Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0123456789

CO-ORDINATED SCIENCES **0654/03**

Paper 3 Theory (Core) **For examination from 2025**

SPECIMEN PAPER **2 hours**

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 120.
- 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 **26** pages.

© Cambridge University Press & Assessment 2022

1 **(a)** Fig. 1.1 is a plan of the tissues found in a cross-section of a root.

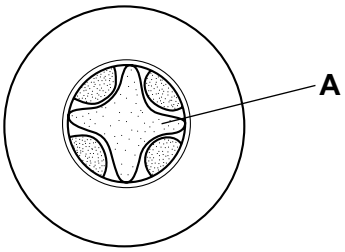


Fig. 1.1

State the **two** main substances transported in the tissue labelled **A** in Fig. 1.1.

1 .....

2 .....
[2]

(b) The list shows different biological molecules found in animals and plants.

amino acids	**fat**	**glycerol**
glycogen	**protein**	**starch**

Identify the substance from the list that:

is a carbohydrate .....

is made by ribosomes .....

gives a positive ethanol emulsion test .....

turns iodine solution blue-black. .....
[4]

© Cambridge University Press & Assessment 2022

(c) The list shows some tissues, organs and organ systems in humans.

heart **muscle**

liver **lung** **nervous system**

Complete Table 1.1. Use all the examples from the list.

Table 1.1

tissue	organ	organ system

[3]

(d) **(i)** The longest cells in the human body are neurones.

The length of one neurone is 90 cm.

The length of one root hair cell is 0.12 cm.

Calculate how many times longer the neurone is than the root hair cell.

..... [1]

(ii) Suggest **one** reason why neurones are very long.

.....

..... [1]

[Total: 11]

© Cambridge University Press & Assessment 2022

2 **(a)** Fig. 2.1 shows a photograph of an area where trees have been cut down.

Fig. 2.1

(i) State the name of the type of habitat destruction shown in Fig. 2.1.

..... [1]

(ii) List **three** undesirable effects of habitat destruction.

1 .....

2 .....

3 .....
[3]

(b) State **three** human activities, other than cutting down large areas of trees, that can cause habitat destruction.

1 .....

2 .....

3 .....
[3]

© Cambridge University Press & Assessment 2022

(c) Describe **three** ways that endangered species can be conserved.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

© Cambridge University Press & Assessment 2022

3 Fig. 3.1 shows a diagram of the human female reproductive system.

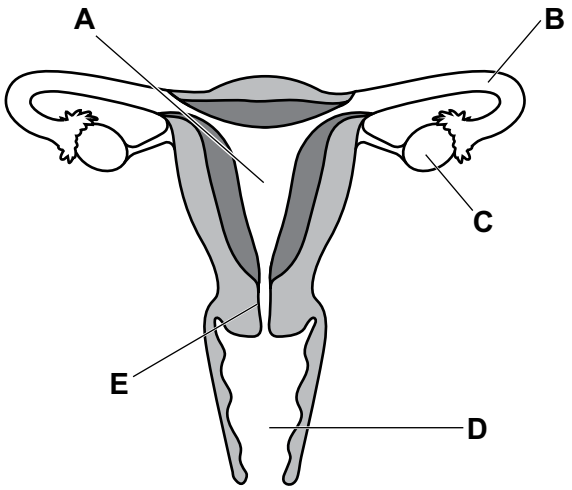


Fig. 3.1

(a) Using letters **A**–**E** in Fig. 3.1, identify:

where eggs are made .....

where fertilisation occurs .....

the ring of muscle at the opening of the uterus. .....
[3]

(b) Oestrogen is a hormone responsible for the development of secondary sexual characteristics during puberty.

(i) State the name of the part of the female reproductive system that secretes oestrogen.

..... [1]

(ii) Describe how hormones are transferred to target organs.

.....

..... [1]

© Cambridge University Press & Assessment 2022

(c) Table 3.1 shows some secondary sexual characteristics.

Place ticks (✓) in Table 3.1 to show which characteristics develop during puberty in boys and in girls.

