



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

**CHEMISTRY**

**0620/23**

Paper 2 Multiple Choice (Extended)

**May/June 2017**

**45 minutes**

Additional Materials:      Multiple Choice Answer Sheet  
   Soft clean eraser  
   Soft pencil (type B or HB is recommended)

\* 0 9 7 1 5 8 7 2 5 0 \*

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.  
Do not use staples, paper clips, glue or correction fluid.  
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.  
**DO NOT WRITE IN ANY BARCODES.**

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 separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

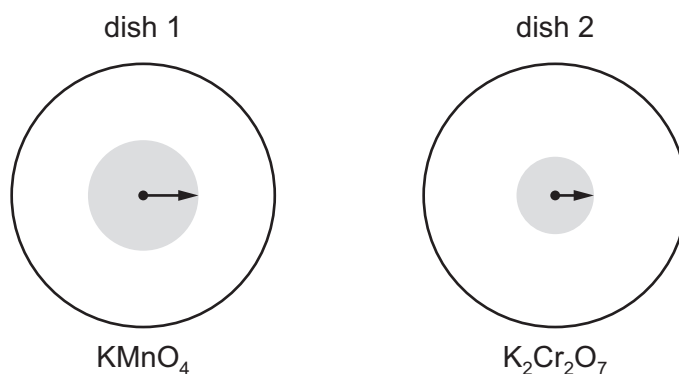
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.  
Any rough working should be done in this booklet.  
A copy of the Periodic Table is printed on page 16.  
Electronic calculators may be used.

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 **15** printed pages and **1** blank page.

- 1 Small crystals of purple  $\text{KMnO}_4$  ( $M_r = 158$ ) and orange  $\text{K}_2\text{Cr}_2\text{O}_7$  ( $M_r = 294$ ) were placed at the centres of separate petri dishes filled with agar jelly. They were left to stand under the same physical conditions.

After some time, the colour of each substance had spread out as shown.



The lengths of the arrows indicate the relative distances travelled by particles of each substance.

Which statement is correct?

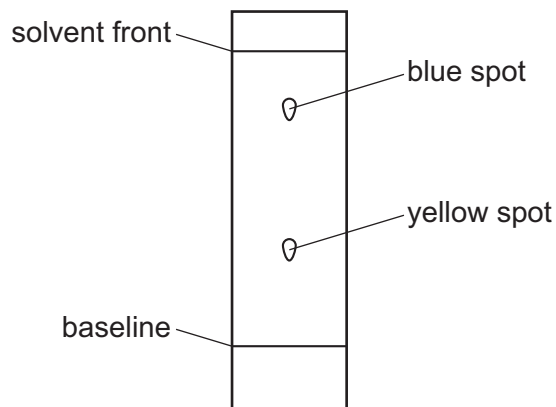
- A Diffusion is faster in dish 1 because the mass of the particles is greater.
  - B Diffusion is faster in dish 2 because the mass of the particles is greater.
  - C Diffusion is slower in dish 1 because the mass of the particles is smaller.
  - D Diffusion is slower in dish 2 because the mass of the particles is greater.
- 2 A compound, X, has a melting point of  $71^\circ\text{C}$  and a boiling point of  $375^\circ\text{C}$ .

Which statement about X is correct?

- A It is a liquid at  $52^\circ\text{C}$  and a gas at  $175^\circ\text{C}$ .
- B It is a liquid at  $69^\circ\text{C}$  and a gas at  $380^\circ\text{C}$ .
- C It is a liquid at  $75^\circ\text{C}$  and a gas at  $350^\circ\text{C}$ .
- D It is a liquid at  $80^\circ\text{C}$  and a gas at  $400^\circ\text{C}$ .

- 3 A student used chromatography to analyse a green food colouring.

The chromatogram obtained is shown.

