



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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NUMBER

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**COMBINED SCIENCE**

**0653/22**

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 **21** printed pages and **3** blank pages.

- 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]

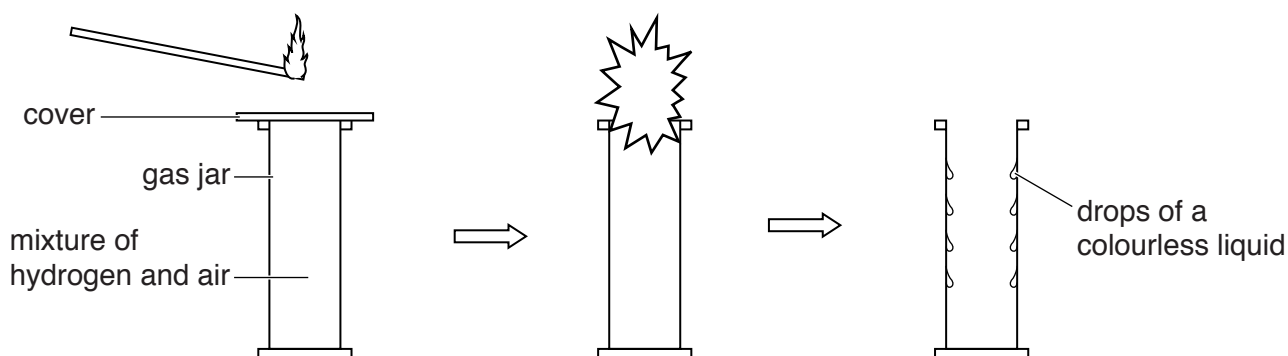
- (ii) Deduce the number of electrons a sodium atom loses when it forms an ion.

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]

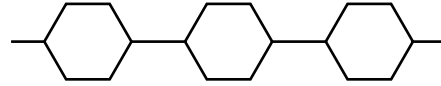
- 2 (a) Most large molecules in living organisms are made by joining many smaller molecules together. An example of this is glycogen which is made from glucose molecules. A short length of glycogen is shown in Fig. 2.1.

small molecule



glucose

part of large molecule



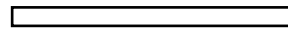
glycogen

**Fig. 2.1**

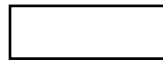
Some of the small molecules that join together to make large molecules in living organisms are shown in Fig. 2.2.



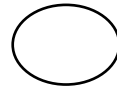
glucose



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.

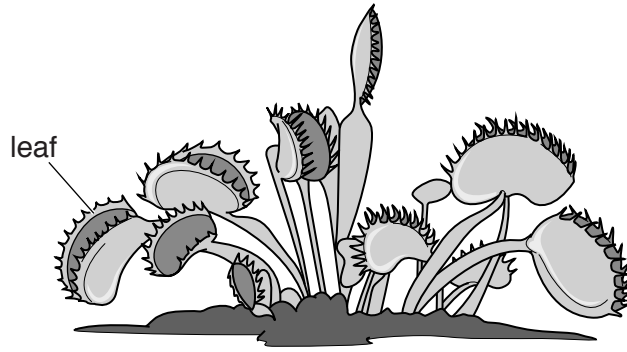
.....  
.....  
.....[2]

(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.

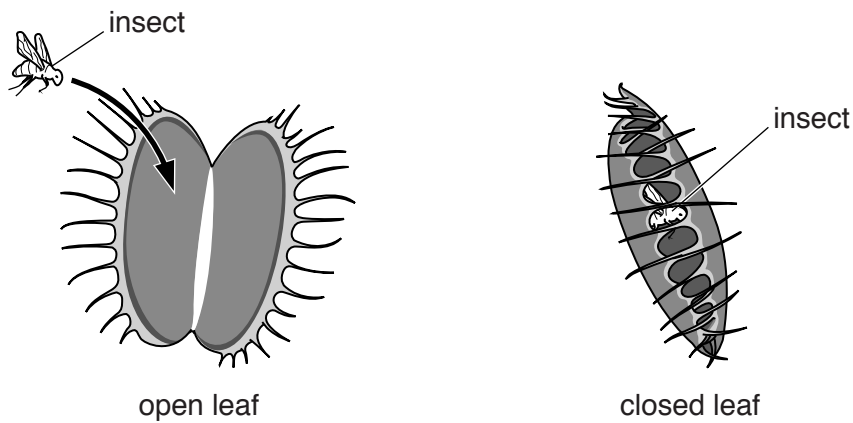
.....  
.....  
.....[2]

