Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **October/November 2024**

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.

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 (WW/SG) 338204/5

[Turn over

1 **(a)** Fig. 1.1 shows sections through two different flowers, **X** and **Y**.

flower **X** flower **Y**

Fig. 1.1

(i) Draw a label line with the letter **A** to identify the anther on flower **X** in Fig. 1.1. [1]

(ii) The flowers have structural adaptations for pollination by different types of agent.

Identify the type of pollination agent for flower **Y**.

Give **one** reason for your answer using evidence from Fig. 1.1.

pollination agent .....

reason .....

.....

[2]

(b) The leaves of plants have different types of cell with different functions.

Complete the sentences about leaves.

- Between the upper epidermis and the spongy mesophyll layers, there is a layer of cells called the ..... mesophyll.
- The mesophyll cells in this layer are adapted for photosynthesis because they contain large numbers of ..... .
- Sugars produced in the leaf are transported to other parts of the plant in ..... vessels.

[3]

(c) Plants are producers in food chains.

(i) Circle **two** of the words in **bold** to give the correct definition of producers.

Producers are organisms that make their own **organic / trophic** nutrients,

usually using **energy / food** from sunlight, through the process of photosynthesis.

[1]

(ii) Circle the type of consumer that feeds on a producer in a food chain.

primary **quaternary** **secondary** **tertiary**

[1]

(d) Plants growing in lakes and ponds are sometimes affected by eutrophication.

Tick (✓) **two** boxes to identify correct descriptions of two parts of the process of eutrophication.

increased aerobic respiration by decomposers in the water	☐
decreased availability of nitrates in the water	☐
increased decomposition of dead producers in the water	☐
increased aerobic respiration by plants	☐
increased concentration of dissolved oxygen in the water	☐

[2]

[Total: 10]

2 Lithium, sodium, potassium and rubidium are elements in Group I of the Periodic Table.

(a) Group I elements react with water.

(i) State the names of the **two** products formed when rubidium reacts with water.

1 .....

2 .....

[2]

(ii) Describe how the reaction of rubidium with water is different from the reaction of lithium with water.

.....

..... [1]

(iii) State the flame test colour for lithium.

..... [1]

(b) A sodium ion, Na^+, has a proton number of 11 and a nucleon number of 23.

Complete Table 2.1 to show the number of protons, neutrons and electrons in this ion.

Table 2.1

	number of protons	number of neutrons	number of electrons
Na^+ ion			

[3]

(c) The melting points and densities of lithium and potassium are shown in Table 2.2.

Table 2.2

element	melting point / °C	density in g / cm^3
lithium	181	0.53
potassium	63	0.86

Predict whether the statements are true or false.

Tick (✓) **one** box for each statement.

	true	**false**
Sodium is a liquid at room temperature.	☐	☐
Rubidium is more dense than potassium.	☐	☐
The density of sodium is less than 0.50 g / cm^3.	☐	☐
The melting point of rubidium is 70 °C.	☐	☐

[2]

(d) Sodium chloride is an ionic compound.

Describe the lattice structure of sodium chloride.

.....

.....

..... [2]

[Total: 11]

3 Fig. 3.1 shows an electric car with solar cells on its roof.

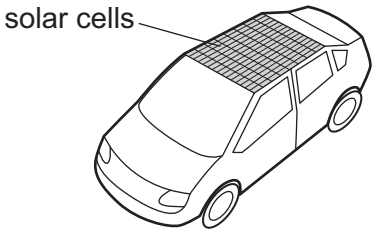

Fig. 3.1

(a) Complete the sentences about energy transfer.

The solar cells absorb light from the Sun. The solar cells charge the car battery.

Energy is stored in the car battery as ..... energy.

[1]

(b) Fig. 3.2 shows a speed–time graph for the motion of the car on a journey.

