Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/22**

Paper 2 Theory **October/November 2025**

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 **16** pages.

[Turn over

1 Table 1.1 contains sentences about nuclear division and reproduction.

Place a tick (✓) by **three** correct sentences.

Table 1.1

sentence	tick if correct
A gamete is a haploid cell.	
Most human cells contain 23 pairs of genes.	
Chromosomes contain DNA (deoxyribonucleic acid).	
Genes carry the codes for enzymes.	
All chromosomes carry the same number of genes.	
A gamete is produced by mitosis.	

[3]

2 **(a)** State the percentage of oxygen gas, O_2, in clean, dry air.

..... [1]

(b) Potassium metal, K, reacts with oxygen to form potassium oxide, K_2O.

$$4K + O_2 \rightarrow 2K_2O$$

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

[A_r: K, 39; O, 16]

(i) Complete the following sentence.

7.8 g of potassium reacts with ..... g of oxygen. [1]

(ii) Describe the electrical conductivity of oxygen and of potassium oxide.

oxygen .....

.....

potassium oxide .....

.....

[2]

(iii) Potassium melts at 63.5 °C and boils at 759 °C.

Place a tick (✓) in the box next to the state of potassium at 810 °C.

Explain your choice.

solid ☐ liquid ☐ gas ☐

explanation .....

.....

[2]

[Total: 6]

3 The mass of a toy rocket is 0.12 kg.

(a) Calculate the weight of the toy rocket.

Gravitational field strength g = 10 N / kg.

weight = ... N [1]

(b) A student launches the rocket.

The rocket reaches a height of 100 m. It then falls back to the ground.

(i) State the acceleration of free fall.

acceleration of free fall = ... m/s^2 [1]

(ii) State the names of the **two** forces that act on the rocket as it falls.

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

(iii) The force acting to slow the rocket is negligible at low speeds.

Calculate the speed of the rocket when it has fallen for 2 seconds from rest.

speed = ... m / s [1]

[Total: 5]

4 Carbohydrates, fats and proteins are nutrients in food that are digested as the food passes along the digestive system from the mouth to the anus.

Fig. 4.1 shows the percentages of carbohydrates, fats and proteins which remain undigested in different parts of the digestive system.

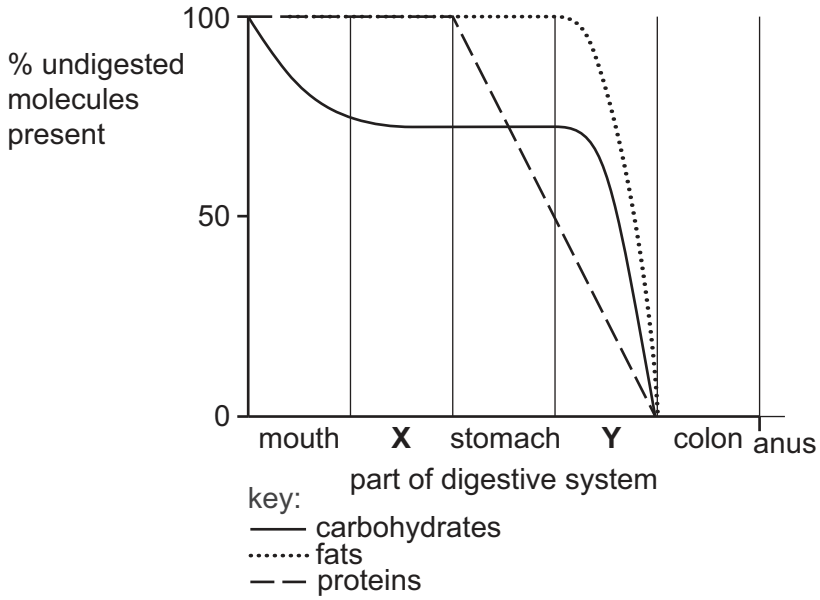

Fig. 4.1

(a) Name the parts of the digestive system labelled **X** and **Y** on Fig. 4.1.

X .....

Y .....

[2]

(b) **(i)** Use the information in Fig. 4.1 to name the nutrients that start being digested in the stomach.

..... [1]

(ii) Name the part of the digestive system where most of the digestion of carbohydrates takes place.

..... [1]

(iii) Explain why the digestion of carbohydrates is reduced in the stomach.

.....

..... [1]

(c) Describe what happens to the small nutrient molecules produced after the nutrients are digested.

.....

.....

