Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/22**

Paper 2 Theory **October/November 2024**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Any blank pages are indicated.

DC (DE/FC) 337971/3

[Turn over

1 Fig. 1.1 shows the human digestive system.

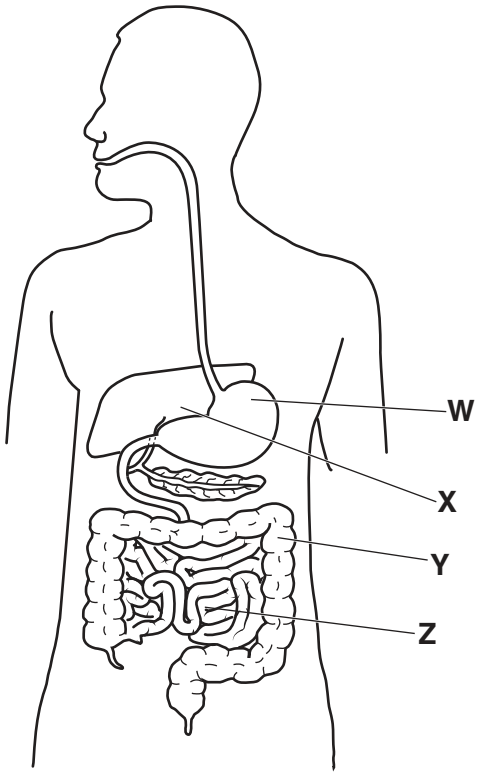

Fig. 1.1

(a) (i) State the name of the part labelled **W** in Fig. 1.1.

..... [1]

(ii) State the name of the part labelled **X** in Fig. 1.1.

..... [1]

(b) State **one** function for **each** of the parts labelled **Y** and **Z** on Fig. 1.1.

function of part **Y** .....

.....

.....

function of part **Z** .....

.....

.....

[2]

(c) Fig. 1.2 shows how the activity of four different enzymes **A**, **B**, **C** and **D** varies with pH.

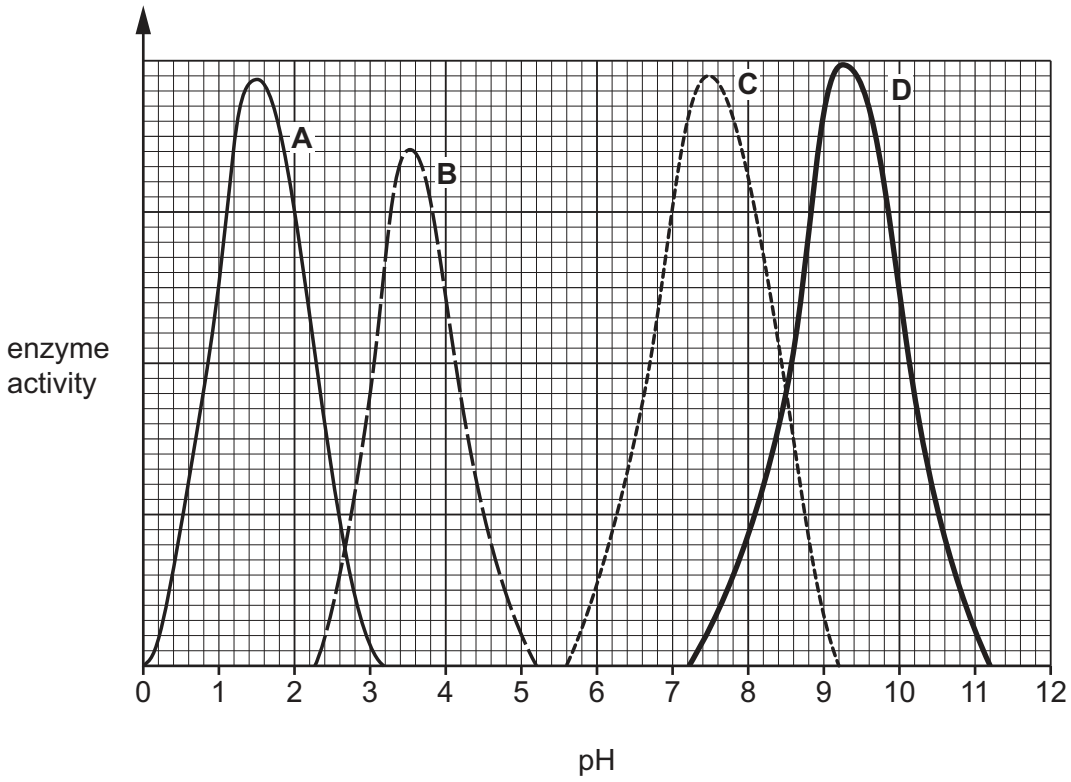

Fig. 1.2

Place a tick (✓) in **three** boxes in Table 1.1 to identify three correct conclusions that can be made from the information in Fig. 1.2.

