



# Cambridge IGCSE™

## CHEMISTRY

Paper 1 Multiple Choice (Core)

0620/13

May/June 2022

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

## INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

## INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



- 1 Two different physical states of iodine are described.

In state 1, iodine exists as  $I_2$  molecules that are widely spaced and in rapid random movement.

In state 2, iodine exists as  $I_2$  molecules that are closely packed and only vibrate.

Iodine can be converted directly from state 2 to form state 1.

Which row about state 2 and the change from state 2 to state 1 is correct?

|          | state 2 | the change from<br>state 2 to state 1 |
|----------|---------|---------------------------------------|
| <b>A</b> | liquid  | evaporation                           |
| <b>B</b> | liquid  | sublimation                           |
| <b>C</b> | solid   | evaporation                           |
| <b>D</b> | solid   | sublimation                           |

- 2 A student measures the time taken for 2.0 g of magnesium to dissolve in 50 cm<sup>3</sup> of dilute sulfuric acid.

Which apparatus is essential to complete the experiment?

- 1 stop-clock
- 2 measuring cylinder
- 3 thermometer
- 4 balance

**A** 1, 2 and 4      **B** 1 and 2 only      **C** 1 and 4 only      **D** 2, 3 and 4

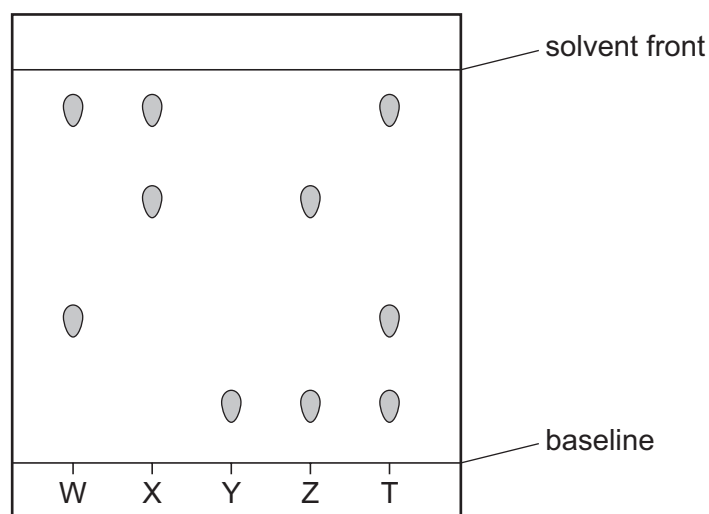
- 3 Which method is used to separate a mixture of the following liquids?

| liquid      | boiling point/°C |
|-------------|------------------|
| methanol    | 64.5             |
| ethanol     | 78.5             |
| propan-1-ol | 97.2             |
| butan-1-ol  | 117.0            |

- A** crystallisation  
**B** evaporation  
**C** filtration  
**D** fractional distillation

- 4 Paper chromatography is used to separate four different coloured inks, W, X, Y and Z, and an unknown ink T.

The chromatogram is shown.



Which inks are present in ink T?

- A** W and X      **B** W and Y      **C** X and Z      **D** Y and Z

- 5 Which row identifies an alloy, a pure metal and a non-metal?

|          | alloy  | pure metal | non-metal |
|----------|--------|------------|-----------|
| <b>A</b> | brass  | carbon     | copper    |
| <b>B</b> | brass  | copper     | carbon    |
| <b>C</b> | copper | brass      | carbon    |
| <b>D</b> | copper | carbon     | brass     |

- 6 An atom of an element contains 4 electrons, 4 protons and 6 neutrons.

In which group of the Periodic Table is this element placed?

- A** Group II  
**B** Group IV  
**C** Group VI  
**D** Group VIII

7 Which row describes an ionic solid?

|          | soluble in water | conducts electricity<br>when solid | conducts electricity<br>when molten |
|----------|------------------|------------------------------------|-------------------------------------|
| <b>A</b> | ✓                | x                                  | ✓                                   |
| <b>B</b> | x                | x                                  | x                                   |
| <b>C</b> | ✓                | x                                  | x                                   |
| <b>D</b> | x                | ✓                                  | ✓                                   |

