Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **5129/22**

Paper 2 Theory **October/November 2023**

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 man throws a ball.

The ball follows the path shown in Fig. 1.1.

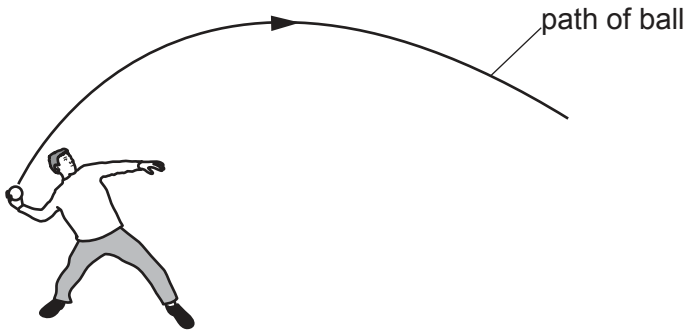

Fig. 1.1

(a) The man wants to calculate the speed of the ball.

Explain what is meant by the speed of the ball.

.....

..... [2]

(b) The speed of the ball is as fast as a car.

Suggest a suitable value for the speed of the ball and include the unit in your answer.

value for speed = ... unit ..... [1]

[Total: 3]

2 **(a)** Table 2.1 contains names and functions of some cells found in blood.

Complete Table 2.1 by inserting the missing information.

Table 2.1

name of cell	function of cell
red blood cell	.....
lymphocyte	.....
.....	engulfs pathogens
.....	clots blood

[4]

(b) Fig. 2.1 shows the liver and its blood vessels.

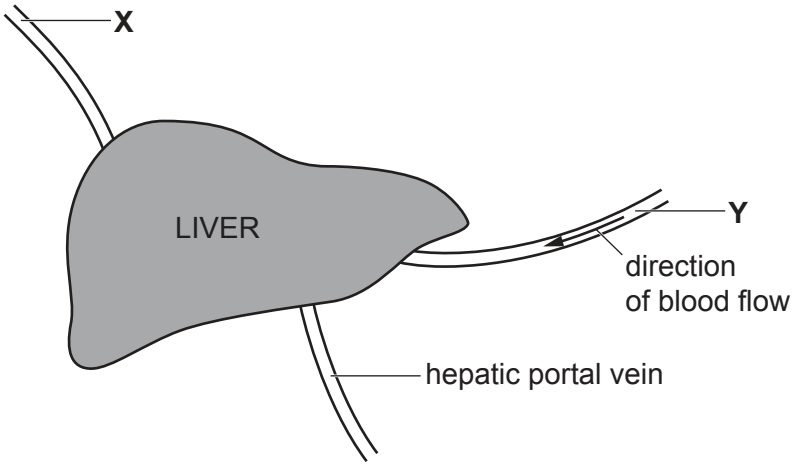

Fig. 2.1

(i) State the names of the blood vessels labelled **X** and **Y** on Fig. 2.1.

X .....

Y .....

[2]

(ii) Draw arrows on blood vessel **X** and the hepatic portal vein in Fig. 2.1 to show the direction of blood flow. [1]

[Total: 7]

3 Methanol, CH_3OH, is produced in a reaction between carbon monoxide and hydrogen.

The equation for the reaction is:

$$CO + 2H_2 \rightarrow CH_3OH$$

[A_r: C, 12; H, 1; O, 16]

(a) (i) Calculate the relative molecular mass M_r of methanol.

M_r = ... [1]

(ii) Complete the following sentences.

..... g of carbon monoxide produces 160 g of methanol.

..... g of hydrogen produces 6.4 g of methanol.

[2]

(iii) Describe the effect of a catalyst on the rate of formation of methanol.

..... [1]

(iv) Compare the mass of a catalyst at the beginning of the reaction with the mass of the catalyst at the end of the reaction.

.....

