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Cambridge Assessment International Education

# Cambridge IGCSE™

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**COMBINED SCIENCE** **0653/32**

Paper 3 Theory (Core) **February/March 2025**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m / $s^2$).

**INFORMATION**

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Any blank pages are indicated.

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**1** **(a)** Fig. 1.1 shows the main organs of the digestive system.

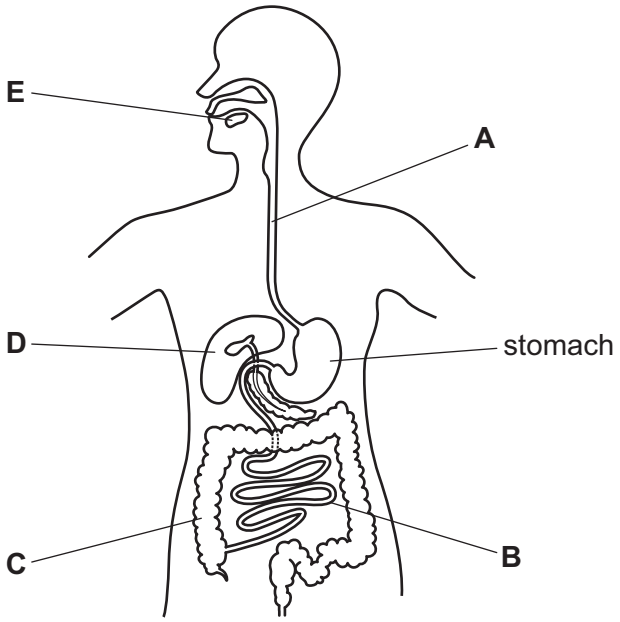



**Fig. 1.1**

State the letter on Fig. 1.1 that identifies:

the large intestine .....

the salivary gland. .....

[2]

**(b)** Proteins are digested in the stomach.

**(i)** Describe the importance of proteins as part of a balanced diet.

.....

..... [1]

**(ii)** Circle the name of the smaller molecules that proteins are made from.

**amino acids** **glucose** **fatty acids** **glycerol**

[1]

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**(c)** Fig. 1.2 shows a food web that includes humans.

