluble salt sodium citrate.

Describe how you could prepare pure dry crystals of sodium citrate from citric acid and sodium hydroxide.

.....

.....

.....

.....

.....

.....[3]

(c) Citric acid can be made by fermentation.

Ethanol can also be made by fermentation.

Which of the following are required to make ethanol by fermentation?

Tick **two** boxes.

enzymes from yeast	☐
temperature above 100 °C	☐
high pressure	☐
concentrated sulfuric acid	☐
glucose	☐

[2]

(d) Complete the structure of ethanol to show all atoms and all bonds.

—O—H

[1]

(e) Ethanol can be made from ethene.

Complete the following sentence about the formation of ethanol from ethene using words from the list below.

carbonate **catalyst**

hydrogen **proton** **steam**

Ethanol can be made by reacting ethene with ..... in the presence of a ..... . [2]

[Total: 9]

3 When sodium hydrogen carbonate is heated at 60 °C, carbon dioxide is given off.

(a) (i) Complete the equation for this reaction.

.....$NaHCO_3$ → Na_2CO_3 + CO_2 + ... [2]

(ii) What type of chemical reaction is this?

Tick **one** box.

addition ☐

neutralisation ☐

oxidation ☐

thermal decomposition ☐

[1]

(b) An aqueous solution of sodium hydrogen carbonate is slightly alkaline.

Which one of the following pH values is slightly alkaline?

Put a ring around the correct answer.

pH 2 pH 7 pH 8 pH 13 [1]

(c) Baking powder contains sodium hydrogen carbonate and crystals of a weak acid.

When water is added, the acid reacts with the sodium hydrogen carbonate.

(i) Complete the general equation for the reaction of an acid with a carbonate.

acid + carbonate → carbon dioxide + ... + ... [2]

(ii) The diagram below shows bread baked with and without the addition of baking powder. All other conditions were kept the same.

bread baked without baking powder

bread baked with baking powder

Why is the bread baked with baking powder bigger?

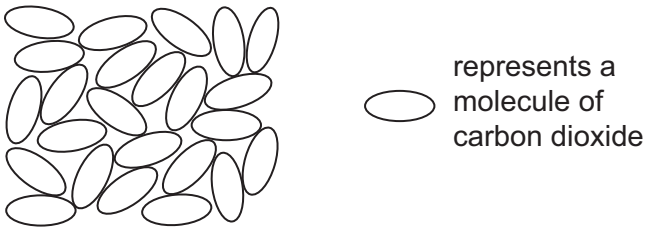
.....

.....[1]

(iii) Explain why the sodium hydrogen carbonate used in breadmaking must be pure.

.....[1]

(d) The diagram shows the arrangement of carbon dioxide molecules at –25 °C and 100 atmospheres pressure.



What is the state of carbon dioxide under these conditions?

Use the kinetic particle theory and the information in the diagram to explain your answer.

.....

.....

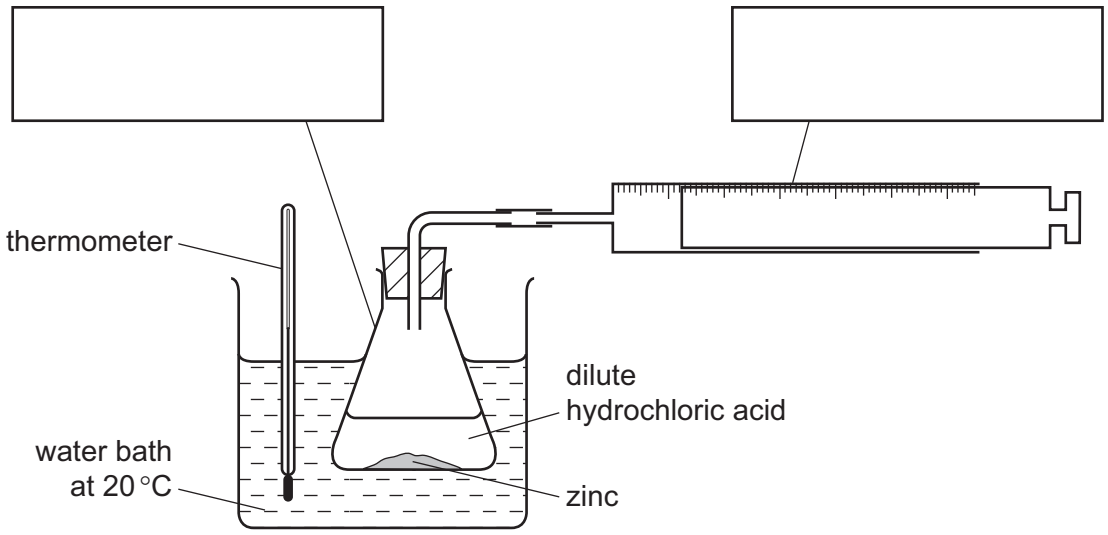
.....[3]

