



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



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.

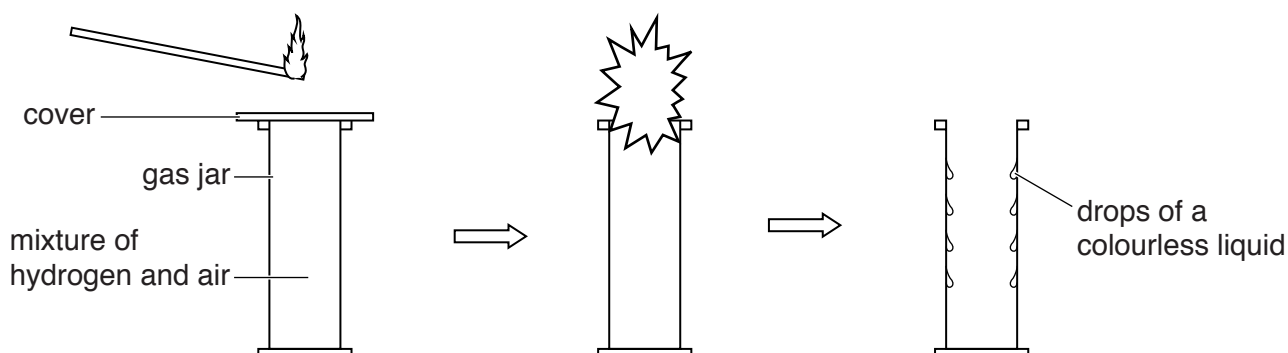


Fig. 1.1

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]

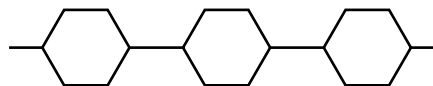
- 2 (a) Most large molecules in living organisms are made by joining many smaller molecules together. An example of this is glycogen which is made from glucose molecules. A short length of glycogen is shown in Fig. 2.1.

small molecule



glucose

part of large molecule



glycogen

Fig. 2.1

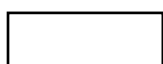
Some of the small molecules that join together to make large molecules in living organisms are shown in Fig. 2.2.



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.

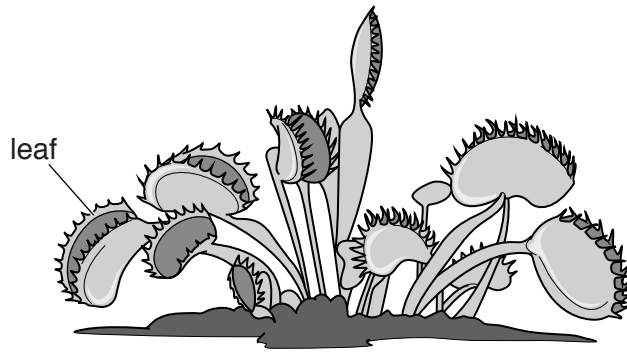


Fig. 2.3

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.

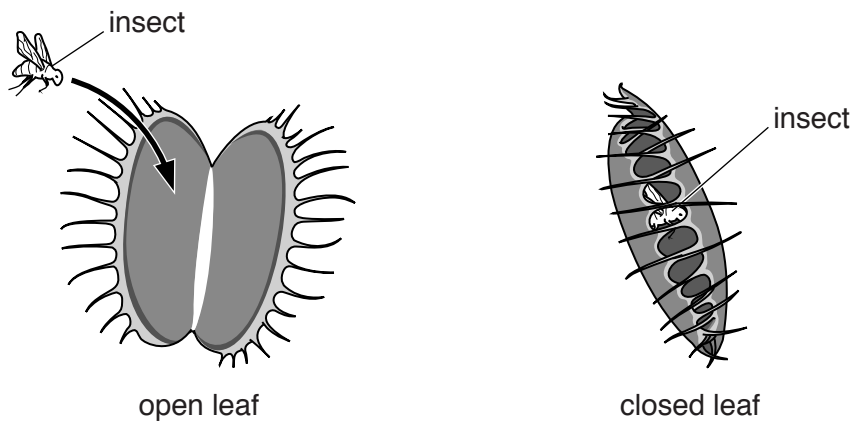


Fig. 2.4

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]

BLANK PAGE

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.

