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0653/21

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.

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

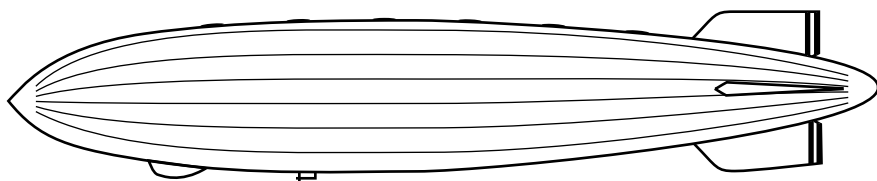


Fig. 1.1

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.

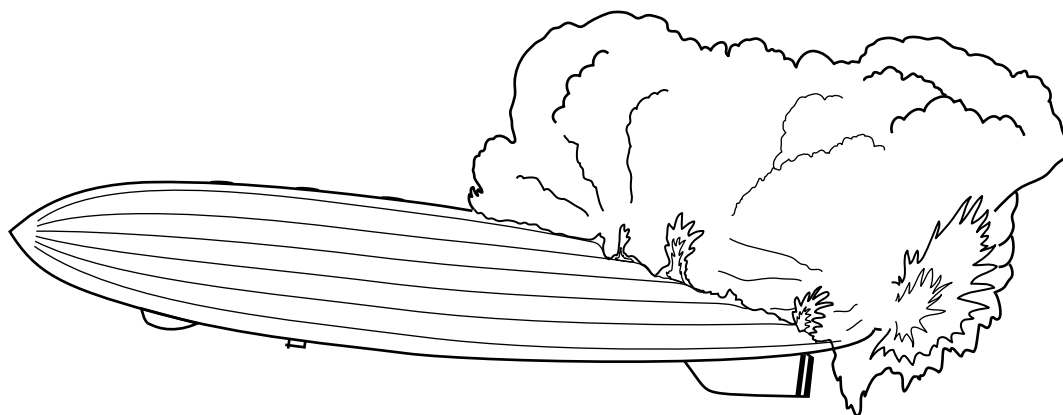


Fig. 1.2

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.

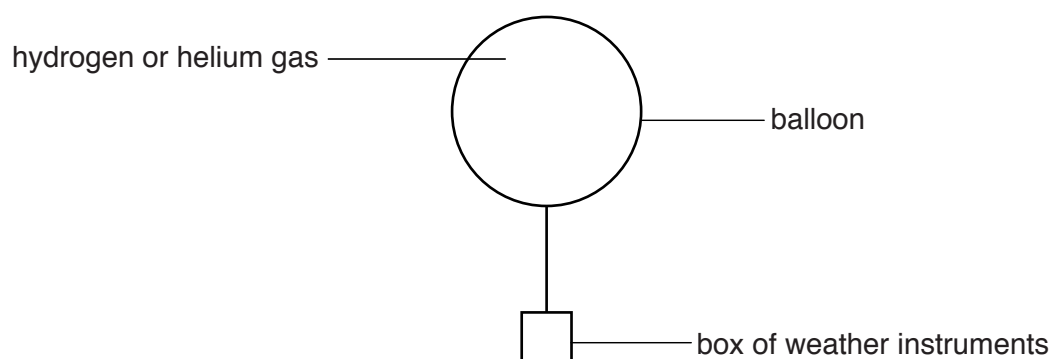


Fig. 1.3

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.

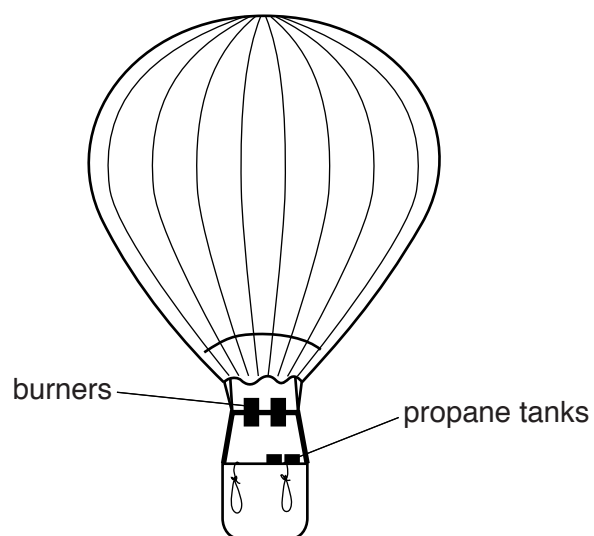


Fig. 1.4

Propane is a hydrocarbon.

Fig. 1.5 shows a model of a propane molecule.

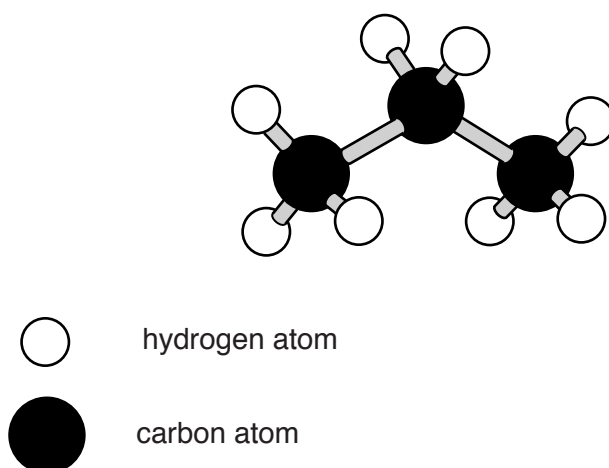


Fig. 1.5

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.

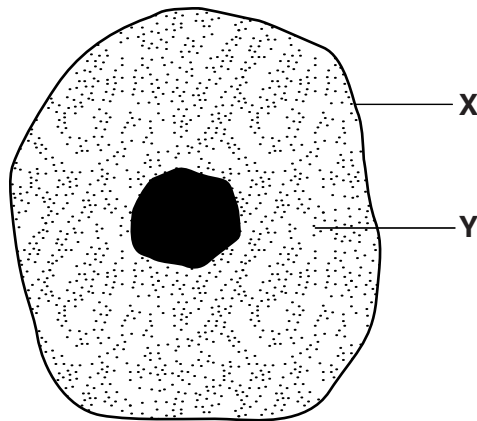


Fig. 2.1

- (i) Name the parts of the cell shown by labels **X** and **Y** on Fig. 2.1.
- X** [1]
- Y** [1]
- (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]

- (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.

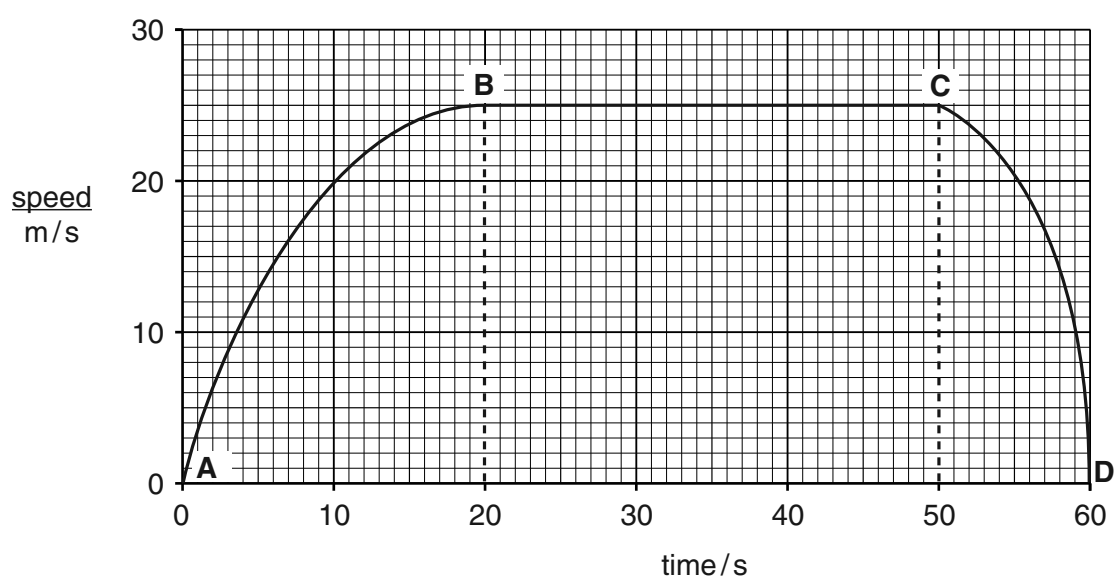


Fig. 3.2

- (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]

- 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.

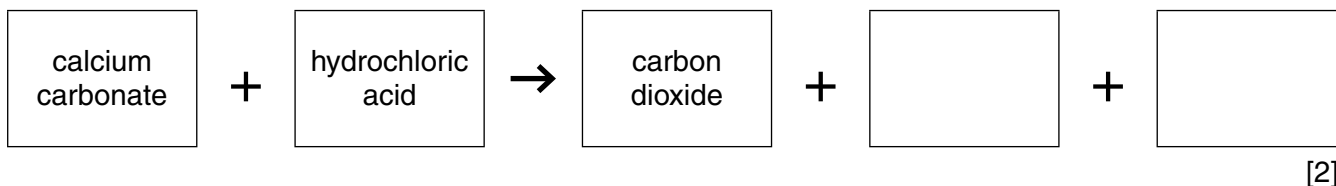
from to [1]

- (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.



- (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.