[Total: 11]

4 A student investigated the rate of reaction of zinc with dilute hydrochloric acid.

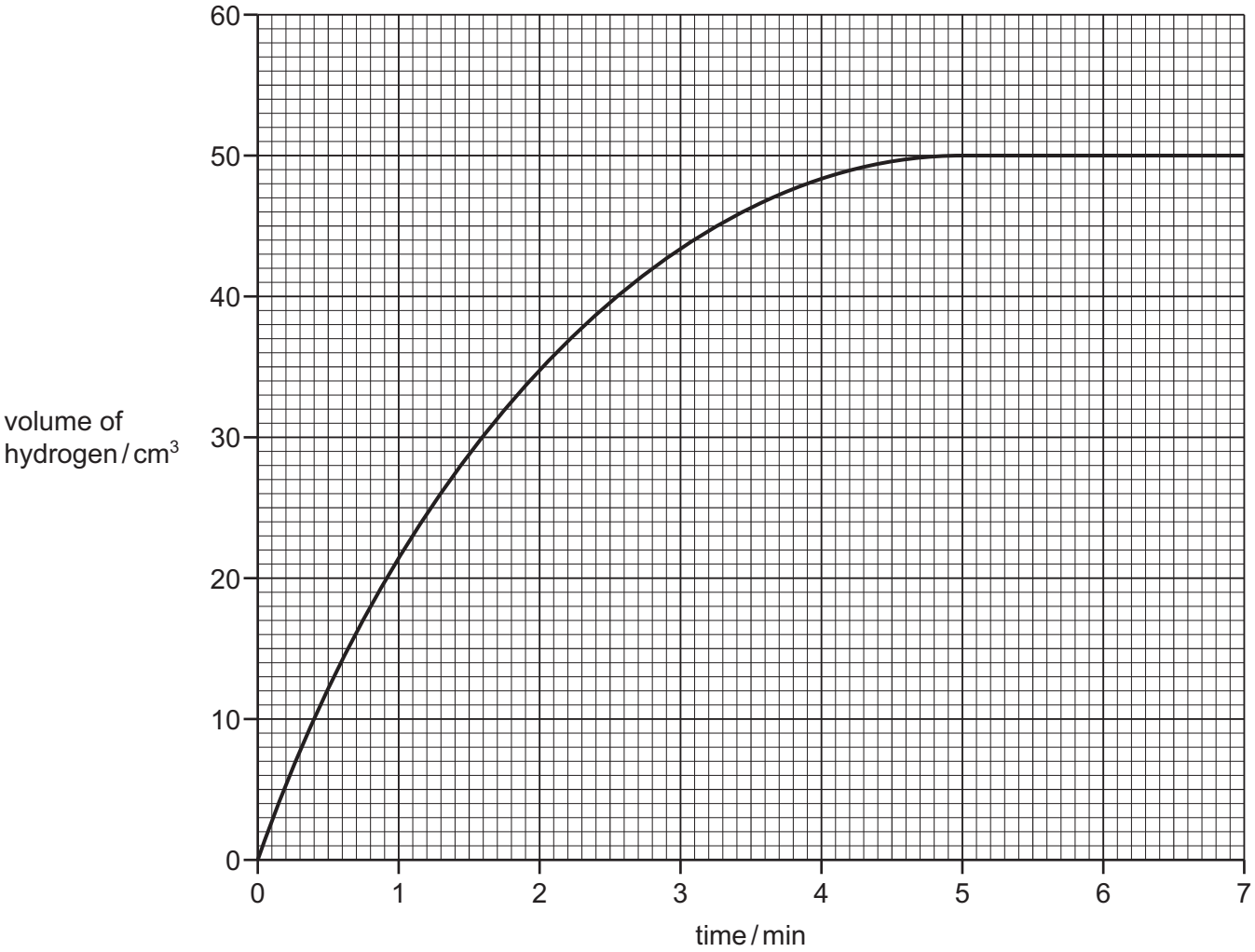
$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

(a) Complete the labelling of the apparatus by filling in the two boxes.