..... [2]

[Total: 7]

5 **(a)** Hydrogen gas, H_2, can be produced by cracking icosane, $C_{20}H_{42}$.

(i) Balance the symbol equation for the reaction shown.

..... $C_{20}H_{42} \rightarrow$ ..... $C_{12}H_{24}$ + ... C_4H_8 + ... H_2

[1]

(ii) State two conditions for cracking.

condition 1 .....

condition 2 .....

[2]

(iii) State a use for hydrogen gas.

..... [1]

(b) Ethane and ethene can also be produced by the cracking of icosane.

Describe **one** similarity and **one** difference in the bonding in ethane and ethene.

similarity .....

.....

difference .....

.....

[2]

[Total: 6]

6 Fig. 6.1 shows apparatus used to determine the density of a liquid.

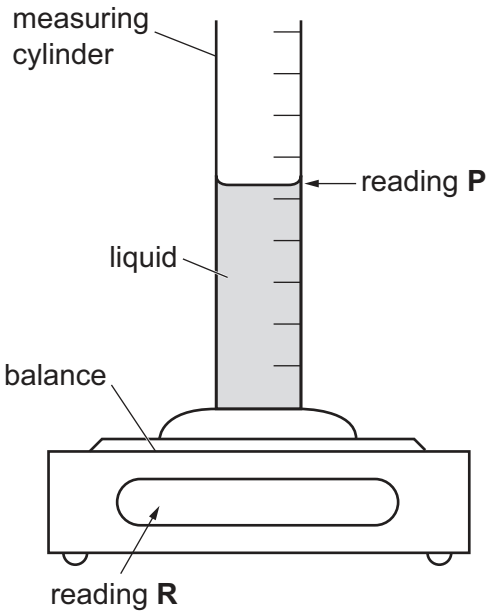

Fig. 6.1

(a) Reading **P** is 54 cm^3.

Reading **R** is 49 g.

Calculate the density of the liquid.

Give your answer to 2 significant figures and state the unit.

density = ... unit ..... [3]

(b) A small stone falls through the liquid in the measuring cylinder before coming to rest on the bottom.

Explain why work is done by the stone as it falls through the liquid.

.....

.....

..... [2]

[Total: 5]

7 Plants use photosynthesis to produce glucose.

(a) Write the balanced chemical equation for photosynthesis by completing the blanks under the word equation.

water + carbon dioxide ⟶ oxygen + glucose

..... + ... ⟶ ..... + ...

[2]

(b) Describe the role of chlorophyll in the process of photosynthesis.

.....

..... [2]

(c) Plants use some of the glucose made in photosynthesis as a source of energy and convert the rest of the glucose into other carbohydrates.

Complete Table 7.1 by stating the functions of these other carbohydrates.

Table 7.1

name of carbohydrate made from glucose	function of carbohydrate
cellulose	....
starch	....
sucrose	....

[3]

[Total: 7]

8 Table 8.1 shows five different chemical equations, labelled **V**, **W**, **X**, **Y** and **Z**.

Table 8.1

process	chemical equation
V	$2NaI + Cl_2 \rightarrow 2NaCl + I_2$
W	$2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$
X	$KBr(aq) + AgNO_3(aq) \rightarrow AgBr(s) + KNO_3(aq)$
Y	$CH_4(l) \rightarrow CH_4(s)$
Z	ethene $\rightarrow$ poly(ethene)

State which equation, **V**, **W**, **X**, **Y** or **Z**, is an example of the type of change described in parts **(a)** to **(e)**.

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

(a) a physical change

..... [1]

(b) a displacement reaction

..... [1]

(c) polymerisation

..... [1]

(d) a test for bromide ions

..... [1]

(e) incomplete combustion

..... [1]

[Total: 5]

9 **(a)** Describe how useful energy may be obtained from geothermal sources.

.....

.....

.....

..... [3]

(b) Describe **one** advantage of using geothermal sources to produce useful energy.

.....

..... [1]

[Total: 4]

10 The boxes on the left contain the names of components of blood.

The boxes on the right contain functions of components of blood.

Draw **one** straight line from each component to its function.

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

component	function
lymphocytes	to transport nutrients
platelets	to engulf pathogens
phagocytes	to help blood form a clot
plasma	to produce antibodies

Fig. 10.1

[3]

11 Aluminium is a metal.

(a) **(i)** Complete Fig. 11.1 by drawing the arrangement of **nine** atoms in solid aluminium in the box provided. One atom has been drawn for you.

