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| Centre Number | Candidate Number | Name |
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CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY

0620/02

Paper 2

October/November 2003

1 hour

Candidates answer on the Question Paper.
No Additional Materials required

READ THESE INSTRUCTIONS FIRST

Write your name, centre number and candidate number in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is provided on page 20.

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

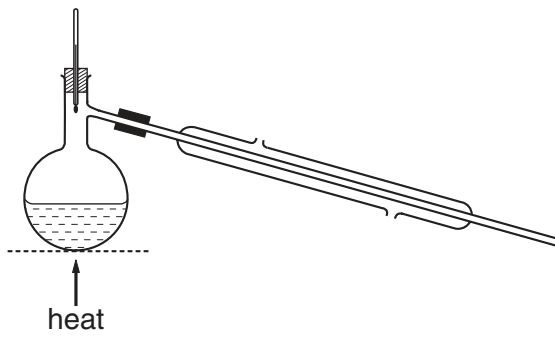
If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

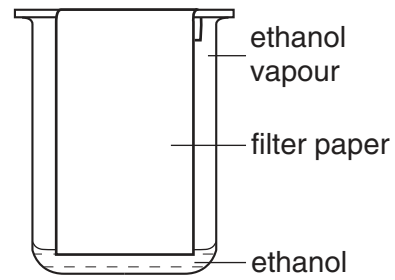
This document consists of **17** printed pages and **3** blank pages.



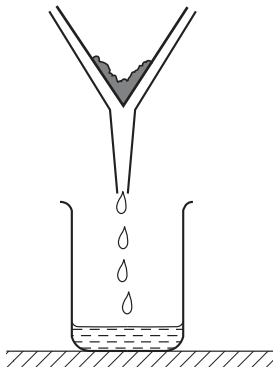
1 The diagrams show four methods of purifying substances.



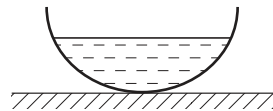
A



B



C



D

(a) Which of these methods, **A**, **B**, **C** or **D**, is best used for

(i) separating the different colours in a sample of ink?

(ii) separating two liquids with different boiling points?

(iii) separating mud from water?

(iv) making crystals of copper sulphate from copper sulphate solution?

[4]

(b) State the name given to the method of separation shown in

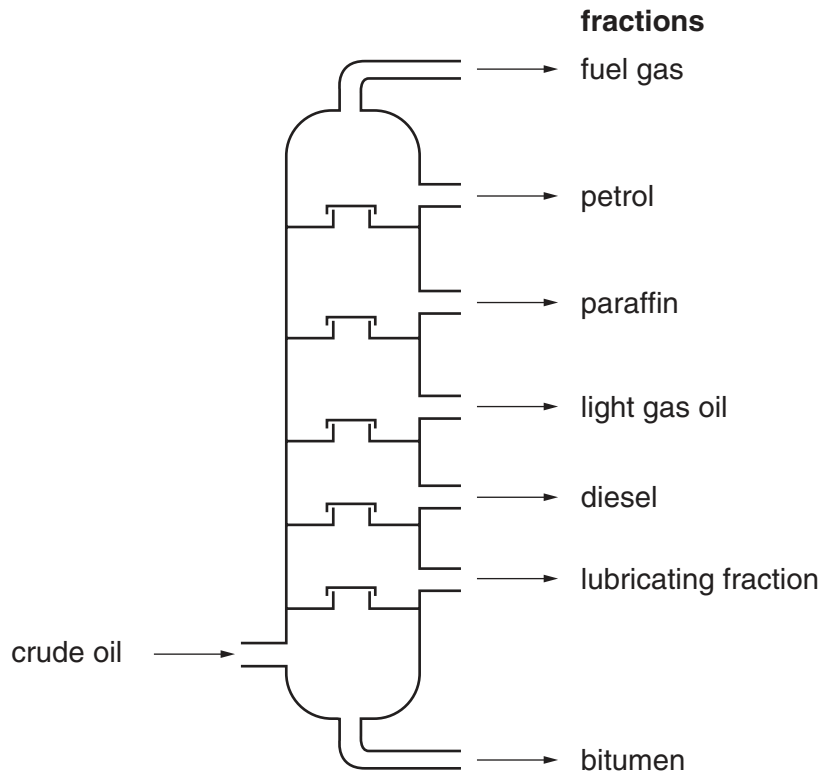
(i) diagram **A**,

(ii) diagram **B**.....

