



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/41

October/November 2022

1 hour 15 minutes

No additional materials are needed.

- 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.

- 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 **24** pages. Any blank pages are indicated.

- 1 (a) Fig. 1.1 shows the structure of a human heart.

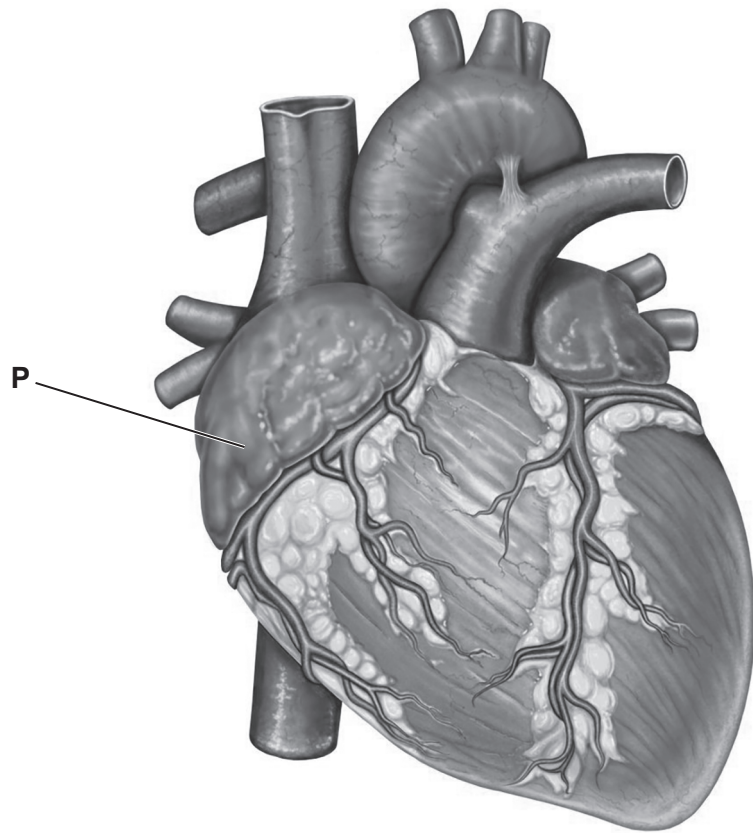


Fig. 1.1

- (i) State the name of the part labelled **P** in Fig. 1.1.

..... [1]

- (ii) State the name of the blood vessel that transports blood from the body to the heart.

..... [1]

- (iii) The human heart is part of a double circulation system.

Describe the double circulation system in humans.

.....

.....

.....

..... [2]

- (b) The waist-to-hip ratio is used to determine whether a person is overweight.

The waist-to-hip ratio is calculated from two measurements using the equation shown.

$$\text{waist-to-hip ratio} = \frac{\text{waist measurement}}{\text{hip measurement}}$$

Fig. 1.2 shows where the measurements are taken.

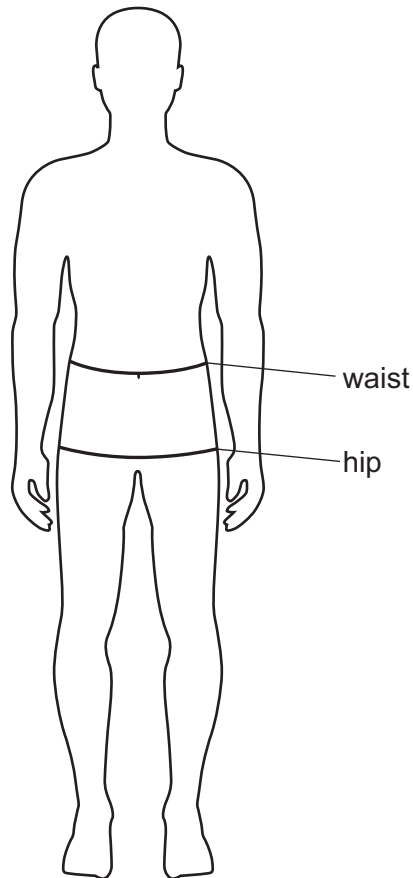


Fig. 1.2

- (i) A person has a waist measurement of 80 cm and a hip measurement of 97 cm.

Calculate the waist-to-hip ratio of this person.

Give your answer to **two** significant figures.

waist-to-hip ratio = ... [2]

- (ii) The people of one country are grouped into different categories according to waist-to-hip ratio.

The incidence of coronary heart disease in each group is recorded.

Fig. 1.3 shows the results.

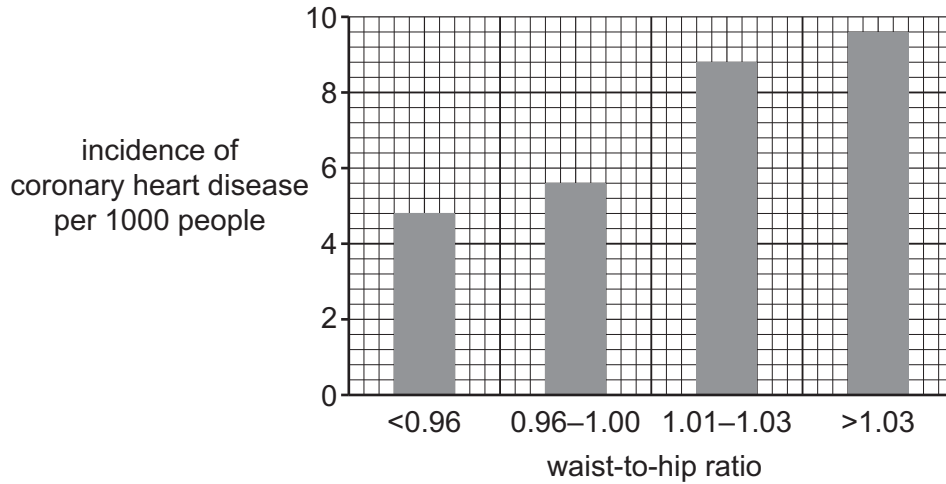


Fig. 1.3

Describe the relationship between incidence of coronary heart disease and waist-to-hip ratio shown in Fig. 1.3.

.....
 [1]

- (iii) Describe how malnutrition may cause coronary heart disease.

.....

 [2]

[Total: 9]

- 2 Concentrated aqueous sodium chloride is electrolysed using inert electrodes, as shown in Fig. 2.1.

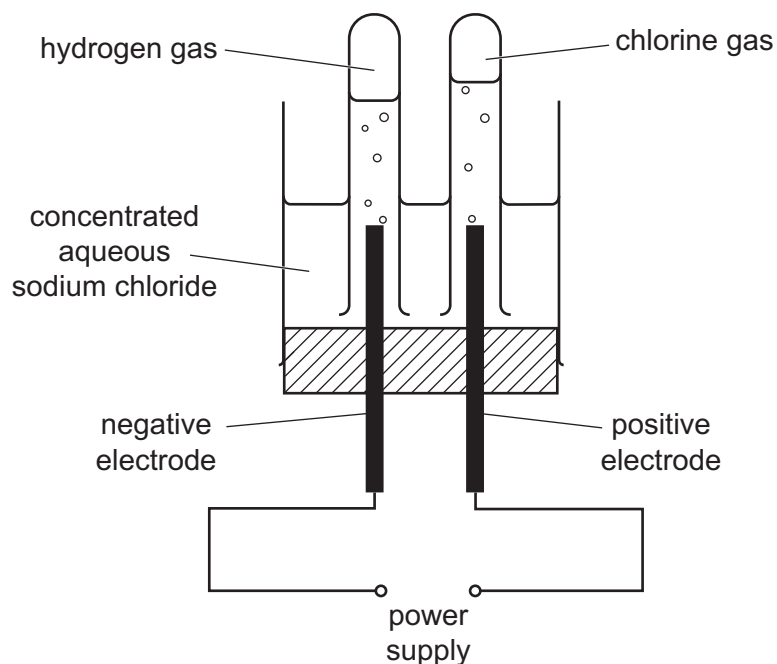


Fig. 2.1

- (a) Describe the chemical tests for hydrogen and for chlorine.

State the positive result for each test.

hydrogen test

positive result

chlorine test

positive result

[2]

- (b) The equation for the electrolysis of concentrated aqueous sodium chloride is shown.



- (i) Complete the equation by adding the missing state symbols. [1]

- (ii) State the name of the product that has the formula NaOH.

..... [1]

- (c) Four statements about the electrolysis of concentrated aqueous sodium chloride are shown in Table 2.1.

Put a tick (✓) in **one** box in each row to show whether each statement is true or false.

Table 2.1

statement	true	false
OH^- ions are attracted to the cathode.		
H^+ ions gain electrons at the negative electrode.		
H^+ ions come from the water in the solution.		
Hydrogen gas is made when OH^- ions lose electrons.		

[2]

- (d) A solution of hydrochloric acid is mixed with universal indicator solution.

State the colour and pH of this mixture.

colour

pH

[2]

[Total: 8]

- 3 Fig. 3.1 shows forces **P**, **Q**, **R** and **S** acting on an airplane moving forward along a runway.

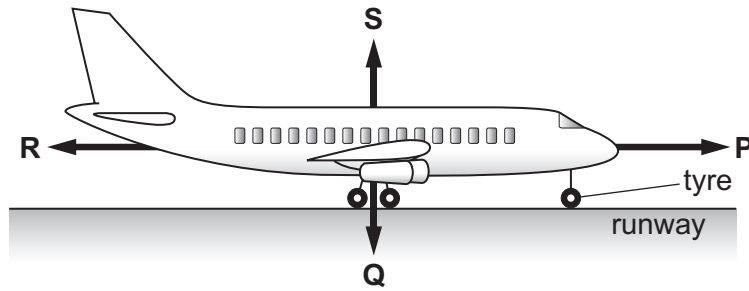


Fig. 3.1

- (a) Use Fig. 3.1 to complete the sentences.

Write **P**, **Q**, **R** or **S** in each gap.

The weight of the airplane, ..., is balanced by force acting in the opposite direction.

When force is greater than force, the airplane accelerates along the runway.

[2]

- (b) The mass of the airplane is 120 000 kg.

- (i) Calculate the weight of the airplane.

The gravitational force on unit mass is 10 N/kg.

weight = ... N [1]

- (ii) The total area of all the airplane tyres in contact with the ground is 0.125 m^2 .

Use your answer to **(b)(i)** to calculate the pressure exerted by the airplane on the ground.

Give the units of your answer.

pressure = ... units [3]

- (iii) The engines of the airplane provide a driving force of $1.2 \times 10^6 \text{ N}$.

The airplane moves a distance of 1500 m along the runway.

Calculate the work done by the engines on the airplane.

work done = ... J [2]

- (iv) The airplane takes off at a speed of 80 m/s.

Calculate the kinetic energy of the airplane as it takes off.

kinetic energy = ... J [2]

- (v) Suggest a reason for the difference between your answers to (b)(iii) and (b)(iv).