Table 1.1

Both enzyme **A** and enzyme **B** could function in the human stomach.	
Enzyme **B** is the most active enzyme.	
Enzyme **D** has the highest activity at pH 9.25.	
Enzyme **C** is active over the widest range of pH values.	
Enzymes **A** and **B** digest the same substrate.	
Enzymes **C** and **D** are equally active at pH 8.5.	

[3]

[Total: 7]

2 **(a)** Fig. 2.1 shows the axes used to plot distance–time graphs.

Fig. 2.2 shows the axes used to plot speed–time graphs.

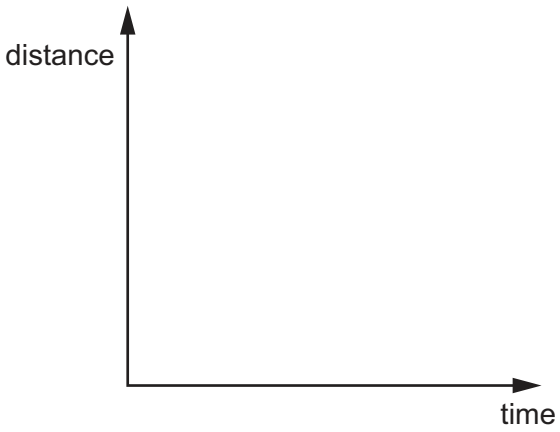

Fig. 2.1

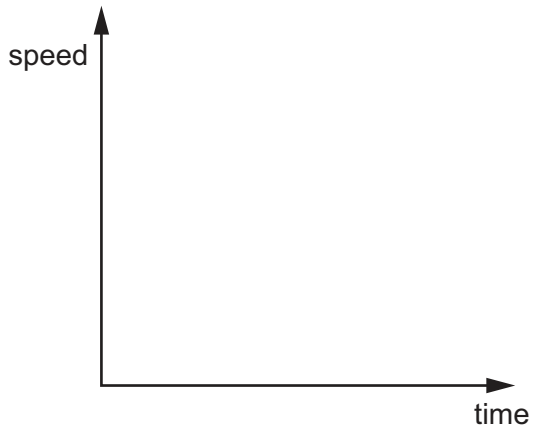

Fig. 2.2

(i) On Fig. 2.1, draw a graph for an object that is moving with decreasing speed. [1]

(ii) On Fig. 2.2, draw a graph for an object that is moving with constant acceleration. [1]

(b) Acceleration a, force F and mass m are related by the equation:

$$a = \frac{F}{m}$$

Determine a value for F and a value for m that combine to produce an acceleration a of $2.0\,\text{m/s}^2$.

State the units of force and mass in your answer.

F = ... unit .....

m = ... unit .....
[2]

[Total: 4]

3 **(a)** Sulfur dioxide, SO_2, reacts with oxygen, O_2, to form sulfur trioxide, SO_3.

Construct a balanced symbol equation for the reaction.

..... [1]

(b) When sulfur trioxide, SO_3, is mixed with water in a conical flask, a reaction takes place that forms sulfuric acid, H_2SO_4.

The equation for the reaction is:

$$SO_3 + H_2O \rightarrow H_2SO_4$$

(i) Calculate the relative molecular mass M_r of sulfuric acid.

The relative atomic masses, A_r, of hydrogen, oxygen and sulfur are shown.

[A_r: H, 1; O, 16; S, 32]

M_r = ... [1]

(ii) Complete the following sentence.

4 g of sulfur trioxide reacts with ..... g of water. [1]

(iii) Describe how the pH of the contents of the conical flask changes as the sulfur trioxide is mixed with water.

..... [1]

(iv) Describe how the pH of the contents of the conical flask is measured.