key

✓ = yes

x = no

8 Which molecule contains more than one pair of shared electrons?

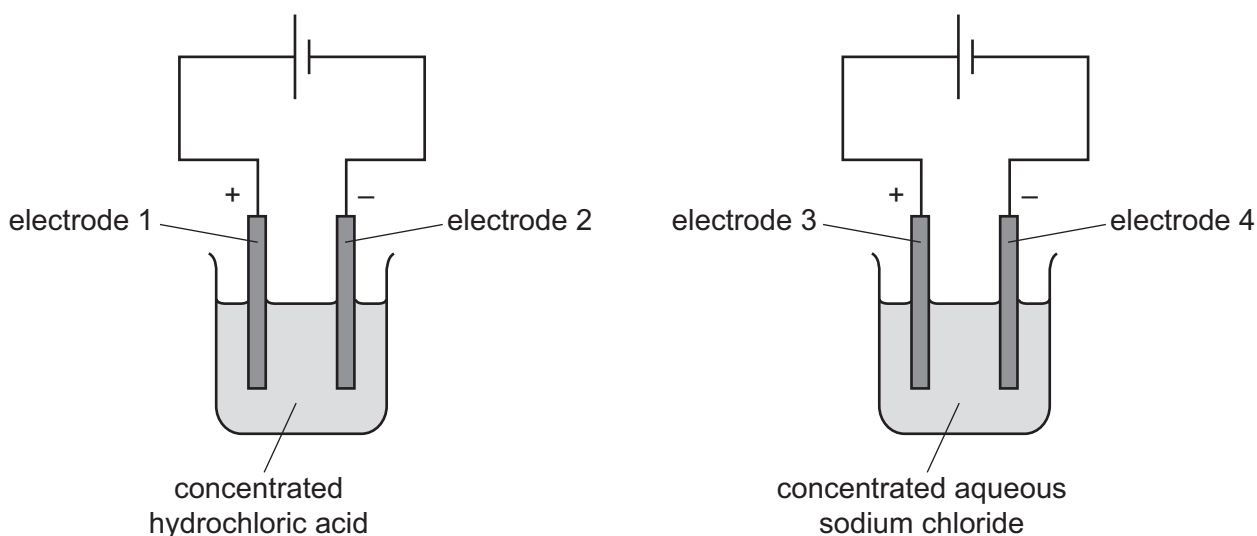
- A** chlorine
- B** hydrogen
- C** hydrogen chloride
- D** water

9 Compounds that contain nitrogen can be used as fertilisers.

Which compound contains the greatest proportion of nitrogen by mass?

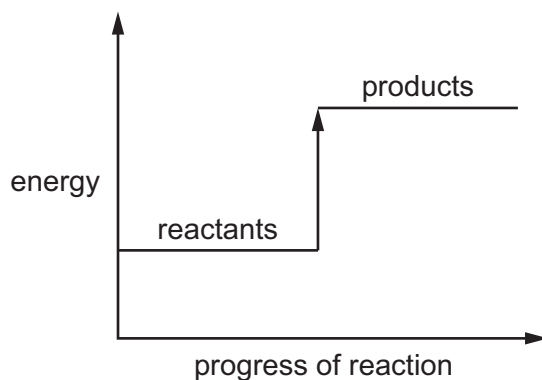
- A**  $\text{CH}_4\text{N}_2\text{O}$       **B**  $\text{NH}_4\text{Cl}$       **C**  $\text{NH}_4\text{NO}_3$       **D**  $(\text{NH}_4)_2\text{SO}_4$

- 10 The diagram shows the electrolysis of concentrated hydrochloric acid and concentrated aqueous sodium chloride using carbon electrodes.



At which electrodes is hydrogen produced?

- A electrode 1 only
  - B electrodes 1 and 3
  - C electrode 2 only
  - D electrodes 2 and 4
- 11 The energy level diagram for a reaction is shown.



Which statement is correct?

- A The reaction is endothermic and heat energy is released.
- B The reaction is endothermic and heat energy is taken in.
- C The reaction is exothermic and heat energy is released.
- D The reaction is exothermic and heat energy is taken in.

**12** Which row identifies a chemical change and a physical change?

|          | chemical change             | physical change             |
|----------|-----------------------------|-----------------------------|
| <b>A</b> | boiling ethanol             | burning ethanol             |
| <b>B</b> | burning ethanol             | evaporating ethanol         |
| <b>C</b> | dissolving ethanol in water | burning ethanol             |
| <b>D</b> | evaporating ethanol         | dissolving ethanol in water |

**13** Metal M reacts with steam and produces gas G.

Which row identifies gas G and the type of reaction when metal M reacts with steam?

|          | gas G    | type of reaction |
|----------|----------|------------------|
| <b>A</b> | hydrogen | redox            |
| <b>B</b> | hydrogen | neutralisation   |
| <b>C</b> | oxygen   | redox            |
| <b>D</b> | oxygen   | neutralisation   |

**14** The rate of the reaction between lumps of zinc and dilute sulfuric acid is determined.

The experiment is repeated four times, making only one change each time.