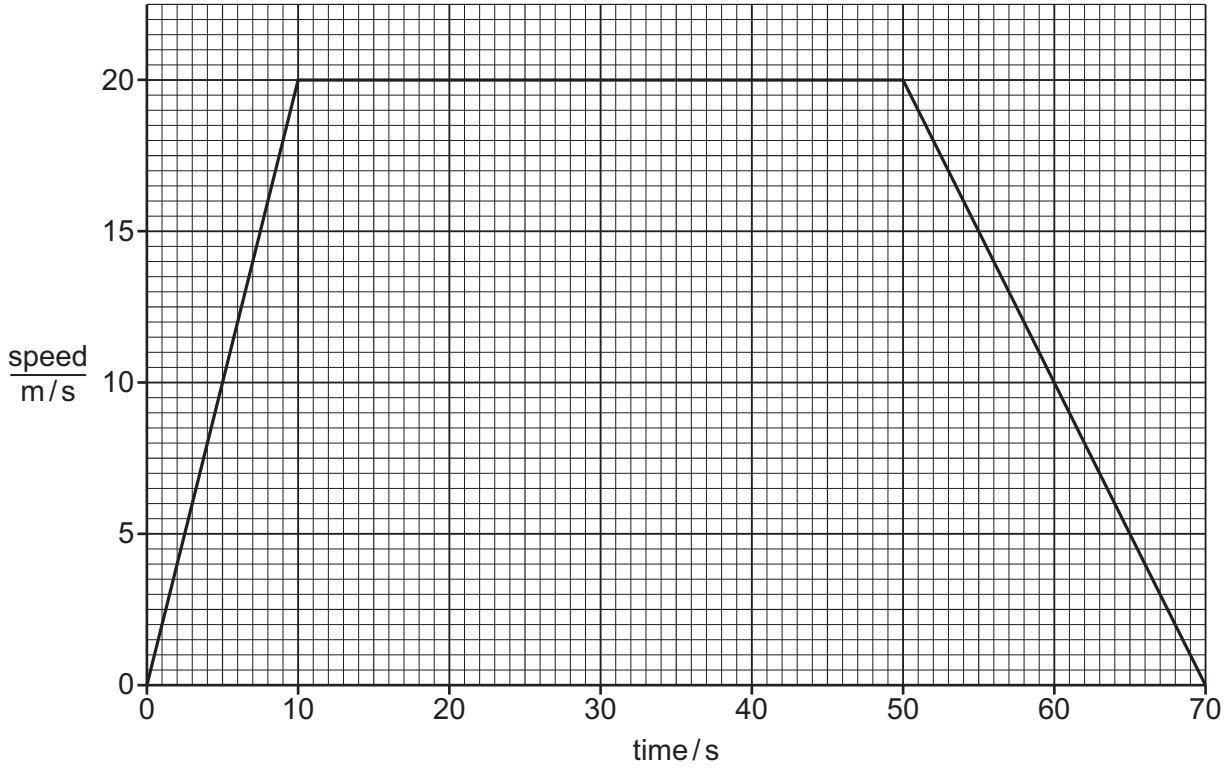

Fig. 3.2

(i) Use Fig. 3.2 to calculate the acceleration of the car during the first 10 s.

acceleration = ... m/s^2 [2]

(ii) Calculate the total distance, in kilometres, travelled by the car on the journey.

distance = ... km [3]

(iii) The mass of the car is 1200 kg.

Calculate the kinetic energy of the car at maximum speed.

kinetic energy = ... J [3]

[Total: 9]

4 **(a)** Fig. 4.1 shows drawings of three different blood vessels, **W**, **X** and **Y**.