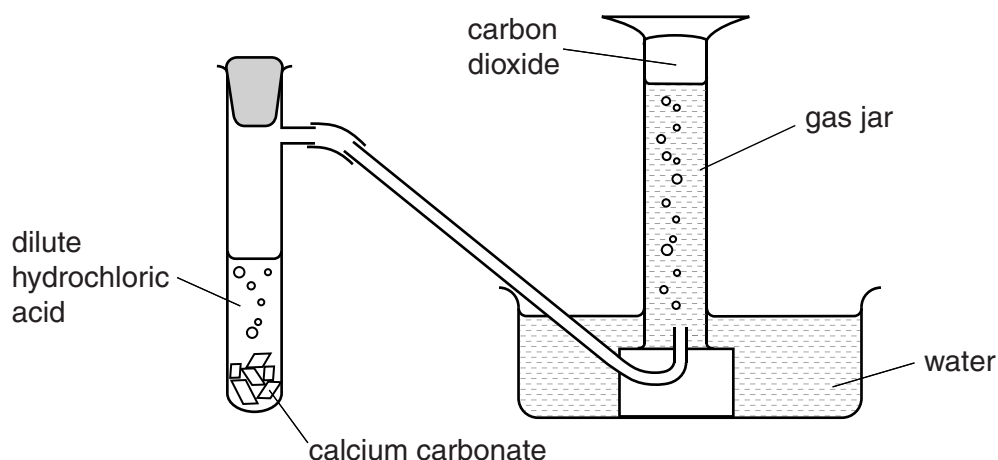


Fig. 4.1

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]

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

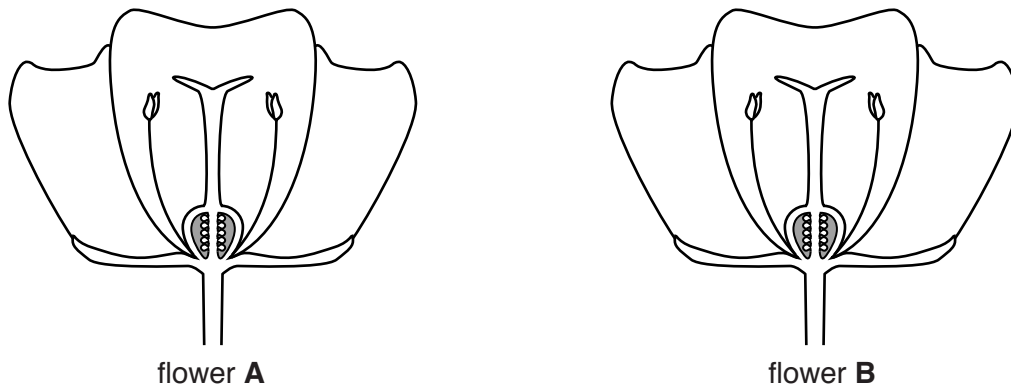


Fig. 5.1

- (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.

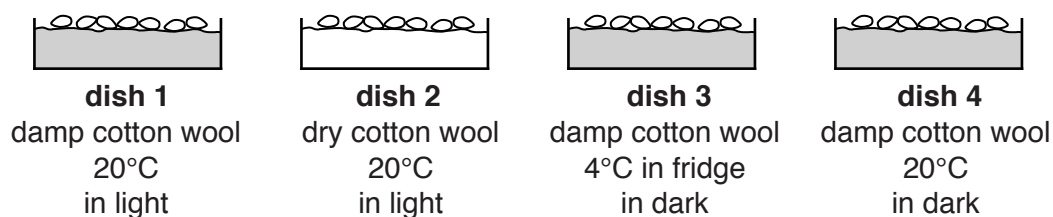


Fig. 5.2

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]

- 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.

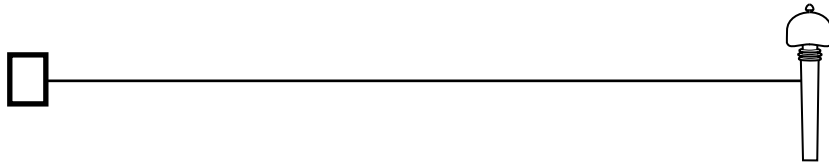


Fig. 6.1

[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.

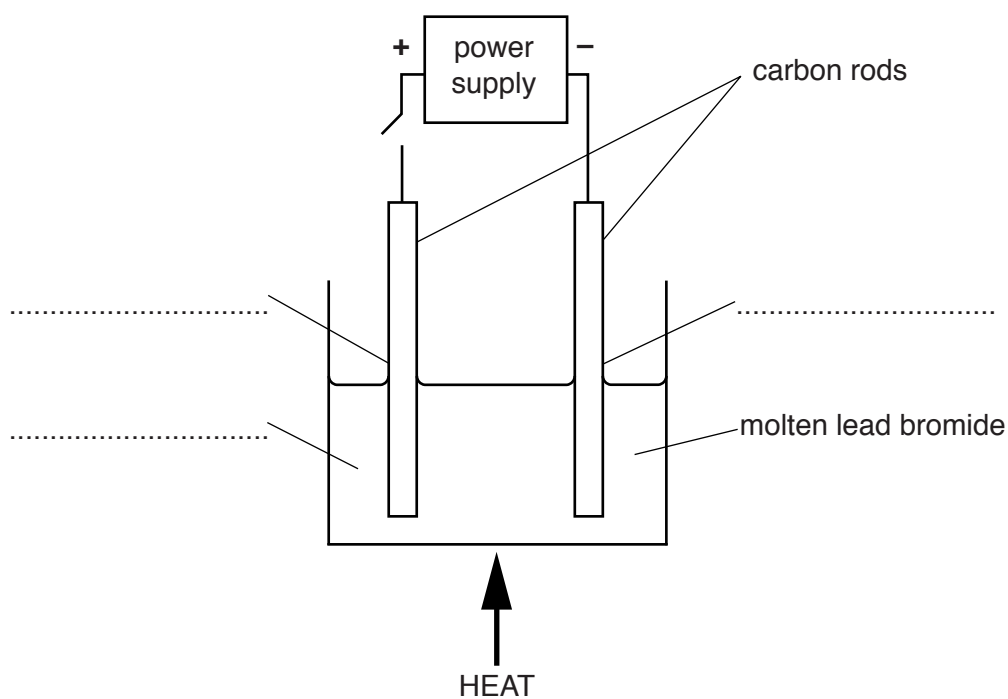


Fig. 7.1

- (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.

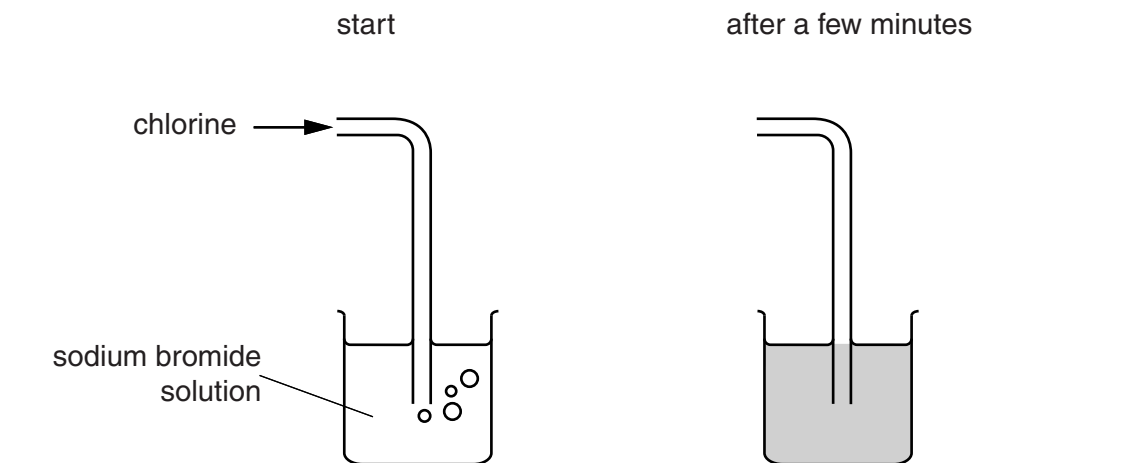


Fig. 7.2

(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.

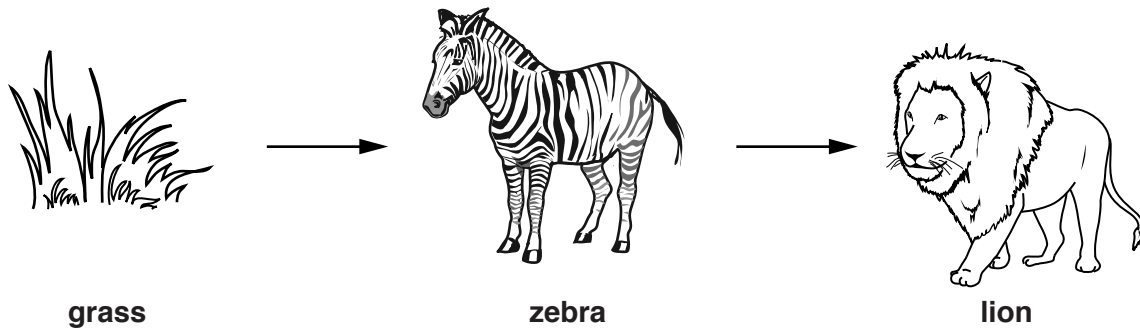


Fig. 8.1

- (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.

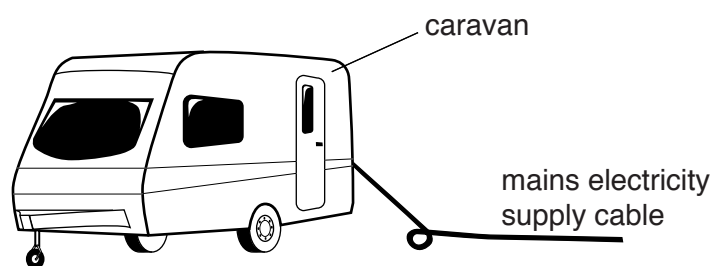


Fig. 9.1

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.