[2]

(b) The student carried out the reaction at 20 °C using small pieces of zinc. She measured the volume of hydrogen given off as the reaction proceeded.



(i) Describe how the volume of hydrogen changes with time.

.....

.....[2]

(ii) At what time did the reaction stop?

.....[1]

(iii) What volume of gas was produced over the first two minutes of the reaction?

.....[1]

(iv) On the graph above draw a line to show how the volume of hydrogen changes when the reaction was carried out at 30 °C. All other conditions remain the same. [2]

(c) How does the rate of reaction change when larger pieces of zinc are used?

All other conditions remain the same.

.....[1]

(d) Molten zinc chloride can be electrolysed using graphite electrodes.

(i) State the names of the product formed at:

the anode .....

the cathode. .....
[2]

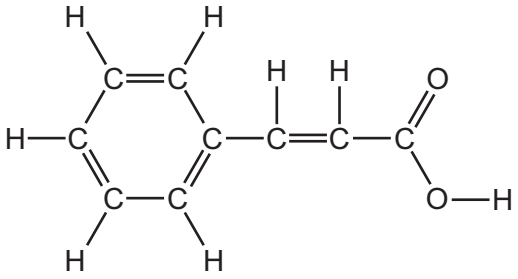
(ii) Graphite conducts electricity. Give one other reason why graphite electrodes are used.

.....[1]

[Total: 12]

5 Cinnamic acid is found in plants called balsams.

The structure of cinnamic acid is shown below.



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

(b) Cinnamic acid is an unsaturated compound.

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

.....

.....[1]

(ii) Describe a test for an unsaturated compound.

.....

.....

.....[2]

(c) Cinnamic acid reacts with sodium hydroxide to form styrene.

$$C_6H_5CH{=}CHCOOH + 2NaOH \rightarrow C_6H_5CH{=}CH_2 + Na_2CO_3 + H_2O$$

Complete the word equation for this reaction.

cinnamic acid + sodium hydroxide → styrene + ... + ...

[2]

(d) Styrene is used to make the polymer poly(styrene).

Poly(ethene) is also a polymer.

Describe how poly(ethene) is made.

In your answer include the words:

- addition
- ethene
- monomer
- polymerisation

.....

.....

.....[3]

(e) Balsam flowers contain a mixture of pigments.

(i) Describe how you could obtain a solution of this mixture of pigments from balsam flowers.

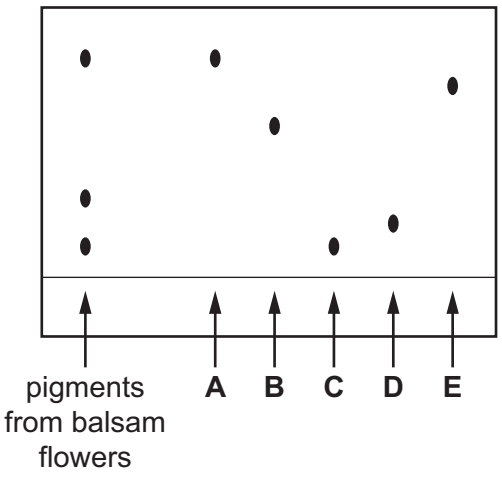
.....

.....

.....[3]

(ii) A student uses chromatography to separate the pigments in balsam flowers. He puts the pigment mixture on a sheet of chromatography paper as well as 5 spots of pure pigments **A**, **B**, **C**, **D** and **E**.

The diagram below shows the results after chromatography.



Which of the pigments **A**, **B**, **C**, **D** and **E** are present in balsam flowers?

.....[1]

[Total: 13]

6 The table shows some properties of aluminium, copper, iron and sodium.

metal	electrical conductivity	density in g/cm^3	melting point/°C	strength	colour
aluminium	very good	2.70	660	fairly strong	silver
copper	very good	8.92	1083	very strong	pink-brown
iron	good	7.86	1535	very strong	silver
sodium	good	0.97	98	weak	silver

(a) Which two metals in the table are transition elements? Explain your answer by referring to a specific property of transition elements given in the table.

