UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3454612941

COMBINED SCIENCE **0653/03**

Paper 3 (Extended) **October/November 2007**

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 a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **21** printed pages and **3** blank pages.

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

1 Hydrogen peroxide, H_2O_2, is a colourless liquid.

Hydrogen peroxide decomposes according to the equation below.

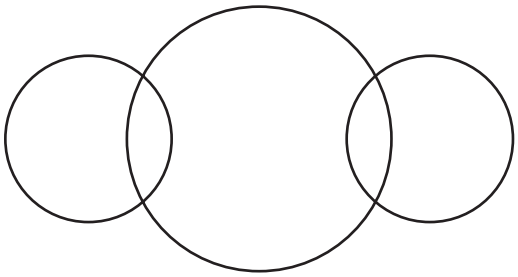
hydrogen peroxide $\rightarrow$ water + oxygen

(a) State the total number of atoms which are bonded in one molecule of hydrogen peroxide.

..... [1]

(b) Complete the bonding diagram below to show

- the chemical symbols of the elements in a molecule of water,
- the arrangement of the outer electrons of each atom.



[2]

(c) Fig. 1.1 shows apparatus which a student used to measure the rate at which hydrogen peroxide decomposes.

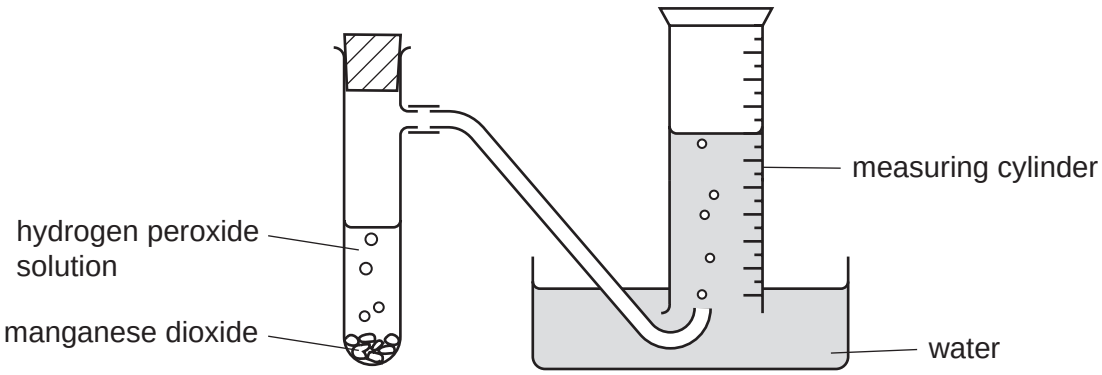


Fig. 1.1

The student measured the time for a known volume of oxygen gas to collect in the measuring cylinder.

Table 1.1 shows results the student obtained for four experiments, **A**, **B**, **C** and **D**.

For Examiner's Use

Table 1.1

experiment	volume of oxygen gas collected /cm^3	time taken for oxygen to collect /seconds
A	40	35
B	40	15
C	40	10
D	40	25

(i) State and explain in which experiment, **A**, **B**, **C** or **D**, the reaction rate was the highest.

.....

.....

..... [1]

(ii) State and explain, in terms of particles, **one** variable (factor) which the student could have changed in order to obtain the results shown in Table 1.1.

.....

.....

.....

..... [3]

For Examiner's Use

2 Fig. 2.1 shows the inside of a refrigerator.

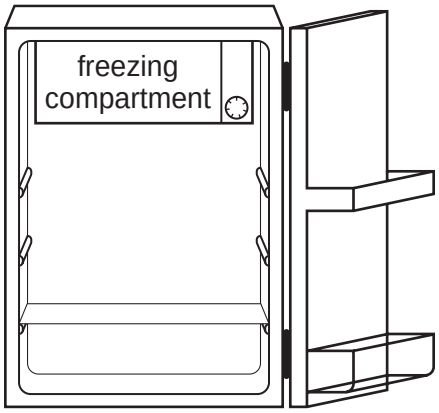


Fig. 2.1

(a) (i) Draw arrows on Fig. 2.1 to show what happens to the air cooled by the freezing compartment. [1]

(ii) Use the idea of density to explain why this happens.

.....

.....

..... [2]

(b) When the refrigerator is used for 60 minutes, 360 000 joules of electrical energy are converted.

(i) How many joules of energy are converted per second?

..... joules [1]

(ii) What is the power of the refrigerator?

..... [1]

For Examiner's Use

(c) The refrigerator has two lamps inside. The supply voltage is 240 V and the current passing through each lamp is 0.04 A.

(i) Show that the resistance of one lamp is 6000 Ω.

State the formula that you use and show your working.

formula used

working

[1]

(ii) The lamps are connected together in parallel.

Calculate the combined resistance of the two lamps.

