

Cambridge IGCSE™

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

COMBINED SCIENCE

0653/43

Paper 4 Theory (Extended)

October/November 2022

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.

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.

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

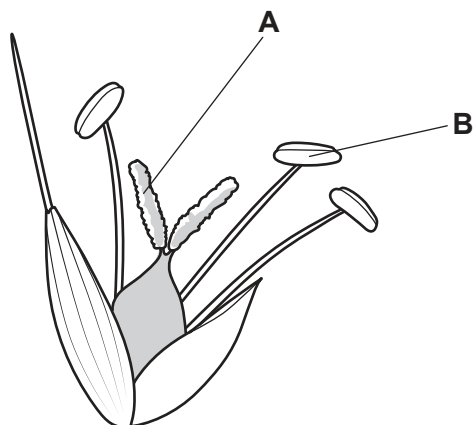


Fig. 1.1

- (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.

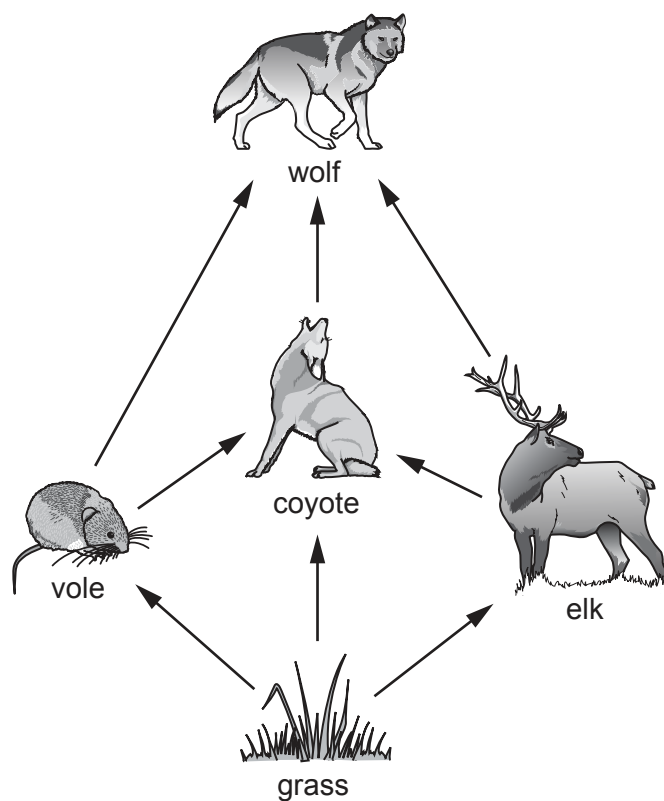


Fig. 1.2

(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.

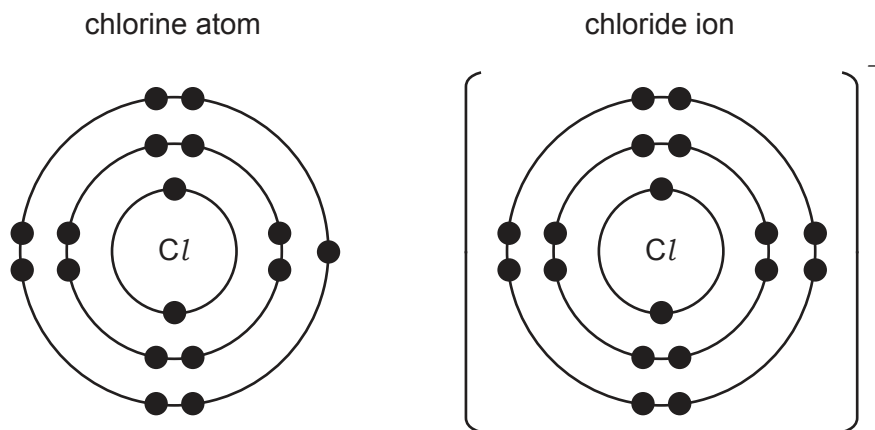


Fig. 2.1

- (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.

