Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 24.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **23** printed pages and **1** blank page.

CAMBRIDGE International Examinations

[Turn over

1 **(a)** Fig. 1.1 shows an early type of airship filled with hydrogen gas.

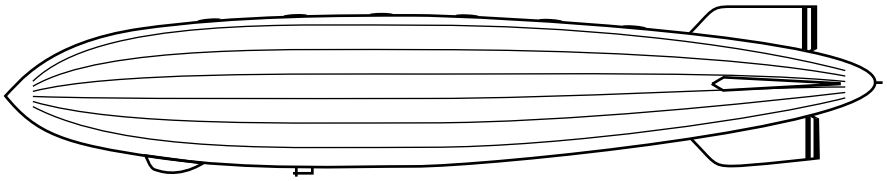


Fig. 1.1

A hydrogen molecule consists of two hydrogen atoms bonded together.
Each hydrogen atom contains a small number of subatomic particles.

(i) State the names and numbers of the subatomic particles in most hydrogen atoms.

.....

..... [2]

(ii) State the type of bonding involved in a hydrogen molecule.

..... [1]

(iii) The use of hydrogen for airships declined following a disaster in which an airship caught fire.

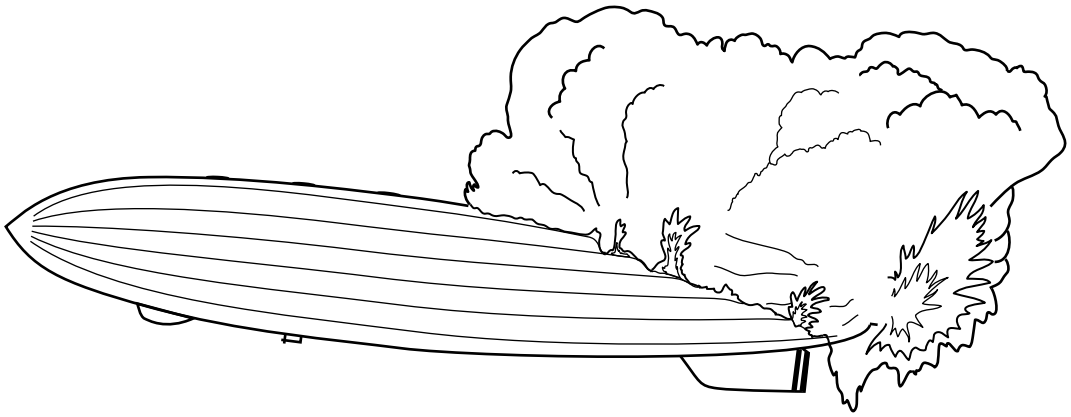


Fig. 1.2

Write a word equation for the combustion of hydrogen.

[2]

(iv) The combustion of hydrogen is an exothermic reaction.
State the meaning of the term *exothermic*.

.....

..... [1]

(v) Hydrogen can be displaced from an acid by reaction with another substance.

Name a substance that could be used to displace hydrogen safely from an acid.
Explain your answer in terms of the reactivity series.

.....

.....

..... [2]

(b) Fig. 1.3 shows a modern weather balloon containing hydrogen or helium gas.

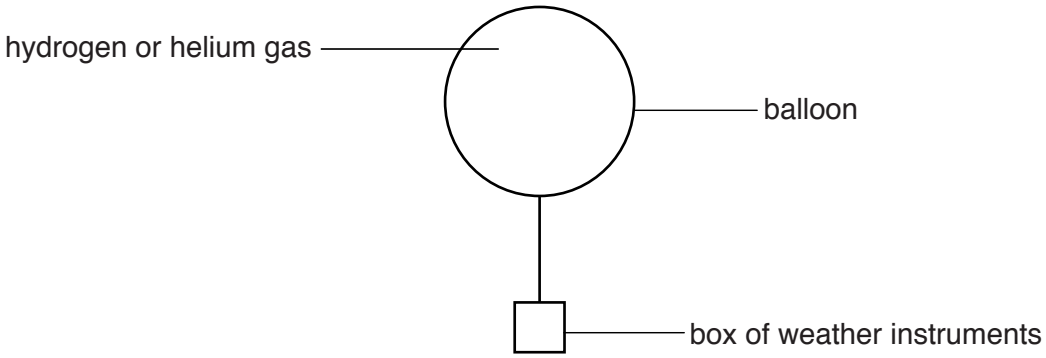


Fig. 1.3

Explain why helium is safer to use than hydrogen.

