Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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2781194872

COMBINED SCIENCE **0653/42**

Paper 4 (Extended) **February/March 2019**

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 **21** printed pages and **3** blank pages.

Cambridge Assessment International Education

1 (a) (i) Fig. 1.1 shows a food chain of some organisms in a garden.

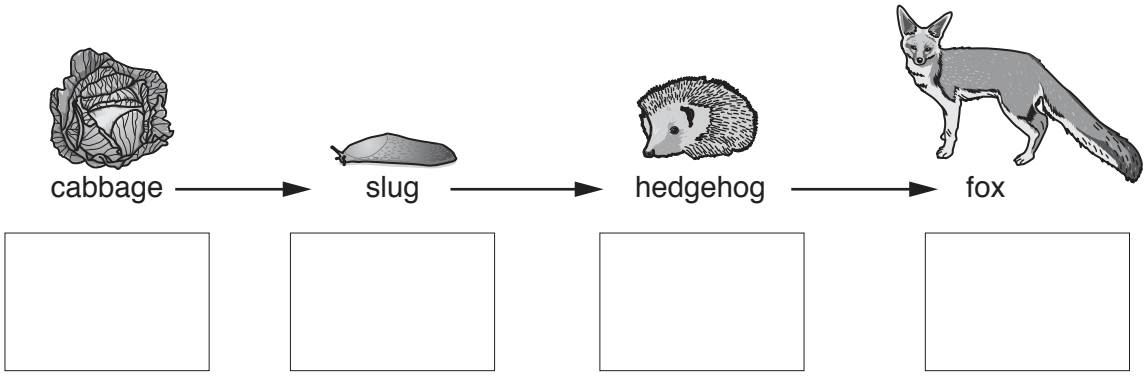

Fig. 1.1

The list shows the trophic levels of the organisms.

primary consumer **producer** **secondary consumer** **tertiary consumer**

In Fig. 1.1 write the correct trophic level in the box below each organism. [1]

(ii) Fig. 1.2 shows a second food chain in the same garden.

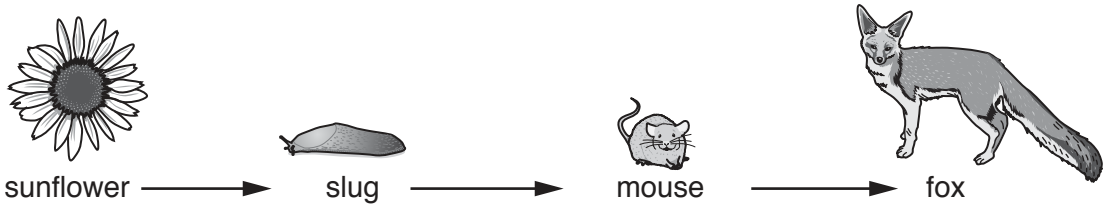

Fig. 1.2

Complete the food web below by combining the organisms in the two food chains shown in Fig. 1.1 and Fig. 1.2. You do **not** need to include the pictures.

cabbage sunflower

[2]

(iii) State **two** ways in which energy is wasted during transfer between trophic levels.

1. .....

.....

2. .....

..... [2]

(b) Humans must eat a variety of foods for a balanced diet.

(i) Use words from the list to complete the essential components of a human's diet.

bile **carbohydrates** **chlorophyll** **enzymes**

haemoglobin **hormones** **proteins**

A balanced diet contains mineral salts, fibre, ... , fats,

water, ... and vitamins. [1]

(ii) Describe the importance of fibre in the diet.

.....

..... [1]

(iii) The list shows some foods. One of them is rich in fibre.

apple **cheese** **fish** **meat** **milk**

State the food rich in fibre. ..... [1]

(c) If a person's diet does not contain all the nutrients needed they can develop deficiency diseases. Scurvy is an example of a deficiency disease.

State the cause of the disease scurvy.

..... [1]

(d) The amount of each nutrient in a balanced diet varies according to a person's need.
The list describes four people **A**, **B**, **C** and **D**.

person **A** is an adult male office worker
person **B** is an adult male gardener
person **C** is a teenage boy
person **D** is a teenage girl

(i) Suggest which person, **A** or **B**, needs more energy supplied by their diet.
Give a reason for your answer.

person .....

reason .....

