Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0123456789

COMBINED SCIENCE **5129/02**

Paper 2 Theory **For examination from 2023**

SPECIMEN PAPER **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 **22** pages. Any blank pages are indicated.

1 Fig. 1.1 shows a section through a root hair cell.

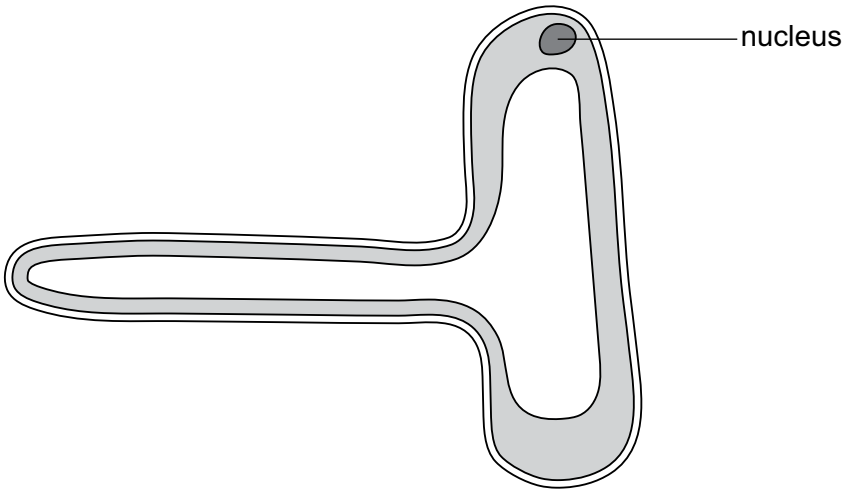

Fig. 1.1

The nucleus is labelled.

Give the names of **two** other structures shown in this root hair cell that are **not** present in a red blood cell.

1 .....

2 .....

[2]

2 The alkane octane, C_8H_{18}, can be cracked to form ethene, C_2H_4, and one other compound.

(a) (i) Complete the equation for the cracking of octane.

$$C_8H_{18} \rightarrow C_2H_4 + \text{.....} \quad [1]$$

(ii) State **two** conditions that are required for cracking.

1 .....

2 .....
[2]

(b) Fig. 2.1 shows three different exothermic reactions, **A**, **B** and **C**, of ethene.

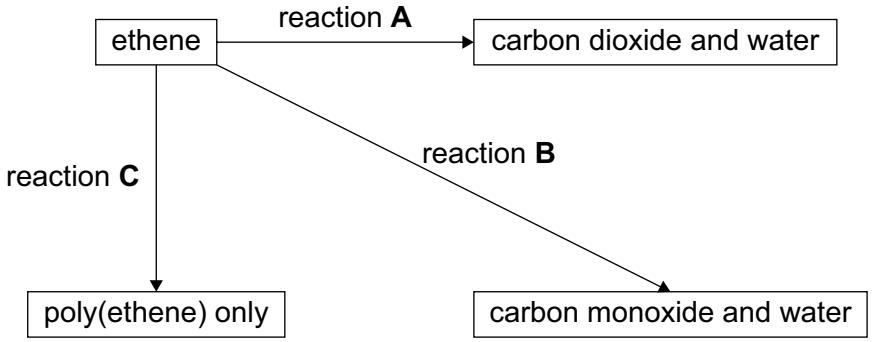

Fig. 2.1

Name the three **different** types of reaction **A**, **B** and **C**.

A .....

B .....

C .....
[3]

[Total: 6]

3 A student runs a race.

At 16 seconds she crosses the finishing line. Her speed decreases for a short time and then she runs at a constant speed for a few seconds more.

The speed–time graph of her motion is shown in Fig. 3.1.