.....

.....

..... [1]

(c) Modern hot air balloons burn propane gas to heat air which inflates the balloon.

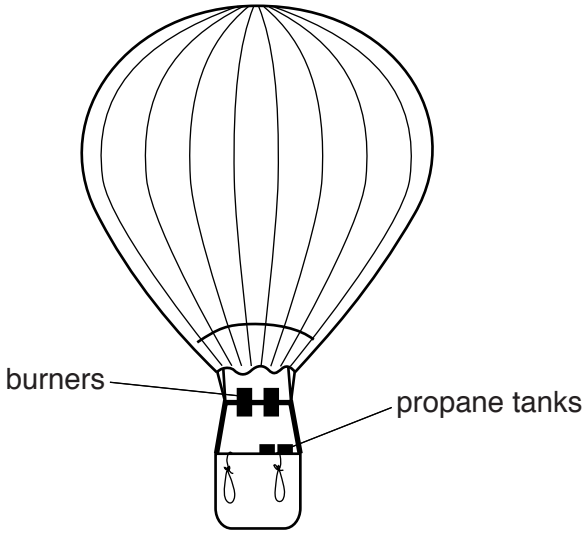


Fig. 1.4

Propane is a hydrocarbon.

Fig. 1.5 shows a model of a propane molecule.

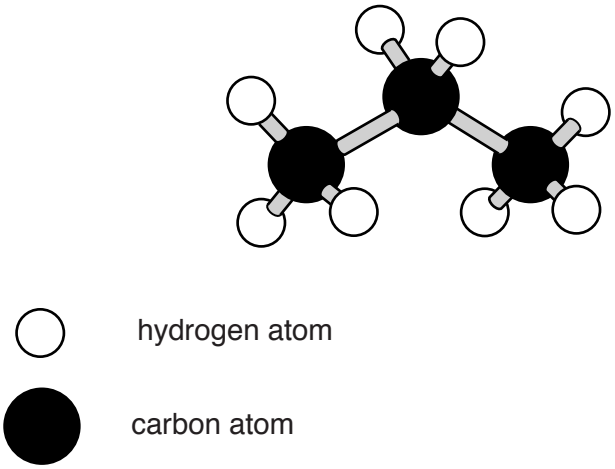


Fig. 1.5

State the molecular formula of propane.

..... [1]

2 **(a)** Most of the chemicals in living things are compounds made from two or more elements chemically joined together.

Choose words from the list of elements below to complete the sentences.

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

carbon **hydrogen** **magnesium** **nitrogen** **oxygen**

potassium **phosphorus** **sulfur**

(i) The elements contained in carbohydrates are

....., ... and ..... [1]

(ii) The elements contained in fats are

....., ... and ..... [1]

(b) Fig. 2.1 shows an animal cell.

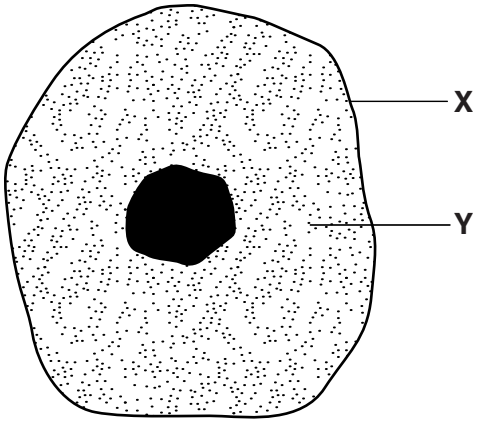


Fig. 2.1

(i) Name the parts of the cell shown by labels **X** and **Y** on Fig. 2.1.

X .....

