



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

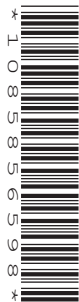
CANDIDATE
NAME

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COMBINED SCIENCE

0653/23

Paper 2 (Core)

October/November 2016

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 pencil for any diagrams or graphs.

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 20.

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 **20** printed pages.

1 Fig. 1.1 shows a man using a longbow to fire arrows at a target.



Fig. 1.1

(a) The man uses a force to pull the arrow back through several centimetres.

(i) State the name of the unit of force.

.....[1]

(ii) Explain why work is done by the man when he pulls the arrow back.

.....
[1]

(b) (i) Complete the sequence of energy transfers from when the man pulls the arrow back, to when he releases the arrow towards the target.

from energy in the man
 to energy in the longbow and bowstring
 to energy in the flying arrow. [3]

(ii) Suggest why the efficiency of the energy transfer between the energy in the longbow and bowstring, and the energy of the flying arrow is not 100%.

.....
[1]

(c) The arrow flies 100m to a target at an average speed of 180 km/hour.

(i) Calculate the average speed of the arrow in metres per second.

Show your working

average speed = m/s [1]

3

- (ii) Use your answer to (c)(i) to calculate the time in seconds taken for the arrow to reach the target after release.

State the formula you use and show your working.

formula

working

time = s [2]

4

2 The chemical symbol of an atom of magnesium is shown below.



(a) Complete Table 2.1 to show the names and numbers of the two types of particle in the nucleus of this magnesium atom.

Table 2.1

particle	number

[2]

(b) A student uses the apparatus in Fig. 2.1 to burn some magnesium in air.

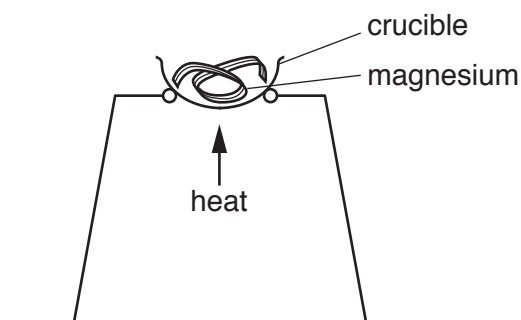


Fig. 2.1

A white solid, magnesium oxide, is formed.

Write the word equation for this reaction.



[2]

- (c) Fig. 2.2 shows test-tubes **A** and **B** which both contain dilute sulfuric acid. The student adds some magnesium to test-tube **A**. He adds some magnesium oxide to test-tube **B**.

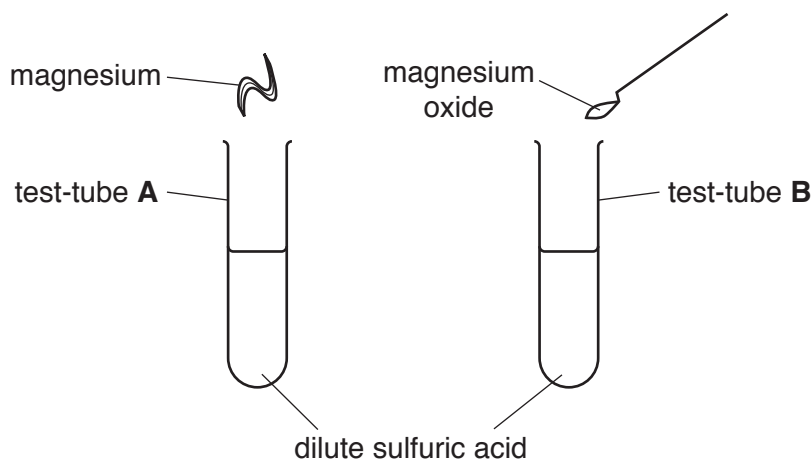


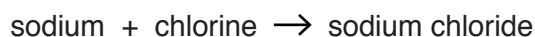
Fig. 2.2

State which of the two test-tubes produces a gas which burns with a squeaky pop. Identify the gas which is produced.

test-tube

gas [1]

- (d) (i) Sodium, a Group I element, reacts with chlorine, a Group VII element, as shown in the equation below.