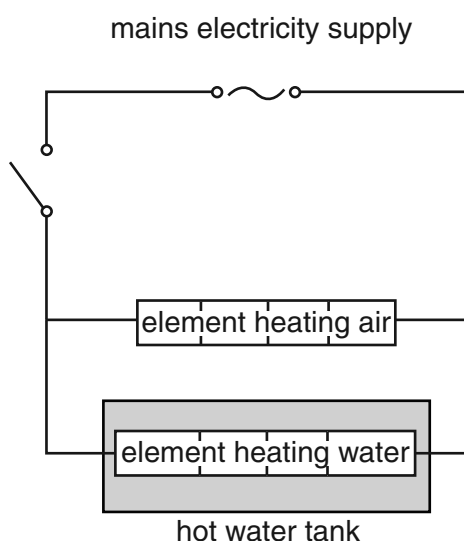


Fig. 9.2

- (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.

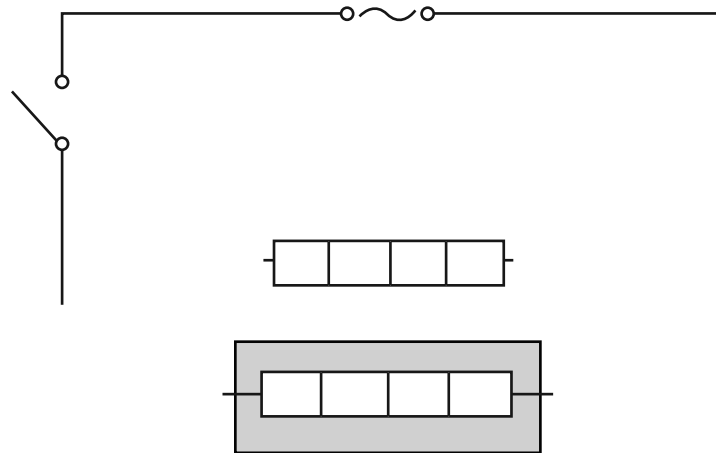


Fig. 9.3

[2]

- (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

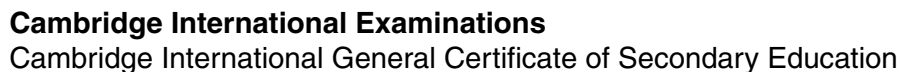
Group																														
I	II											III	IV	V	VI	VII	0													
		1 H Hydrogen																												
3 7 Li Lithium	4 9 Be Beryllium											5 11 B Boron	6 12 C Carbon	7 14 N Nitrogen	8 16 O Oxygen	9 19 F Fluorine	2 4 He Helium													
11 23 Na Sodium	12 24 Mg Magnesium											13 27 Al Aluminium	14 28 Si Silicon	15 31 P Phosphorus	16 32 S Sulfur	17 35.5 Cl Chlorine	10 20 Ne Neon													
19 39 K Potassium	20 40 Ca Calcium	21 45 Sc Scandium	22 48 Ti Titanium	23 51 V Vanadium	24 52 Cr Chromium	25 55 Mn Manganese	26 56 Fe Iron	27 59 Co Cobalt	28 59 Ni Nickel	29 64 Cu Copper	30 65 Zn Zinc	31 70 Ga Gallium	32 73 Ge Germanium	33 75 As Arsenic	34 79 Se Selenium	35 80 Br Bromine	36 84 Kr Krypton													
37 85 Rb Rubidium	38 88 Sr Strontium	39 89 Y Yttrium	40 91 Zr Zirconium	41 93 Nb Niobium	42 96 Mo Molybdenum	43 96 Tc Technetium	44 101 Ru Ruthenium	45 103 Rh Rhodium	46 106 Pd Palladium	47 108 Ag Silver	48 112 Cd Cadmium	49 115 In Indium	50 119 Sn Tin	51 122 Sb Antimony	52 128 Te Tellurium	53 127 I Iodine	54 131 Xe Xenon													
55 133 Cs Caesium	56 137 Ba Barium	57 139 La Lanthanum	72 178 Hf Hafnium	73 181 Ta Tantalum	74 184 W Tungsten	75 186 Re Rhenium	76 190 Os Osmium	77 192 Ir Iridium	78 195 Pt Platinum	79 197 Au Gold	80 201 Hg Mercury	81 204 Tl Thallium	82 207 Pb Lead	83 209 Bi Bismuth	84 209 Po Polonium	85 210 At Astatine	86 222 Rn Radon													
87 223 Fr Francium	88 226 Ra Radium	89 227 Ac Actinium																												
* 58–71 Lanthanoid series † 90–103 Actinoid series																														
											91 140 Ce Cerium	92 141 Pr Praseodymium	93 144 Nd Neodymium	94 147 Pm Promethium	95 150 Sm Samarium	96 152 Eu Eurpium	97 157 Gd Gadolinium	98 159 Tb Terbium	99 162 Dy Dysprosium	100 165 Ho Holmium	101 167 Er Erbium	102 169 Tm Thulium	103 173 Yb Ytterbium	175 175 Lu Lutetium						
											90 232 Th Thorium	91 231 Pa Protactinium	92 238 U Uranium	93 237 Np Neptunium	94 244 Pu Plutonium	95 243 Am Americum	96 247 Cm Curium	97 247 Bk Berkellum	98 251 Cf Californium	99 252 Es Einsteinium	100 257 Fm Fermium	101 258 Md Mendelevium	102 259 No Nobelium	260 260 Lr Lawrencium						
Key											a = relative atomic mass x = atomic symbol b = atomic (proton) number																			
											a	x		b																

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

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

Key

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



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- 1 (a) Table 1.1 gives some facts about one atom of the element sodium and the position of sodium in the Periodic Table.

Table 1.1

element	Group	proton number	nucleon number
sodium	I	11	23

- (i) From the information in Table 1.1, deduce the following information about the atomic structure of sodium.

the number of electrons in a sodium atom

the number of neutrons in this sodium atom [2]

- (ii) Deduce the number of electrons a sodium atom loses when it forms an ion.

number of electrons lost

explanation

.....[1]

- (b) Fig. 1.1 shows a demonstration of the reaction between hydrogen and the oxygen in air.

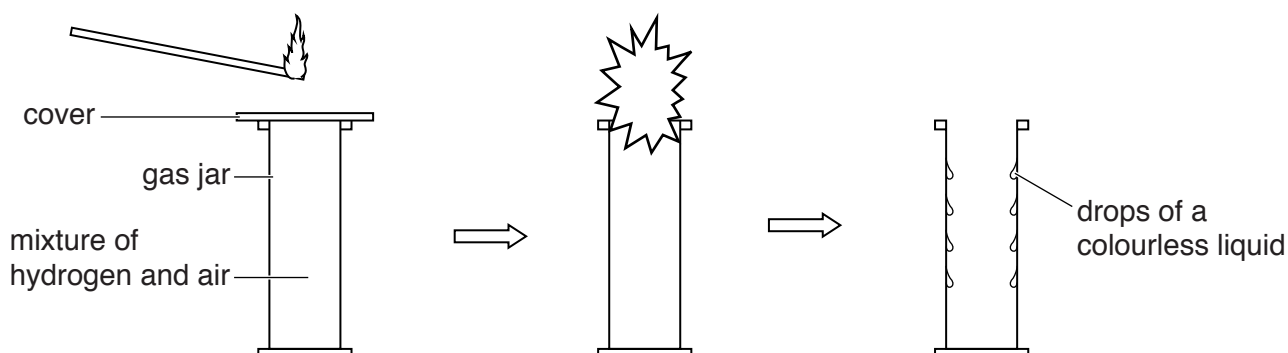


Fig. 1.1

A burning splint is placed over a gas jar containing a mixture of hydrogen and air.

The cover is removed.

The mixture explodes.

- (i) Drops of a colourless liquid are observed inside the gas jar.

Describe a chemical test and the result of this test that shows that the liquid is water.

test

.....

result[2]

- (ii) Write a word equation for the reaction between hydrogen and oxygen.

.....[1]

- (iii) State the type of bond formed between hydrogen and oxygen atoms in this reaction.
Explain your answer.

type of bond

explanation

.....[2]

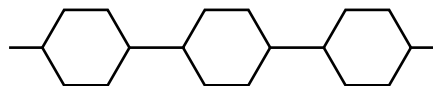
- 2 (a) Most large molecules in living organisms are made by joining many smaller molecules together. An example of this is glycogen which is made from glucose molecules. A short length of glycogen is shown in Fig. 2.1.

small molecule



glucose

part of large molecule



glycogen

Fig. 2.1

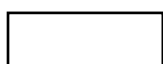
Some of the small molecules that join together to make large molecules in living organisms are shown in Fig. 2.2.



glucose



fatty acid



glycerol



amino acid

Fig. 2.2

- (i) Select molecules from Fig. 2.2 and make drawings in Table 2.1 to show how protein and starch are made up. Your diagrams should be similar to Fig. 2.1.

Table 2.1

large molecule	small molecule	part of large molecule
protein		
starch		

[4]

- (ii) Energy is needed in cells to build large molecules from small ones.

Describe how energy is released in cells for this process.

.....

.....

.....[2]

- (b) (i) A plant usually gets its nitrogen in the form of nitrate ions which are dissolved in the water in the soil.

Describe the path taken by nitrate ions from the soil to the leaves.

.....

.....

.....[2]

- (ii) Fig. 2.3 shows a Venus flytrap. This plant grows in areas where the soil does not have enough nitrogen. A source of the element nitrogen is needed to make proteins.