..... [1]

(ii) Suggest which person, **C** or **D**, needs more energy supplied by their diet.
Give a reason for your answer.

person .....

reason .....

..... [1]

[Total: 11]

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2 **(a)** Fig. 2.1 shows the processes of fractional distillation and cracking.

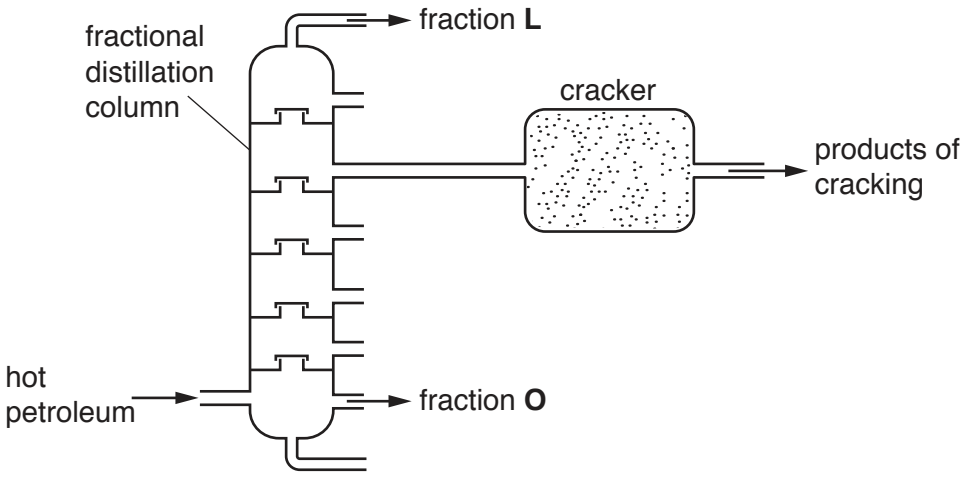


Fig. 2.1

(i) State **two** ways in which fraction **O** differs from fraction **L**.

1. .....

.....

2. .....

..... [2]

(ii) State **one** condition needed for the cracking process.

.....

..... [1]

(b) Cracking breaks down large saturated hydrocarbon molecules into smaller hydrocarbon molecules.

The equation below shows a chemical reaction that occurs during cracking.

$$C_{18}H_{38} \rightarrow C_9H_{20} + 3C_2H_4 + C_xH_y$$

Determine the values of **x** and **y**.

x = ...

y = ... [2]

(c) Ethene, an alkene, has the formula C_2H_4.

Complete the dot-and-cross diagram to show the bonding electrons in a molecule of ethene.

C C

[3]

(d) The hydrocarbon $C_{18}H_{38}$ is an alkane. The alkanes are a homologous series.

Explain what is meant by the term *homologous series*.

.....

.....

..... [2]

[Total: 10]

3 Fig. 3.1 shows a girl throwing a beach ball up in the air.

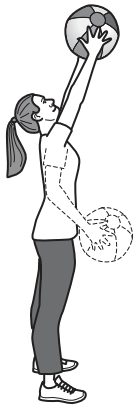


Fig. 3.1

The ball moves vertically upwards, then falls down and the girl catches it.

Fig. 3.2 shows a graph of the ball's motion from when it leaves the girl's hand until she catches it.