[2]

(c) Method A can be modified to separate petroleum into useful fractions.

The diagram below shows the different fractions obtained from a fractionating column.



(i) Which of these fractions has the lowest boiling point?

.....

(ii) State **one** use for each of the following fractions.

paraffin

bitumen

[3]

(d) Petroleum is a mixture of organic compounds.

Which **one** of the following best describes the compounds found in petroleum?

Put a ring around the correct answer.

acids

alcohols

carbohydrates

hydrocarbons

[1]

- (e) Before petroleum is fractionated, it is often heated to remove dissolved natural gas. Most of this natural gas is methane, CH_4 . Draw a diagram to show how the electrons are arranged in methane.

show hydrogen electrons as

•

show carbon electrons as

×

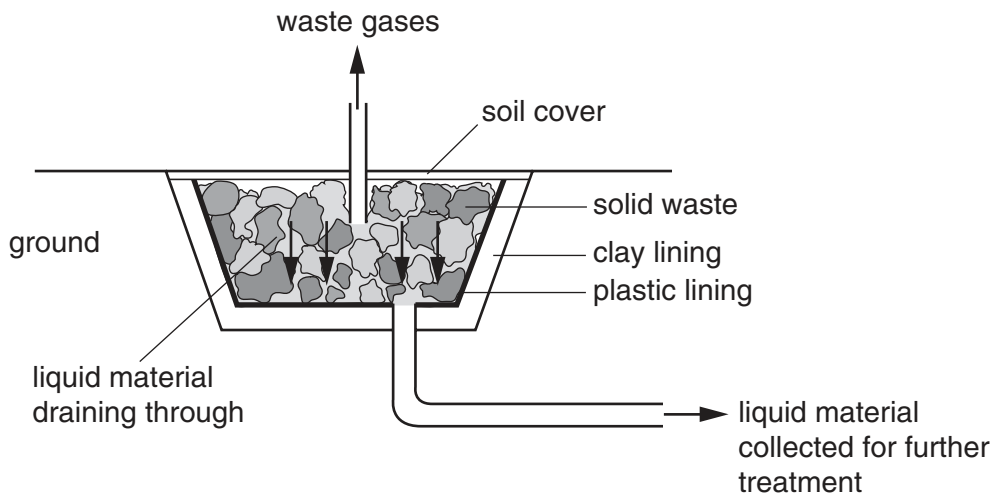
[2]

- (f) Methane, ethane and propane belong to a particular homologous series of compounds. State the name of the homologous series to which these three compounds belong.

.....

[1]

2 The diagram below shows a modern landfill site for the disposal of waste materials.



The waste materials are broken down naturally in several stages.

- (a) In the first stage, micro-organisms (mainly bacteria) break down some of the organic material in the waste to carbon dioxide.
What is the name given to the process by which organisms use food to produce carbon dioxide?

.....[1]

- (b) In the second stage, the micro-organisms break down organic substances to produce ammonia, hydrogen and more carbon dioxide.

- (i) Describe a test for hydrogen.

test

result

- (ii) The large volumes of hydrogen produced may be hazardous.
Explain why hydrogen may be hazardous when mixed with air.

.....

- (iii) Ammonia is a base.
Describe a test for ammonia.

test

result

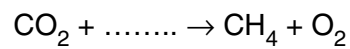
[5]

- (c) In the third stage, ethanoic acid is produced.
Draw the structure of ethanoic acid showing all atoms and bonds.