..... [1]

(b) (i) Complete Fig. 3.1 to show the outer electrons in a molecule of hydrogen.

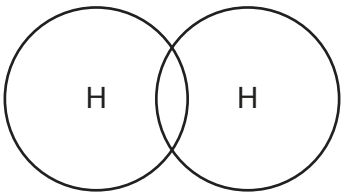

Fig. 3.1

[1]

(ii) Explain why hydrogen is a poor conductor of electricity.

.....

.....

..... [1]

[Total: 7]

4 A wooden block is pulled along a bench.

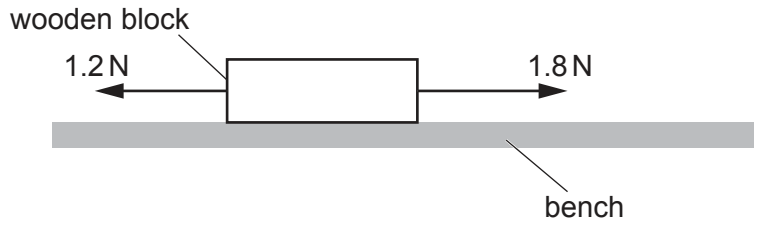

Fig. 4.1

The block moves towards the right.

The sizes and directions of the horizontal forces acting on the block when it is in motion are shown in Fig. 4.1.

(a) The horizontal force of 1.2 N acts in the opposite direction to the direction of motion.

(i) State the name of this force.

..... [1]

(ii) Calculate the resultant force acting on the block.

resultant force = ... N [1]

(b) The wooden block has a mass of 2.0 kg.

(i) State the equation linking mass, force and acceleration.

..... [1]

(ii) Using your answer in **(a)(ii)**, calculate the acceleration of the block.

acceleration = ...m/s^2 [1]

[Total: 4]

5 **(a)** Fig. 5.1 shows a section through a leaf.

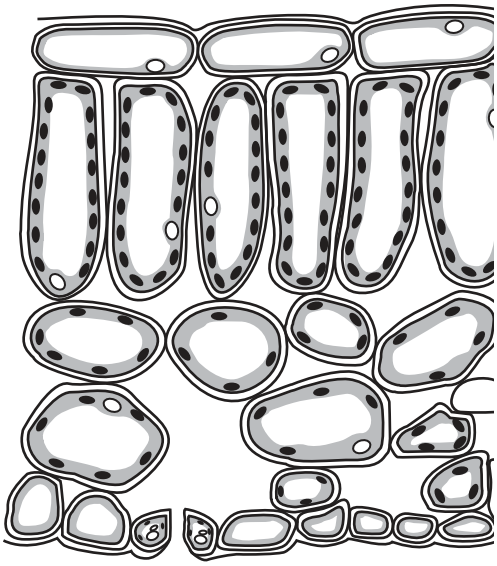

Fig. 5.1

(i) Draw a line to a cell in the palisade mesophyll on Fig. 5.1 and label it **P**. [1]

(ii) Draw a line to an air space on Fig. 5.1 and label it **A**. [1]

(b) **(i)** Some cells in the leaf contain structures called chloroplasts.

Name **one** type of leaf cell where chloroplasts are found.

..... [1]

(ii) Chloroplasts contain chlorophyll.

Name the mineral ion that plants need to make chlorophyll.

..... [1]

(c) Explain how the air spaces in a leaf enable it to carry out photosynthesis efficiently.

.....

.....

.....

.....

..... [2]

[Total: 6]

6 Bromine, Br_2, is a diatomic molecule.

(a) Explain the meaning of 'diatomic'.

..... [1]

(b) State an adverse effect of bromine.

..... [1]

(c) Name the solute when bromine dissolves in water.

..... [1]

(d) Table 6.1 shows some observations made when aqueous solutions of bromine are mixed with different chemicals **X**, **Y** and **Z**.

