UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | |

*7049085722*

**CHEMISTRY** **0620/02**

Paper 2 **May/June 2009**

**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.
A copy of the periodic table is printed on page 16.

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.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| Total | |

This document consists of **15** printed pages and **1** blank page.

*For Examiner's Use*

**1** **(a)** Choose from the list of compounds to answer questions **(i)** to **(v)**.

**calcium carbonate** **carbon dioxide** **hydrogen chloride**

**iron(III) oxide** **lead(II) bromide** **methane** **sodium hydroxide**

Each compound can be used once, more than once or not at all.

Name the compound which

**(i)** is a transition metal compound,

..... [1]

**(ii)** produces brown fumes at the anode when electrolysed,

..... [1]

**(iii)** is used to manufacture lime,

..... [1]

**(iv)** dissolves in water to form an alkaline solution,

..... [1]

**(v)** is the main constituent of natural gas.

..... [1]

**(b)** At a high temperature iron(III) oxide is reduced by carbon.

$$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$$

**(i)** Explain how the equation shows that iron(III) oxide is reduced by carbon.

..... [1]

**(ii)** Complete these sentences about the extraction of iron using words from the list.

**bauxite** **blast** **converter** **haematite** **lime**

**limestone** **sand** **slag**

Iron is extracted from ..... by mixing the ore with coke and ..... in a ..... furnace. The iron ore is reduced to iron and impurities in the ore react with calcium oxide to form ..... . [4]

[Total: 10]

**2** The table shows some observations about the reactivity of various metals with dilute hydrochloric acid.

| metal | observations |
|---|---|
| calcium | many bubbles produced rapidly with much spitting |
| copper | no bubbles formed |
| iron | a few bubbles produced very slowly |
| magnesium | many bubbles produced rapidly with no spitting |

**(a)** Put these metals in order of their reactivity.

most reactive → least reactive

| | | | |
|---|---|---|---|
| | | | |

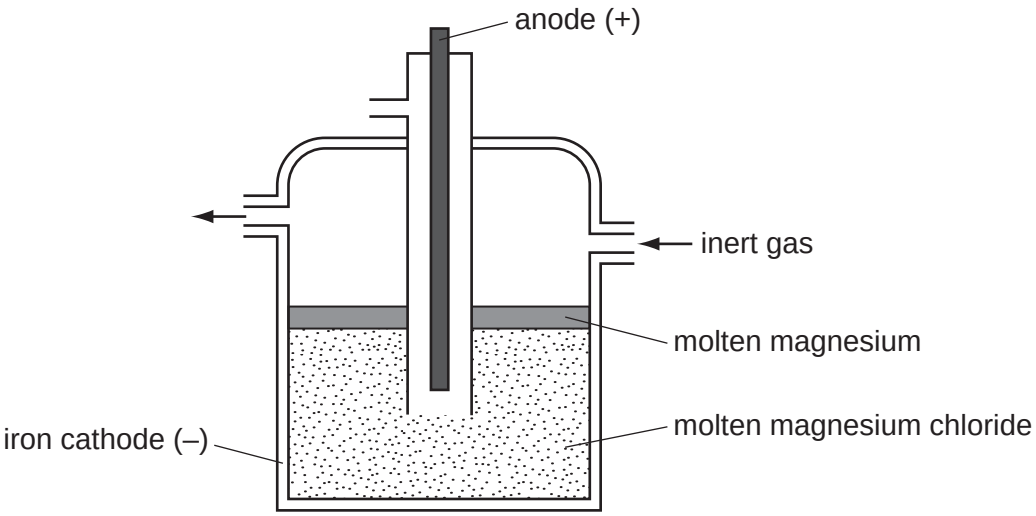
[1]

**(b)** Zinc is between iron and magnesium in its reactivity.
Suggest what observations are made about how fast the bubbles are produced when zinc reacts with dilute hydrochloric acid.

.....

[1]

**(c)** Magnesium is extracted by the electrolysis of molten magnesium chloride.




**(i)** What information in the diagram suggests that magnesium is less dense than molten magnesium chloride?

.....

