



# Cambridge IGCSE™

## CO-ORDINATED SCIENCES

0654/22

Paper 2 Multiple Choice (Extended)

October/November 2025

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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall =  $9.8 \text{ m/s}^2$ ).

### 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 The length of an insect in a photograph is measured as 17 mm.

The actual length of the insect is 12 mm.

What is the magnification of the insect in the photograph?

- A**  $\times 0.7$                       **B**  $\times 0.8$                       **C**  $\times 1.4$                       **D**  $\times 1.5$

- 2 The mass of a potato cylinder is recorded. The potato cylinder is then placed into concentrated sucrose solution.

After 2 hours, the potato cylinder is removed from the solution and the mass recorded.

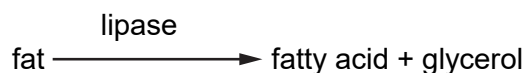
The results are shown.

| time / hours | mass / g |
|--------------|----------|
| 0            | 2.50     |
| 2            | 1.65     |

Which statement explains the change in mass of the potato?

- A** Sucrose moves out of the potato cells because the solution has a higher water potential than the cells.
- B** Sucrose moves out of the potato cells because the solution has a lower water potential than the cells.
- C** Water moves out of the potato cells because the solution has a higher water potential than the cells.
- D** Water moves out of the potato cells because the solution has a lower water potential than the cells.
- 3 Which molecule is a component of proteins?
- A**  $\text{C}_2\text{H}_5\text{NO}_2$               **B**  $\text{C}_3\text{H}_8\text{O}_3$               **C**  $\text{C}_6\text{H}_{12}\text{O}_6$               **D**  $\text{C}_{10}\text{H}_{20}\text{O}_2$

- 4 Which molecule in this reaction has an active site?

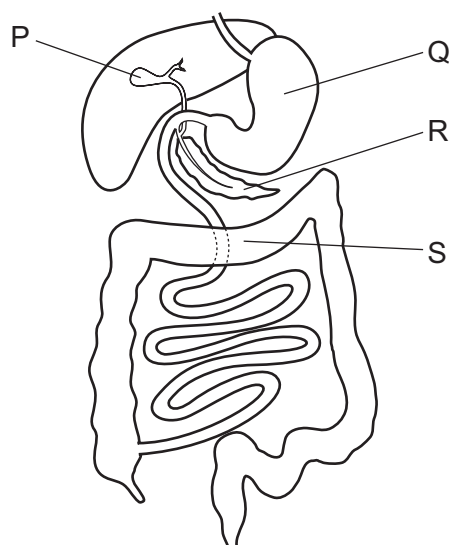


- A** fat
- B** fatty acid
- C** glycerol
- D** lipase

5 Which row shows the effect of magnesium ion deficiency on plants?

|          | leaf colour | growth |
|----------|-------------|--------|
| <b>A</b> | green       | good   |
| <b>B</b> | green       | poor   |
| <b>C</b> | yellow      | good   |
| <b>D</b> | yellow      | poor   |

6 The diagram shows part of the human digestive system.



Which organs produce digestive enzymes?

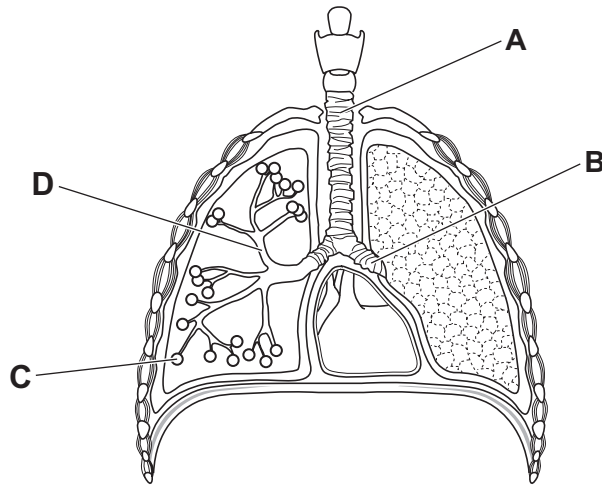
- A** P and Q      **B** Q and R      **C** R and S      **D** S and P

7 Which statement about the human circulatory system is correct?

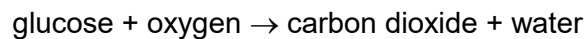
- A** Blood flows through the aorta towards the heart.  
**B** Blood flows through the pulmonary artery towards the lungs.  
**C** Blood flows through the pulmonary vein away from the heart.  
**D** Blood flows through the vena cava away from the lungs.