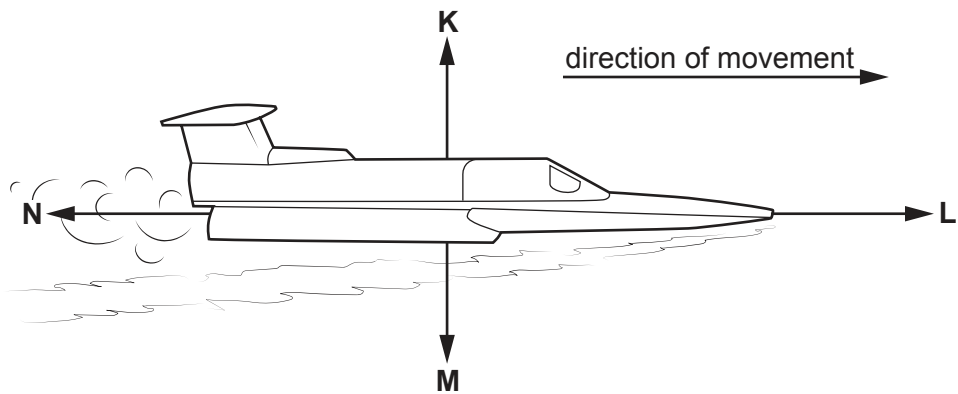


Fig. 3.1

(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.

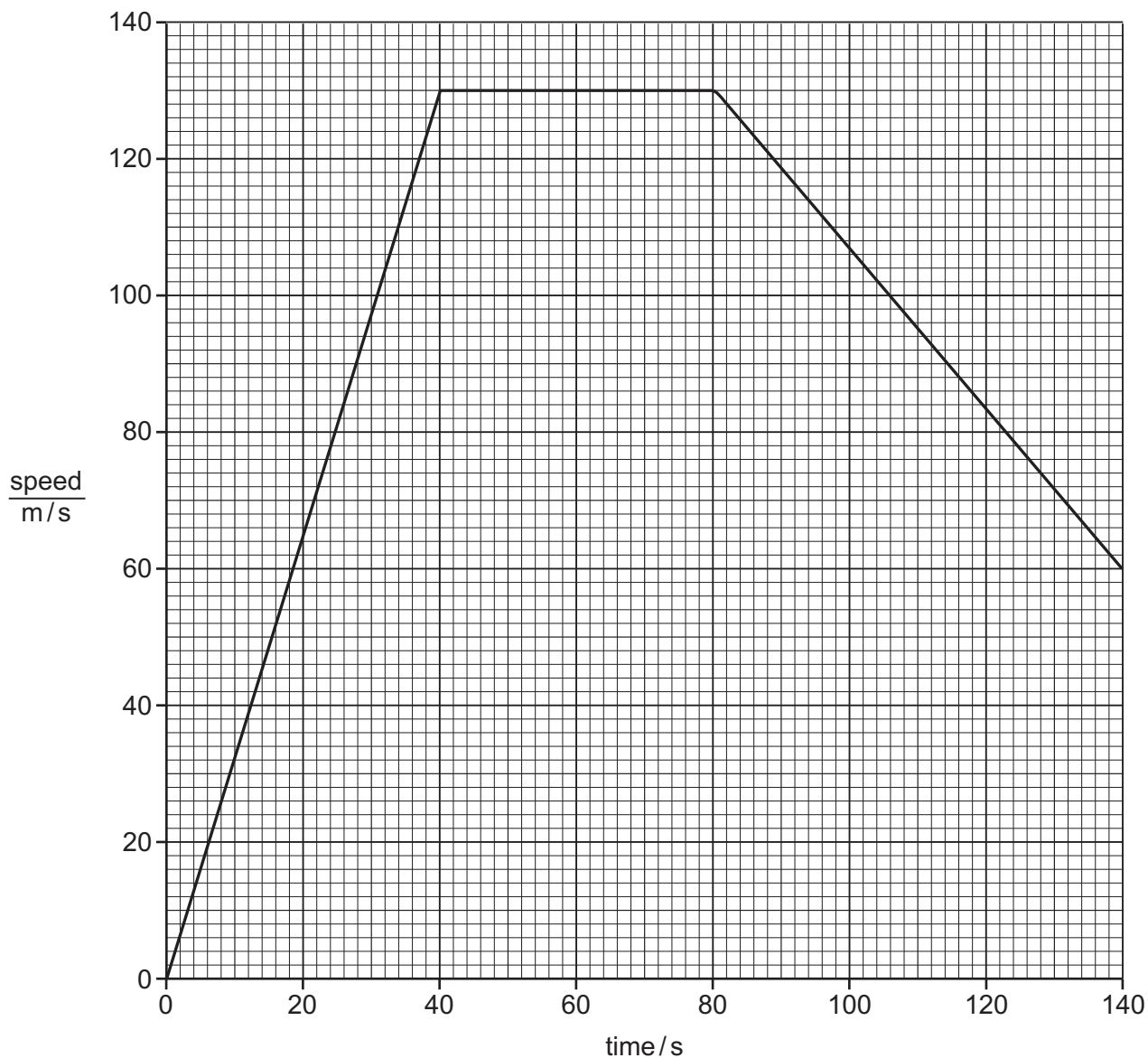


Fig. 3.2

(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.

