

--	--	--	--	--

--	--	--	--

0653/41

May/June 2018

1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

A copy of the Periodic Table is printed on page 20.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **20** printed pages.

- 1 (a) Table 1.1 shows four substances found in food, and elements they may contain.

Complete Table 1.1 by placing a tick (✓) in the box if the elements shown are contained in the substances.

Table 1.1

substance in food	element			
	carbon	hydrogen	nitrogen	oxygen
carbohydrate				
fat				
protein				
water				

[4]

- (b) Health problems can occur if a person does not eat a healthy diet.

Describe how a person can improve their diet if they suffer from constipation.

Explain your answer.

.....

[2]

- (c) A poor diet over a long time can also contribute to coronary heart disease.

Complete the following sentences using the words from the list.

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

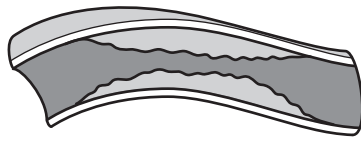
cilia fatty mucus protein
smoking stress unhealthy

Coronary heart disease occurs when the coronary arteries become narrowed by
 deposits. In addition to a poor diet possible causes of coronary
 heart disease are and

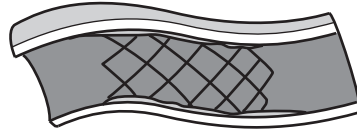
[3]

- (d) Coronary heart disease can be treated by inserting a stent into a narrowed coronary artery.

Fig. 1.1 shows a stent inside a coronary artery. Blood can flow freely through the stent.



narrowed coronary artery



coronary artery with stent inserted

Fig. 1.1

- (i) Describe the effect of the stent on the rate of blood flow through the coronary artery.

Explain your answer.

.....

.....

.....[1]

- (ii) Explain how the stent can benefit the heart muscle.

.....

.....

.....

.....[2]

- 2 (a) A student investigates the relative reactivity of different metals.

She places cleaned pieces of each metal in separate metal chloride solutions, as shown in Fig. 2.1.

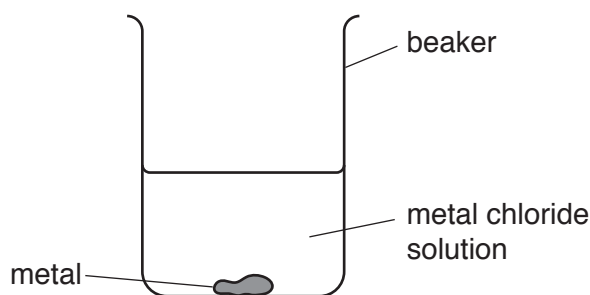


Fig. 2.1

She records her observations in Table 2.1.

Table 2.1

metal	metal chloride solution			
	aluminium chloride	lead chloride	tin chloride	zinc chloride
aluminium	–	✓	✓	✓
lead	✗	–	✗	✗
tin	✗	✓	–	✗
zinc	✗	✓	✓	–

key: ✓ reaction occurs
 ✗ no reaction
 – metal not placed into solution

- (i) Explain why the student does not use all combinations of metal and metal chloride solution.

.....

[1]

- (ii) Deduce the order of reactivity of the four metals, from most reactive to least reactive.

..... most reactive

 least reactive

[2]

- (b) Another metal, magnesium, reacts with dilute hydrochloric acid.

During this reaction, hydrogen gas and a salt are produced.

- (i) Name the salt.

.....[1]

- (ii) Construct the balanced symbol equation for this reaction.

Include state symbols.

.....[2]

- (iii) Complete Fig. 2.2 to show apparatus used to collect the gas produced and measure its volume.

List the additional apparatus needed to measure the rate of this reaction.

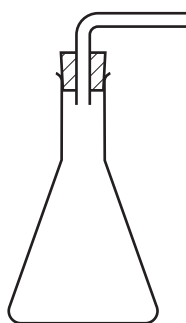


Fig. 2.2

apparatus[2]

(c) An atom of aluminium is represented by:



(i) Define *mass number*.

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

(ii) Complete Fig. 2.3 to show the electronic structure of an atom of aluminium.

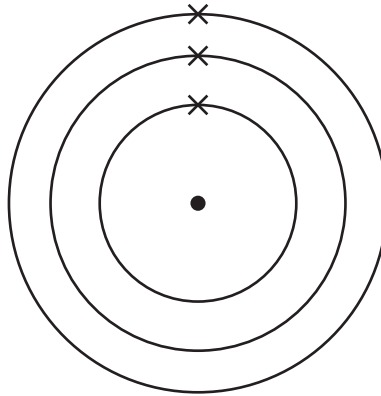


Fig. 2.3

[2]

- 3 Fig. 3.1 shows an airship carrying a load of weight W .

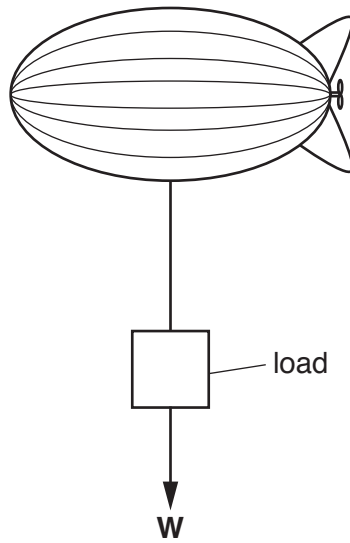


Fig. 3.1

- (a) The airship and load are moving along horizontally on a calm day with no wind.
- (i) On Fig. 3.1 draw another force arrow to show how the vertical forces acting on the load are balanced. [1]
- (ii) At one time in its journey, the airship is moving and all of the forces acting on the airship are balanced.

Describe the motion of the airship at this time.

.....

.....[1]

- (b) The airship moves at a constant height.

Fig. 3.2 shows a speed-time graph for part of the journey.

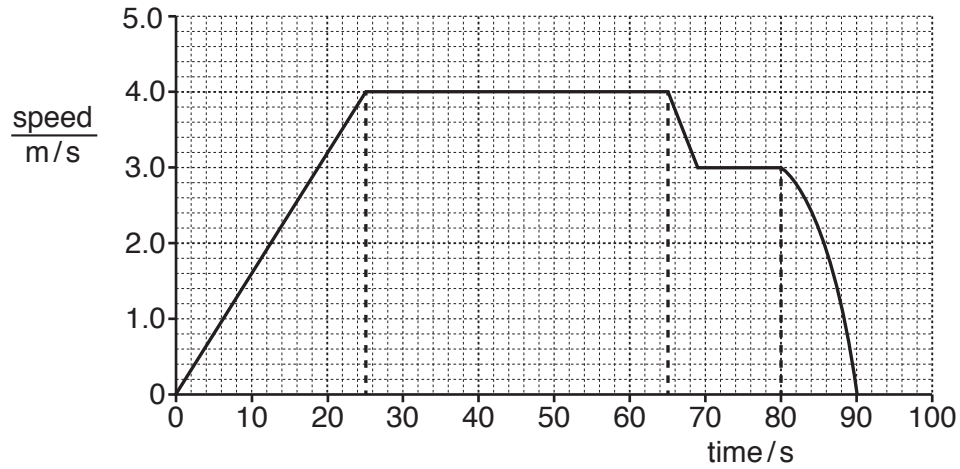


Fig. 3.2

- (i) Use terms from the list to complete the statements below.

Each term may be used once, more than once or not at all.

changing acceleration constant acceleration constant speed

Between 0 s and 25 s the airship travels with

.....

Between 25 s and 65 s the airship travels with

.....

Between 80 s and 90 s the airship travels with

.....

[1]

- (ii) Calculate how far the airship travelled in the first 65 s of its journey.

Show your working.

distance = ... m [2]

- (c) The load is a solid metal cube of density 7000 kg/m^3 . Each side of the cube measures 2.0 m.

Calculate the mass of the metal cube.

State any formula you use and show your working.

mass = ... kg [3]

- 4 (a) Fig. 4.1 shows three leaves **P**, **Q** and **R**. The leaves are of similar size. They are all taken from the same type of plant on a sunny day.

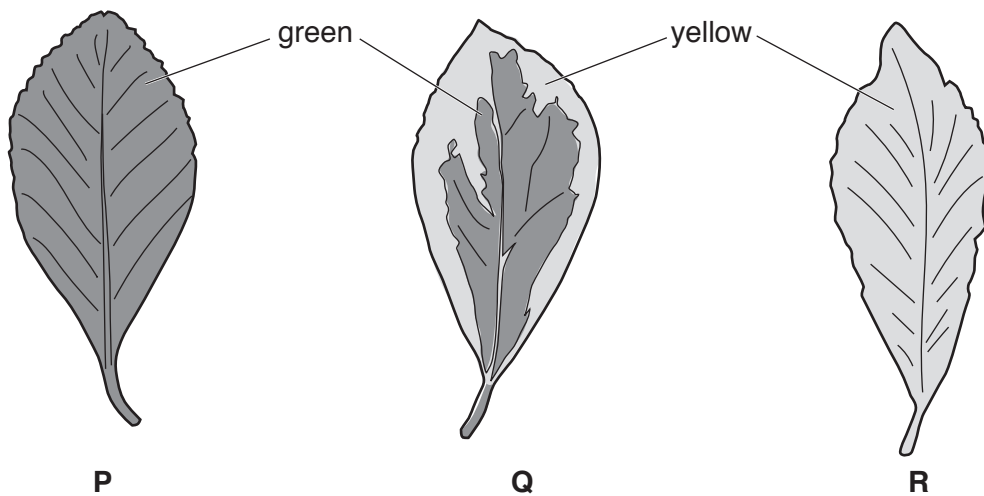


Fig. 4.1

- (i) Suggest which leaf traps the most light energy.

