



# Cambridge IGCSE™

## COMBINED SCIENCE

0653/21

Paper 2 Multiple Choice (Extended)

October/November 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 What are characteristics of all living organisms?

- A breathing, excretion, nutrition
- B excretion, growth, nutrition
- C reproduction, respiration, germination
- D secretion, growth, sensitivity

2 Which row describes a correct structural adaptation for red blood cells and for cells lining the trachea?

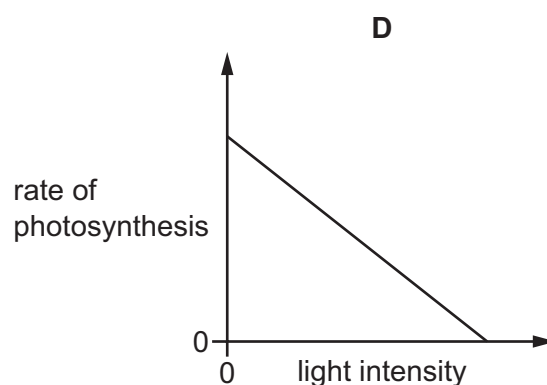
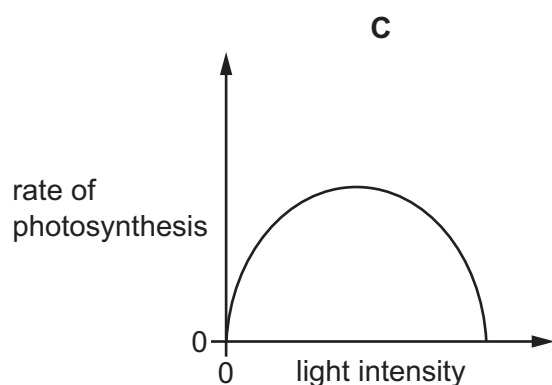
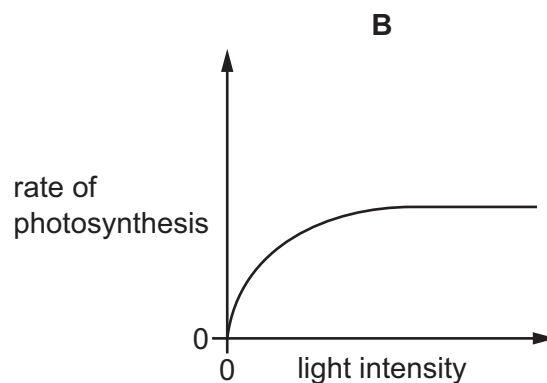
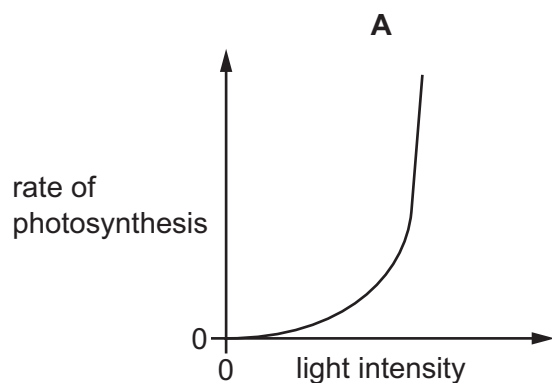
|   | red blood cells | cells lining the trachea |
|---|-----------------|--------------------------|
| A | nucleus absent  | cilia present            |
| B | nucleus present | cilia present            |
| C | nucleus absent  | small surface area       |
| D | nucleus present | small surface area       |

3 A student tests samples of four different foods.

Which row is the correct result for a sample containing only fat and starch?

|   | Benedict's solution | biuret test | ethanol emulsion | iodine solution |
|---|---------------------|-------------|------------------|-----------------|
| A | blue                | purple      | clear            | blue-black      |
| B | blue                | blue        | cloudy           | blue-black      |
| C | red                 | purple      | clear            | brown           |
| D | red                 | blue        | cloudy           | brown           |

- 4 Which graph correctly shows the effect of varying light intensity on the rate of photosynthesis?