Identify the substance in the word equation which contains ionic bonds. Explain your answer.

substance

explanation

..... [2]

- (ii) Sodium also reacts with water, as shown in the word equation below.



Identify a substance in the word equation which contains covalent bonds. Explain your answer.

substance

explanation

..... [2]

3 (a) Fig. 3.1 shows a plan of the human circulatory system.

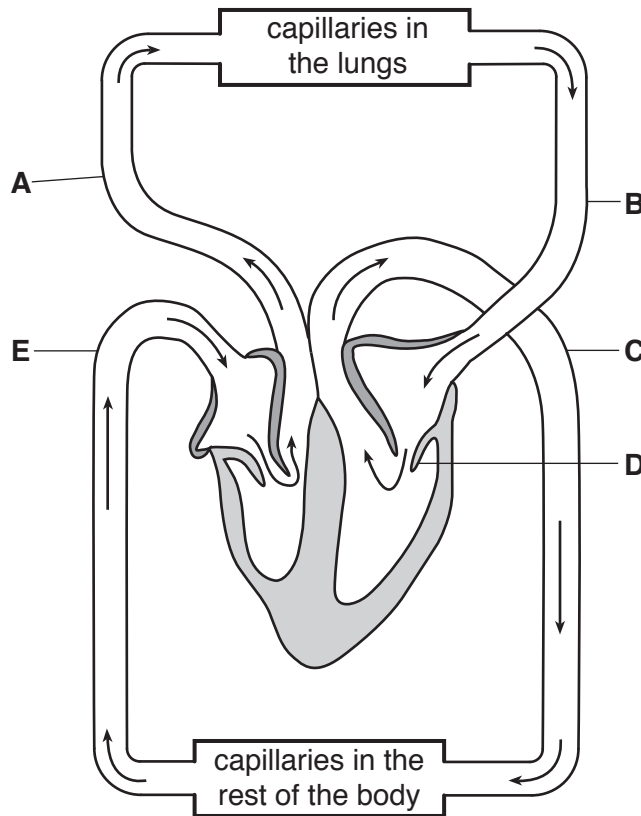


Fig. 3.1

(i) State the letter and name of a vein shown in Fig. 3.1.

letter

name[1]

(ii) Name the type of structure within the heart labelled D and describe its function.

.....

[2]

(iii) Describe how the composition of blood changes as it passes through the capillaries of the lungs.

.....

[2]

(b) A student is running. His heart beats more quickly. His muscles need more blood for respiration.

(i) State the word equation for respiration.

.....[1]

(ii) The energy released by respiration can be used for contraction of his muscles.

State **two** other uses of the energy released.

1.

2.

[2]

(c) A student measures his pulse rate during the day. He takes a reading while sitting, and also as he does different activities. Some of his readings are shown in Table 3.1.

Table 3.1

activity	number of beats per minute
sitting	68
running	164
Y	90

Suggest an activity for **Y**. Explain your answer.

activity

explanation

.....[1]

