Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/21**

Paper 2 Theory **May/June 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 **20** pages. Any blank pages are indicated.

[Turn over

1 **(a)** Use words from the list to complete the definition of transpiration.

cuticle **descent** **diffusion** **evaporation**

mesophyll **osmosis** **stomata** **xylem**

Transpiration is the loss of water vapour from leaves by ..... of water from the surface of ..... cells into the air spaces in the leaf and then the ..... of water vapour out of the leaf through the ..... . [4]

(b) A student investigates the rates of transpiration in two species of plants, species **X** and species **Y**.

The student investigates their rates of transpiration at 15 °C and at 25 °C.

The plants are the same size.

The results are shown in Fig. 1.1.

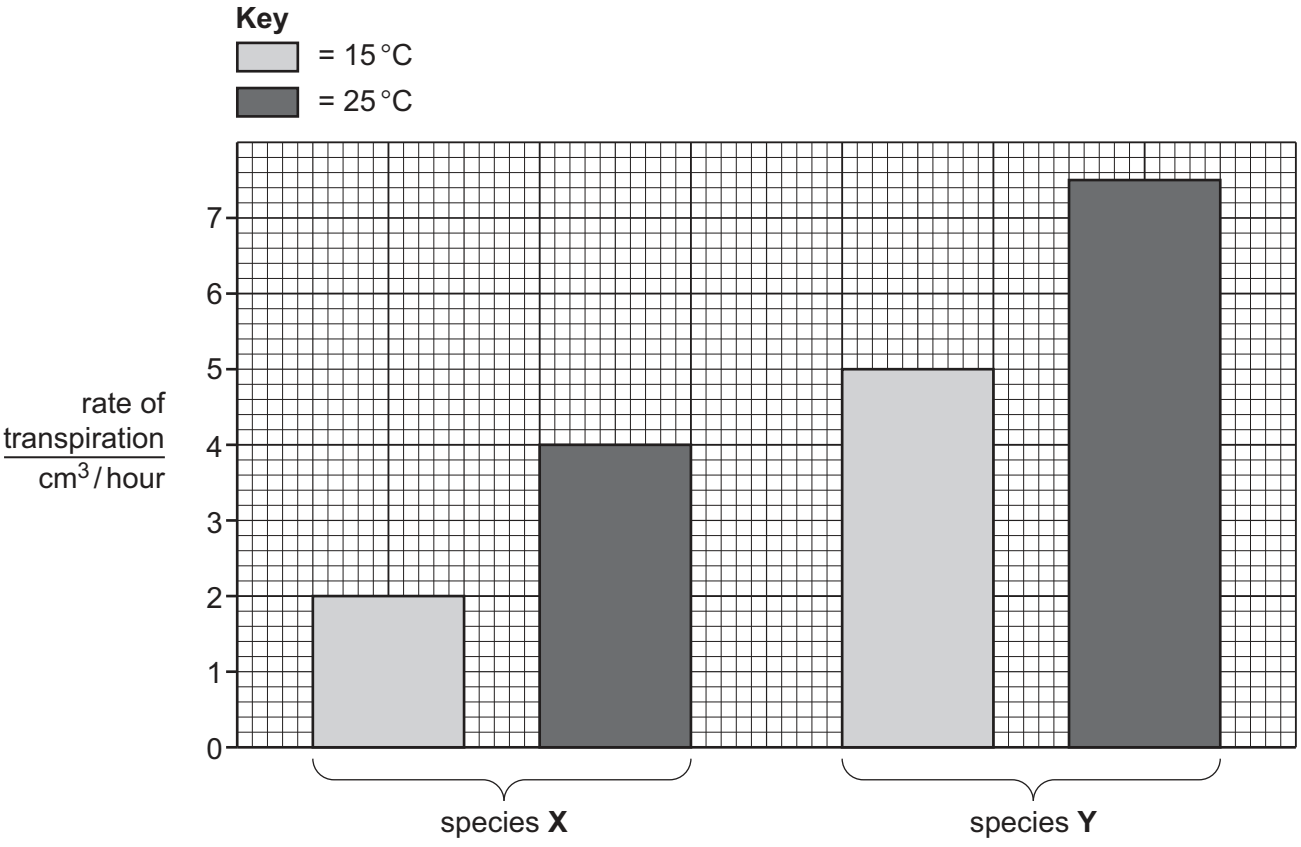


Fig. 1.1

Using data from the graph shown in Fig. 1.1, compare the rates of transpiration for species **X** with the rates of transpiration for species **Y**.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

2 **(a)** Table 2.1 lists the melting points of some Group I elements going down the group.