[1]

*For Examiner's Use*

**(ii)** Suggest why magnesium has to be extracted by electrolysis rather than by heating its oxide with carbon.

..... [1]

**(iii)** Suggest why a stream of inert gas is blown over the surface of the molten magnesium.

..... [1]

**(iv)** State the name of a gaseous element which is inert.

..... [1]

**(d)** In some old magnesium manufacturing plants, coal gas is blown over the surface of the magnesium.
The list shows the main substances in coal gas.

**carbon monoxide** **ethene** **hydrogen**

**hydrogen sulfide** **methane**

**(i)** Draw the structure of ethene showing all atoms and bonds.

[1]

**(ii)** Suggest **two** hazards of using coal gas by referring to **two** specific substances in the list.

substance .....

hazard .....

substance .....

hazard ..... [2]

*For Examiner's Use*

**(e)** Carbon monoxide can be removed from coal gas by mixing it with steam and passing the mixture over a catalyst of iron(III) oxide at 400 °C.

$$CO + H_2O \rightleftharpoons CO_2 + H_2$$

**(i)** Write a word equation for this reaction.

..... [1]

**(ii)** What does the symbol $\rightleftharpoons$ mean?

..... [1]

**(iii)** Iron(III) oxide reacts with acids to form a solution containing iron(III) ions.
Describe a test for aqueous iron(III) ions.

test .....

result .....

..... [2]

[Total: 13]

*For Examiner's Use*

**3** Petroleum is a mixture of hydrocarbons which can be separated into fractions such as petrol, paraffin and diesel.

**(a)** State the name of the process used to separate these fractions.

..... [1]

**(b)** Name **two** other fractions which are obtained from petroleum .

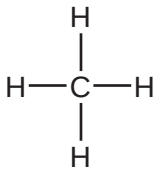
..... and ..... [2]

**(c)** Give **one** use for the paraffin fraction.

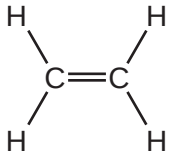
..... [1]

**(d)** Many of the compounds obtained from petroleum are alkanes.
Which **two** of the following structures are alkanes?

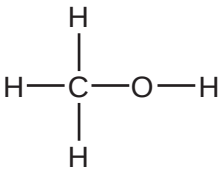
**A**



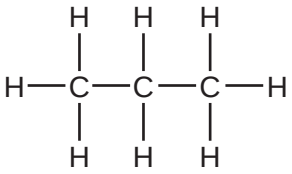
**B**



**C**



**D**



..... [1]

**(e)** Use words from the list below to complete the following sentence.

**ethane** **ethene** **hydrogen** **nitrogen** **oxygen**

**reactive** **unreactive** **water**

Alkanes such as ..... are generally ..... but they can be burnt in ..... to form carbon dioxide and ..... [4]

**(f)** Alkanes are saturated hydrocarbons.
What do you understand by the terms

**(i)** saturated, .....

.....

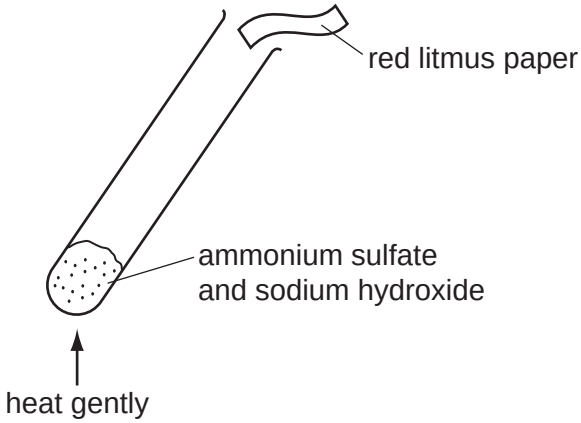
**(ii)** hydrocarbon? .....

..... [2]

[Total: 11]

**4** This question is about some compounds of nitrogen.

A mixture of ammonium sulfate and sodium hydroxide was warmed in a test-tube. The gas was tested with moist red litmus paper.




**(a)** State the name of the gas released.

.....

