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Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2640317685

COMBINED SCIENCE **0653/33**

Paper 3 (Extended) **October/November 2016**

1 hour 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 or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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

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.

This document consists of **23** printed pages and **1** blank page.

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1 Fig. 1.1 shows a man using a longbow to fire arrows at a target.

Fig. 1.1

(a) The man uses a force of 300 N to pull the arrow back through a distance of 40 cm.

(i) Calculate the work done by the man when he draws the arrow back by 40 cm.

State the formula you use, show your working and include the unit of your answer.

formula

working

work done = ... unit ..... [3]

(ii) State how much elastic potential energy is stored in the longbow and bowstring before the arrow is released.

stored energy = ... J [1]

(b) The arrow has a mass of 0.1 kg.

The speed of the arrow as it leaves the longbow is 30 m / s.

(i) Calculate the kinetic energy of the arrow as it leaves the longbow.

State the formula that you use and show your working.

formula

working

kinetic energy = ... J [2]

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(ii) Use your answers to **(a)(ii)** and **(b)(i)** to calculate the efficiency of the energy transfer from the longbow to the arrow.

State the formula you use and show your working.

formula

working

efficiency = ... % [2]

(iii) The speed of the arrow as it approaches the target is 25 m / s.

Suggest why the speed of the arrow is no longer 30 m / s.

.....

.....[1]

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2 **(a)** A student investigates the reaction between dilute hydrochloric acid and 0.1 g of different metals. The metal samples used are of identical size and shape.

The apparatus he uses is shown in Fig. 2.1.

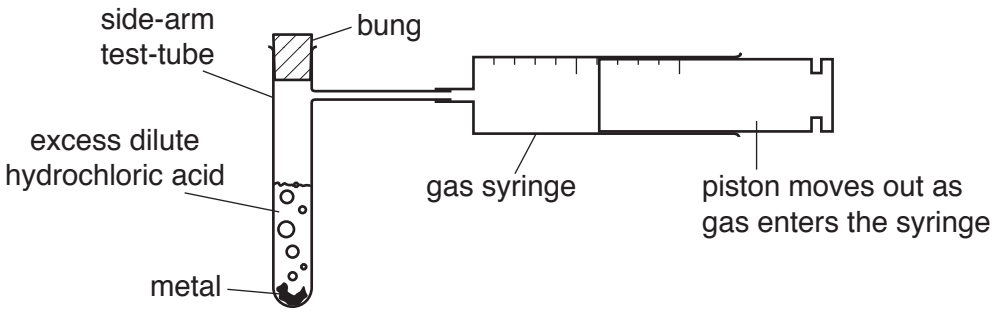

Fig. 2.1

He measures how long it takes to collect 25 cm^3 of gas made in each of the reactions.

(i) Name one other piece of apparatus that is needed to investigate the speed of this reaction.

.....[1]

(ii) The results the student obtains are shown in Table 2.1.

Table 2.1

metal	time to collect 25 cm^3 of gas / s
calcium	10
copper	more than 300
iron	more than 300
magnesium	20
zinc	45

State which metal reacts fastest.

.....[1]

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(b) The student repeats the experiment for copper and iron.

He uses hydrochloric acid with a greater concentration at a higher temperature.

The results the student obtains are shown in Table 2.2.

Table 2.2

metal	time to collect 25 cm^3 of gas / s
copper	more than 300
iron	30

State and explain the effects of changing the concentration and the temperature of the acid on the speed of the reaction with iron.

Use ideas about particles in your answer.

concentration .....

.....

.....

.....

temperature .....

.....

.....

.....[4]

(c) Using the results shown in Table 2.1 and Table 2.2, deduce the order of reactivity of the five metals from most to least reactive.

..... **most reactive**

.....

.....

.....

..... **least reactive**

[1]

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(d) The student places two other metals into test-tubes **A** and **B**, as shown in Fig. 2.2.