- (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]

**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.

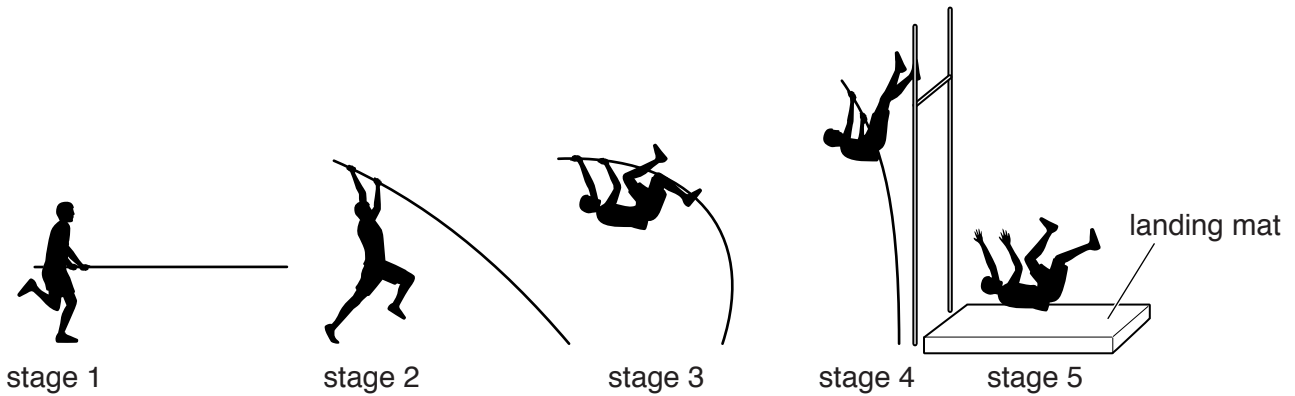


Fig. 3.1

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.

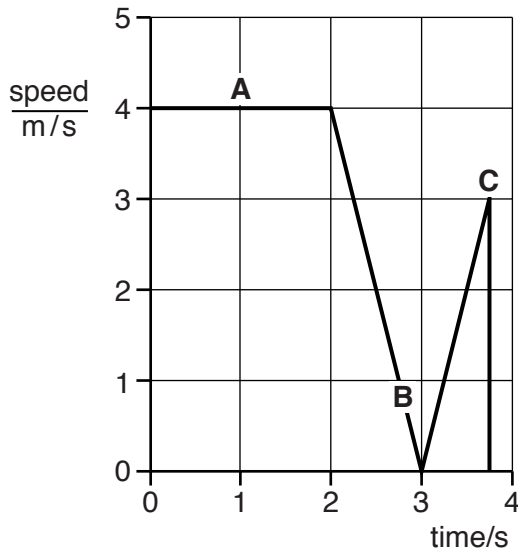


Fig. 3.2

- (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:

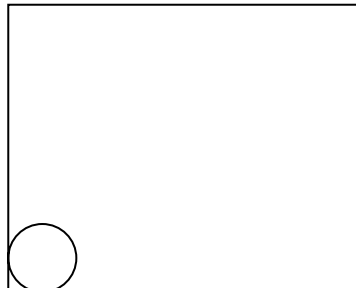
working:

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.