The changes are listed.

- 1 The lumps of zinc are replaced with powdered zinc.
- 2 Water is added to the dilute sulfuric acid.
- 3 The temperature of the dilute sulfuric acid is increased.
- 4 A catalyst is added to the reaction mixture.

Which changes produce an increase in the rate of reaction?

**A** 1, 3 and 4      **B** 1 and 2      **C** 2 only      **D** 3 and 4 only

**15** Water is added to anhydrous copper(II) sulfate.

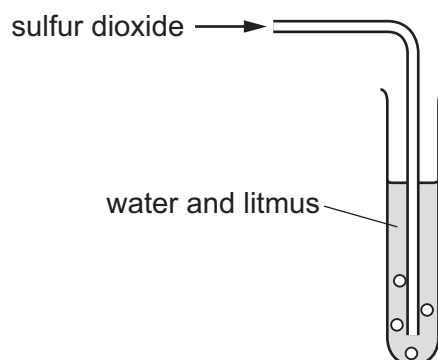
What happens during the reaction?

- A** The copper(II) sulfate turns blue and the solution formed gets colder.  
**B** The copper(II) sulfate turns blue and the solution formed gets hotter.  
**C** The copper(II) sulfate turns white and the solution formed gets colder.  
**D** The copper(II) sulfate turns white and the solution formed gets hotter.

16 Which statement explains why lime is added to soil?

- A to decrease the pH of acidic soil
- B to decrease the pH of alkaline soil
- C to increase the pH of acidic soil
- D to increase the pH of alkaline soil

17 Sulfur dioxide is bubbled through water containing litmus.



Which row describes and explains what happens to the litmus?

|   | observation   | explanation                       |
|---|---------------|-----------------------------------|
| A | it turns blue | sulfur dioxide is a basic oxide   |
| B | it turns blue | sulfur dioxide is an acidic oxide |
| C | it turns red  | sulfur dioxide is an acidic oxide |
| D | it turns red  | sulfur dioxide is a basic oxide   |

- 18** The oxides of two elements, X and Y, are separately dissolved in water and the pH of each solution tested.

| oxide tested | pH of solution |
|--------------|----------------|
| X            | 1              |
| Y            | 13             |

Which information about X and Y is correct?

|          | oxide is acidic | oxide is basic | metal | non-metal |
|----------|-----------------|----------------|-------|-----------|
| <b>A</b> | X               | Y              | X     | Y         |
| <b>B</b> | X               | Y              | Y     | X         |
| <b>C</b> | Y               | X              | X     | Y         |
| <b>D</b> | Y               | X              | Y     | X         |

- 19** An acid is neutralised by adding an excess of an insoluble solid base.

A soluble salt is formed.

How is the pure salt obtained from the reaction mixture?

- A** crystallisation → evaporation → filtration
- B** evaporation → crystallisation → filtration
- C** filtration → crystallisation → evaporation
- D** filtration → evaporation → crystallisation
- 20** Which ion forms a precipitate that dissolves in excess with both aqueous ammonia and with aqueous sodium hydroxide?
- A** calcium ion,  $\text{Ca}^{2+}$
- B** copper(II) ion,  $\text{Cu}^{2+}$
- C** iron(III) ion,  $\text{Fe}^{3+}$
- D** zinc ion,  $\text{Zn}^{2+}$



**21** Part of the Periodic Table is shown.

Which element is a metal?

A simplified periodic table grid is shown, consisting of a 6x12 grid of squares. The grid is divided into four main sections by a vertical gap between the 3rd and 4th columns. The sections are: a 2x2 block in the top left (columns 1-2, rows 1-2), a 1x6 block in the top right (column 12, row 1), a 2x6 block in the middle left (columns 1-2, rows 3-4), and a 2x6 block in the middle right (columns 7-12, rows 3-4). The bottom two rows (rows 5 and 6) are continuous across all 12 columns. Four elements are marked with letters in boxes: 'A' is in the top right section (column 12, row 1); 'B' is in the middle right section (column 9, row 3); 'C' is in the middle right section (column 7, row 4); and 'D' is in the bottom right section (column 11, row 5).