.....
..... [1]

[Total: 11]

4 (a) Starch is broken down by amylase into smaller molecules.

(i) State the type of carbohydrate molecules produced when amylase breaks down starch.

..... [1]

(ii) Fig. 4.1 shows the effect of temperature on amylase activity.

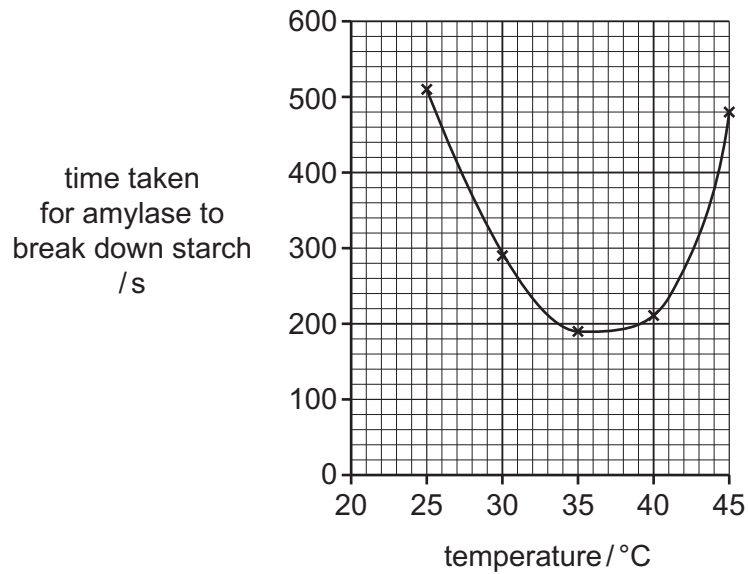


Fig. 4.1

Explain the effect of temperature on amylase activity between 25 °C and 35 °C.

.....

 [3]

(iii) Explain why amylase does **not** break down protein molecules.

.....

 [2]

- (b) Starch is used for storage in plants. Carbon in starch is returned to the atmosphere as part of the carbon cycle.

(i) State **two** processes in the carbon cycle that return carbon to the atmosphere.

1

2

[2]

(ii) State the process in the carbon cycle that traps carbon for millions of years.

..... [1]

- (c) Plants are the producers in a food web.

Fig. 4.2 shows a food web.

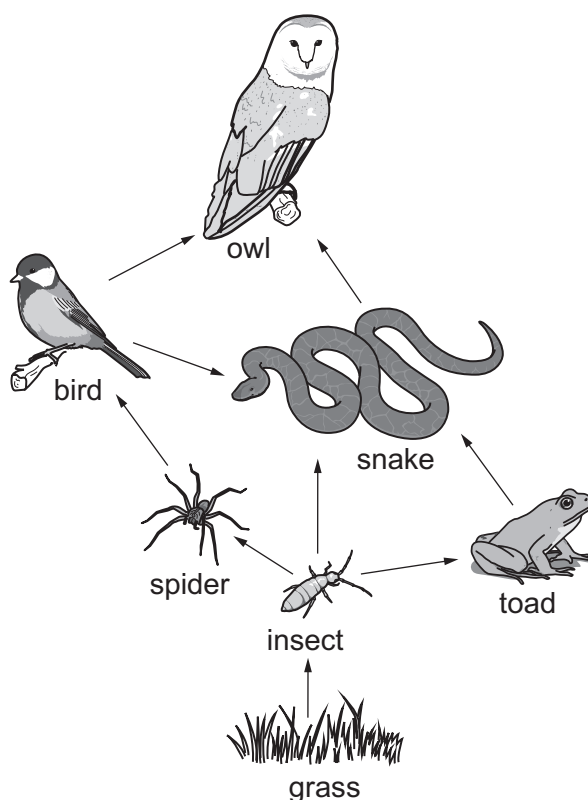


Fig. 4.2

Use Fig. 4.2 to explain why the snake is both a secondary and a tertiary consumer.

.....

.....

..... [2]

[Total: 11]

- 5 The energy level diagram for the combustion of hydrogen is shown in Fig. 5.1.

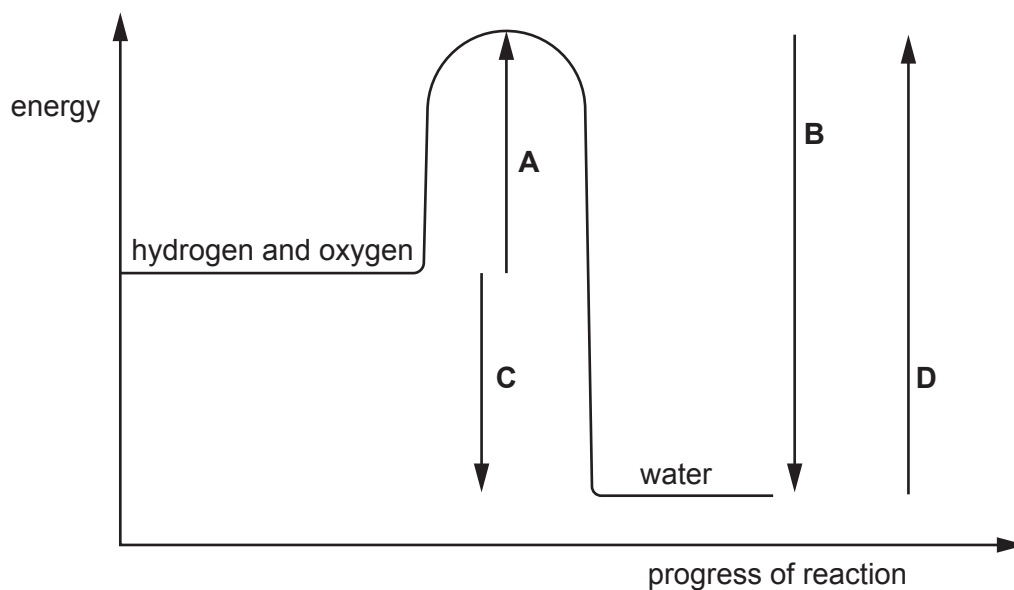


Fig. 5.1

- (a) State which arrow, **A**, **B**, **C** or **D**, represents the overall energy change for the reaction.

..... [1]

- (b) Complete Table 5.1 to describe the changes represented by arrow **A** and arrow **B**.

Place **two** ticks (✓) in each row.

Table 5.1

	bonds break	bonds form	energy is taken in	energy is given out
arrow A				
arrow B				

[2]

- (c) Some cars use hydrogen as a fuel.

Some cars use diesel oil as a fuel. Diesel contains mainly alkanes.

- (i) Give **one** similarity and **one** difference between the products of the combustion of hydrogen and of the complete combustion of alkanes.

similarity

.....

difference

.....

[2]

- (ii) Use your answer to (c)(i) to suggest why diesel cars are considered more harmful to the environment than hydrogen cars.

.....

..... [1]

- (iii) Table 5.2 shows information about the melting points and boiling points of hydrogen and of diesel.

Table 5.2

	melting point/°C	boiling point/°C
hydrogen	–259	–253
diesel	less than 20	greater than 150

Use the information in Table 5.2 to suggest why hydrogen is more difficult to store than diesel at 20 °C.

.....

.....

.....

..... [2]

[Total: 8]

- 6 (a) Fig. 6.1 shows a hairdryer.

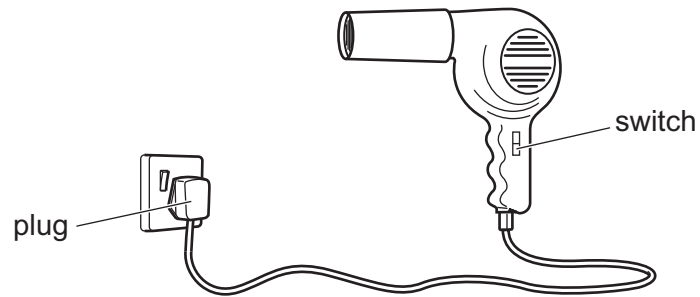


Fig. 6.1

The hairdryer contains an electric motor to blow air and a heater to heat the air.

The plug contains a fuse.

Fig. 6.2 shows the circuit diagram for the hairdryer.

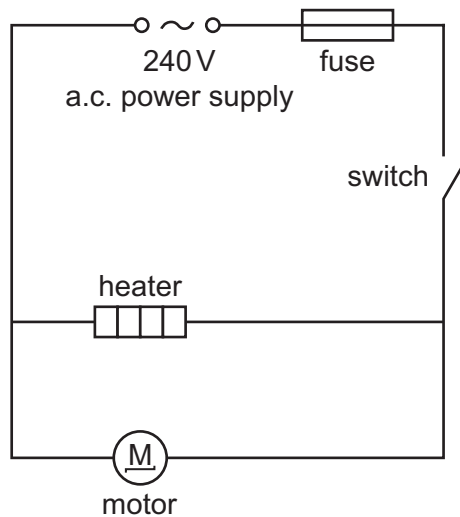


Fig. 6.2

- (i) The electric motor has a power rating of 60 W.

The heater has a power rating of 2300 W.

Show that the current in the fuse is 9.8 A.

[3]

- (ii) Discuss whether 10 A is an appropriate rating for the fuse.

.....

.....

..... [2]

(b) Fig. 6.3 shows a different hairdryer with two switches.

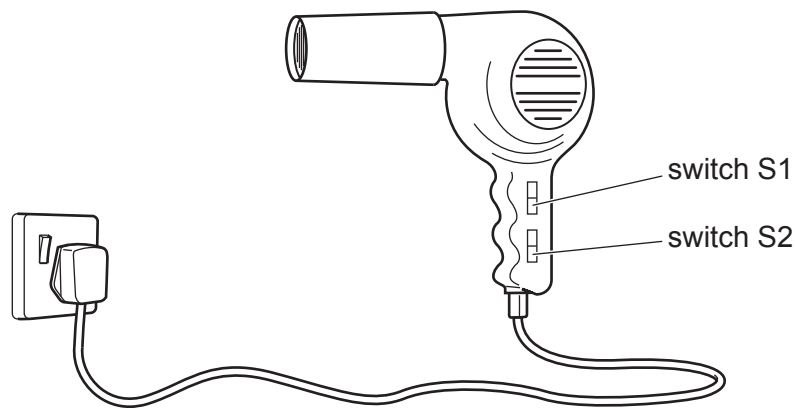


Fig. 6.3

When switch S1 is ON and switch S2 is ON, the hairdryer blows out **heated** air.

When switch S1 is ON and switch S2 is OFF, the hairdryer blows out **unheated** air.

When switch S1 is OFF, both the motor and the heater are switched OFF.

Fig. 6.4 shows an incomplete circuit diagram for the hairdryer.

