Cambridge
O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/21**

Paper 2 **October/November 2019**

2 hours 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 24.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

DC (JC/CT) 174122/5

1 A student observes a mass as it moves down and then up again on the end of a spring.

Fig. 1.1 shows the position of the mass at times $t = 0.10\,s$, $t = 0.20\,s$ and $t = 0.25\,s$.

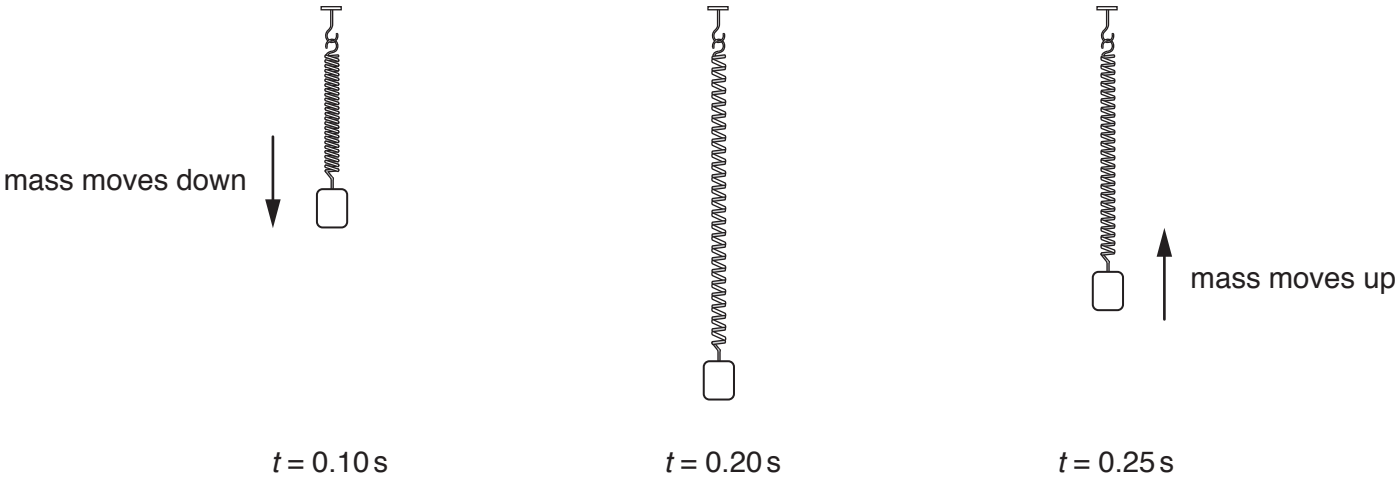

Fig. 1.1

(a) Use ideas about forces to explain why the mass moves down and then up again.

.....

.....

.....

..... [3]

(b) The mass on the spring is 0.20 kg.

Calculate the force needed to accelerate this mass by $35\,m/s^2$.

force = ... N [1]

(c) The student attaches a piece of card to the bottom of the mass, as shown in Fig. 1.2. She repeats the experiment.

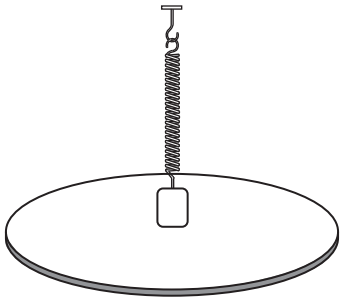

Fig. 1.2

Predict how the card will affect the maximum speed of the moving mass.

Put a tick in the box next to the correct prediction.

1. It increases	
2. It decreases	
3. It stays the same	

Explain your answer.

.....

.....

..... [2]

[Total: 6]

2 An oxide of metal M reacts with dilute nitric acid to produce an aqueous solution of metal nitrate, $M(NO_3)_3$.

The equation for the reaction is shown.

$$M_2O_3 + 6HNO_3 \longrightarrow 2M(NO_3)_3 + 3H_2O$$

(a) The formula of the oxide ion is O^{2-}.

Draw a circle around the formula of the ion of metal M.

M^+ M^{2+} M^{3+} M^{4+}

[1]

(b) The relative molecular mass of the metal oxide, M_2O_3, is 152.

[A_r: O, 16; N, 14; H, 1]

(i) Calculate the relative atomic mass of metal M.

relative atomic mass of M = ... [1]

(ii) Complete the following sentences.

152 g of the metal oxide M_2O_3 produces ..... g of water.

7.6 g of the metal oxide M_2O_3 produces ..... g of water.

[2]

(c) State how crystals of the metal nitrate are obtained from the aqueous solution of the metal nitrate.

.....

.....

..... [2]

[Total: 6]

3 Certain processes are carried out by specialised parts of organisms.

On Fig. 3.1, draw **one** straight line from each process to the specialised part where the process is carried out.

One line has been drawn for you.

