Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/31**

Paper 3 Theory (Core) **May/June 2025**

1 hour 15 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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m/s^2).

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.

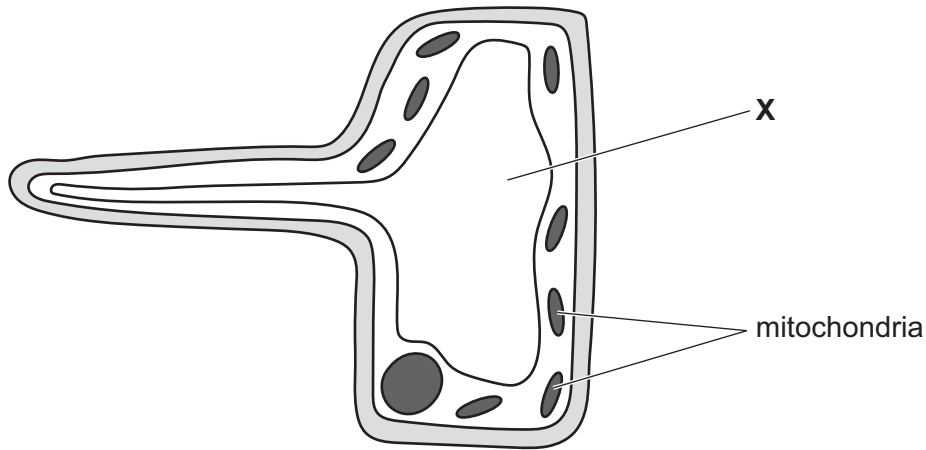**[Turn over**
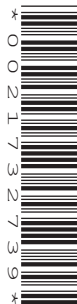
1 (a) Fig. 1.1 is a diagram of a plant root hair cell.

Fig. 1.1

(i) Name the part labelled **X** on Fig. 1.1.

.... [1]

(ii) State the function of mitochondria.

.... [1]

(iii) Suggest why the cell in Fig. 1.1 does **not** have chloroplasts.

....

....

.... [2]

(b) Water enters the root hair cell from the soil.

(i) Complete the sentence to describe the movement of water into the cell.

Water diffuses through a .... permeable membrane by

....

[2]

(ii) Water passes through the root to the xylem.

Circle the name of the root cells that water passes through to reach the xylem.

cortex   guard   mesophyll   palisade

[1]

0653/31/M/J/25

(c) Fig. 1.2 shows part of the carbon cycle.
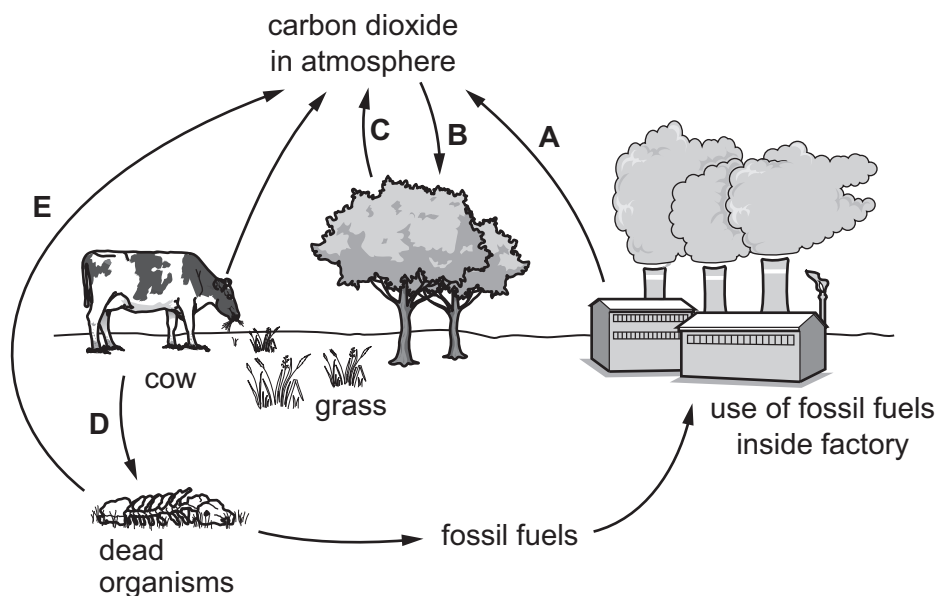
Fig. 1.2

(i) State the letter on Fig. 1.2 that represents:

combustion ....

decomposition. ....

[2]

(ii) Use Fig. 1.2 to explain why the cow is described as a herbivore.

....