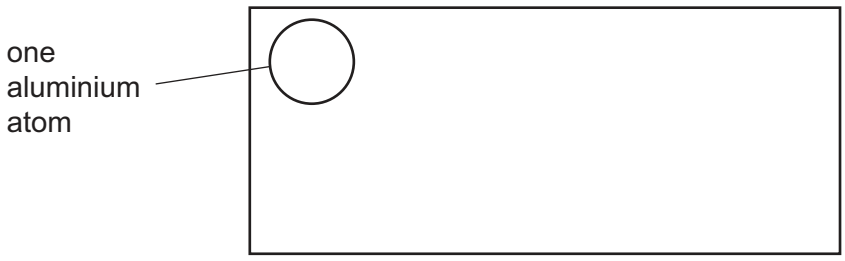

Fig. 11.1

[1]

(ii) Describe the motion of aluminium atoms in solid aluminium.

.....

..... [1]

(b) Aluminium is used in electrical cables because it is a good conductor of electricity.

(i) State **one** other use of aluminium.

..... [1]

(ii) State **two** other general properties of metals.

property 1 .....

property 2 .....

[2]

[Total: 5]

12 A small electric motor is connected in series with a resistor and a power supply as shown in Fig. 12.1.

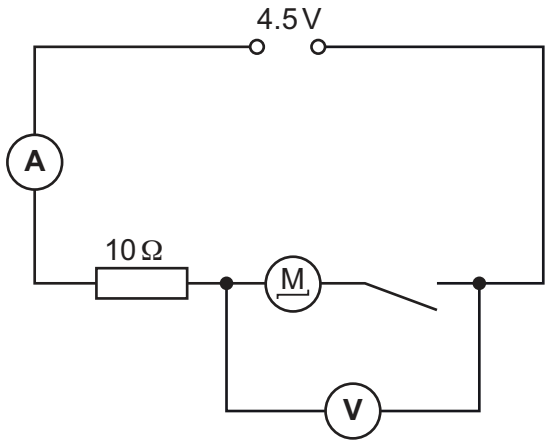

Fig. 12.1

(a) When the switch is closed, the reading on the voltmeter is 3.3 V and the reading on the ammeter is 0.12 A.

(i) Calculate the input power *P* to the motor.

P = ... W [1]

(ii) Show that the potential difference across the 10 Ω resistor is 1.2 V.

[1]

(iii) Show that the resistance in the motor and the resistance of the resistor have a combined total resistance of approximately 38 Ω.

[3]

(b) An electric current that is too large will damage the motor.

State the name of a component that switches off the current in the circuit when it becomes too large.

..... [1]

[Total: 6]

13 Fig. 13.1 shows a cross-section through a human heart.

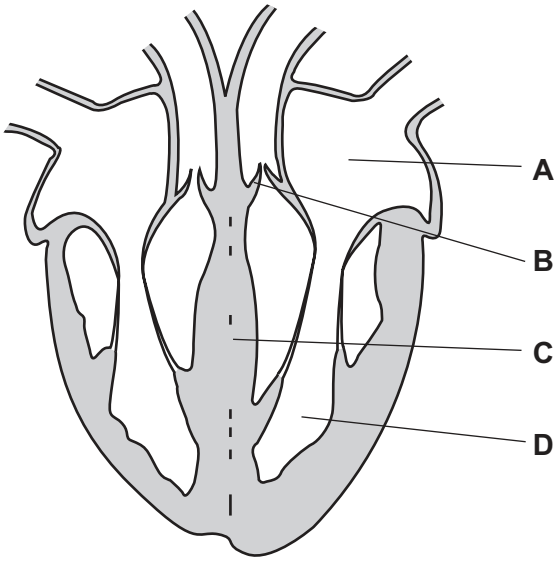

Fig. 13.1

(a) Complete Table 13.1 by inserting the names of the structures labelled **A**, **B**, **C** and **D** in Fig. 13.1.

Table 13.1

letter of structure in Fig. 13.1	name of structure
A	.....
B	.....
C	.....
D	.....

[4]

(b) By referring to the structures labelled **A**, **B**, and **D** on Fig 13.1, state **three** events which occur in the heart during one heartbeat.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 7]

14 A counter records the count rate of a radioactive source.

Fig. 14.1 shows the graph drawn from the results.