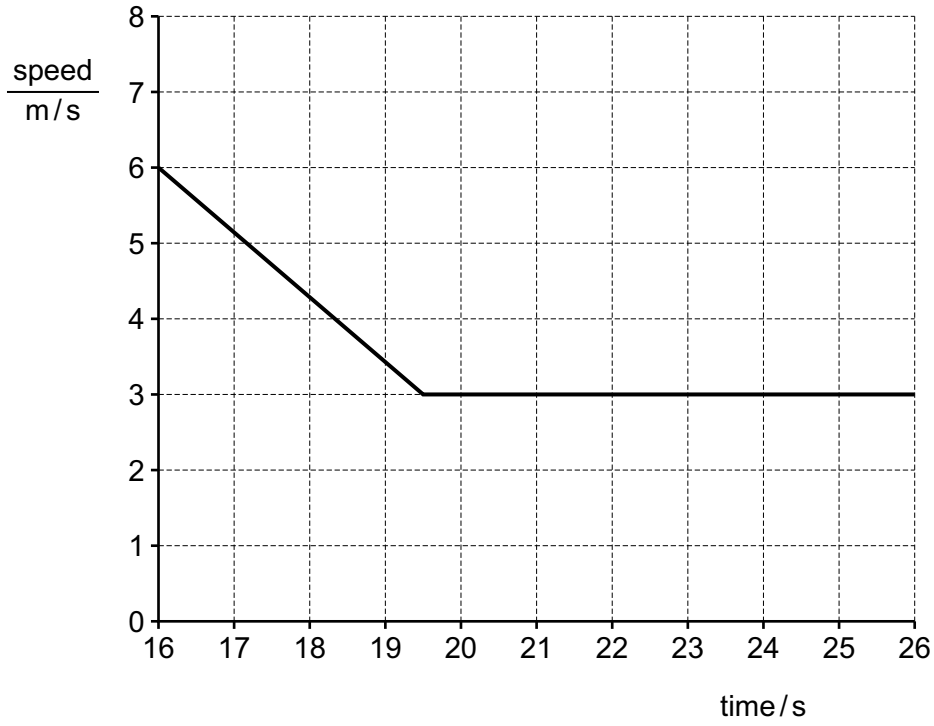

Fig. 3.1

(a) Using Fig. 3.1, determine:

(i) the time taken for the student's speed to decrease

time = ... s [1]

(ii) the student's constant speed.

speed = ... m / s [1]

(b) Calculate the distance that the student moves when her speed is constant.

distance = ... m [2]

[Total: 4]

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4 Plants need carbon dioxide for photosynthesis.

(a) Fig. 4.1 shows a section through a leaf.

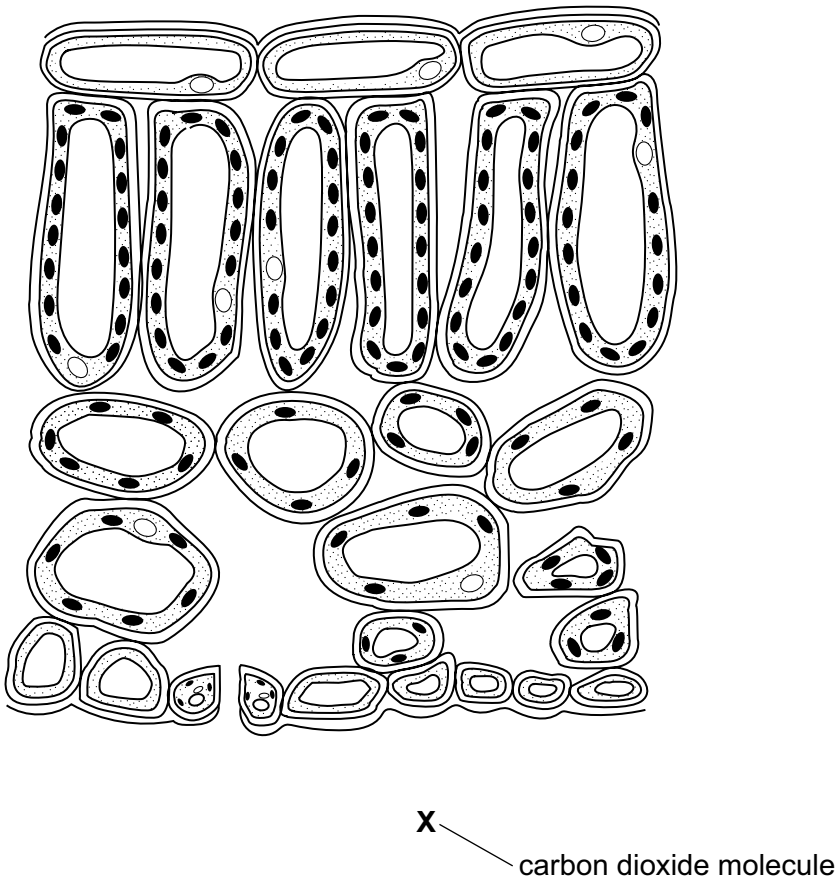

Fig. 4.1

On Fig. 4.1, the **X** shows the position of a molecule of carbon dioxide.