- 5 Which row correctly matches the type of digestion to its effect on the food particles?

|          | type of digestion | makes smaller | makes soluble |
|----------|-------------------|---------------|---------------|
| <b>A</b> | chemical          | no            | yes           |
| <b>B</b> | chemical          | yes           | yes           |
| <b>C</b> | mechanical        | no            | no            |
| <b>D</b> | mechanical        | yes           | yes           |

- 6 A student investigates factors affecting the rate of transpiration in a plant.

Which row shows the correct effects on the rates of transpiration?

|          | increase temperature | decrease humidity |
|----------|----------------------|-------------------|
| <b>A</b> | decreases            | decreases         |
| <b>B</b> | decreases            | increases         |
| <b>C</b> | increases            | decreases         |
| <b>D</b> | increases            | increases         |

- 7 Which structures in the circulatory system ensure the one-way flow of blood?

- A** arteries
- B** atria
- C** valves
- D** ventricles

- 8 When at rest, a student measures his rate of breathing and the volume of air inspired.

| number of breaths<br>per minute | volume of air inspired<br>per minute<br>/dm <sup>3</sup> |
|---------------------------------|----------------------------------------------------------|
| 12                              | 6.0                                                      |

He then runs 400 m and immediately measures his breathing again.

Which set of results does he obtain?

|          | number of breaths<br>per minute | volume of air inspired<br>per minute<br>/dm <sup>3</sup> |
|----------|---------------------------------|----------------------------------------------------------|
| <b>A</b> | 12                              | 6.0                                                      |
| <b>B</b> | 12                              | 12.5                                                     |
| <b>C</b> | 30                              | 6.0                                                      |
| <b>D</b> | 30                              | 12.5                                                     |

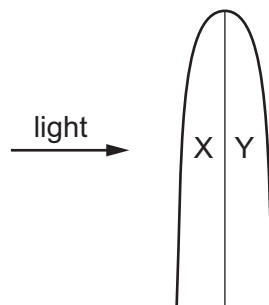
9 What is the word equation for aerobic respiration?

- A carbon dioxide + chlorophyll → glucose + oxygen
- B carbon dioxide + glucose → oxygen + water
- C glucose + oxygen → carbon dioxide + water
- D oxygen + light energy → carbon dioxide + water

10 Which row shows the correct changes when the hormone adrenaline is secreted?

|   | blood glucose | breathing rate | pulse rate |
|---|---------------|----------------|------------|
| A | decreases     | decreases      | decreases  |
| B | increases     | decreases      | increases  |
| C | decreases     | increases      | decreases  |
| D | increases     | increases      | increases  |

11 Light shines on a shoot tip from the direction shown.



After three days, the shoot tip has bent towards the light.

What is the reason for this change?

- A Auxin moves away from the light causing cell elongation in area Y.
- B Auxin moves away from the light preventing cell elongation in area Y.
- C Auxin moves towards the light causing cell elongation in area X.
- D Auxin moves towards the light preventing cell elongation in area X.

12 Which environmental conditions are necessary for seeds to germinate?

|          | oxygen | suitable temperature | sunlight | water |
|----------|--------|----------------------|----------|-------|
| <b>A</b> | yes    | yes                  | yes      | no    |
| <b>B</b> | yes    | yes                  | no       | yes   |
| <b>C</b> | no     | no                   | yes      | yes   |
| <b>D</b> | no     | yes                  | no       | yes   |

13 What is the function of amniotic fluid?

- A** to cushion the fetus
- B** to remove carbon dioxide
- C** to supply nutrients
- D** to supply oxygen

14 Which particles are present in the nuclei of hydrogen atoms,  ${}^1_1\text{H}$ ?

- A** electrons and neutrons
- B** electrons only
- C** protons and neutrons
- D** protons only

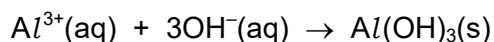
15 Which statement explains the difference in boiling point between ionic and covalent compounds?

- A** The boiling point of covalent compounds is higher because covalent bonds are stronger than ionic bonds.
- B** The boiling point of covalent compounds is higher because the attractive forces between covalent molecules are stronger than the attractive forces between ions.
- C** The boiling point of ionic compounds is higher because the attractive forces between ions are stronger than covalent bonds.
- D** The boiling point of ionic compounds is higher because the attractive forces between ions are stronger than the attractive forces between covalent molecules.