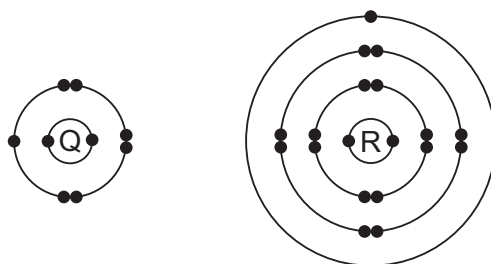


The table lists some yellow food dyes and their  $R_f$  values.

Which yellow food dye does the green food colouring contain?

|          | yellow food dye  | $R_f$ value |
|----------|------------------|-------------|
| <b>A</b> | Quinolene Yellow | 0.48        |
| <b>B</b> | Sunset Yellow    | 0.32        |
| <b>C</b> | tartrazine       | 0.69        |
| <b>D</b> | Yellow 2G        | 0.82        |

- 4 The electronic structures of atoms Q and R are shown.



Q and R form an ionic compound.

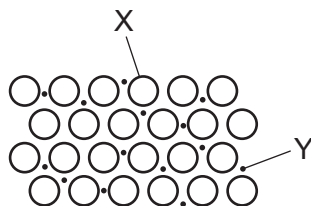
What is the formula of the compound?

- A**  $QR_7$       **B**  $Q_2R_4$       **C**  $QR$       **D**  $Q_7R$

5 Which substance is a macromolecule?

- A ammonia
- B carbon dioxide
- C diamond
- D water

6 The diagram shows metallic bonding.



Which labels are correct?

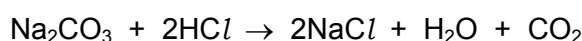
|          | X              | Y               |
|----------|----------------|-----------------|
| <b>A</b> | atomic nucleus | outer electron  |
| <b>B</b> | metal atom     | mobile electron |
| <b>C</b> | metal ion      | mobile electron |
| <b>D</b> | positive ion   | negative ion    |

7 Aqueous iron(III) sulfate and aqueous sodium hydroxide react to give a precipitate of iron(III) hydroxide and a solution of sodium sulfate.

What is the balanced equation for this reaction?

- A  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) + \text{Na}_2\text{SO}_4(\text{aq})$
- B  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 3\text{NaOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$
- C  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 2\text{Fe}(\text{OH})_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$
- D  $2\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 4\text{Fe}(\text{OH})_3(\text{s}) + 6\text{Na}_2\text{SO}_4(\text{aq})$

8 The equation for the reaction between sodium carbonate and dilute hydrochloric acid is shown.



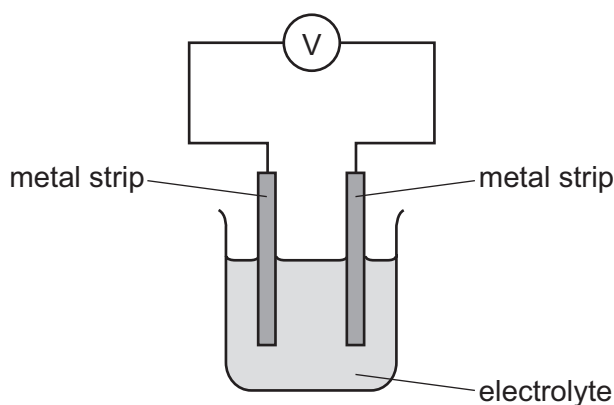
What is the maximum volume of carbon dioxide produced when 26.5 g of sodium carbonate react with dilute hydrochloric acid?

- A  $6 \text{ dm}^3$
- B  $12 \text{ dm}^3$
- C  $18 \text{ dm}^3$
- D  $24 \text{ dm}^3$

- 9 Which statement about electrolysis is correct?
- A** Electrons move through the electrolyte from the cathode to the anode.  
**B** Electrons move towards the cathode in the external circuit.  
**C** Negative ions move towards the anode in the external circuit.  
**D** Positive ions move through the electrolyte towards the anode during electrolysis.
- 10 The reactivity series for a number of different metals is shown.

|               |      |      |        |        |                |
|---------------|------|------|--------|--------|----------------|
| most reactive | →    |      |        |        | least reactive |
| magnesium     | zinc | iron | copper | silver | platinum       |

The diagram shows different metal strips dipped into an electrolyte.