[1]

- (d) In the fourth stage, carbon dioxide reacts with hydrogen to form methane and oxygen.

- (i) Complete the equation for this reaction.



- (ii) State one use of methane.

.....

- (iii) Methane is a gas.
Which **two** of the following statements about gas molecules are true?
Tick **two** boxes.

The molecules are far apart.

The molecules are not moving.

The molecules are randomly arranged.

The molecules are arranged in a regular manner.

[4]

- (e) The list below shows some of the substances which are found in the liquid which drains through the waste.

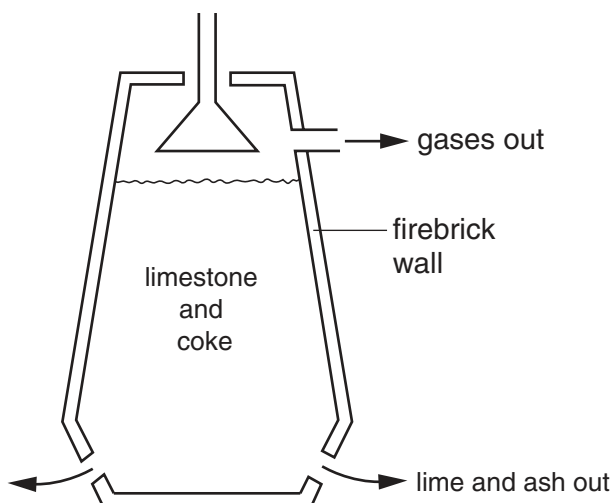
aluminium
calcium carbonate
iron
lead
magnesium
nickel
sodium sulphate
zinc

From this list choose

- (i) a metal used to galvanise iron.
- (ii) a transition metal.
- (iii) a metal which is in Group IV of the periodic table.
- (iv) a substance which will release carbon dioxide when an acid is added.
.....
- (v) a metal which is used to make aircraft bodies.

[5]

- 3 One way of making lime from limestone (calcium carbonate) is shown in the diagram.



The limestone is mixed with coke and dropped into the limekiln. The coke is burnt and releases heat.

- (a) State **one** use of limestone, other than in making lime.

.....[1]

- (b) Coke is mainly carbon.

Write a symbol equation for the burning of carbon.

[2]

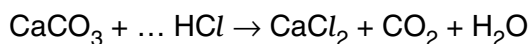
- (c) State the name of the type of reaction which releases heat energy.

.....[1]

- (d) The heat produced by the burning coke causes thermal decomposition of the limestone. Complete the word equation for the thermal decomposition of calcium carbonate.

calcium carbonate → +
.....
[2]

- (e) (i) Complete the following equation for the reaction of calcium carbonate with hydrochloric acid.



- (ii) Describe how you would test for the gas given off in this reaction.

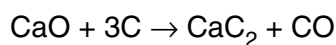
test

result

[3]

- (f) Quicklime, CaO, is a product of the thermal decomposition of calcium carbonate.

When quicklime is heated strongly with coke, calcium carbide is formed.



- (i) What type of reaction is the conversion of C to CO?
Explain your answer.

.....

.....

- (ii) When water is added to calcium carbide, CaC₂, acetylene is formed.
State a use of acetylene.

.....

[3]

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

(a) State the name given to the Group VII elements.

.....[1]

(b) Bromine has two isotopes.

The nucleon (mass) number of bromine-79 is 79 and of bromine-81 is 81.

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

.....
.....

(ii) Complete the table to show the numbers of electrons, neutrons and protons in one atom of bromine-79 and bromine-81. A copy of the Periodic Table is printed on page 20.

| number of | bromine-79 | bromine-81 |
|-----------|------------|------------|
| electrons | | |
| neutrons | | |
| protons | | |

[5]

(c) Bromine is extracted from seawater by treatment with chlorine.

When chlorine is bubbled through a solution of potassium bromide, the solution turns orange-red.