- 16** Aqueous sodium hydroxide is added to aqueous aluminium sulfate.

A white precipitate of aluminium hydroxide is formed.

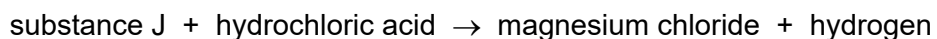
The ionic equation for this reaction is shown.



What is the full symbol equation for this reaction?

- A**  $\text{AlSO}_4(\text{aq}) + 3\text{NaOH}(\text{aq}) \rightarrow \text{Al}(\text{OH})_3(\text{s}) + \text{Na}_3\text{SO}_4(\text{aq})$
- B**  $\text{Al}_2(\text{SO}_4)_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{Al}(\text{OH})_3(\text{s}) + \text{Na}_2\text{SO}_4(\text{aq})$
- C**  $\text{Al}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 2\text{Al}(\text{OH})_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$
- D**  $\text{Al}_3(\text{SO}_4)_2(\text{aq}) + 9\text{NaOH}(\text{aq}) \rightarrow 3\text{Al}(\text{OH})_3(\text{s}) + 2\text{Na}_2\text{SO}_4(\text{aq})$
- 17** Concentrated aqueous sodium chloride is electrolysed using inert electrodes.
- Which statement is correct?
- A** Chloride ions lose electrons at the cathode.
- B** Hydrogen ions gain electrons at the cathode.
- C** Oxide ions gain electrons at the anode.
- D** Sodium ions gain electrons at the cathode.
- 18** Which statements explain why the rate of a reaction increases when the temperature is increased?
- 1 More of the colliding molecules have enough energy to react.
  - 2 The molecules are closer together, so they collide more frequently.
  - 3 The molecules are further apart, so they collide less frequently.
  - 4 The molecules are moving faster, so they collide more frequently.
- A** 1 and 2      **B** 1 and 4      **C** 2 and 3      **D** 3 and 4

- 19 The word equation represents the reaction between substance J and hydrochloric acid.



What is substance J?

- A magnesium
  - B magnesium carbonate
  - C magnesium hydroxide
  - D magnesium oxide
- 20 Which pair of gases can be identified using damp litmus paper and limewater?
- A carbon dioxide and hydrogen
  - B chlorine and carbon dioxide
  - C chlorine and oxygen
  - D hydrogen and chlorine

- 21 Aqueous potassium halides are mixed with aqueous halogens as listed.

- 1 potassium bromide + iodine
- 2 potassium chloride + bromine
- 3 potassium iodide + chlorine
- 4 potassium iodide + bromine

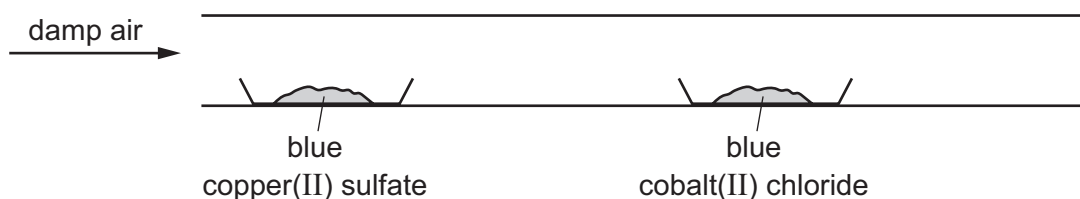
Which mixtures produce a chemical reaction?

- A 1 and 2      B 1 and 4      C 2 and 3      D 3 and 4
- 22 Which properties are shown by transition elements?
- 1 They form coloured compounds.
  - 2 They have low melting points.
  - 3 They have low densities.
  - 4 They can act as catalysts.
- A 1 and 2      B 1 and 4      C 2 and 3      D 3 and 4

23 Which statement about reactions in the blast furnace is **not** correct?

- A Carbon is oxidised by oxygen.
- B Carbon is oxidised by carbon dioxide.
- C Carbon dioxide is reduced by iron oxide.
- D Iron oxide is reduced by carbon monoxide.