[1]

**(b)** State the colour change of the litmus paper.

.....

[1]

**(c)** Complete the word equation for the reaction of ammonium carbonate with hydrochloric acid.

ammonium carbonate + hydrochloric acid ⟶ ……..... + ……..... + ……..... ……..... ……..... [3]

**(d)** Ammonium salts such as ammonium nitrate, $NH_4NO_3$ and ammonium chloride $NH_4Cl$ are used as fertilisers.

**(i)** Explain why farmers need to use fertilisers.

.....

.....

[1]

**(ii)** Explain why ammonium nitrate is a better fertiliser than ammonium chloride.

.....

[1]

**(iii)** Calculate the relative formula mass of ammonium nitrate.

*For Examiner's Use*

[1]

**(e)** When ammonium nitrate is heated nitrogen(I) oxide is given off.
Nitrogen(I) oxide relights a glowing splint.
Name **one** other gas which relights a glowing splint.

..... [1]

**(f)** State **one** harmful effect of nitrogen oxides on the environment.

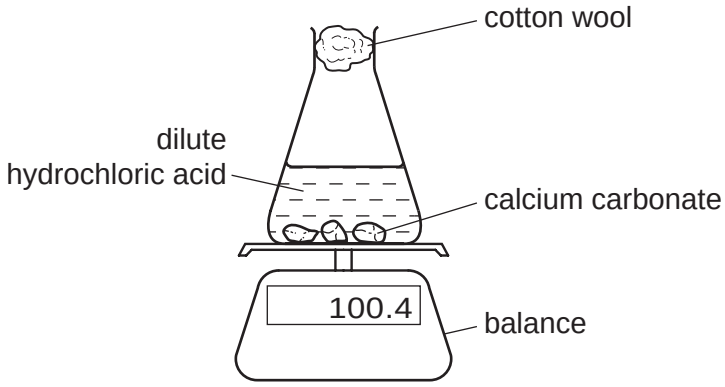
..... [1]

[Total: 10]

*For Examiner's Use*

**5** A student used the apparatus shown below to investigate the rate of reaction of calcium carbonate with dilute hydrochloric acid.

