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.

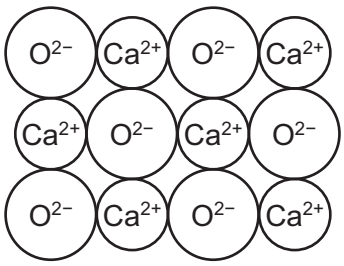
This document consists of **16** printed pages.

CAMBRIDGE International Examinations

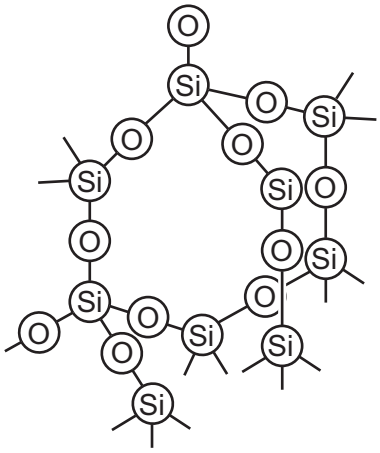
[Turn over

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

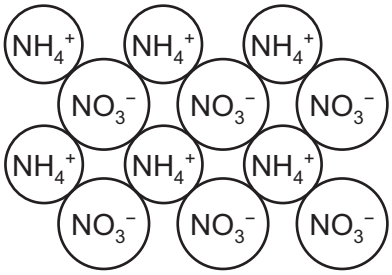
A



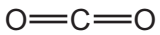
B



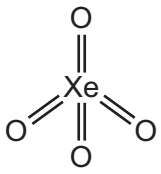
C



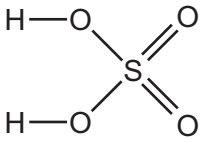
D



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.

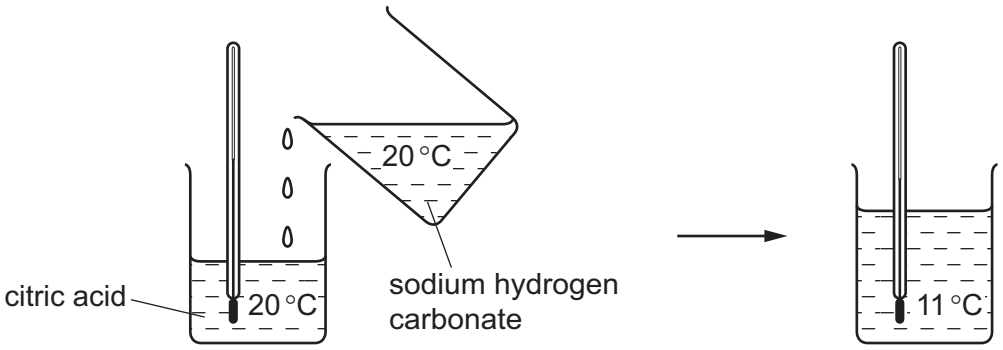
atoms **combined** **mixtures**

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?

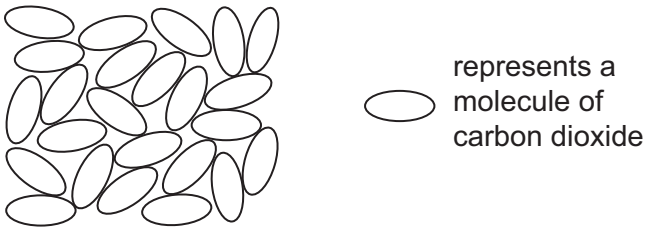
.....

.....[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.

.....

.....