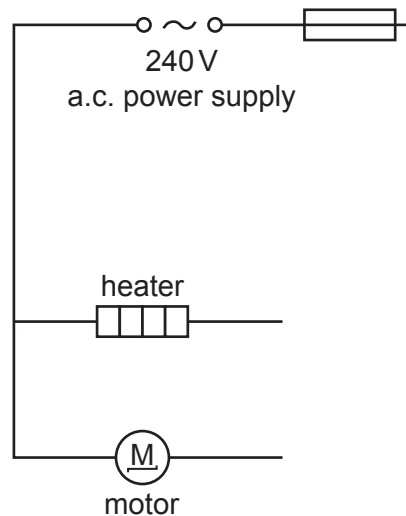


Fig. 6.4

On Fig. 6.4, complete the circuit diagram for the hairdryer by adding switch S1 and switch S2 in the correct positions.

Label the switches S1 and S2.

[2]

[Total: 7]

- 7 (a) Fig. 7.1 is a diagram showing a fetus developing inside the female reproductive system.

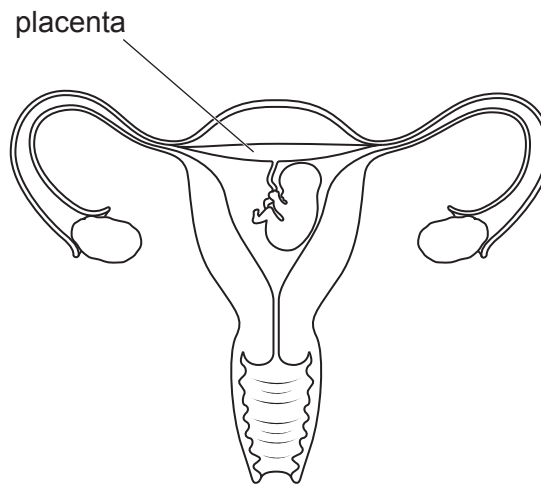


Fig. 7.1

- (i) On Fig. 7.1, draw a label line and the letter **O** to identify one ovary. [1]
- (ii) Complete the sentences about the placenta using one word from the list in each gap.

Each word can be used once, more than once or not at all.

excretory

insoluble

nutrients

oxygen

reproductive

toxins

The placenta provides a barrier to prevent reaching the fetus.

The placenta also allows products to pass from the fetus to the mother.

[2]

- (b) A pregnant female takes vitamin D to supplement her diet.

Explain why vitamin D is needed during **pregnancy**.

.....

.....

..... [2]

- (c) Pregnant females are advised **not** to smoke tobacco.

Tobacco smoke contains nicotine and tar.

Describe the effects of nicotine and tar on the body.

nicotine

.....

tar

.....

[2]

[Total: 7]

8 Period 3 of the Periodic Table is shown in Fig. 8.1.

group	I	II	III	IV	V	VI	VII	VIII
element	Na sodium	Mg magnesium	Al aluminium	Si silicon	P phosphorus	S sulfur	Cl chlorine	Ar argon

Fig. 8.1

(a) Identify **two** metals and **two** non-metals in Period 3.

metals: and

non-metals: and

[2]

(b) A sodium atom forms a sodium ion, Na^+ .

A chlorine atom forms a chloride ion, Cl^- .

Explain why the ions formed by these atoms have different charges.

Use ideas about electron arrangements in your answer.

.....

.....

.....

..... [3]

- (c) Sodium and chlorine react together to form sodium chloride, an ionic solid.

Fig. 8.2 shows the arrangement of ions in solid sodium chloride. Two of the ions have been labelled.

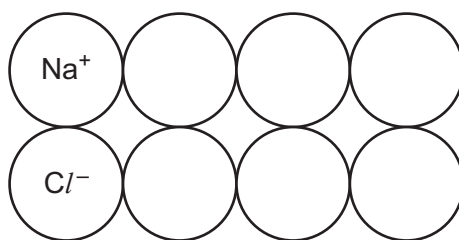


Fig. 8.2

- (i) Complete Fig. 8.2 by labelling the other ions. [1]
- (ii) Explain why ionic solids, such as sodium chloride, have high melting points.
-
-
- [2]
- (iii) State the name of an element in the same group of the Periodic Table as sodium that is more reactive than sodium.
- [1]
- (iv) State the name of an element in the same group of the Periodic Table as chlorine that is more reactive than chlorine.
- [1]

[Total: 10]

- 9 (a) A radar system in an airport uses microwaves to find and track an airplane in the sky.

- (i) Fig. 9.1 shows an incomplete electromagnetic spectrum.

On Fig. 9.1, write microwaves in the correct place.

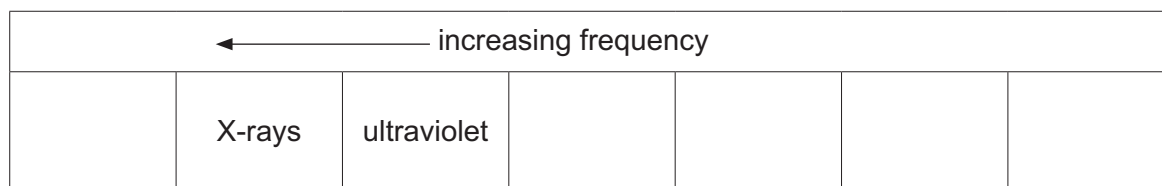


Fig. 9.1

[1]

- (ii) The radar system makes a regular beeping sound.

When the airplane gets close to the airport, the beeping sound increases in volume and pitch.

Fig. 9.2 shows the waveform of the beeping sound when the airplane is far from the airport and when the airplane is close to the airport.

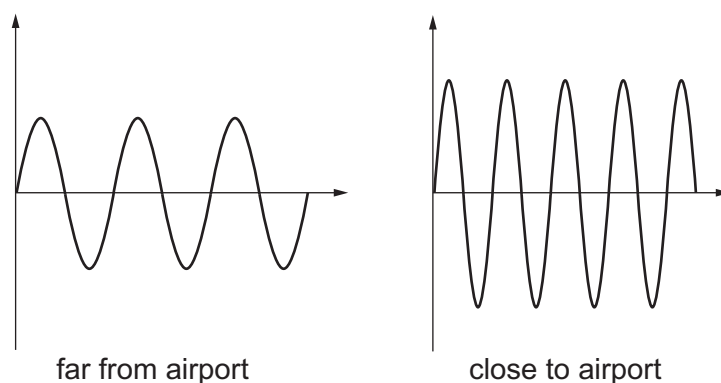


Fig. 9.2

Describe how Fig. 9.2 shows that the beeping sound increases in volume and pitch.

Use the words amplitude and frequency in your answer.

volume

.....

pitch

.....

[2]

- (b) Write **one** word in each gap to complete the sentences about waves.

For a wave, the direction of vibration is at right angles to the direction of travel of the wave.

For a wave, the direction of vibration is parallel to the direction of travel of the wave.

[2]

- (c) An airplane is flying in bright sunlight.

It is warmed by electromagnetic radiation from the Sun.

- (i) State the speed at which electromagnetic radiation travels from the Sun.

speed = ... m/s [1]

- (ii) The distance of the airplane from the Sun is 1.5×10^{11} m.

Use your answer to (c)(i) to calculate the time taken for the electromagnetic radiation to reach the airplane from the Sun.

time = ... s [2]

- (iii) Suggest how painting the airplane in shiny white paint helps to keep the airplane cool.

.....

..... [1]

[Total: 9]

BLANK PAGE

BLANK PAGE

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 (UCLES) 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.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
		1 H hydrogen 1															
		Key atomic number atomic symbol name relative atomic mass															
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 —		114 Fl flerovium —		116 Lv livermorium —		

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 dm³ at room temperature and pressure (r.t.p.).



CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/42

October/November 2022

1 hour 15 minutes

No additional materials are needed.

- 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.

- 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.

- 1 (a) Fig. 1.1 is a diagram of the human heart.

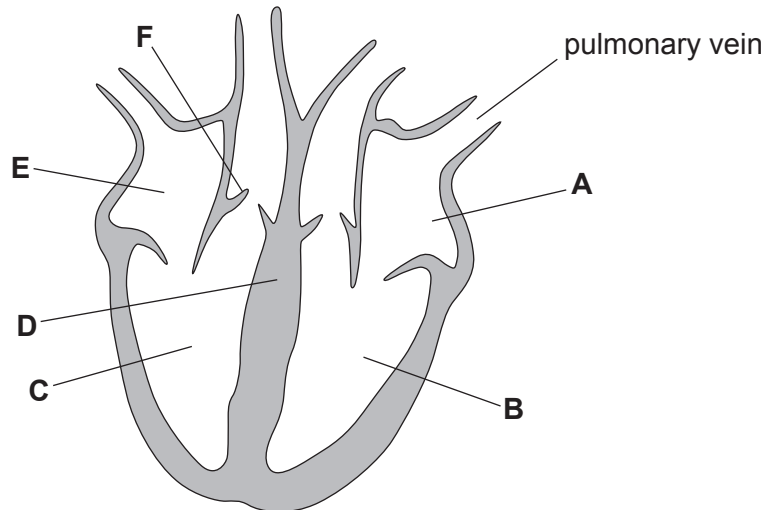


Fig. 1.1

- (i) Table 1.1 lists some of the parts labelled in Fig. 1.1.

Complete Table 1.1.

Table 1.1

letter in Fig. 1.1	name of part
B	left
.....	septum
F	

[3]

- (ii) On Fig. 1.1, draw arrows to show the direction of blood flow through the **left** side of the heart. [1]

- (iii) The heart is part of a double circulation system.

Explain the advantages of a double circulation system.

.....

.....

.....

..... [2]

(b) A hospital records the ages of patients with coronary heart disease.

Fig. 1.2 is a bar chart showing the number of patients in each age group.