Which pair of metals produces the highest voltage?

- A** copper and magnesium  
**B** magnesium and platinum  
**C** magnesium and zinc  
**D** silver and platinum
- 11 Heat energy is produced when hydrocarbons burn in air.
- Which equations represent this statement?
- 1  $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$   
 2  $\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$   
 3  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- A** 1, 2 and 3    **B** 1 and 2 only    **C** 1 and 3 only    **D** 2 and 3 only

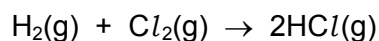
12 Which statements about exothermic and endothermic reactions are correct?

- 1 During an exothermic reaction, heat is given out.
- 2 The temperature of an endothermic reaction goes up because heat is taken in.
- 3 Burning methane in the air is an exothermic reaction.

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

13 Hydrogen and chlorine react to form hydrogen chloride.

The reaction is exothermic.



The overall energy change for this reaction is  $-184 \text{ kJ/mol}$ .

The table gives some of the bond energies involved.

| bond | bond energy in kJ/mol |
|------|-----------------------|
| H-Cl | +430                  |
| H-H  | +436                  |

What is the energy of the Cl-Cl bond?

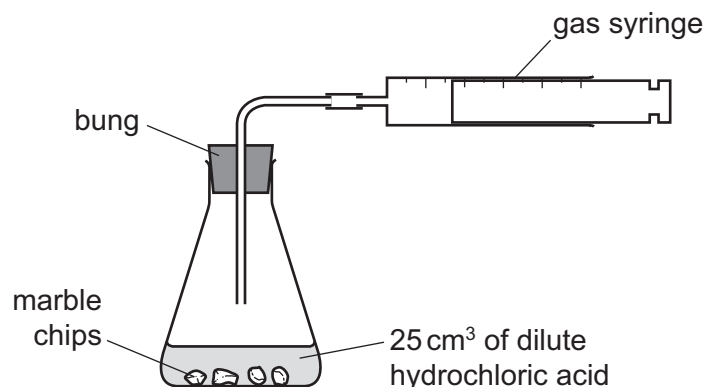
- A**  $-240 \text{ kJ/mol}$   
**B**  $-190 \text{ kJ/mol}$   
**C**  $+190 \text{ kJ/mol}$   
**D**  $+240 \text{ kJ/mol}$

14 Which changes are physical changes?

- 1 melting ice to form water
- 2 burning hydrogen to form water
- 3 adding sodium to water
- 4 boiling water to form steam

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

15 A student was investigating the reaction between marble chips and dilute hydrochloric acid.

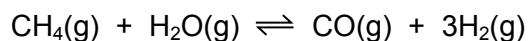


Which changes slow down the rate of reaction?

|          | temperature of acid | concentration of acid | surface area of marble chips |
|----------|---------------------|-----------------------|------------------------------|
| <b>A</b> | decrease            | decrease              | decrease                     |
| <b>B</b> | decrease            | decrease              | increase                     |
| <b>C</b> | increase            | decrease              | decrease                     |
| <b>D</b> | increase            | increase              | increase                     |

16 Hydrogen is produced when methane reacts with steam.

The equation for the reaction is shown.

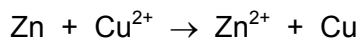


The forward reaction is endothermic.

Which conditions produce the highest yield of hydrogen?

|          | pressure | temperature |
|----------|----------|-------------|
| <b>A</b> | high     | high        |
| <b>B</b> | high     | low         |
| <b>C</b> | low      | high        |
| <b>D</b> | low      | low         |

17 An example of a redox reaction is shown.



Which statement about the reaction is correct?