One has been done for you.

Table 3.1

secondary sexual characteristic	boy	girl
breasts grow		✓
sexual organs enlarge		
growth of pubic hair		
menstrual cycle starts		

[3]

[Total: 8]

© Cambridge University Press & Assessment 2022

4 A student completes different types of activity.

She measures her pulse rate during each type of activity in beats per minute (bpm).
Fig. 4.1 shows the results.

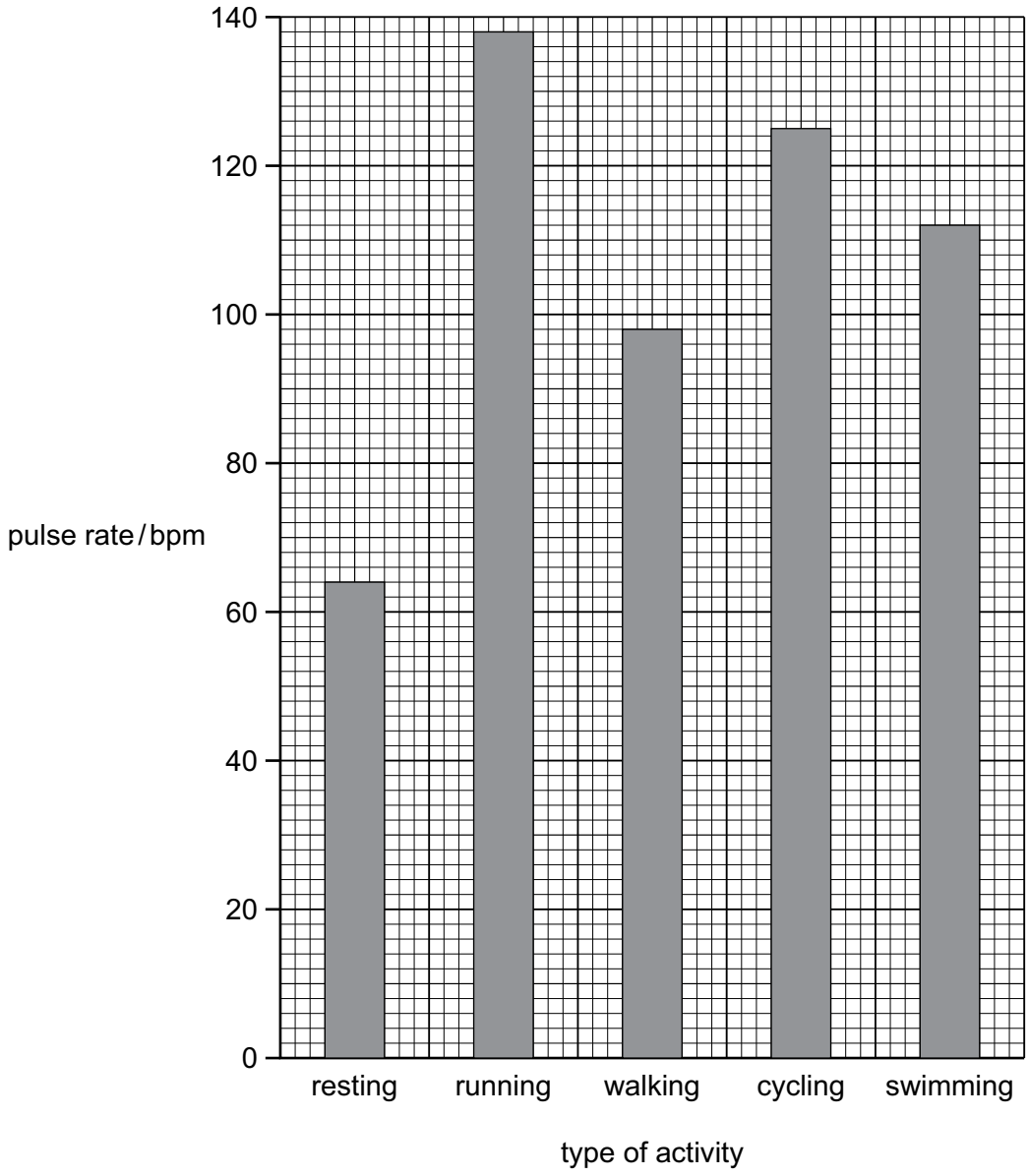


Fig. 4.1

(a) Complete the sentences to describe and explain the results seen in Fig. 4.1.