.....

..... [1]

(c) A solution of sulfuric acid has a concentration of 10 g / dm^3.

Calculate the mass of sulfuric acid that is dissolved in 250 cm^3 of the solution.

[1 dm^3 = 1000 cm^3]

mass = ... g [1]

[Total: 6]

4 The boxes on the left contain the names of blood vessels that carry blood to organs.

The boxes on the right contain the names of organs which receive blood.

Draw one straight line from each box on the left to link the blood vessel carrying the blood to the organ receiving the blood.

You must draw a total of **five** straight lines.

Each box containing an organ may be linked to one blood vessel, more than one blood vessel or not at all.

blood vessel carrying blood	**organ receiving blood**
coronary artery	heart
hepatic portal vein	stomach
pulmonary artery	liver
pulmonary vein	lung
vena cava	

[5]

5 Biofuel gas is produced by the breakdown of animal and plant waste.

Fig. 5.1 shows the biofuel gas released as the waste breaks down. This gas is purified and then stored in a large container.

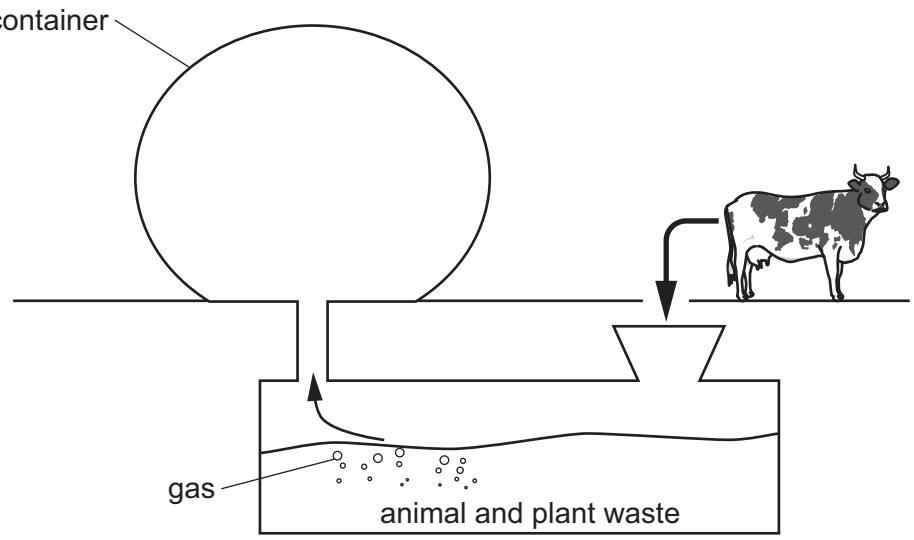

Fig. 5.1

(a) State the name of the energy store in biofuel gas.

..... [1]

(b) Complete the sentences:

The biofuel gas is ..... to release thermal energy.

This heats water in a boiler. The steam produced turns a ..... .

This turns a ..... which creates electrical current.

[3]

(c) State **one** advantage of using biofuel as an energy source.

.....

..... [1]

[Total: 5]

6 A student reacts solid calcium carbonate with dilute hydrochloric acid.

Carbon dioxide gas is produced.

(a) (i) Complete the word equation for the reaction.

calcium carbonate	+	hydrochloric acid	→	....	+	.....	+	carbon dioxide

[2]

(ii) State the name of the piece of apparatus that the student uses to measure the volume of carbon dioxide gas produced.

..... [1]

(iii) Describe a test and the result of the test that shows that carbon dioxide gas is produced.

test .....

result .....

[2]

(b) The student changes the rate of the reaction using four different sets of conditions A, B, C and D.

Table 6.1 shows the different sets of conditions.

Table 6.1

conditions	temperature / °C	concentration of dilute hydrochloric acid / g / dm^3	state of calcium carbonate solid
A	20	10.0	powder
B	20	10.0	lumps
C	40	10.0	powder
D	20	5.0	lumps

List the four different sets of conditions A, B, C and D in order of the highest rate of reaction produced to the lowest rate of reaction produced.

highest rate ⟶ lowest rate

....

[2]

[Total: 7]

7 Draw **three** straight lines from the box on the left to the boxes on the right to make three sentences that are correct for glucose.