- A Zn is the oxidising agent and it oxidises  $\text{Cu}^{2+}$ .
- B Zn is the oxidising agent and it reduces  $\text{Cu}^{2+}$ .
- C Zn is the reducing agent and it oxidises  $\text{Cu}^{2+}$ .
- D Zn is the reducing agent and it reduces  $\text{Cu}^{2+}$ .

18 Which oxide is amphoteric?

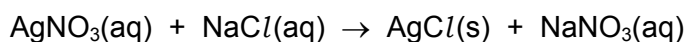
- A  $\text{Al}_2\text{O}_3$       B CaO      C  $\text{Na}_2\text{O}$       D  $\text{SO}_2$

19 Chloric(I) acid,  $\text{HClO}$ , is formed when chlorine dissolves in water. It is a weak acid.

What is meant by the term *weak acid*?

- A It contains fewer hydrogen atoms than a strong acid.
- B It is easily neutralised by a strong alkali.
- C It is less concentrated than a strong acid.
- D It is only partially ionised in solution.

20 Silver nitrate reacts with sodium chloride to produce silver chloride and sodium nitrate. The equation for the reaction is shown.



How is silver chloride separated from the reaction mixture?

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



- 21 Aqueous sodium hydroxide reacts with an aqueous solution of compound Y to give a green precipitate.

Aqueous ammonia also reacts with an aqueous solution of compound Y to give a green precipitate.

In each case the precipitate is insoluble when an excess of reagent is added.

Which ion is present in Y?

- A chromium(III)
  - B copper(II)
  - C iron(II)
  - D iron(III)
- 22 Which element is less reactive than the other members of its group in the Periodic Table?
- A astatine
  - B caesium
  - C fluorine
  - D rubidium
- 23 Ununseptium (atomic number 117) is a man-made element that is below astatine in Group VII of the Periodic Table.
- What is the expected state of ununseptium at room temperature?
- A a diatomic gas
  - B a liquid
  - C a monatomic gas
  - D a solid
- 24 Why are weather balloons sometimes filled with helium rather than hydrogen?
- A Helium is found in air.
  - B Helium is less dense than hydrogen.
  - C Helium is more dense than hydrogen.
  - D Helium is unreactive.

25 Which equation from the zinc extraction process shows the metal being produced by reduction?

- A  $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$
- B  $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$
- C  $\text{Zn(g)} \rightarrow \text{Zn(l)}$
- D  $\text{Zn(l)} \rightarrow \text{Zn(s)}$

26 Element E:

- forms an alloy
- has a basic oxide
- is below hydrogen in the reactivity series.

What is E?

- A carbon
- B copper
- C sulfur
- D zinc

27 The section of the reactivity series shown includes a newly discovered element, symbol X.

The only oxide of X has the formula XO.

Ca  
Mg  
Fe  
X  
H  
Cu

Which equation shows a reaction which occurs?

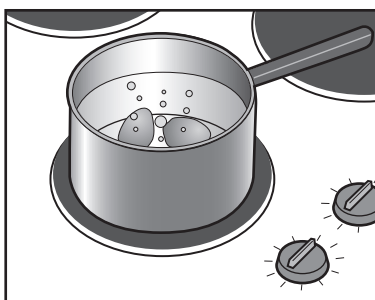
- A  $\text{Cu(s)} + \text{X}^{2+}(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{X(s)}$
- B  $2\text{X(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow 2\text{X}^+(\text{aq}) + \text{Cu(s)}$
- C  $\text{X(s)} + \text{Fe}_2\text{O}_3(\text{s}) \rightarrow 2\text{Fe(s)} + 3\text{XO(s)}$
- D  $\text{X(s)} + 2\text{HCl(aq)} \rightarrow \text{XCl}_2(\text{aq}) + \text{H}_2(\text{g})$

- 28 Stainless steel is an alloy of iron and other metals. It is strong and does not rust but it costs much more than normal steel.