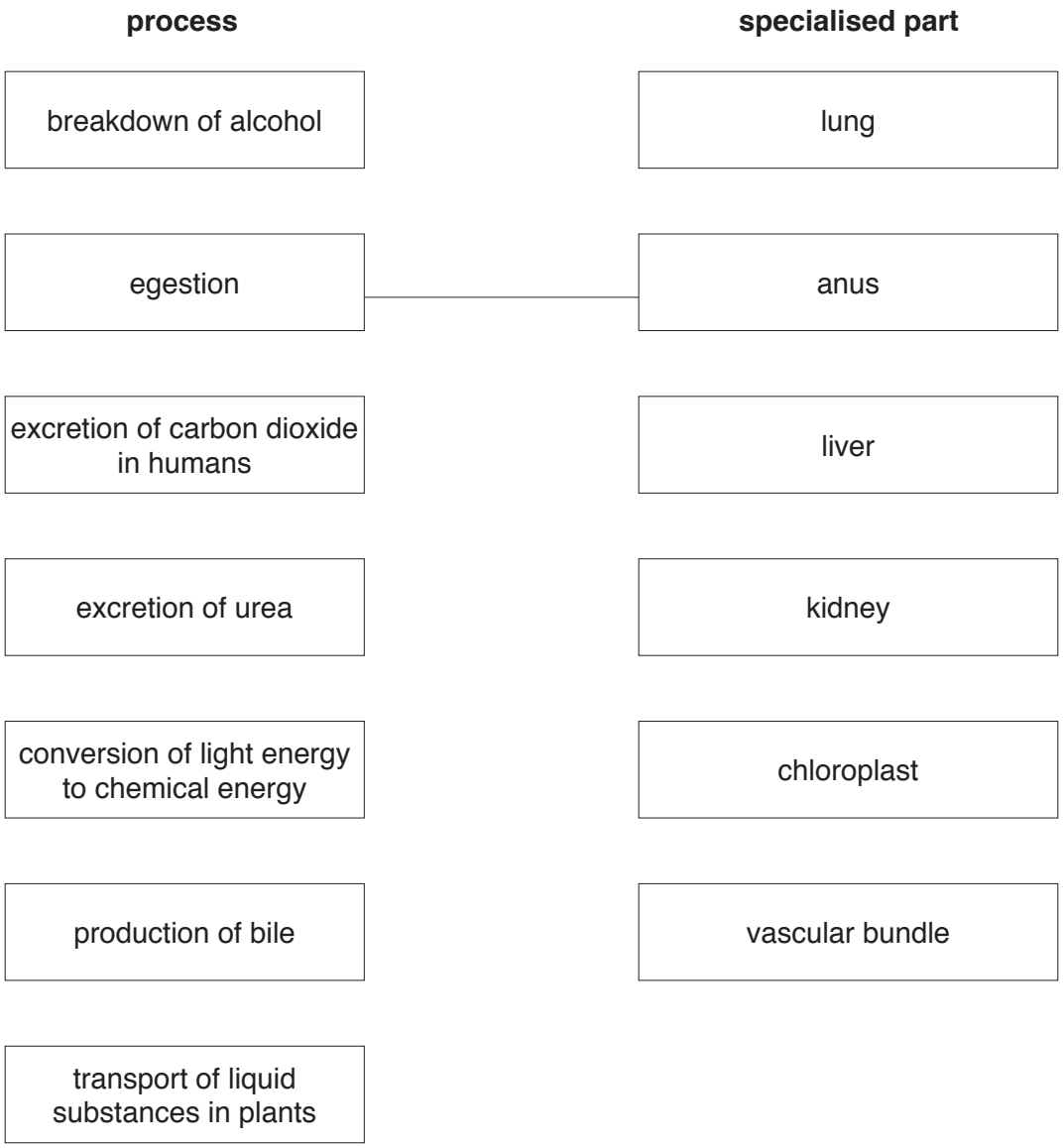

Fig. 3.1

[6]

4 Special machines are used to test the strength of materials. One of these machines is shown in Fig. 4.1.

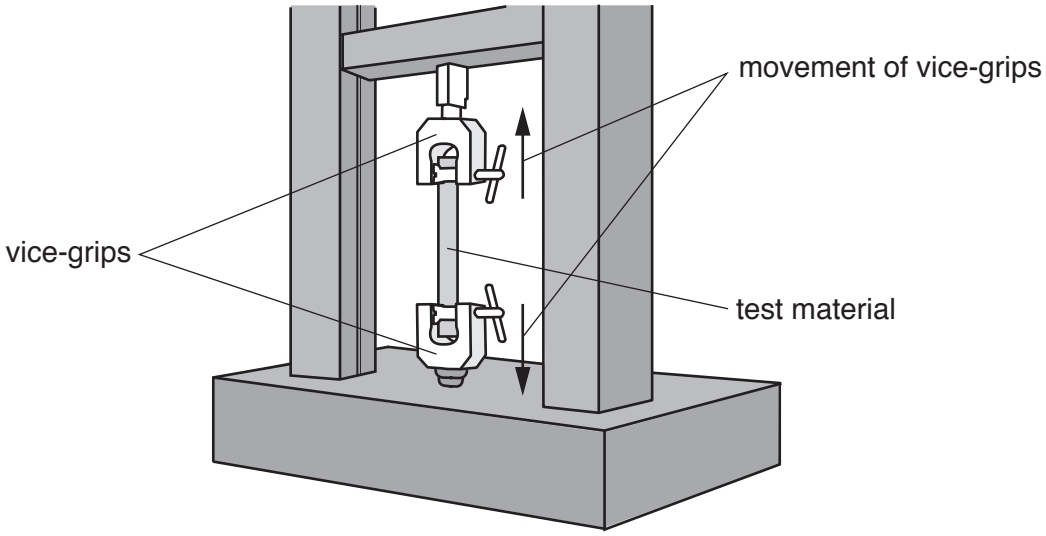

Fig. 4.1

The test material is clamped firmly between vice-grips.

