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| Centre Number | Candidate Number | Name |
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

SCIENCE **5124/03, 5126/03**

Paper 3 Chemistry October/November 2004

1 hour 15 minutes

Additional Materials: Answer paper

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **two** questions.
Write your answers on the lined pages provided and, if necessary, continue on separate answer paper.

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.
A copy of the Periodic Table is printed on page 12.

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.

| For Examiner's Use | |
|--------------------|--|
| Section A | |
| Section B | |
| Total | |

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

- 1 Fig. 1.1 contains the descriptions of **six** substances. Name the substances that fit these descriptions.

| description | name |
|---|------|
| (a) a metal that forms brass when alloyed with copper | |
| (b) a fuel that powers heavy road vehicles | |
| (c) a liquid that is formed by the fermentation of sugar | |
| (d) an element that is used to disinfect contaminated water | |
| (e) an element that is light and strong and used to make aircraft parts | |
| (f) a compound that is added to iron ore and coke in the blast furnace | |

Fig. 1.1

[6]

- 2 Paper chromatography was used to investigate a series of dyes **A, B, C, D, E, F** and **G**. The resulting chromatogram is shown in Fig. 2.1.

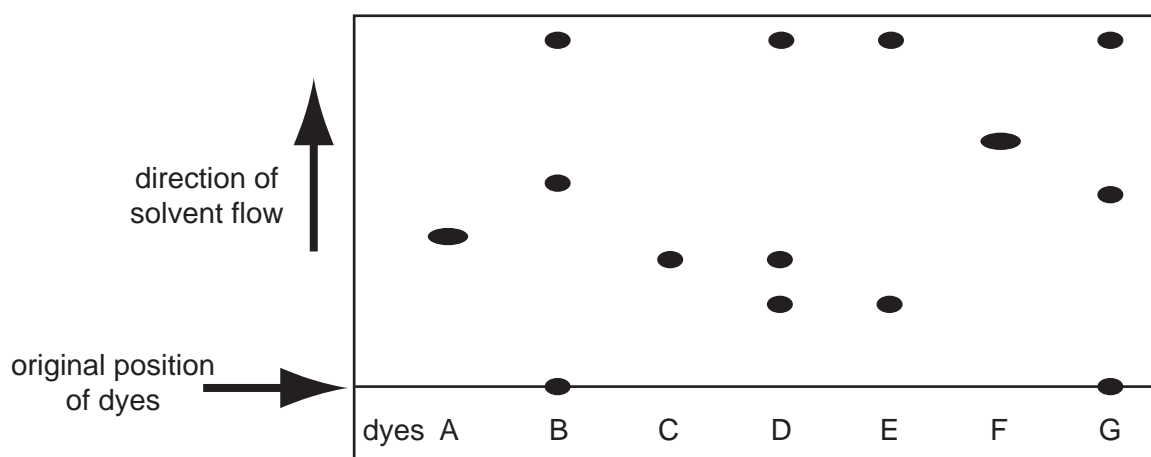


Fig. 2.1

- (a) Suggest the name of a suitable solvent.[1]
- (b) Which dyes are pure substances?[1]
- (c) Which **two** dyes are the same?[1]
- (d) Which dye is a mixture of **C** and **E**?[1]

- 3 (a) Define the *relative molecular mass* of a compound.

.....
[2]

- (b) Six hydrocarbons are identified by the letters **H**, **I**, **J**, **K**, **L** and **M**. Fig. 3.1 shows how the relative molecular masses of these hydrocarbons vary with the number of carbon atoms in each of their molecules. Five of these hydrocarbons are in the same homologous series.