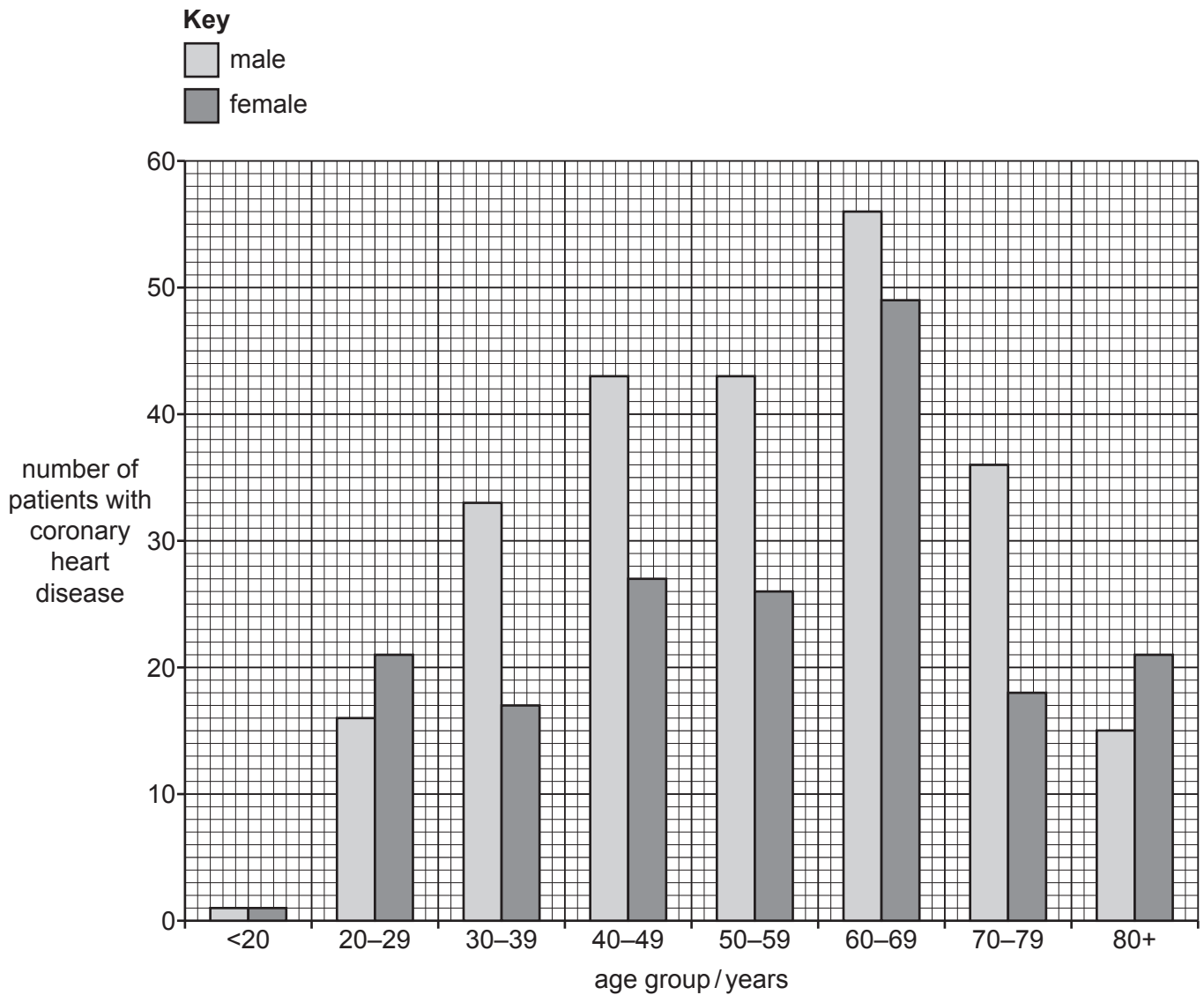


Fig. 1.2

- (i) Use Fig. 1.2 to identify **one** age group that has more females with coronary heart disease than males.

..... [1]

- (ii) Calculate the percentage of patients in the 70–79 age group that are female.

..... % [2]

[Total: 9]

2 Iron is extracted from hematite in the blast furnace.

Fig. 2.1 shows some of the substances that enter and leave the blast furnace.

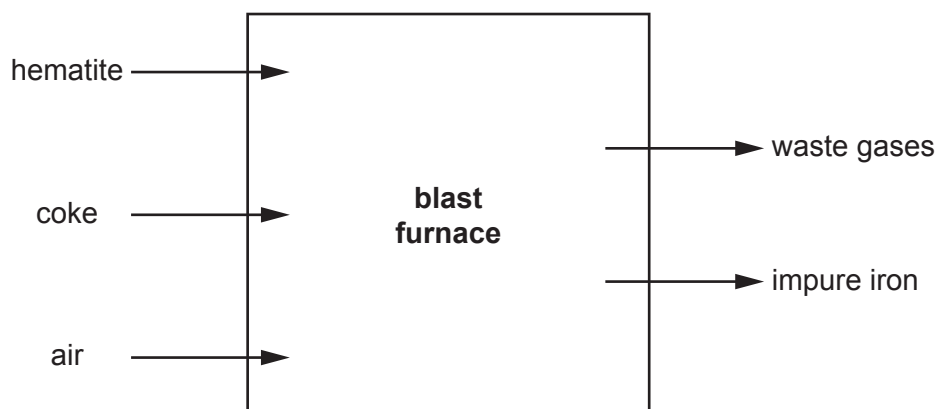
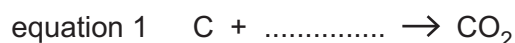


Fig. 2.1

- (a) (i) The equations for some reactions in the blast furnace are shown.

Complete the balanced equations.



[3]

- (ii) State the name of the substance shown in Fig. 2.1 that contains Fe_2O_3 .

..... [1]

- (iii) State why the waste gases that leave the blast furnace also contain nitrogen.

.....
 [1]

- (iv) Carbon monoxide is an air pollutant.

State the name of **one** other air pollutant.

..... [1]

- (b) Stainless steel is an alloy that contains iron.

Stainless steel is used to make cutlery, such as knives and forks.

- (i) Describe what is meant by the term alloy.

.....
..... [1]

- (ii) Suggest **two** reasons why the alloy stainless steel, rather than pure iron, is used to make cutlery.

1

2 [2]

[Total: 9]

3 In 1997, the Thrust Supersonic Car set a world land speed record.

(a) Fig. 3.1 shows forces **R**, **S**, **V** and **T** acting on the moving car.

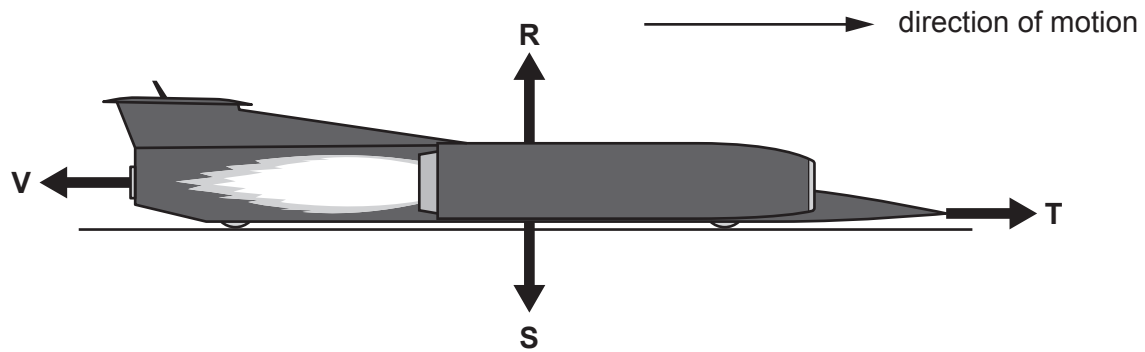


Fig. 3.1

State the letter for the weight of the car.

..... [1]

(b) The record speed of the car is 341 m/s.

(i) Show that 341 m/s is 1228 km/h.

[1]

(ii) The car changes speed from 0 to 341 m/s in 20.0 s.

Calculate the acceleration of the car.

Give the units of your answer.

acceleration = ... units [3]

- (iii) The mass of the car is 10 600 kg.

Calculate the kinetic energy of the car at the record speed of 341 m/s.

kinetic energy = ... J [2]

- (iv) Use your answer to (b)(iii) to calculate the useful power output from the engines of the car as the car accelerates over the 20.0 s.

power = ... W [2]

[Total: 9]

4 (a) Water moves from the roots of a plant through the stem to the leaves.

(i) Complete Fig. 4.1 to show the pathway of water through the plant.

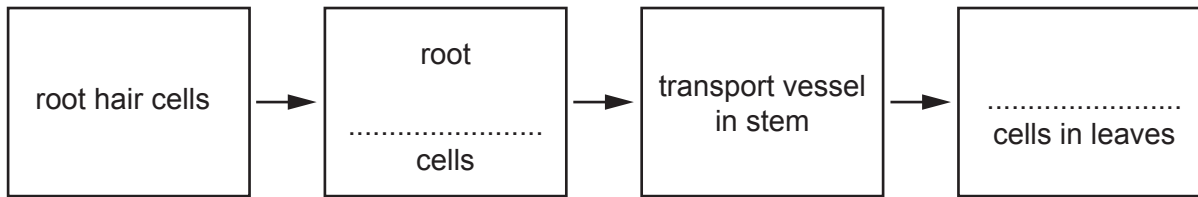


Fig. 4.1

[2]

(ii) Explain how root hair cells are adapted to their function.

.....

.....

..... [2]

(b) Fig. 4.2 is a graph showing the effect of increasing humidity on transpiration rate in plants.

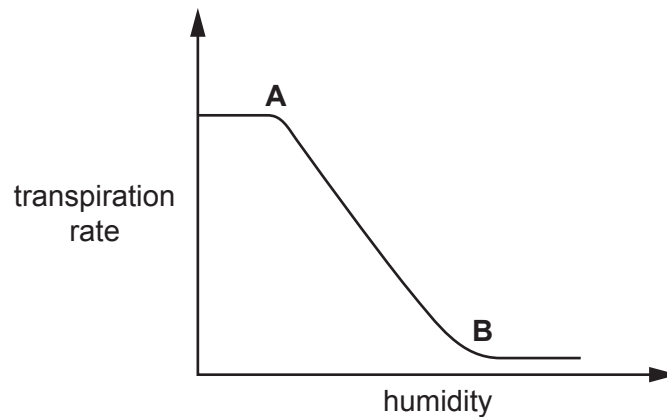


Fig. 4.2

Explain the shape of the graph between points **A** and **B** shown in Fig. 4.2.

.....

.....

.....

.....

..... [3]

- (c) Describe **two** differences between the pollen from insect-pollinated flowers and the pollen from wind-pollinated flowers.

1

.....

2

.....

[2]

[Total: 9]

- 5 The structures of ethane and ethene are shown in Fig. 5.1.

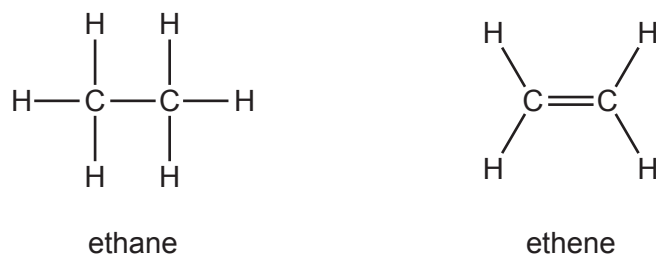


Fig. 5.1

- (a) Put a tick (✓) in **one** box in each row of Table 5.1 to show which description is true for ethane only, which is true for ethene only and which is true for both ethane and ethene.

Table 5.1

	true for ethane only	true for ethene only	true for both ethane and ethene
is a hydrocarbon			
is a saturated compound			
changes the colour of aqueous bromine			

[2]

- (b) State the number of bonding electrons between the two carbon atoms in ethene.

Explain your answer.

number of electrons

explanation

.....

[2]

(c) A student investigates the combustion of ethane, as shown in Fig. 5.2.