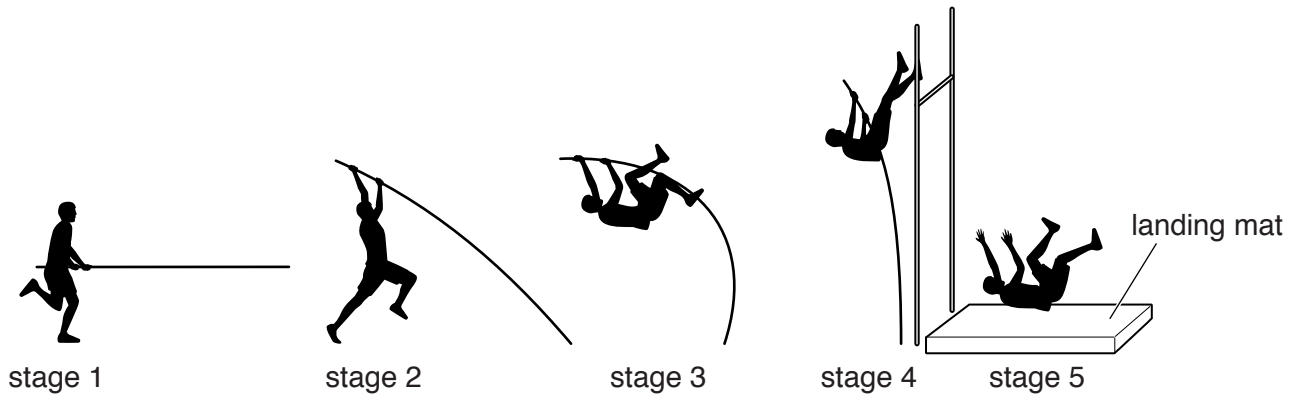


Fig. 3.1

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.

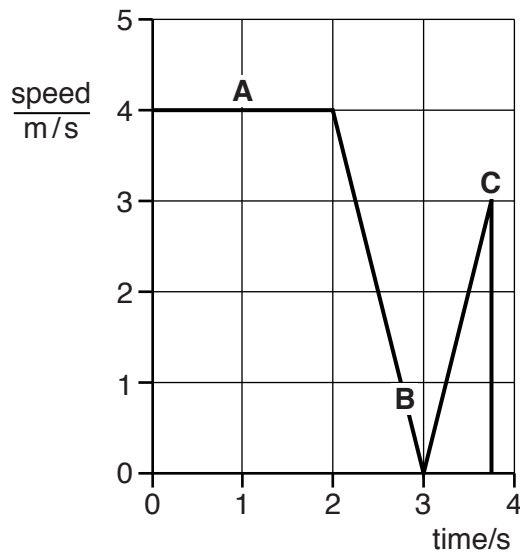


Fig. 3.2

- (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:

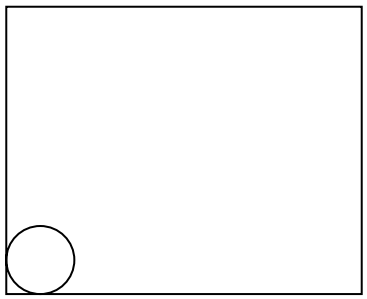
working:

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.

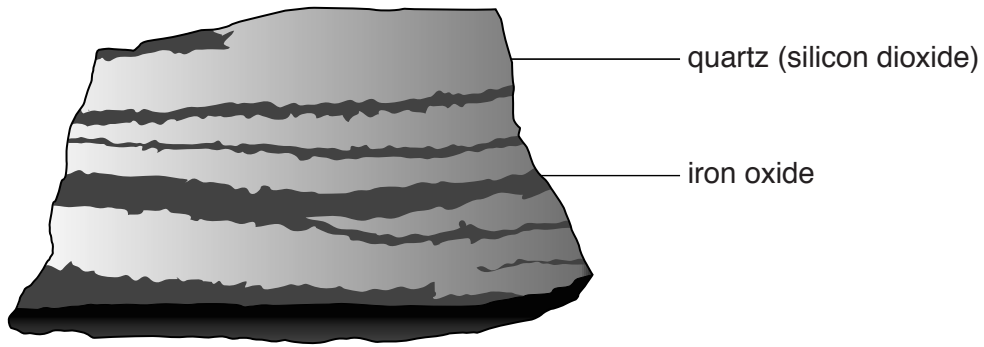


Fig. 4.1

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.