24 Damp air is passed through a tube containing blue copper(II) sulfate and blue cobalt(II) chloride.



What is observed?

|          | copper(II) sulfate | cobalt(II) chloride |
|----------|--------------------|---------------------|
| <b>A</b> | turns white        | turns pink          |
| <b>B</b> | turns white        | no change           |
| <b>C</b> | no change          | turns pink          |
| <b>D</b> | no change          | no change           |

25 Naphtha and diesel oil are two fractions obtained from the fractional distillation of petroleum.

Which statement about naphtha and diesel oil is correct?

- A Molecules in naphtha are smaller than molecules in diesel oil.
- B Naphtha has a higher boiling point range than diesel oil.
- C Naphtha is less volatile than diesel oil.
- D Naphtha is removed from the fractionating column at a lower level than diesel oil.

26 The formula of the hydrocarbon octane is  $C_8H_{18}$ .

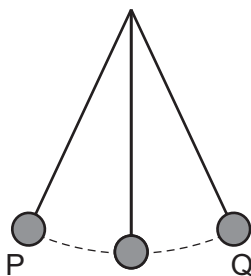
What are the products of the complete combustion of octane?

- A carbon and hydrogen
- B carbon and water
- C carbon dioxide and water
- D carbon monoxide and water

27 Which process is an example of thermal decomposition?

- A cracking an alkane
- B electrolysis of molten lead(II) bromide
- C extraction of iron in the blast furnace
- D fractional distillation of petroleum

28 A pendulum swings repeatedly from P to Q and back to P.



A stop-watch is used to find the period of the pendulum.

Which method gives the most accurate value for the period?

- A timing how long it takes to go from P to Q
- B timing how long it takes to go from P to Q to P
- C timing how long it takes to go from P to Q to P 10 times, and dividing this time by 10
- D timing how long it takes to go from P to Q to P 10 times, and multiplying this time by 10

29 When a spring is stretched by a force of 20 N, its length increases from 3.2 cm to 5.4 cm.

What is the spring constant of the spring?

- A 0.11 N/cm      B 0.27 N/cm      C 3.7 N/cm      D 9.1 N/cm

- 30 The diagram shows a tank containing a liquid.



The base of the tank is rectangular and has dimensions 0.20 m by 0.50 m.

The mass of the liquid is 60 kg and its depth is 0.10 m.

Gravitational field strength  $g = 10 \text{ N/kg}$ .

What is the pressure exerted on the base of the tank by the liquid?

- A** 60 Pa                      **B** 600 Pa                      **C** 6000 Pa                      **D** 60 000 Pa

- 31 A piece of scientific equipment is taken from the Earth to a distant planet.

Which row describes the properties of the equipment on the distant planet?

|          | mass | weight |
|----------|------|--------|
| <b>A</b> | ✓    | ✓      |
| <b>B</b> | ✓    | ✗      |
| <b>C</b> | ✗    | ✓      |
| <b>D</b> | ✗    | ✗      |

key

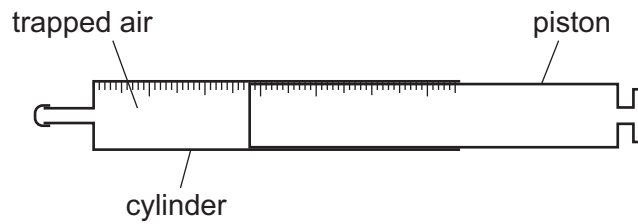
✓ = the same as on Earth

✗ = different on each planet

- 32 For which energy resource is energy stored as gravitational potential energy?

- A** geothermal energy  
**B** hydroelectric energy  
**C** nuclear fission  
**D** wind energy

- 33** Air is trapped in a cylinder by a piston. The piston is moved so that the volume of the trapped air decreases. The pressure of the trapped air increases but the temperature of the trapped air does not change.