Glucose …

… contains the elements carbon, nitrogen, oxygen and hydrogen.

… is a good source of fibre in the diet.

… is digested by amylase in the ileum.

… may be found in the urine of people with Type 2 diabetes.

… is stored as glycogen in the liver.

… is transported round the body in the plasma.

[3]

8 **(a)** Fig. 8.1 shows a flask containing air.

When the flask is warmed, air bubbles come out of the delivery tube and enter the water in the beaker.

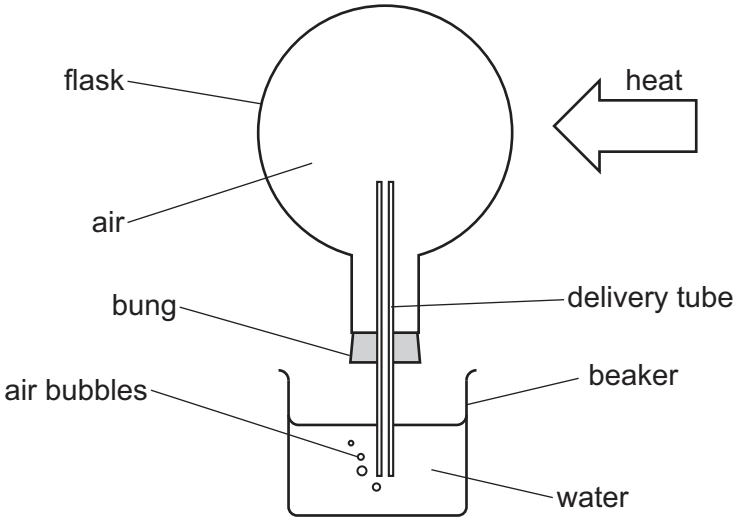

Fig. 8.1

Explain, using ideas about the motion, distances and forces between particles, why the air in the flask enters the water in the beaker.

.....

.....

.....

.....

..... [3]

(b) Fig. 8.2 shows a hot air balloon.

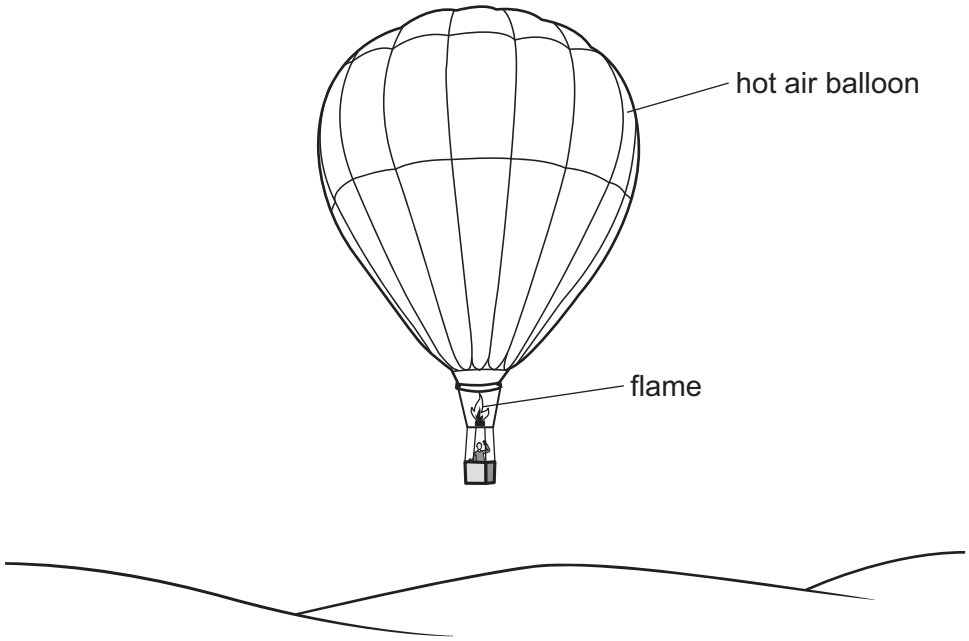

Fig. 8.2

A pilot uses a flame to heat the air inside the balloon, and the balloon rises.

Suggest why the pilot must heat the air regularly to keep the balloon at the same height.

.....

.....

.....

.....