Y ..... [2]

(ii) One function of a cell is to carry out respiration which needs a constant supply of oxygen.

Outline how oxygen gets from the alveoli of the lungs to a muscle cell.

.....

.....

..... [2]

[Turn over

(c) Energy is released by respiration in cells.

Explain why the rate of respiration increases in some cells during exercise.

.....

..... [1]

(d) Food stores in the body are broken down by respiration to release energy during exercise. Some people exercise when they are trying to lose weight.

Table 2.1 shows the approximate energy needed for a person of body mass 70 kg to do 30 minutes of different types of exercise.

Table 2.1

type of exercise	energy needed for 30 minutes of exercise / kJ
cycling	850
golf	670
jogging	1260
swimming	830
walking	580

Sarbjit and Anna each have a body mass of 70 kg. They both exercise for 90 minutes.

During this time they do 30 minutes each of three different exercises.

Calculate the total energy needed for each girl's exercise, as follows.

(i) Sarbjit did jogging, swimming and golf.

total energy needed = ... kJ

Anna did cycling, walking and swimming.

total energy needed = ... kJ [1]

(ii) State and explain which girl's exercises were more effective for losing weight.

.....

.....

..... [2]

(iii) Suggest **one** reason why the energy values given in Table 2.1 cannot be exactly the same for everyone doing the exercises.

.....

..... [1]

3 Fig. 3.1 shows a man on a snowboard moving down a hill.

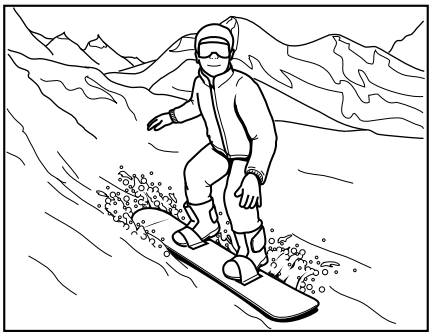


Fig. 3.1

Fig. 3.2 shows a graph of the man's speed as he goes down the hill.

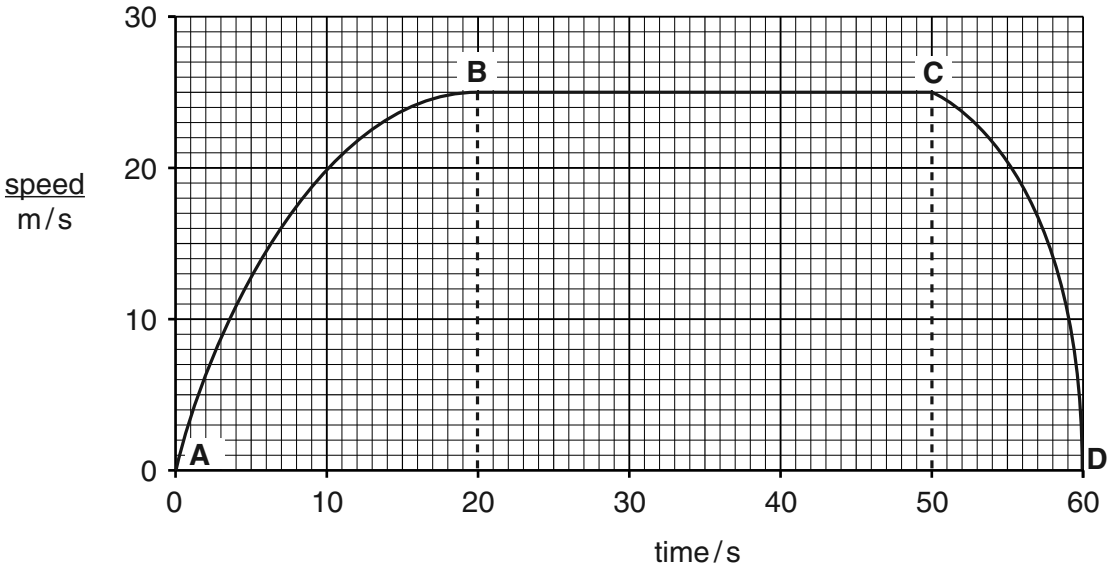


Fig. 3.2

(a) State the force that causes the man to move downhill.