Draw a line from the **X** to show the pathway a carbon dioxide molecule takes to reach a spongy mesophyll cell in the leaf. [2]

(b) **(i)** State the name of the structure in a leaf cell that contains chlorophyll.

..... [1]

(ii) State the role of chlorophyll in photosynthesis.

..... [1]

(iii) State the role of photosynthesis in plant nutrition.

..... [1]

(c) Photosynthesis removes carbon dioxide from the atmosphere.

Describe **two** other ways in which photosynthesis is essential for animals to survive.

1 .....

.....

2 .....

..... [2]

[Total: 7]

5 When copper carbonate is heated it decomposes to produce copper oxide and carbon dioxide.

$$CuCO_3 \rightarrow CuO + CO_2$$

[A_r: C, 12; O, 16; Cu, 64]

The relative formula mass of copper carbonate is 124.

(a) Complete the following sentences.

248 g of copper carbonate produces ..... g of copper oxide

and ..... g of carbon dioxide.

31 g of copper carbonate produces ..... g of copper oxide.

[3]

(b) State a test, and the result, which shows that the gas produced is carbon dioxide.

test .....

result .....

[2]

(c) State **one** adverse effect of increased levels of carbon dioxide in the atmosphere.

..... [1]

[Total: 6]

6 A simple turbine is placed above a hot flame as shown in Fig. 6.1.

Energy is transferred and the turbine starts to spin about a pivot in the direction shown.

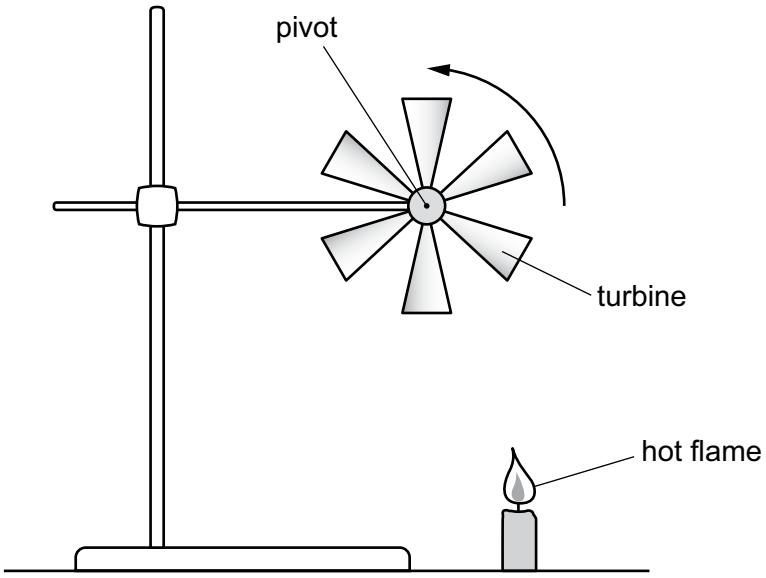

Fig. 6.1

(a) Energy is transferred between stores.

State the store of energy in:

the hot flame .....

the spinning turbine. .....
[2]

(b) The energy is transferred by the movement of molecules in the air.

(i) On Fig. 6.1 draw an arrow to show the direction of movement of the molecules in the air above the hot flame. [1]

(ii) Describe what happens to the motion and to the separation of the molecules in the air when the temperature is raised.

.....

..... [2]

(iii) The moving air exerts a force of 1.2×10^{-5} N on the turbine at a distance of 3.0×10^{-2} m from the pivot.

Calculate the moment of this force about the pivot.

moment = ... N m [1]

[Total: 6]

7 Fig. 7.1 shows the names of some processes that occur in the body and the names of some structures found in the body.

Complete Fig. 7.1 by drawing **one** line from each process to the structure where the process occurs.

process	**structure**
breaks down excess amino acids	vein
transports blood towards the heart	liver
excretes urea	heart
pumps blood to the lungs	artery
	kidney

Fig. 7.1 [4]

8 Water needs to be treated before it is suitable for drinking.

(a) Complete Fig. 8.1 to describe three stages in the purification of a domestic water supply.