4 Fig. 4.1 shows a simple solar heating system to provide hot water for a house.

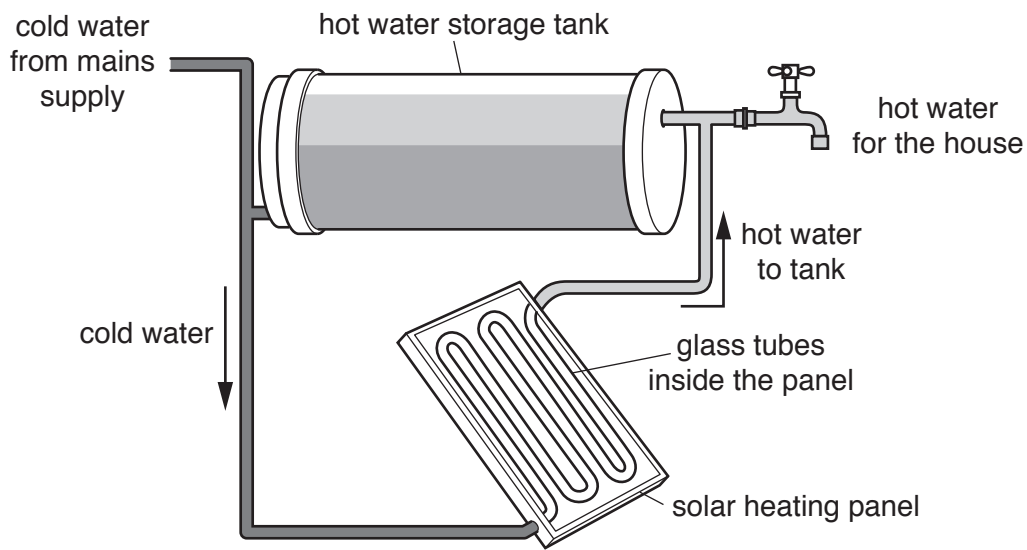


Fig. 4.1

- Cold water in glass tubes inside the panel is heated by energy from the Sun.
 - The hot water then flows to the hot water storage tank above.
 - Cold water from the tank flows back to the panel.
 - A supply of hot water for the house can be taken from the tank.
- (a) The Sun emits energy as electromagnetic radiation, some of which is absorbed by the solar panel.

On Table 4.1, in the correct box write the name of the main part of the electromagnetic spectrum which heats the solar panel.

Table 4.1

gamma radiation		ultraviolet				radio waves
-----------------	--	-------------	--	--	--	-------------

[2]

(b) The solar panel is made of glass tubes through which the water flows.

Fig. 4.2 shows how each glass tube is placed inside an outer glass tube. The space between the outer and inner tubes has had all the air pumped out, leaving a vacuum between the tubes.

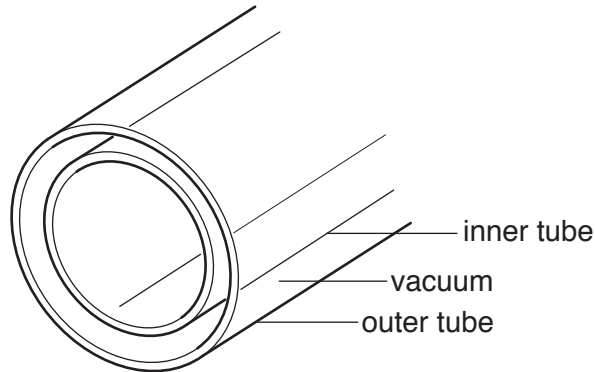


Fig. 4.2

State the method of thermal energy transfer

1. from the outer glass tube across the vacuum to the inner tube which contains the water,

2. from the hot water in the glass tubes up to the storage tank on top of the panel.

[2]

(c) The water in the storage tank reaches a temperature of 60°C on a sunny day.

Suggest how the storage tank is designed to prevent the stored hot water cooling down again at night.

.....
[1]

- (d) The storage tank is made of metal.

Describe the change to the storage tank caused by the increase in temperature.

.....

.....

.....[1]

- (e) On a cold night in winter, the temperature falls below the melting point of water.

Suggest one problem this might cause for this solar heating system on the roof of a house.

.....

.....[1]

- (f) Light from the Sun has to pass through the walls of the glass tubes.

On Fig. 4.3 complete the ray diagram to show the path of light from the Sun through the outer glass tube into the vacuum between the tubes.

Show the angles of incidence and refraction at the air-to-glass surface.

