



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

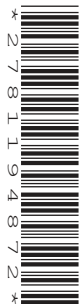
CANDIDATE
NAME

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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.

2

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

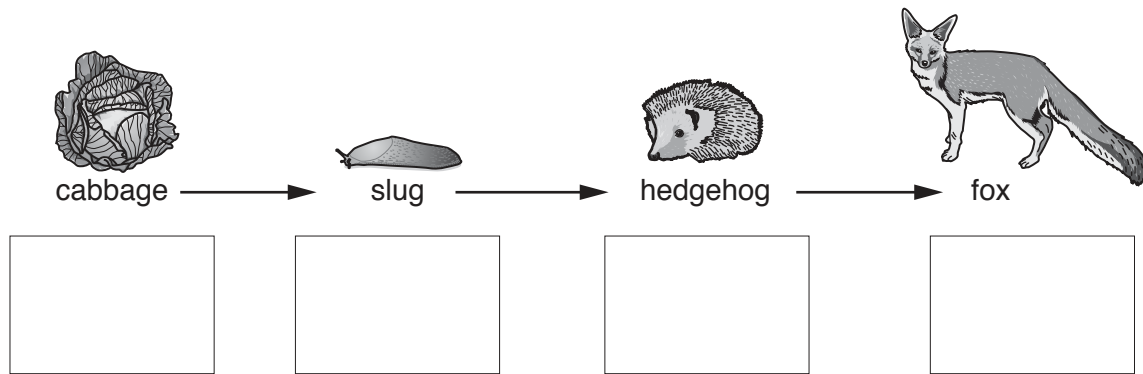


Fig. 1.1

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]

3

(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]

4

- (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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6

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

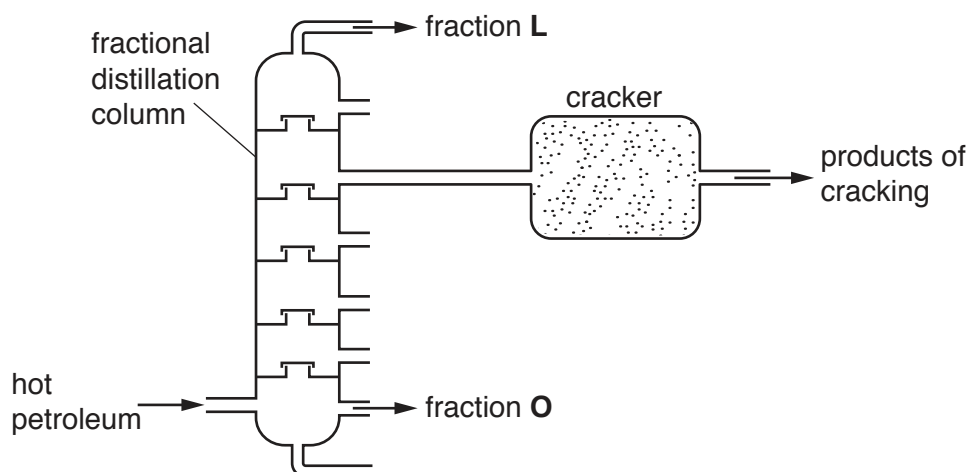


Fig. 2.1

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

1.

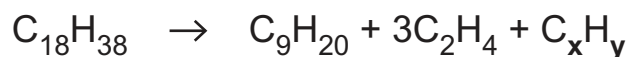
 2.
 [2]

- (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.



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

x =

y =

[2]

7

- (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]

8

- 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.