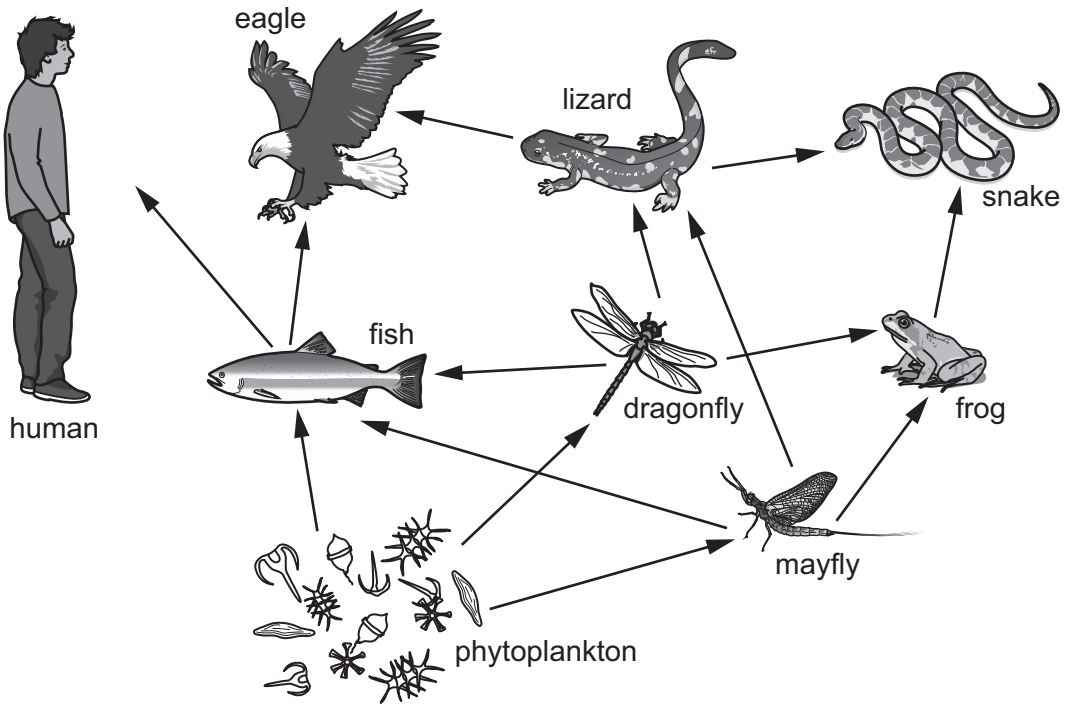



**Fig. 1.2**

**(i)** Identify the food source for the human in Fig. 1.2.

..... [1]

**(ii)** Identify the producer in Fig. 1.2.

..... [1]

**(iii)** Explain why the frog in Fig. 1.2 is a carnivore.

.....

..... [1]

**(d)** In some parts of the world, eagles are endangered.

Suggest **two** reasons why eagles may become endangered.

1 .....

.....

2 .....

.....

[2]

[Total: 9]

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**2** **(a)** Fig. 2.1 shows the structure of an insect-pollinated flower.

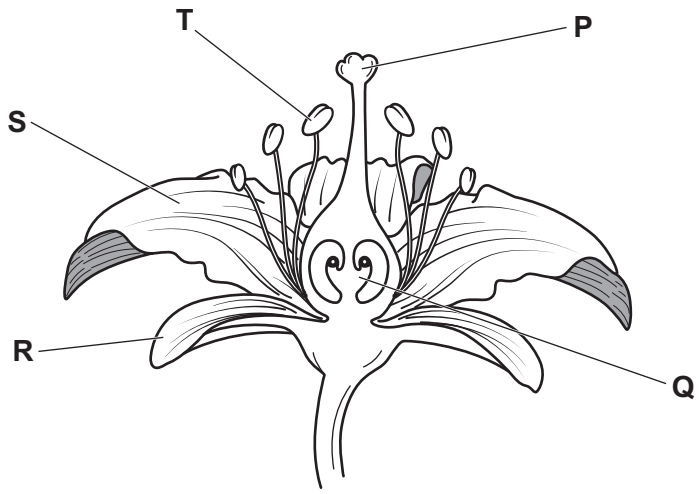



**Fig. 2.1**

The flower in Fig. 2.1 can self-pollinate. This means pollen grains made by the flower are used to pollinate the same flower.

Using letters **P**–**T**, complete these sentences about the flower in Fig. 2.1.

Pollen grains are made on the part labelled ..... .

Insects are attracted to the flower by the part labelled ..... .

The insects then transfer the pollen grains to the part labelled ..... .

[3]

**(b)** Pollen grains are the male gametes in plants.

State the name of the male gametes in humans.

..... [1]

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**(c)** Some plant seeds are left to germinate in different conditions. All the seeds are given the same volume of water.

Table 2.1 shows the different conditions and the number of seeds that germinate.

**Table 2.1**

| number of seeds | description of different conditions | number of seeds that germinate | percentage of seeds that germinate |
|---|---|---|---|
| 40 | warm temperature with light | 38 | 95 |
| 40 | warm temperature with **no** light | 36 | |
| 40 | cold temperature with light | 2 | 5 |
| 40 | cold temperature with **no** light | 4 | 10 |

**(i)** Calculate the percentage of seeds that germinate in a warm temperature with **no** light.

percentage of seeds that germinate = ..... [2]

**(ii)** Seeds need a suitable temperature to germinate, but they do **not** need light to germinate.

Describe evidence from Table 2.1 that supports this statement.