**22** The elements sodium to argon form Period 3 of the Periodic Table.

Which row describes the trend across Period 3 from left to right?

|          | number of<br>outer-shell electrons | metallic<br>character | group<br>number |
|----------|------------------------------------|-----------------------|-----------------|
| <b>A</b> | decreases                          | decreases             | decreases       |
| <b>B</b> | decreases                          | increases             | decreases       |
| <b>C</b> | increases                          | decreases             | increases       |
| <b>D</b> | increases                          | increases             | increases       |

**23** Lithium and sodium are in Group I of the Periodic Table.

Which statements about the properties of lithium and sodium are correct?

- 1 Lithium has a lower melting point than sodium.
- 2 They both produce hydrogen when they react with water.
- 3 Lithium is less dense than sodium.
- 4 Lithium is more reactive than sodium.

**A** 1 and 2

**B** 1 and 4

**C** 2 and 3

**D** 3 and 4

**24** Which row describes the properties of a typical transition element?

|          | melting point | density | used as catalyst |
|----------|---------------|---------|------------------|
| <b>A</b> | high          | high    | yes              |
| <b>B</b> | high          | low     | no               |
| <b>C</b> | low           | high    | yes              |
| <b>D</b> | low           | low     | no               |

**25** Which row describes an atom of a noble gas?

|          | number of protons | number of neutrons | number of electrons |
|----------|-------------------|--------------------|---------------------|
| <b>A</b> | 2                 | 2                  | 0                   |
| <b>B</b> | 2                 | 2                  | 2                   |
| <b>C</b> | 8                 | 8                  | 8                   |
| <b>D</b> | 8                 | 8                  | 10                  |

**26** Some properties of four elements, P, Q, R and S, are shown.

Solid P reacts with dilute hydrochloric acid to give hydrogen.

Solid Q does not conduct electricity.

Solid R is used to make saucepans because it is a good conductor of heat.

Solid S reacts with oxygen to form a compound where atoms of S share electrons with atoms of oxygen.

Which elements are metals?

- A** P and R      **B** P and S      **C** Q and R      **D** Q and S

**27** Three metals, X, Y and Z, are added separately to dilute hydrochloric acid.

The oxides of each metal are heated with carbon.

The results of the reactions are shown.

|   | dilute aqueous hydrochloric acid | metal oxide with carbon     |
|---|----------------------------------|-----------------------------|
| X | no reaction                      | brown solid forms           |
| Y | fast fizzing                     | no change                   |
| Z | slow fizzing                     | silver coloured solid forms |

What are X, Y and Z?

|          | X      | Y       | Z         |
|----------|--------|---------|-----------|
| <b>A</b> | copper | calcium | zinc      |
| <b>B</b> | copper | zinc    | magnesium |
| <b>C</b> | iron   | calcium | zinc      |
| <b>D</b> | iron   | zinc    | magnesium |

**28** Which uses of the metals shown are correct?

|          | aluminium       | stainless steel |
|----------|-----------------|-----------------|
| <b>A</b> | aircraft bodies | car bodies      |
| <b>B</b> | car bodies      | aircraft bodies |
| <b>C</b> | chemical plant  | food containers |
| <b>D</b> | food containers | cutlery         |

**29** Carbon dioxide and methane are both greenhouse gases.

Which activity produces both of these gases?

- A** farming animals
- B** cracking alkanes
- C** the thermal decomposition of limestone
- D** using petrol-powered cars

30 Which statement about carbon monoxide is correct?

- A It damages stone buildings.
- B It is a pollutant which causes acid rain.
- C It is produced during the decomposition of vegetation.
- D It is formed during the incomplete combustion of natural gas.

31 Fertilisers are used to provide three of the elements needed for plant growth.

Which two compounds would give a fertiliser containing all three of these elements?

- A  $\text{Ca}(\text{NO}_3)_2$  and  $(\text{NH}_4)_2\text{SO}_4$
- B  $\text{Ca}(\text{NO}_3)_2$  and  $(\text{NH}_4)_3\text{PO}_4$
- C  $\text{KNO}_3$  and  $(\text{NH}_4)_2\text{SO}_4$
- D  $\text{KNO}_3$  and  $(\text{NH}_4)_3\text{PO}_4$

32 Sulfur dioxide is tested by reacting it with acidified potassium manganate(VII).

Which colour change is seen in the test?