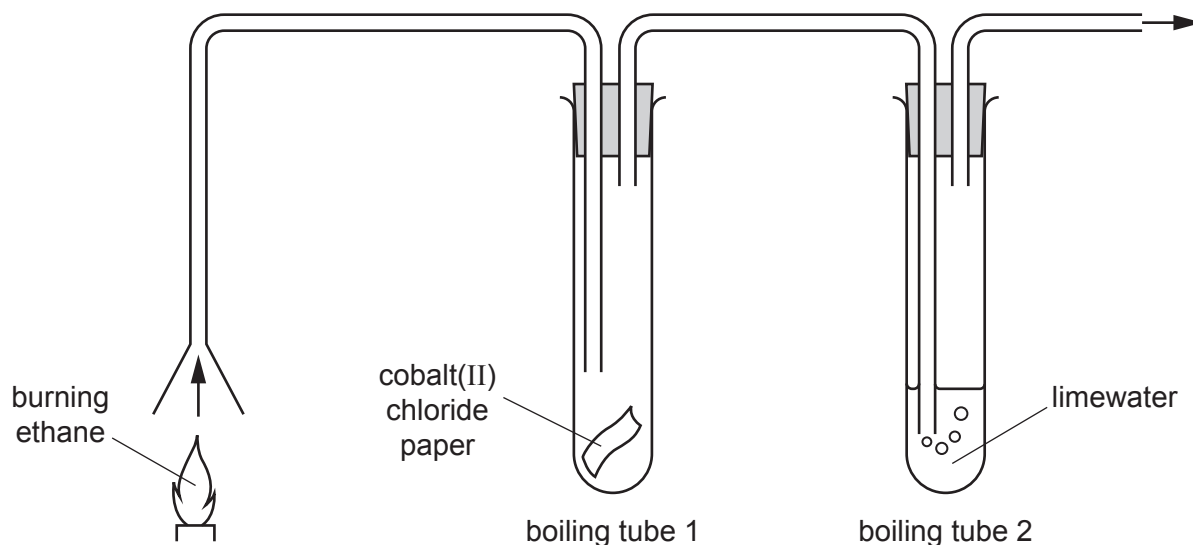


Fig. 5.2

The gases produced by the combustion of ethane pass through boiling tube 1 and boiling tube 2.

(i) State the change in colour of the cobalt(II) chloride paper in boiling tube 1.

Explain why this change happens.

colour changes from to

explanation

[2]

(ii) Explain what happens to the limewater in boiling tube 2.

.....

.....

..... [2]

(d) Describe the formation of poly(ethene) from ethene.

.....

.....

.....

..... [2]

[Total: 10]

- 6 Fig. 6.1 shows an electric heater with two heating elements connected to a 240 V supply.

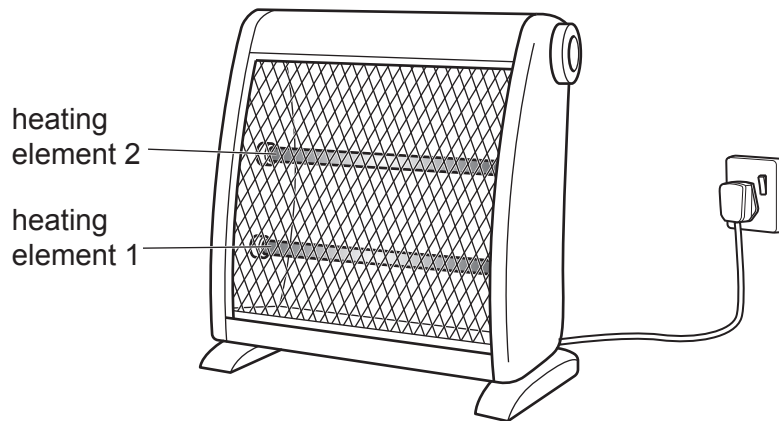


Fig. 6.1

Fig. 6.2 shows the circuit diagram for the heater.

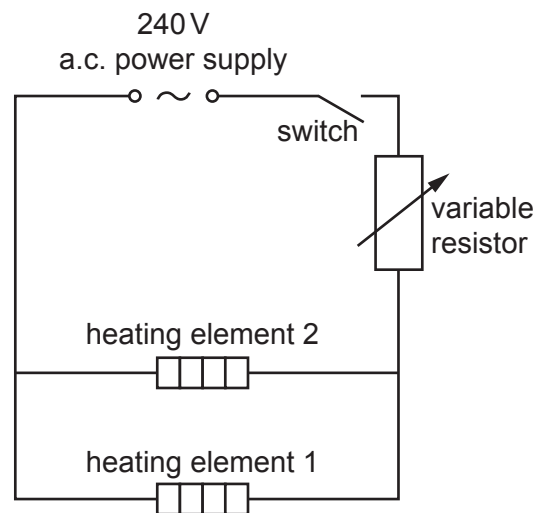


Fig. 6.2

Heating element 1 has a resistance of $72\ \Omega$.

Heating element 2 has a resistance of $36\ \Omega$.

- (a) The heater is switched on. The variable resistor is set to have zero resistance.

- (i) Show that the combined resistance of the two heating elements is $24\ \Omega$.

(ii) Calculate the current from the supply.

current = ...A [2]

(b) The resistance of the variable resistor is increased.

Explain the effect this has on the total thermal energy output from the heater.

.....

 [3]

(c) Fig. 6.3 shows the structure of a heating element.

wire wound into a coil

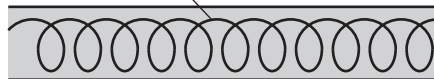


Fig. 6.3

The wire in heating element 2 is the same length as the wire in heating element 1.

The wire in heating element 2 is the same material as the wire in heating element 1.

Describe how heating element 2 has a lower resistance than heating element 1.

.....
 [2]

[Total: 9]

- 7 (a) Chemical digestion and mechanical digestion take place in the alimentary canal.

Place ticks (✓) in the boxes next to the correct statements about chemical and mechanical digestion.

Both types of digestion **always** form soluble molecules.

☐

Both types of digestion take place in the mouth.

☐

Both types of digestion use enzymes.

☐

Only chemical digestion takes place in the stomach.

☐

Only mechanical digestion involves no chemical change.

☐

[2]

- (b) The pancreas secretes the enzyme protease.

- (i) State the name of **one** other enzyme secreted by the pancreas.

..... [1]

- (ii) State the substrate and product of digestion of the enzyme protease.

substrate

product

[1]

(c) Fig. 7.1 shows the effect of pH on protease activity.

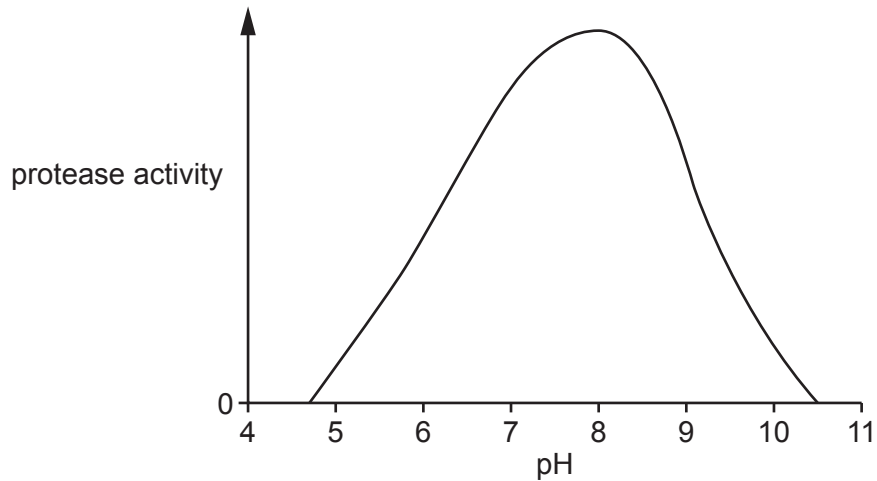


Fig. 7.1

(i) Explain why protease activity is zero at pH 10.5.

.....

.....

.....

.....

..... [3]

(ii) Use Fig. 7.1 to explain why this protease is from the pancreas and **not** from gastric juice.

.....

.....

..... [2]

[Total: 9]

- 8 Lead(II) bromide is electrolysed using inert electrodes, as shown in Fig. 8.1.

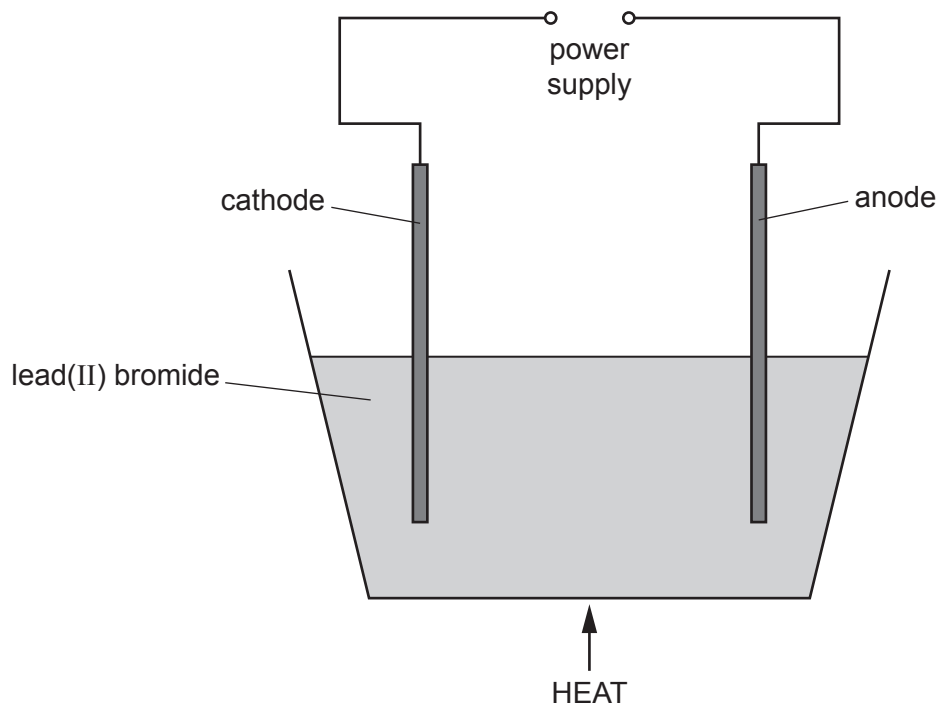


Fig. 8.1

- (a) Lead forms during the electrolysis.

Table 8.1 shows the melting points of lead(II) bromide and lead.

Table 8.1

	melting point/ $^{\circ}\text{C}$
lead(II) bromide	373
lead	328

- (i) Lead(II) bromide must be heated strongly for the electrolysis to work.

Explain why.

Use ideas about ions in your answer.

.....

.....

..... [2]

- (ii) Suggest a suitable temperature for the electrolysis to take place.

Explain your answer.

temperature °C

explanation

[1]

- (iii) State whether lead forms as a solid or as a liquid during the electrolysis.