.....

.....

.....[2]

(b) Use the information in the table to suggest

(i) why overhead electricity cables are made from aluminium with a steel core,

.....

.....[2]

(ii) one reason why sodium is not used for electricity cables.

.....

.....[1]

(c) Cobalt chloride is a transition element compound.

Calcium chloride is a compound of a Group II metal.

Describe one difference between cobalt chloride and calcium chloride.

.....

.....[1]

(d) The table below shows some observations about the reaction of four metals with water or steam.

metal	observations
aluminium	reacts with steam when strongly heated
lithium	reacts rapidly with cold water
magnesium	reacts very slowly with cold water but rapidly with steam
silver	does not react with steam

Place these metals in order of their reactivity.

least reactive ⟶ most reactive

[1]

(e) When iron is heated with steam, hydrogen is given off.

$$3Fe + 4H_2O \rightleftharpoons Fe_3O_4 + 4H_2$$

(i) What does the sign $\rightleftharpoons$ mean?

.....[1]

(ii) Describe a test for hydrogen.

test .....

result .....

[2]

(f) Steel is an alloy of iron. Write about alloys of iron.

In your answer refer to:

- the meaning of the term alloy,
- why alloys are used instead of pure iron,
- an example of the use of an alloy of iron.

.....

.....

.....

.....

.....

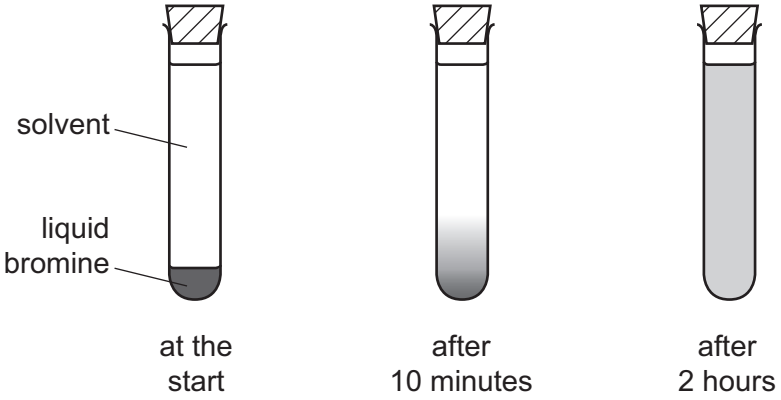
.....[4]

[Total: 14]

7 A teacher placed a few drops of liquid bromine in the bottom of a test-tube containing a solvent.

After 10 minutes, the brown colour of the bromine had spread a little way through the solvent.

After 2 hours, the brown colour had spread throughout the solvent.



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

.....

.....

.....

.....

.....

.....[3]

(b) Bromine is a halogen in Group VII.

The properties of some halogens are given in the table below.

halogen	melting point/°C	boiling point/°C	density at boiling point in g/cm^3	electron arrangement of halogen atom
fluorine	–220	–188	1.51	2,7
chlorine	–101	–35	1.56	2,8,7
bromine	–7	+59		2,8,18,7
iodine	+114	+184	4.93	2,8,18,18,7

Use the information in the table to:

(i) Deduce the state of fluorine at –200 °C.

.....[1]

(ii) Describe how the melting point changes down Group VII.

.....[1]

(iii) Estimate the density of bromine.

.....[1]

(iv) Deduce the number of completely filled electron shells in an atom of chlorine.

.....[1]

(c) Aqueous bromine reacts with aqueous potassium iodide to form iodine and potassium bromide.

(i) Complete the equation for this reaction.

$$Br_2 + 2KI \longrightarrow \text{.....} + 2KBr$$

[1]

(ii) Explain why aqueous bromine does not react with an aqueous solution of potassium chloride.

.....[1]

(d) Bromine reacts with fluorine to form bromine trifluoride, BrF_3.

Calculate the relative molecular mass of bromine trifluoride.

Show all your working.

[2]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 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	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103

* 58–71 Lanthanoid series
† 90–103 Actinoid series

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

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