- A blue to white
- B colourless to purple
- C purple to colourless
- D white to blue

33 Which products use calcium carbonate in their manufacture?

- 1 aluminium
- 2 cement
- 3 iron
- 4 sulfuric acid

- A 1 and 3      B 1 and 4      C 2 and 3      D 2 and 4

34 What are the products when limestone (calcium carbonate) is heated strongly?

- A calcium hydroxide and carbon dioxide
- B calcium hydroxide and carbon monoxide
- C calcium oxide and carbon dioxide
- D calcium oxide and carbon monoxide

35 Which structures represent ethene and ethanol?

|          | ethene                                                                                                                                             | ethanol                                                                                                                                                      |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b> | $\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$ | $\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$  |
| <b>B</b> | $\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$ | $\begin{array}{c} \text{H} \quad \text{O} \\   \quad // \\ \text{H}-\text{C}-\text{C} \\   \quad \backslash \\ \text{H} \quad \text{O}-\text{H} \end{array}$ |
| <b>C</b> | $\begin{array}{c} \text{H} \quad \text{H} \\ \backslash \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{H} \end{array}$ | $\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$  |
| <b>D</b> | $\begin{array}{c} \text{H} \quad \text{H} \\ \backslash \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{H} \end{array}$ | $\begin{array}{c} \text{H} \quad \text{O} \\   \quad // \\ \text{H}-\text{C}-\text{C} \\   \quad \backslash \\ \text{H} \quad \text{O}-\text{H} \end{array}$ |

36 One of the fractions obtained from the fractional distillation of petroleum is naphtha.

What is a major use of the naphtha fraction?

- A** as a fuel for jet aircraft
- B** as a lubricant for moving machine parts
- C** as a smooth surface covering for roads
- D** as a starting material to make other chemicals

37 Which statement describes the process of cracking?

- A** It is the breakdown of a compound using electricity.
- B** It is the breakdown of long chain hydrocarbons.
- C** It is the combination of many small monomers.
- D** It is the separation of a mixture of hydrocarbons.

38 Which temperature range is used in the production of ethanol by fermentation?

- A** 0–20 °C
- B** 25–40 °C
- C** 50–70 °C
- D** 80–100 °C

**39** A hydrocarbon is tested with aqueous bromine.

The aqueous bromine turns from orange to colourless.

Which row describes the hydrocarbon?

|          | homologous series | type of hydrocarbon |
|----------|-------------------|---------------------|
| <b>A</b> | alkane            | saturated           |
| <b>B</b> | alkane            | unsaturated         |
| <b>C</b> | alkene            | saturated           |
| <b>D</b> | alkene            | unsaturated         |

**40** Which polymers are constituents of food?

- 1 carbohydrate
- 2 nylon
- 3 *Terylene*
- 4 protein

**A** 1 and 2

**B** 1 and 4

**C** 2 and 3

**D** 3 and 4

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The Periodic Table of Elements