Explain your answer.

leaf

explanation

[1]

- (ii) Describe in detail what happens to the light energy that is trapped in the leaves.

.....

.....

.....[2]

- (b) All cells of plants need a source of glucose for aerobic respiration.

- (i) State the balanced symbol equation for aerobic respiration.

.....[2]

- (ii) Suggest how root cells are supplied with glucose.

.....

.....

.....[2]

5 (a) Ethene is manufactured by cracking larger hydrocarbon molecules.

(i) State what is meant by a *hydrocarbon*.

.....
[2]

(ii) Complete the dot-and-cross diagram in Fig. 5.1 to show the bonding electrons in a molecule of ethene, C_2H_4 .



Fig. 5.1

[2]

(iii) Describe a test to distinguish between ethane and ethene.

State the result for each.

test
 ethane
 ethene
 [2]

(b) During the complete combustion of hydrocarbons, carbon dioxide is formed.

(i) The proportion of carbon dioxide in air is increasing.

Explain why this gives cause for concern.

.....
[1]

- (ii) The combustion of hydrocarbons is an exothermic change.

Explain what is meant by *exothermic*.

Use ideas about energy transformations in your answer.

.....

.....

.....[2]

- 6 Fig. 6.1 shows a man watching television. He changes the channel with a remote control. The channel he now watches is showing a hot-air balloon high in the sky.

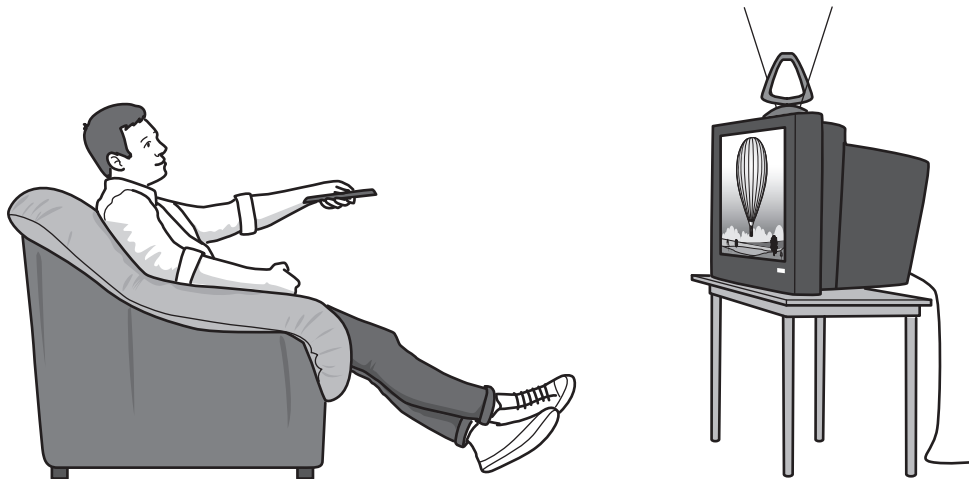


Fig. 6.1

- (a) Fig. 6.2 shows an incomplete electromagnetic spectrum.

On Fig. 6.2 write in their correct boxes the names of the parts of the electromagnetic spectrum used for

- television transmission,
- changing the channel,
- watching the television.

Draw a line to link each use to the correct part of the spectrum you have named. One line has been completed for you.

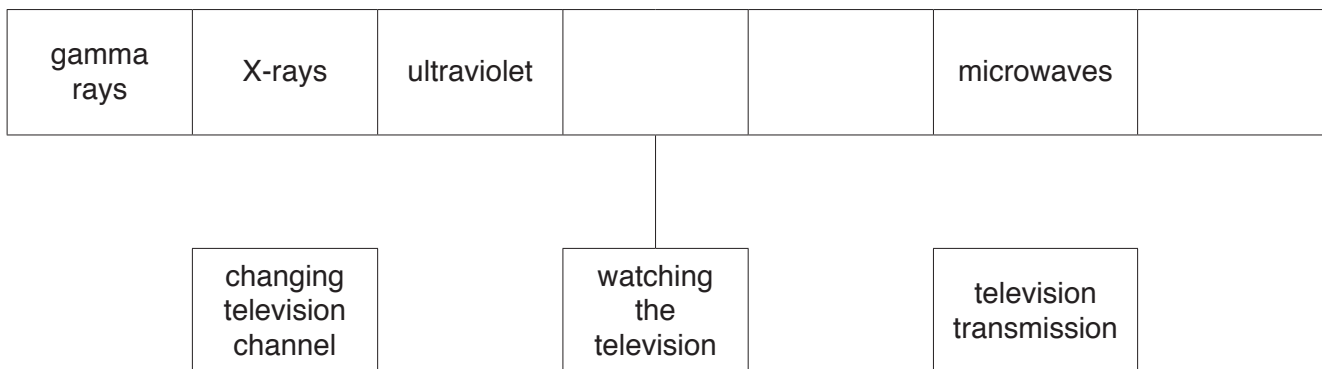


Fig. 6.2

[3]

- (b) Fig. 6.3 shows a hot-air balloon being prepared for flight. A fuel burner produces hot gases. The balloon fills with the hot gases and the balloon rises up into the air.

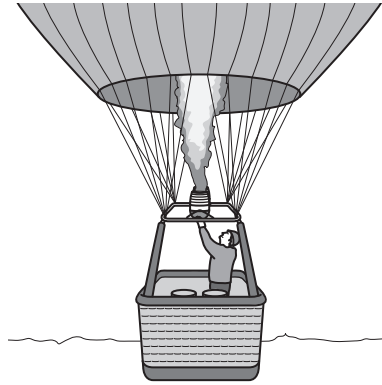


Fig. 6.3

- (i) State the name of the method of thermal energy transfer from the fuel burner upwards into the balloon.
[1]
- (ii) Explain in terms of density changes why this method of thermal energy transfer fills the balloon with the hot gases.

[2]
- (iii) Explain in terms of the motion of molecules, and the forces and distances between them, why the density of a gas changes on heating.

[3]

7 (a) Fig. 7.1 shows a food web in a garden.

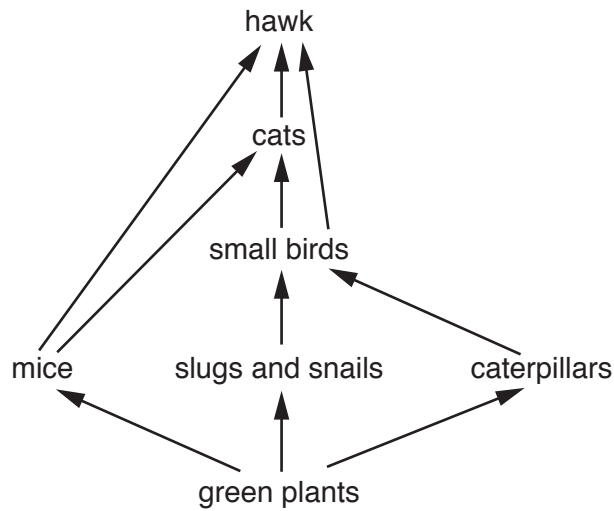


Fig. 7.1

- (i) Using information in Fig. 7.1, draw a complete food chain consisting of only **four** organisms.

[2]

- (ii) Name **all** organisms that feed at the same trophic level as the small birds.

.....[2]

- (b) (i) The arrows show the transfer of chemical energy from one organism to another.

State **two** reasons why not all of the energy is transferred from the cat to the hawk.

1.

2.

[2]

- (ii) Explain why there are not usually more than five trophic levels in a food chain.

.....

[1]

- 8 (a) A student tries to make lead from a sample of solid lead(II) bromide using the electrolysis apparatus shown in Fig. 8.1.