The resting pulse rate is ..... bpm.

The activity that resulted in the highest pulse rate is ..... .

The difference in pulse rate between walking and swimming is ..... bpm.

Pulse rate increases during physical activity to supply more oxygen to the muscles for

....

[4]

© Cambridge University Press & Assessment 2022

(b) Measuring the pulse rate is one way of monitoring the activity of the heart.

State **one** other way of monitoring the activity of the heart.

.....

..... [1]

(c) Regular exercise is one way to reduce the risk of developing coronary heart disease (CHD).

Describe **one** way a person's diet can **increase** the risk of developing CHD.

.....

..... [1]

(d) Coronary heart disease is **not** caused by a pathogen.

(i) State **one** type of pathogen.

..... [1]

(ii) State **two** body defences against pathogens.

1 .....

2 .....
[2]

(e) Explain why it is important to clean surfaces after preparing food.

.....

.....

.....

..... [2]

[Total: 11]

© Cambridge University Press & Assessment 2022

5 **(a)** The list shows seven gases.

carbon monoxide
chlorine
helium
hydrogen
nitrogen
oxygen
sulfur dioxide

Use this list to answer the following questions. Each gas may be used once, more than once or not at all.

(i) Name **one** gas that is monatomic.

..... [1]

(ii) Name the **two** gases used in a fuel cell to produce electricity.

..... and ..... [2]

(iii) Name the gas used to kill microbes during the treatment of drinking water.

..... [1]

(iv) Name the gas that is 78% of clean air.

..... [1]

© Cambridge University Press & Assessment 2022

(b) Fig. 5.1 shows the electrolysis of dilute sulfuric acid using inert electrodes.

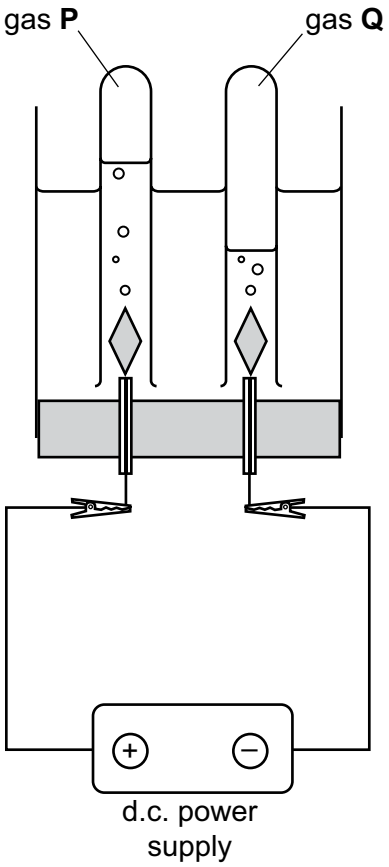


Fig. 5.1

(i) On Fig. 5.1, draw a line and label it to show the cathode. [1]

(ii) On Fig. 5.1, draw a line and label it to show the electrolyte. [1]

(iii) Name a suitable material for the cathode.

..... [1]

(iv) Identify gas **P**.

..... [1]

[Total: 9]

© Cambridge University Press & Assessment 2022

6 **(a)** Name **two** air pollutants that cause acid rain.

1 .....

2 .....
[2]

(b) Particulates are also air pollutants.

State the source of particulates in the atmosphere.

.....

..... [1]

(c) Methane, CH_4, is an air pollutant.

Complete Fig. 6.1 to show the electronic configuration of methane.

Draw the outer-shell electrons only.