..... [3]

[Total: 6]

9 Iron(III) oxide, Fe_2O_3, reacts with carbon monoxide, CO, to form iron, Fe, and carbon dioxide, CO_2.

The equation for the reaction is shown.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

(a) Explain how the equation shows that iron(III) oxide is reduced.

.....

..... [1]

(b) Iron(III) oxide is an ionic compound.

Describe **two** properties of ionic compounds.

property 1 .....

.....

property 2 .....

.....

[2]

(c) Complete Fig. 9.1 to show the outer electrons in a molecule of carbon dioxide.

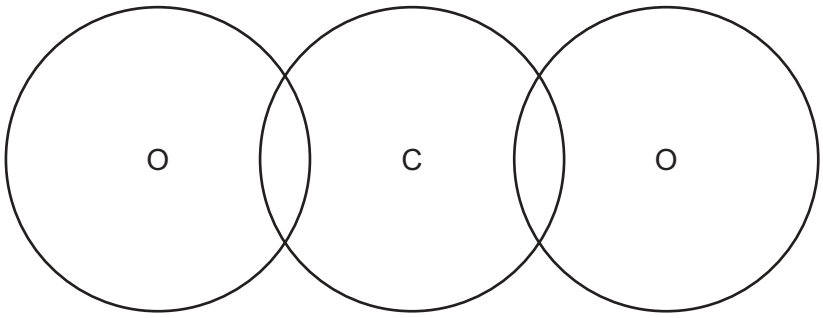

Fig. 9.1

[2]

[Total: 5]

10 (a) Complete the description of transpiration by inserting appropriate words in the spaces.

Transpiration is the ..... of water from the surface of

..... cells into the air spaces of a leaf and then diffusion of

water vapour out of the leaf through the ..... .

[3]

(b) Fig. 10.1 shows how the rate of transpiration in a plant is affected by four different environmental factors.

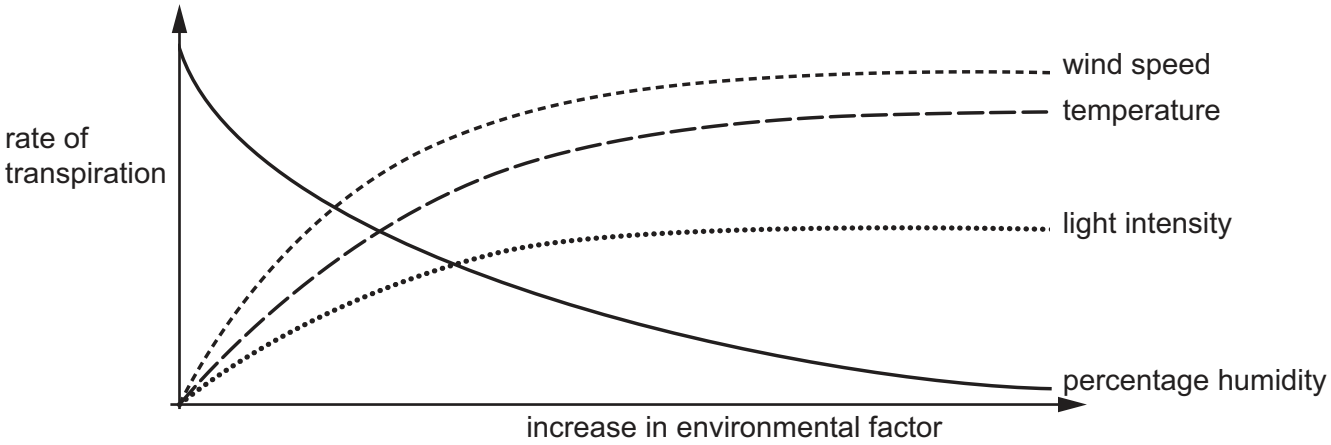

Fig. 10.1

(i) State which environmental factor causes the rate of transpiration to decrease as the factor increases.

..... [1]

(ii) State which environmental factor causes the greatest increase in the rate of transpiration as the factor increases.

..... [1]

(iii) Suggest why an increase in the light intensity when the light intensity is low causes the rate of transpiration to increase.

.....

.....

.....

.....