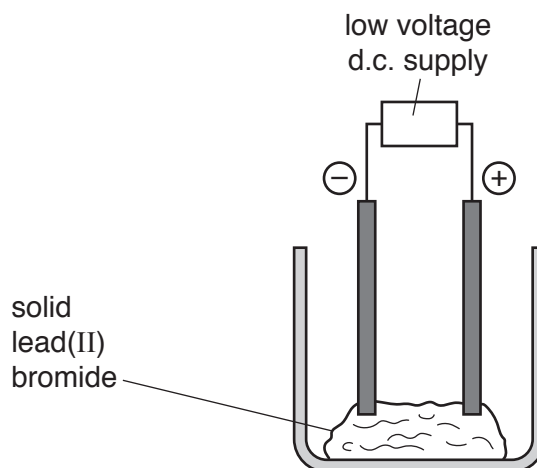


Fig. 8.1

This electrolysis does not work.

- (i) Suggest a change that the student can make to the lead(II) bromide so that the electrolysis does work.

.....[1]

- (ii) Explain why the electrolysis of solid lead(II) bromide does not work.

Use ideas about ions in your answer.

.....
[1]

- (b) (i) Iron is extracted from its ore using carbon in an industrial process.

Name the industrial reaction vessel used.

.....[1]

- (ii) Iron can be extracted from its ore using carbon.

Calcium, a Group II metal, cannot be extracted from its ore using carbon.

Explain this difference.

Use ideas about the reactivity of carbon and metals in your answer.

.....

[2]

- (c) (i) Metal **X** forms a coloured compound which acts as a catalyst.

Name the collection of metals in the Periodic Table which includes **X**.

.....[1]

- (ii) Gas **Y** is an element that is used as an inert atmosphere in lamps.

Name the group of elements in the Periodic Table which includes **Y**.

.....[1]

- 9 Fig. 9.1 shows a small electric cooker with two hot plates.

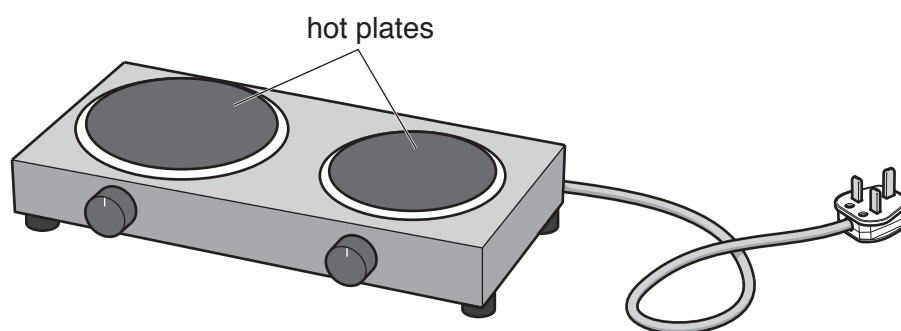


Fig. 9.1

The cooker is connected to a 240 V supply.

The plug contains a fuse with a rating of 13A.

Each hot plate is controlled by a switch and a variable resistor.

Each hot plate can be turned on and off and controlled without affecting the other hot plate.

- (a) (i)** In Table 9.1 draw the circuit symbols for each component used in the cooker circuit.

Table 9.1

component	fuse	switch	variable resistor
symbol			

[2]

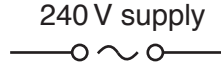
- (ii)** Name the type of circuit connection that will allow each hot plate to be controlled separately by its own switch.

.....[1]

- (iii) Use the information about the cooker to draw a circuit diagram for the cooker.

Use the circuit symbol for a heater to represent a hot plate: 

The circuit diagram has been started for you.



[4]

- (b) The larger hot plate is rated at a maximum of 1.5 kW, and the smaller hot plate is rated at a maximum of 1.0 kW.

Show by calculation that the 13 A fuse in the plug will not blow when the cooker is used with both hot plates at maximum rating.

State the formula you use and show your working.

formula

working

[3]

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.

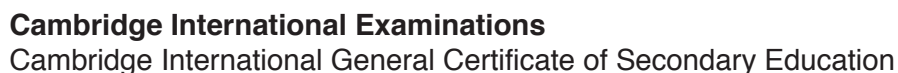
To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk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

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

Group

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	euporium	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



--	--	--	--	--

--	--	--	--

0653/42

May/June 2018

1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

A copy of the Periodic Table is printed on page 24.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **21** printed pages and **3** blank pages.

- 1 (a) Fig. 1.1 shows an experiment with a germinating seed. At the start, a seed is pinned to a wall and is placed in the dark.

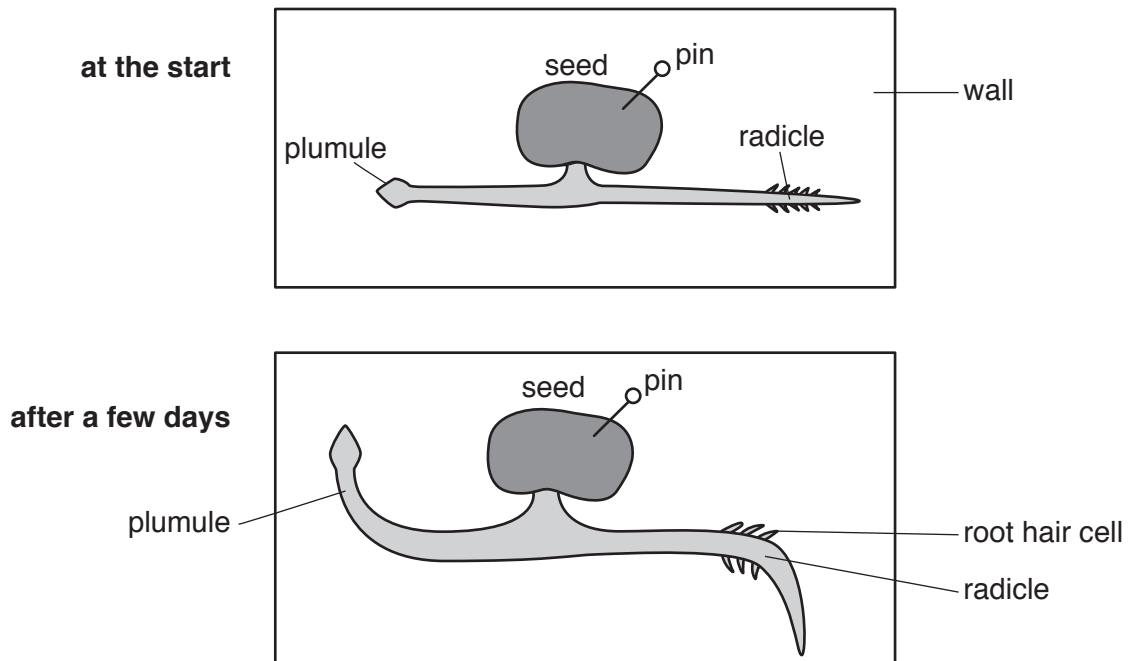


Fig. 1.1

- (i) Name the response shown by the seed in Fig. 1.1 after a few days.

.....[1]

- (ii) Explain the response of the plumule in Fig. 1.1 after a few days in terms of the action of auxin hormones.

.....

[2]

- (iii) Describe how the action of auxin hormones is different in the cells of the radicle.

.....
[1]

(b) A radicle has root hair cells which are used in water uptake from the soil.

(i) Explain how the shape of the root hair cell helps it with its function of water uptake.

.....

.....

.....[2]

(ii) Explain why water moves into the root hair cell from the soil.

.....

.....

.....[2]

(c) State the tissue which carries water through the plant.

.....[1]

- 2 (a) A student investigates the combustion of a hydrocarbon, as shown in Fig. 2.1.

Gases move through the apparatus in the direction shown by the arrows.

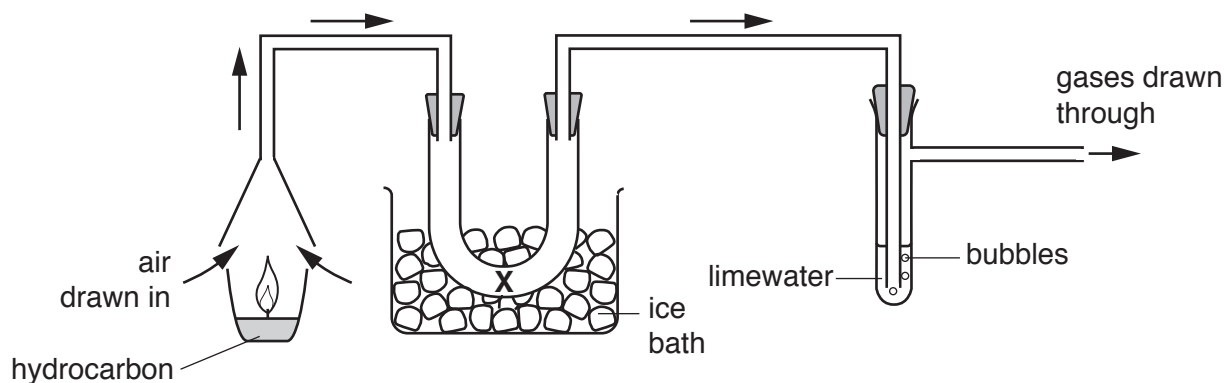


Fig. 2.1

The student thinks that carbon dioxide and water are formed when the hydrocarbon burns.