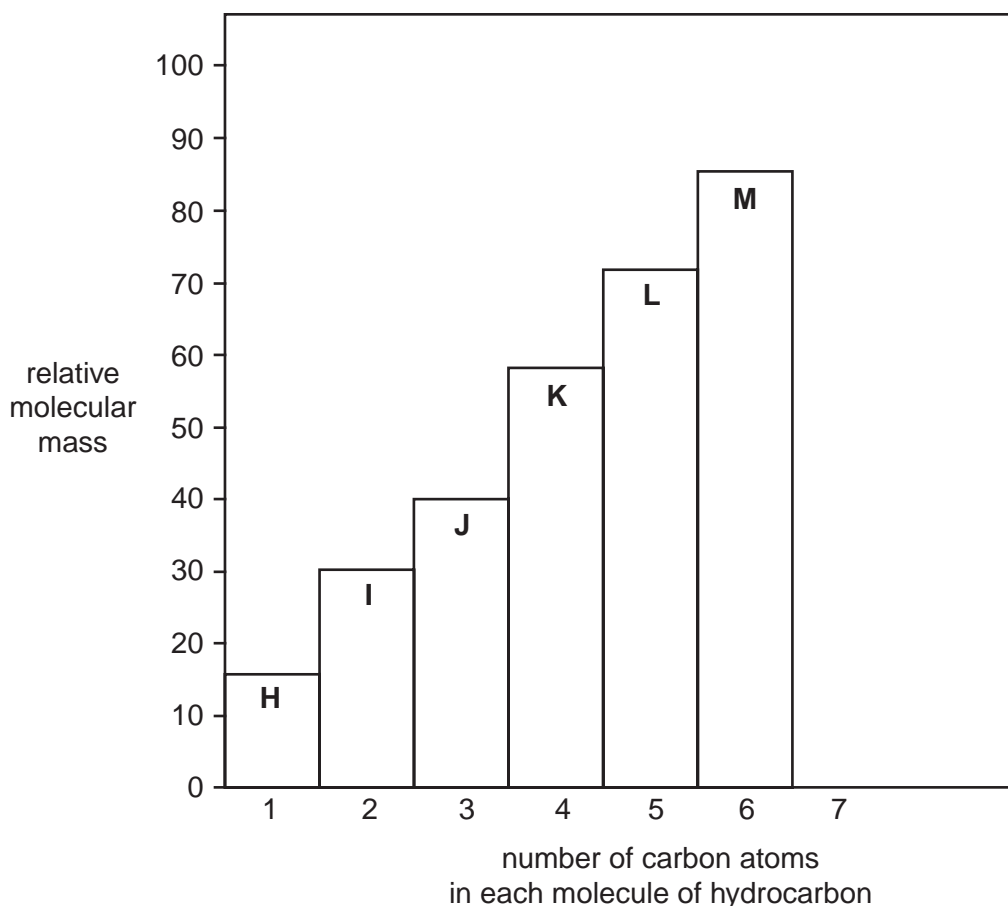


Fig. 3.1

- (i) Hydrocarbon **H** has a relative molecular mass of 16. Suggest the name of this hydrocarbon.

[Relative atomic masses: A_r : H, 1; C, 12]

.....

- (ii) Which **one** of the hydrocarbons is not a member of the same homologous series as the other **five**?

.....

- (iii) Add to Fig. 3.1 the block for the next hydrocarbon in the homologous series.

- (iv) Suggest a physical property of the hydrocarbons that changes with increasing number of carbon atoms.

.....

- 4 The following are labels that describe the **contents** of four different bottles.

Content of bottle **N**.
Coloured white. Only some parts
dissolve in an excess of water.

Content of bottle **O**.
All its identical molecules when burnt
in air form carbon dioxide and water.

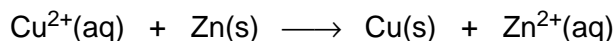
Content of bottle **P**.
Has a constant composition. Contains
several different atoms.

Content of bottle **Q**.
When burnt in air, only water is formed.

Classify the contents of each bottle and draw a **circle** around either **element**, or **compound**, or **mixture**.

- | | | | | |
|------------------------------------|---------|----------|---------|-----|
| (a) Substance in bottle N : | element | compound | mixture | [1] |
| (b) Substance in bottle O : | element | compound | mixture | [1] |
| (c) Substance in bottle P : | element | compound | mixture | [1] |
| (d) Substance in bottle Q : | element | compound | mixture | [1] |

- 5 The ionic equation for the reactions between zinc and copper(II) sulphate solution is shown below.