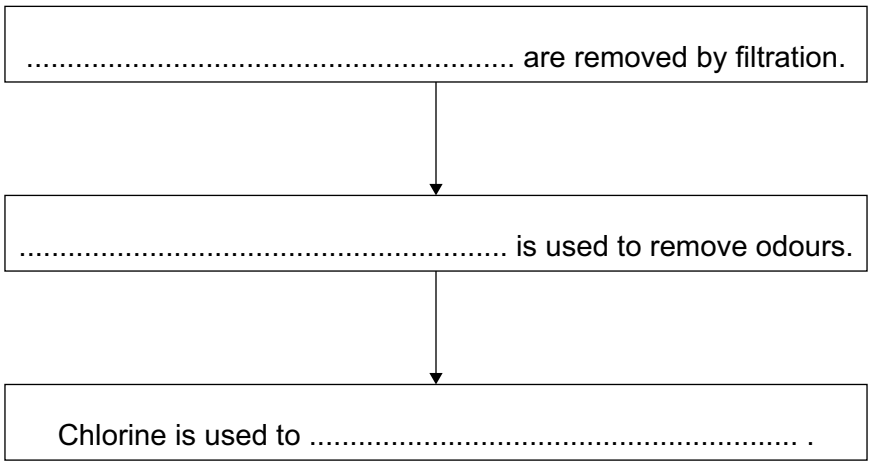

Fig. 8.1 [3]

(b) Water is a simple covalent molecule.

(i) Complete Fig. 8.2 to show the outer electrons in a molecule of water.

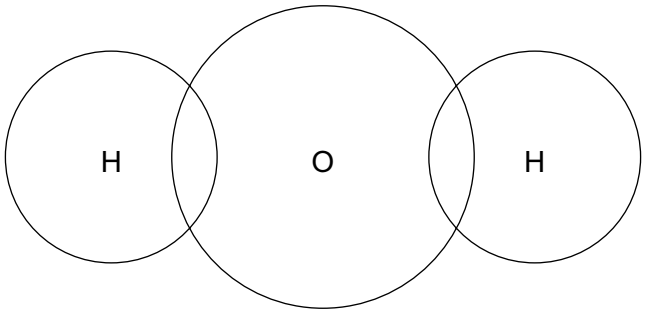

Fig. 8.2 [2]

(ii) Explain why simple covalent molecules have low boiling points.

.....

..... [1]

[Total: 6]

9 A student is investigating resistors.

He sets up the circuit shown in Fig. 9.1 using three 1.5 V cells.

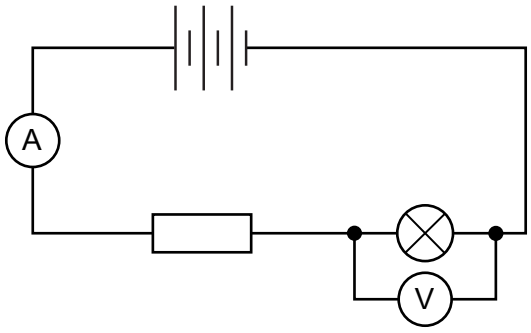

Fig. 9.1

The current in the circuit is 0.20 A.

The potential difference across the lamp is 2.4 V.

(a) (i) Calculate the total voltage of the battery.

voltage = ... V [1]

(ii) Calculate the resistance of the lamp in the circuit.

resistance = ... Ω [2]

(iii) Calculate the power produced in the resistor.

power = ... W [2]

(b) The wires in the circuit are made of metal.

Describe electrical conduction in metals.

.....

..... [2]

[Total: 7]

10 When resting, muscle cells respire aerobically.

(a) State the balanced chemical equation for aerobic respiration.

..... [2]

(b) During vigorous exercise, muscle cells also respire anaerobically.

State **two** ways anaerobic respiration differs from aerobic respiration in muscle cells.

1 .....

.....

2 .....

.....

[2]

[Total: 4]

11 When magnesium powder reacts with dilute hydrochloric acid, hydrogen gas is produced.

1 g of magnesium powder is added to an excess of dilute hydrochloric acid.

The time for the reaction to complete is recorded.

This is experiment 1.

In experiments 2 and 3 either the concentration of the dilute hydrochloric acid or the temperature of the reaction mixture is changed.

All other variables are kept the same.

(a) (i) Predict the time taken for the reaction to complete in experiments 2 and 3.

Write your answers in Table 11.1.

Table 11.1

experiment	concentration of dilute hydrochloric acid in g / dm^3	temperature / °C	time for reaction to complete / s
1	50	20.0	30
2	100	20.0	.....
3	50	10.0	.....

[2]

(ii) In experiment 1, the total volume of gas collected is recorded every 5 s for 50 s.