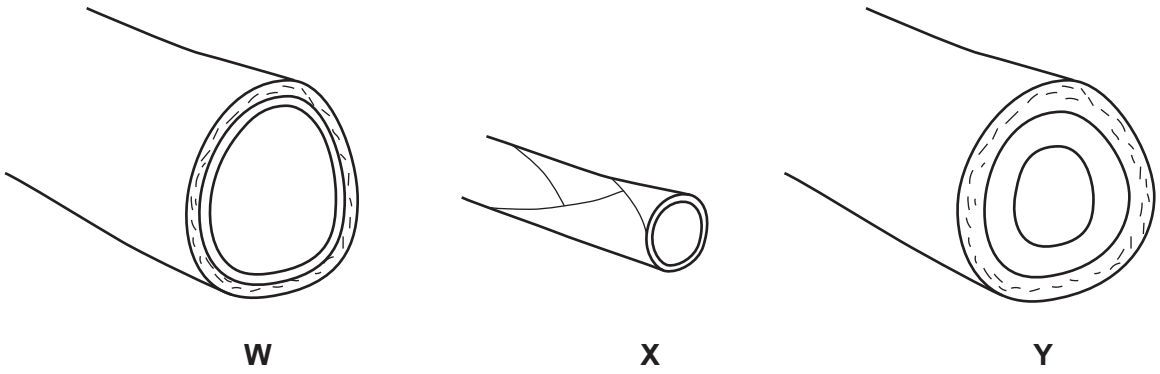

Fig. 4.1

Each blood vessel in Fig. 4.1 has an adaptation for a particular function.

Draw **one** straight line from each blood vessel to its adaptation and **one** straight line from each adaptation to its function.

blood vessel	**adaptation**	**function**
W	thick elastic walls	for diffusion of materials
X	permeable walls	to withstand high blood pressure
Y	large lumen	to reduce resistance to blood flow

[3]

(b) (i) Describe coronary heart disease.

.....

.....

..... [2]

(ii) A scientist records the number of people that die from coronary heart disease in one country in one year.

Table 4.1 shows the results.

Table 4.1

population of country	number of people that die from coronary heart disease
329 million	659 000

Calculate the percentage of the population that die from coronary heart disease.

percentage of population = ... % [2]

(iii) Smoking is a risk factor for coronary heart disease.

State **two** types of disease of the **gas exchange system** caused by smoking.

1 .....

2 .....
[2]

[Total: 9]

5 **(a)** State the names of **two** elements that are used to make inert electrodes for electrolysis.

1 .....

2 .....

[2]

(b) Concentrated aqueous sodium chloride is electrolysed using inert electrodes, as shown in Fig. 5.1.

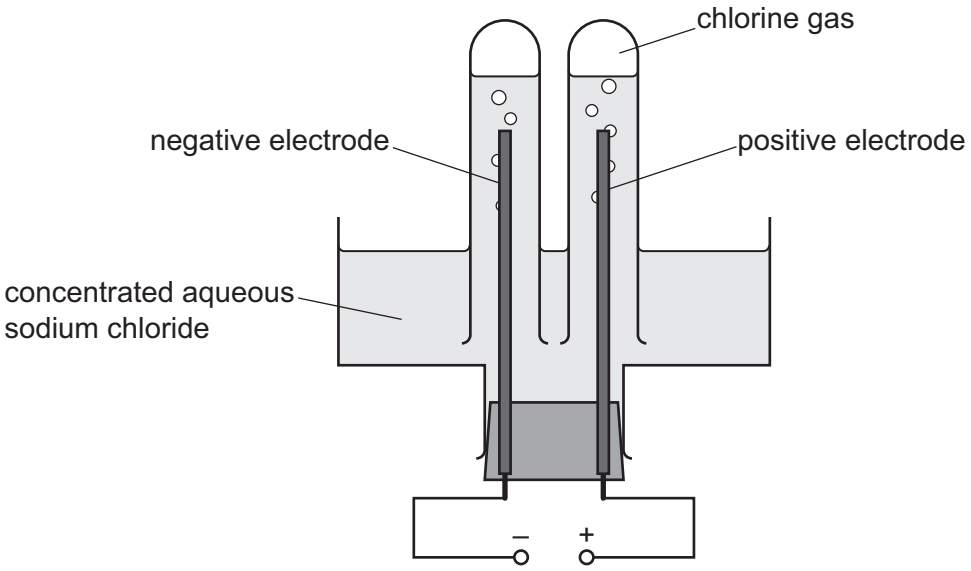

Fig. 5.1

(i) State the name of the gas that forms at the negative electrode.