- (a) What is the meaning of the following symbols?

(i) (aq)

(ii) (s)

[2]

- (b) Use the equation to show that

(i) copper ions have been reduced,

.....
.....

(ii) zinc atoms have been oxidised.

.....
.....

[2]

(c) A student dropped a lump of zinc into dilute copper(II) sulphate solution.

(i) Suggest **one** way in which the student can make the reaction go faster.

.....

(ii) Explain why the rate of reaction will increase when he makes this change.

.....

.....

[2]

6 An atom of calcium, ${}^{40}_{20}\text{Ca}$, forms a calcium ion, Ca^{2+} . The ion contains protons, neutrons and electrons.

(a) Complete Fig. 6.1 to describe the particles in the calcium ion.

| | number in one Ca^{2+} ion | electrical charge |
|----------|---------------------------------------|-------------------|
| proton | | positive charge |
| neutron | | |
| electron | | |

Fig. 6.1

[5]

(b) How does the formation of the calcium ion show that calcium is a metal?

.....

.....[1]

(c) How will another isotope of calcium

(i) differ from ${}^{40}_{20}\text{Ca}$,

.....

(ii) be the same as ${}^{40}_{20}\text{Ca}$?

.....[2]

- 7 (a) One dm^3 of a solution contains 80 g of sodium hydroxide, NaOH.

[Relative atomic masses: A_r : H, 1; O, 16; Na, 23]

Calculate the concentration of the solution in mol/dm^3 .

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

- (b) If 80 g of sodium hydroxide is dissolved in water and then made up to 250 cm^3 , what will be the concentration of the solution in g/dm^3 ?

.....[1]

- (c) (i) Write the chemical equation for the reaction of sodium hydroxide with sulphuric acid, excluding state symbols.

.....

- (ii) What volume of 1.0 mol/dm^3 sulphuric acid will react with 100 cm^3 of 2.0 mol/dm^3 sodium hydroxide?

.....

.....[3]

- 8 The solubility of a substance is the maximum mass that will dissolve in 100 g of water, so forming a saturated solution. Solubility depends upon temperature.

Fig. 8.1 contains a solubility curve for substance **V**. This shows how the solubility of substance **V** changes with temperature.

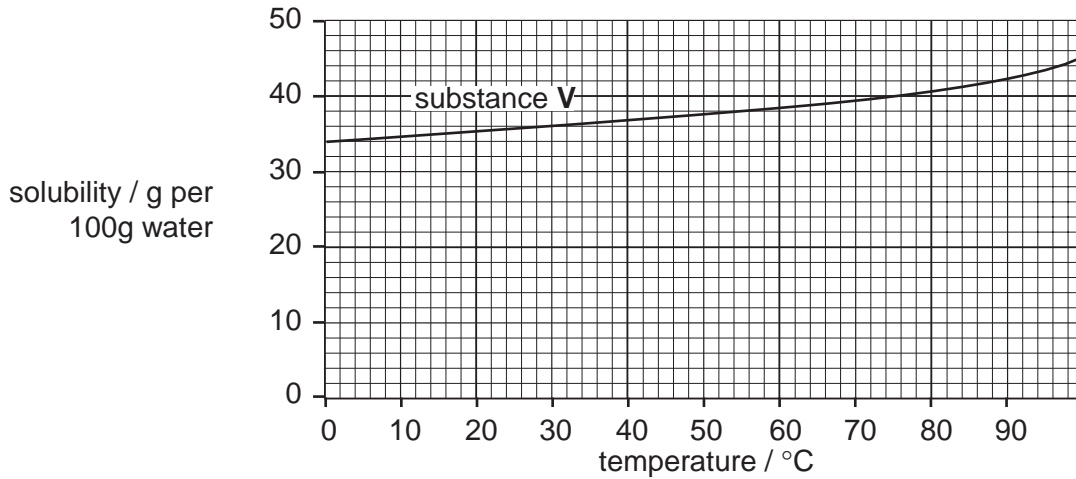


Fig. 8.1

- (a) Fig. 8.2 shows the solubility of substance **W** at various temperatures.