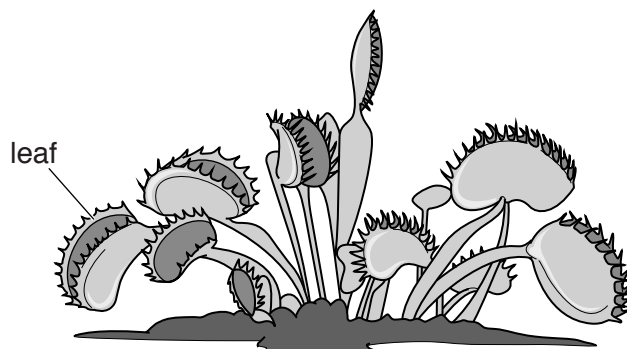


Fig. 2.3

The Venus flytrap captures and digests insects. The insect shown in Fig. 2.4 lands on the open leaf. The leaf then traps the insect by closing around it very quickly.

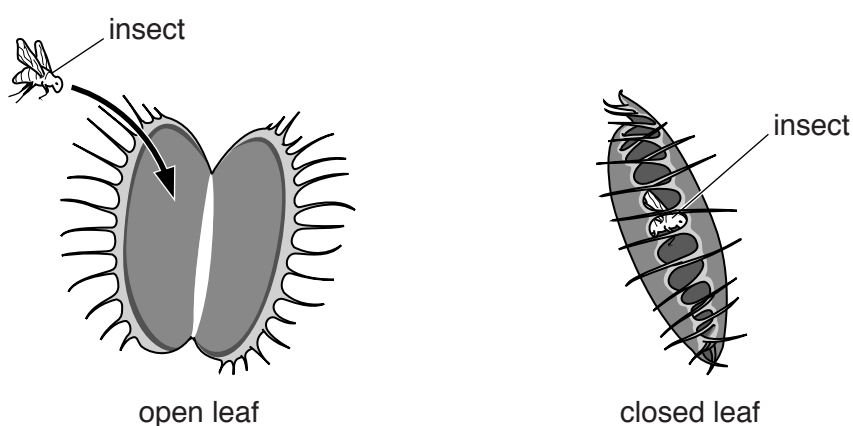


Fig. 2.4

State **two** characteristics of living things which the Venus flytrap shows when it traps a fly.

1

2[2]

- (iii) When the leaves of the Venus flytrap are open they look like flowers in order to attract insects.

Suggest **two** features the leaves may have that would enable them to look like flowers.

1

2[2]

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Question 3 continues over the page.

- 3 The pole vault is an athletics event in which the athlete attempts to get over a very high bar with the help of a long pole.

Fig. 3.1 shows an athlete at five stages during a pole vault.

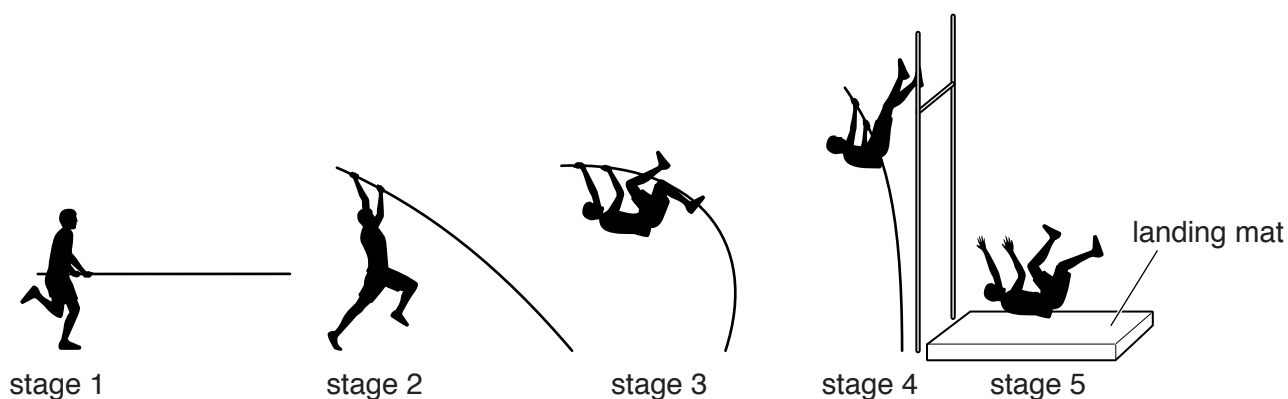


Fig. 3.1

The athlete runs with his pole, places the pole in the ground and pushes himself upwards. He rises to the height of the bar, remains there for a brief moment, then falls over the bar to the landing mat.

Fig. 3.2 shows a simplified graph of the athlete's speed during the pole vault.

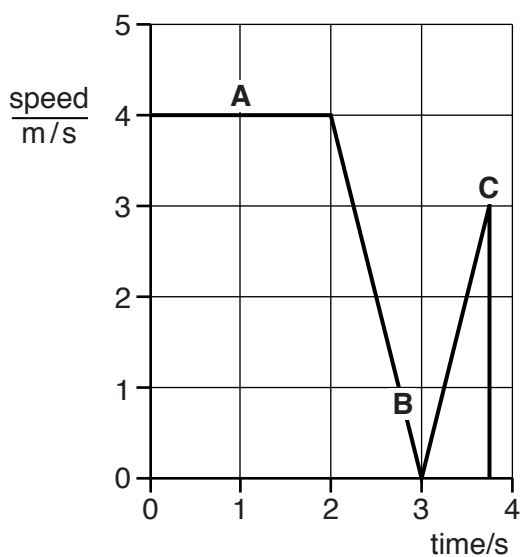


Fig. 3.2

- (a) The letters **A**, **B** and **C** on the graph in Fig. 3.2 correspond to three of the five stages in the pole vault shown in Fig. 3.1.

Explain why **A** on the graph corresponds to stage 1.

.....
[1]

- (b) The energy of the athlete changes during this pole vault. He starts with chemical energy in his muscles.

State the main energy changes that follow between stages 3 and 5 before he lands on the mat.

from chemical energy to kinetic energy to energy

to energy [2]

- (c) (i) Describe the motion of the athlete between points **B** and **C**.

.....[1]

- (ii) Explain why the motion described in (i) occurs between points **B** and **C**.

.....[1]

- (d) Calculate the distance travelled by the athlete in the first 2 seconds shown on the graph in Fig. 3.2.

State the formula that you use and show your working.

formula:

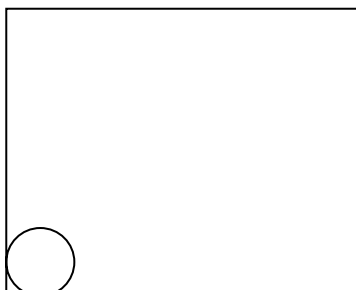
working:

distance = ... m [2]

- (e) The pole used by the athlete is made of metal.

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

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



[2]

- 4 (a) Fig. 4.1 shows a sample of rock containing bands of iron oxide.

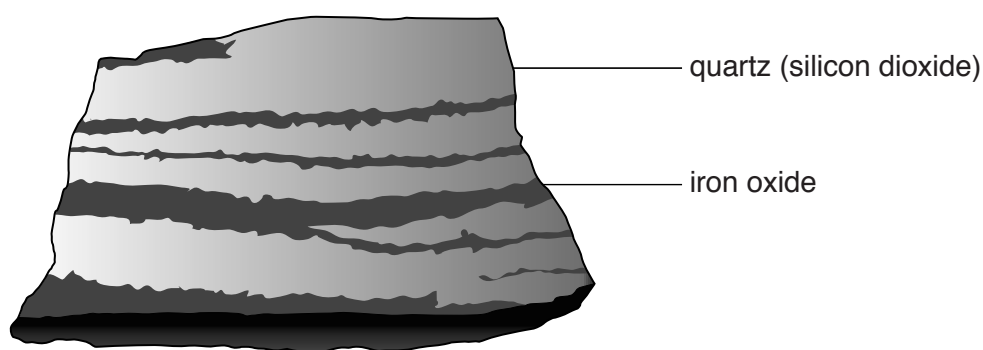


Fig. 4.1

Some information about the formation of this rock is shown below:

- this rock was formed about 2.5 billion years ago;
- oxygen was produced by bacteria in the oceans;
- iron compounds were dissolved in the oceans;
- iron compounds were oxidised by reacting with oxygen to make insoluble iron oxide;
- iron oxide settled on the ocean bed to produce the dark layers in the rock.

- (i) State **one** physical change and **one** chemical change that occurred when the rock shown in Fig. 4.1 was formed.

physical change.....

.....

chemical change

.....[2]

- (ii) Describe the difference between a physical change and a chemical change.

.....

.....[1]

(b) Fig. 4.2 shows the approximate composition of the Earth's atmosphere 3 billion years ago.

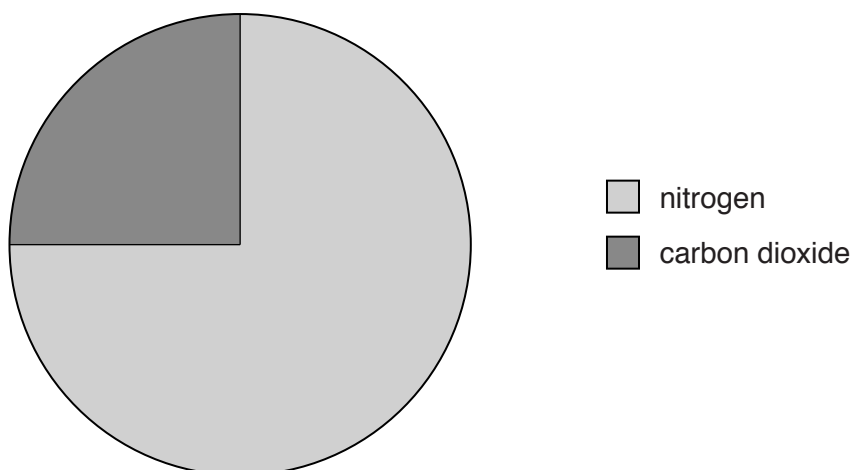


Fig. 4.2

Describe **two** differences and **one** similarity between this and our present day atmosphere.

difference 1

difference 2

similarity[3]

(c) Another type of rock contains copper oxide.