What happens to the average speed of the air particles and what happens to the average distance between them?

|          | average speed of particles | average distance between particles |
|----------|----------------------------|------------------------------------|
| <b>A</b> | does not change            | decreases                          |
| <b>B</b> | does not change            | increases                          |
| <b>C</b> | increases                  | decreases                          |
| <b>D</b> | increases                  | increases                          |

- 34** In which states of matter is thermal energy transferred because of changes in the density of the medium?

- A** solids and liquids only
- B** liquids and gases only
- C** gases and solids only
- D** solids, liquids and gases

- 35** Light takes 500 s to travel from the Sun to the Earth.

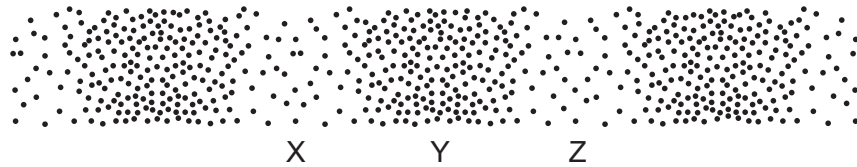
What is the distance from the Sun to the Earth?

- A**  $1.7 \times 10^5 \text{ m}$
- B**  $6.0 \times 10^5 \text{ m}$
- C**  $3.0 \times 10^8 \text{ m}$
- D**  $1.5 \times 10^{11} \text{ m}$

36 A sound wave passes through air.

The diagram shows the arrangement of the air particles at one moment.

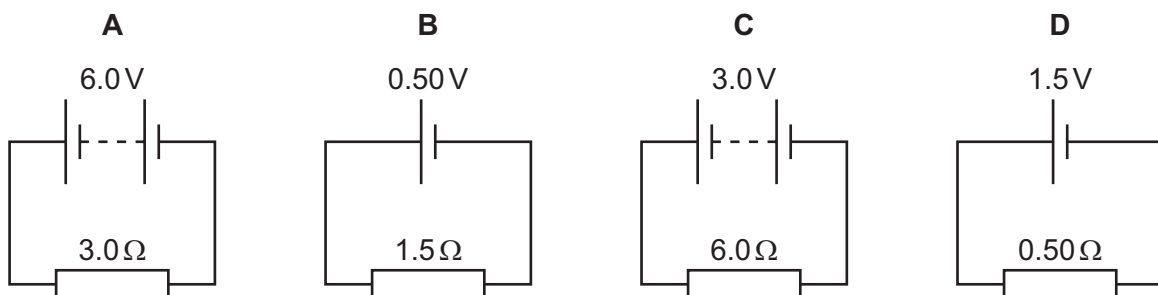
Three regions are labelled X, Y and Z.



In which region is there a rarefaction and which distance is equal to the wavelength of the sound wave?

|          | rarefaction | wavelength |
|----------|-------------|------------|
| <b>A</b> | X           | XY         |
| <b>B</b> | X           | XZ         |
| <b>C</b> | Y           | XY         |
| <b>D</b> | Y           | XZ         |

37 In which circuit is there a current of 2.0 A?



38 The resistance of a wire depends on its length and on its diameter.

Which row shows two changes that **both** increase the resistance of the wire?

|          | change to length | change to diameter |
|----------|------------------|--------------------|
| <b>A</b> | decrease         | decrease           |
| <b>B</b> | decrease         | increase           |
| <b>C</b> | increase         | decrease           |
| <b>D</b> | increase         | increase           |

- 39** A 20 V power supply provides a current of 5.0 A for 1.0 minute.

How much energy does the power supply transfer?

- A** 4.0 J                      **B** 100 J                      **C** 240 J                      **D** 6000 J

- 40** Why is the electricity supply to a mains circuit fitted with a fuse?

- A** to increase the current in the circuit
- B** to increase the resistance of the circuit
- C** to maintain a constant current in the circuit
- D** to prevent overheating of the cables in the circuit

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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   | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 1<br>H<br>hydrogen<br>1     |                             |                             |                               |                           |                           |  | 2<br>He<br>helium<br>4 |
|                            |                             |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                           |                           |  |                        |
|                            |                             |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                           |                           |  |                        |
| 11<br>Na<br>sodium<br>23   | 12<br>Mg<br>magnesium<br>24 | 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 dm³ at room temperature and pressure (r.t.p.).