Table 2.1

element	melting point / °C
lithium	181
sodium	98
potassium	.....
rubidium	39
caesium	28

Suggest a value for the melting point of potassium.

melting point of potassium = ... °C [1]

(b) When potassium, K, reacts with water, potassium hydroxide, KOH, and hydrogen are formed.

$$2K + 2H_2O \rightarrow 2KOH + H_2$$

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

[A_r: H, 1; O, 16; K, 39]

Calculate the mass of water that reacts with 3.9 g of potassium.

mass = ... g [1]

(c) State the name of the gas produced when lithium reacts with water.

..... [1]

(d) Aluminium is a reactive metal but does not appear to react with water.

Explain why.

.....

..... [1]

[Total: 4]

3 The winner of a running race has the highest average speed for the race.

(a) (i) Define speed.

.....

..... [1]

(ii) In 1998, an athlete ran 1500 m in 3 minutes and 26 seconds.

Calculate the average speed of the athlete.

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

average speed = ... unit ..... [3]

(b) Fig. 3.1 shows the speed of the athlete at different times during the race.

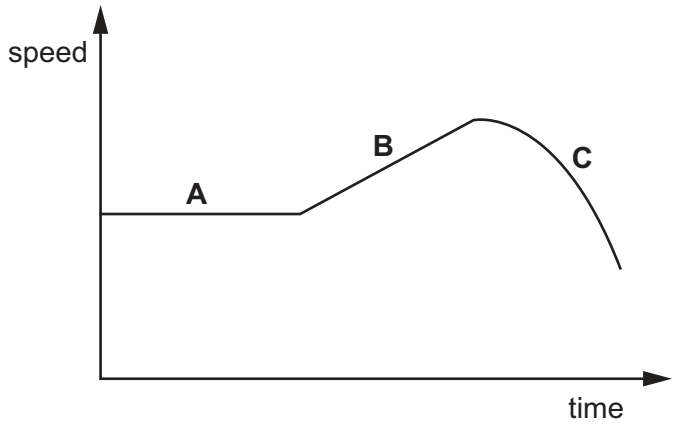


Fig. 3.1

Describe the motion of the athlete at time **A**, time **B** and time **C**.

time **A** .....

time **B** .....

time **C** .....

[2]

[Total: 6]

4 On Fig. 4.1, draw **three** lines from the box on the left to three different boxes on the right to make three correct sentences about enzymes.

Enzymes in the human body …	… are biological catalysts.
	… are denatured at 37 °C.
	… are proteins.
	… always change shape after reacting with a substrate.
	… act on specific substrates.
	… act only inside the cells which produce them.

Fig. 4.1

[3]

5 Aqueous silver nitrate, $AgNO_3$, is used to test for the presence of halide ions.

When a sample of aqueous silver nitrate is added to an aqueous solution of sodium bromide, NaBr, the following reaction takes place:

$$AgNO_3\,(aq) + NaBr\,(aq) \rightarrow AgBr\,(s) + NaNO_3\,(aq)$$

(a) Explain how the equation shows that this is a precipitation reaction.

.....

..... [1]

(b) **(i)** State the name of the method used to separate solid silver bromide, AgBr, from the reaction mixture.

..... [1]

(ii) Describe how the sample of silver bromide is purified.

.....

..... [1]

(c) 2 g of silver nitrate is dissolved in 200 cm^3 of distilled water.

Calculate the concentration of the solution.

[1 dm^3 = 1000 cm^3]

concentration = ...g / dm^3 [1]

(d) The formula of silver bromide is AgBr.

Suggest the formula of silver chloride.