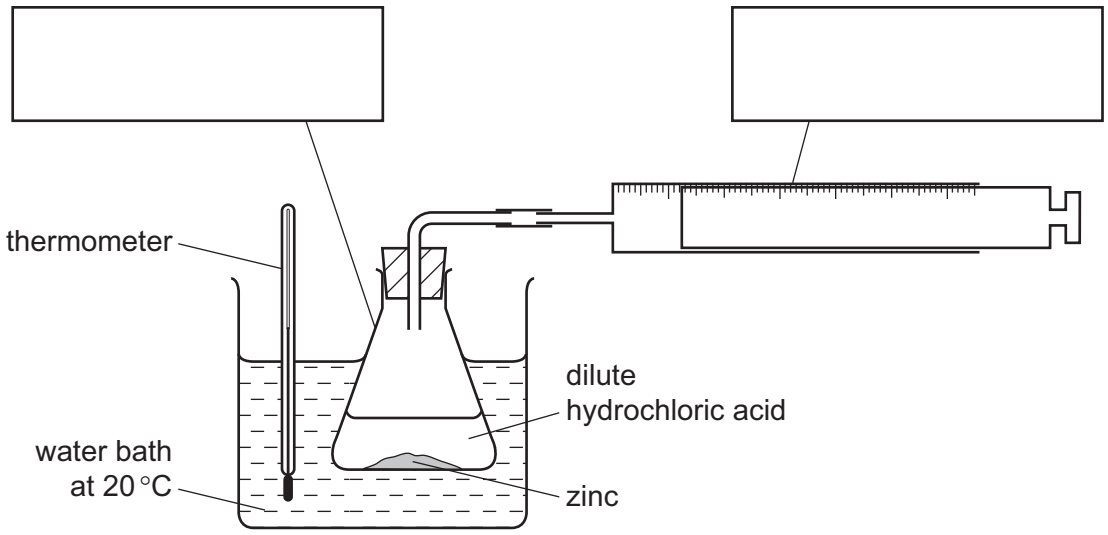
.....[3]

[Total: 11]

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

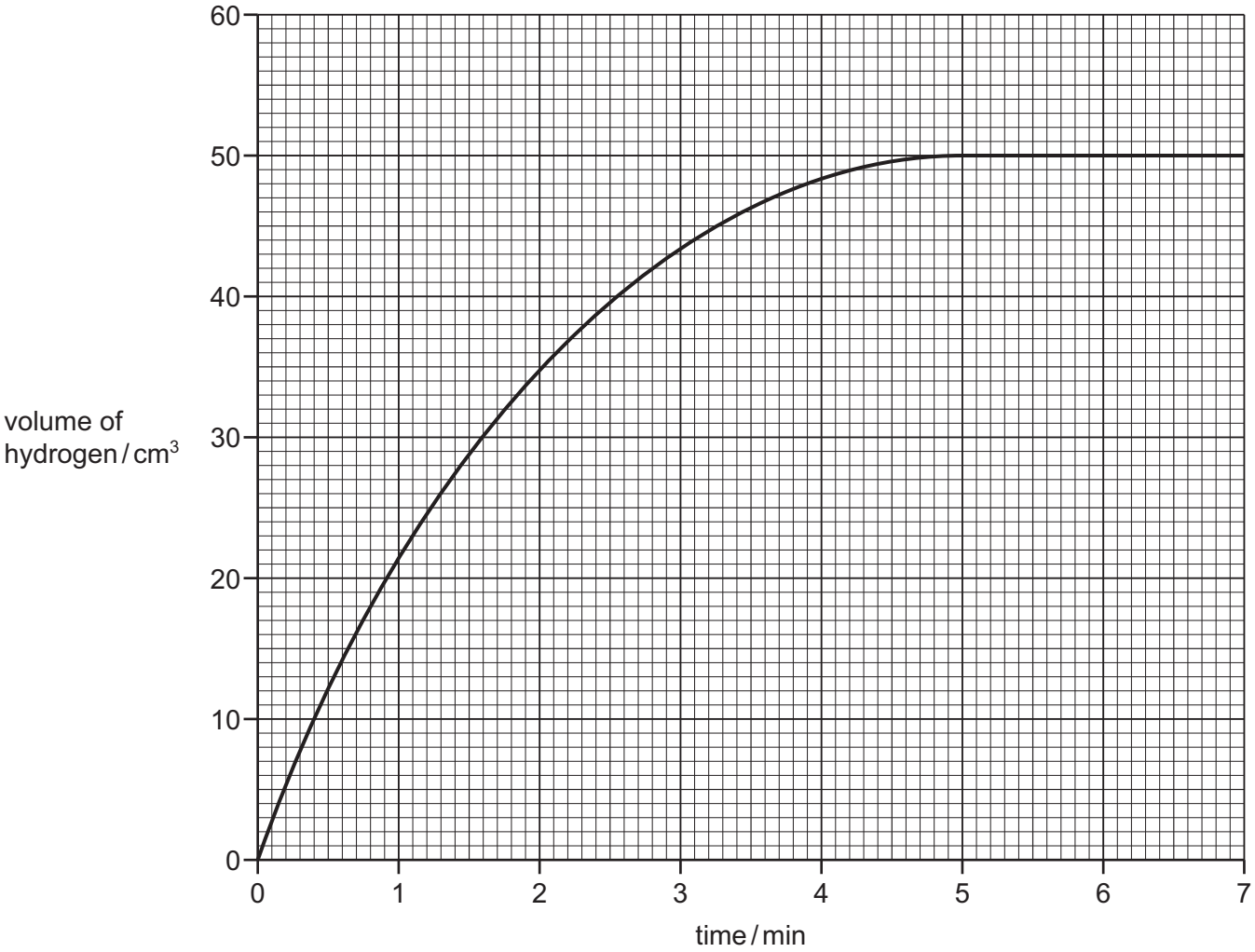
$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