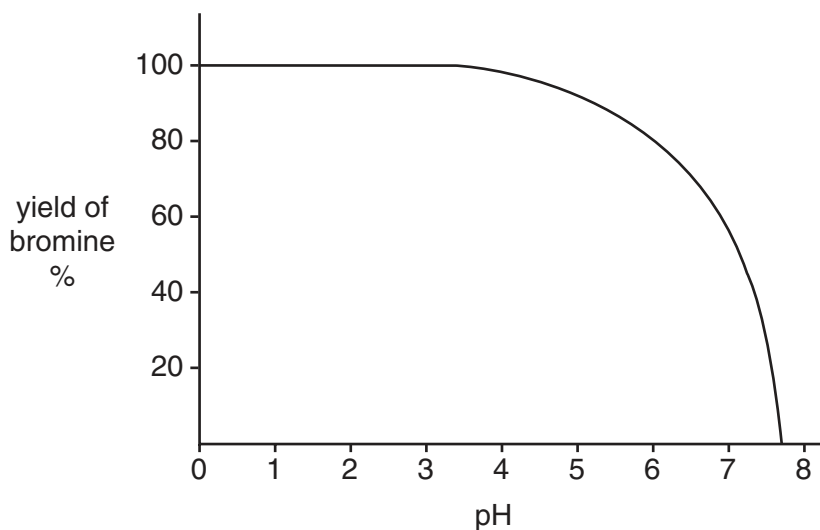
(i) What does this tell you about the reactivity of chlorine compared with bromine?

.....

(ii) Write a word equation for this reaction.

[2]

- (d) In order to get the maximum yield of bromine from seawater, acid is added during the extraction procedure.
The graph shows how the yield of bromine changes with pH.



- (i) What is the highest pH at which the yield of bromine is 100%?

.....

- (ii) The pH scale is used to measure acidity.
Some pH values are given below.

pH 3

pH 5

pH 7

pH 9

pH 11

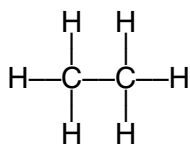
From this list of pH values choose

the pH which is most acidic.

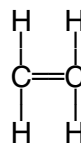
the pH of a neutral solution.

[3]

- (e) Bromine water can be used to distinguish between ethane and ethene.



ethane



ethene

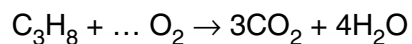
Describe what you would observe when bromine water is added to ethene.

.....

[1]

5 When fuels are burnt, carbon dioxide and water are formed.

(a) Complete the equation for the burning of propane.



[1]

(b) Describe a chemical test for water.

test

result

[2]

(c) In which **two** of the following is carbon dioxide produced.
Tick **two** boxes.

a car driven by a petrol engine

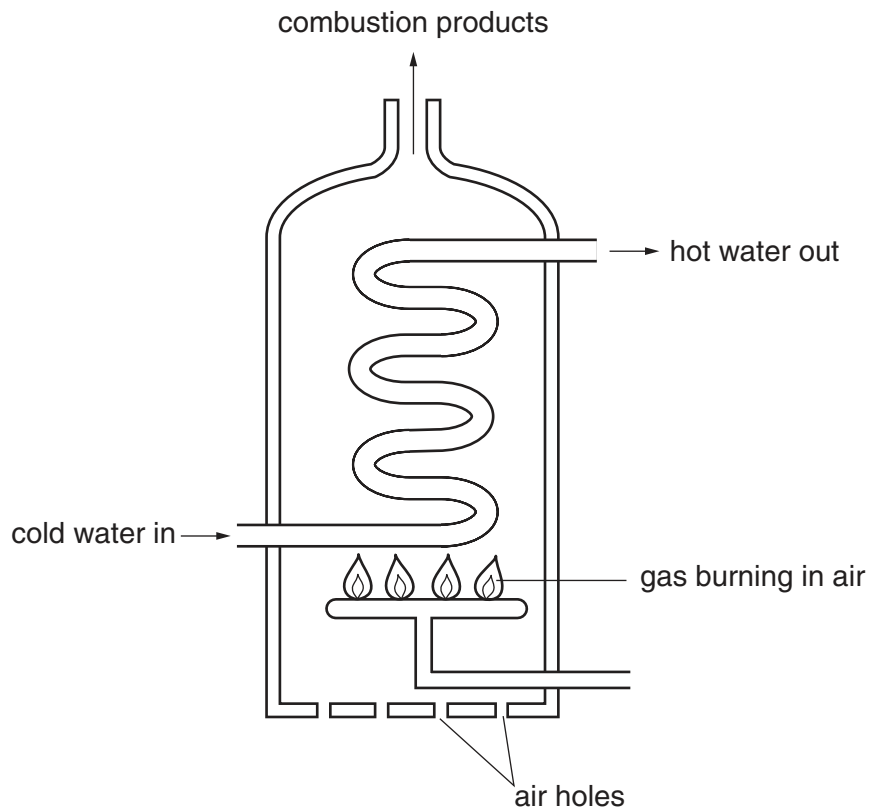
magnesium carbonate reacting with an acid