Fig. 11.1 shows a graph of these results.

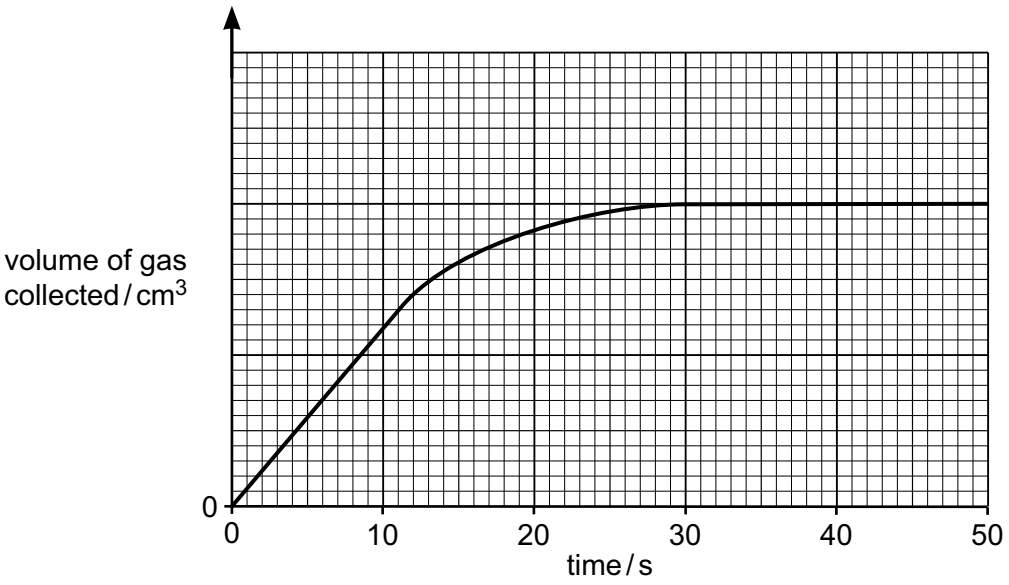

Fig. 11.1

On Fig. 11.1, draw the curve you would expect if experiment 1 is repeated with 0.5 g of magnesium powder. [2]

(b) State the effect on reaction time when a catalyst is added to a reaction.

..... [1]

[Total: 5]

12 **(a)** Different regions of the electromagnetic spectrum have different applications.

Give **one** application for each region of the electromagnetic spectrum.

microwaves .....

gamma rays .....

visible light .....

[3]

(b) **(i)** Compare the speed in a vacuum of microwave radiation with the speed in a vacuum of gamma radiation.

..... [1]

(ii) Compare the frequency of microwave radiation with the frequency of gamma radiation.

..... [1]

[Total: 5]

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13 The human digestive system breaks down large molecules and absorbs the small soluble molecules produced.

(a) (i) State the type of enzyme which breaks down lipids.

..... [1]

(ii) State **two** end-products of lipid digestion.

1 .....

2 .....
[1]

(b) Starch is broken down as it travels through the digestive system.

Fig. 13.1 shows how the percentage of undigested starch changes as food passes through the digestive system.