Use Table 8.1 to explain your answer.

lead forms as a

explanation

[1]

- (b) Complete the sentences about the electrolysis of lead(II) bromide.

Use words from the list.

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

anode

atoms

cathode

gain

lose

molecules

share

Lead ions are attracted to the

The lead ions electrons to form

lead

[2]

- (c) Bromine gas forms during the electrolysis of lead(II) bromide.

State the colour of bromine gas.

..... [1]

[Total: 7]

9 (a) The electromagnetic spectrum has seven different regions, including microwaves and X-rays.

(i) Fig. 9.1 shows an incomplete electromagnetic spectrum.

On Fig. 9.1, write microwaves and X-rays in their correct places.

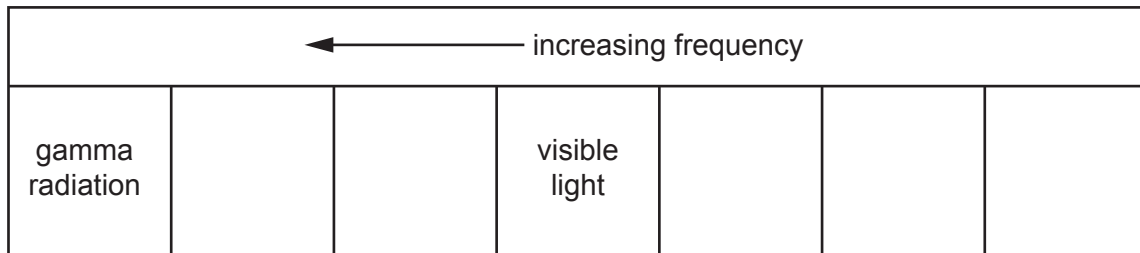


Fig. 9.1

[2]

(ii) Microwave ovens use microwaves to heat food.

A microwave oven uses microwaves with a frequency of 2.48×10^9 Hz.

The speed of the microwaves is 3×10^8 m/s.

Calculate the wavelength of the microwaves.

wavelength = ... m [2]

(iii) X-rays are used for medical imaging.

State **one** danger of X-rays to human health.

..... [1]

(b) Fig. 9.2 shows two cups of hot water, **A** and **B**.

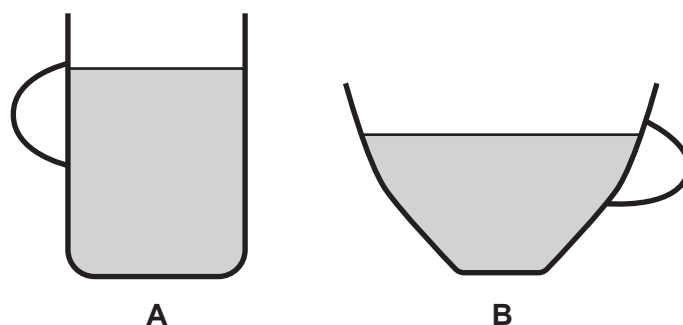


Fig. 9.2

Both cups:

- are made of the same material
- contain the same volume of hot water at the same temperature
- rest on the same surface in the same surroundings.

(i) Describe **two** ways in which both cups of water lose thermal energy to their surroundings.

1

2 [2]

(ii) Explain why the water in cup **B** cools more quickly than the water in cup **A**.

.....

.....

..... [2]

[Total: 9]

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 (UCLES) 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.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
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		2 He helium 4
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 —		114 Fl flerovium —		116 Lv livermorium —			

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 dm³ at room temperature and pressure (r.t.p.).



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/43

October/November 2022

1 hour 15 minutes

No additional materials are needed.

- 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.

- 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.

- 1 (a) Fig. 1.1 is a diagram of a wind-pollinated flower.

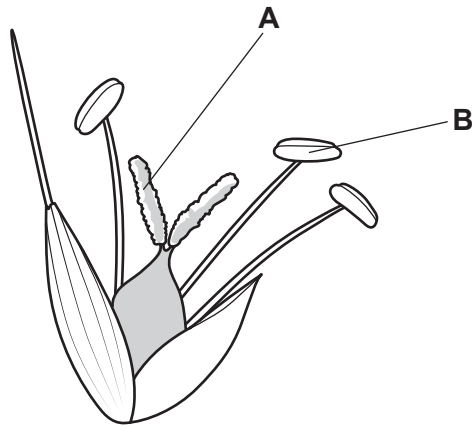


Fig. 1.1

- (i) State the names of the parts labelled **A** and **B** on Fig. 1.1.

A

B

[2]

- (ii) On Fig. 1.1, draw a label line and the letter **X** to identify the part that produces ovules. [1]

- (iii) Describe **two** adaptations for wind pollination of the flower shown in Fig. 1.1.

1

2

[2]

(b) Fig. 1.2 shows a food web.

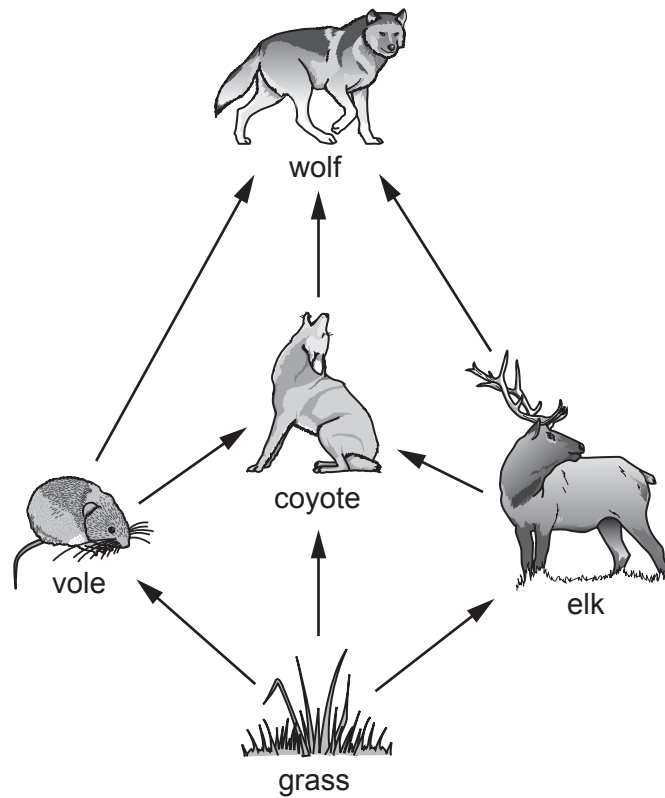


Fig. 1.2

(i) Use Fig. 1.2 to construct **one** food chain that contains the vole.

..... [2]

(ii) Identify **one** organism in Fig. 1.2 that is on the third trophic level.

..... [1]

(iii) Identify **one** organism in Fig. 1.2 that is a primary **and** a secondary consumer.

..... [1]

(c) Grass photosynthesises.

State the balanced chemical equation for photosynthesis.

..... [2]

[Total: 11]

- 2 The electronic structures of a chlorine atom and a chloride ion are shown in Fig. 2.1.

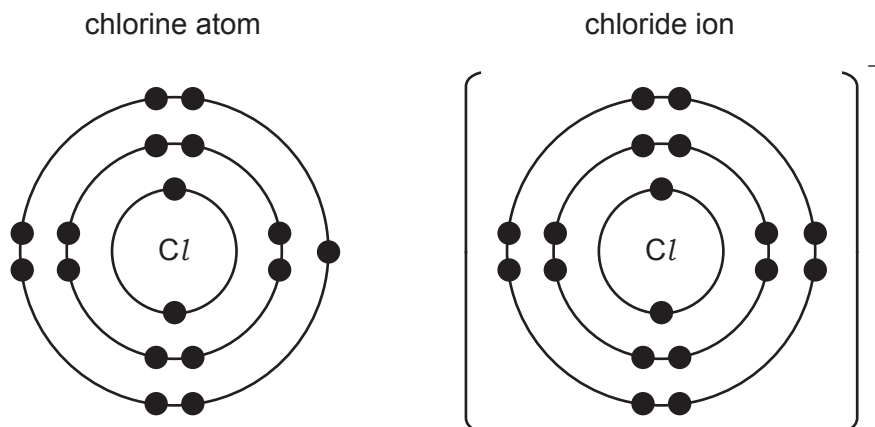


Fig. 2.1

- (a) State **two** differences between the chlorine atom and the chloride ion shown in Fig. 2.1.

1

2 [2]

- (b) (i) Explain how Fig. 2.1 can be used to deduce the proton number of chlorine.

.....

..... [1]

- (ii) Explain how Fig. 2.1 can be used to deduce the period number of chlorine in the Periodic Table.

.....

..... [1]

- (iii) Element **X** and chlorine are in the same group of the Periodic Table.

Element **X** is less reactive than chlorine.

Suggest the identity of element **X**.

Give a reason for your answer.

element **X**

reason

..... [2]

- (c) Table 2.1 shows the melting points of chlorine and sodium chloride.

Table 2.1

	melting point / °C
chlorine	–101
sodium chloride	801

Explain the difference in the melting points of chlorine and sodium chloride.

Use ideas about structure and attractive forces in your answer.

.....

.....

.....

..... [3]

[Total: 9]

- 3 A new world water speed record was set in 1978 by a specially designed speed boat.

Fig. 3.1 shows forces **K**, **L**, **M** and **N** acting on the moving boat.

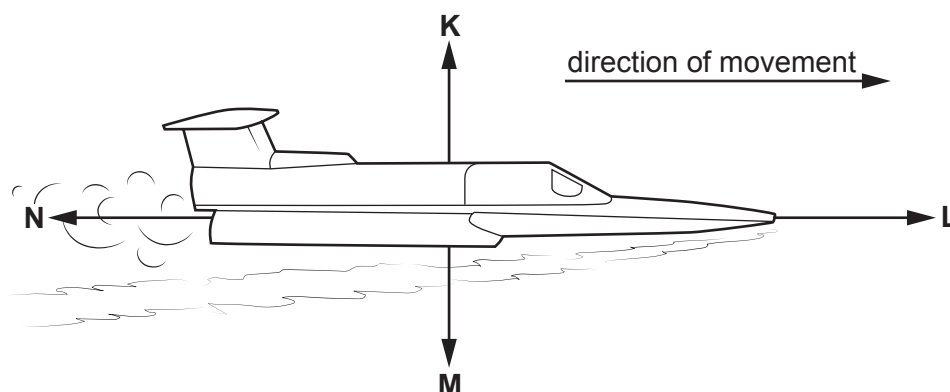


Fig. 3.1

- (a) (i) State the letter that represents the friction acting on the boat. [1]

- (ii) Force **L** is 10 000 N. Force **N** is 8 000 N.

Describe the effect of these forces on the motion of the boat.

.....
 [1]

- (b) The world record speed of the boat is 142 m/s.

- (i) Calculate the world record speed of the boat in kilometres per hour (km/h).

speed = ... km/h [1]

- (ii) The engine of the boat exerts a force of 15 000 N to accelerate the boat from rest to its world record speed.