- (i) Suggest a chemical that the student uses at position X to test for the presence of water.

State the observation that shows that water is present.

chemical

observation

[2]

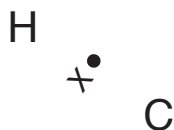
- (ii) Limewater contains calcium hydroxide, $\text{Ca}(\text{OH})_2$.

Calcium hydroxide reacts with carbon dioxide to form calcium carbonate, CaCO_3 .

Write the symbol equation with state symbols for this reaction.

.....[2]

- (b) (i) Complete the dot-and-cross diagram for the hydrocarbon C_2H_4 , showing the bonding electrons.



[2]

- (ii) Carbon and hydrogen are non-metallic elements.

State the type of chemical bond that forms between these two elements.

.....[1]

- (c) An atom of carbon is represented by:



State the electronic structure of carbon.

.....[1]

- 3 Fig. 3.1 and Fig. 3.2 show two circuit diagrams each connected to operate an electric motor and a lamp.

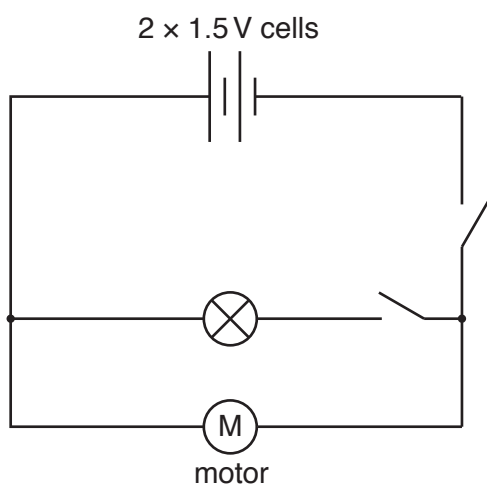


Fig. 3.1

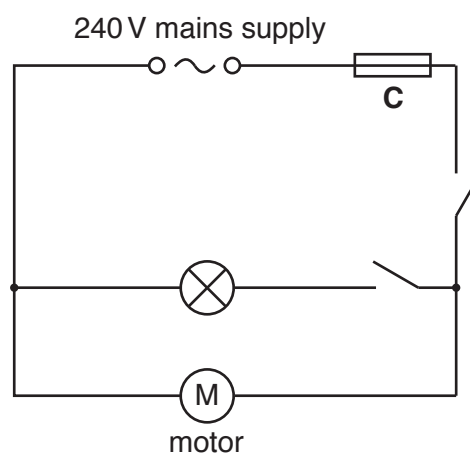


Fig. 3.2

- (a) Identify component **C** and explain why it is necessary in the circuit in Fig. 3.2, but not in the circuit in Fig. 3.1.

component **C**

explanation

.....

.....

.....[3]

- (b) (i) In Fig. 3.1, when the motor is switched on, but the lamp is not, a current of 0.2A flows through the motor.

Calculate the resistance of the motor.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

- (ii) In Fig. 3.2, the motor has a power rating of 20 W and the lamp has a power rating of 100 W.

Calculate the current in the main circuit when both the motor and the lamp are switched on.

State the formula you use and show your working.

formula

working

current = ... A [3]

- (c) A lamp is placed in front of a mirror. A student tries to look at the reflection of the lamp in the mirror, as shown in Fig. 3.3.

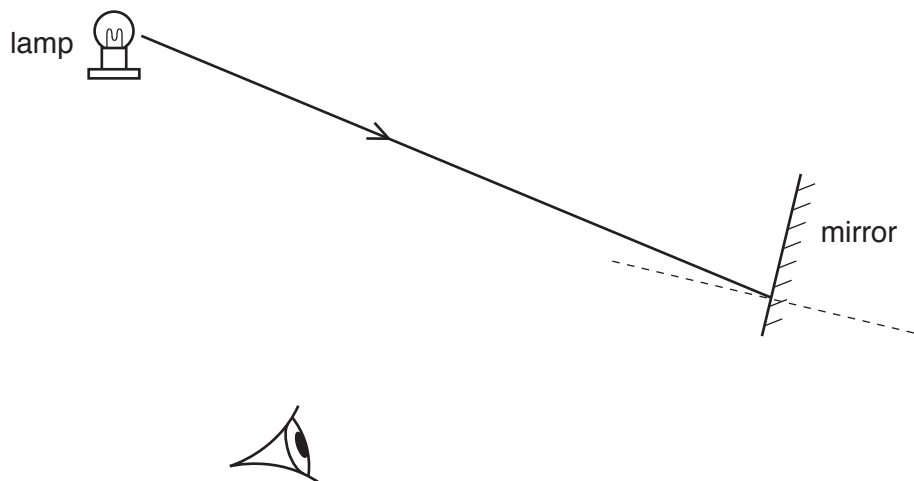
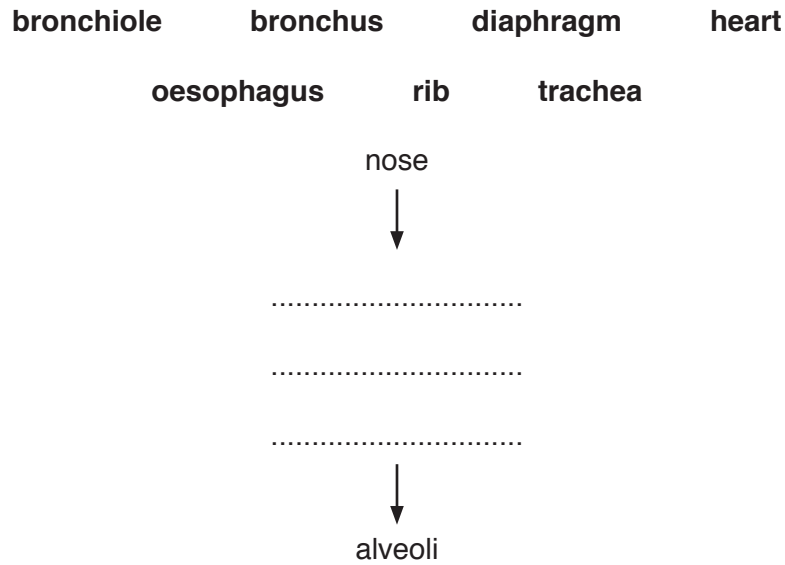


Fig. 3.3

On Fig. 3.3, complete the ray diagram to show whether the student can see the image of the lamp in the mirror or not. [1]

- 4 (a) During inspiration air passes through different parts of the airway to reach the alveoli.

Use the list of words to show the correct order of structures through which the air passes.



[1]

- (b) Fig. 4.1 shows drawings of the alveoli in healthy lungs. Fig. 4.1 also shows the alveoli of a person with a lung infection such as bronchitis.

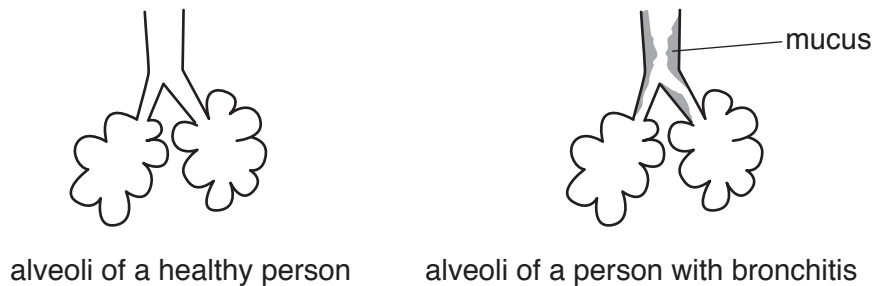


Fig. 4.1

People who smoke are more likely to suffer from bronchitis.

Describe how cigarette smoke encourages bronchitis by its effect on

1. the amount of mucus produced by cells lining the airway,

.....

.....

2. the cilia on the surface of cells lining the airway.

.....

.....

[3]

- (c) Fig. 4.2 shows a drawing of the alveoli in healthy lungs. Fig. 4.2 also shows the alveoli of a person with emphysema, a lung disease caused by smoking.

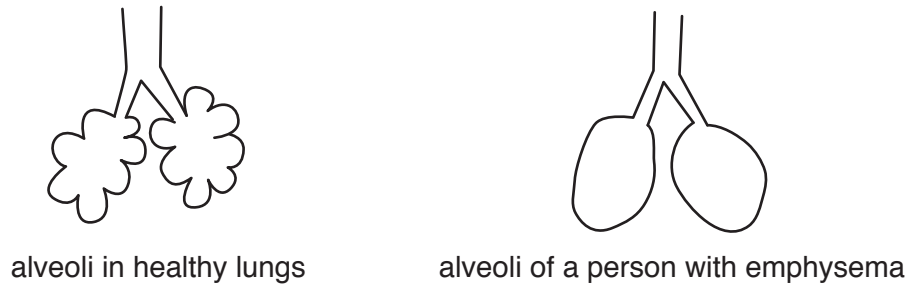


Fig. 4.2

Suggest how the rate of gas exchange is affected in a person with emphysema.