| | | | | | | | |
|--|----|----|----|----|----|----|----|
| solubility of W / g per 100 g of water | 5 | 7 | 10 | 19 | 24 | 37 | 46 |
| temperature / °C | 10 | 20 | 30 | 50 | 60 | 80 | 90 |

Fig. 8.2

- (i) Plot on Fig. 8.1 a solubility curve for substance **W**.
- (ii) At what temperature are the solubilities of substances **V** and **W** the same?
.....
- (iii) Use your plot to estimate the temperature at which substance **W** has a solubility of 17 g per 100 g of water.
.....

[4]

- (b) Equal volumes of saturated solutions of **V** and **W** are cooled from 80 °C to 40 °C. Will solution **W** deposit a **larger, equal,** or **smaller** mass of crystals than solution **V**?

.....[1]

Section B

Answer any **two** questions.

Write your answers on the lined pages provided and, if necessary, continue on separate answer paper.

- 9 (a) Name the reagents and give the essential conditions of the catalytic manufacture of ammonia, NH_3 . Explain the purpose of the catalyst and write a chemical equation for the reaction. State symbols are not required. [7]
- (b) Calculate the relative molecular mass of ammonia and determine the percentage of nitrogen by mass in a sample of pure ammonia. [3]

[Relative atomic masses: A_r : H, 1; N, 14]

- 10 (a) Write the name and formula of an ion found in

- (i) every acid solution,
(ii) every alkaline solution.

[2]

- (b) Fig. 10.1 gives the properties and reactions of several substances.

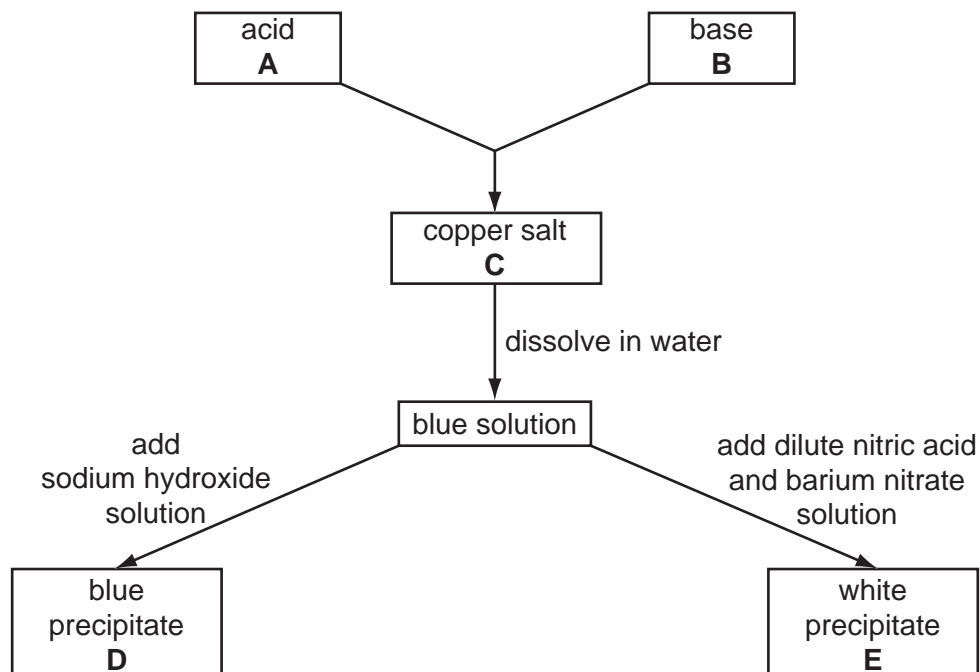


Fig. 10.1

Identify the following:

(i) blue precipitate **D**

(ii) white precipitate **E**

(iii) copper salt **C**

(iv) acid **A**

(v) base **B**

[6]

(c) Write a chemical equation for any **one** of the reactions in Fig. 10.1.
State symbols are not required.