When a piece of this rock is added to dilute hydrochloric acid, the pH of the solution increases. Explain why this occurs.

.....

.....[1]

(d) Copper metal can be extracted from the rock containing copper oxide.

(i) Explain why the extraction of copper from copper oxide is called *reduction*.

.....[1]

(ii) Describe how copper can be extracted from copper oxide in the laboratory.

.....

.....

.....[2]

5 Fig. 5.1 shows the internal structure of the heart.

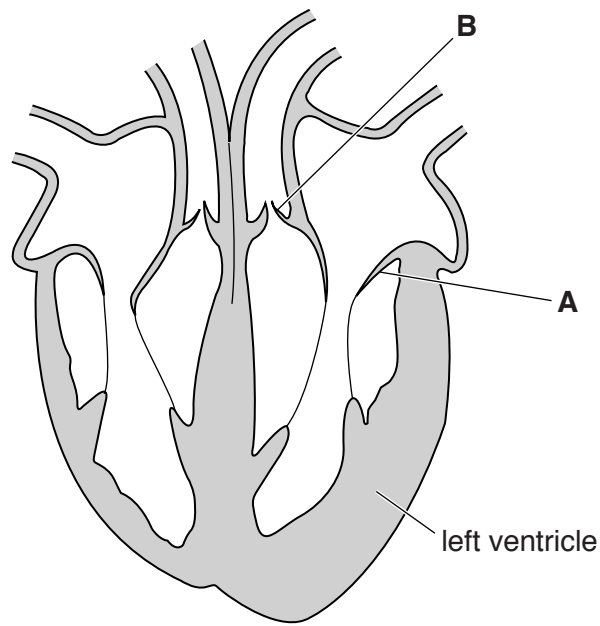


Fig. 5.1

(a) On Fig. 5.1

(i) draw a label line and the letter **P** to show the pulmonary artery, [1]

(ii) draw arrows to show the direction of blood flow through the **left** side of the heart. [2]

(b) **(i)** **A** and **B** are valves. Describe the function of the valves in the heart.

.....
[1]

(ii) Explain why valve **A** closes when the left ventricle contracts.

.....
[1]

(c) The red cells in the blood contain haemoglobin.

Describe the function of haemoglobin.

.....
[1]

- (d) The blood also contains platelets.

Describe the function of platelets and explain why this is important.

.....

.....

.....[2]

- 6 (a) Electromagnetic waves have many uses.

Name **one** type of electromagnetic wave and state one example of a use for that type of wave.

name

use

.....[2]

- (b) Fig. 6.1 shows apparatus called a ripple tank. This is used by students for experiments to investigate water waves.

The electric motor causes the board to vibrate. At a constant speed of rotation the motor produces waves at a constant rate.

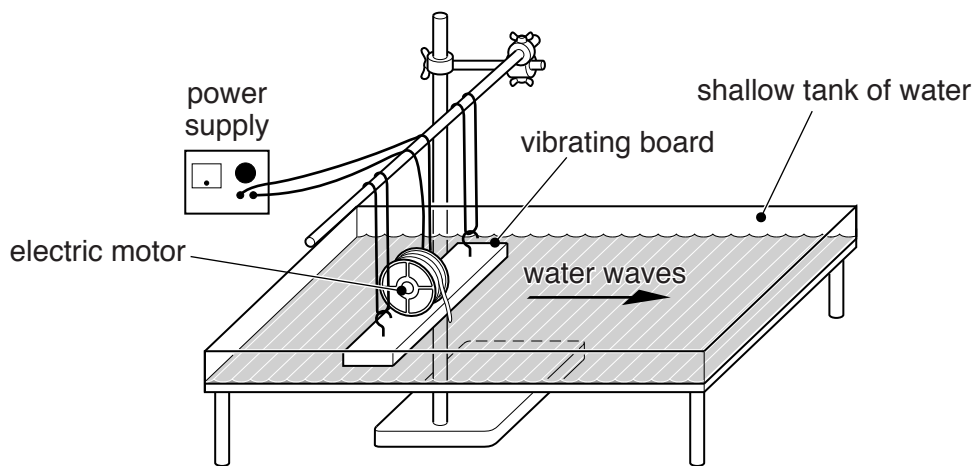


Fig. 6.1

Fig. 6.2 shows a close-up side view of some water waves during an experiment in the tank.

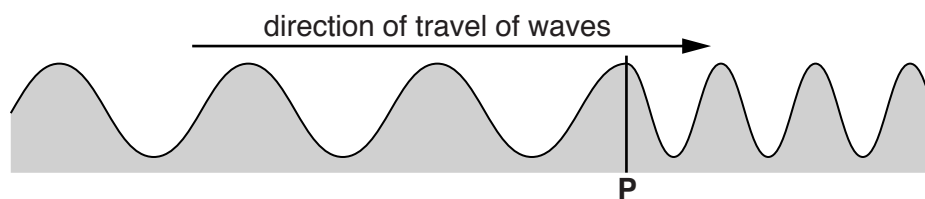


Fig. 6.2

- (i) Describe what is meant by wave motion, using the water waves shown in Fig. 6.2 as an example.

.....

.....

.....[2]

- (ii) Fig. 6.2 shows a change in the wave pattern at point **P**.

From the diagram in Fig. 6.2 state

one property of the wave motion that changes at point **P** and describe how this changes,

.....

one property of the wave motion that does not change at point **P**.

.....
 [3]

- (c) As the speed of the motor is increased, the board vibrates more rapidly.

When the board is vibrating at 10 vibrations per second, the students cannot hear any sound.

When the board is vibrating at 30 vibrations per second, the students can hear a sound with a low pitch.

Explain why the students cannot hear any sound when the board makes 10 vibrations per second.

.....
[1]

- 7 (a) A copper compound contains two carbon atoms and four oxygen atoms for every copper atom.

Write the chemical formula for the compound.

.....[2]

- (b) Fig. 7.1 shows the electrolysis of copper chloride solution.

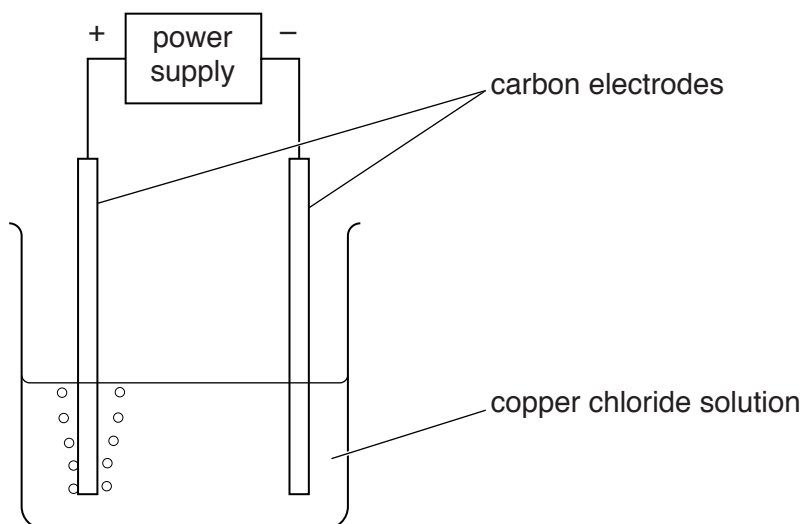


Fig. 7.1

Copper is deposited on one of the electrodes.

- (i) Describe the appearance of the copper that is deposited.

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

- (ii) State the polarity of the electrode where the copper is deposited.

.....[1]

- (iii) State the name of the electrode where the copper is deposited.

.....[1]

- (c) A student carries out experiments to compare the reactivity of some metals.

Fig. 7.2 shows test-tubes containing pieces of calcium and magnesium. Some water is added to each test-tube.

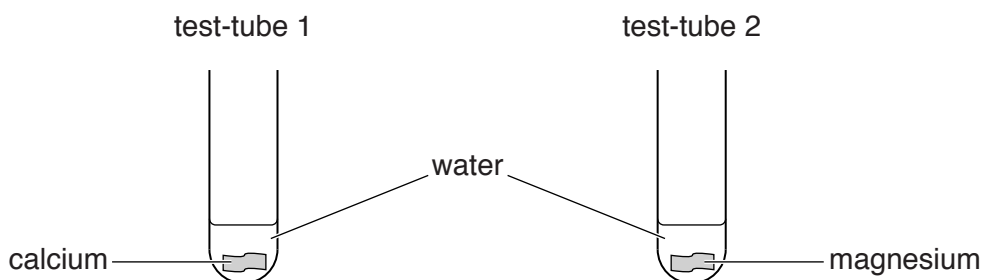


Fig. 7.2

Describe what the student observes in each test-tube and state, with a reason, which metal is the more reactive.

test-tube 1

test-tube 2

This means that is the more reactive metal because

.....

.....[2]

- (d) (i) Use the Periodic Table on page 24 to write the first three members of Group I, the alkali metals, in order of reactivity.

most reactive

.....

least reactive

[1]

- (ii) When a piece of sodium is dropped into a trough of water it melts, skims over the surface and produces bubbles of gas.

Describe how the observations would be different if a piece of potassium is used instead of sodium.

.....

.....[1]

- 8 (a) Large areas of forest are cleared in some parts of the world so that the land can be used to grow crops. Fig. 8.1 shows the burning of trees to clear forests.