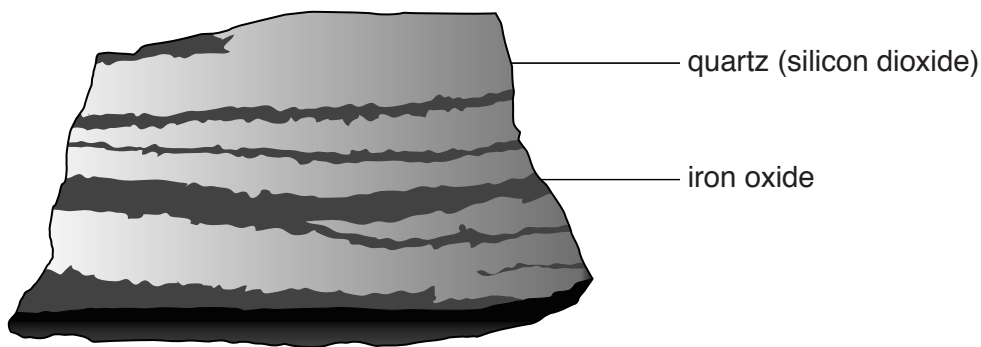


Fig. 4.1

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 .....

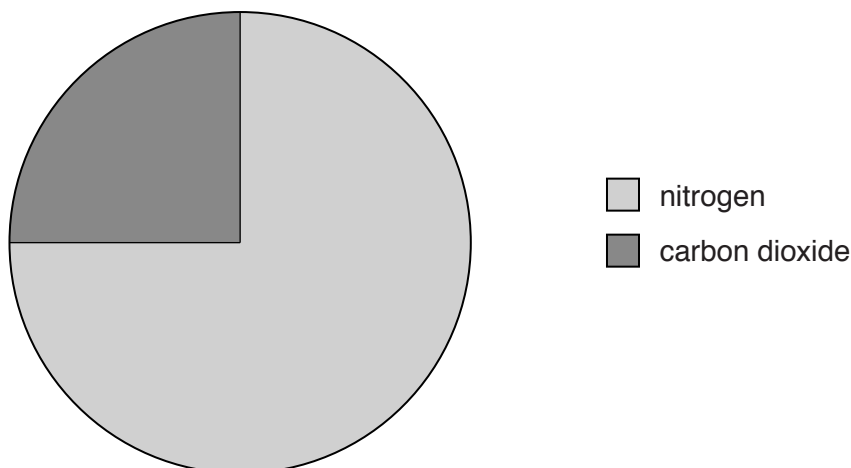
.....[2]

(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.

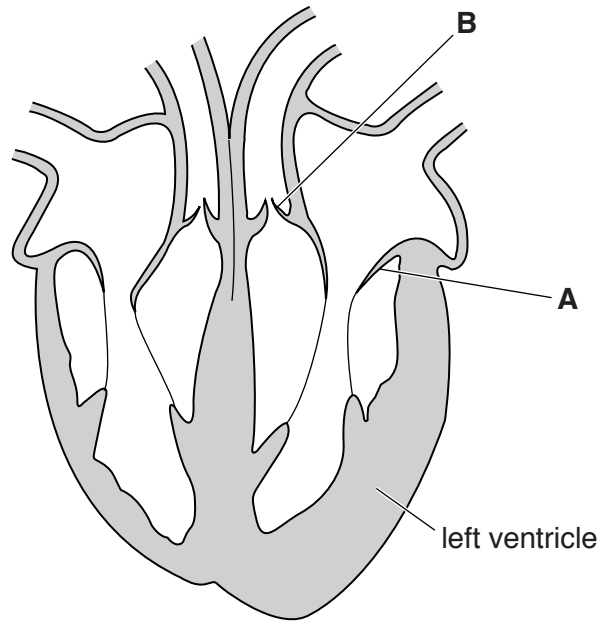


Fig. 5.1

(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.