.....

.....

.....

..... [2]

**(d)** Plants take in water from the soil.

**(i)** State the name of the type of plant cells that absorb water from the soil.

..... [1]

**(ii)** Water moves into cells through a partially permeable membrane by a type of diffusion.

State the name of this type of diffusion.

..... [1]

[Total: 10]

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**3** **(a)** Blood contains different components.

**(i)** Circle the component of blood that transports urea and nutrients.

**plasma** **platelets** **red blood cells** **white blood cells**

[1]

**(ii)** State the type of blood vessels that return blood to the heart.

..... [1]

**(iii)** State the name of the structure that separates the left and right ventricles of the heart.

..... [1]

**(b)** Some pathogens are transmitted by direct contact through blood.

**(i)** Describe what is meant by pathogen.

.....

..... [1]

**(ii)** Describe **one** way that a pathogen is transmitted indirectly.

.....

..... [1]

**(iii)** Blood is one of the body's defences against pathogens.

State **one** of the body's other defences against pathogens.

..... [1]

**(c)** Blood transports oxygen to the muscles.

Complete these sentences.

Choose words from the list. You may use each word once, more than once or not at all.

**breakdown** **contraction** **division**

**flow** **release** **synthesise**

The muscles use oxygen to ..... energy from glucose by the process of aerobic respiration.

The energy is then used for muscle ..... to move the body.

[2]

[Total: 8]

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**4** Lithium, sodium and potassium are elements in Group I of the Periodic Table.

**(a)** Melting point and boiling point are properties of the elements in Group I.

These properties show a trend down Group I.

State **two** other properties that show a trend down Group I.

1 .....

2 .....

[2]

**(b)** A mixture of sodium and potassium is used as a coolant in nuclear reactors.

**(i)** Circle the word that describes a mixture of metals.

**alloy** **brass** **compound** **element**

[1]

**(ii)** The melting point and boiling point of a mixture of sodium and potassium are shown in Table 4.1.

**Table 4.1**

| | melting point / °C | boiling point / °C |
|---|---|---|
| mixture of sodium and potassium | –13 | 785 |

Room temperature is 25 °C.

Deduce whether the mixture of sodium and potassium is a solid, a liquid or a gas at room temperature.

Use Table 4.1 to explain your answer.

solid, liquid or gas .....

explanation .....

.....

[2]

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**(c)** The arrangement of particles in an atom of lithium is shown in Fig. 4.1.

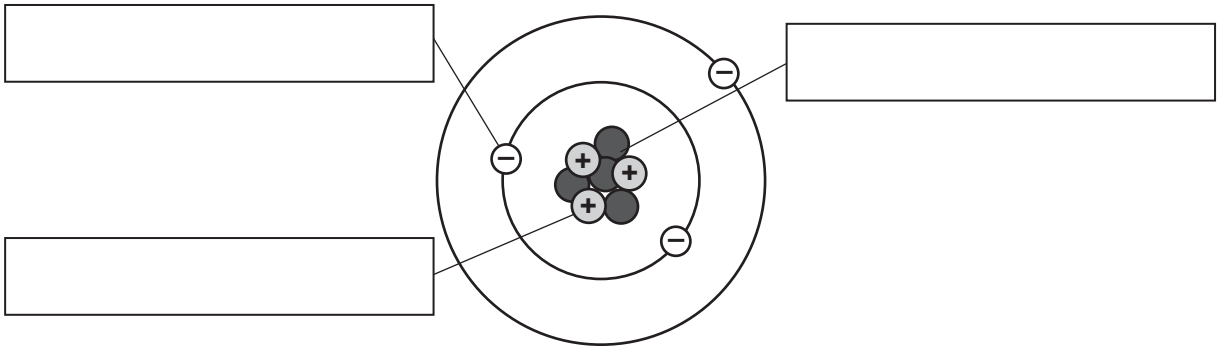


**Fig. 4.1**

Complete the labels in Fig. 4.1 with the name of each particle in the atom. [3]

[Total: 8]

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**5** Table 5.1 shows the percentage of gases in a sample of natural gas.