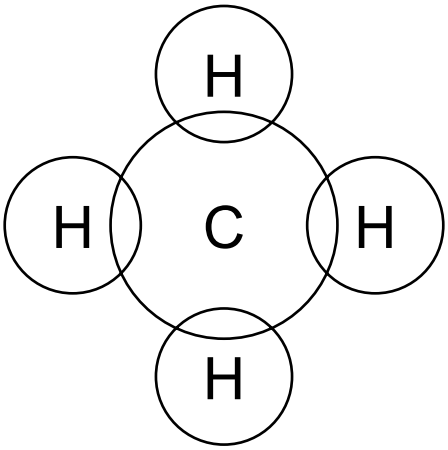


Fig. 6.1

[2]

(d) During the complete combustion of methane in oxygen, carbon dioxide and water are produced.

Complete the balanced equation for this reaction.

$$CH_4 + ... O_2 \rightarrow CO_2 + ... H_2O$$ [1]

© Cambridge University Press & Assessment 2022

(e) Methane is an alkane.

Explain how you can tell from the name that methane is an alkane.

.....

..... [1]

(f) State the name of a substance used to distinguish between an alkane and an alkene.

..... [1]

[Total: 8]

© Cambridge University Press & Assessment 2022

7 **(a)** Table 7.1 shows information about an alloy.

Table 7.1

element	percentage by mass
aluminium	6.0
calcium	2.5
magnesium	91.5

(i) Calculate the mass of calcium in 200 g of the alloy.

mass of calcium = ... g [1]

(ii) Suggest **two** reasons why the alloy in Table 7.1 is **not** stainless steel.

1 .....

2 .....
[2]

(iii) Stainless steel is used to make cutlery.

State **two** physical properties of stainless steel that are important for this use.

1 .....

2 .....
[2]

© Cambridge University Press & Assessment 2022

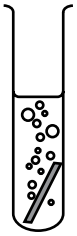
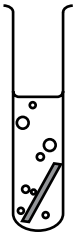
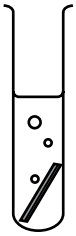
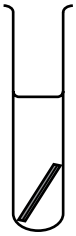
(b) A student investigates the reactivity of four metals.
The student adds dilute hydrochloric acid to four test-tubes each containing one of four metals: calcium, copper, magnesium and zinc.

(i) State the name of the gas produced when metals react with dilute hydrochloric acid.

..... [1]

(ii) Table 7.2 shows the student's observations.

Table 7.2

observation				
metal	.....	.....	.....	.....

Complete Table 7.2 by writing the names of the four metals in the correct boxes.

calcium **copper** **magnesium** **zinc** [2]

(c) Copper is a transition element. Magnesium is **not** a transition element.
One property of transition elements is that they act as catalysts.

(i) State what is meant by a catalyst.

.....

.....

..... [2]

(ii) A second property of transition elements is that they have high melting points.

State **two** other properties of transition elements that are **not** properties of magnesium.

1 .....

2 .....
[2]

[Total: 12]

© Cambridge University Press & Assessment 2022

8 Group VII of the Periodic Table contains non-metallic elements called halogens.

(a) Explain why the chemical reactions of the elements chlorine, bromine and iodine are similar.

.....

..... [1]

(b) An atom of bromine is represented as $^{80}_{35}Br$.

(i) State the number of protons and the number of neutrons in this bromine atom.

protons .....

neutrons .....

[2]

(ii) Name the part of an atom that contains the protons and neutrons.

..... [1]

(iii) A teacher places some brown bromine gas into a gas jar and places a gas jar of clean air above it.
The jars are then left for one hour.
Fig. 8.1 shows how the red-brown colour spreads completely throughout the gas jars.

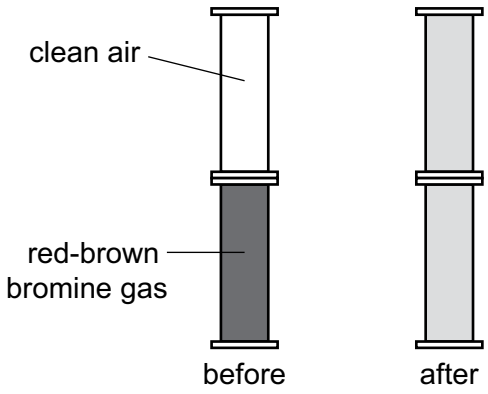


Fig. 8.1

Use the kinetic particle theory to explain these observations.