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

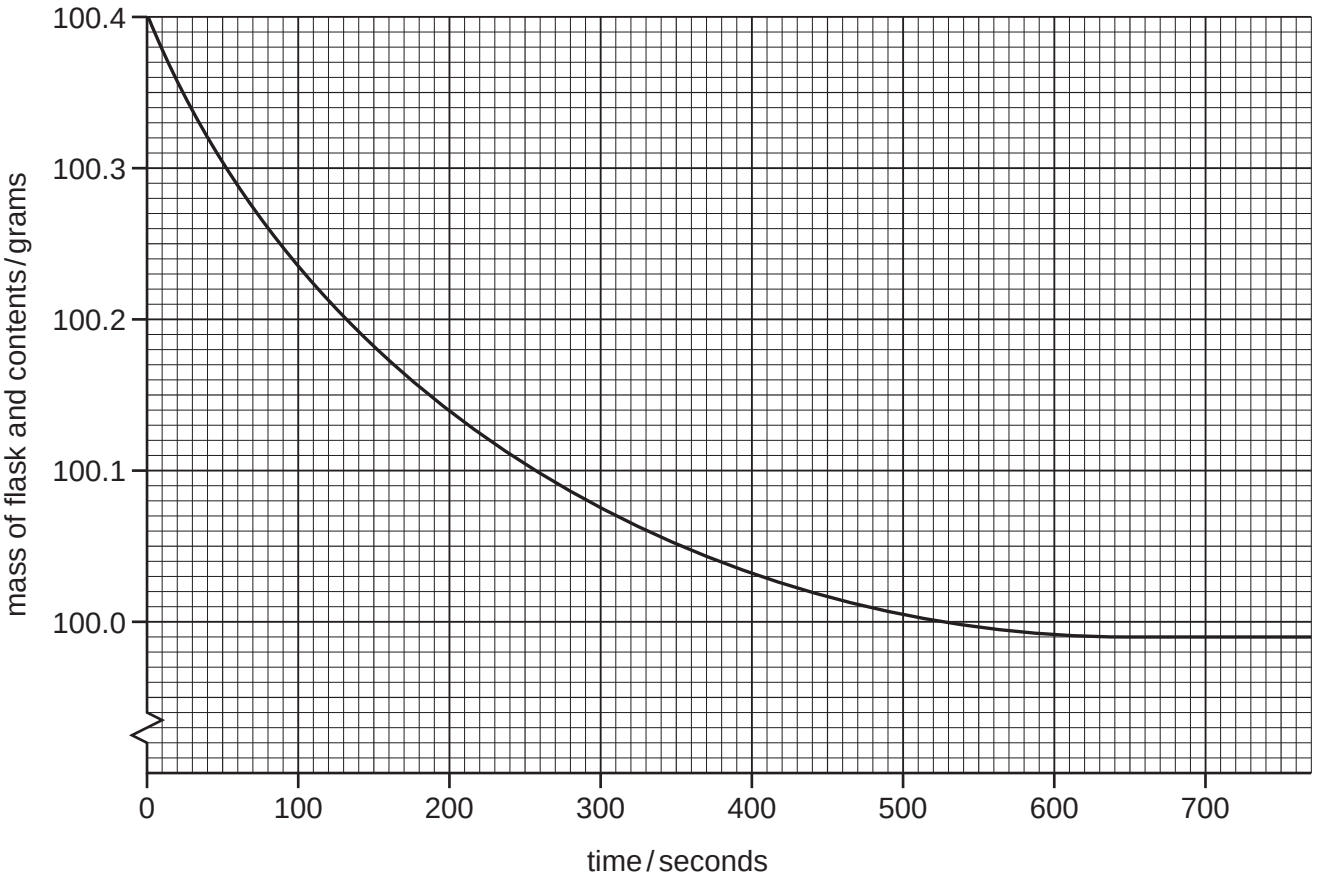



**(a)** Use the information in the equation to suggest why the mass of the flask and contents decreases with time.

.....

..... [1]

**(b)** The graph shows how the mass of the flask and its contents changes with time.



*For Examiner's Use*

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

..... [1]

**(ii)** On the graph, mark with an **X** the point where the speed (rate) of reaction was fastest. [1]

**(iii)** The student repeated the experiment but altered the concentration of the hydrochloric acid so that it was half the original value. In both experiments calcium carbonate was in excess and all other conditions were kept the same.

On the graph on page 10, draw a curve to show how the mass of the flask and contents changes with time when hydrochloric acid of half the concentration was used. [2]

**(c)** How does the speed (rate) of this reaction change when

**(i)** the temperature is increased, ..... [1]

**(ii)** smaller pieces of calcium carbonate are used? ..... [1]

**(d)** Complete the following sentence using words from the list.

**combustion** **expansion** **large** **rapid** **slow** **small**

In flour mills there is often the risk of an explosion due to the rapid .....

of the very ..... particles which have a very

..... surface area to react. [3]

**(e)** Cells in plants and animals break down glucose to carbon dioxide and water.

glucose + oxygen ⟶ carbon dioxide + water

**(i)** State the name of this process.

..... [1]

**(ii)** In this process enzymes act as catalysts.
What do you understand by the term *catalyst*?

..... [1]

[Total: 12]

*For Examiner's Use*

**6** Bromine is an element in Group VII of the Periodic Table.

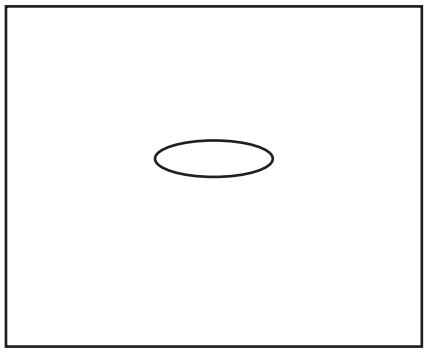
**(a)** Write the formula for a molecule of bromine.

.....