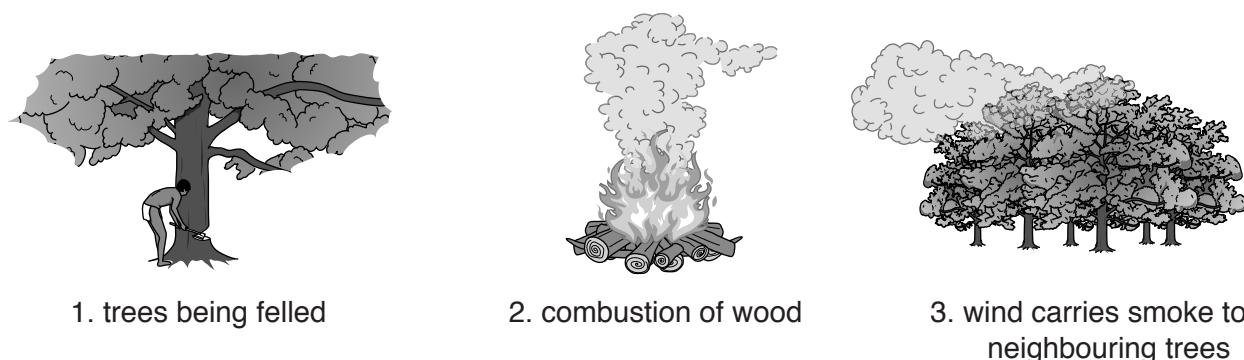


Fig. 8.1

When the trees burn, smoke is produced that contains carbon particles. The wind carries the smoke to neighbouring trees. This affects the rate of photosynthesis in these trees.

Complete the sentences below using words from the list.

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

carbon dioxide

chlorophyll

increased

light

oxygen

reduced

unchanged

water

The rate of photosynthesis is because particles of carbon landing on the upper surface of the leaves prevent being absorbed by the leaf.

The rate of photosynthesis is because particles of carbon blocking the stomata in the leaves prevent being absorbed by the leaf. [4]

- (b) Deforestation causes the concentration of carbon dioxide in the Earth's atmosphere to increase.

Describe one consequence of an increase in the carbon dioxide concentration of the Earth's atmosphere.

.....
[1]

- (c) Describe the undesirable effects of deforestation on the animal life in the forest.

.....

[2]

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Question 9 continues over the page.

- 9 A student is building a model motorcycle.

Fig. 9.1 shows a circuit he designs for the electrical equipment he wants on the motorcycle.

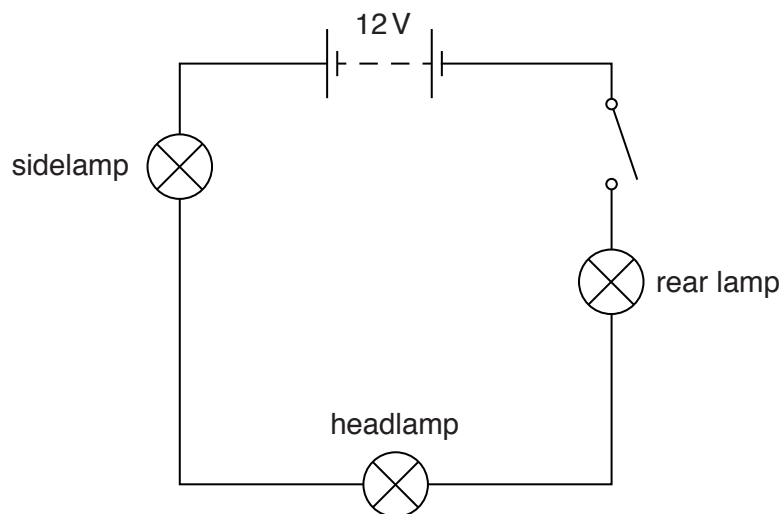
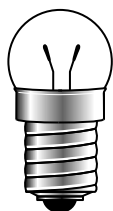


Fig. 9.1

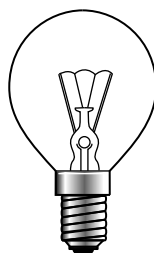
- (a) Fig. 9.2 shows the lamps he uses for his model. The markings on the lamps are shown below the pictures.

sidelamp



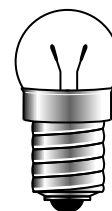
12 V, 0.5 A

headlamp



12 V, 2 A

rear lamp



12 V, 0.5 A

Fig. 9.2

State and explain what is meant by the quantity '12 V' on the lamps.

.....

.....[2]

- (b) When the student switches on the circuit in Fig. 9.1, the lamps glow only very faintly. He has not designed his circuit correctly.

On Fig. 9.3 complete the circuit diagram to show the sidelamp and rear lamp connected so that all the lamps glow brightly.

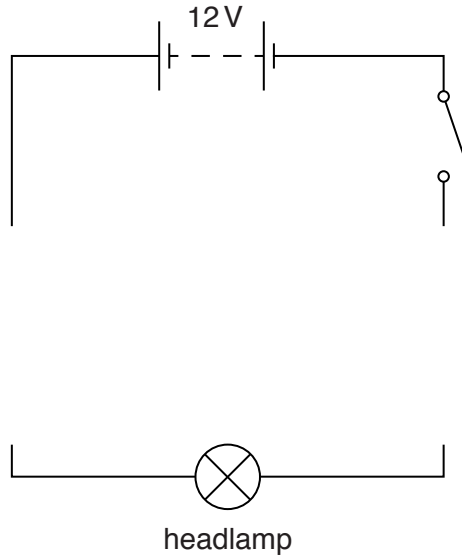


Fig. 9.3

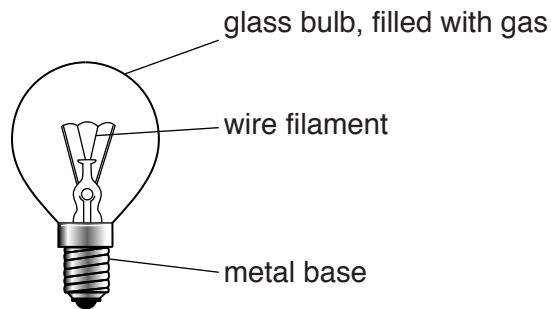
[2]

- (c) The sidelamp is replaced with a new lamp that uses a lower current when connected to the 12V battery.

State the property of the new lamp that is different from the old lamp in order to use less current and describe how it is different.

.....
[1]

- (d) Each lamp contains a thin wire filament surrounded by a glass bulb attached to a metal base. The space inside the glass bulb is filled with a gas. When the lamp is lit, the filament reaches a very high temperature.



After the lamps have been lit for a few minutes, the glass bulbs become hot.

Describe and explain **two** ways by which heat energy can be transferred from the hot filament to the glass bulb.

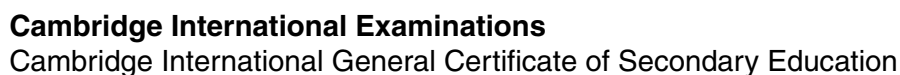
- 1
-
- 2
-

[4]

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DATA SHEET
The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
		1 H Hydrogen																
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	98 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																		
a X b a = relative atomic mass X = atomic symbol b = atomic (proton) number																		
Key																		
		175 Lu Lutetium 71																
		260 Lr Lawrencium 103																



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0653/23

May/June 2015

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 **23** printed pages and **1** blank page.

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

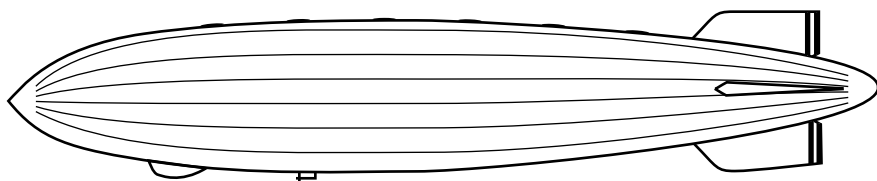


Fig. 1.1

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.

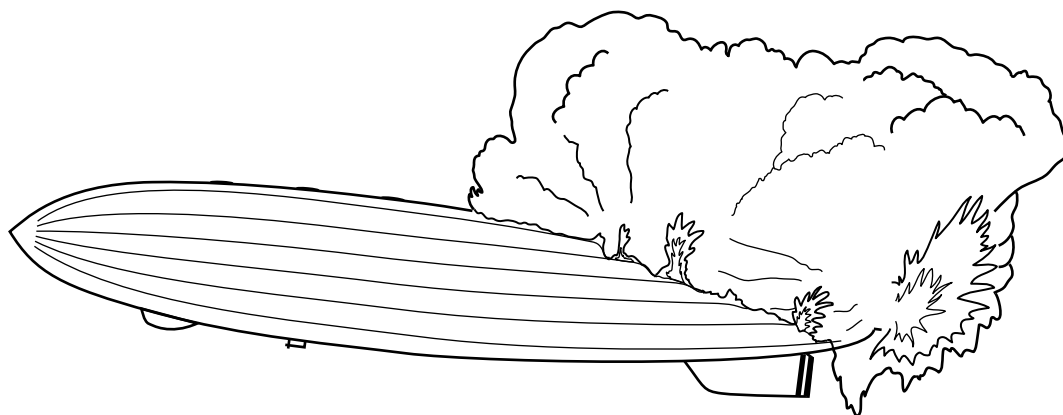


Fig. 1.2

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.