sodium reacting with water

zinc reacting with hydrochloric acid

[2]

(d) The diagram shows a water heater.



If some of the air holes become blocked, a poisonous gas is produced.

(i) State the name of this poisonous gas.

.....

(ii) Explain how this poisonous gas has been formed.

.....

.....

[2]

- (e) The table below compares the amounts of carbon dioxide and sulphur dioxide formed when 1 kilogram of different fuels are burnt.

| fuel | mass of carbon dioxide produced / g | mass of sulphur dioxide produced / g |
|------|-------------------------------------|--------------------------------------|
| oil | 2900 | 5.0 |
| gas | 2500 | 0.1 |
| coal | 2500 | 11.0 |

- (i) Which fuel is **least** polluting?

.....

- (ii) Which fuel when burnt, contributes most to the formation of acid rain?

.....

- (iii) State two harmful effects of acid rain.

.....

.....

- (iv) When acid rain falls on the ground, it can react with insoluble aluminium compounds in the soil. A solution of aluminium ions is formed.

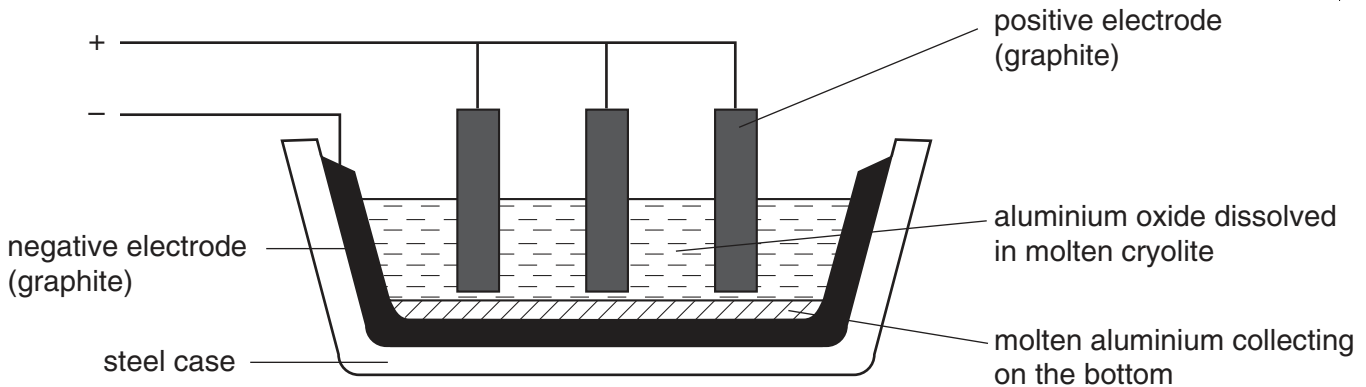
Describe what you would observe when aqueous sodium hydroxide is added to a solution containing aluminium ions.