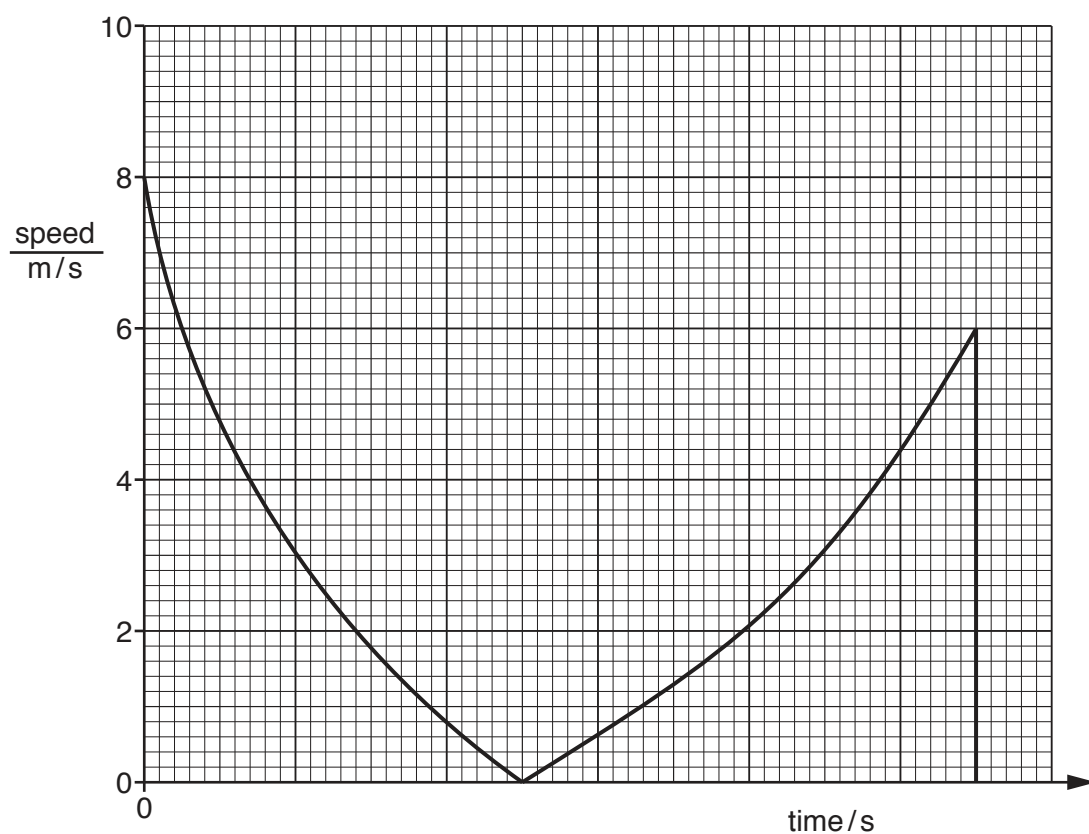


Fig. 3.2

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

[1]

9

- (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, $g = 10 \text{ N/kg}$

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]

10

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

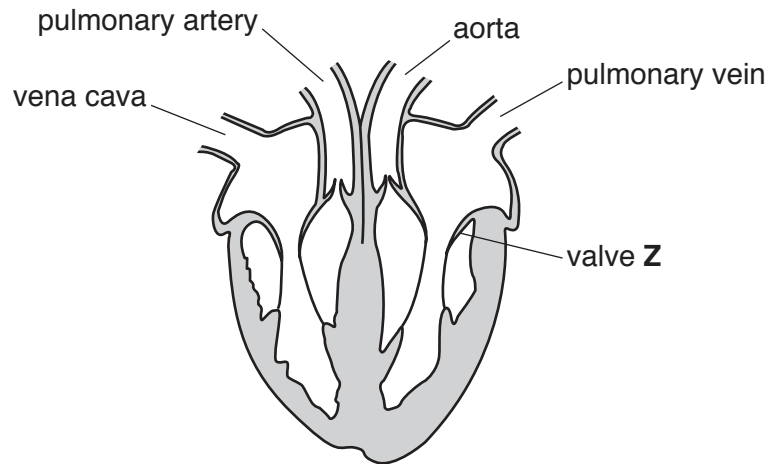


Fig. 4.1

- (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.