Explain your answer.

.....
[1]

- (d) Smoking is also a possible cause of coronary heart disease.

- (i) Describe changes in the heart which cause coronary heart disease.

.....

[2]

- (ii) List **two** other possible causes of coronary heart disease.

1.
 2.[2]

- 5 (a) A student adds magnesium powder to dilute hydrochloric acid.

She then uses a balance to investigate the rate of this reaction, as shown in Fig. 5.1.

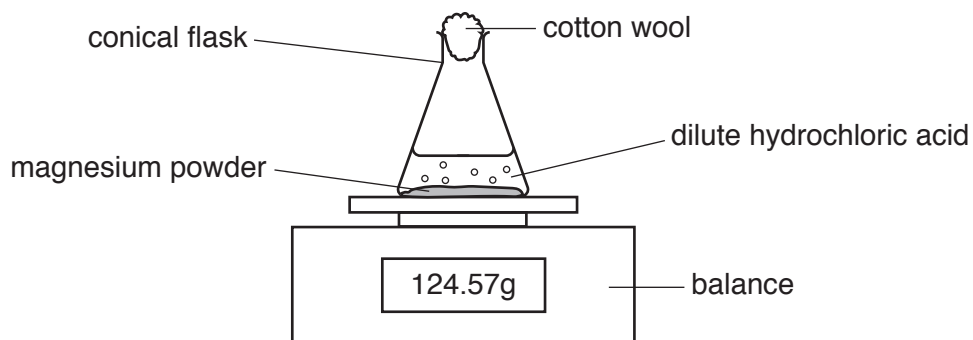


Fig. 5.1

- (i) Describe the change in the mass, if any, of the conical flask and its contents.

Explain your answer.

change

explanation

[2]

- (ii) State the effect of increasing the temperature on the rate of this reaction.

Explain your answer.

effect

explanation

[2]

- (iii) Predict the effect of using calcium, rather than magnesium, on the rate of reaction.

Explain your answer using ideas about reactivity.

effect

explanation

[2]

(b) Magnesium is produced by the electrolysis of molten magnesium chloride.

Magnesium chloride consists of magnesium ions, Mg^{2+} , and chloride ions, Cl^- .

(i) Name the electrode at which magnesium forms.

.....[1]

(ii) Describe, in terms of electrons, how chloride ions turn into chlorine atoms in this process.

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

(iii) Predict the formula of magnesium chloride.

.....[1]

(iv) Magnesium is also produced by heating magnesium oxide with silicon.

In this process, oxygen is removed from magnesium oxide.

State the type of reaction that leads to the loss of oxygen from a substance.

.....[1]

- 6 (a) Fig. 6.1 shows an incomplete electromagnetic spectrum linked to some uses of different parts of the electromagnetic spectrum.

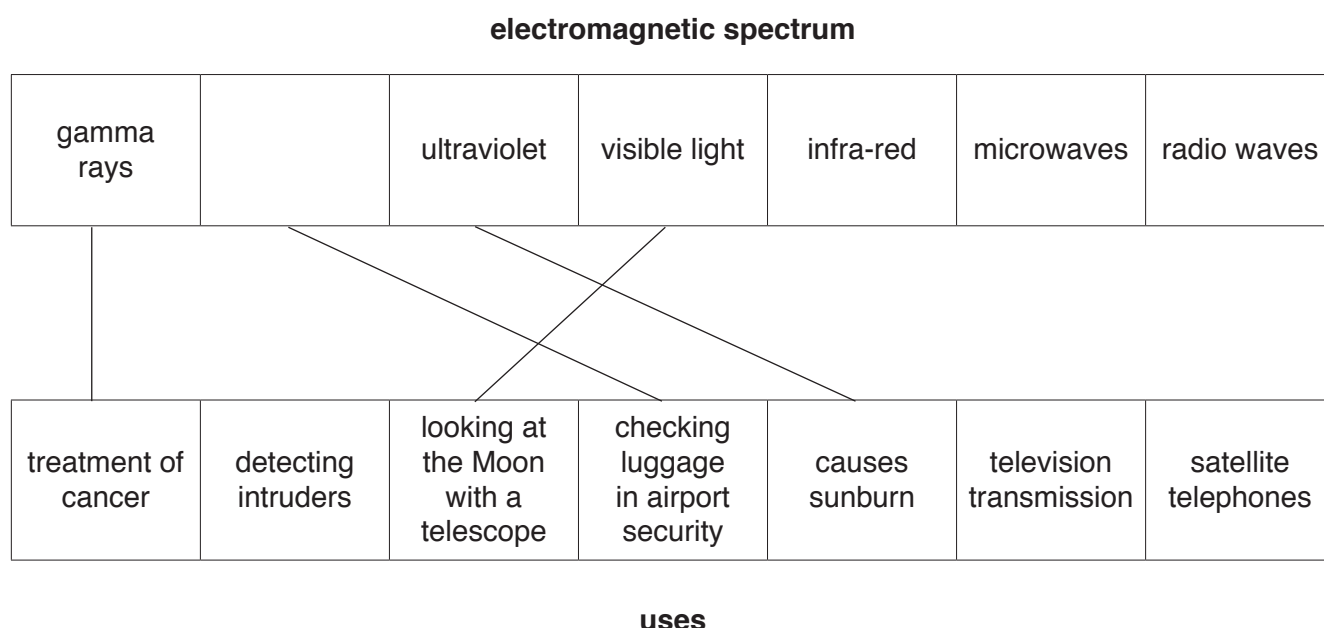


Fig. 6.1

- (i) On Fig. 6.1 complete the empty box in the electromagnetic spectrum. [1]

- (ii) On Fig. 6.1 draw **three more** lines so that each type of electromagnetic wave is linked to a use of that type.

Four lines have already been done for you. [1]

- (b) Infra-red radiation is also used in remote controls for television sets and other electronic devices in the home.

An astronaut on a space walk outside the International Space Station uses the same type of remote control to operate an electronic device in space.

Explain why it is possible for a remote control to work in space.

.....

.....[1]

- (c) Fig. 6.2a and Fig. 6.2b show an experiment to investigate the transfer of thermal energy (heat).

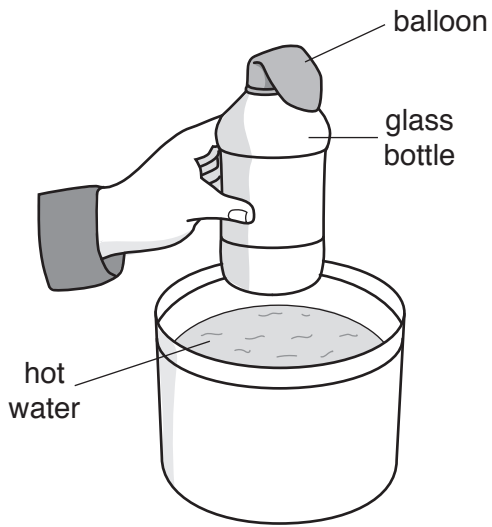


Fig. 6.2a

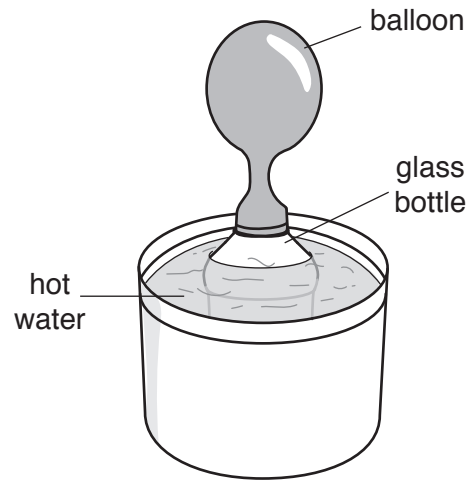


Fig. 6.2b

Fig. 6.2a shows the apparatus before the glass bottle is lowered into the hot water.

Fig. 6.2b shows the apparatus after the bottle has been in the water for 5 minutes.

The bottle and the air inside are slowly heated as thermal energy is conducted through the glass and warms the air inside. As the bottle is heated, the balloon fills with air.

- (i) Suggest why the heating of the air in the bottle is slow.

.....[1]

- (ii) Explain in terms of the arrangement and the speed of molecules why the balloon above the glass bottle fills with warm air as the air is heated.

.....

.....

.....

.....

.....[3]

- 7 Fig. 7.1 shows a simplified version of the carbon cycle. The numbers represent processes involved in the cycle.

