GradeMax

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

9746570447

COMBINED SCIENCE **0653/31**

Paper 3 Theory (Core) **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 **24** pages. Any blank pages are indicated.

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1 **(a)** Fig. 1.1 shows part of the alimentary canal and associated organs.

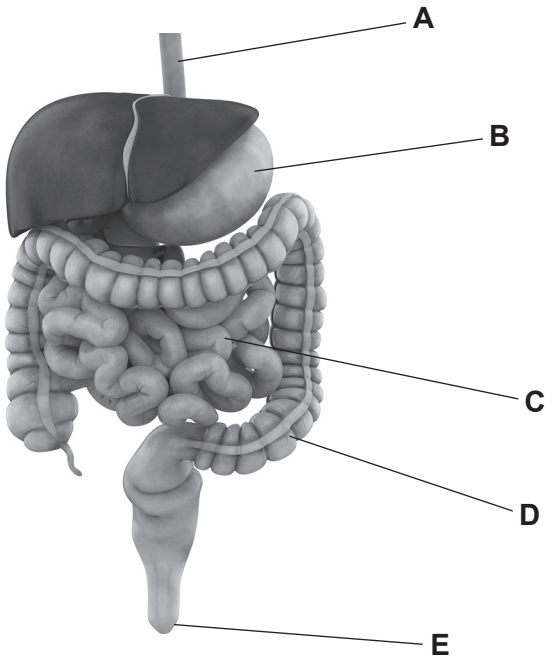


Fig. 1.1

(i) State the letter in Fig. 1.1 that identifies the stomach. ..... [1]

(ii) State the letter in Fig. 1.1 that identifies where egestion occurs. ..... [1]

(b) Chemical digestion takes place in the alimentary canal.

(i) Explain why chemical digestion is needed before some nutrients can be absorbed.

.....

.....

..... [2]

(ii) Biological catalysts are used in chemical digestion.

Circle the name of these biological catalysts.

acids **enzymes** **hormones** **platelets**

[1]

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(c) Table 1.1 shows the recommended daily intake of some different nutrients for males and females of different ages.

Table 1.1

		males		females	
		11–14 years	15–18 years	11–14 years	15–18 years
recommended daily intake	protein / g	42	55	41	45
	vitamin C / mg	35	40	35	40
	iron / mg	11	11	14	14

(i) State the recommended daily intake of **protein** for 12-year-old males.

..... g [1]

(ii) Calculate the difference in recommended daily intake of **iron** for 15-year-old males and 15-year-old females.

..... mg [1]

(iii) Between the ages of 15 and 18, males usually grow more than females.

Identify evidence from Table 1.1 to support this statement.

.....

..... [1]

(d) State the importance of **calcium** in the diet.

.....

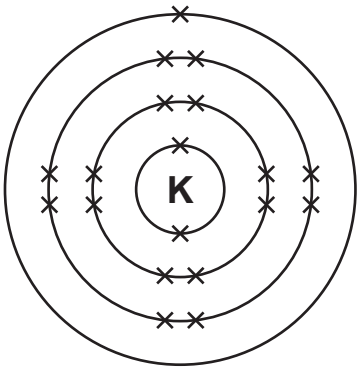
..... [1]

[Total: 9]

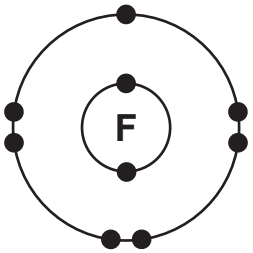
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2 **(a)** Potassium, K, and fluorine, F, are both elements.

The electronic structure of a potassium atom and of a fluorine atom are shown in Fig. 2.1.



potassium atom

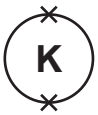


fluorine atom

Fig. 2.1

Potassium and fluorine react exothermically to form the compound potassium fluoride.

(i) Complete Fig. 2.2 to show the electronic structure of a potassium **ion** and of a fluoride **ion** in potassium fluoride.



potassium ion



fluoride ion

Fig. 2.2

[2]

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(ii) State what is meant by the term exothermic.

.....

..... [1]

(iii) State what is meant by the terms element and compound.

element .....

.....

compound .....

.....
[2]

(b) A student investigates the rate of reaction between solid potassium oxide and dilute sulfuric acid.