**Table 5.1**

| gas | percentage |
|---|---|
| methane | 83 |
| ethane | 9 |
| propane | 5 |
| butane | 2 |
| nitrogen | 0.5 |
| other gases | |

**(a) (i)** Use the data in Table 5.1 to calculate the percentage of other gases in the sample of natural gas.

percentage of other gases = ..... [1]

**(ii)** State the named gas in Table 5.1 that is in clean air.

..... [1]

**(b)** Name the **two** products of the complete combustion of methane.

1 .....

2 .....

[2]

**(c)** Propane and butane are in the refinery gas fraction obtained from petroleum.

Tick (✓) **one** use of refinery gas.

added to water to kill microbes ☐

fuel used for heating and cooking ☐

fuel used in diesel engines ☐

used to make road surfaces ☐

[1]

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**(d)** Fig. 5.1 shows the structure of ethane.

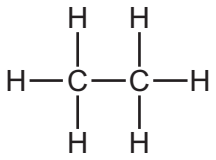


**Fig. 5.1**

**(i)** Use Fig. 5.1 to explain why ethane is a saturated molecule.

.....

..... [1]

**(ii)** State the number of electrons shared between the carbon atoms in a molecule of ethane.

..... [1]

[Total: 7]

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**6** Table 6.1 shows the products and observations at the electrodes in the electrolysis of three electrolytes.

**Table 6.1**

| electrolyte | negative electrode | | positive electrode | |
|---|---|---|---|---|
| | product | observation | product | observation |
| molten lead(II) bromide | lead | grey liquid | ..... | bubbles of red-brown gas |
| concentrated aqueous sodium chloride | hydrogen | bubbles of colourless gas | chlorine | bubbles of green gas |
| dilute sulfuric acid | ..... | bubbles of colourless gas | ..... | bubbles of colourless gas |

**(a)** Complete Table 6.1. [3]

**(b)** Explain why the mass of concentrated aqueous sodium chloride decreases during electrolysis.

.....

..... [1]

**(c)** Use Table 6.1 to explain why electrolysis is a chemical change.

.....

..... [1]

**(d)** Inert electrodes are used in each electrolysis.

Name **one** substance used as inert electrodes.

..... [1]

**(e)** State the name of the negative electrode.

..... [1]

**(f)** Electrolysis is an endothermic process.

State the meaning of endothermic.

.....

..... [1]

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**(g)** Draw **one** straight line from each description to the correct substance.

| description | substance |
| --- | --- |
| salt that contains ionic bonds | chlorine |
| compound with a pH less than 7 | dilute sulfuric acid |
| Group VII element | hydrogen |
| | lead |
| | lead(II) bromide |

[3]

[Total: 11]

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**7** An electric motor is connected to a battery. The motor lifts a mass through a vertical distance, as shown in Fig. 7.1.