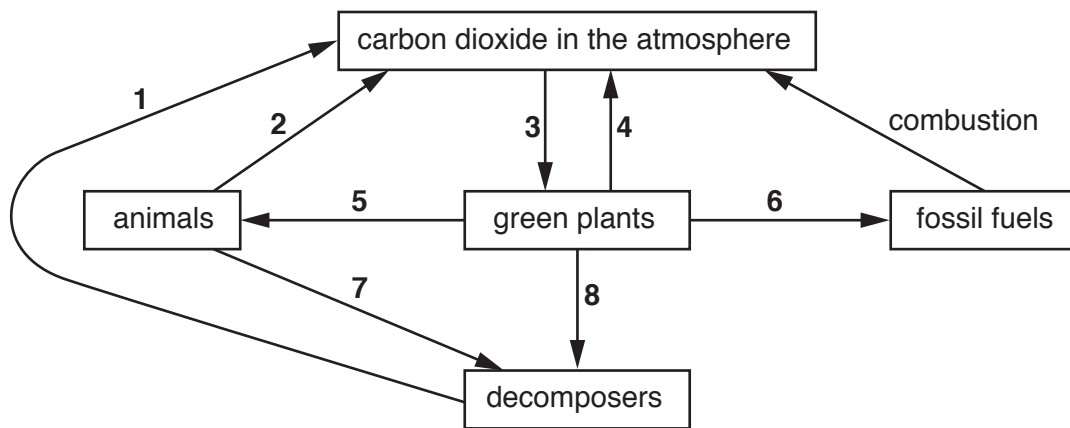


Fig. 7.1

- (a) (i) State the source of the energy input to the carbon cycle.

.....[1]

- (ii) Name process 7.

.....[1]

- (iii) Using Fig. 7.1 state the numbers which represent respiration.

.....[1]

- (b) (i) Name process 3.

.....[1]

- (ii) With reference to process 3, explain the effect of deforestation on the carbon dioxide concentration in the atmosphere.

.....

.....

.....

.....[2]

- (c) The gas sulfur dioxide is released into the atmosphere during the combustion of fossil fuels.

Explain the consequences of adding sulfur dioxide to the atmosphere.

.....

.....

.....

.....[3]

- 8 (a) (i) Elements are arranged in the Periodic Table in atomic number order.

State the relationship between the group number of an element and the number of outer-shell electrons in an atom of the element.

.....[1]

- (ii) Describe the relationship between the number of outer-shell electrons and the metallic/non-metallic character of an element.

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

- (b) Rubidium is a Group I metal below potassium in the Periodic Table.

Rubidium is a solid at room temperature, 20 °C.

Potassium melts at 63 °C and reacts vigorously with water.

- (i) Suggest the melting point of rubidium.

..... °C [1]

- (ii) Compare the reactivities of rubidium and of potassium with cold water.

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

- (c) Explain the use of chlorine in water purification.

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

- (d) The reaction between sodium and chlorine is exothermic.

Sodium chloride is formed in this reaction.

- (i) State what is meant by *exothermic*.

Use ideas about energy transformations in your answer.

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

- (ii) Suggest **one** substance that reacts safely with dilute hydrochloric acid to form sodium chloride.

.....[1]

9 Fig. 9.1 shows a crane carrying a load.

The crane is floating in the sea on a calm day.

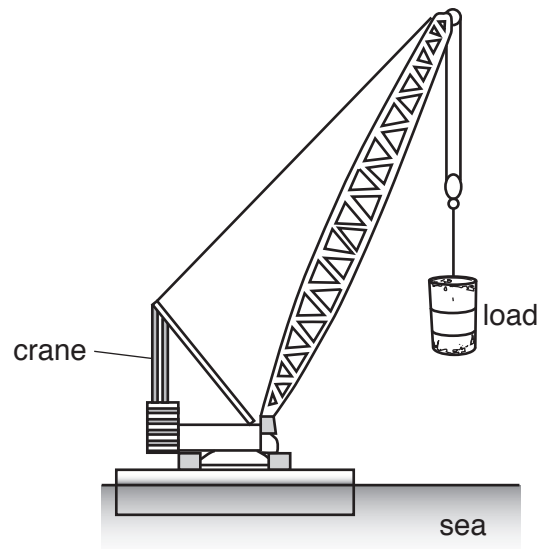


Fig. 9.1

(a) (i) The load is stationary.

On Fig. 9.1 draw two force arrows to show the vertical forces acting on the load. [2]

(ii) One of the forces acting on the load is called *tension*.

Name the other force acting on the load.

.....[1]

(b) The crane lifts the load vertically upwards from the sea bed to a position above the sea surface.

Fig. 9.2 shows a speed-time graph for the load during this operation.

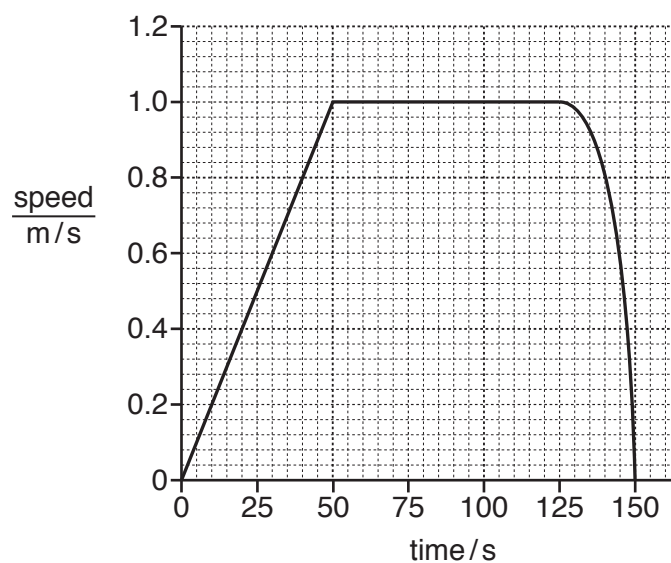


Fig. 9.2

- (i) Use terms from this list to complete the statements below.

changing acceleration

constant acceleration

constant speed

Between 0 s and 50 s the load travels with

.....

Between 50 s and 125 s the load travels with

.....

Between 125 s and 150 s the load travels with

.....

[1]

- (ii) The load reaches the sea surface after 125 s.

Use Fig. 9.2 to calculate the depth of the sea from the sea bed to the sea surface.

Show your working.

depth of sea = ... m [2]

- (iii) The total work done by the crane in 150 s is 2 000 000 J.

Calculate the average power output of the crane during this time.

State the formula you use and show your working.

formula

working

power output = ... W [2]

- (c) The load being lifted by the crane is a container full of sea water.

The volume inside the container is 5000 dm^3 . The density of sea water is 1025 kg/m^3 .

Calculate the mass of sea water being lifted.

State the formula you use and show your working.

formula

working

mass = ... kg [3]

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 International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

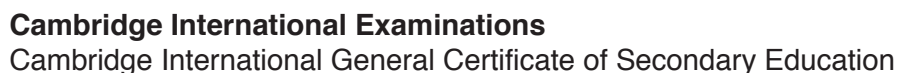
Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

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.).



--	--	--	--	--

--	--	--	--

0653/43

May/June 2018

1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

A copy of the Periodic Table is printed on page 20.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **20** printed pages.

- 1 (a) Fig. 1.1 shows a diagram of a duckweed plant. Duckweed is found in lakes. The green leaves float on the top of the water and the roots reach down into the water.

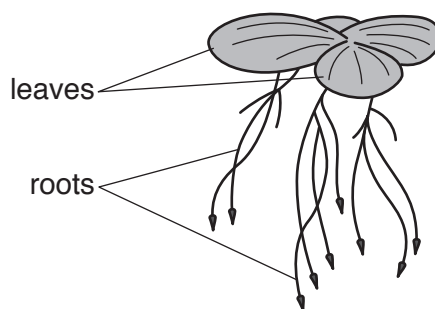


Fig. 1.1

- (i) Photosynthesis takes place in the leaves of the duckweed.

State the balanced symbol equation for photosynthesis.

.....[2]

- (ii) Air is trapped between the cells in the leaves of the duckweed.

Suggest how this is an advantage to the survival of the duckweed.

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

- (b) An investigation is carried out to find the effect of increased concentration of nitrate ions on the growth of a duckweed population.

At the start, dishes **A** and **B** each contain lake water and six duckweed plants. Nitrate ions are added to dish **B** and both dishes are left for five days.

The results are shown in Fig. 1.2.