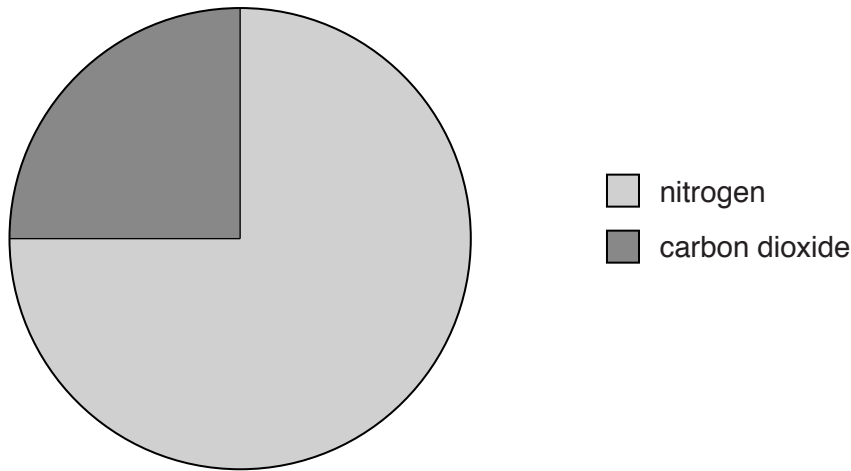


Fig. 4.2

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.

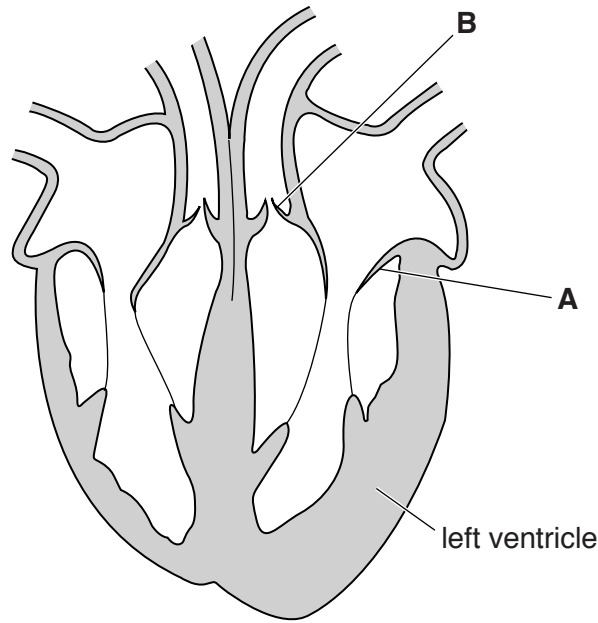


Fig. 5.1

(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.

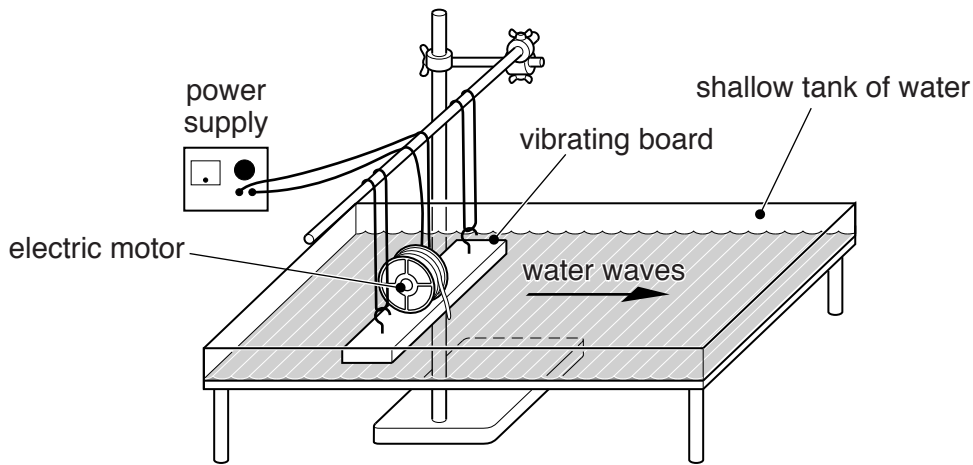


Fig. 6.1

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

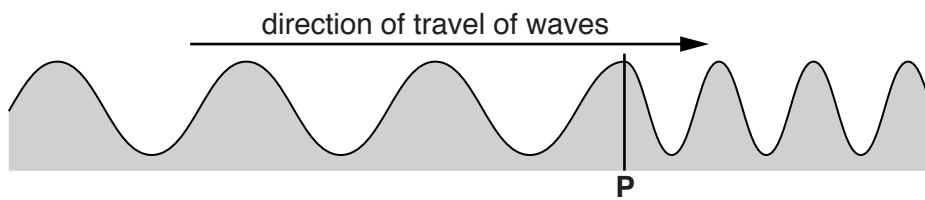


Fig. 6.2

(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.