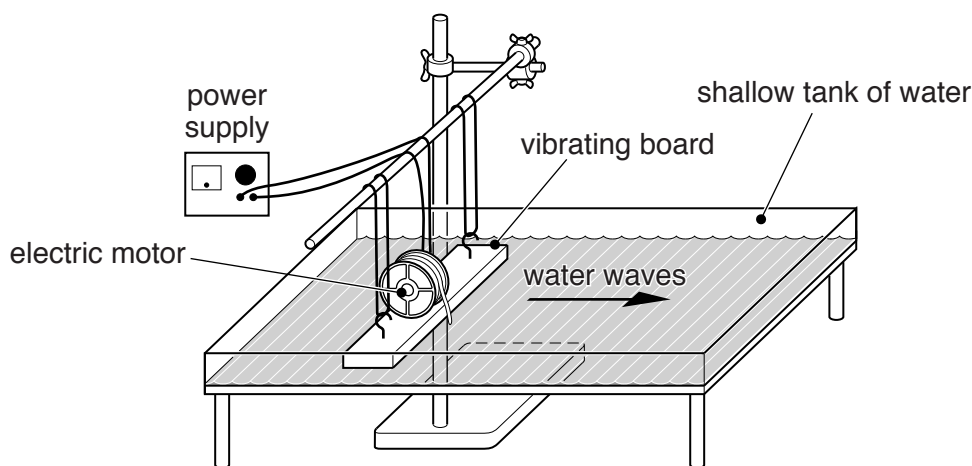


Fig. 6.1

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

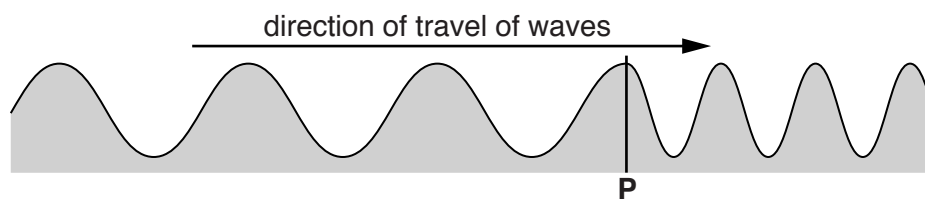


Fig. 6.2

(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.

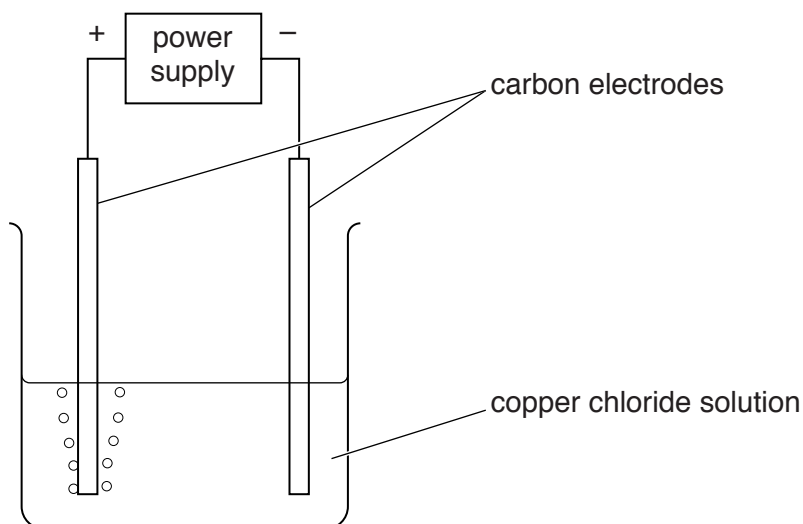
.....  
..... [1]

- 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]

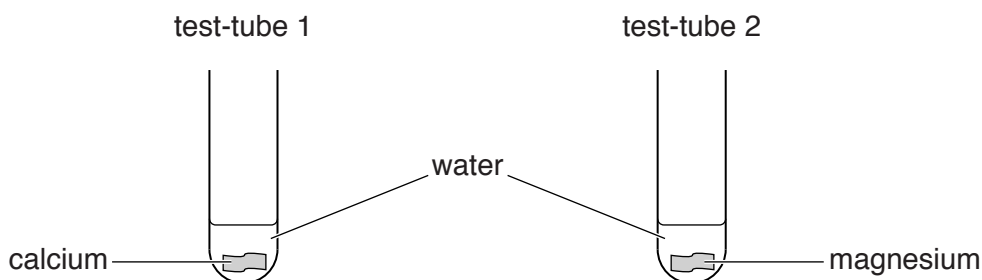
- (iii) State the name of the electrode where the copper is deposited.