..... [1]

[Total: 5]

6 A rubber block is pulled along a bench.

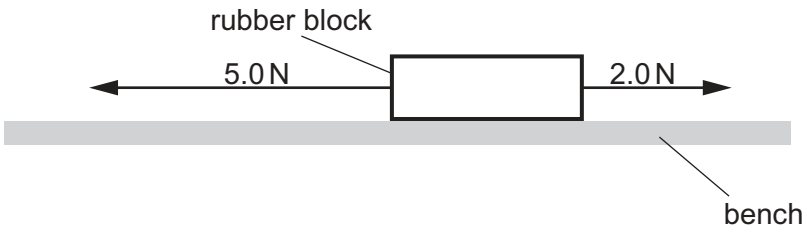


Fig. 6.1

A force of 2.0 N acts towards the right.

A force of 5.0 N acts towards the left.

(a) Complete the sentence.

The resultant force is ..... N towards the ..... . [1]

(b) **(i)** The resultant force causes the block to accelerate.

The mass of the block is 0.9 kg.

Calculate the acceleration of the block.

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

(ii) The rubber block is elastic.

Describe **two** other possible effects on the rubber block of the forces shown in Fig. 6.1.

1 .....

2 .....

[2]

[Total: 5]

7 The boxes on the left contain the names of specialised human cells.

The boxes on the right each contain a cell function.

Complete Fig. 7.1 by drawing **five** straight lines to link five of the specialised cells to their function.

specialised cell	cell function
red blood cell	
motor neurone	allows rapid diffusion of gases
lymphocyte	engulfs pathogens
platelet	causes blood clotting
phagocyte	passes nerve impulse to a muscle
cell in the wall of an alveolus	transports oxygen
relay neurone	

Fig. 7.1

[5]

8 Petroleum is a mixture of different hydrocarbons.

Complete the sentences about petroleum.

Petroleum is separated into useful fractions by ..... .

Refinery gas is a fraction used in homes for ..... .

The complete combustion of refinery gas forms water and ..... .

The flammability of refinery gas is ..... the flammability of kerosene.

[4]

9 Fig. 9.1 shows how a builder uses a steel rod to lift a heavy concrete block.

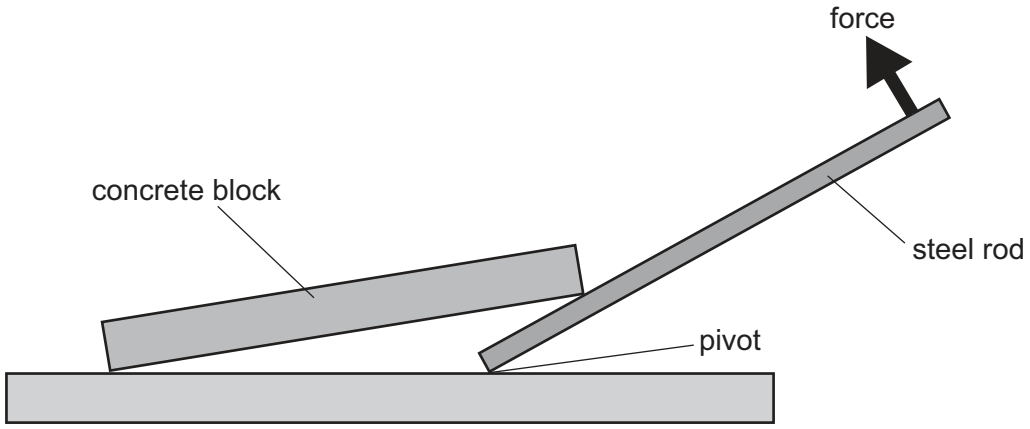


Fig. 9.1

The bottom end of the steel rod acts as a pivot.

(a) Explain why this method makes it easier for the builder to lift the concrete block.

Use ideas about moments in your answer.

.....

.....

..... [2]

(b) The builder applies a force of 40 N at the top end of the rod in the direction of the arrow.