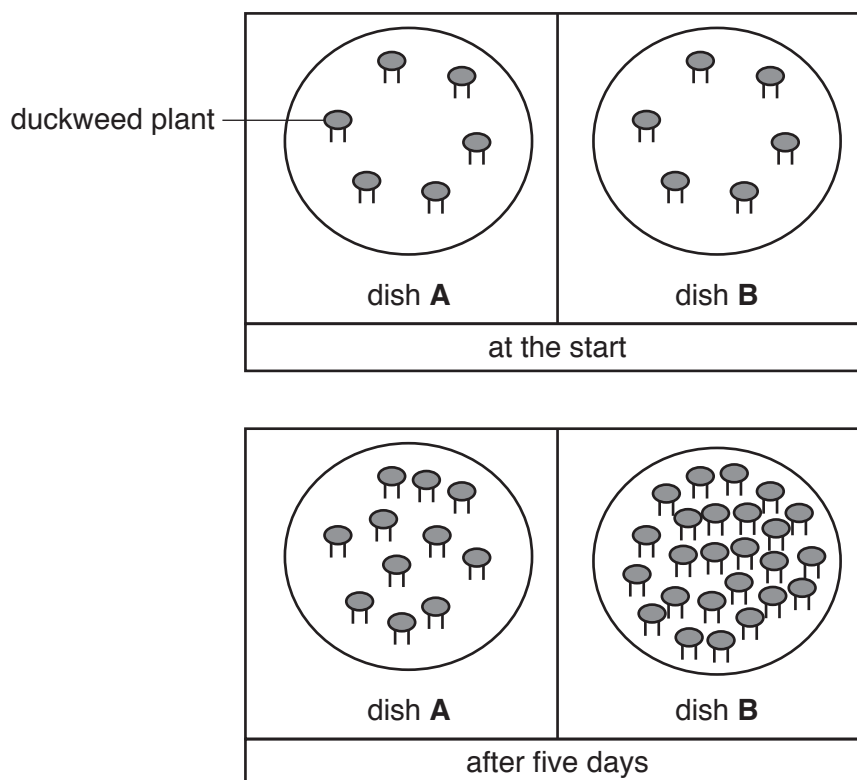


Fig. 1.2

- (i) Use the information in Fig. 1.2 to describe the difference between the results in dishes **A** and **B** after five days.

.....

 [2]

- (ii) State a conclusion that can be drawn from the results seen in Fig. 1.2.

.....
 [1]

- (c) Some fertiliser containing nitrate ions accidentally enters a lake which has a small number of duckweed plants on the surface.

- (i) Predict how the surface of the lake changes over the next few weeks.

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

- (ii) The plants beneath the surface of the lake die. The fish in the lake die too.

Describe the role of the lake bacteria in these events.

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

- 2 (a) An aqueous solution of an ionic compound is electrolysed using inert electrodes.

The apparatus is shown in Fig. 2.1.

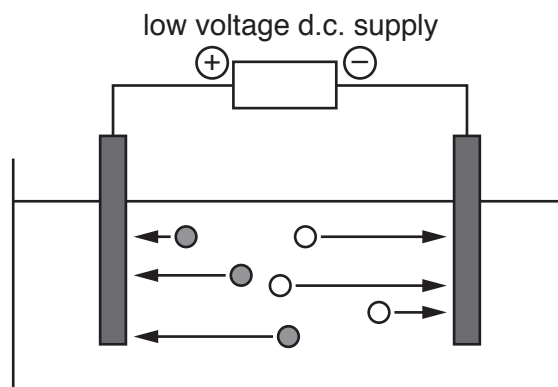


Fig. 2.1

- (i) On Fig. 2.1, add label lines to identify

- **one** metal ion,
- **one** non-metal ion,
- the electrolyte,
- the anode.

[3]

- (ii) State, in terms of electrons, what happens during electrolysis to

the positive ions, ...

the negative ions.

[2]

- (b) Sodium cannot be extracted by the electrolysis of aqueous sodium chloride.

Describe how sodium is extracted from sodium chloride.

.....

 [2]

- (c) Iron is obtained from iron ore in the blast furnace.

- (i) A substance is used in the blast furnace as a fuel to produce a high temperature.

Name this substance.

..... [1]

- (ii) Name **one** reducing agent that reacts with iron oxide in the blast furnace to form iron.

..... [1]

- 3 Fig. 3.1 shows a small quadcopter (drone with four rotors) being operated by radio control.



Fig. 3.1

- (a) The drone is hovering above the ground with its rotors turning, but the drone is not moving. Fig. 3.1 shows one of the forces acting on the drone.

- (i) On Fig. 3.1 draw an arrow for a second force needed if the drone is not moving. [1]

- (ii) The radio control is used to stop the rotors turning.

Describe the resulting motion of the drone.

.....

 [2]

- (iii) Give a reason for your answer to (a)(ii) in terms of forces.

.....
 [1]

- (b) The drone has a mass of 5 kg. It takes off from the ground and climbs vertically upwards to a height of 50 m.

- (i) Calculate the gravitational potential energy gained by the drone.

(gravitational field strength, $g = 10 \text{ N/kg}$)

State the formula you use, show your working and give the unit of your answer.

formula

working

potential energy gained = ... unit[3]

- (ii) The drone is powered by batteries that drive electric motors to turn the rotors.

Complete the sequence of energy changes as the drone takes off and climbs to a height of 50 m above the ground.

..... energy

→ energy

→ energy

→ gravitational potential energy [2]

- (c) The radio control sends radio signals to control the drone.

- (i) State the type of wave that includes radio waves.

.....[1]

- (ii) The radio signals used travel at $3.0 \times 10^8 \text{ m/s}$ and have a frequency of $35 \times 10^6 \text{ Hz}$.

Calculate the wavelength of these radio waves.

State the formula you use and show your working.

formula

working

wavelength = ... m [2]

4 Fig. 4.1 shows a wind-pollinated flower.

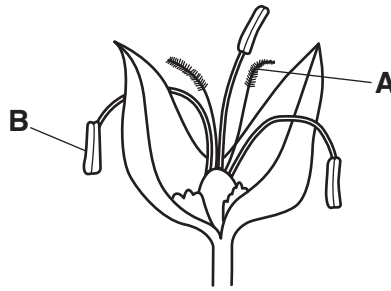


Fig. 4.1

(a) Name structures **A** and **B** and explain how they make the flower suited to wind pollination.

A

explanation

.....

B

explanation

.....

[4]

(b) All parts of the flower in Fig. 4.1 are pale green.

Suggest why bright colours are **not** needed in these flowers.

.....

.....[1]

(c) The plant which produces the flower in Fig. 4.1 reproduces by sexual reproduction.

Define the term *sexual reproduction*.

.....

.....

.....

.....[2]

- 5 (a) The electronic structure of an atom of element **E** is shown in Fig. 5.1.

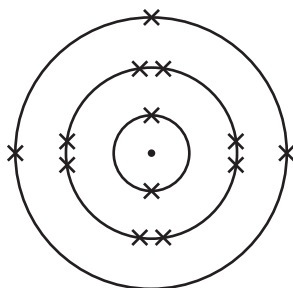


Fig. 5.1

- (i) Use Fig. 5.1 to deduce the atomic number of element **E**.

Explain how the information in Fig. 5.1 is used.

atomic number

explanation

[1]

- (ii) Use the Periodic Table on page 20 to name element **E**.

.....[1]

- (b) An atom of chlorine is represented by:



- (i) State the mass number and the number of neutrons in this atom.

mass number

number of neutrons

[2]

- (ii) The electronic structure of this atom of chlorine is 2, 8, 7.

Complete Fig. 5.2 to show the electronic structure of a chloride **ion**.



Fig. 5.2

[1]

- (iii) Explain why chlorine is shown in the Periodic Table, but sodium chloride is not.

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

- (c) An aqueous solution is tested to find out if chloride ions are present.

Describe the test **and** state the positive result.

test

result

[2]

- 6 Fig. 6.1 shows ice cubes being added to a drink at 25°C to cool the drink down.

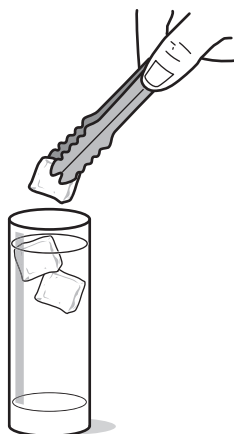


Fig. 6.1

- (a) Fig. 6.2 shows a graph of the temperature change in the drink with time after the ice cubes are added.

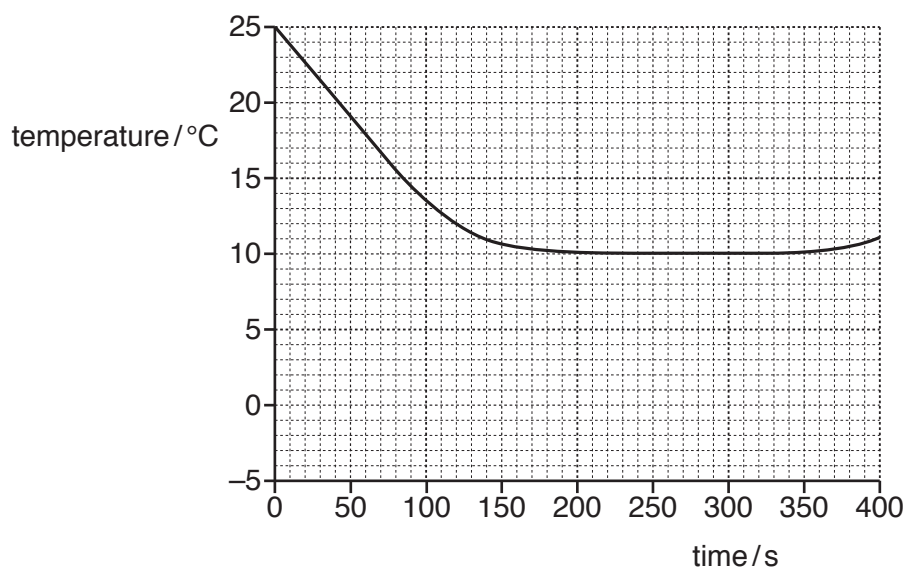


Fig. 6.2

The ice cubes are at a temperature of -5°C when they are added to the drink. The melting point of ice is 0°C .