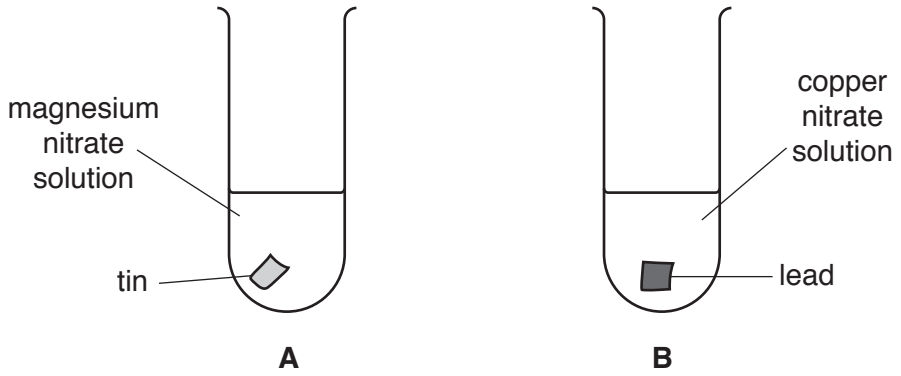

Fig. 2.2

There is no change in the contents of test-tube **A**, but in test-tube **B** the surface of the lead turns brown.

Explain these observations in terms of the reactivity of metals.

test-tube **A** .....

.....

.....

test-tube **B** .....

.....

.....

[2]

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Please turn over for Question 3.

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3 **(a)** Fig. 3.1 shows a plan of the human circulatory system.

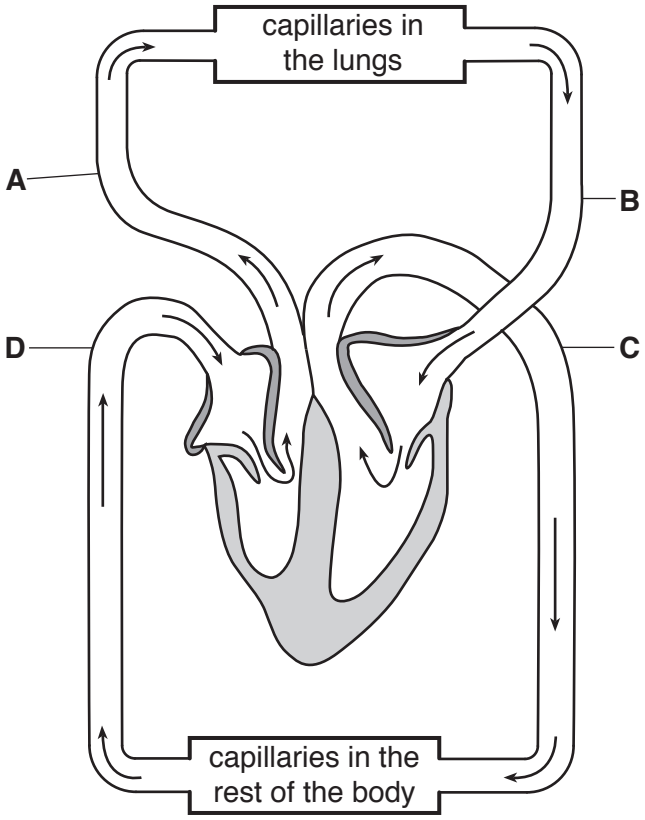

Fig. 3.1

(i) Explain why the human circulatory system is described as a *double circulation*.

.....

.....

.....[1]

(ii) State the letter and name of the blood vessel with the highest pressure in Fig. 3.1.

Explain your answer.

letter and name .....

explanation .....

.....

.....

[2]

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(iii) Describe how each of the following features of veins enables them to return blood to the heart from parts of the body such as the feet.

valves .....

.....

.....

wide lumen .....

.....

.....