..... [2]

[Total: 7]

11 Resistors R_1, R_2, and R_3 are connected in a circuit as shown in Fig. 11.1.

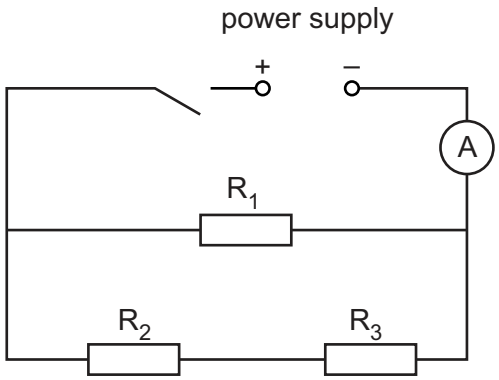

Fig. 11.1

Resistor R_1 has a resistance R_1 of 100 Ω.

Resistor R_2 has a resistance R_2 of 50 Ω.

Resistor R_3 has a resistance R_3 of 220 Ω.

(a) Explain why the combined resistance of R_2 and R_3 is 270 Ω rather than approximately 42 Ω.

..... [1]

(b) The reading on the ammeter is the total current I in the circuit.

The current in each branch is less than I.

The potential difference of the power supply is 10.0 V.

Show that I = 0.137 A.

[3]

[Total: 4]

12 Ethene, C_2H_4, undergoes complete combustion to form carbon dioxide, CO_2, and water, H_2O.

(a) (i) Complete combustion requires thermal energy and a fuel. Ethene is the fuel.

State **one** other substance that must be present for the complete combustion of ethene.

..... [1]

(ii) State an adverse effect of carbon dioxide.

..... [1]

(b) (i) Draw the displayed formula of ethene, C_2H_4.

[1]

(ii) Ethene has a boiling point of –103.7 °C.

Name the state of ethene at –90.0 °C.

..... [1]

(iii) Explain why ethene has a low boiling point.

.....

.....

..... [2]

(iv) Name the type of reaction that produces ethene from large alkanes.

..... [1]

(v) Draw a (ring) around the word that describes ethene.

alkane **alkene** **polymer** **saturated** [1]

[Total: 8]

13 Use words or phrases from the list to complete the sentences about reproduction in humans.

embryo **ovaries** **oviduct** **pancreas**

phagocyte **prostate gland** **sperm** **sperm ducts**

testes **uterus** **zygote**

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

In human females, egg cells develop in the ..... .

Fertilisation occurs when the nuclei of an egg cell and a .....
fuse together.

Sperm cells are made in the ..... of a male.

The fertilised egg cell is called a ..... . This travels down

a tube and embeds in the wall of the ..... .

[5]

14 **(a)** All of the regions of the electromagnetic spectrum have useful applications.

Fig. 14.1 shows three of these regions and three applications.

On Fig. 14.1, draw one straight line from each region to its application.

You must draw a total of **three** lines.

region	application
radio	television communication
ultraviolet	medical imaging
X-ray	sterilising water

Fig. 14.1

[2]

(b) Ultraviolet and X-ray radiations are ionising.

State **one** other region of the electromagnetic spectrum that is ionising.

..... [1]

(c) Fig. 14.2 represents how another form of ionising radiation collides with and ionises an atom.

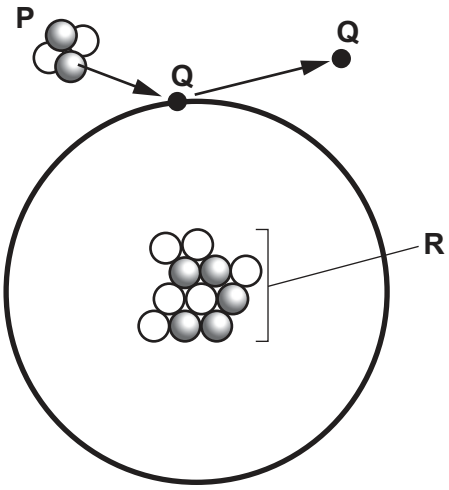

Fig. 14.2

The particle of ionising radiation **P** collides with particle **Q** which is in orbit around the central structure **R**.

(i) Deduce the name of:

- particle **P** .....
- particle **Q** .....
- central structure **R**. .....

[3]

(ii) In Fig. 14.2, all the particles in the central structure **R** are shown.

Use the periodic table on page 20 to explain why this atom is an isotope of boron.

.....

..... [2]

[Total: 8]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

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.).