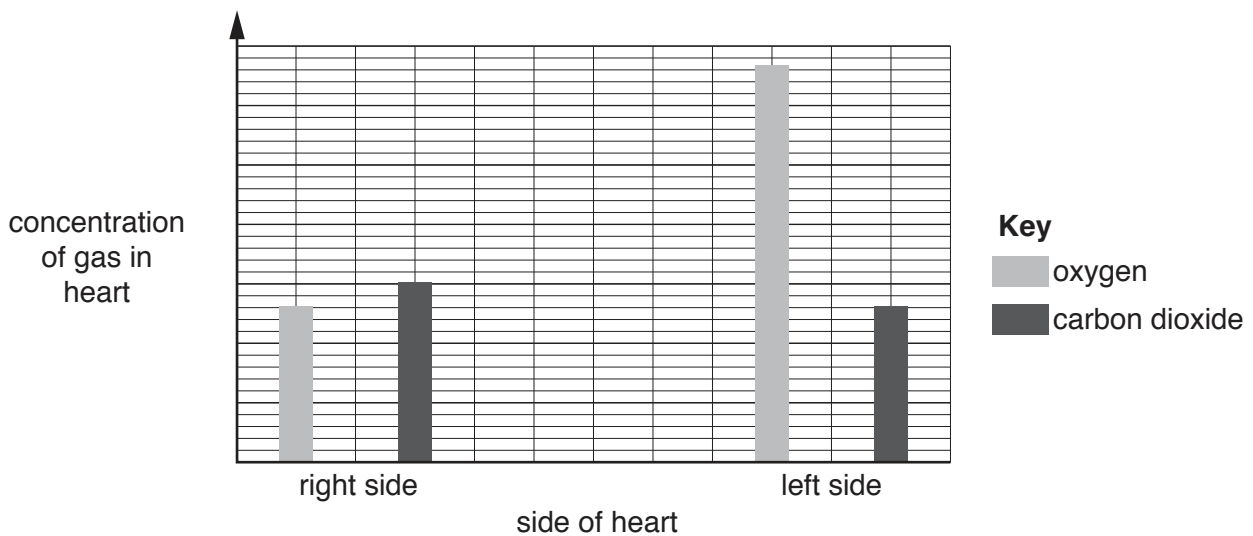


Fig. 4.2

11

- (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]

13

- (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, $\text{Fe}_2(\text{SO}_4)_3$, is a soluble salt.

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

1.
2. [1]

[Total: 10]

14

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.

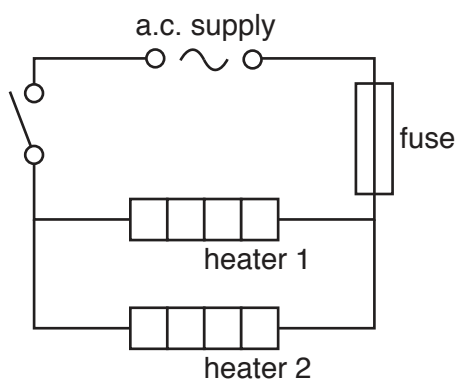


Fig. 6.1

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]

15

- (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]

16

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

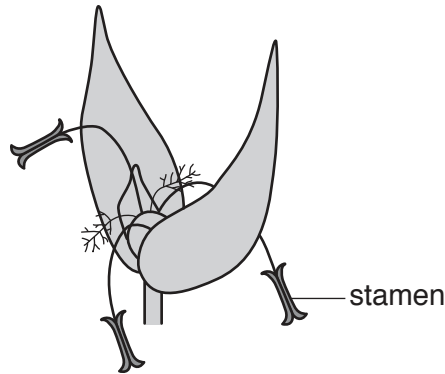


Fig. 7.1

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.

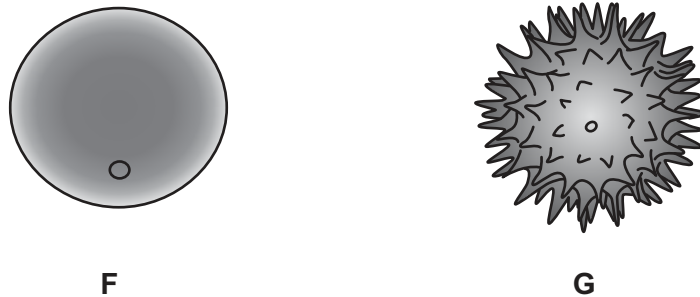


Fig. 7.2

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

Give a reason for your answer.

pollen grain

reason

..... [1]

17

- (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]

18

- 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.

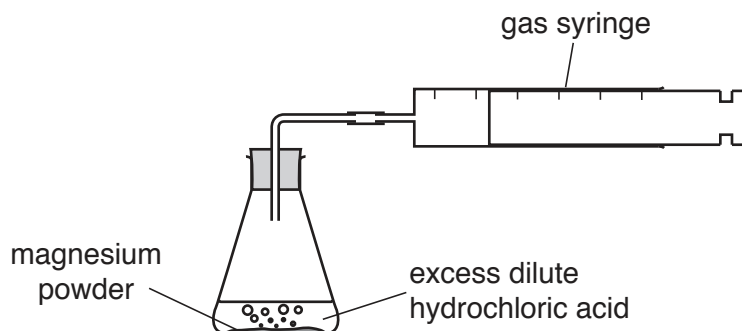


Fig. 8.1

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

Fig. 8.2 shows a graph of her results.