The vice-grips move apart and elastic deformation of the material is observed.

(a) (i) Describe how the size and shape of the material change as the vice-grips move apart.

size .....

.....

shape .....

..... [2]

(ii) State what happens to the material when the vice-grips return to their original position.

..... [1]

(b) On Fig. 4.2 draw the extension–load graph for a material that exhibits elastic deformation.

Label the axes.

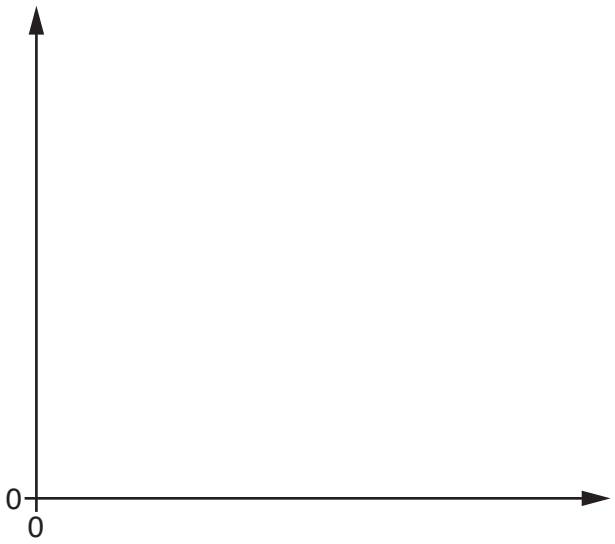

Fig. 4.2

[2]

[Total: 5]

5 Study the reaction scheme shown in Fig. 5.1.

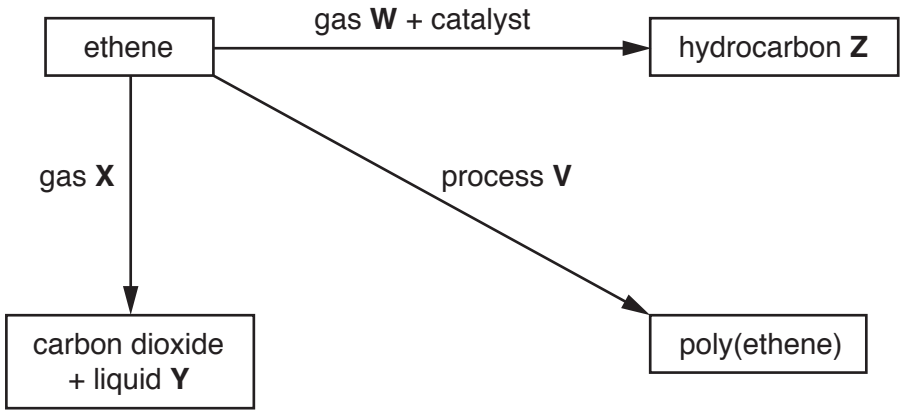

Fig. 5.1

(a) Identify substances **W**, **X**, **Y** and **Z**.

gas **W** .....

gas **X** .....

liquid **Y** .....

hydrocarbon **Z** .....

[4]

(b) Complete the following sentences.

Process **V** is known as ..... polymerisation.

The ethene molecules are known as ..... units.

[2]

(c) One of the reactions in Fig. 5.1 uses a catalyst.

Suggest why a catalyst is used in this reaction.

..... [1]

(d) Explain, in terms of its structure, why ethene changes the colour of bromine water from orange-brown to colourless.

.....

..... [1]

[Total: 8]

6 Use words or phrases from the list to complete the sentences about blood.

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

antibiotics	**antibodies**	**capillaries**	**plasma**
platelets	**red blood cells**	**veins**	**water**

The liquid part of the blood is called ..... .

White blood cells carry out phagocytosis and also produce ..... .

Blood clotting is caused by the action of ..... .

Chemicals pass in and out of the blood when it is flowing through blood vessels called ..... .

[4]

7 **(a)** **(i)** State the name of the substance that plants use to convert light energy into chemical energy.

..... [1]

(ii) Name **two** of the substances that plants use to make glucose.

1 .....

2 .....
[2]

(iii) Explain why plants need nitrogen for healthy growth.

.....

..... [1]

(b) Fig. 7.1 shows the effect of adding a nitrogen-containing fertiliser to fields of wheat plants.