[2]

(b) A student measures his pulse rate during the day. He takes a reading while sitting, and also as he does different activities. Some of his readings are shown in Table 3.1.

Table 3.1

activity	number of beats / min
sitting	68
running	164
Y	85

(i) Explain in detail why the muscles of the student's legs need a greater supply of blood while he is running.

.....

.....

.....

.....

.....

.....[3]

(ii) Suggest an activity for **Y**. Explain your answer.

activity .....

explanation .....

.....

[1]

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4 Fig. 4.1 shows a simple solar heating system to provide hot water for a house.

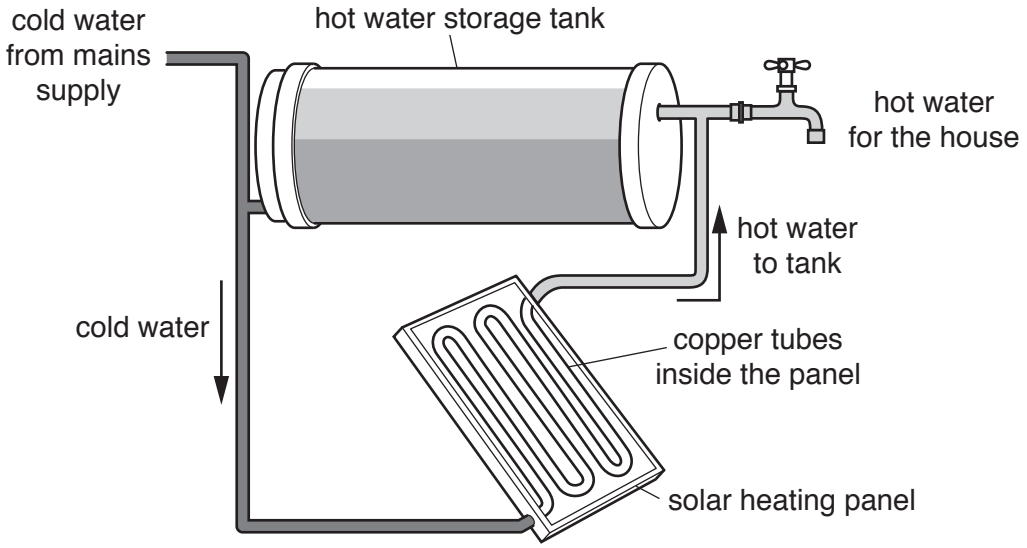

Fig. 4.1

- Cold water in copper tubes inside the panel is heated by energy from the Sun.
- The hot water then flows to the hot water tank above.
- Cold water from the tank flows back to the panel.
- A supply of hot water for the house can be taken from the tank.

(a) The Sun emits energy as electromagnetic radiation, some of which is absorbed by the solar panel.

(i) On Table 4.1, in the correct box write the name of the main part of the electromagnetic spectrum which heats the solar panel.

Table 4.1

gamma radiation		ultraviolet				radio waves

[2]

(ii) The Sun also emits radio waves which take 8 minutes to reach the Earth.

A student says he thinks the radiation that heats the solar panel would take longer than 8 minutes to reach the Earth.

Explain why the student is wrong.

.....

.....[1]

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(b) The solar panel contains copper tubes through which the water flows.

(i) The copper tubes are painted to improve the efficiency of energy absorption by the panel.

Suggest the colour of the paint that would give the best efficiency. Give a reason for your answer.

.....

.....

.....

.....[2]

(ii) State the method of thermal energy transfer

1. from the outside of the copper tubes to the water inside the tubes,

.....

2. from the hot water in the copper tubes to the hot water storage tank.

.....
[2]

(iii) Explain why the heated water in the copper tubes is able to travel up to the storage tank above the panel without pumping.

.....

.....

.....

.....

.....[2]

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5 **(a)** **(i)** Name the main constituent of natural gas.

.....[1]

(ii) Complete the sentences below using suitable words or phrases.