..... [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]

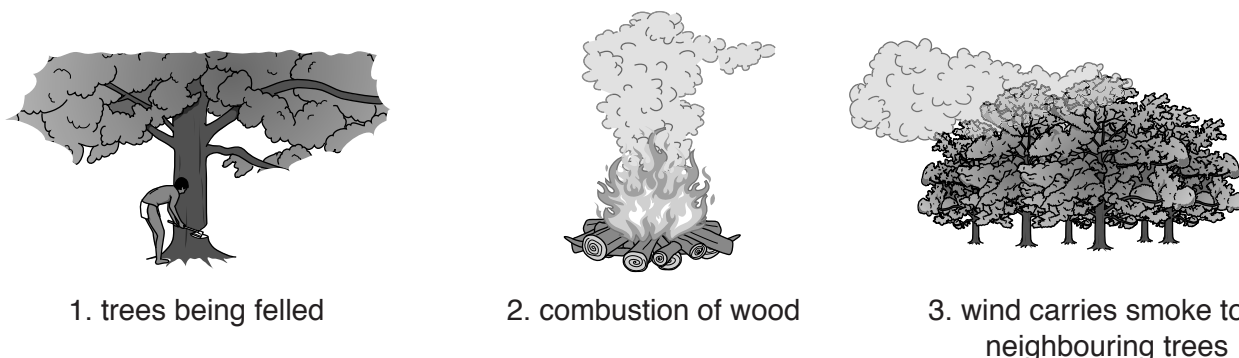
(ii) When a piece of sodium is dropped into a trough of water it melts, skims over the surface and produces bubbles of gas.

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.

- |                       |                    |                  |              |
|-----------------------|--------------------|------------------|--------------|
| <b>carbon dioxide</b> | <b>chlorophyll</b> | <b>increased</b> | <b>light</b> |
| <b>oxygen</b>         | <b>reduced</b>     | <b>unchanged</b> | <b>water</b> |

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]

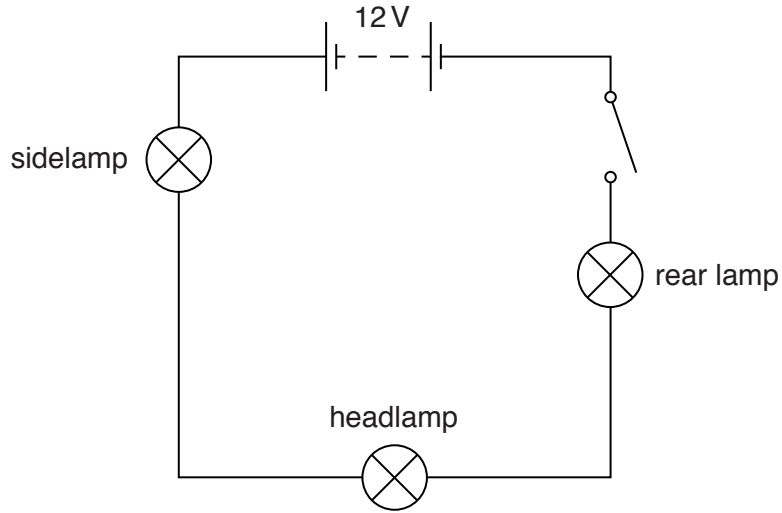
- (c) Describe the undesirable effects of deforestation on the animal life in the forest.

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

**Question 9 continues over the page.**

9 A student is building a model motorcycle.

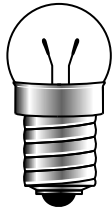
Fig. 9.1 shows a circuit he designs for the electrical equipment he wants on the motorcycle.



**Fig. 9.1**

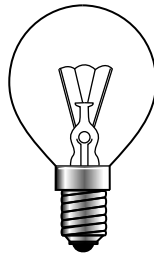
(a) Fig. 9.2 shows the lamps he uses for his model. The markings on the lamps are shown below the pictures.

sidelamp



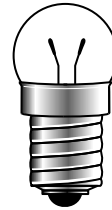
12 V, 0.5 A

headlamp



12 V, 2 A

rear lamp



12 V, 0.5 A

**Fig. 9.2**

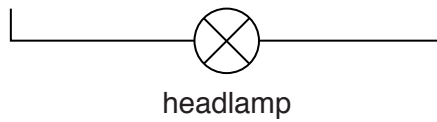
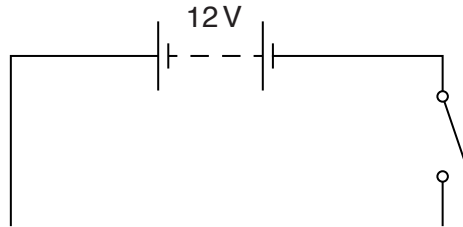
State and explain what is meant by the quantity '12 V' on the lamps.