On Fig. 6.2, sketch a graph to represent the temperature change of the water molecules that start in the ice cubes over the same time. [3]

(b) As the ice melts at the top of the drink, the cold liquid formed sinks to the bottom. This makes warmer liquid come up to the surface where the ice is floating.

(i) State the name of the method of thermal energy transfer that is happening as the cold liquid sinks, and warmer liquid rises.

.....[1]

(ii) Explain why this circulation of liquid occurs as the ice melts.

.....

.....

.....[1]

- 7 (a) Fig. 7.1 shows a diagram of the human gas exchange system.

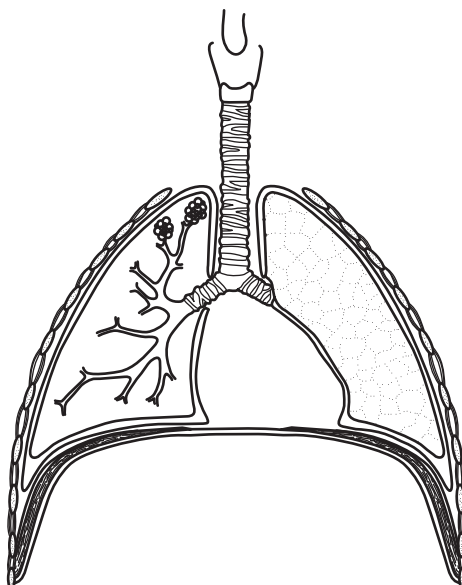


Fig. 7.1

On Fig. 7.1 use label lines to identify

(i) the larynx, [1]

(ii) a bronchiole. [1]

- (b) Fig. 7.2 shows a diagram of an alveolus in the lungs.

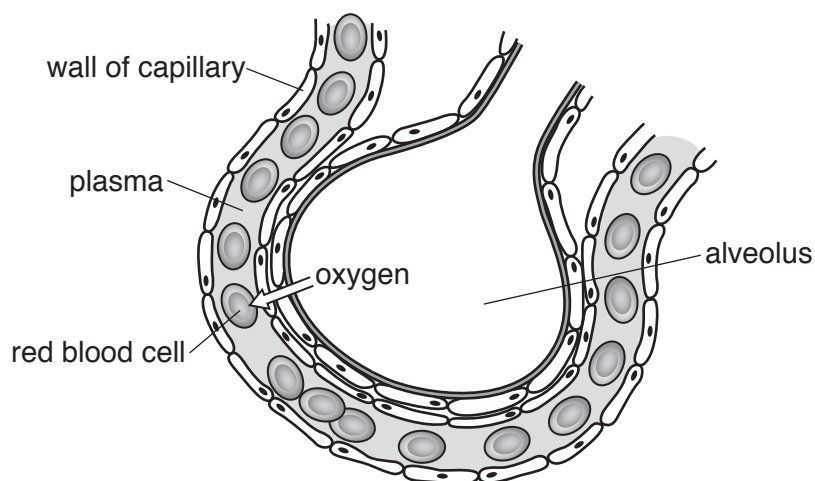


Fig. 7.2

- (i) Describe **two** features of a gas exchange surface which are visible in Fig. 7.2.

1.

2.

[2]

- (ii) Oxygen diffuses into the blood at the alveoli.

Explain why oxygen diffuses from the alveoli into the blood.

.....

.....

.....[1]

- (c) Describe how the gas exchange system is protected by mucus and cilia.

mucus

.....

cilia

.....[2]

- (d) The blood leaving the heart from the left ventricle has a greater pressure than the blood leaving the right ventricle.

Explain why this difference in pressure is needed.

.....

.....

.....

.....[2]

8 Petroleum is a fossil fuel.

(a) (i) Name **two other** fossil fuels.

1.
2. [1]

(ii) Name the industrial process used to separate the substances in petroleum.

..... [1]

(b) The structures of two hydrocarbon molecules are shown in Fig. 8.1.

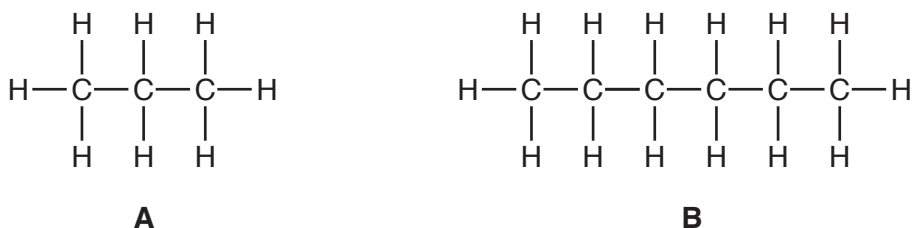


Fig. 8.1

(i) Construct the balanced symbol equation for the complete combustion of hydrocarbon **A**.

..... [2]

(ii) State the formula of hydrocarbon **B**.

..... [1]

(iii) State which of these two hydrocarbons has the higher boiling point.

Explain your answer.

hydrocarbon

explanation

.....

.....

[2]

(c) The formula of hydrocarbon **C** is C_2H_4 .

- (i) Name the process used to manufacture hydrocarbon **C** from larger hydrocarbon molecules.

.....[1]

- (ii) Draw the dot-and-cross diagram to show the bonding electrons in a molecule of hydrocarbon **C**.

C

C

[2]

- 9 Fig. 9.1 shows an electric toaster used for toasting bread slices in a hotel dining room.

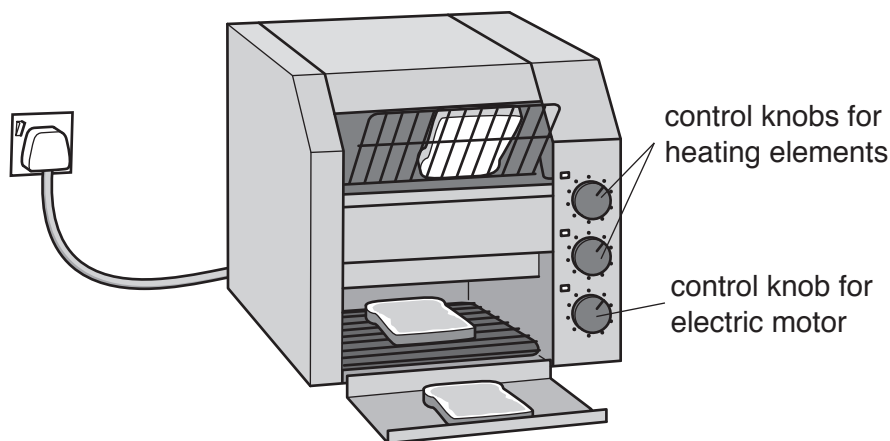


Fig. 9.1

The two heating elements inside, one to toast each side of the bread, are connected in parallel. They are each controlled by a switch.

An electric motor carries the bread slices on a moving rack between the heating elements. The motor is controlled by a third switch and is connected in parallel with the heating elements.

The plug at the end of the cable has a fuse inside, and is plugged into a 240 V mains supply.

- (a) The circuit symbols for each of these components used in the toaster circuit are:

electric motor

fuse

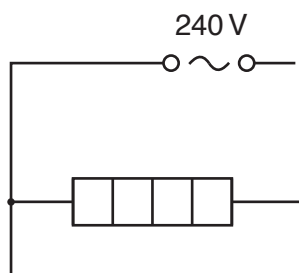
heating element

switch



Use the information about the toaster to draw a circuit diagram for the toaster.

The circuit diagram has been started for you.



- (b) The two heating elements are each rated at 240 V, 1.2 kW. The electric motor is rated at 240 V, 100 W. The plug has a 10 A fuse fitted.

Show by calculation that the fuse in the plug is not adequate when both heating elements and the motor are in operation.

Show your working.

[3]

- (c) A smoke alarm is fitted in the dining room in case the toaster causes a fire.

When it goes off, the smoke alarm has to make a loud high-pitched sound that everyone can hear. The highest frequency of sound some older residents can hear is 5 kHz below the top of the normal human hearing range.

Suggest a frequency for the high-pitched sound from the smoke alarm that all residents should be able to hear.

Give a reason for your answer.

suggested frequency kHz

reason

.....

.....

[2]

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 International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

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