Coal, natural gas and petroleum are all ..... fuels.

Petroleum is a mixture of different compounds and is separated by the process of

..... . [2]

(b) Cracking is used to break large molecules into smaller molecules.

During cracking a molecule of octane forms one molecule of ethane, C_2H_6, and three molecules of another compound.

The structure of octane is shown in Fig. 5.1.

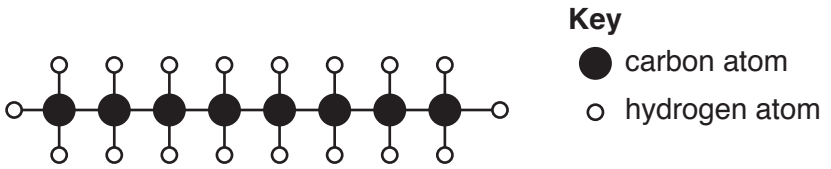

Fig. 5.1

Deduce the formula of octane and complete the symbol equation for the cracking of octane.

$$\underset{\text{octane}}{\text{.....}} \rightarrow C_2H_6 + 3 \text{ .....}$$

[2]

(c) Ethane is a hydrocarbon.

(i) State what is meant by the term *hydrocarbon*.

.....

.....

.....[2]

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(ii) The formulae of two other hydrocarbons are C_6H_{12} and C_6H_{14}.

Deduce which is an alkene.
Explain your answer.

alkene .....

explanation .....

.....

.....

[1]

(iii) Name a reagent that is used in a test to distinguish between alkanes and alkenes.
State the observation for each test.

reagent .....

alkanes .....

alkenes .....

[2]

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6 **(a)** Describe how the following structures of a wind-pollinated flower differ from those of an insect-pollinated flower.

the stamen .....

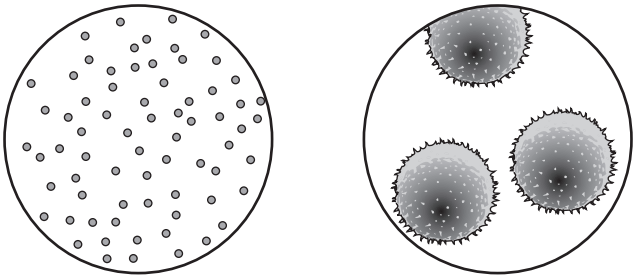
.....

the stigma .....

.....

[2]

(b) A student looks at some pollen from a wind-pollinated flower and an insect-pollinated flower under the microscope at the same magnification. Fig. 6.1 shows what she sees.



slide **1** slide **2**

Fig. 6.1

State the slide showing pollen from a wind-pollinated flower.

.....

Explain how this pollen is adapted for wind pollination.

.....

.....

[1]

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(c) Another student investigates the rate of transpiration from a leafy twig under different conditions. Fig. 6.2 shows the apparatus he uses.