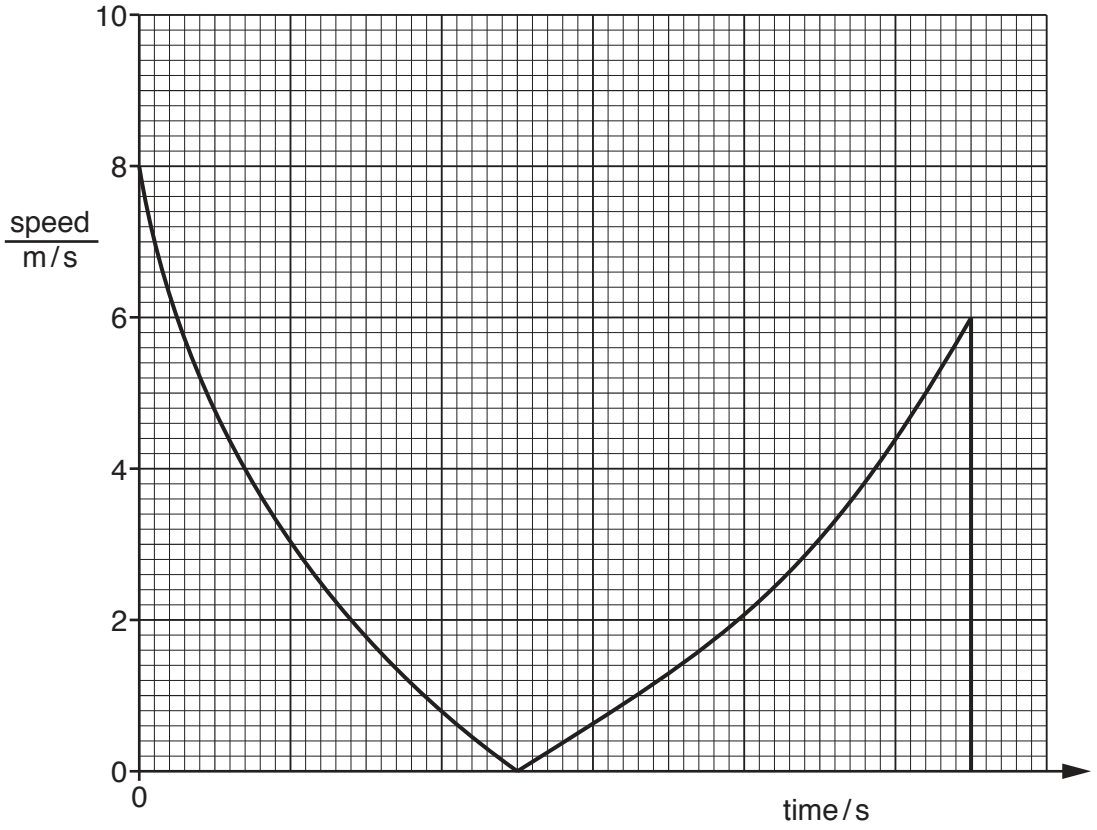


Fig. 3.2

(a) On Fig. 3.2, label with an **X** the point when the ball reaches its maximum height. [1]

(b) The girl applies an upward force of 8.4 N to the ball.

The ball has a mass of 0.12 kg.

(i) Calculate the resultant force on the ball.

gravitational field strength, g = 10 N / kg

Show your working.

force = ... N [2]

(ii) The ball left the girl's hand when it was 1.4 m above the ground.

Calculate the increase in gravitational potential energy of the ball when it reaches a height of 4.1 m above the ground.

Show your working.

gravitational potential energy = ... J [3]

(c) **(i)** State the formula for calculating the kinetic energy of a moving object.

..... [1]

(ii) The mass of the ball is 0.12 kg.

Use this information and Fig. 3.2 to calculate the kinetic energy of the ball as it left the girl's hand.

Show your working.

kinetic energy = ... J [2]

[Total: 9]

4 Fig. 4.1 shows a diagram of the internal structure of the heart and the blood vessels entering and leaving the heart.

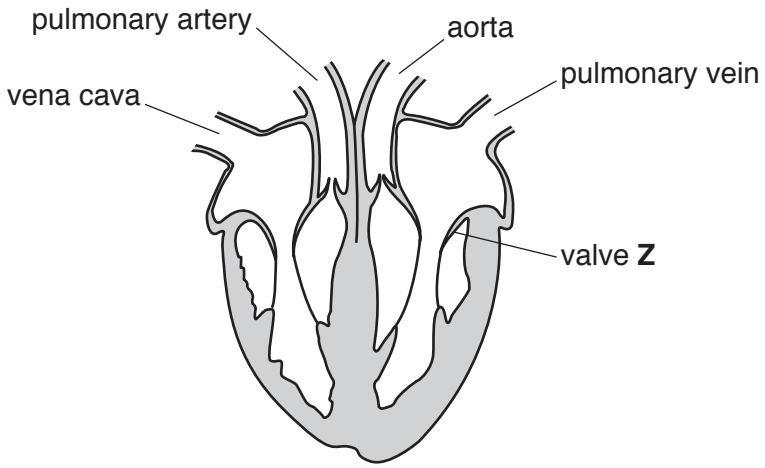


Fig. 4.1

(a) Describe the function of valve **Z** in the heart shown in Fig. 4.1.

.....

.....