..... [1]

(b) Describe the motion of the man between points

A and **B**, ...

.....

B and **C**. .....

.....

[2]

(c) Calculate the distance travelled by the man between points **B** and **C**.

State the formula you use and show your working.

formula

working

distance = ... m [2]

(d) The man on the snowboard wants to go faster down the hill.

Explain in terms of the forces acting on the man and his snowboard why

(i) he covers the underside of the snowboard with wax to make it smooth,

.....

..... [1]

(ii) he bends down low on the snowboard while going down the hill.

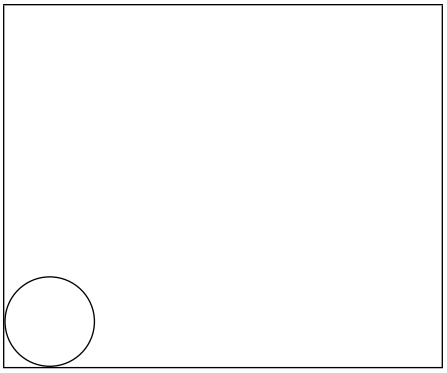
.....

..... [1]

(e) Snow is made of solid ice crystals.

In the box below, draw a diagram to show the arrangement of particles in a solid.

One particle has been drawn for you. You need to draw at least 11 more.



[2]

[Turn over

4 **(a)** A sample of soil is taken from near a city where coal has been burned for many years.

Full-range indicator (Universal Indicator) is added to some pure water. The soil sample is mixed with the water and filtered.

The indicator shows that the pH of the water is 3.

(i) Describe the change in colour of the indicator.

from ..... **to** ..... [1]

(ii) Burning coal produces an acidic gas called sulfur dioxide.
Explain why the sample of soil has a low pH.

.....

.....

..... [2]

(iii) In order to improve soil, by reducing its acidity, limestone is sometimes added.
Limestone consists mainly of calcium carbonate.

Complete the word equation for the reaction occurring between calcium carbonate and hydrochloric acid.

calcium carbonate	+	hydrochloric acid	→	carbon dioxide	+		+	

[2]

(b) Some students are asked whether the size of the pieces of calcium carbonate used in a reaction with dilute hydrochloric acid affects the rate of reaction.

Fig. 4.1 shows the apparatus they use to investigate the problem.

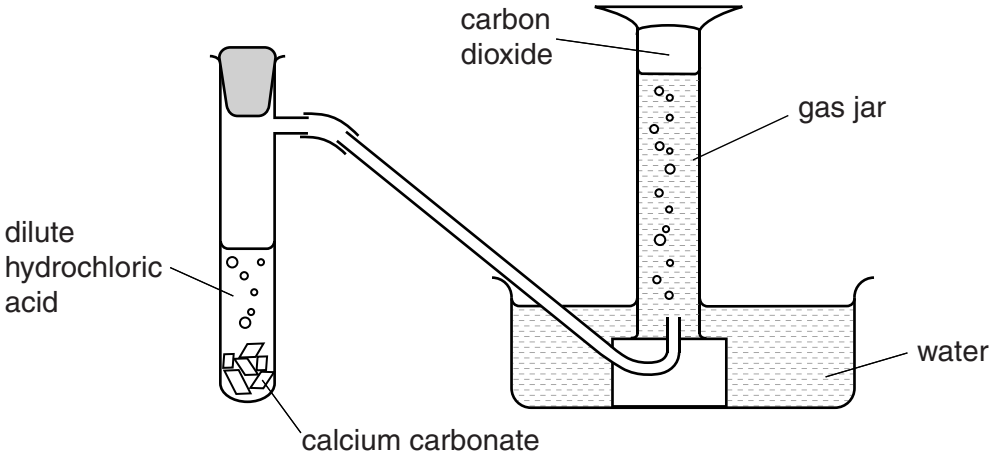


Fig. 4.1

The reaction is repeated with differently-sized pieces of calcium carbonate and the time taken to fill the gas jar with carbon dioxide is measured for each repeat.