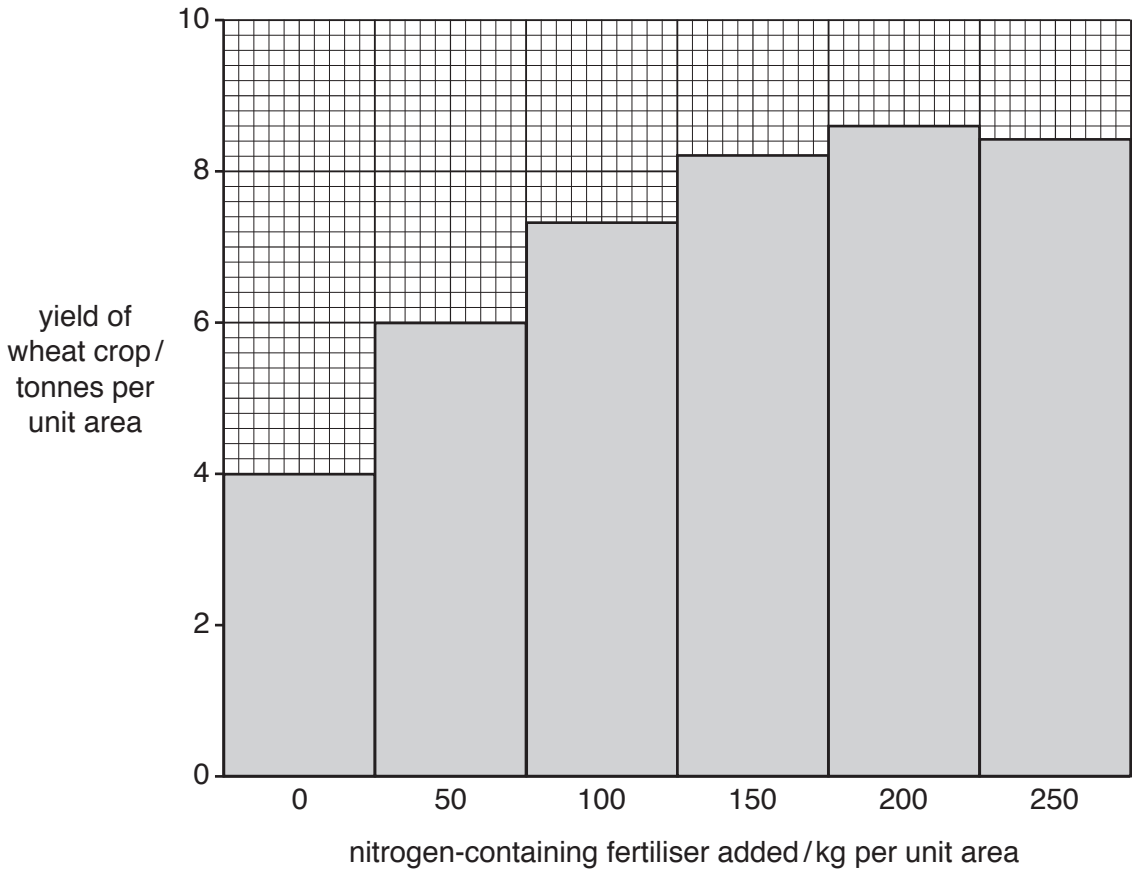

Fig. 7.1

(i) Use Fig. 7.1 to calculate the increase in the yield of wheat crop produced by adding 50 kg of nitrogen-containing fertiliser per unit area rather than not adding fertiliser.

..... tonnes per unit area [1]

(ii) Describe the trend in the results shown in Fig. 7.1.

.....

.....

.....

..... [2]

(iii) Predict what happens to the yield of wheat if 300 kg of this fertiliser is used per unit area.

prediction ..... [1]

[Total: 8]

8 A teacher demonstrates the transfer of thermal energy in water.

She fills a glass tube with cold water and places some soluble purple crystals in the water. Then she heats the tube at point **A**.

The crystals dissolve and the purple colour moves towards point **C**, as shown in Fig. 8.1.