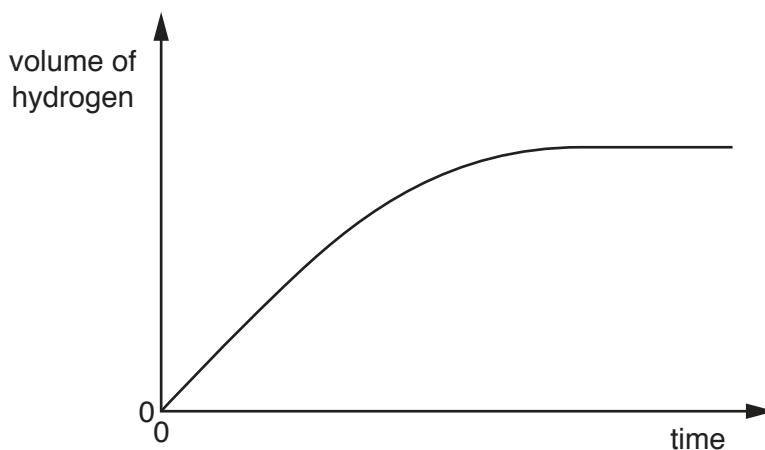


Fig. 8.2

- (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]

19

(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]

20

- 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 240V. The current in each lamp is 0.50A.

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 $589 \times 10^{-9}\text{m}$.

- (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 $184 \times 10^{-9}\text{ m}$ 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]

The Periodic Table of Elements

Group																		
I	II											III	IV	V	VI	VII	VIII	
1 H hydrogen 1 2 He helium 4																		
3	4											5	6	7	8	9		
Li lithium 7	Be beryllium 9											B boron 11	C carbon 12	N nitrogen 14	O oxygen 16	F fluorine 19		
11	12											13	14	15	16	17	18	
Na sodium 23	Mg magnesium 24											Al aluminium 27	Si silicon 28	P phosphorus 31	S sulfur 32	Cl chlorine 35.5	Ar argon 40	
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
K potassium 39	Ca calcium 40	Sc scandium 45	Ti titanium 48	V vanadium 51	Cr chromium 52	Mn manganese 55	Fe iron 56	Co cobalt 59	Ni nickel 59	Cu copper 64	Zn zinc 65	Ga gallium 70	Ge germanium 73	As arsenic 75	Se selenium 79	Br bromine 80	Kr krypton 84	
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Rb rubidium 85	Sr strontium 88	Y yttrium 89	Zr zirconium 91	Nb niobium 93	Mo molybdenum 96	Tc technetium —	Ru ruthenium 101	Rh rhodium 103	Pd palladium 106	Ag silver 108	Cd cadmium 112	In indium 115	Sn tin 119	Sb antimony 122	Te tellurium 128	I iodine 127	Xe xenon 131	
55	56	57–71 lanthanoids		72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs caesium 133	Ba barium 137			Hf hafnium 178	Ta tantalum 181	W tungsten 184	Re rhenium 186	Os osmium 190	Ir iridium 192	Pt platinum 195	Au gold 197	Hg mercury 201	Tl thallium 204	Pb lead 207	Bi bismuth 209	Po polonium —	At astatine —	Rn radon —
87	88	89–103 actinoids		104	105	106	107	108	109	110	111	112			116			
Fr francium —	Ra radium —			Rf rutherfordium —	Db dubnium —	Sg seaborgium —	Bh bohrium —	Hs hassium —	Mt meitnerium —	Ds darmstadtium —	Rg roentgenium —	Cn copernicium —	Fl flerovium —		Lv livermorium —			
lanthanoids		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71		
		La lanthanum 139	Ce cerium 140	Pr praseodymium 141	Nd neodymium 144	Pm promethium —	Sm samarium 150	Eu europium 152	Gd gadolinium 157	Tb terbium 159	Dy dysprosium 163	Ho holmium 165	Er erbium 167	Tm thulium 169	Yb ytterbium 173	Lu lutetium 175		
actinoids		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103		
		Ac actinium —	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium —	Pu plutonium —	Am americium —	Cm curium —	Bk berkelium —	Cf californium —	Es einsteinium —	Fm fermium —	Md mendelevium —	No nobelium —	Lr lawrencium —		

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).