[2]

11 (a) Name **three** of the gases present in clean air.

[3]

(b) A gas is cooled to a very low temperature.

(i) Name the two changes in state that will occur.

(ii) Describe how the movement, spacing and arrangement of the gas particles will change during this cooling.

[7]

A series of horizontal dotted lines for writing.

DATA SHEET
The Periodic Table of the Elements

| Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| I | II | III | IV | V | VI | VII | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | 1 H Hydrogen 1 | 11 B Boron 5 | 12 C Carbon 6 | 13 Al Aluminium 13 | 14 N Nitrogen 7 | 15 O Oxygen 8 | 16 F Fluorine 9 | 17 Ne Neon 10 | 18 Ar Argon 18 | 19 Cl Chlorine 17 | 20 S Sulphur 16 | 21 P Phosphorus 15 | 22 Si Silicon 14 | 23 Al Aluminium 13 | 24 Mg Magnesium 12 | 25 Ca Calcium 20 | 26 Sc Scandium 21 | 27 Ti Titanium 22 | 28 V Vanadium 23 | 29 Cr Chromium 24 | 30 Mn Manganese 25 | 31 Fe Iron 26 | 32 Ni Nickel 28 | 33 Cu Copper 29 | 34 Zn Zinc 30 | 35 Ga Gallium 31 | 36 Ge Germanium 32 | 37 Rb Rubidium 37 | 38 Sr Strontium 38 | 39 Y Yttrium 39 | 40 Zr Zirconium 40 | 41 Nb Niobium 41 | 42 Mo Molybdenum 42 | 43 Tc Technetium 43 | 44 Ru Ruthenium 44 | 45 Rh Rhodium 45 | 46 Pd Palladium 46 | 47 Ag Silver 47 | 48 Cd Cadmium 48 | 49 In Indium 49 | 50 Sn Tin 50 | 51 Sb Antimony 51 | 52 Te Tellurium 52 | 53 I Iodine 53 | 54 Xe Xenon 54 | 55 Cs Caesium 55 | 56 Ba Barium 56 | 57 La Lanthanum 57 | 58 Ce Cerium 58 | 59 Pr Praseodymium 59 | 60 Nd Neodymium 60 | 61 Pm Promethium 61 | 62 Sm Samarium 62 | 63 Eu Europium 63 | 64 Gd Gadolinium 64 | 65 Tb Terbium 65 | 66 Dy Dysprosium 66 | 67 Ho Holmium 67 | 68 Er Erbium 68 | 69 Tm Thulium 69 | 70 Yb Ytterbium 70 | 71 Lu Lutetium 71 | 72 Fr Francium 87 | 73 Ra Radium 88 | 74 Ac Actinium 89 | 75 Th Thorium 90 | 76 Pa Protactinium 91 | 77 U Uranium 92 | 78 Np Neptunium 93 | 79 Pu Plutonium 94 | 80 Am Americium 95 | 81 Cm Curium 96 | 82 Bk Berkelium 97 | 83 Cf Californium 98 | 84 Es Einsteinium 99 | 85 Fm Fermium 100 | 86 Md Mendelevium 101 | 87 No Nobelium 102 | 88 Lr Lawrencium 103 | 89 Rn Radon 86 | 90 At Astatine 85 | 91 Po Polonium 84 | 92 Bi Bismuth 83 | 93 Pb Lead 82 | 94 Tl Thallium 81 | 95 Hg Mercury 80 | 96 Au Gold 79 | 97 Pt Platinum 78 | 98 Ir Iridium 77 | 99 Pd Palladium 46 | 100 Ag Silver 47 | 101 Cu Copper 29 | 102 Ni Nickel 28 | 103 Co Cobalt 27 | 104 Fe Iron 26 | 105 Mn Manganese 25 | 106 Cr Chromium 24 | 107 V Vanadium 23 | 108 Ti Titanium 22 | 109 Sc Scandium 21 | 110 Zn Zinc 30 | 111 Cd Cadmium 48 | 112 