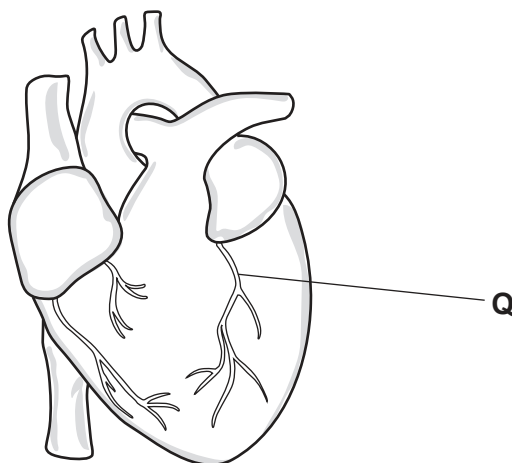


Fig. 4.1

- (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.

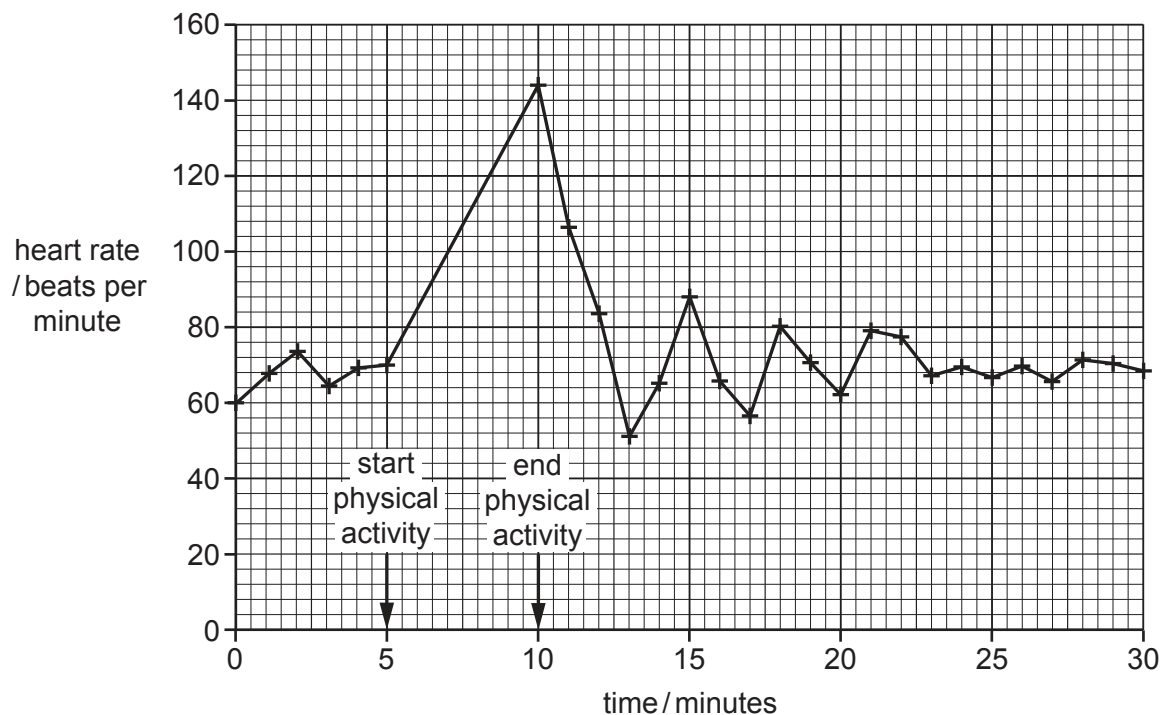


Fig. 4.2

(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.

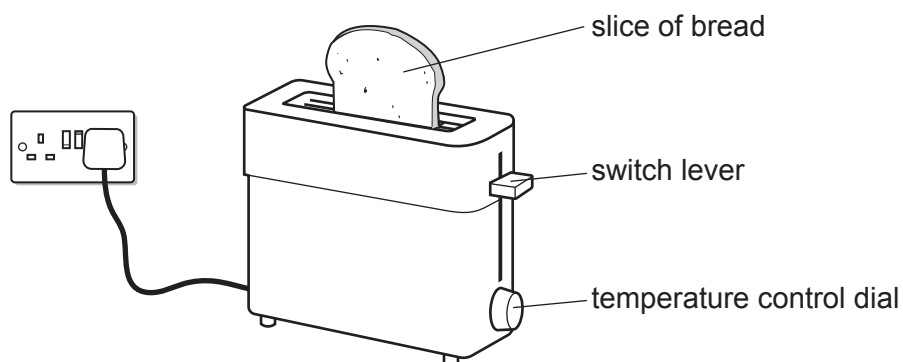


Fig. 6.1

Fig. 6.2 shows the circuit diagram for the toaster.