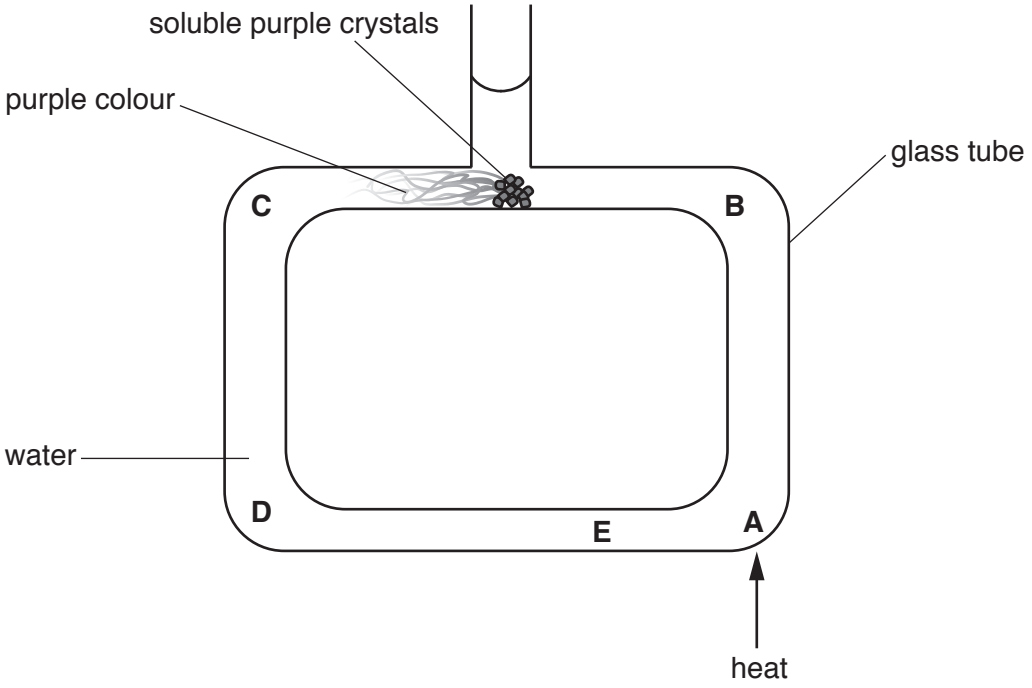

Fig. 8.1

(a) Describe the movement of water around the tube when the water is heated at point **A**.

Explain why the movement occurs.

description .....

.....

.....

explanation .....

.....

[2]

(b) State the name of the type of thermal energy transfer shown by the movement of water in the glass tube.

..... [1]

(c) When the water is heated for a short time, the temperature of the water at point **B** increases.

Explain why the temperature of the water at point **E** stays the same.

.....

..... [1]

[Total: 4]

9 Atoms are made up of electrons, neutrons and protons.

(a) Complete Table 9.1 to show the relative charge and the relative mass of each particle.

Table 9.1

particle	relative charge	relative mass
electron		1/1840
proton	+1	
neutron		1

[3]

(b) An atom of element **Q** contains 121 neutrons and 85 electrons.

The atom is represented by the symbol shown

$$^{A}_{Z}\mathbf{Q}$$

(i) Deduce the values of A and Z for this atom of **Q**.

A .....

Z .....

[2]

(ii) The element **Q** is placed in Group VII of the Periodic Table.

Suggest why, in terms of its electronic structure, element **Q** is placed in Group VII.

.....

..... [1]

[Total: 6]

10 A teacher shows his class a picture of the ripples produced by a droplet of water landing in a pool of water, as shown in Fig. 10.1.

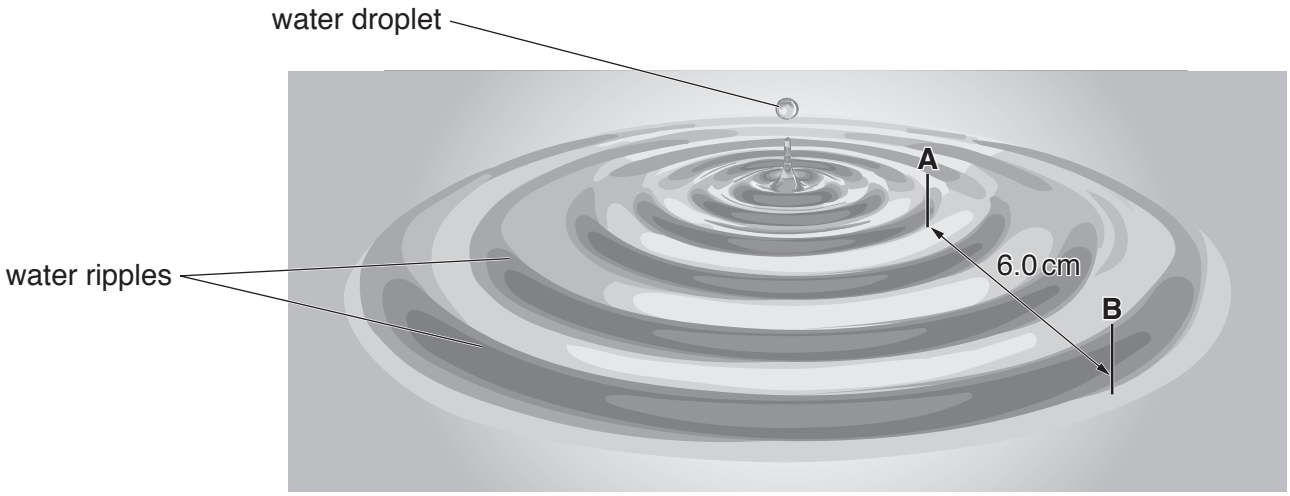

Fig. 10.1

He tells his class that this is an example of wave motion.

(a) Use the example in Fig. 10.1 to describe what is meant by *wave motion*.

.....

.....

..... [2]

(b) Point **A** and point **B** on Fig. 10.1 are 6.0 cm apart.

The speed of the wave is 40 cm / s.

(i) State the number of complete wavelengths between point **A** and point **B** on Fig. 10.1.