Table 6.1

chemical	observation
X	colourless solution formed
Y	colour of solution changes to dark brown
Z	no change

(i) Suggest the name of a hydrocarbon that is chemical **X**.

..... [1]

(ii) Suggest the name of a sodium halide that is chemical **Y**.

..... [1]

(iii) Suggest the name of a hydrocarbon that is chemical **Z**.

..... [1]

[Total: 6]

[Turn over

7 A student hangs a mass on an elastic band as shown in Fig. 7.1.

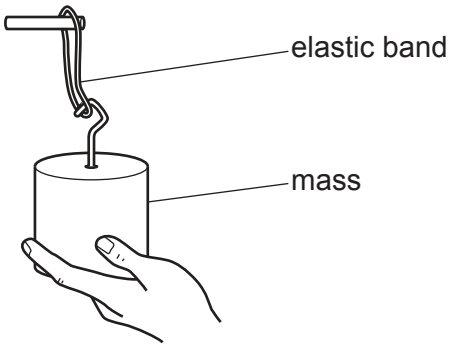

Fig. 7.1

(a) When she releases the mass, the mass moves down.

Energy is transferred between stores.

Complete the sentences:

(i) As the mass moves down just after being released, energy is transferred **from**

the ..... energy store. [1]

(ii) After a few moments, the elastic band starts to stretch and the mass slows down as it falls. When the elastic band is stretching, energy is transferred to

the ..... energy store

and also to

the ..... energy store. [2]

(b) Energy is conserved when it is transferred between stores.

100 J of energy is transferred from the store in **(a)(i)**.

Determine the total amount of energy gained by the stores in **(a)(ii)**.

..... [1]

[Total: 4]

8 Draw lines from the box on the left to **three** boxes on the right to make three correct statements about the use of bacteria in biotechnology.

Bacteria are often used in biotechnology because …

… there are no ethical concerns about using them.

… they are not affected by temperature.

… they are resistant to herbicides.

… they can make complex chemicals.

… they do not need any energy.

… they reproduce very rapidly.

[3]

9 Aqueous solutions of lead nitrate and potassium chloride react to produce insoluble lead chloride, $PbCl_2$, and soluble potassium nitrate, KNO_3.

(a) (i) Balance the chemical equation for this reaction and add the state symbols.

…. $Pb(NO_3)_2$ (...) + …. KCl (...) → …. $PbCl_2$ (...) + …. KNO_3 (...) [2]

(ii) Complete the sentence to describe the formation of lead chloride in this reaction with a word from the list.

displacement **neutralisation** **precipitation** **redox**

Lead chloride is formed in a ..... reaction. [1]

(b) State which property of lead chloride allows it to be separated from the resulting mixture by filtration.

..... [1]

[Total: 4]

10 A mobile phone network transmits signals using a frequency of 2100 MHz.

(a) State the name of the region of the electromagnetic spectrum that is used by mobile phones.

..... [1]

(b) The mobile phone signals are transmitted through air.

(i) State the approximate speed of electromagnetic radiation in air.

..... [1]

(ii) Using your answer to **(b)(i)**, calculate the wavelength, in metres, of the phone signals.

wavelength = ... m [2]

[Total: 4]

11 People who have high blood pressure have a blood pressure which is greater than normal for the whole population.

Fig. 11.1 shows the percentage of men and women in different age ranges with high blood pressure.