(i) State the name of the salt that forms in this reaction.

..... [1]

(ii) Suggest **two** ways of increasing the rate of this reaction.

1 .....

2 .....
[2]

(c) Potassium carbonate reacts with dilute hydrochloric acid to make potassium chloride and a gas and one other product.

Complete the word equation for this reaction.

potassium carbonate	+	dilute hydrochloric acid	→	potassium chloride	+		+	

[2]

[Total: 10]

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[Turn over

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

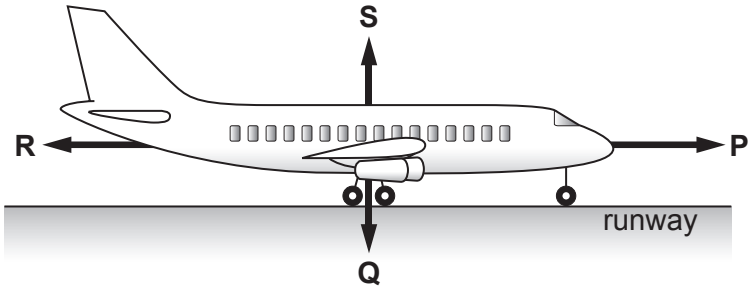


Fig. 3.1

(a) Force **P** is the driving force of the airplane engines.

State the name of force **R**.

..... [1]

(b) The airplane has a weight of 1 200 000 N.

Calculate the mass of the airplane.

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

mass = ... kg [2]

(c) The airplane moves along the runway for 50 s at a constant speed of 100 km / h.

(i) Show that the speed of the airplane in metres per second is 28 m / s.

[2]

(ii) Calculate the distance the airplane moves along the runway in 50 s.

distance = ... m [2]

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(d) (i) The airplane moves along the runway.

- From $t = 0$ s to $t = 50$ s, the airplane moves at a constant speed of 28 m / s.
- From $t = 50$ s to $t = 100$ s, the airplane accelerates with constant acceleration.
- At $t = 100$ s, the airplane reaches a speed of 84 m / s.

On Fig. 3.2, plot a speed-time graph of the motion of the airplane from $t = 0$ s to $t = 100$ s.