- 8 The diagram shows part of the breathing system in humans.

Which labelled part is the trachea?



- 9 The word equation for aerobic respiration is shown.



How many molecules of carbon dioxide will be produced from the breakdown of four molecules of glucose?

- A** 4                      **B** 8                      **C** 16                      **D** 24

- 10 Which statement about blood flow to the skin in the maintenance of a constant internal body temperature is correct?

- A** If the internal body temperature is too high then vasoconstriction of skin arterioles occurs.
- B** If the internal body temperature is too low then vasoconstriction of skin capillaries occurs.
- C** If the internal body temperature is too high then vasodilation of skin arterioles occurs.
- D** If the internal body temperature is too low then vasodilation of skin capillaries occurs.

- 11 Which statement is correct?

- A** Asexual reproduction produces offspring which can adapt quickly to changes in the environment.
- B** Asexual reproduction produces genetically different offspring much faster than sexual reproduction.
- C** Sexual reproduction produces genetically different offspring enabling natural selection to occur.
- D** Sexual reproduction produces genetically identical offspring by the production of gametes.

12 Which combination of chromosomes produces a male in humans?

- A** XO                      **B** XY                      **C** YY                      **D** XX

13 Rabbits are herbivores.

Which trophic levels can the rabbit occupy?

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

14 Which row shows the electronic configuration of a calcium atom and of a fluoride ion?

|          | calcium atom | fluoride ion |
|----------|--------------|--------------|
| <b>A</b> | 2,8,8        | 2,7          |
| <b>B</b> | 2,8,8        | 2,8          |
| <b>C</b> | 2,8,8,2      | 2,7          |
| <b>D</b> | 2,8,8,2      | 2,8          |

15 Which statement explains why isotopes of an element have the same chemical properties?

- A** They have the same atomic mass.  
**B** They have the same number of neutrons.  
**C** They have the same electronic configuration.  
**D** They have the same density.

16 Which changes take place at the electrodes during electrolysis?

|          | anode                                     | cathode                                   |
|----------|-------------------------------------------|-------------------------------------------|
| <b>A</b> | negatively charged ions<br>gain electrons | positively charged ions<br>lose electrons |
| <b>B</b> | negatively charged ions<br>lose electrons | positively charged ions<br>gain electrons |
| <b>C</b> | positively charged ions<br>gain electrons | negatively charged ions<br>lose electrons |
| <b>D</b> | positively charged ions<br>lose electrons | negatively charged ions<br>gain electrons |

17 Which row shows the dot-and-cross diagrams for nitrogen and ethene?

|          | nitrogen | ethene |
|----------|----------|--------|
| <b>A</b> |          |        |
| <b>B</b> |          |        |
| <b>C</b> |          |        |
| <b>D</b> |          |        |

18 Which particles are free to move in a giant metallic lattice?

|          | positive ions | negative ions | electrons |
|----------|---------------|---------------|-----------|
| <b>A</b> | ✓             | ✓             | ✗         |
| <b>B</b> | ✓             | ✗             | ✓         |
| <b>C</b> | ✗             | ✓             | ✗         |
| <b>D</b> | ✗             | ✗             | ✓         |

19 P is in Group II of the Periodic Table.

Q is a non-metallic element.

P reacts with Q to form an ionic compound,  $P_3Q_2$ .

What is the charge on the element Q ion in  $P_3Q_2$ ?

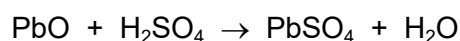
- A** 1–                      **B** 2–                      **C** 3–                      **D** 4–

20 Which statement about the Avogadro constant is correct?

- A It is the volume of 1 mole of a gas at room temperature and pressure.
- B It is the mass of 1 mole of a substance.
- C It is the number of particles in 1 mole of a substance.
- D It has a value of  $24 \text{ dm}^3$ .