.....

.....[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]

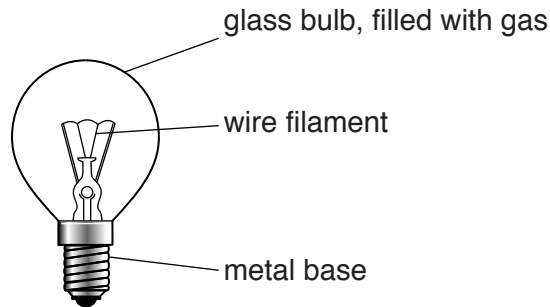
- (c) The sidelamp is replaced with a new lamp that uses a lower current when connected to the 12V battery.

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]



**DATA SHEET**  
**The Periodic Table of the Elements**

		Group										
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1 <b>H</b> Hydrogen 1											2 <b>He</b> Helium 2	
3 <b>Li</b> Lithium 3	4 <b>Be</b> Beryllium 4											5 <b>B</b> Boron 5
11 <b>Na</b> Sodium 11	12 <b>Mg</b> Magnesium 12											6 <b>C</b> Carbon 6
19 <b>K</b> Potassium 19	20 <b>Ca</b> Calcium 20											7 <b>N</b> Nitrogen 7
37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38											8 <b>O</b> Oxygen 8
55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56											9 <b>F</b> Fluorine 9
87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88											10 <b>Ne</b> Neon 10
												16 <b>O</b> Oxygen 16
												17 <b>Cl</b> Chlorine 17
												18 <b>Ar</b> Argon 18
												34 <b>Se</b> Selenium 34
												35 <b>Br</b> Bromine 35
												52 <b>Te</b> Tellurium 52
												53 <b>I</b> Iodine 53
												84 <b>Po</b> Polonium 84
												85 <b>At</b> Astatine 85
												86 <b>Rn</b> Radon 86
												88 <b>Ra</b> Radium 88
												90 <b>Th</b> Thorium 90
												91 <b>Pa</b> Protactinium 91
												92 <b>U</b> Uranium 92
												93 <b>Np</b> Neptunium 93
												94 <b>Pu</b> Plutonium 94
												95 <b>Am</b> Americium 95
												96 <b>Cm</b> Curium 96
												97 <b>Bk</b> Berkelium 97
												98 <b>Cf</b> Californium 98
												99 <b>Es</b> Einsteinium 99
												100 <b>Fm</b> Fermium 100
												101 <b>Md</b> Mendelevium 101
												102 <b>No</b> Nobelium 102
												103 <b>Lr</b> Lawrencium 103
												104 <b>Rf</b> Rutherfordium 104
												105 <b>Db</b> Dubnium 105
												106 <b>Sg</b> Seaborgium 106
												107 <b>Bh</b> Bohrium 107
												108 <b>Hs</b> Hassium 108
												109 <b>Mt</b> Meitnerium 109
												110 <b>Ds</b> Darmstadtium 110
												111 <b>Rg</b> Roentgenium 111
												112 <b>Cn</b> Copernicium 112
												113 <b>Nh</b> Nihonium 113
												114 <b>Fl</b> Flerovium 114
												115 <b>Mc</b> Moscovium 115
												116 <b>Lv</b> Livermorium 116
												117 <b>Ts</b> Tennessine 117
												118 <b>Og</b> Oganesson 118
												119 <b>Uu</b> Ununennium 119
												120 <b>Uub</b> Unbibium 120
												121 <b>Uut</b> Untrium 121
												122 <b>Uuq</b> Unquadium 122
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