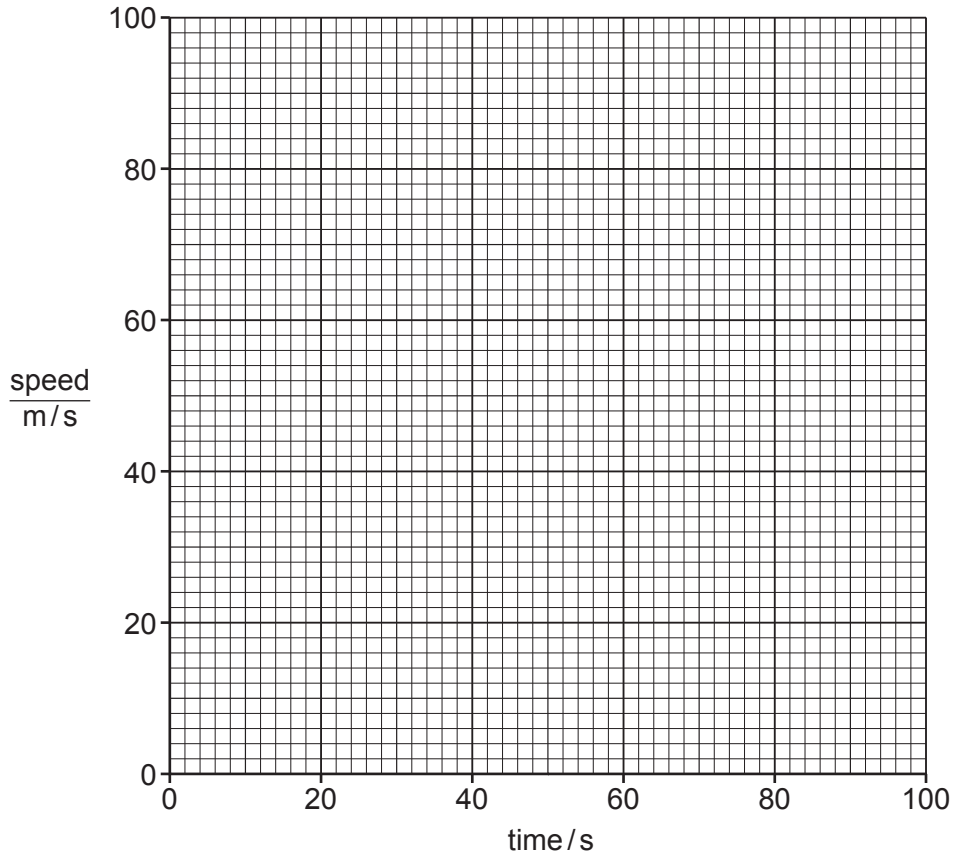


Fig. 3.2

[3]

(ii) At $t = 100$ s, the airplane takes off.

The airplane climbs to a height of 5000 m above the ground.

State the form of energy gained by the airplane due to its increase in height.

..... [1]

[Total: 11]

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4 **(a)** A student draws a labelled diagram of a human heart.

Fig. 4.1 shows the drawing.

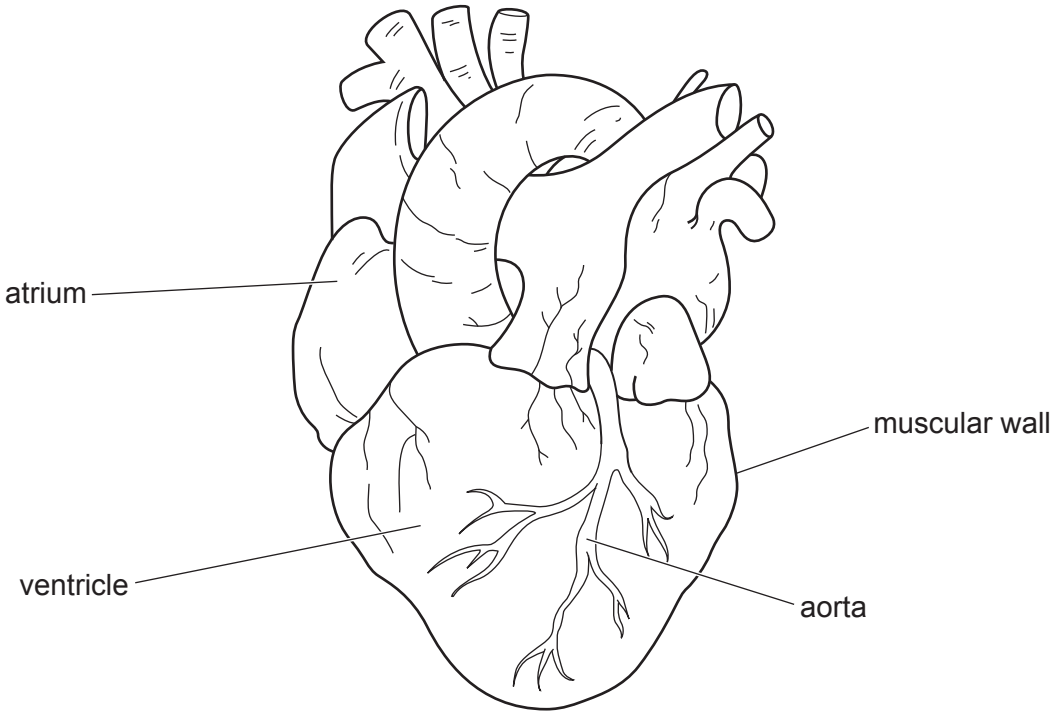


Fig. 4.1

(i) One of the labels in Fig. 4.1 is **not** correct.

Circle the label in Fig. 4.1 that is **not** correct. [1]

(ii) State the name of the blood vessel that brings blood to the heart from the lungs.

..... [1]

(iii) State the function of the heart.

..... [1]

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(b) Fig. 4.2 is a photomicrograph of blood vessels.