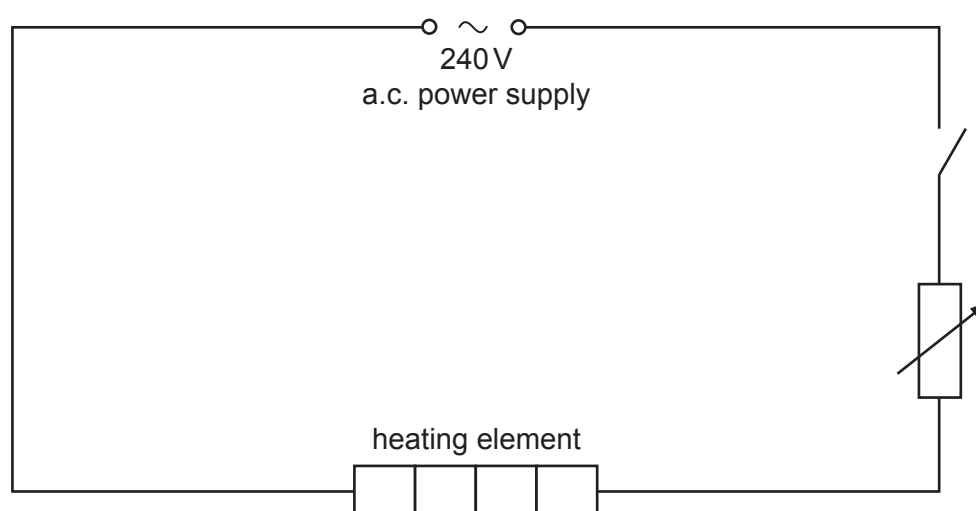


Fig. 6.2

- (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.

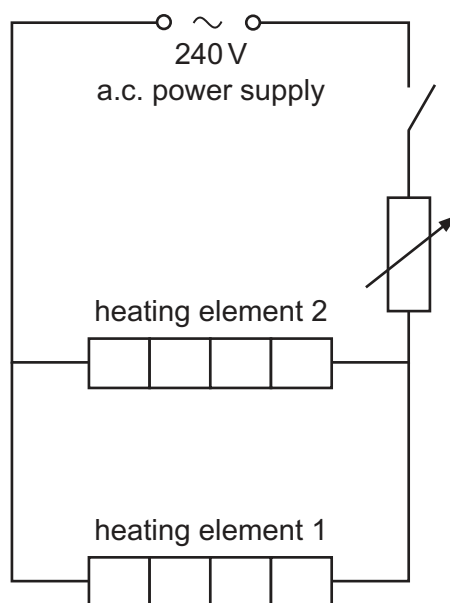


Fig. 6.3

- (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.

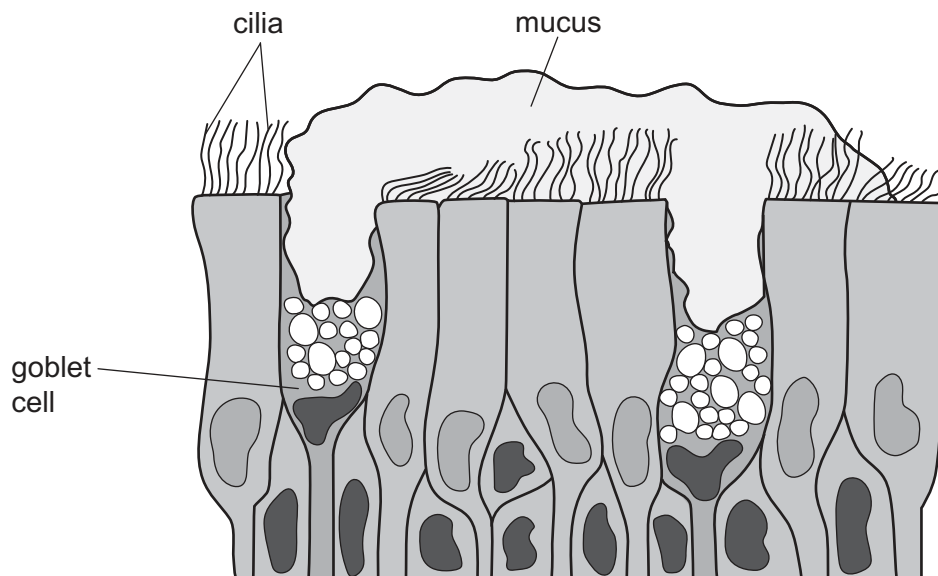


Fig. 7.1

- (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.