(i) Describe how the size of the pieces of calcium carbonate used affects the time taken to fill the gas jar with carbon dioxide.

.....

.....

..... [1]

(ii) Describe how changing **one** of the other reaction conditions will affect the rate of this reaction.

.....

.....

..... [1]

[Turn over

5 **(a)** Fig. 5.1 shows two flowers of the same species.

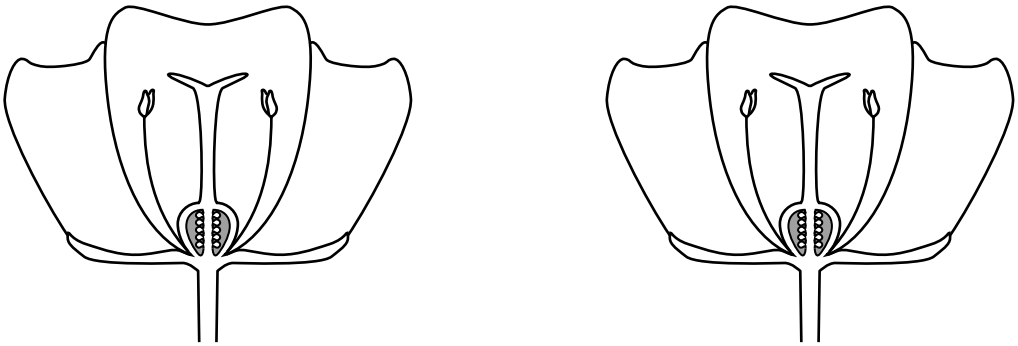


Fig. 5.1

(i) On Fig. 5.1 draw an arrow to show the transfer of pollen from flower **A** to flower **B** during pollination. [2]

(ii) From Fig. 5.1 describe **two** adaptations of this flower for insect pollination.
Use only features visible in Fig. 5.1.

1 .....

.....

2 .....

..... [2]

(b) A student sets up an experiment to investigate the conditions needed for germination of seeds. She uses cotton wool and seeds as shown in Fig. 5.2.

dish 1	**dish 2**	**dish 3**	**dish 4**
damp cotton wool 20°C in light	dry cotton wool 20°C in light	damp cotton wool 4°C in fridge in dark	damp cotton wool 20°C in dark

Fig. 5.2

After a few days the dishes are examined.
Table 5.1 shows what the student observes.

Table 5.1

dish number	observations
1	all seeds germinated
2	no germination
3	no germination
4	all seeds germinated

(i) Use the results in Table 5.1 to confirm that the following conditions are needed for germination.

warmth

.....

.....

water

.....

..... [2]

(ii) Study the evidence in Table 5.1 to decide whether light is needed for germination. Explain your answer.

.....

..... [1]

(iii) State **one** other condition, not investigated in the experiment, that is needed for germination of seeds.

..... [1]

[Turn over

6 Many different musical instruments are played in an orchestra.

Table 6.1 shows the lowest and highest frequencies for the sounds produced by some musical instruments in an orchestra.

Table 6.1

instrument	lowest frequency / Hz	highest frequency / Hz
bassoon	58	932
cello	65	659
clarinet	147	1865
flute	262	2093
harp	31	3322
trumpet	165	1000
violin	196	2637

(a) State which instrument in the table

(i) has the smallest range of frequencies, ... [1]

(ii) produces a sound with the shortest wavelength, ... [1]

(iii) produces a sound with the lowest pitch. ..... [1]

(b) String instruments, such as the violin and guitar, produce sound waves when the strings are plucked.

(i) On Fig. 6.1 draw a diagram to show the motion of a violin or guitar string when it is plucked.

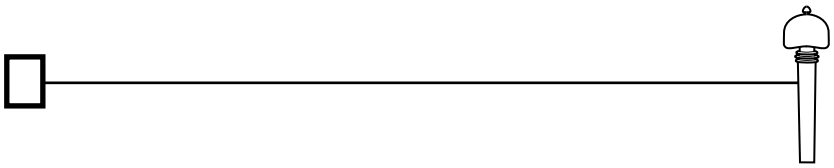


Fig. 6.1

[1]

(ii) State how your diagram would change if the string produces a louder sound.