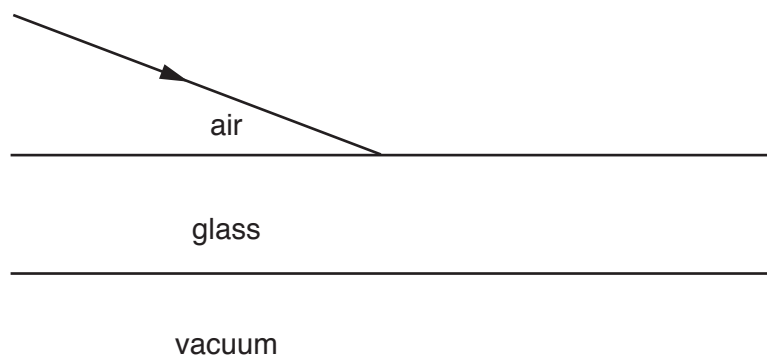


Fig. 4.3

[3]

- 5 Fig. 5.1 shows a bottle labelled copper(II) chloride solution.

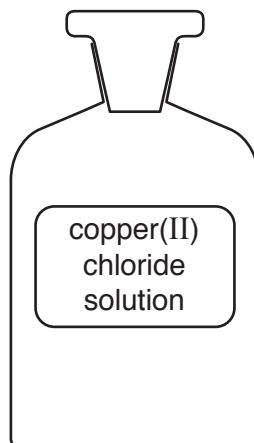


Fig. 5.1

- (a) A student tests the solution in the bottle to make sure that it contains copper chloride.

Complete Table 5.1. State the reagents and give the positive result for the test for each ion.

Table 5.1

ion	reagent	result
copper(II)		
chloride		

[4]

(b) Fig. 5.2 shows the electrolysis of the copper chloride solution using inert electrodes.

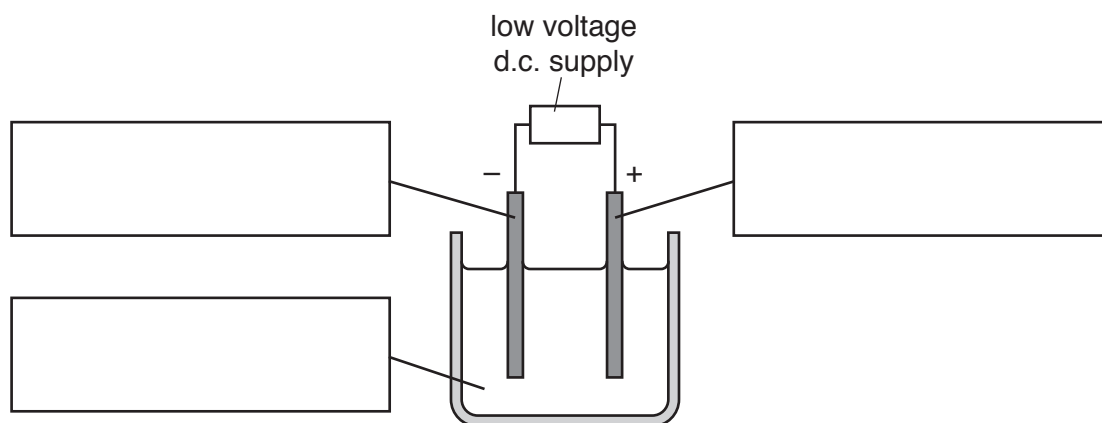


Fig. 5.2

(i) Use the words *anode*, *cathode* and *electrolyte* in the correct boxes to complete Fig. 5.2. [2]

(ii) After a few minutes a coloured solid forms on the negative electrode.

Name the solid and state its colour.

name

colour

[2]

(iii) Chlorine gas forms at the positive electrode and is tested with damp blue litmus paper.

State the colour of chlorine gas and the final colour of the litmus paper.

colour of chlorine gas

colour of litmus paper

[2]

6 (a) A student takes a flower apart and displays all the flower parts as shown in Fig. 6.1.