..... [2]

(b) The concentrations of oxygen gas and of carbon dioxide gas in the blood in each side of the heart are measured.
The results are shown on Fig. 4.2.

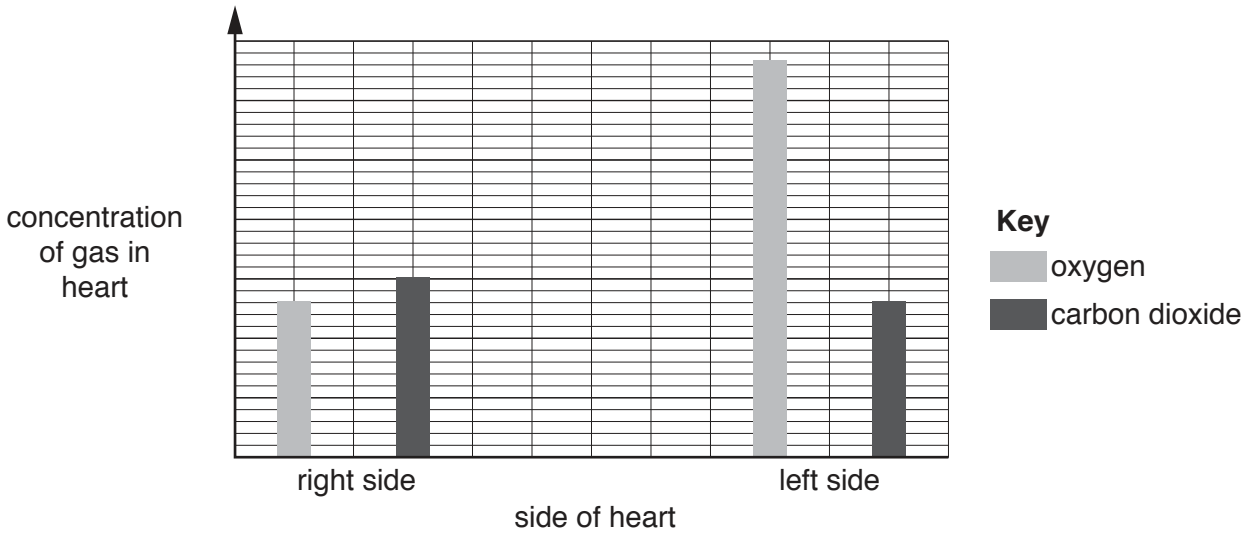


Fig. 4.2

(i) Explain why the concentration of carbon dioxide in the blood in the right side of the heart is higher than in the left side.

.....

.....

..... [2]

(ii) Describe what causes the oxygen concentration in the blood to be higher in the left side of the heart compared with the right side.

.....

..... [1]

(c) (i) State what is meant by *coronary heart disease*.

.....

.....

..... [2]

(ii) Describe **one** lifestyle choice a person can make to reduce the chance of developing coronary heart disease.

.....

..... [1]

[Total: 8]

5 **(a)** Iron is an element in Period 4 of the Periodic Table shown on page 24.

(i) Name the collection of metals in Period 4 that contains iron.

..... [1]

(ii) Deduce the number of electrons in an atom of iron.

electrons ..... [1]

(b) Suggest why iron is used in the form of alloys, rather than as pure iron, for making cars.

.....

..... [1]

(c) Iron is extracted from iron (III) oxide in a blast furnace.

(i) State the fuel used in a blast furnace.

..... [1]

(ii) Deduce the formula of the oxide of iron containing iron (III) ions, Fe^{3+}, and oxide ions, O^{2-}.

formula ..... [1]

(iii) The word equation for one of the reactions occurring in the blast furnace is shown below.

iron (III) oxide + carbon monoxide $\rightarrow$ iron + carbon dioxide

Explain why this is a redox reaction.

.....

.....

..... [2]

(iv) Explain why aluminium cannot be extracted from aluminium oxide in a blast furnace.

.....

..... [1]

(v) The carbon dioxide produced in a blast furnace escapes into the atmosphere.

Carbon dioxide is a greenhouse gas.

State **one** possible effect of an increase in the concentration of carbon dioxide gas in the atmosphere.

.....

..... [1]

(d) Iron (III) sulfate, $Fe_2(SO_4)_3$, is a soluble salt.

Name **two** substances that react together to form iron (III) sulfate.

1. .....