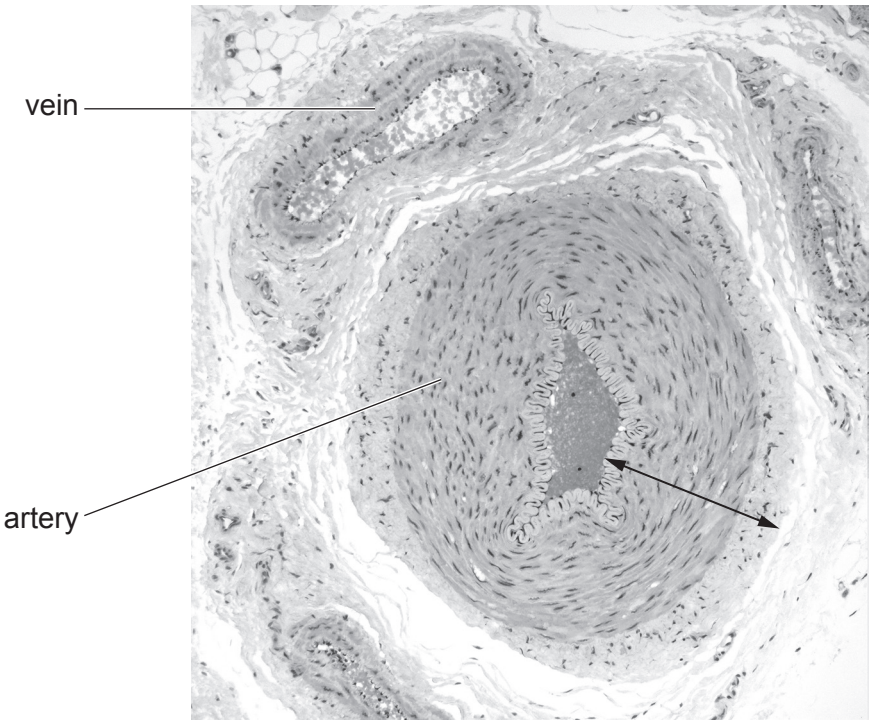


Fig. 4.2

(i) The width of the artery wall shown by the arrow (⟷) on Fig. 4.2 is 25 mm.

The magnification of the photomicrograph is × 85.

Calculate the actual width of the artery wall.

Give your answer to **one** significant figure.

..... mm [2]

(ii) Fig. 4.2 shows that the artery is bigger than the vein.

Describe **two** other ways Fig. 4.2 shows that the **structure** of the artery is different to the vein.

1 .....

2 .....
[2]

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(c) Complete the sentences about transport in plants.

Choose words from the list. Each word can be used once, more than once or not at all.

cilia	**cortex**	**excretion**	**hair**
osmosis	**phloem**	**transpiration**	**xylem**

Plants take in water from the soil through root ..... cells.

The water enters the cells by a type of diffusion called ..... .

Water is then transported to the leaves through ..... vessels.

[3]

[Total: 10]

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5 **(a)** Copper and aluminium are metals. They are extracted from their oxides by different methods.

Copper is extracted from copper oxide by reaction with carbon.

The equation for this reaction is shown.

$$2CuO + C \rightarrow 2Cu + CO_2$$

During the reaction, the mass of the reaction mixture decreases, and the copper ions are reduced.

(i) State **one** condition required for copper oxide to react with carbon.

..... [1]

(ii) Explain why the mass of the reaction mixture decreases.

.....

..... [1]

(iii) Use the equation for the reaction between copper oxide and carbon to explain what is meant by reduction.

.....

..... [1]

(iv) Aluminium ore contains aluminium oxide.

State the process used to extract aluminium from aluminium oxide.

..... [1]

(b) Copper is a transition metal. Aluminium is a Group III metal.

(i) Suggest **one** property of copper that is also a property of aluminium.

..... [1]

(ii) Suggest **two** properties of copper that are **not** properties of aluminium.

1 .....

2 .....
[2]

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(c) A student investigates the reactivities of copper, magnesium and two unknown metals, **X** and **Y**, as shown in Fig. 5.1.

Metal **X** and magnesium are added to cold water.

Copper and metal **Y** are added to dilute hydrochloric acid.