21 Lead sulfate,  $\text{PbSO}_4$ , is prepared by reacting lead oxide,  $\text{PbO}$ , with excess dilute sulfuric acid.

The equation for the reaction is shown.



What is the mass of lead oxide required to produce 22.6 g of lead sulfate?

- A 15.4 g                      B 16.6 g                      C 17.6 g                      D 17.8 g

22 When magnesium reacts with dilute hydrochloric acid, the temperature of the mixture increases.

Which statement about this reaction is correct?

- A It is endothermic as thermal energy is taken in from the surroundings.
- B It is endothermic as thermal energy is transferred to the surroundings.
- C It is exothermic as thermal energy is taken in from the surroundings.
- D It is exothermic as thermal energy is transferred to the surroundings.

23 Which change to the conditions of a reaction can produce the same number of successful collisions between reacting particles per second?

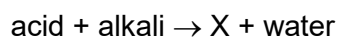
|   | temperature | reactant concentration |
|---|-------------|------------------------|
| A | higher      | lower                  |
| B | higher      | unchanged              |
| C | lower       | lower                  |
| D | lower       | unchanged              |

**24** Which statements about oxidation and reduction are correct?

- 1 Oxidation is the gain of oxygen.
- 2 Oxidation is the loss of oxygen.
- 3 Reduction is the gain of oxygen.
- 4 Reduction is the loss of oxygen.

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

**25** The word equation shown is incomplete.



What is X?

- A** base
- B** carbon dioxide
- C** hydrogen
- D** salt

**26** Which type of reaction occurs when ethene reacts with steam?

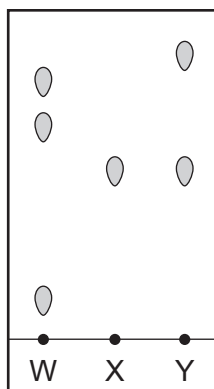
- A** addition
- B** cracking
- C** displacement
- D** polymerisation

27 The boiling points of three substances, W, X and Y, are shown.

|                    | W       | X   | Y       |
|--------------------|---------|-----|---------|
| boiling point / °C | 116–118 | 132 | 141–145 |

The substances are tested using chromatography.

The chromatogram is shown.



Which statement is correct?

- A One of the components of Y has a boiling point of 132 °C.
- B Substance Y has a smaller boiling point range than substance W.
- C Substance W produces the largest  $R_f$  value.
- D Substance X is an impure mixture.

28 An object of mass  $m$  falls through a vacuum. The speed of the object at one instant is  $v$ .

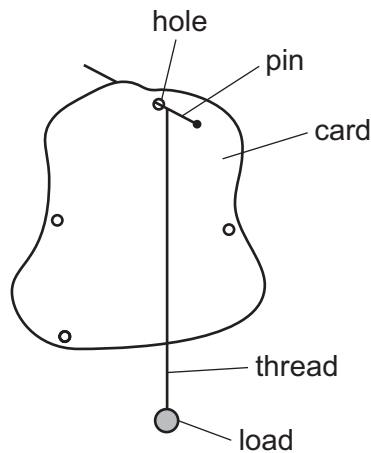
Which row shows the quantities that affect the acceleration of free fall of the object?

|   | $m$ | $v$ |
|---|-----|-----|
| A | no  | no  |
| B | no  | yes |
| C | yes | no  |
| D | yes | yes |

- 29** The diagram shows the apparatus that a student uses to determine the centre of gravity of a piece of card.

The student:

- makes several holes in the card
- suspends the card from a pin placed through one of the holes
- hangs a load from a thread attached to the pin
- marks the line of the thread on the card.



The student repeats the steps using a different hole each time.

What is the smallest number of lines that the student needs to draw to determine the position of the centre of gravity of the card?

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

- 30** A 60 W lamp is switched on and 30 J of energy is transferred by the lamp.

How long is the lamp switched on for?

- A** 0.50 s              **B** 2.0 s              **C** 90 s              **D** 1800 s

- 31** The temperature of a liquid in a beaker decreases because particles escape from the surface of the liquid.