..... [1]

(ii) Calculate the average wavelength for **one** wave.

average wavelength = ... cm [1]

(iii) Use your answer to **b(ii)** to calculate the frequency of the wave.

frequency = ... Hz [2]

[Total: 6]

11 A balloon containing helium gas is shown in Fig. 11.1.

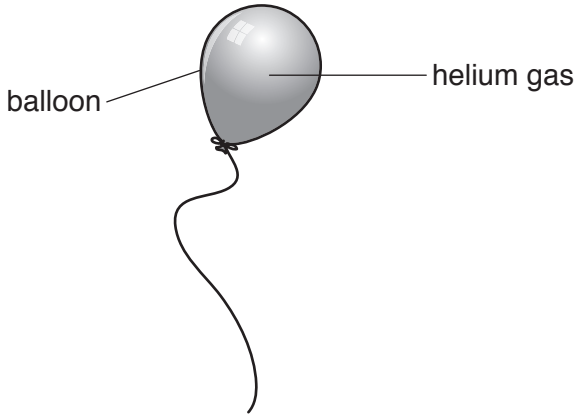

Fig. 11.1

(a) (i) Describe the movement and the bunching of the helium particles in the balloon.

.....

.....

.....

..... [2]

(ii) State how the energy of the helium particles changes when the balloon is cooled.

..... [1]

(b) Suggest a reason why helium is used to fill weather balloons.

..... [1]

[Total: 4]

[Turn over

12 Fig. 12.1 shows the male reproductive system.

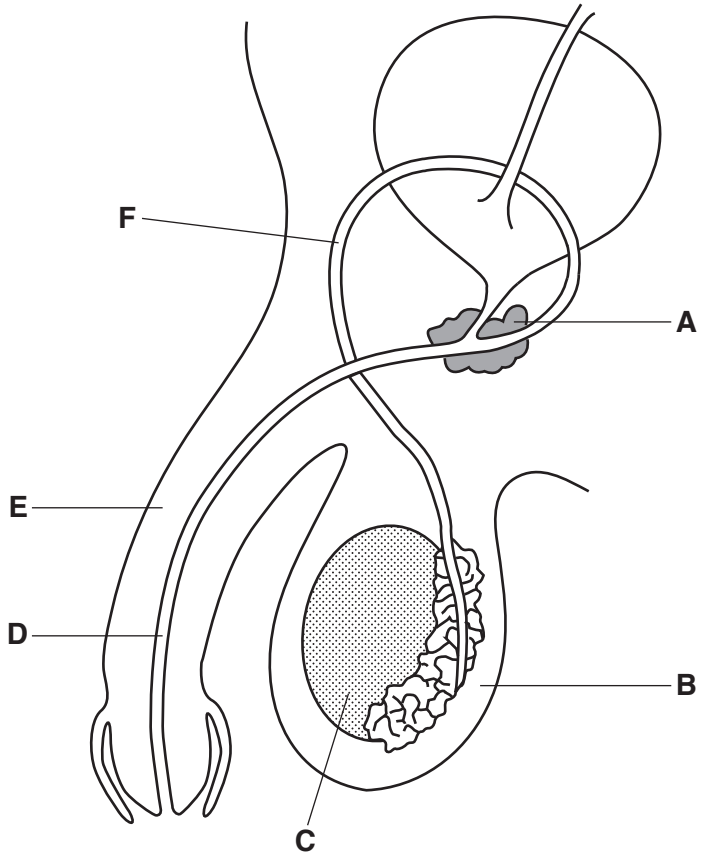

Fig. 12.1

Complete Table 12.1 by stating the letter to show which part is responsible for the function.

Table 12.1

function	letter
produces secretions which activate the sperm	
produces sperm	
tube which carries sperm only	

[3]

13 (a) Complete the circuit in Fig. 13.1 by adding the circuit symbols for:

- a switch to control the current through the resistor only
- a lamp in parallel with the resistor
- an ammeter to measure the current through the lamp only.

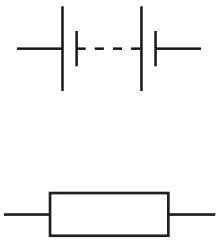

Fig. 13.1

[3]

(b) When the switch in the circuit in Fig. 13.1 is closed, a charge of 280 C moves through the circuit in 4.0 minutes.

Calculate the current in the circuit and state the unit.

current = ... unit ..... [3]

[Total: 6]

[Turn over

14 **(a)** A balanced diet contains carbohydrates, minerals and water.

State **three** other substances present in a balanced diet.

1 .....

2 .....

3 .....

[3]

(b) One of the carbohydrates in the diet is starch.

Name the enzyme which digests starch and name the substance produced by this digestion.

enzyme .....

substance produced .....

[2]

(c) Name the process which moves food along the alimentary canal.

..... [1]

(d) Starch is digested as it travels along the alimentary canal.

Fig. 14.1 shows how the percentage of undigested starch changes as food passes along the alimentary canal.