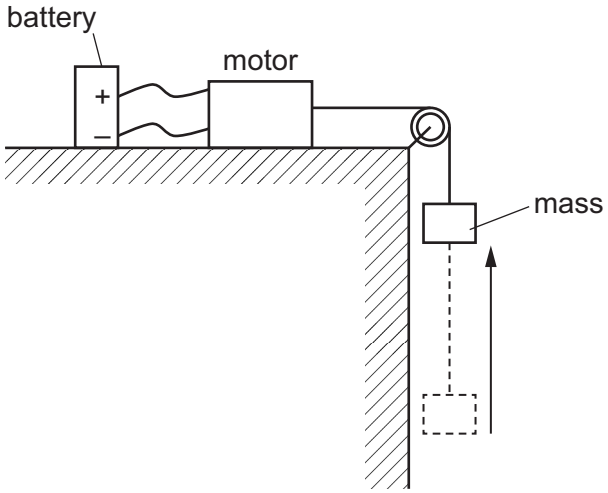



**Fig. 7.1**

**(a)** Fig. 7.2 shows a speed–time graph for the motion of the mass.

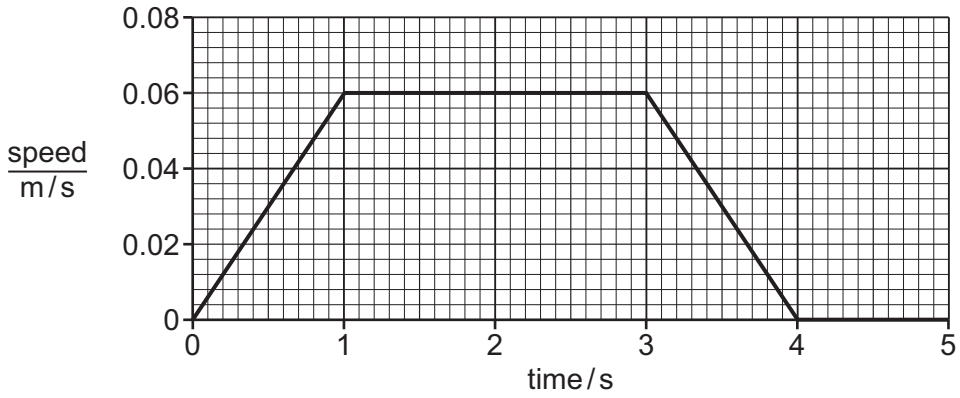



**Fig. 7.2**

Draw **one** straight line from each time to the correct description of the motion of the mass at that time.

| **time** | **motion of the mass** |
|---|---|
| 0.5 s | accelerating |
| 2.5 s | at rest |
| 4.5 s | moving at constant speed |

[2]

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**(b)** The mass is lifted through a vertical distance of 18 cm in a time of 4.0 s.

Calculate the average speed, in metres per second, of the mass.

average speed = ..... m/s [3]

**(c)** The mass is lifted through a vertical distance.

Complete the sentence about the main energy transfer that occurs.

The energy in the ..... store of the battery transfers to the

..... ..... store of the mass.

[2]

**(d)** The power output of the motor is 80 W.

Calculate the energy output from the motor in 4.0 s.

energy = ..... J [2]

[Total: 9]

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**8** **(a)** Fig. 8.1 shows three diagrams, **A**, **B** and **C**, of particles in the three states of matter.

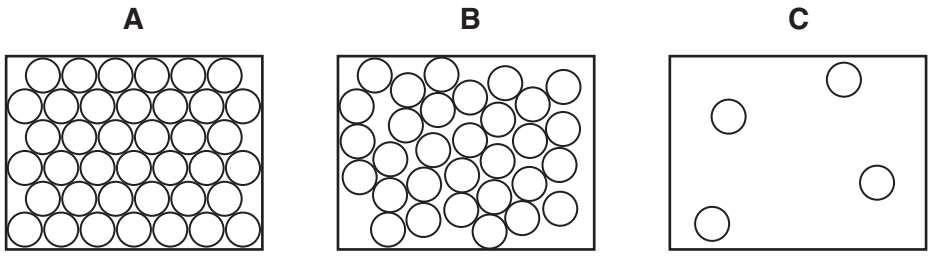



**Fig. 8.1**

**(i)** State which diagram, **A**, **B** or **C**, shows the particles in a gas.

Give **two** reasons for your answer.

diagram .....

reason 1 .....

reason 2 .....

[2]

**(ii)** Give the term for the change in state from a gas to a liquid.

..... [1]

**(iii)** Describe how the motion of particles in cold water is different from the motion of particles in hot water.

.....

..... [1]

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**(b)** Table 8.1 shows the approximate frequency ranges for the different regions of the electromagnetic spectrum.