2. ..... [1]

[Total: 10]

6 The bathroom in a house has electric heating under the floor.

(a) Fig. 6.1 shows part of the heating circuit, with two identical heaters, heater 1 and heater 2.

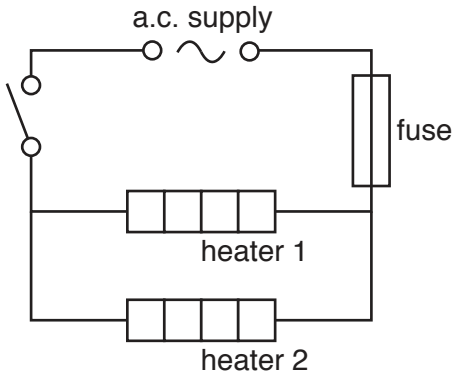


Fig. 6.1

When the circuit is switched on, the current in heater 1 is 4 A.

State the current in the fuse.

current = ... A

Explain your answer.

.....

.....

[2]

(b) The heaters are placed underneath a wooden floor.

The heating circuit is switched on, and the temperature of the heaters quickly reaches 70 °C.

Thermal energy conducted through the wood causes the temperature of the upper surface of the floor to increase slowly from 20 °C to 25 °C.

Air in contact with the floor is heated and warms the bathroom by convection.

Describe in terms of molecules:

(i) how thermal energy passes through the wood by conduction

.....

.....

..... [2]

(ii) how thermal energy is transferred from the surface of the floor to the ceiling of the bathroom.

.....

.....

.....

..... [3]

(c) When the heaters are switched on, a small gap between the edge of the wooden floor and the walls of the bathroom slowly disappears.

Predict what will happen when the heaters are switched off again.

Explain your answer.

prediction .....

explanation .....

.....

[2]

[Total: 9]

7 **(a)** Fig. 7.1 shows a diagram of a wind-pollinated flower.

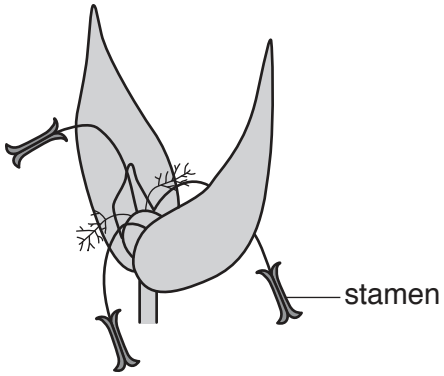


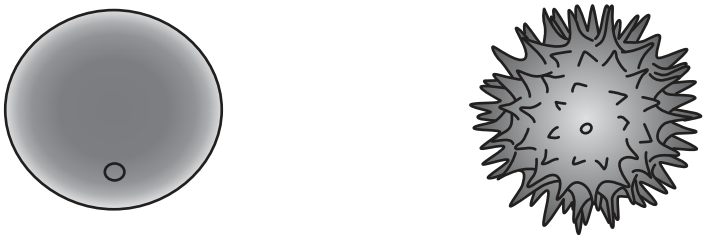
Fig. 7.1

Describe how the stamen in Fig. 7.1 is adapted for wind-pollination.

.....

..... [2]

(b) Fig. 7.2 shows two pollen grains. One is from a wind-pollinated flower and the other is from an insect-pollinated flower. They are not drawn to scale.



F **G**

Fig. 7.2

Suggest which pollen grain, **F** or **G**, comes from a wind-pollinated flower.

Give a reason for your answer.

pollen grain .....

reason .....

..... [1]

(c) After pollination, fertilisation must take place before seeds can be produced.

Describe the difference between pollination and fertilisation.

.....

.....

..... [2]

(d) Pollen grains in the flower need energy from photosynthesis in the leaves.

(i) Name the cells in the leaf where most photosynthesis takes place.

..... [1]

(ii) Describe how the cells you named in **(i)** are adapted for photosynthesis.

.....

..... [1]

(iii) Name the part of the plant that transports sugars.

..... [1]

[Total: 8]

8 **(a)** Fig. 8.1 shows the apparatus a student uses to investigate the reaction between magnesium powder and excess dilute hydrochloric acid. The reaction produces a salt and hydrogen gas.