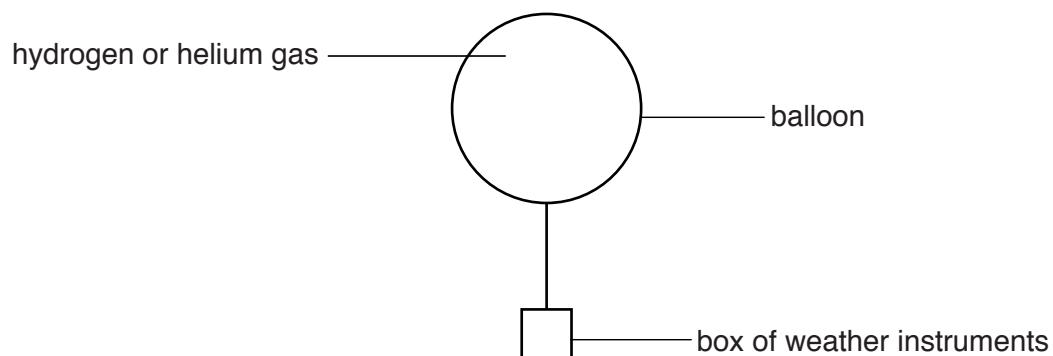


Fig. 1.3

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.

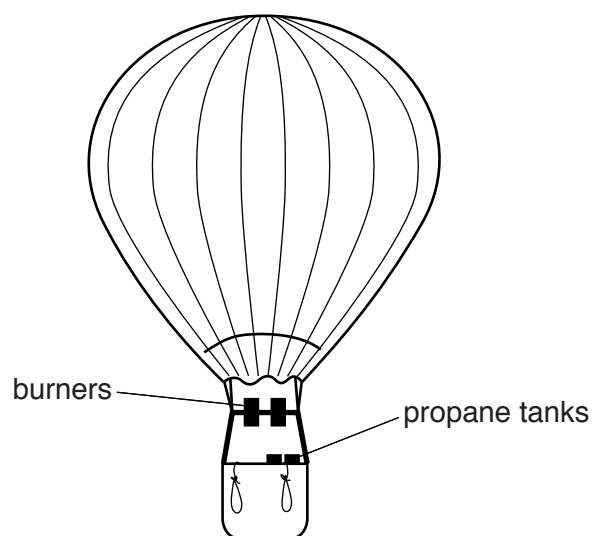


Fig. 1.4

Propane is a hydrocarbon.

Fig. 1.5 shows a model of a propane molecule.

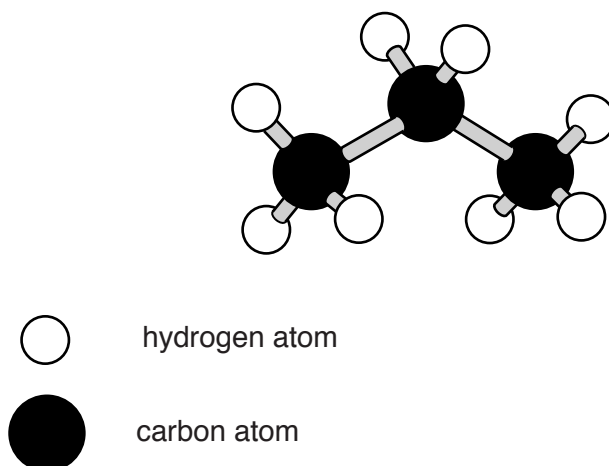


Fig. 1.5

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.

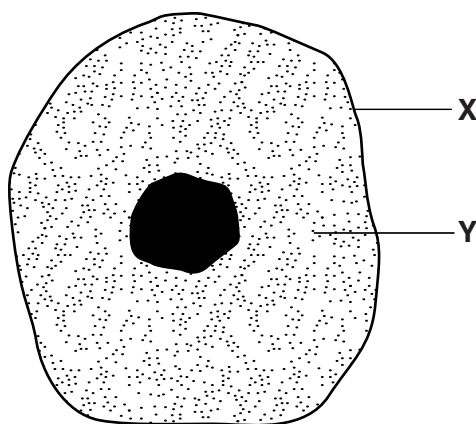


Fig. 2.1

- (i) Name the parts of the cell shown by labels **X** and **Y** on Fig. 2.1.
- X** [1]
- Y** [1]
- (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]

- (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.

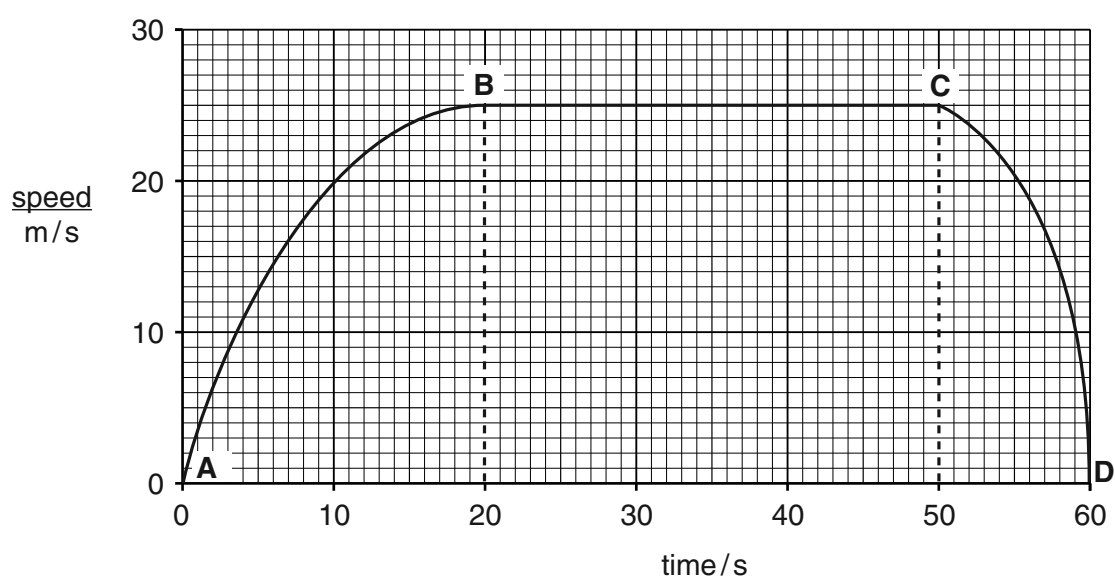


Fig. 3.2

- (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]

- 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.

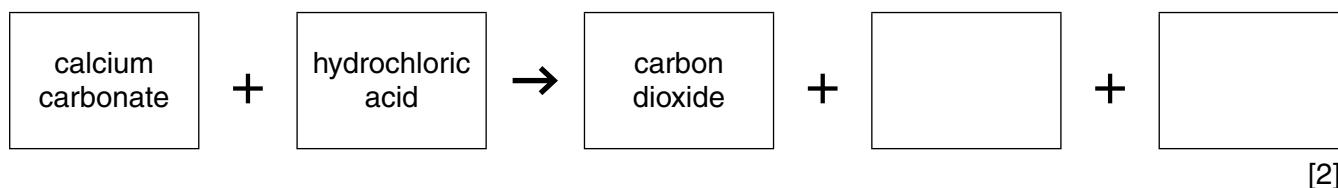
from to [1]

- (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.



- (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.

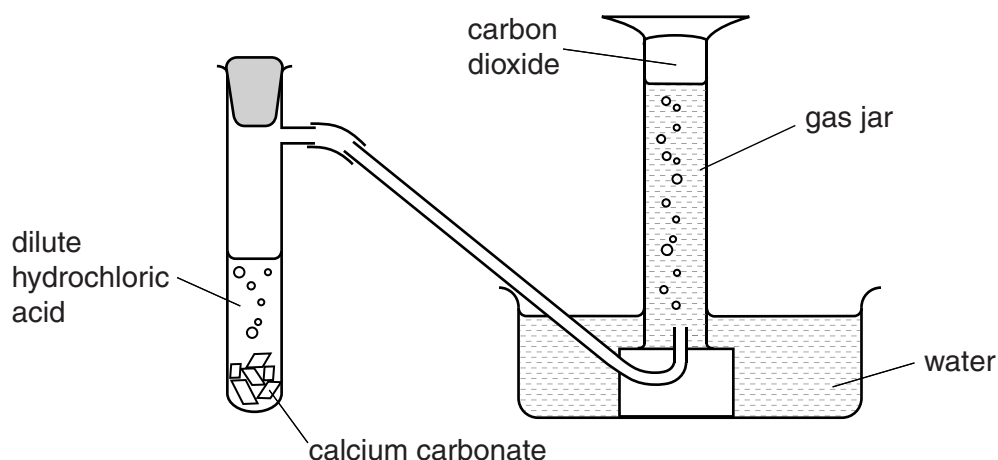


Fig. 4.1

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]

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

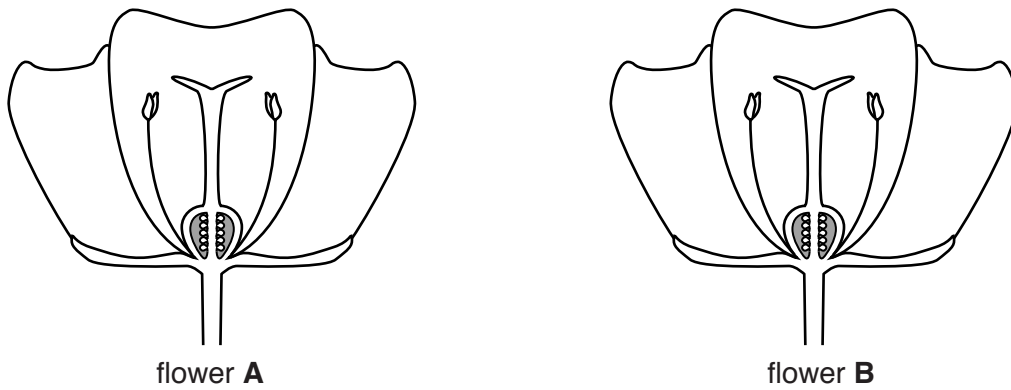


Fig. 5.1

- (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.