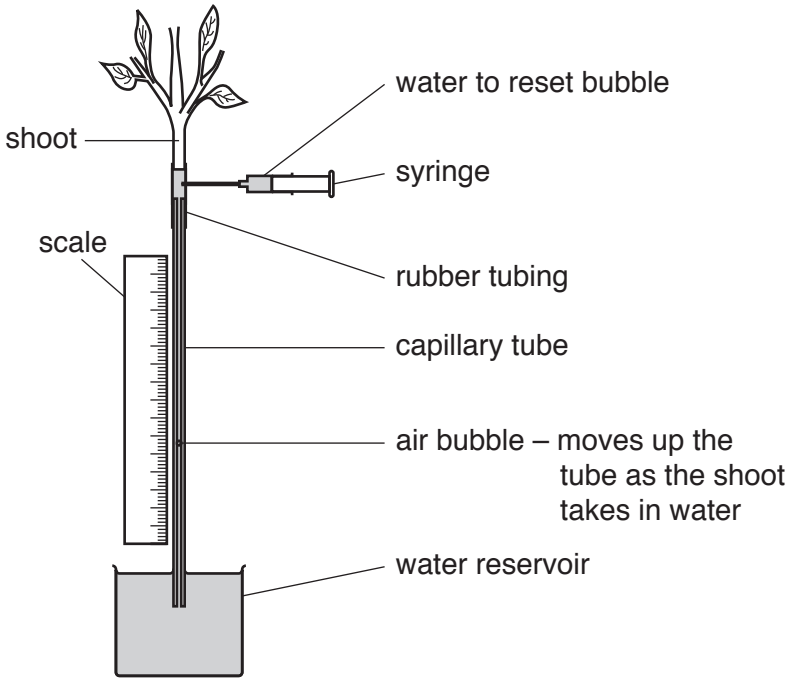

Fig. 6.2

- He measures how far the air bubble moves upwards in one minute.
- He uses the syringe of water to reset the apparatus.
- The student repeats the experiment under different environmental conditions.
- His readings are shown in Table 6.1.

Table 6.1

conditions	distance moved by bubble in one minute / cm
dry air at 22 °C	1.1
dry air at 27 °C	6.8
humid air at 22 °C	

(i) Explain why the distance the bubble moved increases when the temperature rises to 27 °C.

.....

.....

.....

.....[2]

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(ii) Suggest a possible reading for humid air at 22 °C. Explain your answer.

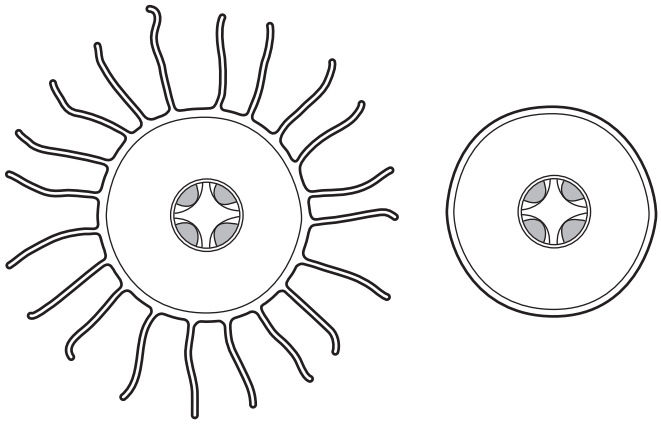
reading .....

explanation .....

.....

.....[1]

(d) In the ground the plant takes in water at the roots.
Fig. 6.3 shows the distribution of the tissues in the cross-sections of two similar roots of the same size.



root **X** root **Y**

Fig. 6.3

Suggest which root would take in water more quickly.

root .....

Describe and explain why this root takes in water more quickly.

.....

.....

.....[2]

(e) These roots do not carry out photosynthesis because they are found underground and do not have chlorophyll.

Describe the role of chlorophyll in photosynthesis.

.....

.....

.....

.....[2]

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7 **(a)** Fig. 7.1 shows a wave generated in a string. One end of the string is fixed to a stand and clamp, while the other end is attached to a vibrator driven by an electric motor.

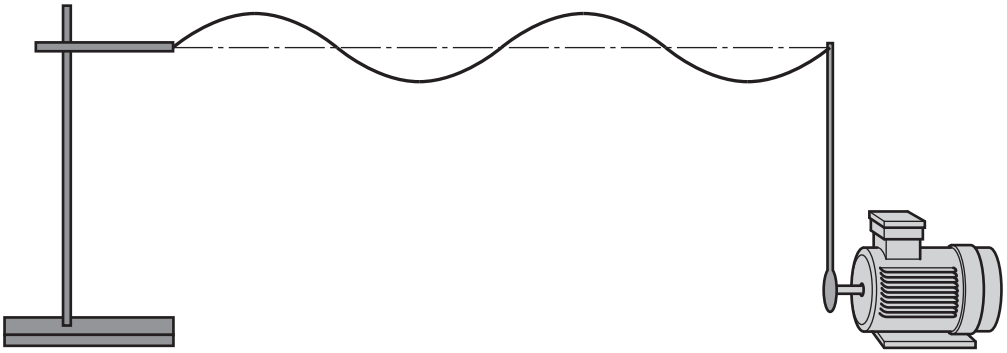

Fig. 7.1

(i) The length of the string is 100 cm.