..... [1]

(c) A listener at an outdoor pop concert is 66 m away from the stage.

Calculate the delay between the time a guitar string is plucked and the time she hears the sound.

The speed of sound in air is 330 m / s.

Show your working.

time delay = ... s [2]

7 **(a)** Complete Table 7.1 to show the physical states of the halogens at room temperature.

Table 7.1

halogen	physical state
chlorine	
bromine	
iodine	

[2]

(b) Fig. 7.1 shows the apparatus used for the electrolysis of molten lead bromide.

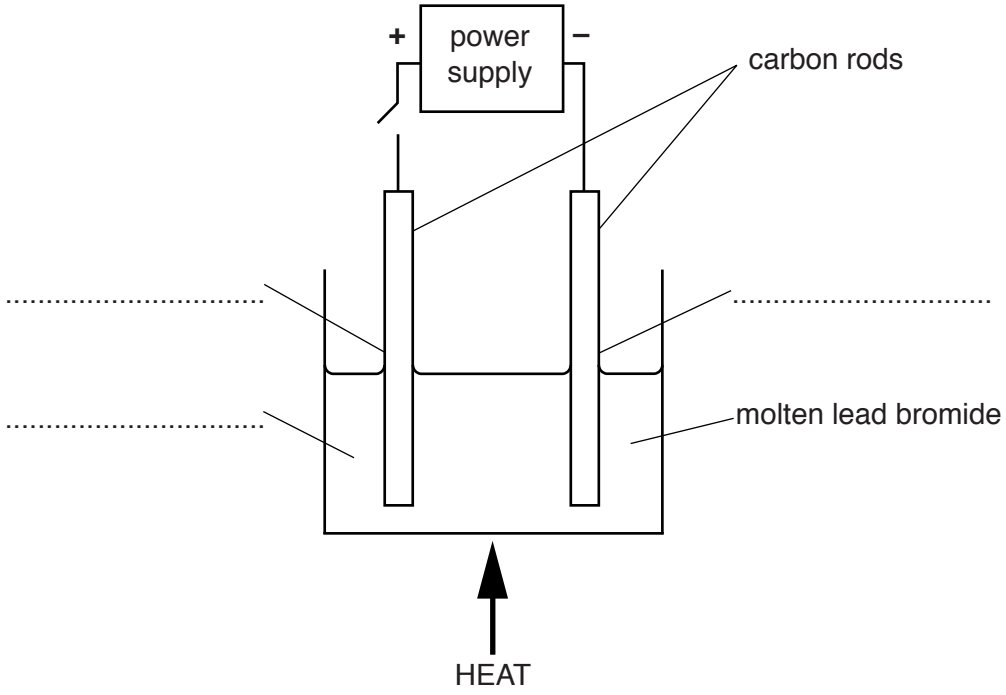


Fig. 7.1

(i) Complete the labelling of the diagram, choosing from the words below.

ammeter **anode**

cathode **electrolyte** **insulator**

resistor **water**

[2]

(ii) Place an **X** on the diagram to show where bromine would appear. [1]

(iii) Describe the appearance of the bromine.

.....

..... [1]

(c) Bromine is produced on a large scale by passing chlorine gas through sodium bromide solution.

Fig. 7.2 shows how this can be demonstrated in the laboratory.