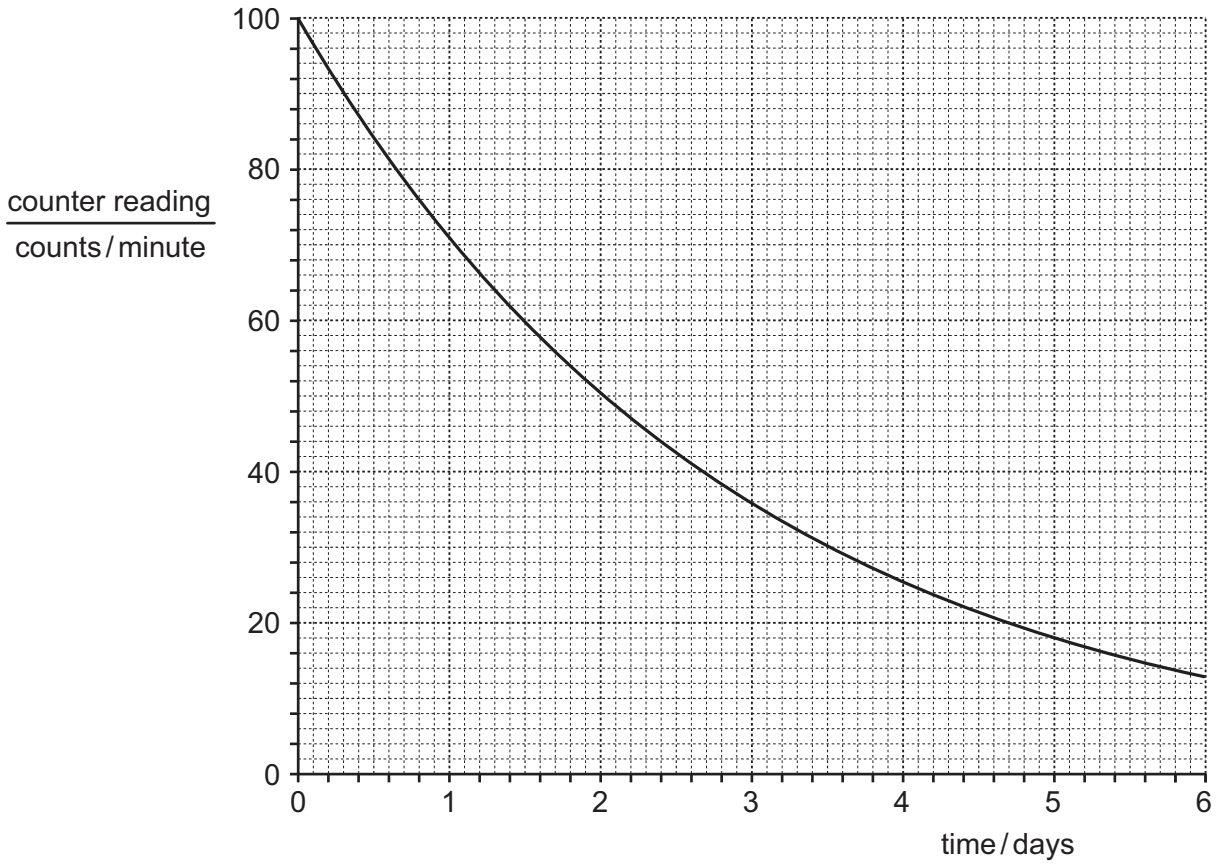

Fig. 14.1

(a) The time taken for the counter reading to halve is the half-life.

On Fig. 14.1, draw **one** horizontal line and **one** vertical line to show how the half-life of the radioactive source can be determined.

Record the value of the half-life determined using the lines that you have drawn.

half-life = ... days [2]

(b) Radioactive sources are used in smoke alarms.

State **two** other uses of radioactive sources.

1 .....

2 .....

[2]

(c) Describe **two** precautions for the safe handling of radioactive sources.

1 .....

.....

2 .....

.....

[2]

[Total: 6]

15 Magnesium carbonate is an insoluble solid.

A student reacts magnesium carbonate with an acid to form soluble magnesium sulfate.

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

magnesium carbonate + ... acid → magnesium sulfate + ... + water

.....

[2]

(ii) The student uses an excess of magnesium carbonate to ensure that all the acid reacts.

Describe how the student makes a pure, dry sample of the magnesium sulfate from the reaction mixture.

.....

.....

..... [2]

(b) State **one** way in which the rate of the reaction between magnesium carbonate and the acid can be decreased.

..... [1]

[Total: 5]

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.).