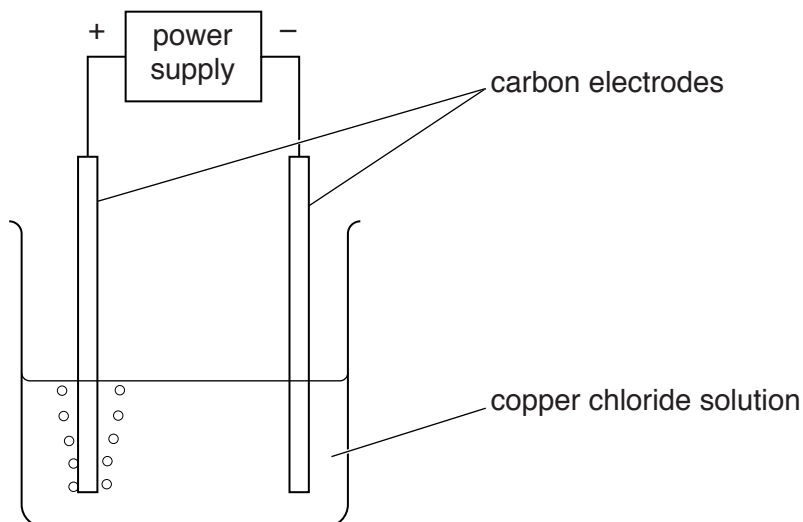


Fig. 7.1

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.

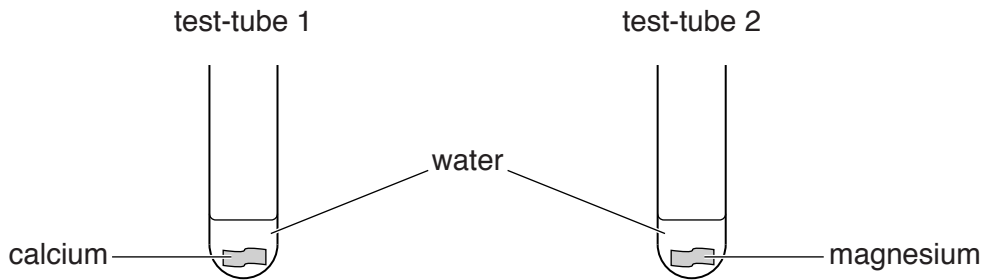


Fig. 7.2

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]

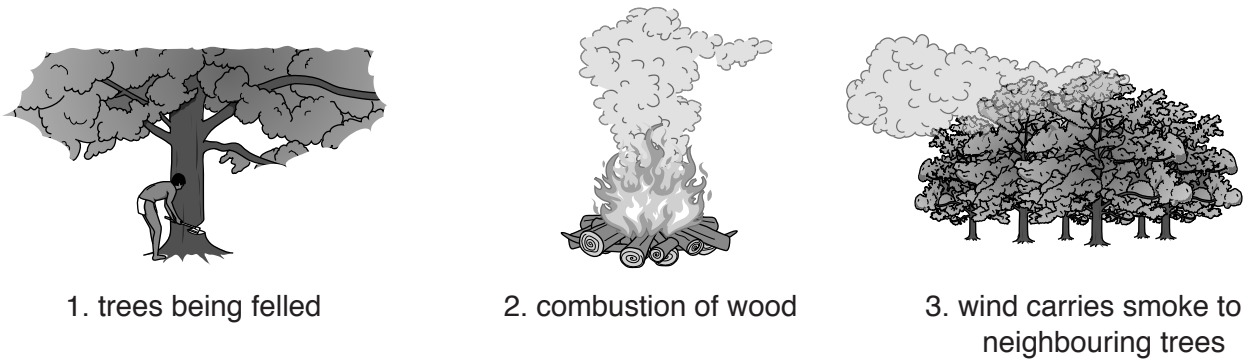
(ii) When a piece of sodium is dropped into a trough of water it melts, skims over the surface and produces bubbles of gas.