..... [1]

(ii) Complete the ionic equation for the reaction at the positive electrode.

$2Cl^- \rightarrow$ ..... + ...

[2]

(c) Molten sodium chloride is also electrolysed using inert electrodes.

State the names of the **two** products formed when **molten** sodium chloride is electrolysed.

1 .....

2 .....

[2]

[Total: 7]

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6 **(a)** Fig. 6.1 shows a circuit with two resistors, **X** and **Y**, connected in series.

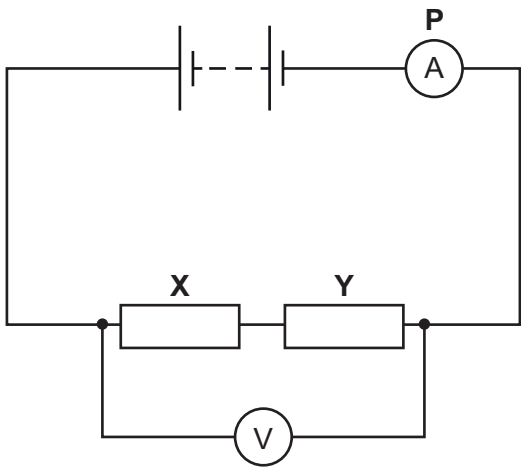

Fig. 6.1

Resistor **X** has a resistance of 18 Ω.

Resistor **Y** has a resistance of 15 Ω.

The reading on ammeter **P** is 0.20 A.

(i) Determine the reading on the voltmeter.

reading = ... V [3]

(ii) Determine the time taken for the battery to supply 330 J of energy.

time = ... s [2]

(b) Fig. 6.2 shows a circuit with two different resistors, **F** and **G**, connected in parallel.

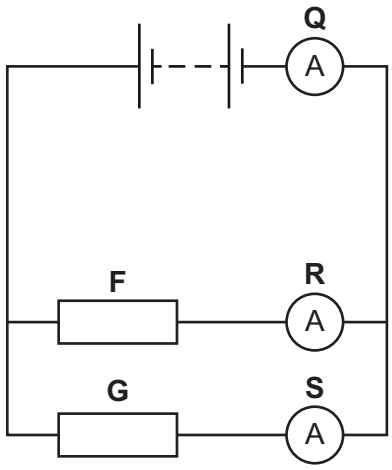

Fig. 6.2

(i) The reading on ammeter **Q** is 1.05A.

The reading on ammeter **R** is 0.41A.

Determine the reading on ammeter **S**.

reading = ... A [1]

(ii) Resistor **F** has a resistance of 51Ω.

Resistor **G** has a resistance of 33Ω.

Calculate the combined resistance of resistors **F** and **G** in parallel.

resistance = ... Ω [2]

[Total: 8]

7 **(a)** Fig. 7.1a shows a model of an enzyme.

Fig. 7.1b shows four possible substrates, **A**–**D**, for this enzyme.

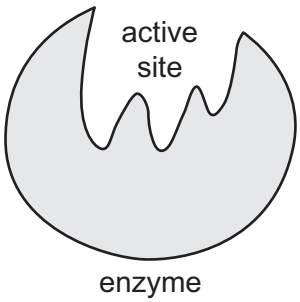

Fig. 7.1a

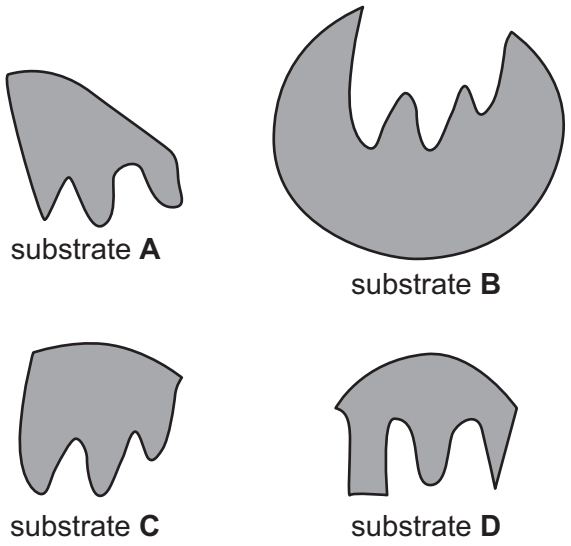

Fig. 7.1b

Identify which substrate, **A**–**D**, is the substrate for the enzyme shown in Fig. 7.1a.