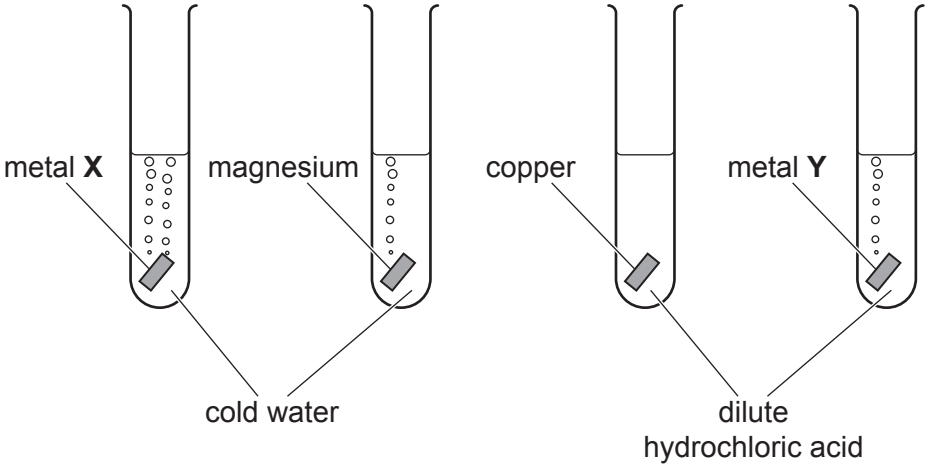


Fig. 5.1

Deduce the order of reactivity for these four metals.

most reactive .....

.....

.....

least reactive .....

[2]

[Total: 9]

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6 Fig. 6.1 shows a hairdryer.

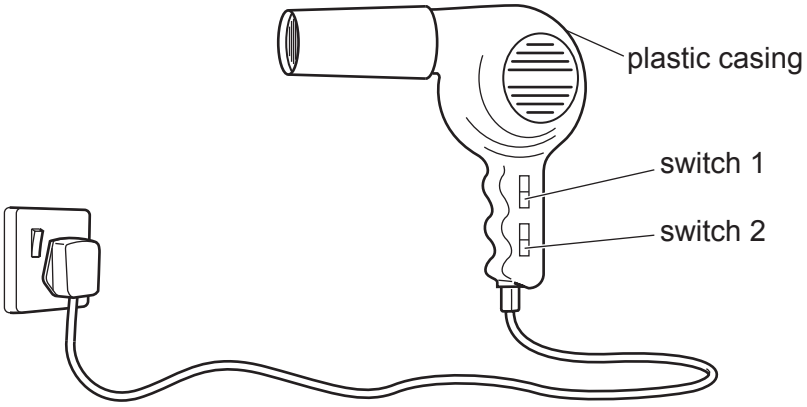


Fig. 6.1

The hairdryer has an electric motor to blow air. A heater is used to heat the air.

Fig. 6.2 shows the circuit diagram for the hairdryer.

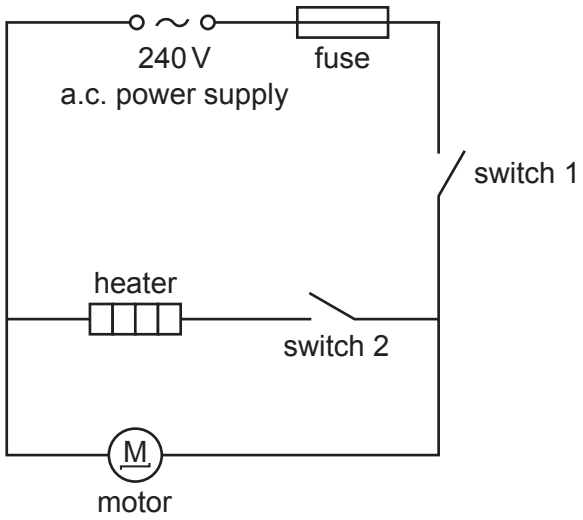


Fig. 6.2

(a) When both switch 1 and switch 2 are closed, the hairdryer blows out heated air.

Describe what the hairdryer does when switch 1 is closed and switch 2 is open.

..... [1]

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(b) Switch 1 and switch 2 are both closed.

(i) The current in the heater is 9.5A.

The hairdryer is connected to a 240V supply.

Calculate the resistance of the heater. Give the unit of your answer.

resistance = ... unit ..... [3]

(ii) State the purpose of a fuse.

.....

..... [1]

(iii) The total current in the circuit is 10A.

Circle the appropriate rating for the fuse.

3A **5A** **10A** **13A** **30A**

[1]

(c) The hairdryer casing is made of plastic.

The electric motor and heater are inside the hairdryer casing.