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.



1. trees being felled

2. combustion of wood

3. wind carries smoke to neighbouring trees

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]

BLANK PAGE

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.

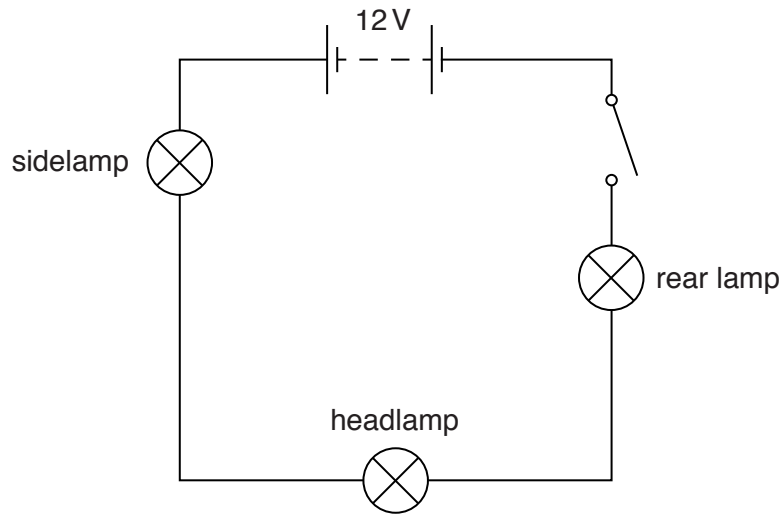
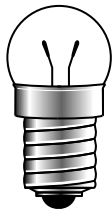


Fig. 9.1

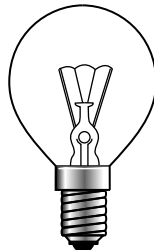
(a) Fig. 9.2 shows the lamps he uses for his model. The markings on the lamps are shown below the pictures.

sidelamp



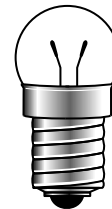
12 V, 0.5 A

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.

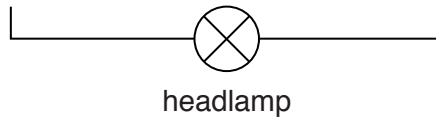
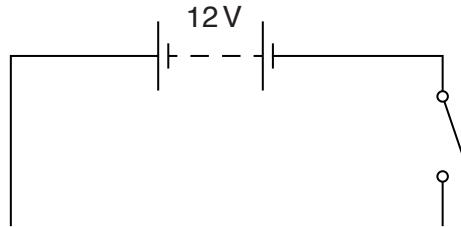


Fig. 9.3

[2]

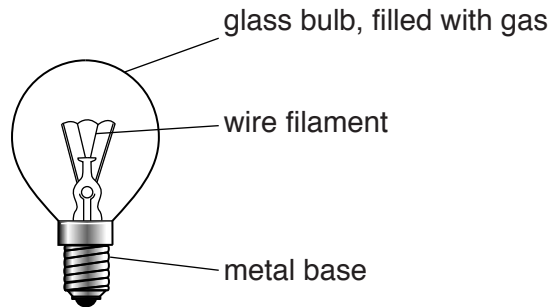
- (c) The sidelamp is replaced with a new lamp that uses a lower current when connected to the 12V battery.

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]

BLANK PAGE

DATA SHEET
The Periodic Table of the Elements

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

140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Nd Neodymium 60	145 Eu Europium 63	146 Gd Gadolinium 64	147 Pm Promethium 61	148 Sm Samarium 62	149 Eu Europium 63	150 Sm Samarium 62	151 Gd Gadolinium 64	152 Eu Europium 63	153 Gd Gadolinium 64	154 Tb Terbium 65	155 Dy Dysprosium 66	156 Ho Holmium 67	157 Er Erbium 68	158 Tm Thulium 69	159 Yb Ytterbium 70	160 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	238 U Uranium 92	239 Am Americium 95	240 Cm Curium 96	241 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	244 Pu Plutonium 94	245 Cm Curium 96	246 Bk Berkelium 97	247 Cf Californium 98	248 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

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

Key

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

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