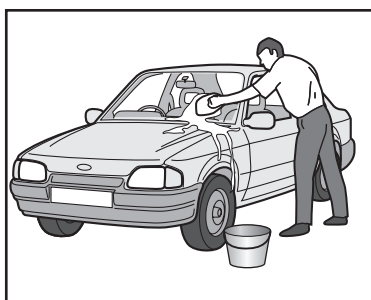
What is **not** made from stainless steel?

- A cutlery
- B pipes in a chemical factory
- C railway lines
- D saucepans

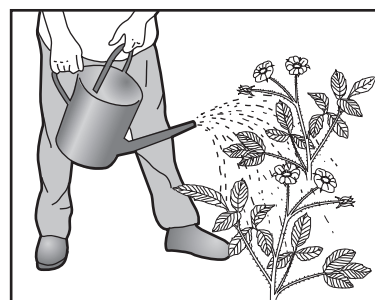
- 29 The diagram shows some uses of water in the home.



1



2



3

For which uses is it important for the water to have been treated?

- A 1 only
  - B 2 only
  - C 3 only
  - D 1, 2 and 3
- 30 The carbon cycle describes how carbon dioxide gas is added to or removed from the atmosphere.

Which row describes the movement of carbon dioxide during each process?

|   | photosynthesis              | combustion                  | respiration                 |
|---|-----------------------------|-----------------------------|-----------------------------|
| A | added to the atmosphere     | added to the atmosphere     | removed from the atmosphere |
| B | added to the atmosphere     | removed from the atmosphere | added to the atmosphere     |
| C | removed from the atmosphere | added to the atmosphere     | added to the atmosphere     |
| D | removed from the atmosphere | added to the atmosphere     | removed from the atmosphere |

31 Which row gives the catalyst for the Haber process and the sources of the raw materials?

|          | catalyst           | source of hydrogen | source of nitrogen |
|----------|--------------------|--------------------|--------------------|
| <b>A</b> | iron               | electrolysis       | fertiliser         |
| <b>B</b> | iron               | methane            | air                |
| <b>C</b> | vanadium pentoxide | methane            | air                |
| <b>D</b> | vanadium pentoxide | methane            | fertiliser         |

32 Petrol burns in a car engine to produce waste gases which leave through the car exhaust.

One of these waste gases is an oxide of nitrogen.

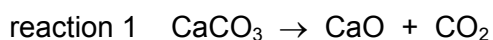
Which statement describes how this oxide of nitrogen is formed?

- A** Carbon dioxide reacts with nitrogen in the catalytic converter.
- B** Nitrogen reacts with oxygen in the car engine.
- C** Nitrogen reacts with oxygen in the catalytic converter.
- D** Petrol combines with nitrogen in the car engine.

33 Which statement about sulfuric acid is correct?

- A** It is made by the Haber process.
- B** It is made in the atmosphere by the action of lightning.
- C** It reacts with ammonia to produce a fertiliser.
- D** It reacts with copper metal to produce hydrogen gas.

34 Two equations are shown.



Which terms describe reactions 1 and 2?

|          | reaction 1            | reaction 2 |
|----------|-----------------------|------------|
| <b>A</b> | reduction             | hydration  |
| <b>B</b> | reduction             | hydrolysis |
| <b>C</b> | thermal decomposition | hydration  |
| <b>D</b> | thermal decomposition | hydrolysis |

- 35 Fuel oil, gasoline, kerosene and naphtha are four fractions obtained from the fractional distillation of petroleum.