.... [1]

[Total: 10]

2 Fig. 2.1 shows the structure of a human heart.
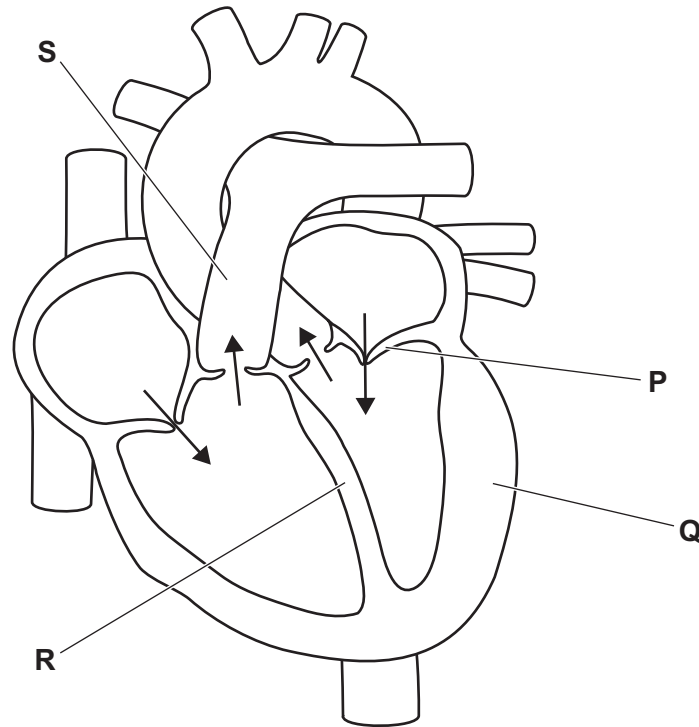
Fig. 2.1

The arrows in Fig. 2.1 show the direction of blood flow through the heart.

(a) Use letters **P**–**S** to complete the sentences about the heart in Fig. 2.1.

The part labelled .... is the muscular wall of the left ventricle.

Blood is transported away from the right side of the heart in the part labelled ....

The part labelled .... ensures one-way flow of blood.

[3]

(b) The activity of the heart may be monitored by ECG (electrocardiogram).

State **one other** way to monitor the activity of the heart.

.... [1]

(c) Blood contains four main components.

Name the component of blood that:

transports hormones ....

produces antibodies ....

contains haemoglobin. ....

[3]

(d) Blood is pumped away from the heart in arteries and returns to the heart in veins.

Describe **two** differences in the structure of arteries compared to veins.

1 ....

....

2 ....

....

[2]

[Total: 9]

3   **(a)** Nutrition is one of the characteristics of living organisms.

Define nutrition.

....

.... [1]

(b) Table 3.1 shows some information about nutrients in bananas.

Table 3.1

nutrient	mass of nutrient per 100g of banana / g
carbohydrate	12.2
protein	1.1
fat	0.3
fibre (roughage)	2.6
vitamin C	0.0087

(i) Identify the nutrient in Table 3.1 that helps to keep food moving through the large intestine.

.... [1]

(ii) A health authority recommends that adults should eat 0.040g of vitamin C per day.

A person eats 100g of bananas.

Use Table 3.1 to calculate the percentage of the recommended mass of vitamin C the person eats.

percentage = ... [2]

(c) Banana trees that grow in the wild need to be pollinated before they can produce fruit.

Complete the sentences about pollination.

Use words from the list.

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

anther	**fertilisation**	**filament**	**germination**
ovary	**ovule**	**reproduction**	**stigma**

Pollination is the transfer of pollen grains from the .... to

the ....

The pollen nucleus then fuses with the nucleus of the ....

The fusion of nuclei is called ....

[4]

[Total: 8]

4 **(a)** Iron is a metal.

Fig. 4.1 shows the three physical states of iron.
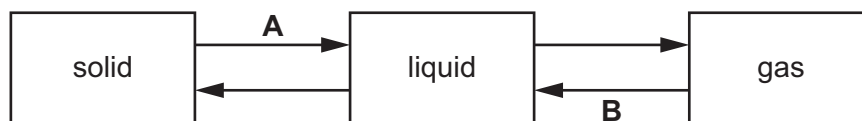
Fig. 4.1

Name the changes of state shown by arrows **A** and **B**.

A..

B..

[2]

(b) Complete the sentences about the particles in a liquid.

Use words or phrases from the list.

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

    at the same speed as   **more quickly than**   **stable**

    more slowly than   **regular**   **random**

The particles in a liquid move .... in a solid.

Particles in a liquid have a .... arrangement.

[2]

(c) The symbol equation for the reaction of solid iron with oxygen is shown.

$$4Fe(............) + 3O_2(............) \rightarrow 2Fe_2O_3(s)$$
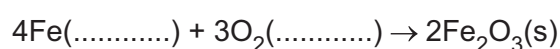
(i) Complete the symbol equation by adding the state symbols. [1]

(ii) Explain how the equation shows that oxidation takes place.