[1]

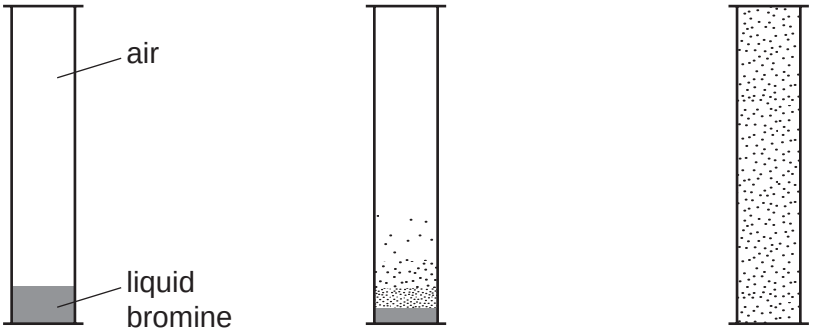
**(b)** Complete the diagram below to show the arrangement of the molecules in liquid bromine.


represents a bromine molecule



[2]

**(c)** A teacher placed a small amount of liquid bromine in the bottom of a sealed gas jar of air. After two minutes brown fumes were seen just above the liquid surface. After one hour the brown colour had spread completely throughout the gas jar.




Use the kinetic particle theory to explain these observations.

.....

.....

.....

[3]

For Examiner's Use

**(d)** Magnesium salts are colourless but Group VII elements are coloured.
An aqueous solution of magnesium bromide reacts with an aqueous solution of chlorine.

magnesium bromide + chlorine ⟶ magnesium chloride + bromine

State the colour change in this reaction.

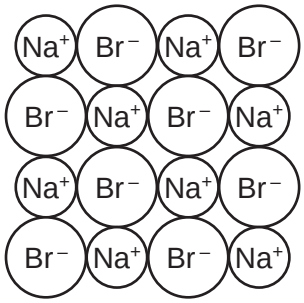
..... [2]

**(e)** A solution of magnesium bromide will not react with iodine.
Explain why there is no reaction.

..... [1]

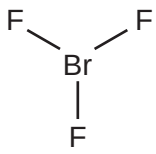
**(f)** The structures of some compounds containing bromine are shown below.

**A**

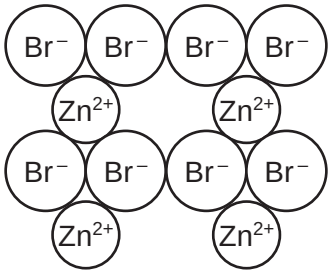



**B**


**C**




**D**




**(i)** Write the simplest formula for the substance with structure **A**.

..... [1]

**(ii)** State the name of the substance with structure **D**.

..... [1]

**(iii)** State the type of bonding within a molecule of structure **C**.

..... [1]

**(iv)** Which **two** structures are giant structures?

..... and ..... [1]

**(v)** Why does structure **A** conduct electricity when it is molten?

..... [1]

[Total: 14]

*For Examiner's Use*

7 Hydrogen chloride can be made by burning hydrogen in chlorine.

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

$$H_2 + \text{……...} \longrightarrow \text{…….....} \quad HCl$$

[2]

**(b)** Draw a dot and cross diagram for a molecule of hydrogen chloride.
Show all the electrons.

use **o** for an electron from a hydrogen atom
use **x** for an electron from a chlorine atom

[2]

**(c)** Hydrochloric acid is formed when hydrogen chloride gas dissolves in water.
Suggest the pH of hydrochloric acid.
Put a ring around the correct answer.

**pH 1** **pH7** **pH9** **pH 13**

[1]

**(d)** Complete the equation for the reaction of hydrochloric acid with zinc.

zinc + hydrochloric acid ⟶ zinc chloride + …… [1]

**(e)** Describe how dry crystals of zinc chloride can be obtained from a solution of zinc chloride.

.....

.....

..... [2]

**(f)** A student electrolysed molten zinc chloride.
State the name of the product formed at

**(i)** the anode, ..... [1]

**(ii)** the cathode. ..... [1]

[Total: 10]

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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 | 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.).