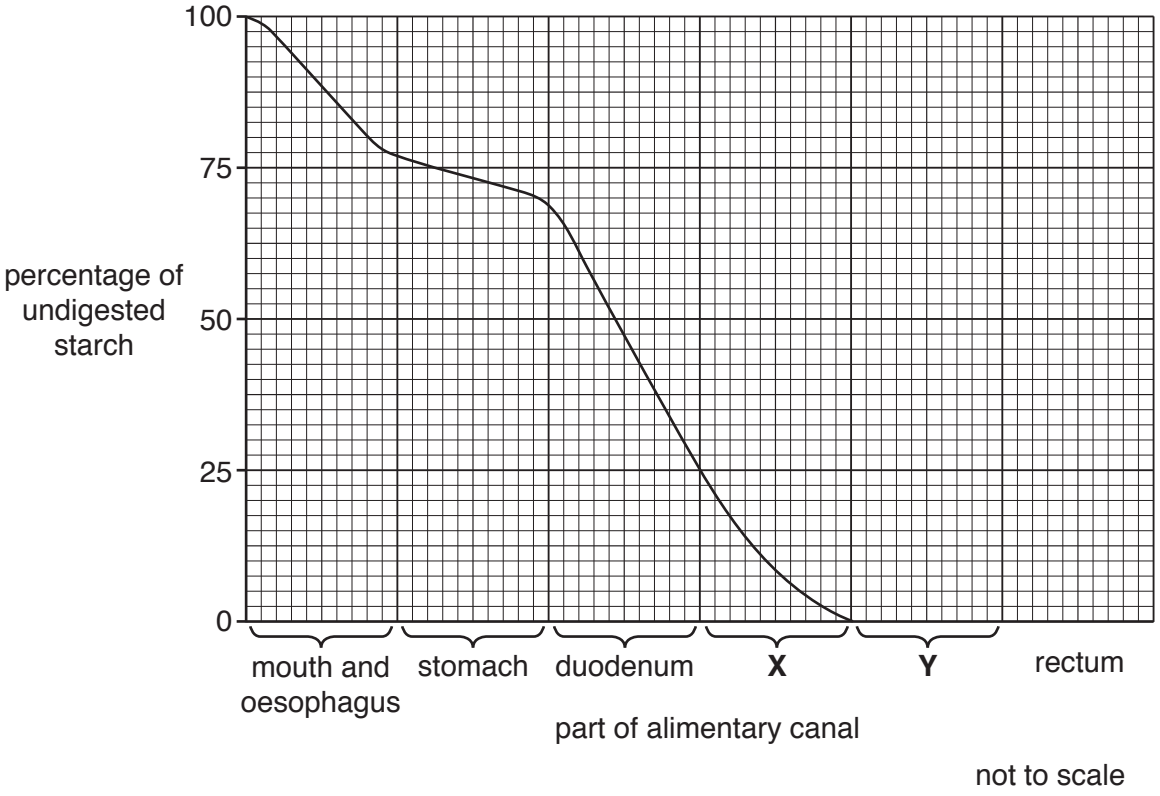

Fig. 14.1

(i) Name the parts of the alimentary canal labelled **X** and **Y** on Fig. 14.1.

X .....

Y .....
[2]

(ii) Use Fig. 14.1 to estimate the percentage of starch which is digested before the food reaches the stomach.

..... % [1]

(iii) Suggest why very little starch digestion takes place in the stomach.

.....

.....

.....

..... [2]

(iv) Suggest why the line of the curve in Fig. 14.1 is not shown in region **Y**.

.....

..... [1]

[Total: 12]

[Turn over

15 A student investigates static electricity.

She uses the instrument shown in Fig. 15.1.

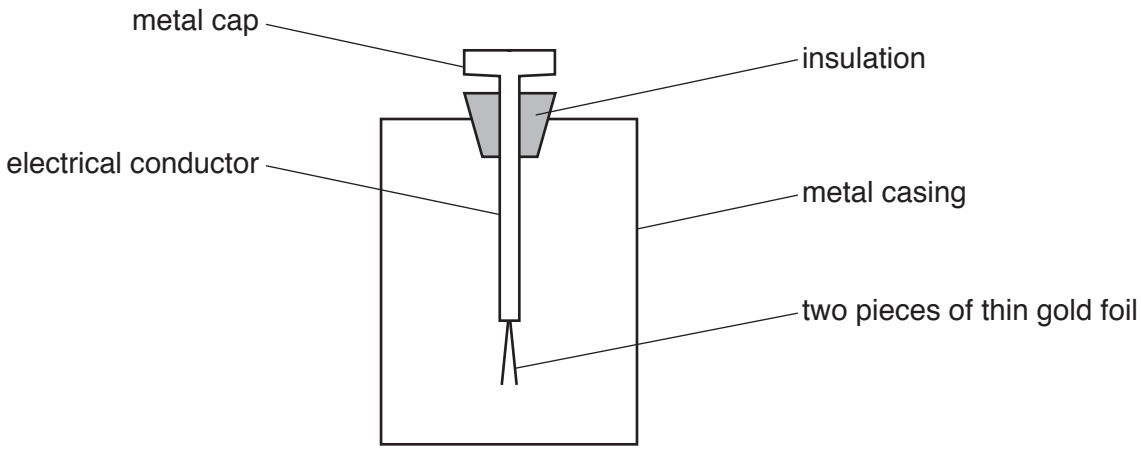

Fig. 15.1

The instrument detects electric charge.