**Table 8.1**

| gamma radiation | X-rays | ultraviolet | visible light | infrared | microwaves | radio waves |
|---|---|---|---|---|---|---|
| above $1.0 \times 10^{19}$ Hz | $1.0 \times 10^{16}$ Hz to $1.0 \times 10^{19}$ Hz | $8.0 \times 10^{14}$ Hz to $1.0 \times 10^{16}$ Hz | $4.0 \times 10^{14}$ Hz to $8.0 \times 10^{14}$ Hz | $1.0 \times 10^{11}$ Hz to $4.0 \times 10^{14}$ Hz | $1.0 \times 10^{9}$ Hz to $1.0 \times 10^{11}$ Hz | below $1.0 \times 10^{9}$ Hz |

**(i)** State the **colour** of visible light with the lowest frequency.

..... [1]

**(ii)** Identify the region of the electromagnetic spectrum which has waves with a frequency of $3.0 \times 10^{9}$ Hz.

State **one** application for this region of the electromagnetic spectrum.

region .....

application .....
[2]

**(iii)** The speed of light is $3.0 \times 10^{8}$ m/s.

Calculate the wavelength of visible light with a frequency of $5.0 \times 10^{14}$ Hz.

wavelength = ..... m [2]

[Total: 9]

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**9** A spacecraft travels through space from Earth to Mars.

**(a)** Earth and Mars are planets in the Solar System.

**(i)** State how many planets there are in the Solar System.

..... [1]

**(ii)** State the name of the galaxy that contains the Solar System.

..... [1]

**(b)** The spacecraft contains electrical equipment powered by batteries.

Suggest a suitable energy resource for recharging the batteries of the spacecraft in space.

..... [1]

**(c)** Fig. 9.1 shows a circuit diagram for an electrical circuit on the spacecraft.

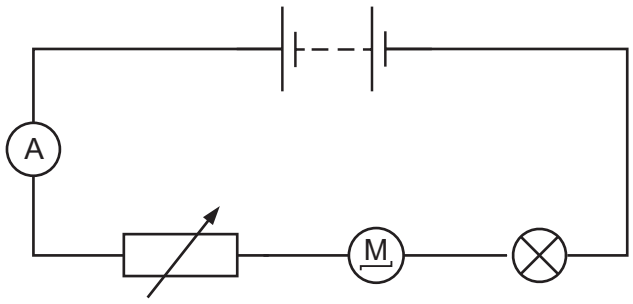



**Fig. 9.1**

**(i)** Name the component represented by the symbol shown.




..... [1]

**(ii)** On Fig. 9.1, draw a voltmeter connected to measure the voltage across the lamp. [2]

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**(iii)** The voltage across the lamp is 6.5 V.

The reading on the ammeter is 1.3 A.

Calculate the resistance of the lamp.

resistance = ..... Ω [2]

**(iv)** The resistance of the variable resistor in Fig. 9.1 is increased. The voltage across the variable resistor increases.

Explain why the voltage across the lamp decreases.

.....

..... [1]

[Total: 9]

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## The Periodic Table of Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group VIII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 3 Li lithium 7 | 4 Be beryllium 9 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium – | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57–71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium – | 85 At astatine – | 86 Rn radon – |
| 87 Fr francium – | 88 Ra radium – | 89–103 actinoids | 104 Rf rutherfordium – | 105 Db dubnium – | 106 Sg seaborgium – | 107 Bh bohrium – | 108 Hs hassium – | 109 Mt meitnerium – | 110 Ds darmstadtium – | 111 Rg roentgenium – | 112 Cn copernicium – | 113 Nh nihonium – | 114 Fl flerovium – | 115 Mc moscovium – | 116 Lv livermorium – | 117 Ts tennessine – | 118 Og oganesson – |

**Key**

atomic number
atomic symbol
name
relative atomic mass

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

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).

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