....

.... [1]

(d) Iron is used as a catalyst in a reaction to make ammonia.

Describe the effect of a catalyst on the rate of reaction.

.... [1]

[Total: 7]

9

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5 Potassium and magnesium are metals.

(a) A solid compound contains potassium ions.

Describe the use of a flame test to identify potassium ions.

....

....

....

.... [2]

(b) A small piece of potassium is added to cold water. An exothermic reaction happens.

(i) Complete the sentence about an exothermic reaction.

An exothermic reaction transfers .... energy to the surroundings. [1]

(ii) State **one** observation that shows this reaction is exothermic.

.... [1]

(iii) Complete the word equation for this reaction.

| potassium | + | water | → | | + | |

[1]
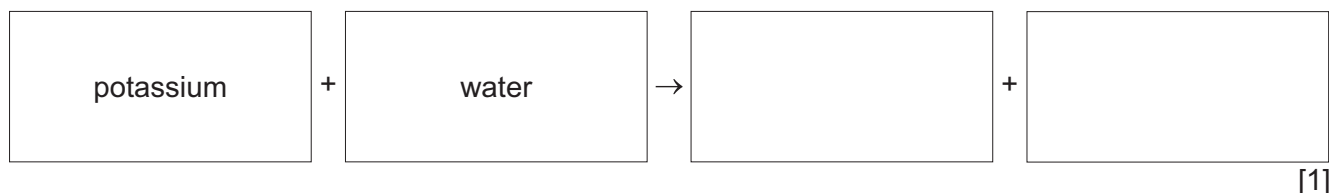
(c) Magnox is an alloy of magnesium.

Describe what is meant by an alloy.

....

.... [1]

(d) The proton number of magnesium is 12.

Determine the electronic configuration of magnesium.

.... [1]

Page 11

(e) Fig. 5.1 shows the structure of a compound of magnesium.
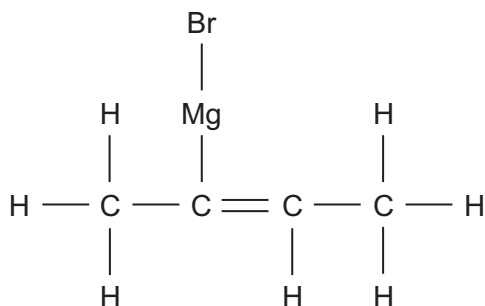
Fig. 5.1

Deduce the molecular formula of this compound.

.... [1]

[Total: 8]

6 **(a)** The formulas of some compounds of carbon are shown.

$$C_2H_4 \qquad CaCO_3 \qquad CH_4 \qquad CO \qquad CO_2$$

Use the formulas of these compounds to answer the following questions.

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

State which compound:

(i) decolourises aqueous bromine

.... [1]

(ii) is the main constituent of natural gas

.... [1]

(iii) forms poly(ethene) in an addition polymerisation reaction

.... [1]

(iv) is a product of the complete combustion of alkanes **and** leads to global warming

.... [1]

(v) is a toxic gas formed by incomplete combustion

.... [1]

(vi) is a waste gas produced from digestion in animals

.... [1]

(vii) is an acidic oxide.

.... [1]

(b) State what is meant by a hydrocarbon.

....

.... [1]

(c) Bitumen and refinery gas are obtained from petroleum.

Name **one** use of:

bitumen ....

refinery gas. ....

[2]

(d) Coal is a fossil fuel.

During the combustion of coal, a compound that contains sulfur is made.

Name this compound.

.... [1]

[Total: 11]

7 Fig. 7.1 shows an electric motorcycle.

direction of motion
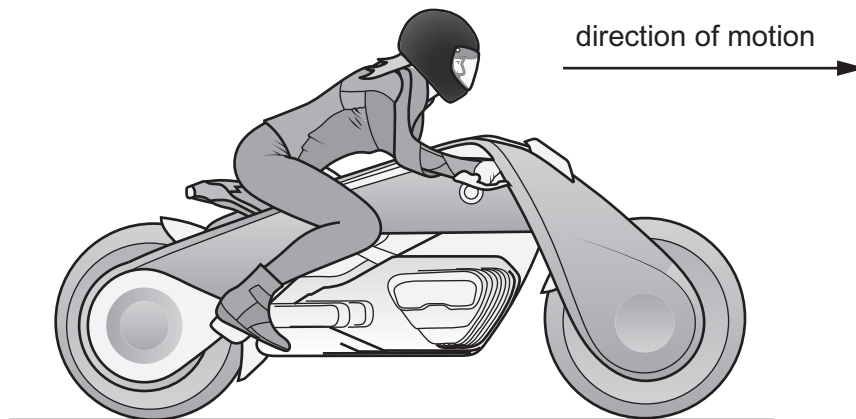
Fig. 7.1

(a) (i) On Fig. 7.1, draw an arrow to show the direction of the air resistance acting on the motorcycle.