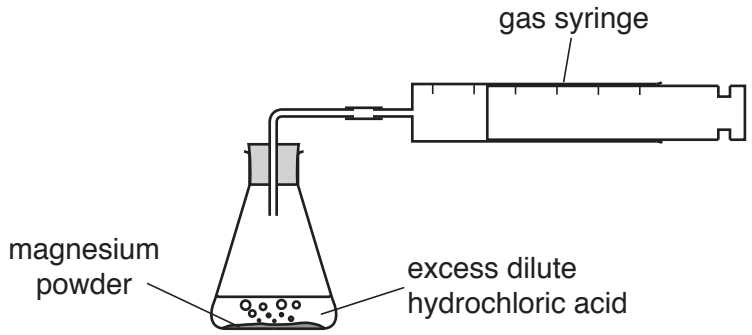


Fig. 8.1

The student measures the volume of gas in the gas syringe at regular intervals.

Fig. 8.2 shows a graph of her results.

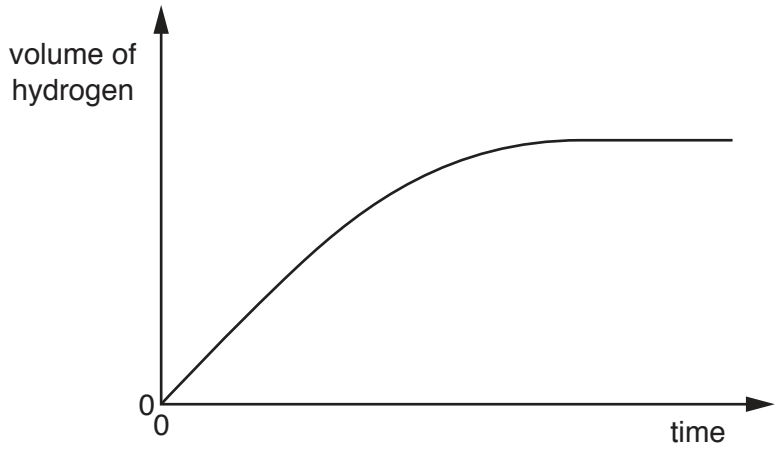


Fig. 8.2

(i) On Fig. 8.2 mark with an **X** a time at which the reaction has already finished. [1]

(ii) The student repeats the investigation at a higher temperature.

On Fig. 8.2 sketch a line to suggest the results of this experiment. [1]

(iii) Explain the line you sketched in **(a)(ii).**

.....

.....

.....

..... [2]

(b) Table 8.1 shows the composition of an alloy.

Table 8.1

element	% by mass
aluminium	8.0
magnesium	91.2
manganese	0.2
zinc	0.6

Calculate the mass of magnesium in 500 g of the alloy.

mass of magnesium = ... g [1]

(c) Magnesium is produced by the electrolysis of molten magnesium chloride.

Name the substance produced at the anode.

..... [1]

[Total: 6]

9 In many cities, sodium street lamps are used at night. These lamps produce an intense yellow light.

(a) A street is lit by eight identical sodium lamps using mains voltage of 240 V. The current in each lamp is 0.50 A.

The street is lit for 12 hours during the night.

Calculate the electrical energy used.

Show your working.

energy = ... J [3]

(b) A sodium street lamp emits electromagnetic radiation as yellow light with a wavelength of 589×10^{-9} m.

(i) State the speed at which electromagnetic waves travel.

speed = ... m/s [1]

(ii) Use your answer to **(b)(i)** to calculate the frequency of the yellow light emitted by a sodium lamp.

Show your working.

frequency = ... Hz [2]

(c) Electromagnetic radiation and water waves are examples of transverse wave motion.

Sound is an example of longitudinal wave motion.

Describe **one** way in which a longitudinal wave differs from a transverse wave.

.....

..... [1]

(d) Table 9.1 shows some of the wavelengths of electromagnetic radiation emitted by another type of street lamp called a mercury-vapour lamp.

Table 9.1

wavelength / 10^{-9} m	colour
184	not visible
404	violet
436	blue
546	green
578	yellow-orange

(i) Use information in Table 9.1 to suggest the part of the electromagnetic spectrum where a wavelength of 184×10^{-9} m is likely to be found.

Give a reason for your answer.

part of spectrum .....

reason .....

.....

[1]

(ii) Describe a danger to human health if this wavelength is **not** removed when mercury-vapour lamps are used near people.

.....

..... [1]

[Total: 9]

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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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).