Calculate the work done moving the top end of the rod a distance of 2.0×10^{-2} m.

work done = ... J [2]

[Total: 4]

10 Fig. 10.1 shows the female reproductive system.

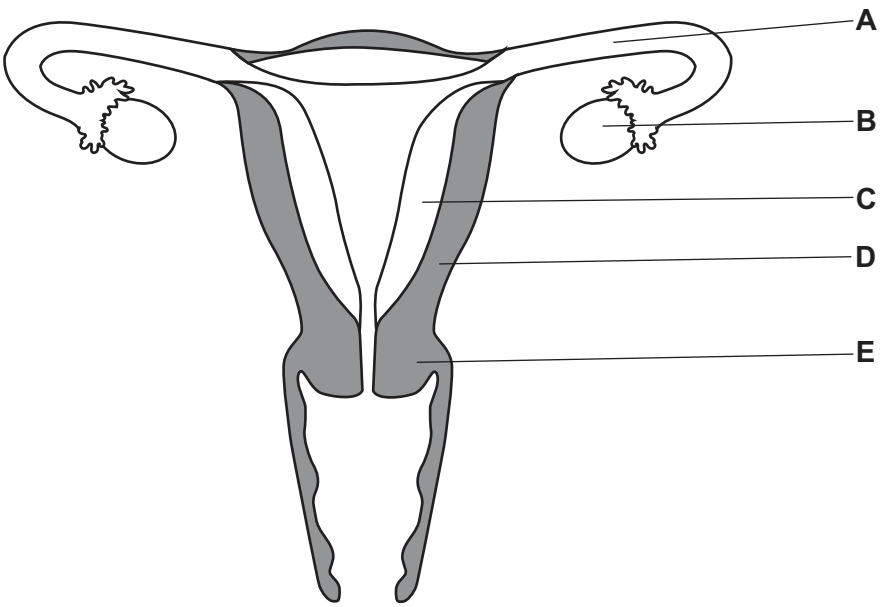


Fig. 10.1

(a) Draw an **X** on Fig. 10.1 to show where sperm are deposited during sexual intercourse. [1]

(b) State the name of structure **C** on Fig. 10.1.

..... [1]

(c) Table 10.1 gives some names and some functions of structures **A**, **B**, **D** and **E** in Fig. 10.1.

Complete Table 10.1 by adding the names of **A** and **B**, **one** function of **D** and **one** function of **E**.

Table 10.1

letter from Fig. 10.1	name of structure	one function of structure
A	.....	transfers egg cells to the uterus
B	.....	produces egg cells
D	uterus wall	....
E	cervix	....

[4]

[Total: 6]

11 **(a)** Fig. 11.1 shows the electronic configuration of an atom of an element.

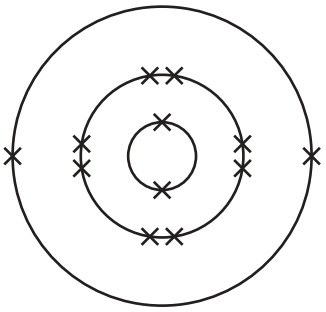


Fig. 11.1

(i) Deduce the group number and period number of the element shown in Fig. 11.1.

group number .....

period number .....

[2]

(ii) Describe how the electronic configuration changes when the atom of the element forms a +2 ion.

.....

..... [2]

(b) State the word used for a positive ion.

..... [1]

[Total: 5]

12 Natural gas is a fossil fuel.

(a) State the energy store in natural gas.

..... [1]

(b) **(i)** A metal tube is heated using natural gas so that it can be joined to a cold metal shaft.

The hot metal tube has an internal diameter *d* and the cold metal shaft has a diameter *D* as shown in Fig. 12.1.

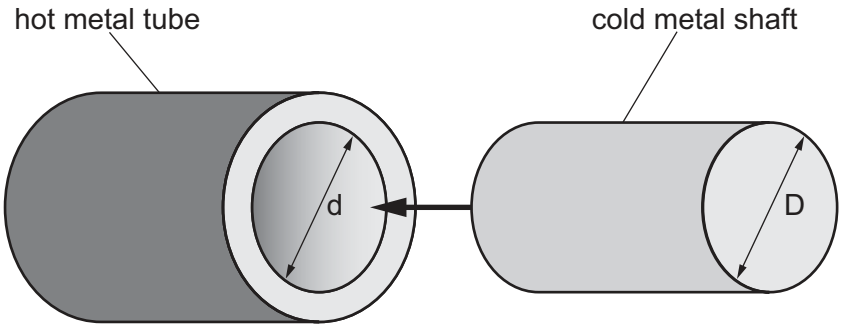


Fig. 12.1

The cold metal shaft is placed inside the hot metal tube and the hot metal tube is then allowed to cool.