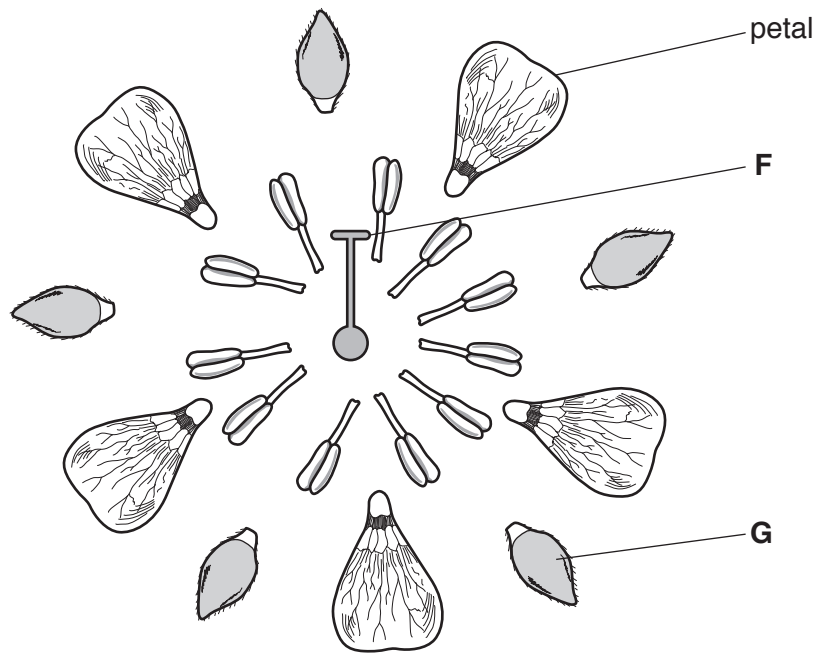


Fig. 6.1

(i) Name flower parts F and G.

F

G

[2]

(ii) On Fig. 6.1 label and name a part of the flower that contains many haploid cells.

Explain your answer.

.....

.....[2]

(iii) The flower is insect-pollinated.

Suggest **one** feature that helps with insect pollination.

.....

.....[1]

- (b) A student investigates the rate of transpiration from a leafy twig under different conditions. Fig. 6.2 shows the apparatus he uses.

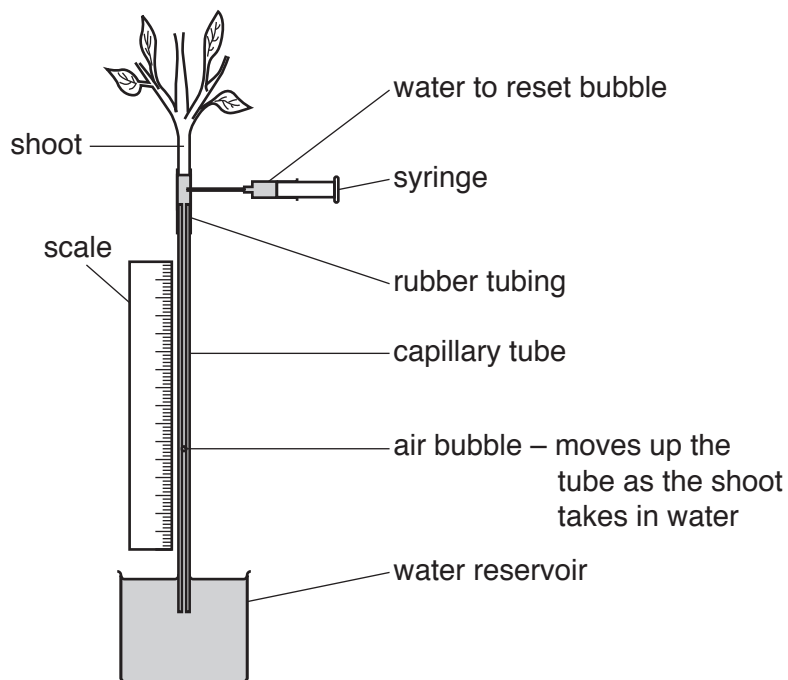


Fig. 6.2

- He measures how far the air bubble moves upwards in one minute.
- He uses the syringe of water to reset the apparatus.
- The student repeats the experiment under different environmental conditions.
- His readings are shown in Table 6.1.