State **two** properties of plastic that make it a suitable material for the hairdryer casing.

1 .....

2 .....

[2]

[Total: 8]

7 **(a)** Fig. 7.1 shows a cell from the spongy mesophyll of a plant.

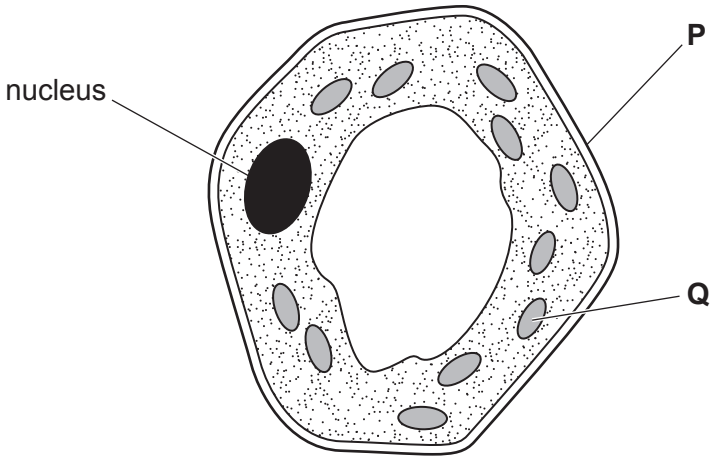


Fig. 7.1

(i) State the names of the parts labelled **P** and **Q** in Fig. 7.1.

P .....

Q .....
[2]

(ii) State the function of the nucleus.

..... [1]

(b) The drawing in Fig. 7.2 shows the layers in a cross-section through a leaf.

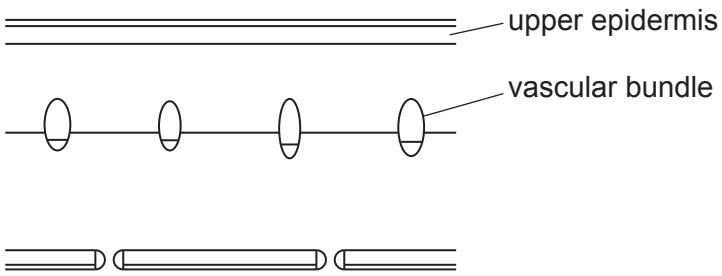


Fig. 7.2

On Fig. 7.2, use a label line and the letter **M** to show the position of the spongy mesophyll layer.
[1]

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(c) Photosynthesis takes place inside spongy mesophyll cells.

Complete the word equation for photosynthesis.

carbon dioxide + ... ⟶ ..... + ...

[2]

(d) Photosynthesis is one process in the carbon cycle.

(i) As part of the carbon cycle, living organisms release carbon dioxide into the atmosphere.

State the name of this process.

..... [1]

(ii) Using coal as a fuel also releases carbon dioxide into the atmosphere.

State the name of this process.

..... [1]

[Total: 8]

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8 **(a)** Describe a chemical test for water and state the positive result.

test .....

result .....
[2]

(b) Compounds **P** and **Q** are two different types of hydrocarbon.

- Compound **P** is a monomer in an addition polymerisation reaction.
- Compound **Q** does **not** react with aqueous bromine.

Identify these two types of hydrocarbon.

compound **P** .....

compound **Q** .....
[2]

(c) Methane is the main constituent of one fossil fuel.

(i) State the name of this fossil fuel.

..... [1]

(ii) Complete the dot-and-cross diagram in Fig. 8.1 to show all of the atoms and the bonding electrons in a molecule of methane.

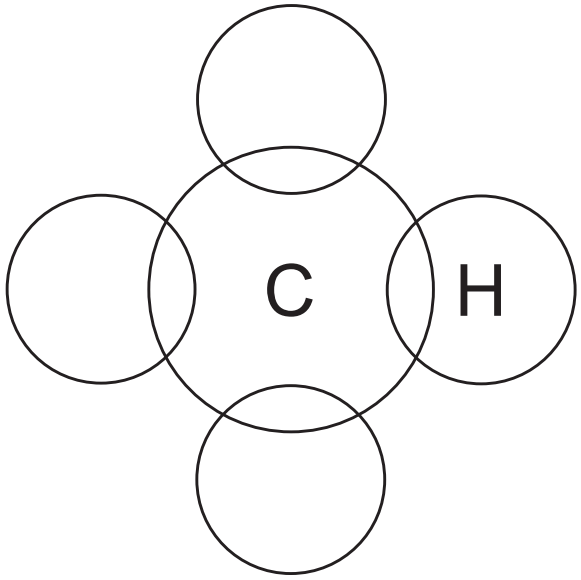


Fig. 8.1

[2]