Describe how this process eventually causes the metal shaft to become strongly joined to the metal tube.

.....

.....

..... [2]

(ii) The metal tube has a black outer surface.

Explain how the black outer surface makes the process of joining the metal shaft to the metal tube take less time.

.....

..... [2]

[Total: 5]

13 **(a)** Describe the role of a decomposer.

.....

..... [1]

(b) Outline **two** consequences of deforestation and explain how each one arises after deforestation has occurred.

consequence 1 .....

.....

explanation .....

.....

.....

consequence 2 .....

.....

explanation .....

.....

.....

[4]

(c) State **one** way other than deforestation in which human activity harms ecosystems.

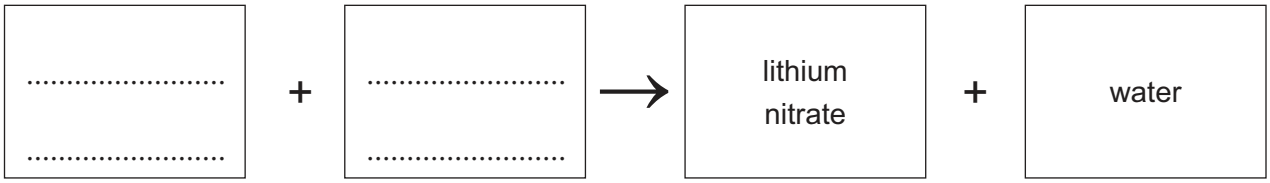
.....

..... [1]

[Total: 6]

14 A neutralisation reaction produces lithium nitrate, water and no other product.

(a) Complete the word equation for the reaction.



[2]

(b) The reaction is exothermic.

State the meaning of 'exothermic'.

..... [1]

(c) Explain why the reaction is **not** a physical change.

.....

..... [1]

[Total: 4]

15 **(a)** The boxes on the left in Fig. 15.1 contain words used when measuring or describing waves.

The boxes on the right contain definitions of the words.

Draw **one** straight line from each word to its definition.

word	definition
amplitude	a line drawn at a right angle to a surface
incidence	the maximum distance from the mean position
normal	an angle at which a ray of light meets a surface

Fig. 15.1

[2]

(b) Radio waves and microwaves are both used in communications.

(i) State **two** other similarities between radio waves and microwaves.

1 .....

2 .....

[2]

(ii) Describe **one** difference between radio waves and microwaves.

..... [1]

(c) Light is also used in communications. Rays of light are carried by optical fibres made from glass.

The speed of light in glass is 2.0×10^8 m/s.

Show that, in glass, light travels a distance of 90 km in a time of 450 μs.

[1]

[Total: 6]

16 Fig. 16.1 shows a chromatogram of five substances **A**, **B**, **C**, **D** and **E**.

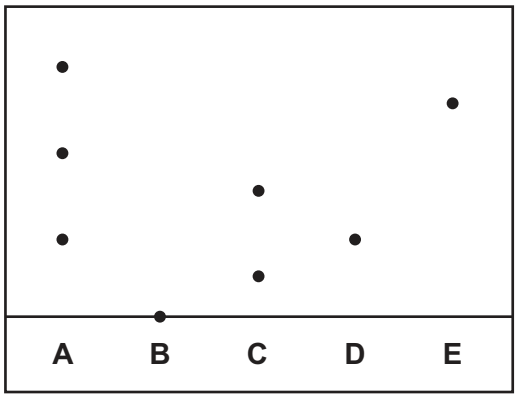


Fig. 16.1

(a) Use the chromatogram to deduce which of the substances **A**, **B**, **C**, **D** or **E**, are:

(i) impure

substances ..... and ..... [1]

(ii) insoluble in the solvent used.

substance ..... [1]

(b) Air is a mixture of gases.

(i) State the name of the element that makes up 78% of clean, dry air.

..... [1]

(ii) Carbon dioxide, CO_2, is present in air.

Explain why carbon dioxide is a gas at room temperature and pressure.

.....

..... [1]

(iii) A gas can be condensed by lowering the temperature.

Describe **one** other way of condensing a gas.

.....

..... [1]

[Total: 5]

BLANK PAGE

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.).