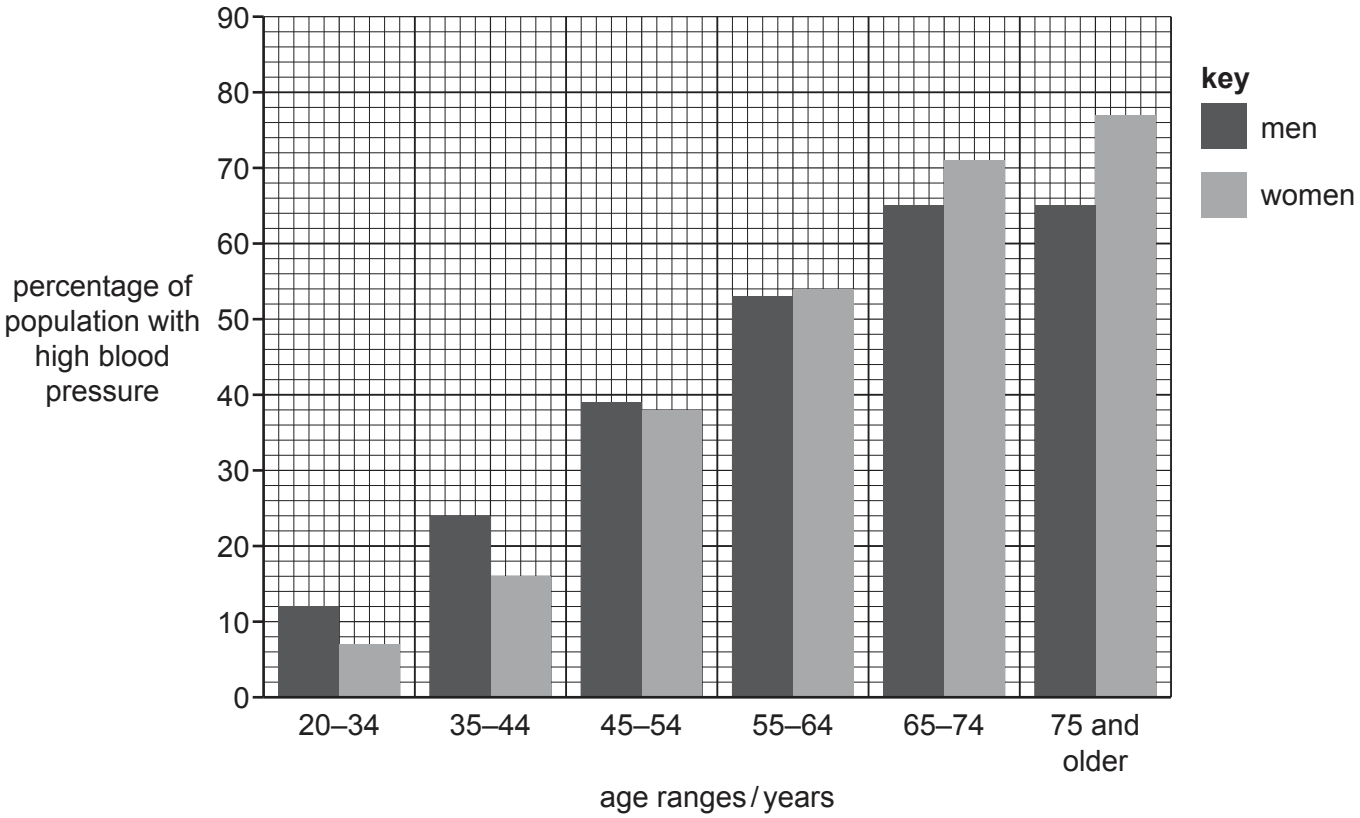

Fig. 11.1

(a) State the percentage of women who have high blood pressure in the age range 35–44 years old.

..... % [1]

(b) Describe **two** trends shown in the graph in Fig. 11.1.

trend 1 .....

.....

trend 2 .....

.....

[2]

(c) People who have high blood pressure are more likely to suffer from coronary heart disease.

State **two other** risk factors which can increase the risk of a person developing coronary heart disease.

risk factor 1 .....

risk factor 2 .....

[2]

[Total: 5]

12 Air is a mixture of gases.

(a) **(i)** Describe the arrangement of the gas particles in air.

.....

..... [1]

(ii) State the percentage of nitrogen in clean, dry air.