State the wavelength of the wave motion shown in Fig. 7.1.

..... cm [1]

(ii) State what is meant by the *amplitude* of the wave.

.....

.....[1]

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(b) Fig. 7.2 shows part of the circuit diagram for the circuit used to drive the vibrator.

The frequency of the vibrator depends on the speed of the motor. The speed of the motor depends on the current through the motor.

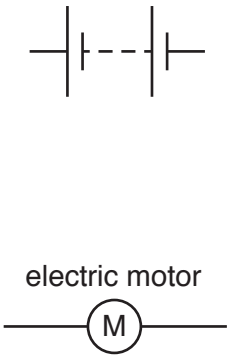

Fig. 7.2

Complete the circuit diagram by using the symbols for suitable circuit components in the correct places in the circuit to

1. control the current through the motor,
2. measure the current through the motor. [3]

(c) A voltmeter connected across the motor reads 3.0 V. The current through the motor is 2.0 A.

(i) Calculate the resistance of the motor.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

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(ii) Calculate the power input to the motor.

State the formula you use and show your working.

formula

working

power = ... W [2]

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8 During the electrolysis of aluminium oxide, Al_2O_3, aluminium is produced.
This process is shown in Fig. 8.1.

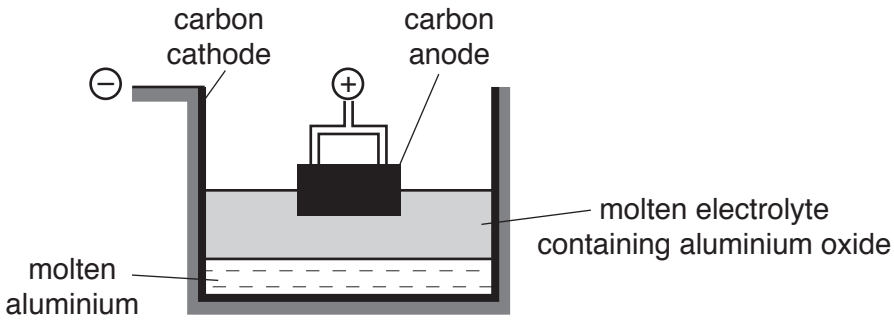

Fig. 8.1

(a) Explain why the electrolysis of aluminium oxide does not take place at room temperature. Use ideas about particles in your answer.

.....

.....

.....

.....

.....[2]

(b) Describe what happens to the oxide ions, O^{2-}, during the electrolysis of aluminium oxide.

.....

.....

.....

.....[2]

(c) State and explain whether aluminium is oxidised or reduced during electrolysis.

.....

.....[1]

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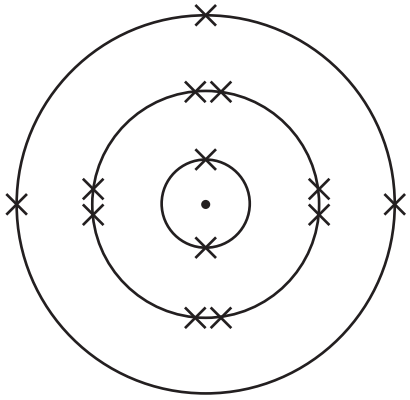
(d) The electronic structure of an aluminium atom is shown in Fig. 8.2a.



A*l* atom

Fig. 8.2a

A*l* ion

Fig. 8.2b

Draw the electronic structure of an aluminium ion in Fig. 8.2b. [1]

(e) Predict the type of bonding in a compound formed between rubidium, a Group I element, and fluorine, a Group VII element.