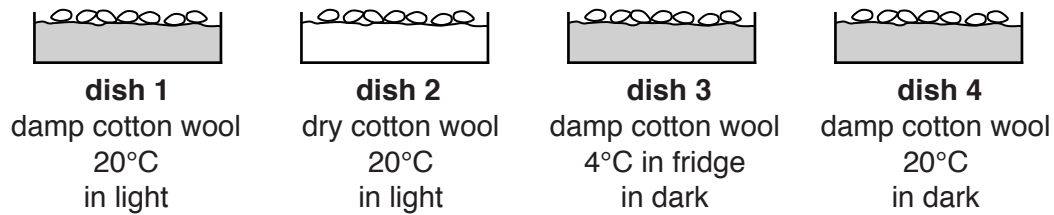


Fig. 5.2

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]

- 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.

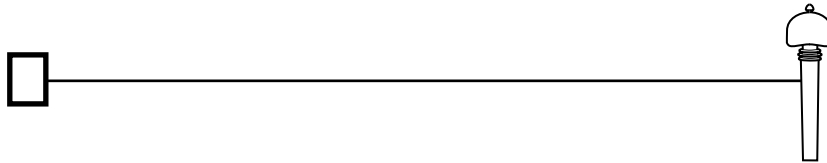


Fig. 6.1

[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.

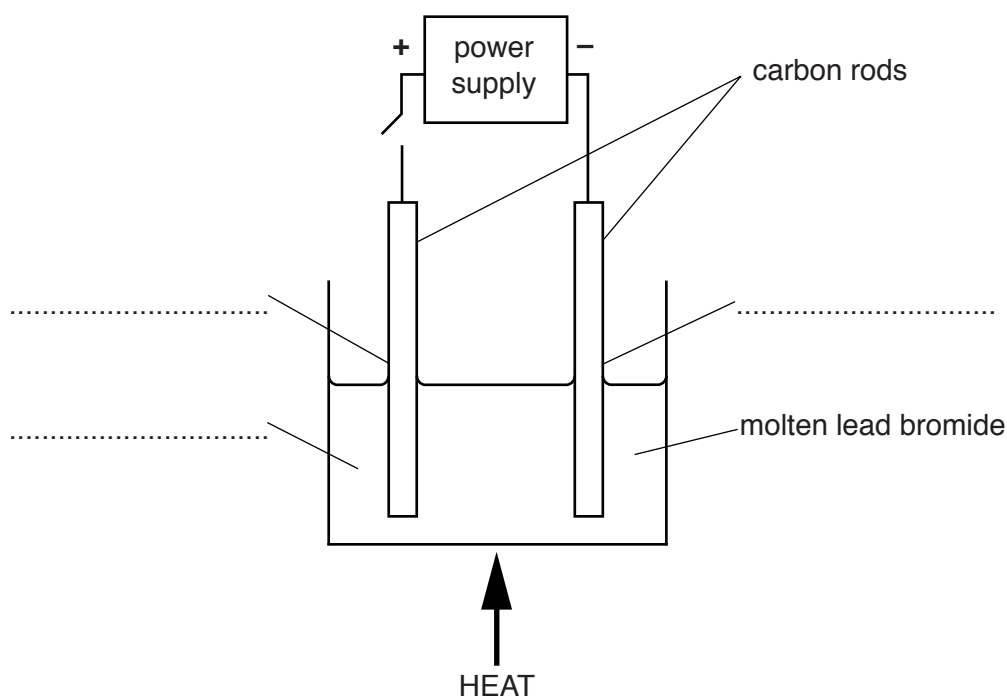


Fig. 7.1

- (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.

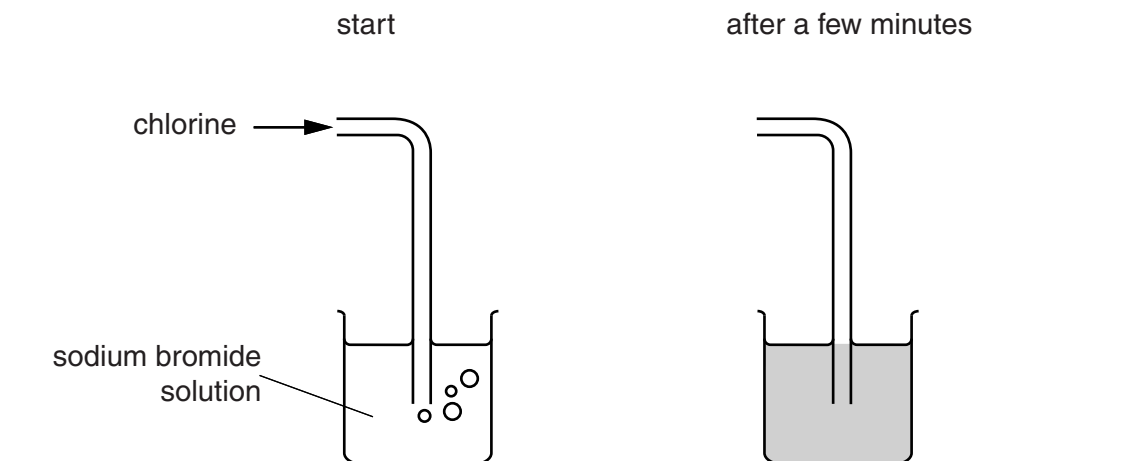


Fig. 7.2

(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.

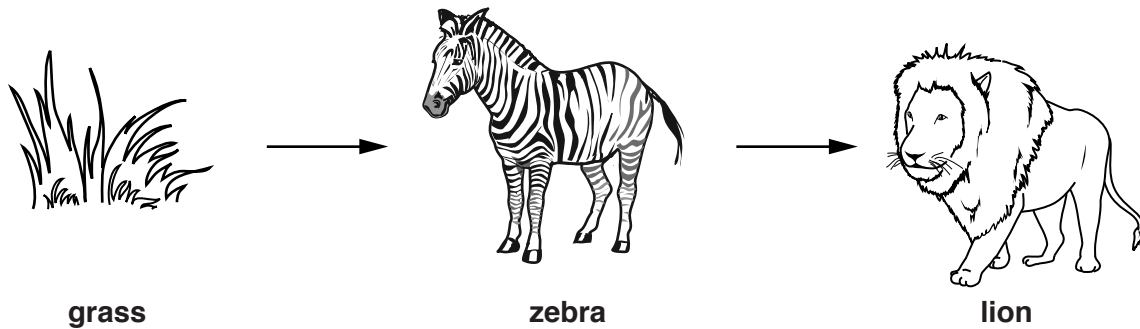


Fig. 8.1

- (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.

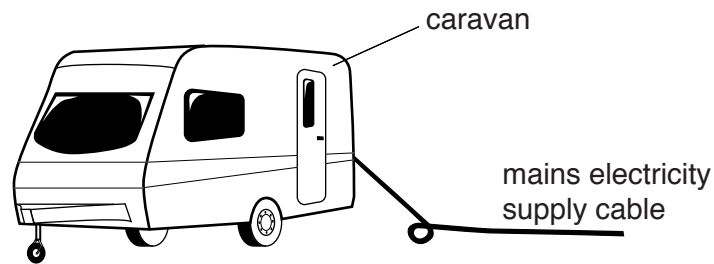


Fig. 9.1

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.

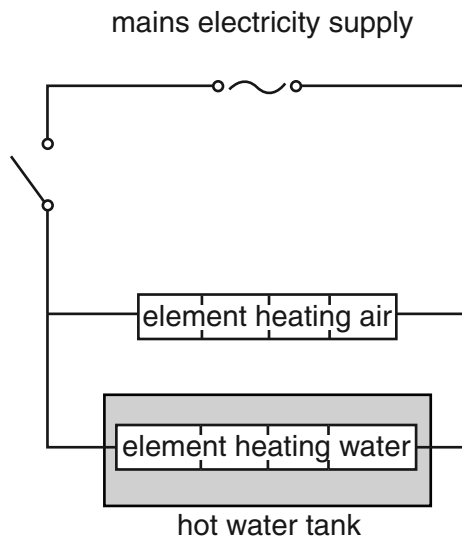


Fig. 9.2

- (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.

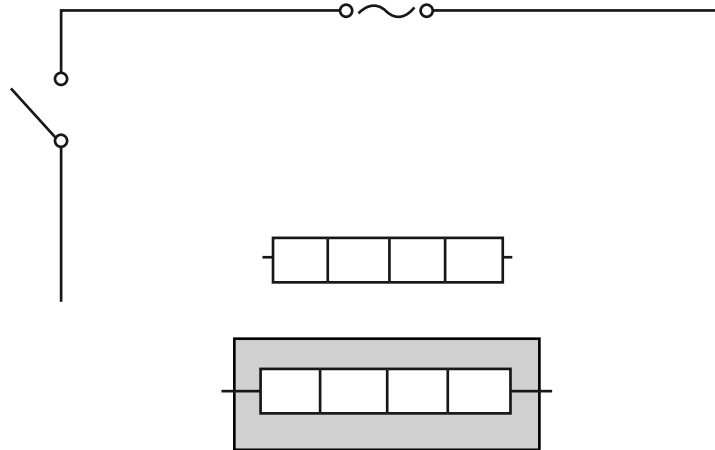


Fig. 9.3

[2]

- (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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Group																	
I	II	1 H Hydrogen 1						III	IV	V	VI	VII	O				
7 Li Lithium 3	9 Be Beryllium 4												4 He Helium 2				
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10										
39 K Potassium 19	40 Ca Calcium 20	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										
85 Rb Rubidium 37	88 Sr Strontium 38	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
133 Cs Caesium 55	137 Ba Barium 56	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	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	127 Te Tellurium 52	128 I Iodine 53	131 Xe Xenon 54	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	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	210 Po Polonium 84	210 At Astatine 85	227 Ac Actinium 89

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

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

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