..... [1]

(b) State **two** substances found in air that are products of the complete combustion of alkanes.

substance 1 .....

substance 2 .....
[2]

(c) Explain why deforestation increases global warming.

.....

.....

..... [2]

[Total: 6]

13 The electrical items in a house use 0.6 kW of electrical power, on average, every hour.

(a) The cost of 1 kilowatt-hour (kW h) is 8 cents.

Calculate the cost, in cents, of using the electrical items for one day.

cost = ... cents [2]

(b) A number of the electrical items are connected to the mains by a single extension lead as shown in Fig. 13.1.

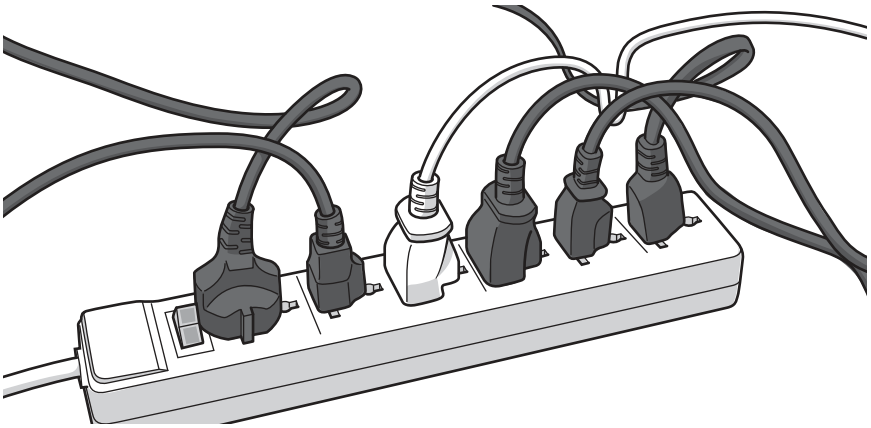

Fig. 13.1

State and explain the risk of connecting too many appliances to a single extension lead.

risk .....

explanation .....

.....

[2]

(c) State the names of **two** of the wires in a mains circuit.

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

[Total: 5]

14 The boxes on the left contain descriptions of processes connected with the digestion of food.

The boxes on the right contain the names of structures where these processes occur.

Draw **one** straight line from each process to link it to the structure where it occurs.

Each structure can be used once, more than once or not at all.

process	**structure**
protein digestion in an acid environment	small intestine
egestion	anus
digestion of maltose to glucose	stomach
urea produced	liver
salivary amylase digests starch	mouth
storage of glycogen	rectum

[6]

15 Table 15.1 shows the electronic configuration of five elements, **A**, **B**, **C**, **D** and **E**.

The letters are not the symbols of the elements.

Table 15.1

element	electronic configuration
A	2
B	2,6
C	2,8,1
D	2,8,6
E	2,8,7

Use the information in Table 15.1 to answer parts **(a)** to **(d)**.

(a) State the letters of **two** elements that are in the same group of the Periodic Table.

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

(b) State the letter of an element that is a metal.

..... [1]

(c) Explain why elements **C** and **D** are in the same period of the Periodic Table.

.....

..... [1]

(d) Explain how the electronic configuration of element **A** shows that it is a noble gas.

.....

..... [1]

[Total: 4]

16 Fig. 16.1 shows a symbol used in food labelling.

The symbol means that the food is exposed to ionising radiation before it is sold.

Fig. 16.1

(a) State the name of one type of ionising radiation.

..... [1]

(b) Explain why some food is exposed to ionising radiation.

.....

.....

..... [2]

(c) Table 16.1 shows data for three radioactive isotopes.

Table 16.1

isotope	half-life
caesium-137	30 years
polonium-210	140 days
technetium-99m	6 hours

(i) Explain what is meant by 'half-life'.

.....

..... [2]

(ii) Suggest which isotope in Table 16.1 is most useful in a factory where food is exposed to radiation.

..... [1]

[Total: 6]

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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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).