[Total: 7]

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9 **(a)** Draw **one** straight line from each word to its description.

word	description
amplitude	distance between the peaks on consecutive waves
frequency	maximum displacement of a wave
wavelength	number of waves passing a point in space per second

[2]

(b) The driver of a car uses visible light to look at the road.

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

On Fig. 9.1, write visible light in the correct place.

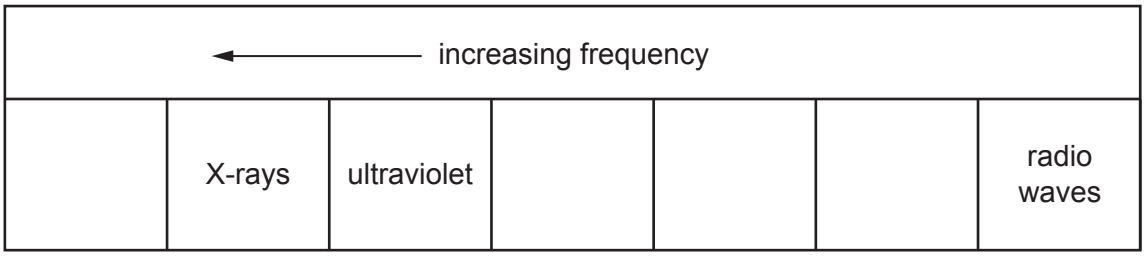


Fig. 9.1

[1]

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(ii) The driver of the car looks in the car mirror and sees a taxi behind.

Fig. 9.2 shows the incident ray of light from the taxi to the mirror.

On Fig. 9.2, draw the reflected ray of light from the mirror to the driver's eye.

Label the angle of incidence *i* and the angle of reflection *r*.

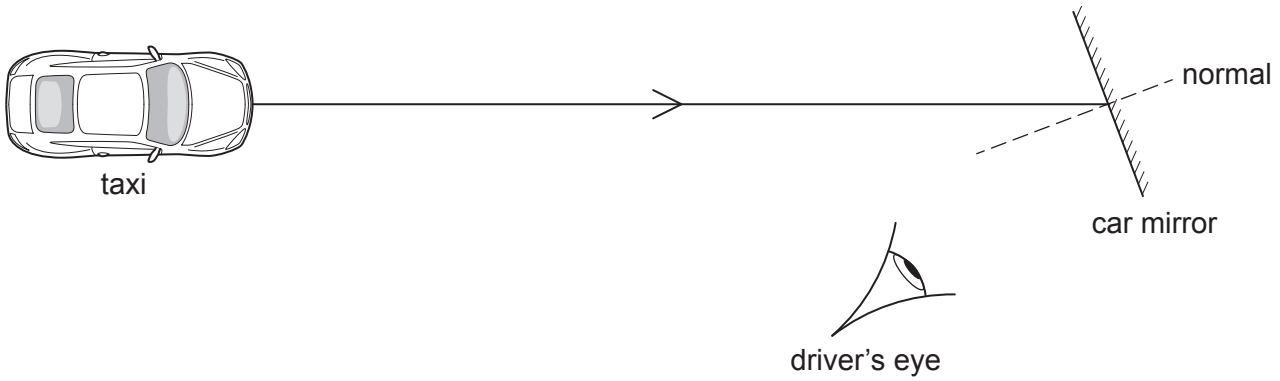


Fig. 9.2

[2]

(iii) The car is in direct sunlight, and the roof of the car gets hot.

The driver is **not** in direct sunlight, but the driver also gets hot.

Complete the sentences about energy transfers by using **one** word in each gap.

The metal roof of the car absorbs ..... radiation from the Sun.

Thermal energy is transferred through the metal roof of the car by ..... .

The movement of air inside the car transfers thermal energy to the driver by ..... .

[3]

[Total: 8]

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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 –		114 Fl flerovium –		116 Lv livermorium –		

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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