| Group                      |                             |                                                                |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                           |
|----------------------------|-----------------------------|----------------------------------------------------------------|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|---------------------------|
| I                          | II                          | 1<br>H<br>hydrogen<br>1                                        |                                 |                             |                              |                             |                              |                              |                                |                               |                               | III                         | IV                          | V                           | VI                            | VII                          | VIII                      |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   | atomic number<br>atomic symbol<br>name<br>relative atomic mass |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 5<br>B<br>boron<br>11       | 6<br>C<br>carbon<br>12      | 7<br>N<br>nitrogen<br>14    | 8<br>O<br>oxygen<br>16        | 9<br>F<br>fluorine<br>19     | 10<br>Ne<br>neon<br>20    |
|                            |                             |                                                                |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                           |
| 11<br>Na<br>sodium<br>23   | 12<br>Mg<br>magnesium<br>24 |                                                                |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 13<br>Al<br>aluminium<br>27 | 14<br>Si<br>silicon<br>28   | 15<br>P<br>phosphorus<br>31 | 16<br>S<br>sulfur<br>32       | 17<br>Cl<br>chlorine<br>35.5 | 18<br>Ar<br>argon<br>40   |
| 19<br>K<br>potassium<br>39 | 20<br>Ca<br>calcium<br>40   | 21<br>Sc<br>scandium<br>45                                     | 22<br>Ti<br>titanium<br>48      | 23<br>V<br>vanadium<br>51   | 24<br>Cr<br>chromium<br>52   | 25<br>Mn<br>manganese<br>55 | 26<br>Fe<br>iron<br>56       | 27<br>Co<br>cobalt<br>59     | 28<br>Ni<br>nickel<br>59       | 29<br>Cu<br>copper<br>64      | 30<br>Zn<br>zinc<br>65        | 31<br>Ga<br>gallium<br>70   | 32<br>Ge<br>germanium<br>73 | 33<br>As<br>arsenic<br>75   | 34<br>Se<br>selenium<br>79    | 35<br>Br<br>bromine<br>80    | 36<br>Kr<br>krypton<br>84 |
| 37<br>Rb<br>rubidium<br>85 | 38<br>Sr<br>strontium<br>88 | 39<br>Y<br>yttrium<br>89                                       | 40<br>Zr<br>zirconium<br>91     | 41<br>Nb<br>niobium<br>93   | 42<br>Mo<br>molybdenum<br>96 | 43<br>Tc<br>technetium<br>— | 44<br>Ru<br>ruthenium<br>101 | 45<br>Rh<br>rhodium<br>103   | 46<br>Pd<br>palladium<br>106   | 47<br>Ag<br>silver<br>108     | 48<br>Cd<br>cadmium<br>112    | 49<br>In<br>indium<br>115   | 50<br>Sn<br>tin<br>119      | 51<br>Sb<br>antimony<br>122 | 52<br>Te<br>tellurium<br>128  | 53<br>I<br>iodine<br>127     | 54<br>Xe<br>xenon<br>131  |
| 55<br>Cs<br>caesium<br>133 | 56<br>Ba<br>barium<br>137   | 57–71<br>lanthanoids                                           | 72<br>Hf<br>hafnium<br>178      | 73<br>Ta<br>tantalum<br>181 | 74<br>W<br>tungsten<br>184   | 75<br>Re<br>rhenium<br>186  | 76<br>Os<br>osmium<br>190    | 77<br>Ir<br>iridium<br>192   | 78<br>Pt<br>platinum<br>195    | 79<br>Au<br>gold<br>197       | 80<br>Hg<br>mercury<br>201    | 81<br>Tl<br>thallium<br>204 | 82<br>Pb<br>lead<br>207     | 83<br>Bi<br>bismuth<br>209  | 84<br>Po<br>polonium<br>—     | 85<br>At<br>astatine<br>—    | 86<br>Rn<br>radon<br>—    |
| 87<br>Fr<br>francium<br>—  | 88<br>Ra<br>radium<br>—     | 89–103<br>actinoids                                            | 104<br>Rf<br>rutherfordium<br>— | 105<br>Db<br>dubnium<br>—   | 106<br>Sg<br>seaborgium<br>— | 107<br>Bh<br>bohrium<br>—   | 108<br>Hs<br>hassium<br>—    | 109<br>Mt<br>meitnerium<br>— | 110<br>Ds<br>darmstadtium<br>— | 111<br>Rg<br>roentgenium<br>— | 112<br>Cn<br>copernicium<br>— |                             | 114<br>Fl<br>flerovium<br>— |                             | 116<br>Lv<br>livermorium<br>— |                              |                           |

lanthanoids

actinoids

|                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| 57<br>La<br>lanthanum<br>139 | 58<br>Ce<br>cerium<br>140  | 59<br>Pr<br>praseodymium<br>141 | 60<br>Nd<br>neodymium<br>144 | 61<br>Pm<br>promethium<br>— | 62<br>Sm<br>samarium<br>150 | 63<br>Eu<br>europium<br>152 | 64<br>Gd<br>gadolinium<br>157 | 65<br>Tb<br>terbium<br>159 | 66<br>Dy<br>dysprosium<br>163 | 67<br>Ho<br>holmium<br>165   | 68<br>Er<br>erbium<br>167 | 69<br>Tm<br>thulium<br>169    | 70<br>Yb<br>ytterbium<br>173 | 71<br>Lu<br>lutetium<br>175  |
| 89<br>Ac<br>actinium<br>—    | 90<br>Th<br>thorium<br>232 | 91<br>Pa<br>protactinium<br>231 | 92<br>U<br>uranium<br>238    | 93<br>Np<br>neptunium<br>—  | 94<br>Pu<br>plutonium<br>—  | 95<br>Am<br>americium<br>—  | 96<br>Cm<br>curium<br>—       | 97<br>Bk<br>berkelium<br>— | 98<br>Cf<br>californium<br>—  | 99<br>Es<br>einsteinium<br>— | 100<br>Fm<br>fermium<br>— | 101<br>Md<br>mendelevium<br>— | 102<br>No<br>nobelium<br>—   | 103<br>Lr<br>lawrencium<br>— |

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