The student places a charged rod near the metal cap as shown in Fig. 15.2.

The pieces of gold foil move apart.

The distance D_1 between the rod and the cap is 9 mm.

The angle A_1 between the pieces of foil is 20°.

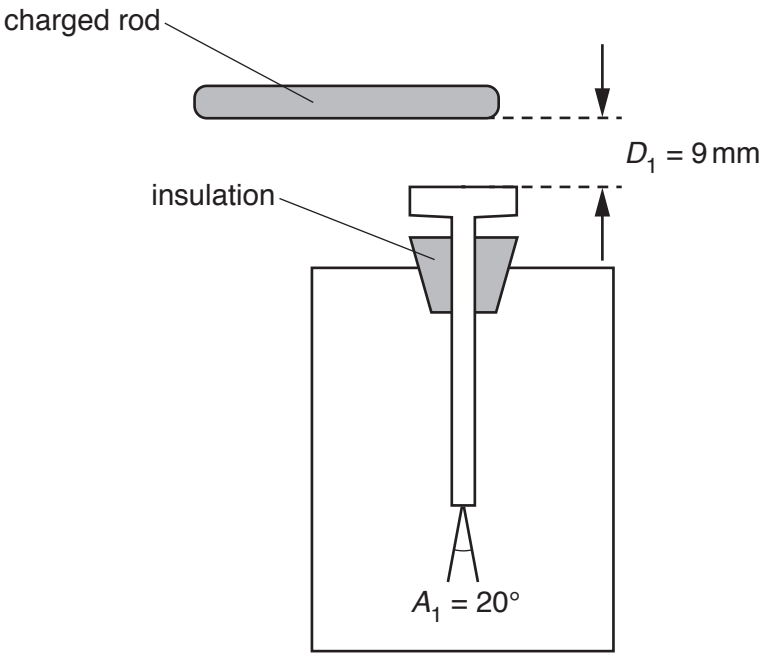

Fig. 15.2

(a) (i) Suggest why the pieces of gold foil move apart.

..... [1]

(ii) Suggest why insulation is used between the metal cap and the metal casing.

..... [1]

(b) The student changes the distance between the charged rod and the metal cap.

The angle A_2 between the pieces of foil is now 60°.

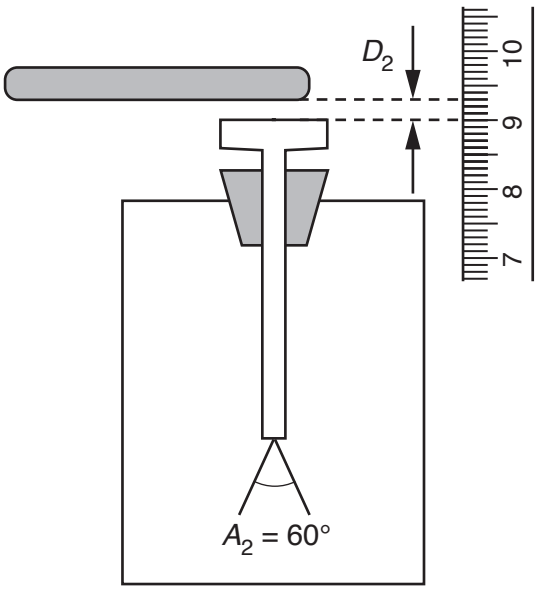

Fig. 15.3

(i) Use Fig. 15.3 to determine the distance D_2 between the charged rod and the metal cap.

D_2 = ... mm [1]

(ii) Calculate

1. the ratio of the distances $\frac{D_1}{D_2}$ .....

and

2. the ratio of the angles $\frac{A_1}{A_2}$ .....

[2]

(iii) Describe the relationship between D and A.

..... [1]

[Total: 6]

16 The following is a list of metals.

aluminium **calcium** **copper** **iron**

lithium **magnesium** **potassium** **zinc**

Some descriptions of metals are shown in Table 16.1.

Complete Table 16.1 by selecting the metal from the list that matches the description.

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

Table 16.1

description	metal
reacts with oxygen to form an amphoteric oxide	
used to galvanise steel	
the most difficult to extract from its ore	
a Group I metal that is less reactive than sodium	
is protected from corrosion by an oxide layer	

[5]

17 Oxygen is a diatomic molecule. Oxygen is a gas at room temperature.

(a) (i) Explain what is meant by the term *diatomic*.

.....

..... [1]

(ii) State the type of bonding in an oxygen molecule.

..... [1]

(b) State the test and result of the test for oxygen.

test .....

result .....

[2]

(c) Welding torches burn a mixture of oxygen and acetylene.

Balance the equation for the combustion of acetylene, C_2H_2.

..... C_2H_2 + ... O_2 ⟶ ..... CO_2 + ... H_2O

[1]

[Total: 5]

The Periodic Table of Elements

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 –		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.).