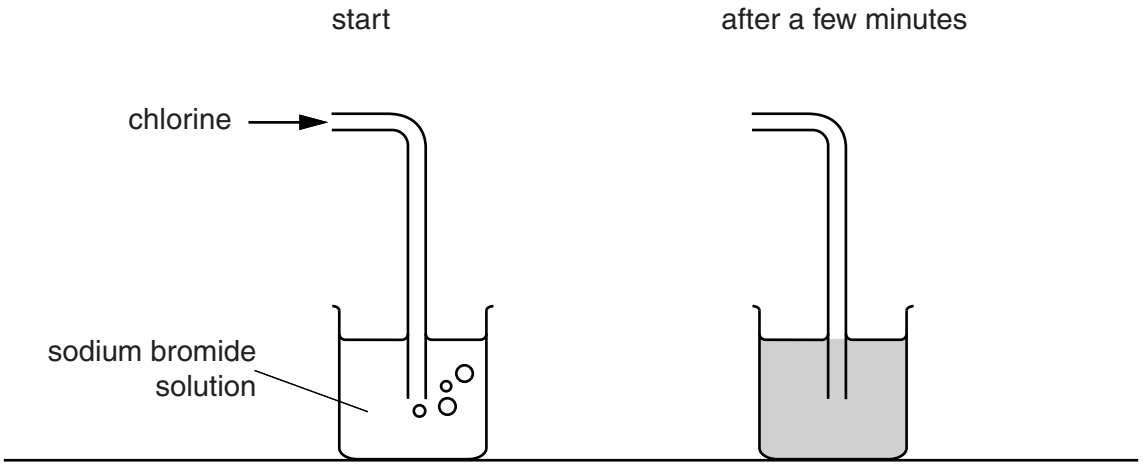


Fig. 7.2

(i) Name the substance, other than bromine, that is formed in the beaker.

..... [1]

(ii) Suggest a suitable compound from which iodine could be extracted using a similar method to that shown in Fig. 7.2.

..... [1]

(iii) Use your knowledge of Group VII of the Periodic Table to explain your answer to **(ii)**.

.....

..... [1]

8 Fig. 8.1 shows a food chain in Africa.

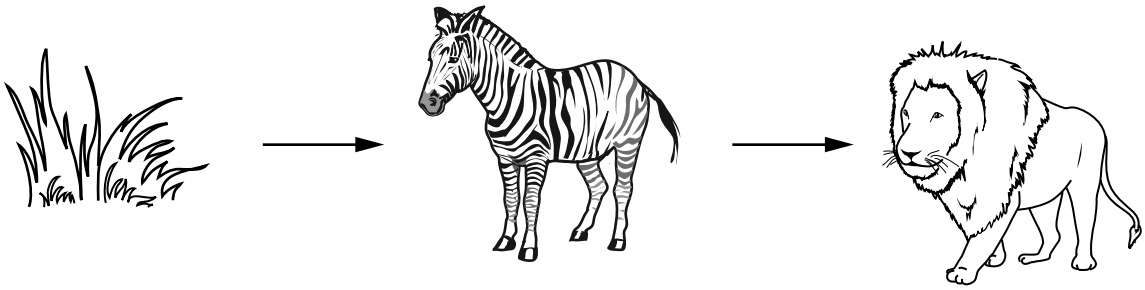


Fig. 8.1

(a) **(i)** The source of energy for the food chain is sunlight. The grass needs sunlight for photosynthesis.

Complete the word equation for photosynthesis.

carbon dioxide + ... → ..... + oxygen [2]

(ii) From the food chain in Fig. 8.1 name

one consumer,

.....

one carnivore.

..... [2]

(b) In most habitats the organisms have more than one food source. These can be added to the food chain to make a food web.

Use the statements below to add labels and arrows to the food chain in Fig. 8.1 to build up a food web.

A lion also eats a hyena.

A hyena eats a zebra.

You may use the word 'hyena' rather than trying to draw one. [2]

(c) The element carbon is transferred along the food chain in Fig. 8.1.

(i) Describe how carbon atoms are transferred from the zebra to the lion.

.....

..... [1]

(ii) Not all the carbon in the zebra is transferred to the lion.

State **two** reasons why some of the carbon atoms in the zebra are **not** transferred to the lion.

1 .....

.....

2 .....

..... [2]

9 Fig. 9.1 shows a caravan which uses an electric heater to supply warm air to heat the caravan and to heat water.

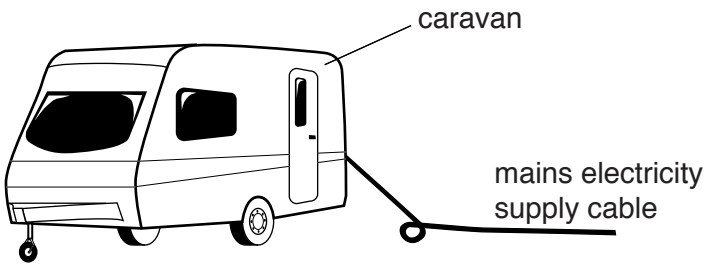


Fig. 9.1

Fig. 9.2 shows a circuit diagram for the electric heater. It contains two elements, one for heating the air and one for heating the water.