Table 6.1

conditions	distance moved by bubble in one minute/cm
dry air at 22 °C	1.1
dry air at 27 °C	6.8
humid air at 22 °C	

- (i) Explain why the distance the bubble moves increases when the temperature rises to 27 °C.

.....

.....

.....

.....[2]

(ii) Suggest a possible reading for humid air at 22 °C. Explain your answer.

reading

explanation

.....
[1]

(c) In the ground the plant takes in water at the roots.

Fig. 6.3 shows the distribution of the tissues in the cross-sections of two similar roots of the same size.

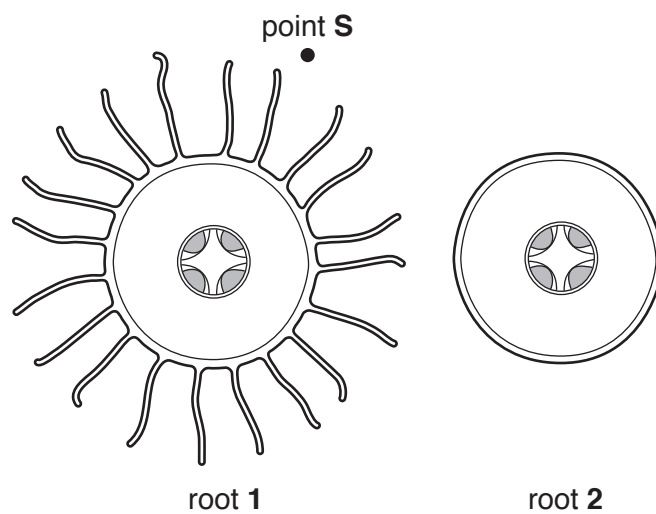


Fig. 6.3

(i) Suggest which root takes in water more quickly. Explain your answer.

root

explanation

.....
[1]

(ii) On Fig. 6.3 draw a line to show a path taken by water from point S to the xylem. [2]

- 7 (a) Fig. 7.1 shows a wave generated in a string. One end of the string is fixed to a stand and clamp, while the other end is attached to a vibrator driven by an electric motor.

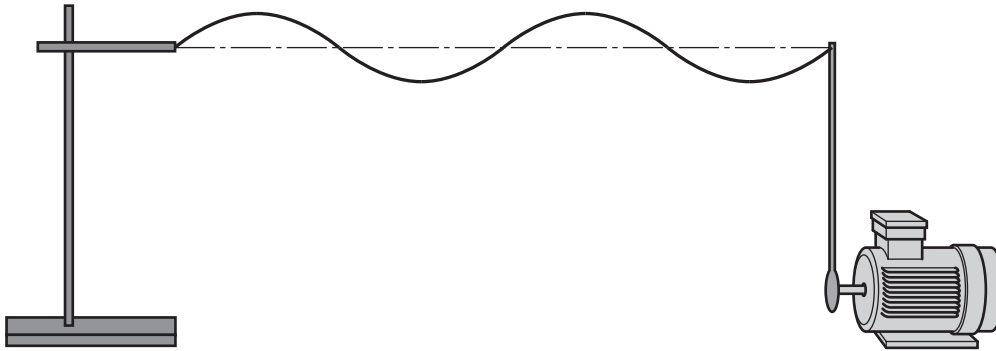


Fig. 7.1

- (i) The length of the string is 100 cm.

State the wavelength of the wave motion shown in Fig. 7.1.

..... cm [1]

- (ii) On Fig. 7.1 draw a double-headed arrow (\longleftrightarrow or \updownarrow) to show the *amplitude* of the wave. [1]

- (b) Fig. 7.2 shows part of the circuit diagram for the circuit used to drive the vibrator.

The vibrator is driven by the electric motor. The speed of the motor is controlled by a variable resistor.