Explain your answer.

bonding .....

explanation .....

.....

.....

[2]

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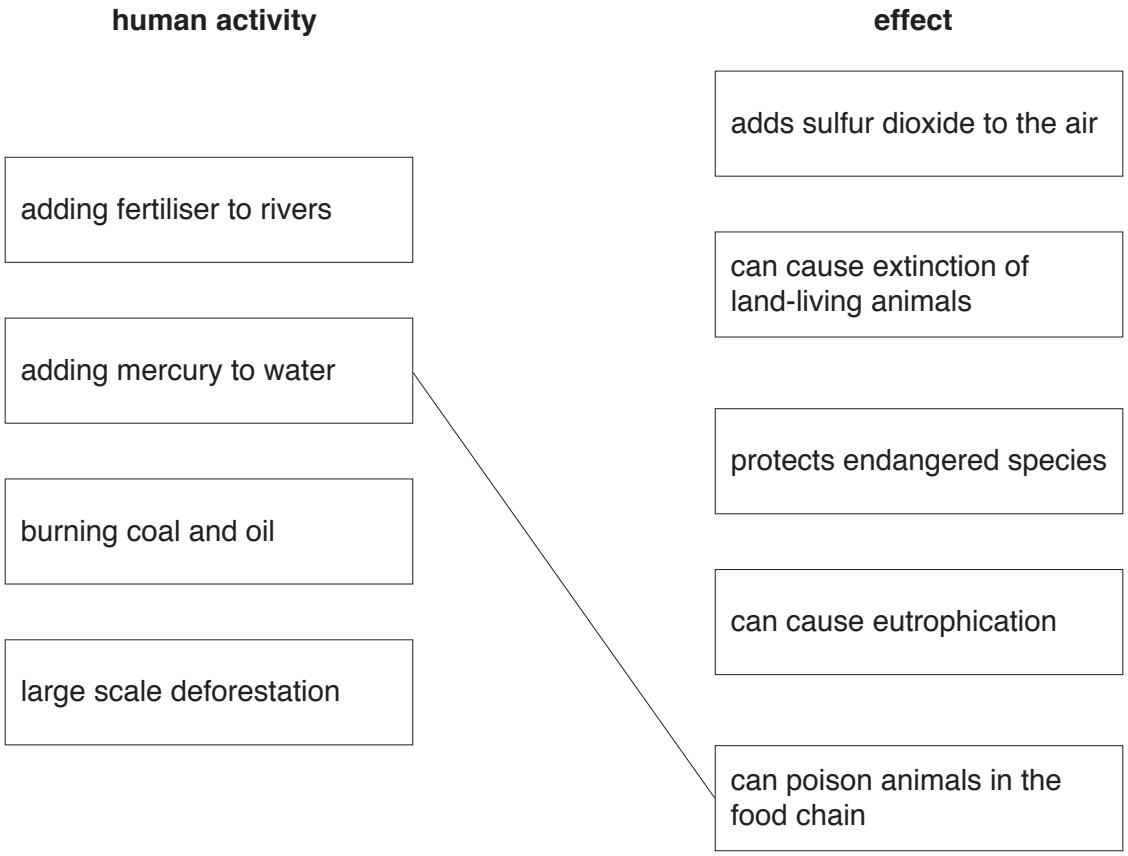
9 **(a)** Many human activities can affect the environment.

Draw **one** line from each human activity to its effect. One line is drawn for you.



[3]

(b) Human activities can cause an increase in the concentration of carbon dioxide in the atmosphere.

(i) State one large-scale human activity that increases the concentration of carbon dioxide in the atmosphere.

.....[1]

(ii) Explain why an increase in the concentration of carbon dioxide in the atmosphere is undesirable.

.....

.....

.....

.....

.....

.....[3]

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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 –

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