The boat moves a distance of 504 m.

Calculate the work done by the engine on the boat.

Give the unit of your answer.

work done = ... unit [3]

(c) Fig. 3.2 shows the speed–time graph for the boat doing a practice run.

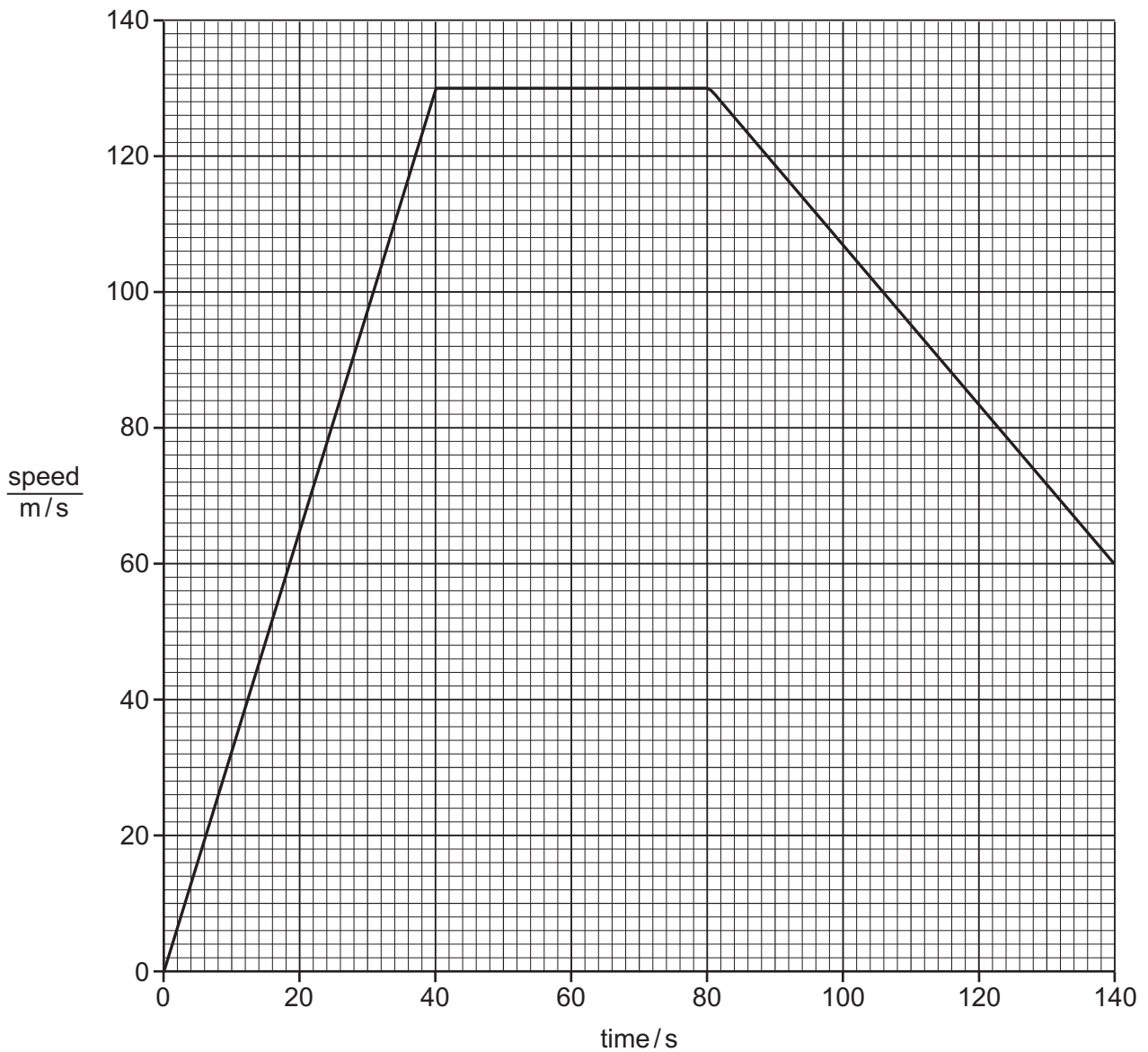


Fig. 3.2

(i) State the maximum speed of the boat shown in Fig. 3.2.

maximum speed = ... m/s [1]

(ii) Use Fig. 3.2 to determine the distance the boat moves between 0 and 80 s.

distance = ... m [3]

[Total: 10]

- 4 (a) Fig. 4.1 is a diagram of a human heart.

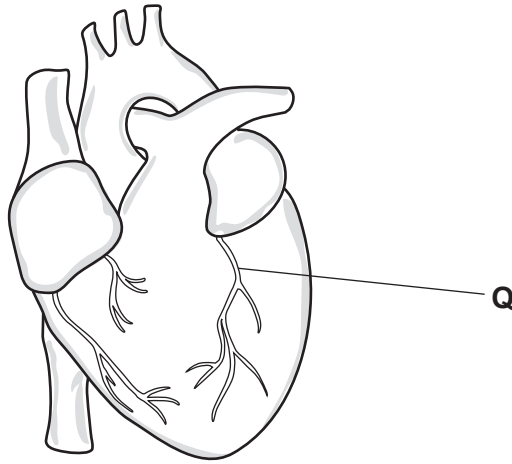


Fig. 4.1

- (i) State the name of part **Q** and explain how it is linked to coronary heart disease.

Q

explanation

.....

[2]

- (ii) Risk factors for coronary heart disease include diet and smoking.

State **two** other risk factors for coronary heart disease.

1

2

[2]

(b) Fig. 4.2 shows how physical activity affects heart rate.

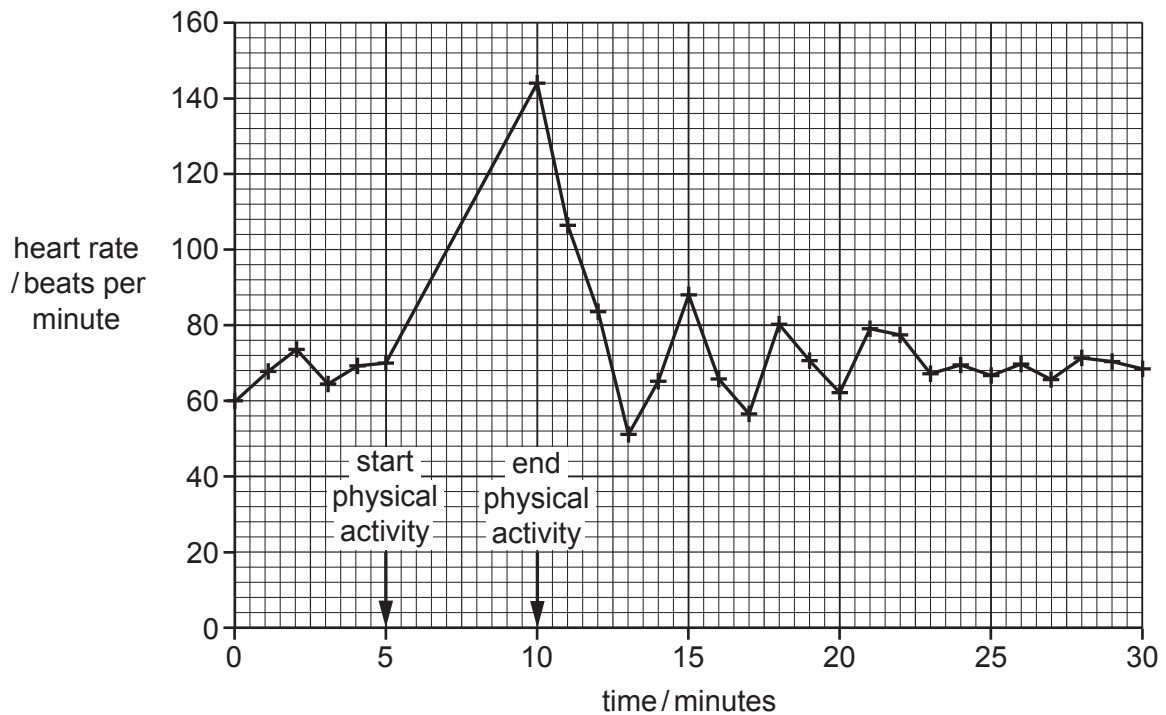


Fig. 4.2

(i) Use Fig. 4.2 to calculate the percentage increase in heart rate between 0 and 10 minutes.

percentage increase in heart rate = ... % [2]

(ii) Explain the shape of the graph in Fig. 4.2 between 5 and 10 minutes.

.....

.....

.....

.....

..... [3]

[Total: 9]

- 5 (a) Iron is extracted from hematite in the blast furnace.

One chemical equation for the extraction of iron in the blast furnace is shown.



- (i) Complete the balanced chemical equation. [2]

- (ii) Identify the reducing agent in this extraction.

Explain your answer.

reducing agent

explanation

..... [1]

- (b) Iron rusts when it reacts with oxygen and water to make hydrated iron(III) oxide.

- (i) A word equation for the rusting of iron is shown.



Explain why rusting is described as an oxidation reaction.

..... [1]

- (ii) State **one** method of rust prevention and describe how this method works.

method

description

..... [2]

(c) Iron reacts with dilute hydrochloric acid in an exothermic reaction.

(i) The reaction produces iron(II) chloride.

State the formula of iron(II) chloride.

..... [1]

(ii) Explain how a reaction is exothermic.

Use ideas about bonds in your answer.

.....
.....
.....
.....
..... [3]

[Total: 10]

- 6 Fig. 6.1 shows an electric toaster used to toast one slice of bread.

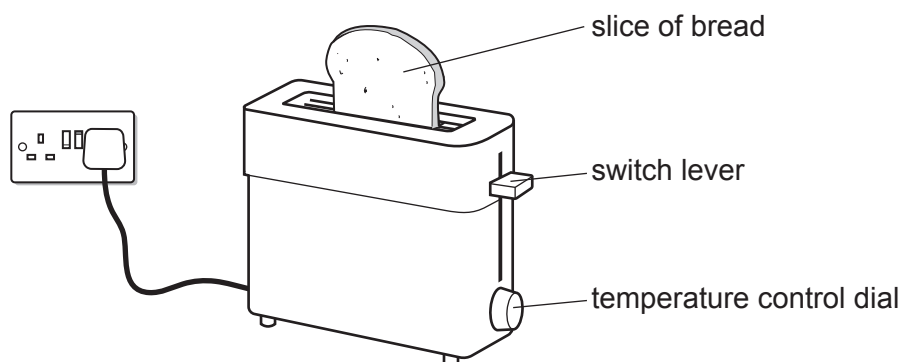


Fig. 6.1

Fig. 6.2 shows the circuit diagram for the toaster.