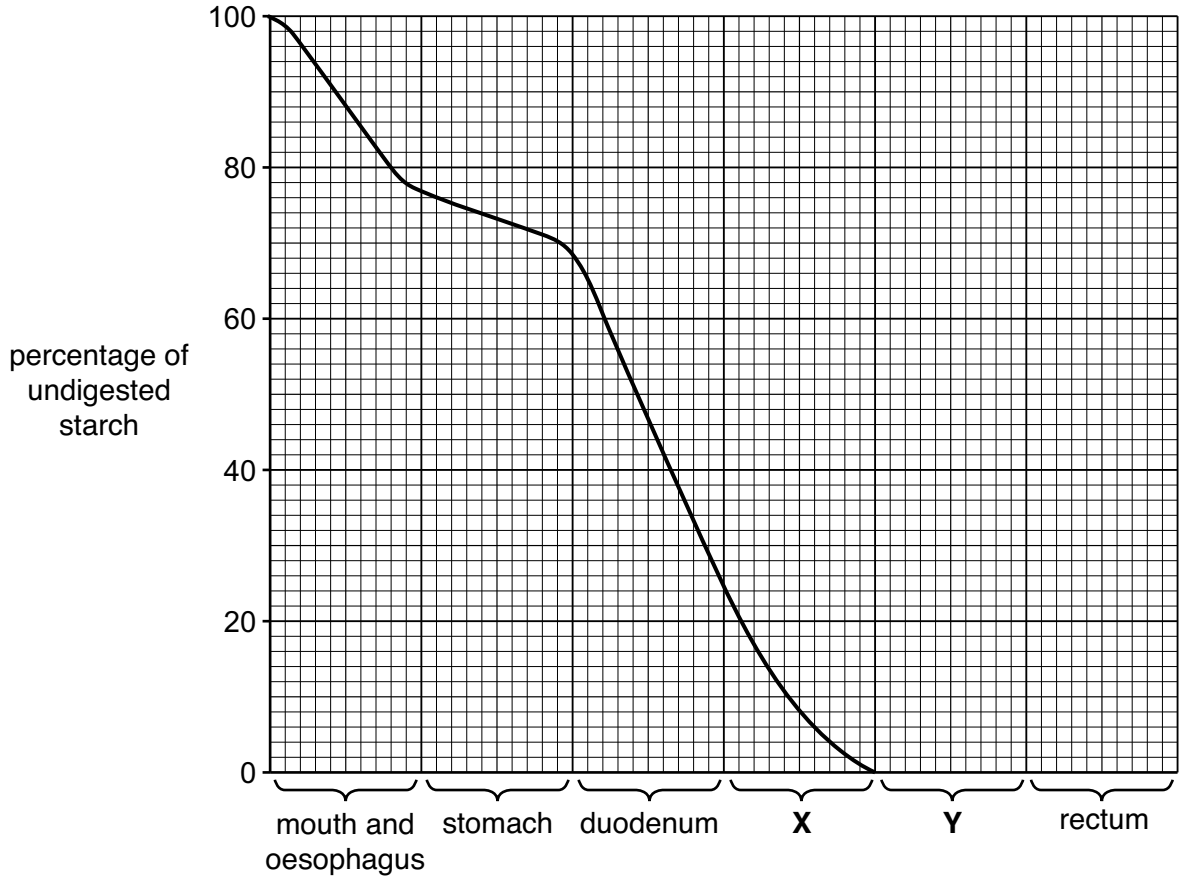

Fig. 13.1

(i) Name the parts of the digestive system labelled **X** and **Y** on Fig. 13.1.

X .....

Y .....
[2]

(ii) Use Fig. 13.1 to determine the percentage of starch which is digested in the stomach.

Show your working.

.....% [2]

[Total: 6]

14 Aqueous sodium bromide, NaBr, reacts with aqueous chlorine, Cl_2, to form an aqueous solution of sodium chloride, NaCl, and bromine, Br_2.

(a) (i) Suggest the colour of the solution at the end of the reaction.

..... [1]

(ii) Construct a balanced symbol equation for the reaction.

..... [1]

(b) Explain why sodium bromide does **not** react with iodine.

.....

..... [1]

(c) Fluorine is at the top of Group VII in the Periodic Table.

Table 14.1 shows the densities of some Group VII elements.

Table 14.1

element	$\frac{\text{density}}{\text{g/dm}^3}$
chlorine	3.2
bromine	3123
iodine	4930

Suggest a value for the density of fluorine.

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

[Total: 4]

15 Ionising radiation is emitted during radioactive decay.

(a) Explain what is meant by the term radioactive decay.

.....

..... [2]

(b) State the type of radiation emitted by radioactive decay that is the most ionising.

..... [1]

(c) Ionising radiation can be used to irradiate fresh food.

Explain why fresh food is irradiated.

.....

..... [2]

[Total: 5]

16 Fig. 16.1 shows two different food chains involving humans.

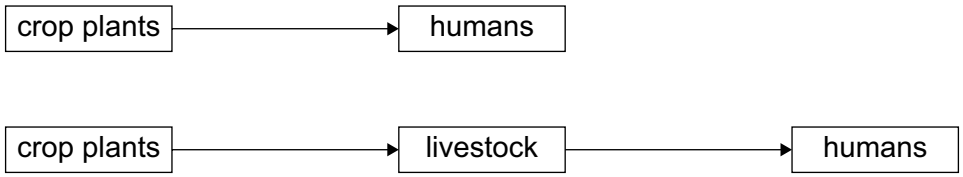

Fig. 16.1

Explain why it is more energy efficient for humans to eat crop plants than to eat livestock that have been fed on crop plants.

.....

.....

.....

.....

.....

.....

..... [3]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).