.....

.....

.....

.....

..... [3]

© Cambridge University Press & Assessment 2022

(c) An acid–base titration is used to make sodium chloride.

(i) Name the acid and the base used in this titration.

acid .....

base .....
[2]

(ii) Describe how to identify the end-point of an acid–base titration.

.....

.....

..... [2]

[Total: 11]

9 **(a)** Fig. 9.1 shows a bat emitting ultrasound waves to locate a moth.

Fig. 9.1

The ultrasound takes 0.40 s to reach the moth and return to the bat after reflection.

The speed of ultrasound in air is 340 m / s.

(i) Calculate the total distance travelled by the ultrasound.

distance = ... m [2]

(ii) Suggest a frequency for the ultrasound.

State the unit of your answer.

frequency = ... unit ..... [2]

(iii) A second bat emits ultrasound with a higher pitch.

Compare the frequencies of the two ultrasound waves.

.....

..... [1]

(b) State the name given to the reflection of a sound.

..... [1]

© Cambridge University Press & Assessment 2022

(c) The mass of the bat is 19 g.

Calculate the weight of the bat.

weight = ... N [3]

[Total: 9]

10 **(a)** A car travels 1500 m along a straight road in 90 s.
The driving force of the car's engine is 12 000 N.

(i) Show that the work done by the driving force is 18 000 000 J.

[1]

(ii) Calculate the useful power output from the car's engine in 90 s.

power = ... W [2]

(b) The car accelerates up a hill. Thermal energy stored in the car increases.

State **two** other energy stores in the car that increase as the car accelerates up the hill.

..... and ..... [2]

(c) The car stops on a horizontal part of the road. Each of its four tyres has an area of 0.020 m^2 in contact with the road.
The weight of the car is 16 000 N.

Calculate the pressure exerted by the car on the road.

pressure = ... N / m^2 [2]

© Cambridge University Press & Assessment 2022

(d) (i) The two headlamps of the car are powered by a battery.
The lamps are connected in parallel. The lamps are controlled by one switch.

Complete the circuit diagram in Fig. 10.1 to show the two lamps connected in parallel and the switch.
The battery has been drawn for you.

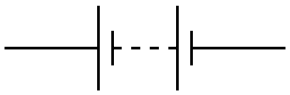


Fig. 10.1

[3]

(ii) State **one** advantage of connecting the lamps in parallel.

.....

..... [1]

[Total: 11]

11 (a) (i) A star emits most of its energy in the infrared, visible light and ultraviolet regions of the electromagnetic spectrum.

Fig. 11.1 shows an incomplete electromagnetic spectrum.

Write **visible light** and **ultraviolet** in their correct positions on Fig. 11.1.

increasing frequency ←						
	X-rays			infrared		

Fig. 11.1

[2]

(ii) Explain why it takes the same time for infrared, visible light and ultraviolet to travel from the Sun to the Earth.

.....

..... [1]

(b) State the name of the galaxy that contains the Sun and many other stars.

..... [1]

(c) The Sun consists mainly of two gases.

State the names of these **two** gases.

..... and ..... [2]

(d) The Sun is a small mass star.

Use words or phrases from the list to describe the life cycle of a small mass star.

planetary nebula **black hole** **neutron star** **red giant**

red supergiant **supernova** **white dwarf**

small mass star → ..... → ..... + ... [2]

© Cambridge University Press & Assessment 2022

(e) Telescopes are used to observe stars. Telescopes contain lenses.
Rays of light from a distant star pass through the lens shown in Fig. 11.2.