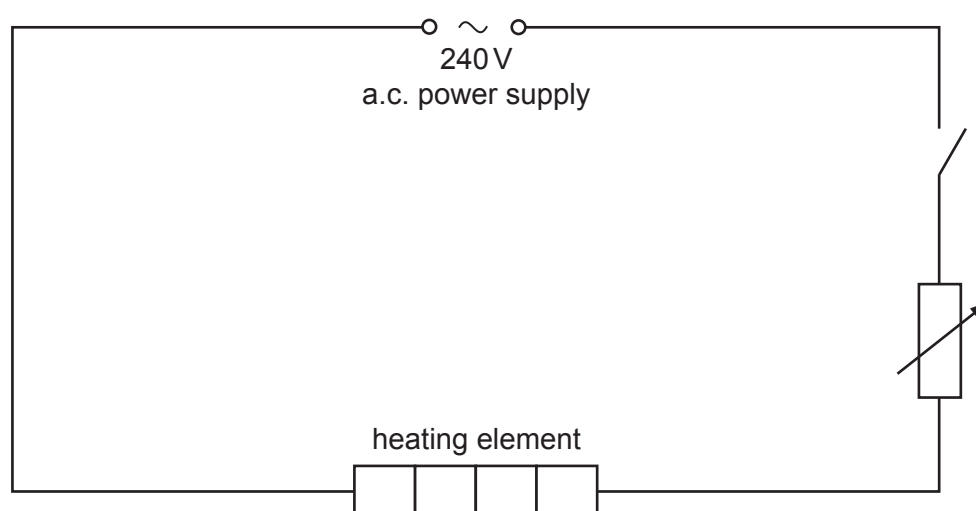


Fig. 6.2

- (a) Add a voltmeter to the circuit diagram in Fig. 6.2 to measure the potential difference (p.d.) across the heating element.

Use the correct circuit symbol.

[1]

- (b) The switch lever is pushed down to switch the toaster on.

The temperature control dial adjusts the variable resistor.

- (i) The resistance of the variable resistor is adjusted to $36\ \Omega$.

The resistance of the heating element is $54\ \Omega$.

Calculate the total resistance in the circuit.

resistance = ... Ω [1]

- (ii) The resistance of the variable resistor is decreased.

Explain why the thermal energy output from the heating element increases.

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

- (c) Fig. 6.3 shows the circuit diagram for a different toaster that has two heating elements connected in parallel.

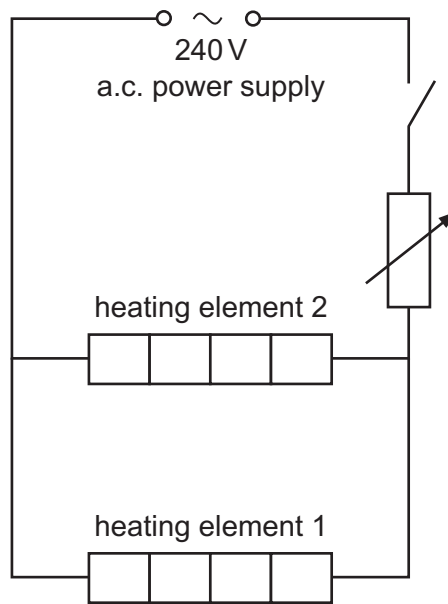


Fig. 6.3

- (i) Heating element 1 has a resistance of $41.0\ \Omega$.

Heating element 2 has a resistance of $53.0\ \Omega$.

Show that the combined resistance of the two heating elements in parallel is $23.1\ \Omega$.

[2]

- (ii) The variable resistor is adjusted so that the total resistance in the circuit is $60.0\ \Omega$.

The toaster is switched on.

The current in heating element 1 is 2.3 A .

Calculate the current in heating element 2.

current = ... A [3]

[Total: 9]

- 7 (a) Fig. 7.1 shows cells that line the gas exchange system of humans.

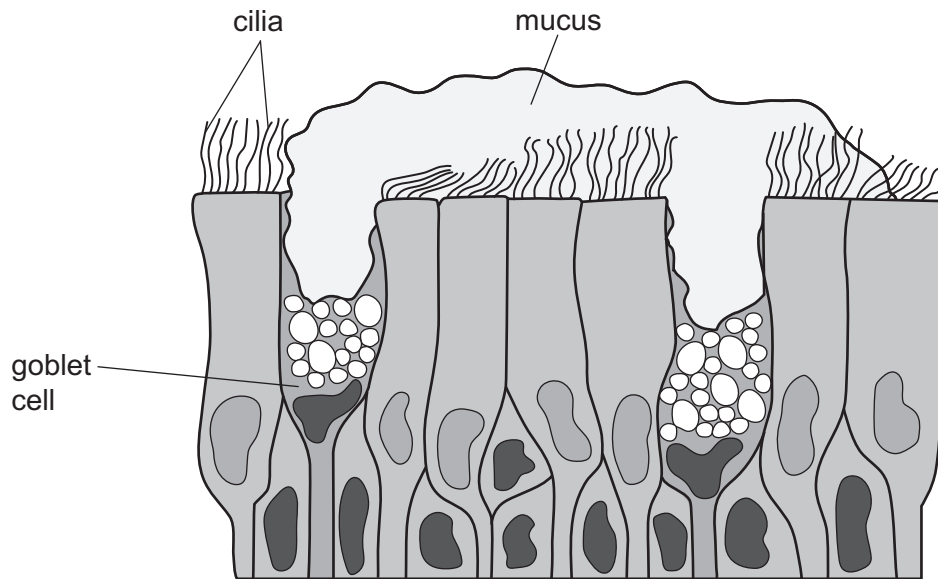


Fig. 7.1

- (i) Use Fig. 7.1 to explain how tar in tobacco smoke prevents the cells from protecting the gas exchange system.

.....

.....

.....

.....

..... [3]

- (ii) Explain how the carbon monoxide in tobacco smoke affects the function of red blood cells.

.....

.....

..... [2]

- (b) The lungs contain a gas exchange surface. This surface is large and thin.

State **two** other features of gas exchange surfaces.

1

2

[2]

[Total: 7]

8 Car engines take in air.

Unreacted air and other gases leave the car in the exhaust gases, as shown in Fig. 8.1.

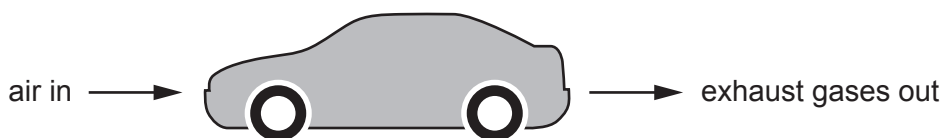


Fig. 8.1

- (a) The air entering a car engine is a mixture of gases which includes nitrogen, oxygen, argon and carbon dioxide.

(i) State which **one** of these gases is monoatomic.

..... [1]

(ii) Air is a mixture. Carbon dioxide is a compound.

Explain the difference between a mixture and a compound.

.....

 [2]

- (b) The concentration of oxygen in the air entering a car engine is greater than the concentration of oxygen in the exhaust gases leaving the car.

Explain why.

.....
 [2]

- (c) Car exhaust gases cause an increase in the concentration of carbon dioxide in the atmosphere. This causes an enhanced greenhouse effect.

State **one** impact of an enhanced greenhouse effect.

..... [1]

- (d) Carbon dioxide in the air dissolves in rainwater and causes damage to buildings.

State the name of **one** other gas that causes the same problem.

..... [1]

[Total: 7]

- 9 (a) (i) Fig. 9.1 shows an incomplete electromagnetic spectrum.

On Fig. 9.1, write infrared radiation in its correct place.

← increasing frequency						
gamma radiation			visible light			

Fig. 9.1

[1]

- (ii) State the speed of infrared radiation in a vacuum.

..... m/s [1]

- (iii) A toaster for toasting bread is one use of infrared radiation.

State **one** other use of infrared radiation.

..... [1]

(b) Fig. 9.2 shows a type of vacuum flask used for carrying a cold liquid at 5°C .

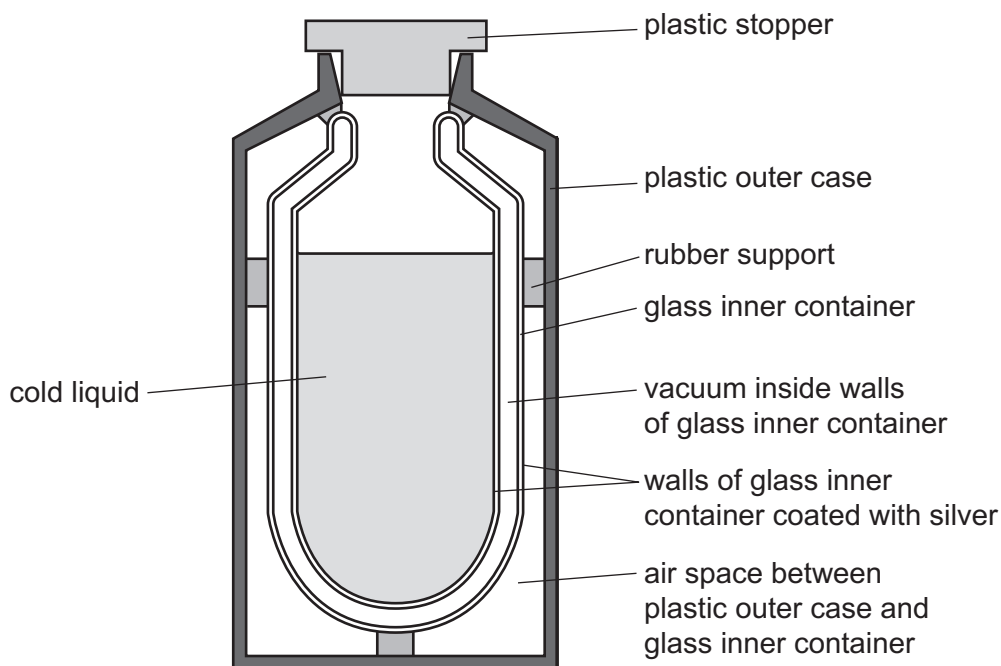


Fig. 9.2

The flask is placed in a room. The temperature of the room is 20°C .

- (i) Describe **one** way that the design of the flask reduces the transfer of thermal energy from the room to the liquid by:

convection

.....

radiation.

.....

[2]

- (ii) Describe how a small amount of thermal energy is transferred from the room to the liquid by **conduction**.

Use ideas about vibrations in your answer.

.....

.....

..... [2]

- (iii) A special type of vacuum flask is used to store liquid air at -196°C .

Table 9.1 shows the boiling points of the main components of liquid air.

Table 9.1

component	boiling point/ $^{\circ}\text{C}$
argon	-186
nitrogen	-196
oxygen	-183

State which component is most likely to form bubbles of gas first.

Give a reason for your answer.

component

reason

.....

[1]

[Total: 8]

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 (UCLES) 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.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	VIII		
		1 H hydrogen 1																	
		Key atomic number atomic symbol name relative atomic mass																	
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 —		114 Fl flerovium —		116 Lv livermorium —			

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
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 —

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).