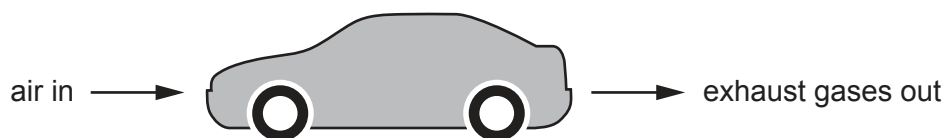


Fig. 8.1

- (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.

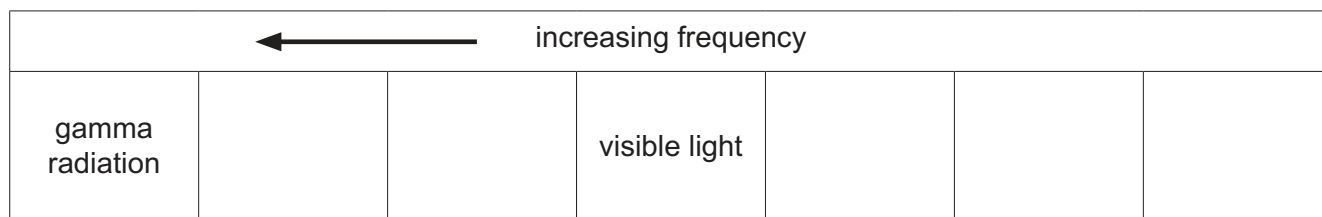


Fig. 9.1

[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.

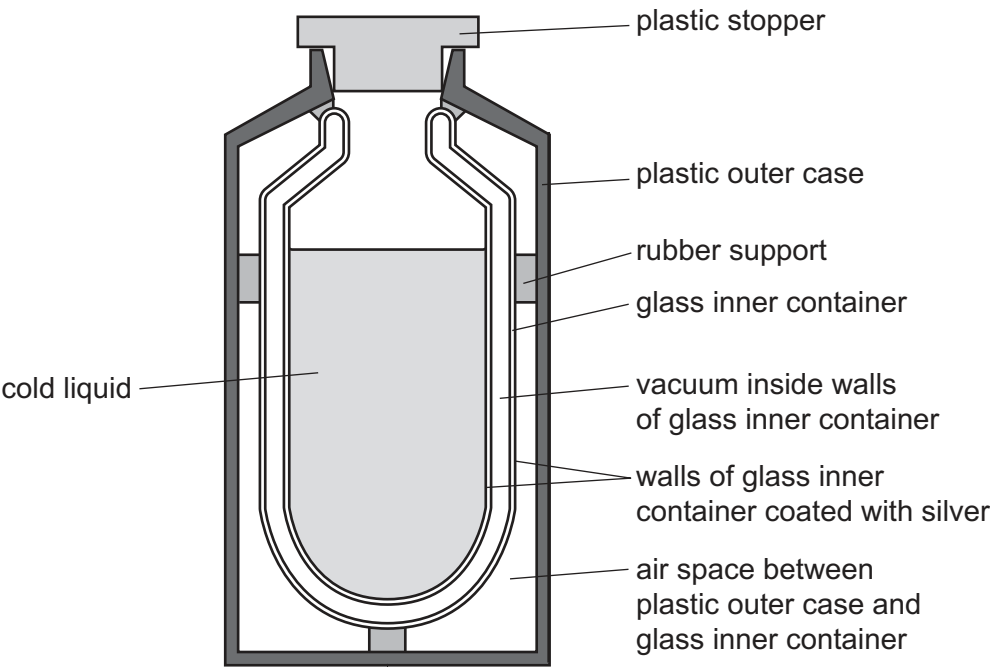


Fig. 9.2

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		
		1Hhydrogen1																	
		Key atomic number atomic symbol name relative atomic mass																	
3Li lithium 7	4Be beryllium 9													5B boron 11	6C carbon 12	7N nitrogen 14	8O oxygen 16	9F fluorine 19	10Ne neon 20
11Na sodium 23	12Mg magnesium 24													13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84		
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131		
55Cs caesium 133	56Ba barium 137	57–71 lanthanoids	72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —		
87Fr francium —	88Ra radium —	89–103 actinoids	104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —		114Fl flerovium —		116Lv 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.).