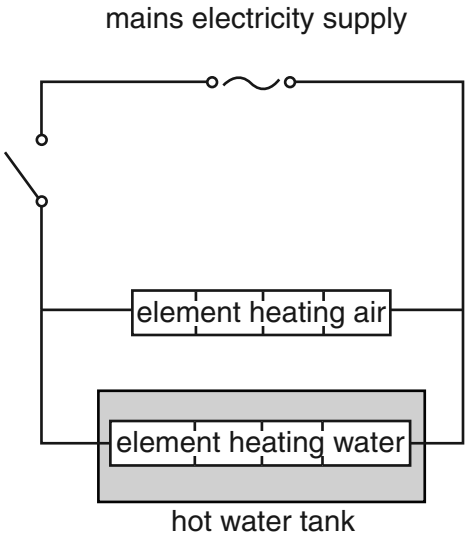


Fig. 9.2

(a) (i) The air around the electric heater is heated. The heated air then flows around the caravan and warms the people sitting inside.

State the method of thermal energy transfer involved in the flow of air around the caravan.

..... [1]

(ii) Thermal energy from the element heating water must be transferred through the wall of the element into the water around it.

State the method of thermal energy transfer through the wall of the element.

..... [1]

(iii) The hot water must be kept hot in the hot water tank after the heater is switched off.

Suggest and explain a method of keeping the water hot for a long time in the tank after heating.

method .....

.....

explanation .....

..... [2]

(b) The circuit diagram in Fig. 9.2 only allows both heating elements to be switched on together, or both heating elements to be switched off together.

Complete the circuit diagram in Fig. 9.3 to show a circuit which allows the people in the caravan to have one element switched on and the other element switched off.

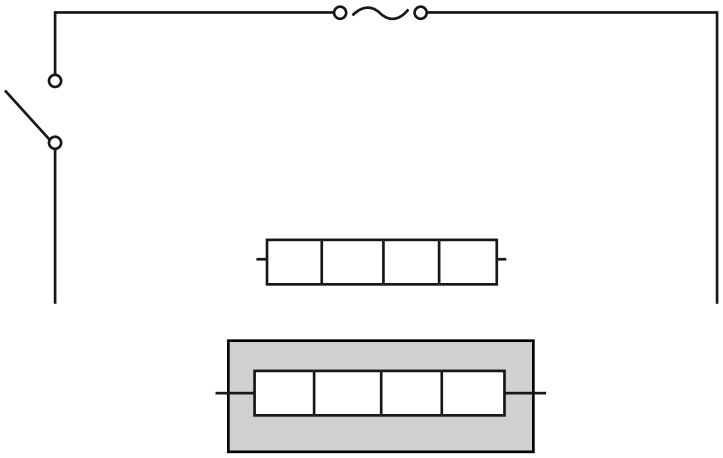


Fig. 9.3

[2]

[Turn over

(c) When both elements are switched on, the current in the water-heating element is 8 A and the current in the air-heating element is 4 A.

Suggest how the resistance of the water-heating element compares with the resistance of the air-heating element.

Explain your answer.

comparison of resistances .....

.....

explanation .....

..... [3]

(d) One day the caravan owner touches the metal casing of the heater. He is surprised to suffer an electrical shock.

Suggest an electrical hazard that might be responsible for this happening.

.....

..... [1]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	209 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **Fr** Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

* 58–71 Lanthanoid series
† 90–103 Actinoid series

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	147 **Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103

Key: a above **X** above b

a = relative atomic mass
X = atomic symbol
b = atomic (proton) number

The volume of one mole of any gas is $24\,dm^3$ at room temperature and pressure (r.t.p.).