(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]

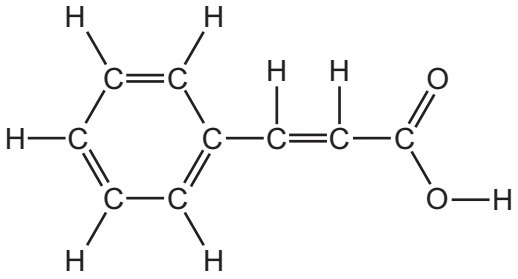
(ii) Graphite conducts electricity. Give one other reason why graphite electrodes are used.

.....[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.

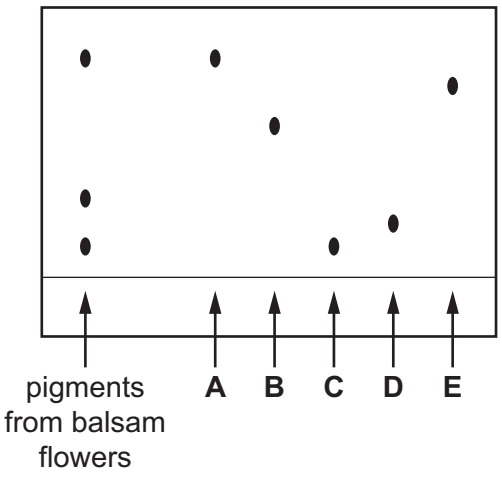
.....

.....

.....[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.

.....

.....

.....

.....

.....

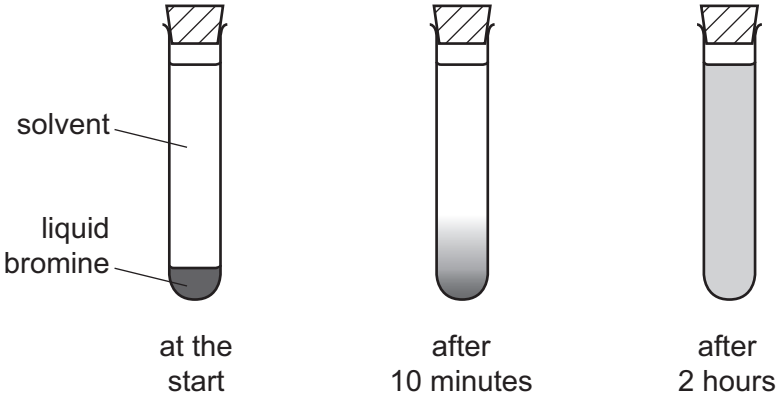
.....[4]

[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

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	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
X
b

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.).