What is the order of the boiling points of these fractions?

|          | highest boiling point → lowest boiling point |
|----------|--|
| <b>A</b> | fuel oil → kerosene → gasoline → naphtha     |
| <b>B</b> | fuel oil → kerosene → naphtha → gasoline     |
| <b>C</b> | gasoline → naphtha → kerosene → fuel oil     |
| <b>D</b> | naphtha → gasoline → kerosene → fuel oil     |

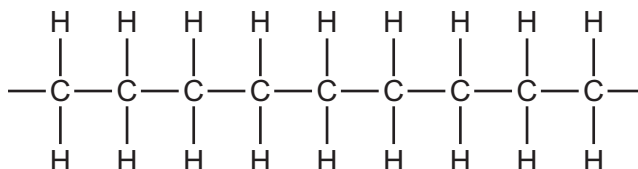
- 36 Butane and methylpropane are isomers with molecular formula  $C_4H_{10}$ .

Which statements are correct?

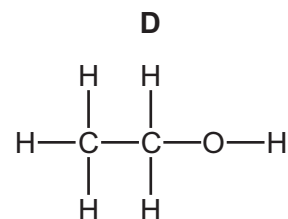
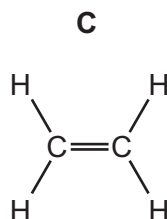
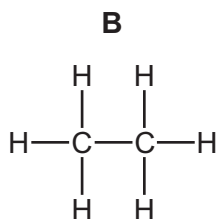
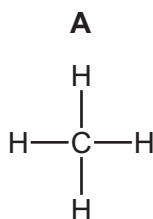
- They have similar chemical properties.
- They have the same general formula.
- They have the same structural formula.

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

- 37 The diagram shows part of the molecule of a polymer.



Which diagram shows the monomer from which this polymer could be manufactured?

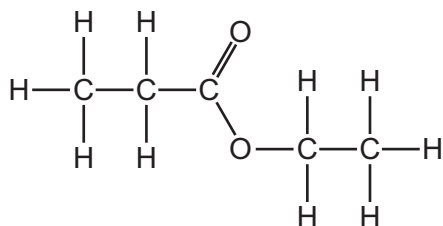


38 Ethanol can be produced by fermentation or by the catalytic addition of steam to ethene.

Which row shows an advantage and a disadvantage for each process?

|          | fermentation           |                       | catalytic addition of steam to ethene |                        |
|----------|------------------------|-----------------------|---------------------------------------|------------------------|
|          | advantage              | disadvantage          | advantage                             | disadvantage           |
| <b>A</b> | batch process          | slow reaction         | continuous process                    | fast reaction          |
| <b>B</b> | fast reaction          | continuous process    | pure ethanol formed                   | renewable raw material |
| <b>C</b> | renewable raw material | batch process         | pure ethanol formed                   | slow reaction          |
| <b>D</b> | renewable raw material | impure ethanol formed | fast reaction                         | finite raw material    |

39 The structure of an ester is shown.



Which alcohol and carboxylic acid produce this ester?

|          | alcohol  | carboxylic acid |
|----------|----------|-----------------|
| <b>A</b> | ethanol  | ethanoic acid   |
| <b>B</b> | ethanol  | propanoic acid  |
| <b>C</b> | propanol | ethanoic acid   |
| <b>D</b> | propanol | propanoic acid  |

40 How can the amino acids in a protein be separated and identified?

- A** Add a locating agent to the protein.
- B** Hydrolyse the protein and then use chromatography.
- C** Polymerise the protein and then add a locating agent.
- D** Use chromatography on a solution of the protein.

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The Periodic Table of Elements

|                            |                             | Group  |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                               |                             |                              |                           |                              |
|----------------------------|-----------------------------|--|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|------------------------------|---------------------------|------------------------------|
| I                          | II                          |  |                                 |                             |                              |                             |                              |                              |                                |                               |                               | III                         | IV                            | V                           | VI                           | VII                       | VIII                         |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   | <p align="center"><b>Key</b></p> <p align="center">atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</p> |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 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 |  |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 1<br>H<br>hydrogen<br>1     | 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 |
| 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 | 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  |
| actinoids   | 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.).