Which row gives the name of this process and shows which particles escape from the liquid?

|          | name of process | particles that escape |
|----------|-----------------|-----------------------|
| <b>A</b> | condensation    | less energetic        |
| <b>B</b> | condensation    | more energetic        |
| <b>C</b> | evaporation     | less energetic        |
| <b>D</b> | evaporation     | more energetic        |

- 32** What is the main method of thermal energy transfer in liquid water?

- A** boiling
- B** conduction
- C** convection
- D** radiation

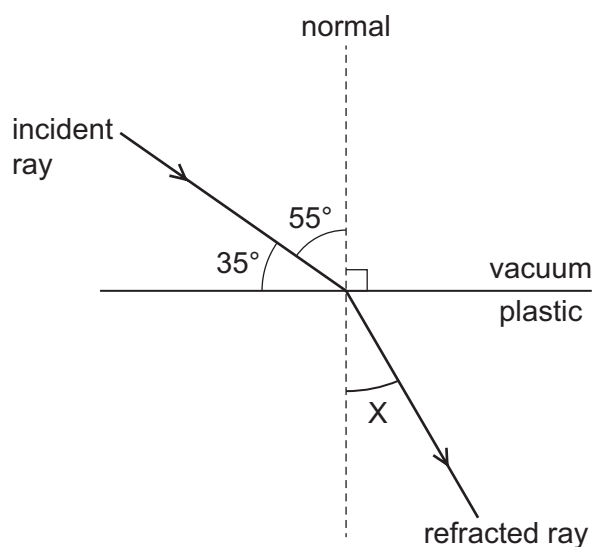
- 33** Which row contains an example of a longitudinal wave and an example of a transverse wave?

|          | longitudinal wave | transverse wave |
|----------|-------------------|-----------------|
| <b>A</b> | radio wave        | water wave      |
| <b>B</b> | sound wave        | radio wave      |
| <b>C</b> | water wave        | radio wave      |
| <b>D</b> | water wave        | sound wave      |

- 34** The diagram shows a ray of light that passes from a vacuum into plastic.

The plastic has a refractive index of 1.5.

An angle  $X$  is labelled on the diagram.



What is angle  $X$ ?

- A**  $22^\circ$       **B**  $23^\circ$       **C**  $33^\circ$       **D**  $37^\circ$
- 35** Sound travels at different speeds in water, in steel and in air.

Each row in the table gives the three speeds at room temperature.

Which row gives the correct speeds?

|          | <u>speed of sound in water</u><br>m/s | <u>speed of sound in steel</u><br>m/s | <u>speed of sound in air</u><br>m/s |
|----------|---------------------------------------|---------------------------------------|-------------------------------------|
| <b>A</b> | 300                                   | 1500                                  | 4500                                |
| <b>B</b> | 300                                   | 4500                                  | 1500                                |
| <b>C</b> | 1500                                  | 4500                                  | 300                                 |
| <b>D</b> | 4500                                  | 1500                                  | 300                                 |

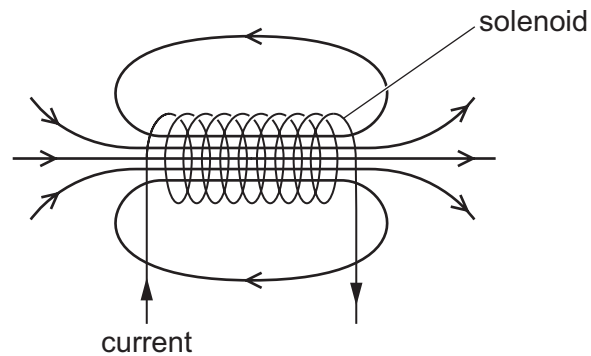
- 36 An electric heater operates at 220 V.

The current in the heater is 15 A.

Which expression gives the time for the heater to transfer  $1.0 \times 10^4$  J of energy?