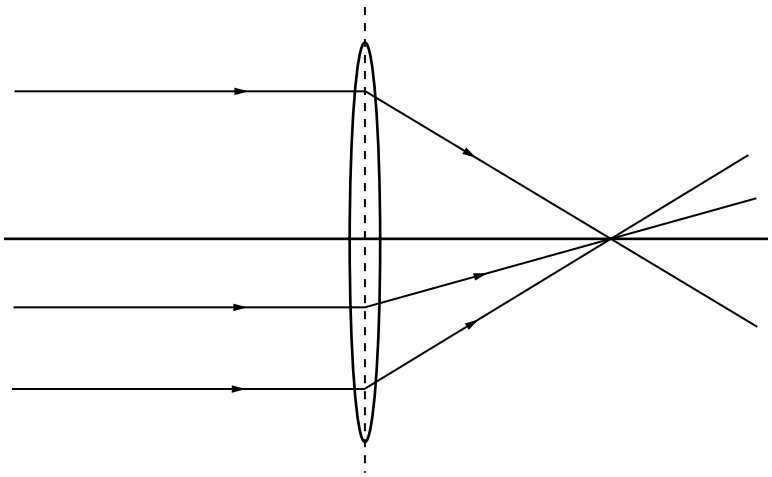


Fig. 11.2

(i) Draw a double headed arrow (↔ or ↕) on Fig. 11.2 to show the focal length of the lens. [1]

(ii) A ray of light changes direction as it leaves the lens.

State the name of this process.

..... [1]

[Total: 10]

© Cambridge University Press & Assessment 2022

12 A nuclear power station is used to generate electricity.

(a) The nuclear power station produces waste radioactive isotopes.

(i) Suggest **one** way of safely storing a small quantity of a waste radioactive isotope.

.....

..... [1]

(ii) The radioactive waste contains an isotope that decays by β-emission.

Use the words **proton**, **neutron** and **electron** to complete the sentences to describe what happens in the nucleus of an atom during β-emission.

You may use each word once, more than once or not at all.

During β-emission, one ..... changes into

one ..... and one ..... .

The ..... is emitted from the nucleus.

[2]

(b) The generator at the power station supplies a current of 50 A at a voltage of 25 000 V.

Calculate the electrical power output of the generator.

power = ... W [2]

© Cambridge University Press & Assessment 2022

(c) Electricity is used to boil water in a kettle.

(i) State the boiling temperature of water.

temperature = ... °C [1]

(ii) When liquid water boils, it changes into a gas (steam).

Fig. 12.1 shows the arrangement of particles in a solid.

Complete Fig. 12.1 to show the arrangement of particles in a liquid and in a gas.

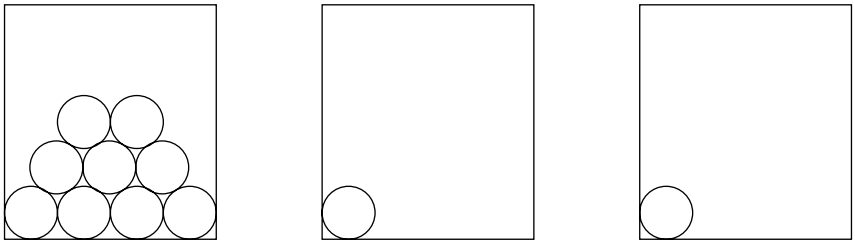


Fig. 12.1

[2]

(d) A 2.0 kW kettle is used for 2.0 hours.

(i) Calculate the amount of energy transferred to the kettle in kW h.

energy = ... kW h [1]

(ii) 1.0 kW h of energy costs $0.40.

Calculate the cost of using the kettle for 2.0 hours.

cost = $ ..... [1]

[Total: 10]

© Cambridge University Press & Assessment 2022

The Periodic Table of Elements

	Group																	
	I	II										III	IV	V	VI	VII	VIII
																	2 He helium 4
							1 H hydrogen 1					5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
	3 Li lithium 7	4 Be beryllium 9										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
	11 Na sodium 23	12 Mg magnesium 24										31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
	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	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
	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.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (Cambridge University Press & Assessment) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge Assessment International Education is part of Cambridge University Press & Assessment. Cambridge University Press & Assessment is a department of the University of Cambridge.

© Cambridge University Press & Assessment 2022