Give a reason for your answer.

substrate .....

reason .....

.....

[2]

(b) A protease is an enzyme that breaks down proteins.

(i) State the name of the solution used to test for the presence of protein.

..... [1]

(ii) Explain how the protein requirement of a woman changes during pregnancy.

.....

.....

..... [2]

(iii) The small intestine has a pH range of 6.0 to 7.4.

Explain why the protease in gastric juice stops working when it reaches the small intestine.

.....

.....

.....

..... [3]

[Total: 8]

8 Carbon dioxide is a gas in air.

(a) Dilute hydrochloric acid reacts with calcium carbonate to form carbon dioxide.

State the names of the **two** other products formed when dilute hydrochloric acid reacts with calcium carbonate.

1 .....

2 .....

[2]

(b) Carbon dioxide is made from calcium carbonate by thermal decomposition.

Describe the thermal decomposition of calcium carbonate.

.....

.....

..... [2]

(c) Carbon dioxide is also formed in the blast furnace by the combustion of carbon.

Complete the balanced equation for one **other** reaction in the blast furnace that produces carbon dioxide.

..... + ... → ..... + $3CO_2$

[2]

(d) Carbon dioxide is a greenhouse gas.

(i) State the name of **one** other greenhouse gas.

..... [1]

(ii) Suggest why scientists are concerned about the **enhanced** greenhouse effect.

.....

..... [1]

[Total: 8]

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9 Fig. 9.1 shows a candle made of wax.

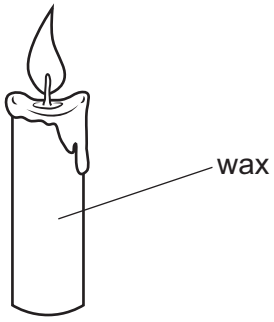

Fig. 9.1

(a) A thin converging lens is used to focus light from the candle.

Fig. 9.2 shows three rays of light incident on the lens.

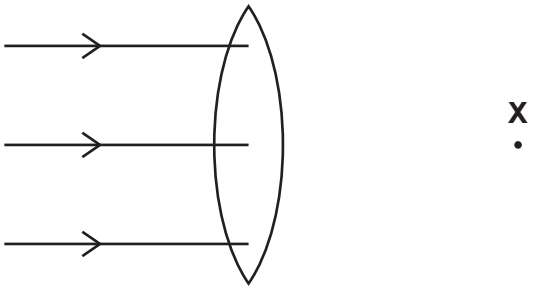

Fig. 9.2

(i) Complete the ray diagram to show how the rays are focused at point **X**. [1]

(ii) State the name of point **X**.

..... [1]

(b) The candle is made of solid wax of density 920 kg / m^3.

The wax has a mass of 0.23 kg.

Calculate the volume of the wax.

volume = ... m^3 [2]

(c) Some of the candle wax melts.

Describe the differences between solid wax and liquid wax in terms of:

- the forces between the wax molecules
- the motion of the wax molecules.

.....

.....

.....

.....

..... [3]

(d) Fig. 9.3 shows liquid wax being heated in a beaker.

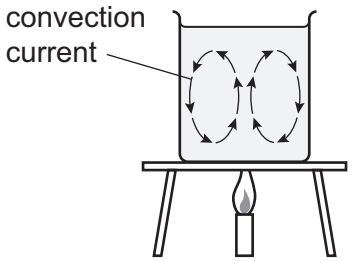

Fig. 9.3

Fig. 9.3 shows convection currents in the liquid wax.

Explain why density changes in the liquid wax cause the convection currents shown.

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

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.).