Label the arrow with the letter **R**. [1]

(ii) Complete the sentences about the motorcycle.

The motorcycle is moving at constant speed along a level road.

The total resistance force is 250 N.

The driving force must also be 250 N because the .... force is zero.

[1]

(iii) Name the unit represented by N.

.... [1]

(b) The motorcycle is powered by a battery.

(i) The motorcycle travels a distance of 24 km at an average speed of 16 m/s.

Show that the time taken to travel this distance is 1500 s.

[2]

(ii) The battery supplies a constant current of 45 A at a voltage of 72 V.

Calculate the power supplied by the battery.

power = ... W [2]

(iii) Use your answer to **(b)(ii)** to calculate the total energy supplied by the battery in 1500 s.

energy = ...J [2]

[Total: 9]

8 Some cars are powered by petrol (gasoline) engines made of iron.

(a) Petrol burns inside the engine at a temperature of 1800 °C.

(i) Iron melts at a temperature of 1538 °C.

Suggest why the car engine must be cooled by a flow of cold water.

....

.... [1]

(ii) The mass of iron used in the car engine is 150 kg.

The density of iron is 7900 kg/m^3.

Calculate the volume of iron used in the car engine.

volume = ... m^3 [2]

(b) A car driver listens to the radio.

(i) Fig. 8.1 shows a wave.

displacement

distance
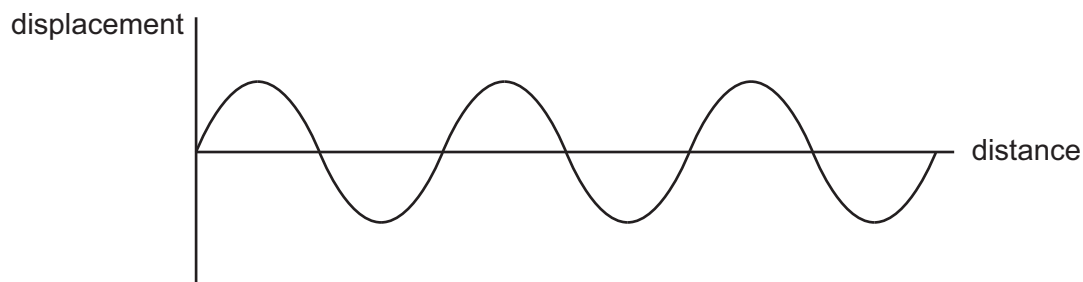
Fig. 8.1

On Fig. 8.1, draw a double-headed arrow (↔ or ↕) to show **one** wavelength.   [1]

(ii) The radio waves have a wavelength of 1200 m.

The speed of the radio waves is 3.0×10^8 m/s.

Calculate the frequency of the radio waves.

Include the unit in your answer.

frequency = ... unit .... [3]

(iii) Radio waves are used for radio transmissions.

State **one other** application of radio waves.

.... [1]

[Total: 8]

9 A spacecraft is on a journey to the planet Saturn.

(a) Fig. 9.1 shows a circuit for an electric motor used in the spacecraft.
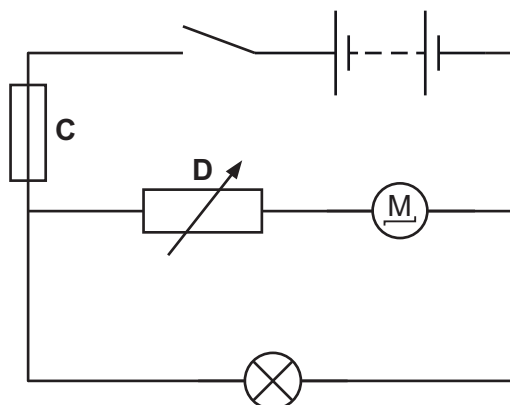
Fig. 9.1

(i) State the name and purpose of component **C**.

name ....

purpose ....

....
[2]

(ii) Describe how component **D** is used to control the current in the motor.

....

....

.... [2]

(iii) The voltage across the lamp is 6.3 V.

The current in the lamp is 0.45 A.

Calculate the resistance of the lamp.

resistance = ... Ω [2]

(b) Complete the sentences about the journey of the spacecraft.

The spacecraft travels directly from the Earth to the planet Saturn.

On the way to Saturn, the spacecraft first crosses the orbit of the

planet .... and then crosses the orbit of

the planet ....

[2]

(c) Explain why the planets orbit around the Sun.

....

....

....

.... [2]

[Total: 10]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	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 –

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 dm³ at room temperature and pressure (r.t.p.).