- A  $\frac{1.0 \times 10^4 \times 220}{15}$  s
- B  $\frac{1.0 \times 10^4 \times 15}{220}$  s
- C  $\frac{1.0 \times 10^4}{220 \times 15}$  s
- D  $1.0 \times 10^4 \times 220 \times 15$  s

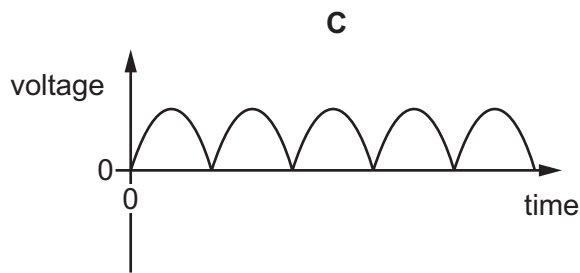
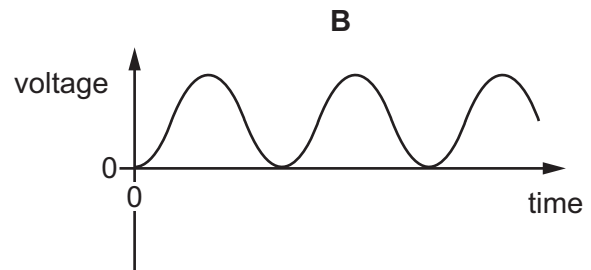
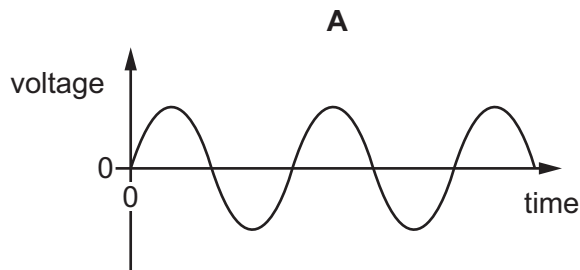
- 37 The diagram shows the magnetic field due to a current in a solenoid.



Which change reverses the direction of the magnetic field?

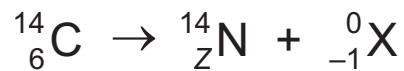
- A Change the current direction.
- B Decrease the current.
- C Increase the current.
- D Switch off the current.

- 38 Which graph shows how the output electromotive force (e.m.f.) of an a.c. generator varies with time?



- 39 A carbon-14 nucleus decays to form a nitrogen-14 nucleus and one particle X of ionising radiation.

The decay equation is shown.



Which row gives the value of Z and the identity of particle X?

|          | Z | particle X |
|----------|---|------------|
| <b>A</b> | 5 | $\beta$    |
| <b>B</b> | 7 | $\alpha$   |
| <b>C</b> | 7 | $\beta$    |
| <b>D</b> | 8 | $\alpha$   |

- 40 A moon that orbits a planet has an orbit radius of  $9.4 \times 10^6 \text{ m}$  and an orbital period of 7.7 hours.

What is the orbital speed of this moon?

- A**  $6.8 \times 10^2 \text{ m/s}$   
**B**  $2.1 \times 10^3 \text{ m/s}$   
**C**  $1.3 \times 10^5 \text{ m/s}$   
**D**  $1.6 \times 10^{12} \text{ m/s}$

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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                             |                                 |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                             |                              |                         |  |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|-----------------------------|------------------------------|-------------------------|--|
| I                          | II                          |                                                                                             |                             |                                 |                              |                              |                              |                              |                                |                               |                               | III                         | IV                          | V                           | VI                            | VII                          | VIII                        |                              |                         |  |
|                            |                             | <div>1<br/>H<br/>hydrogen<br/>1</div>                                                       |                             |                                 |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                             |                              |                         |  |
|                            |                             | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                             |                                 |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                             |                              |                         |  |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   |                                                                                             |                             |                                 |                              |                              |                              |                              |                                |                               |                               |                             |                             | 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     |                         |  |
| 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   | 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>— | 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>— | 113<br>Nh<br>nihonium<br>—  | 114<br>Fl<br>flerovium<br>— | 115<br>Mc<br>moscovium<br>— | 116<br>Lv<br>livermorium<br>— | 117<br>Ts<br>tennessine<br>— | 118<br>Og<br>oganesson<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.).