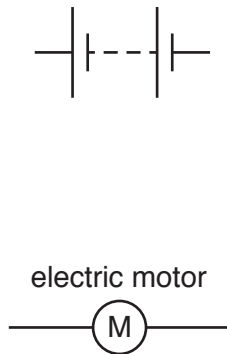


Fig. 7.2

Complete the circuit diagram by including the correct symbols in the correct places in the circuit for

1. a variable resistor to control the current through the motor,
2. a way of measuring the current through the motor.

[3]

- (c) The variable resistor is adjusted so that the current through the motor is 2A. The potential difference (p.d.) across the motor is 3.0V.

- (i) State the name of the property of the motor given by the expression

$$\frac{\text{p.d.}}{\text{current}}$$

.....[1]

- (ii) Calculate the value of this property and give the unit of your answer.

Show your working.

value of property = unit[2]

- 8 Fig. 8.1 shows the processes a student uses to make the salt, zinc sulfate.

She reacts zinc carbonate powder with dilute sulfuric acid.

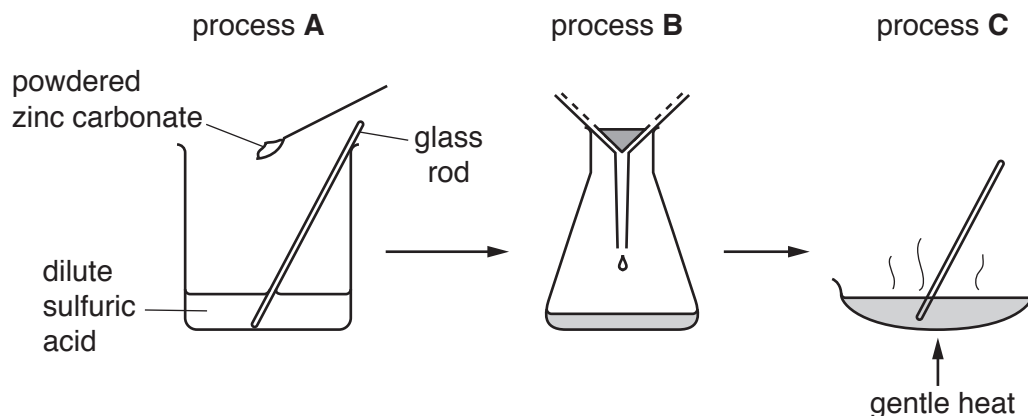


Fig. 8.1

- (a) Name processes **B** and **C**.

process **B**

process **C**

[2]

- (b) The student stirs the mixture to increase the speed of the reaction in process **A**.

Suggest **two** other ways of increasing the speed of this reaction.

1.

2.

[2]

- (c) (i) Deduce the identity of the salt and name the gas which forms when the student adds sodium carbonate to dilute sulfuric acid.

salt

gas

[2]

- (ii) Describe what happens to the pH of the acid as it reacts with sodium carbonate.

..... [1]

- (iii) The formula of sodium carbonate is Na_2CO_3 .