Hg Mercury 80 | 113 In Indium 49 | 114 Sn Tin 50 | 115 Sb Antimony 51 | 116 Te Tellurium 52 | 117 I Iodine 53 | 118 Xe Xenon 54 | 119 Pb Lead 82 | 120 Bi Bismuth 83 | 121 Po Polonium 84 | 122 At Astatine 85 | 123 Rn Radon 86 | 124 Fr Francium 87 | 125 Ra Radium 88 | 126 Ac Actinium 89 | 127 Th Thorium 90 | 128 Pa Protactinium 91 | 129 U Uranium 92 | 130 Np Neptunium 93 | 131 Pu Plutonium 94 | 132 Am Americium 95 | 133 Cm Curium 96 | 134 Bk Berkelium 97 | 135 Cf Californium 98 | 136 Es Einsteinium 99 | 137 Fm Fermium 100 | 138 Md Mendelevium 101 | 139 No Nobelium 102 | 140 Lr Lawrencium 103 | 141 Ce Cerium 58 | 142 Pr Praseodymium 59 | 143 Nd Neodymium 60 | 144 Pm Promethium 61 | 145 Sm Samarium 62 | 146 Eu Europium 63 | 147 Gd Gadolinium 64 | 148 Tb Terbium 65 | 149 Dy Dysprosium 66 | 150 Ho Holmium 67 | 151 Er Erbium 68 | 152 Tm Thulium 69 | 153 Yb Ytterbium 70 | 154 Lu Lutetium 71 | 155 Fr Francium 87 | 156 Ra Radium 88 | 157 Ac Actinium 89 | 158 Th Thorium 90 | 159 Pa Protactinium 91 | 160 U Uranium 92 | 161 Np Neptunium 93 | 162 Pu Plutonium 94 | 163 Am Americium 95 | 164 Cm Curium 96 | 165 Bk Berkelium 97 | 166 Cf Californium 98 | 167 Es Einsteinium 99 | 168 Fm Fermium 100 | 169 Md Mendelevium 101 | 170 No Nobelium 102 | 171 Lr Lawrencium 103 | 172 Rn Radon 86 | 173 At Astatine 85 | 174 Po Polonium 84 | 175 Bi Bismuth 83 | 176 Pb Lead 82 | 177 Tl Thallium 81 | 178 Hg Mercury 80 | 179 Au Gold 79 | 180 Pt Platinum 78 | 181 Ir Iridium 77 | 182 Rh Rhodium 45 | 183 Pd Palladium 46 | 184 Ag Silver 47 | 185 Cu Copper 29 | 186 Ni Nickel 28 | 187 Co Cobalt 27 | 188 Fe Iron 26 | 189 Mn Manganese 25 | 190 Cr Chromium 24 | 191 V Vanadium 23 | 192 Ti Titanium 22 | 193 Sc Scandium 21 | 194 Zn Zinc 30 | 195 Cd Cadmium 48 | 196 Hg Mercury 80 | 197 In Indium 49 | 198 Sn Tin 50 | 199 Sb Antimony 51 | 200 Te Tellurium 52 | 201 I Iodine 53 | 202 Xe Xenon 54 | 203 Pb Lead 82 | 204 Bi Bismuth 83 | 205 Po Polonium 84 | 206 At Astatine 85 | 207 Rn Radon 86 | 208 Fr Francium 87 | 209 Ra Radium 88 | 210 Ac Actinium 89 | 211 Th Thorium 90 | 212 Pa Protactinium 91 | 213 U Uranium 92 | 214 Np Neptunium 93 | 215 Pu Plutonium 94 | 216 Am Americium 95 | 217 Cm Curium 96 | 218 Bk Berkelium 97 | 219 Cf Californium 98 | 220 Es Einsteinium 99 | 221 Fm Fermium 100 | 222 Md Mendelevium 101 | 223 No Nobelium 102 | 224 Lr Lawrencium 103 |

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

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

Key

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).