.....

.....

[6]

- 6 Aluminium is extracted from its ore, bauxite.
The bauxite is purified to give aluminium oxide.
Electrolysis is then used to extract the aluminium from aluminium oxide dissolved in cryolite.



The melting point of pure aluminium oxide is 2070 °C.
The melting point of the mixture of aluminium oxide and cryolite is about 1000 °C.

- (a) Suggest why electrolysis is used to extract aluminium from aluminium oxide rather than reduction using carbon.

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

- (b) How is the electrolyte of aluminium oxide and cryolite kept molten?

.....[1]

- (c) What property of graphite makes it suitable for use as electrodes?

.....[1]

- (d) State the name given to the negative electrode.

.....[1]

- (e) The melting point of steel is about 1500 °C.
Suggest **two** reasons why molten aluminium oxide is not used by itself in this electrolysis.

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

- (f) During the electrolysis, hot oxygen is formed at the positive electrodes.
Suggest why the positive electrodes have to be replaced frequently.

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

- (g) Aluminium is formed at the negative electrode.
Complete the following equation for the reaction at the negative electrode.



[1]

- (h) Why do aluminium ions move towards the negative electrode?

.....[1]

- (i) A sample of bauxite ore had the following composition:

| | |
|--------------------|------|
| aluminium oxide | 120g |
| iron(III) oxide | 30g |
| silica | 40g |
| titanium(IV) oxide | 10g |

Calculate the percentage of aluminium oxide in this sample of bauxite.

[1]

- (j) Aluminium is a metal in Group III of the Periodic Table.
State three physical properties which are typical of most metals.

1

2

3

[3]

DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | | | | | | | | | |
|-----------------------------------|------------------------------------|-------------------------------------|-----------------------------------|--|-------------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|--|-------------------------------------|---------------------------------------|---------------------------------|------------------------------------|---------------------------------|---------------------------------|--|--|--|
| I | II | III | IV | V | VI | VII | 0 | | | | | 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 | 13 Al Aluminium 13 | 14 Si Silicon 14 | 15 P Phosphorus 15 | 16 S Sulphur 16 | 17 Cl Chlorine 17 | 18 Ar Argon 18 | 19 F Fluorine 9 | 20 Ne Neon 10 | | | | | | | | | | | |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | 27 Co Cobalt 27 | 28 Ni Nickel 28 | 29 Cu Copper 29 | 30 Zn Zinc 30 | 31 Ga Gallium 31 | 32 Ge Germanium 32 | 33 As Arsenic 33 | 34 Se Selenium 34 | 35 Br Bromine 35 | 36 Kr Krypton 36 | | | | | | | | | | | |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 45 Sc Scandium 21 | 51 V Vanadium 23 | 52 Cr Chromium 24 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 64 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 84 Kr Krypton 36 | | | | | | | | | |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 89 Y Yttrium 39 | 91 Ti Titanium 22 | 92 V Vanadium 23 | 93 Nb Niobium 41 | 94 Zr Zirconium 40 | 95 Mo Molybdenum 42 | 96 Cr Chromium 24 | 97 Mn Manganese 25 | 98 Fe Iron 26 | 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 | 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 | 210 Po Polonium 84 | 210 At Astatine 85 | 222 Rn Radon 86 | | | | | | |
| 87 Fr Francium | 226 Ra Radium | 227 Ac Actinium | | | | | | | | | | | | | | | | | | | | | |
| | | | 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 146 Pm Promethium 61 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 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 | 238 Pa Protactinium 91 | 238 U Uranium 92 | 238 Np Neptunium 93 | 238 Pu Plutonium 94 | 238 Am Americium 95 | 238 Cm Curium 96 | 238 Bk Berkelium 97 | 238 Cf Californium 98 | 238 Es Einsteinium 99 | 238 Fm Fermium 100 | 238 Md Mendelevium 101 | 238 No Nobelium 102 | 238 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 dm³ at room temperature and pressure (r.t.p.).