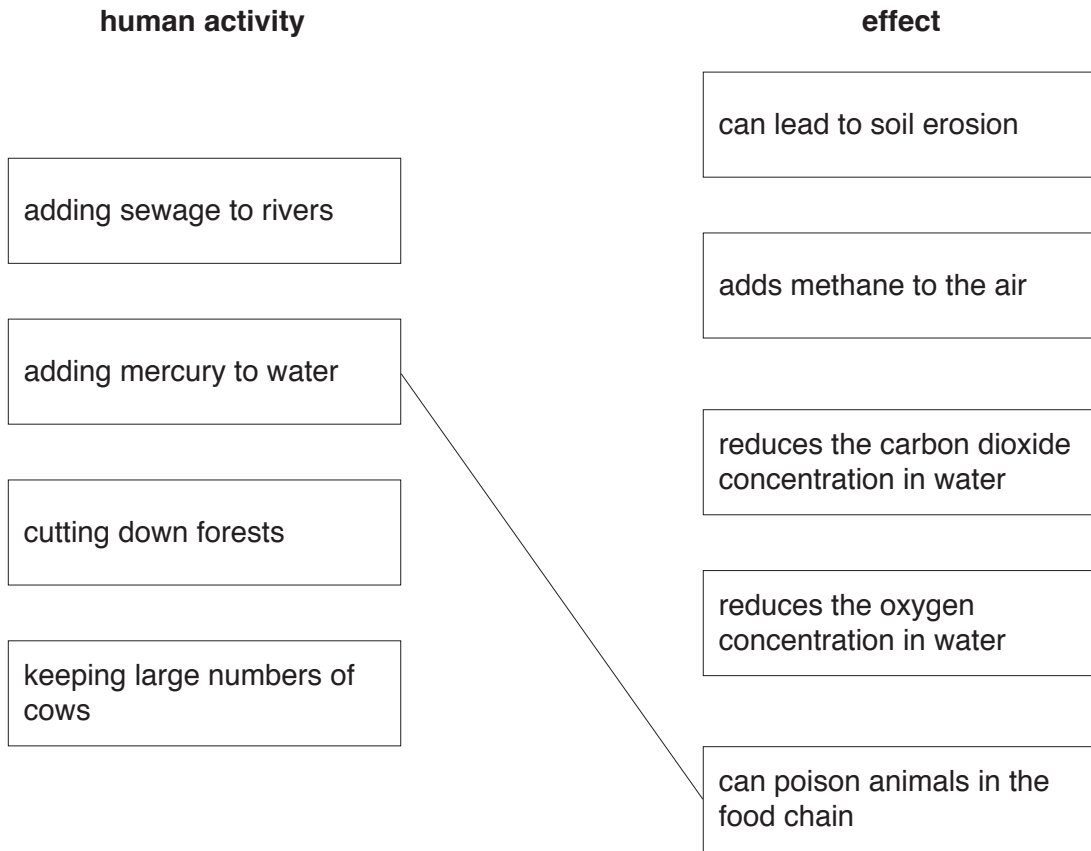
State the number of different elements in sodium carbonate.

.....

[1]

9 (a) Many human activities can affect the environment.

Draw **one** line from each human activity to its effect. One line is drawn for you.



[3]

(b) Human activities can cause an increase in the concentration of carbon dioxide in the atmosphere.

(i) State one large-scale activity of humans which increases the concentration of carbon dioxide in the atmosphere.

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

(ii) Explain why an increase in the concentration of carbon dioxide in the atmosphere is undesirable.

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

The Periodic Table of Elements

Group																																																																																														
I	II	III							IV	V	VI	VII	VIII																																																																																	
3 Li lithium 7	4 Be beryllium 9	<table border="0"> <tr> <td>1 H hydrogen 1</td> <td colspan="10" rowspan="2"> <table border="0"> <tr> <td colspan="2" rowspan="2"> <table border="0"> <tr> <td colspan="2">Key</td> </tr> <tr> <td>atomic number</td> <td>atomic symbol</td> </tr> <tr> <td>name</td> <td>relative atomic mass</td> </tr> </table> </td> </tr> <tr> <td>5 B boron 11</td> <td>6 C carbon 12</td> <td>7 N nitrogen 14</td> <td>8 O oxygen 16</td> <td>9 F fluorine 19</td> <td>10 Ne neon 20</td> </tr> <tr> <td>13 Al aluminium 27</td> <td>14 Si silicon 28</td> <td>15 P phosphorus 31</td> <td>16 S sulfur 32</td> <td>17 Cl chlorine 35.5</td> <td>18 Ar argon 40</td> </tr> <tr> <td>19 K potassium 39</td> <td>20 Ca calcium 40</td> <td>21 Sc scandium 45</td> <td>22 Ti titanium 48</td> <td>23 V vanadium 51</td> <td>24 Cr chromium 52</td> <td>25 Mn manganese 55</td> <td>26 Fe iron 56</td> <td>27 Co cobalt 59</td> <td>28 Ni nickel 59</td> <td>29 Cu copper 64</td> <td>30 Zn zinc 65</td> <td>36 Kr 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lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

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