State the formula that you use and show your working.

formula used

working

..... [3]

For Examiner's Use

3 Fig. 3.1 shows a plant, and also a cell from part of the plant.

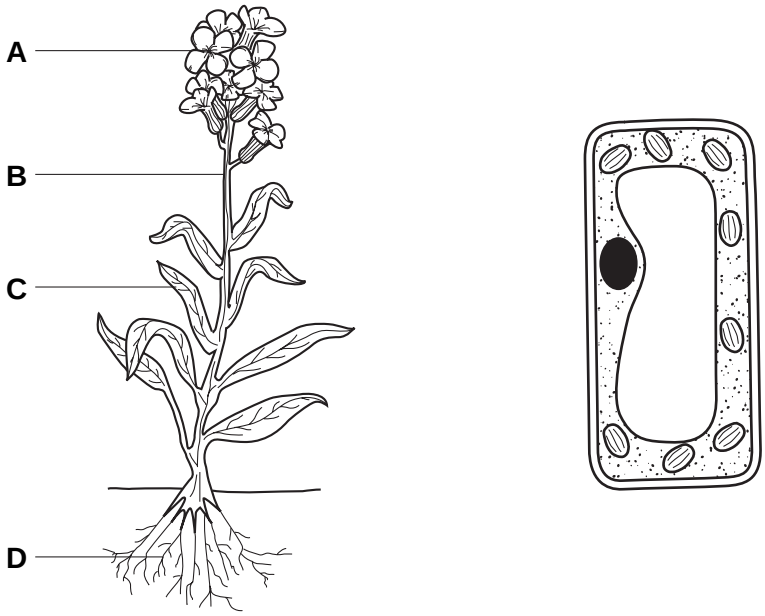


Fig. 3.1

(a) From which part of the plant, **A**, **B**, **C** or **D**, does the cell come?

.....

[1]

(b) On the diagram of **the cell** in Fig. 3.1, label the following structures.

Use label lines and the appropriate letters.

P a partially permeable membrane

Q the part of the cell that contains DNA

R a part of the cell that contains a substance whose molecules contain magnesium

[3]

(c) When a leaf is tested for starch, it is first boiled in water and then put into hot alcohol.

Explain why these steps are necessary.

boiling in water .....

.....

putting into hot alcohol .....

..... [2]

For Examiner's Use

(d) Part **A** of the plant in Fig. 3.1 is a flower.

(i) Is this an insect-pollinated or a wind-pollinated flower?

Explain your answer.

type of pollination .....

explanation .....

..... [1]

(ii) Some pollen from one of the flowers on this plant is transferred onto the stigma of another flower on the same plant. The male gamete in the pollen fertilises a female gamete in the flower.

Is this asexual reproduction or sexual reproduction?

Explain your answer.

type of reproduction .....

explanation .....

..... [1]

(iii) Explain why a plant breeder may prefer to use an asexual method of propagation of his plants, rather than a sexual method.

.....

.....

..... [2]

[Turn over

4 The apparatus in Fig. 4.1 can be used to study the reaction between potassium and oxygen.

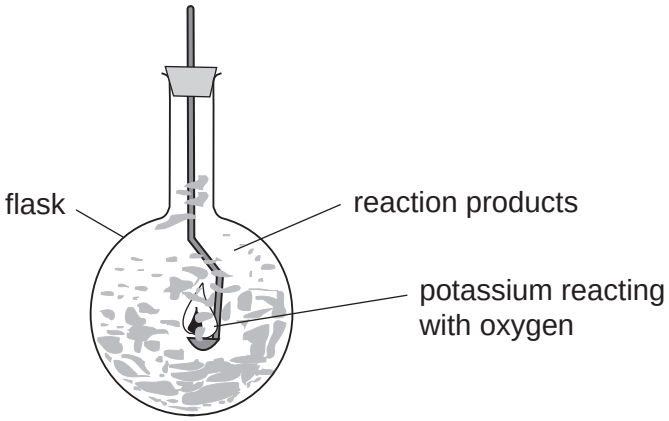


Fig. 4.1

(a) Suggest why the flask becomes warm during the reaction.

.....

..... [1]

(b) One of the compounds formed in this reaction is potassium oxide.

The electron configurations of a potassium **atom** and an oxygen **atom** are shown below.

K	2.8.8.1
O	2.6

Use this information to explain the bonding in potassium oxide. In your answer you should describe any changes in the electron configurations of these atoms, and deduce the chemical formula of potassium oxide.

.....

.....

.....

.....

.....

.....

..... [5]

(c) Another compound formed in the reaction in Fig. 4.1 is potassium peroxide, K_2O_2. When potassium peroxide is added to water the products are potassium hydroxide and oxygen gas.

(i) A student attempted to work out the balanced equation for this reaction. His attempt is shown below.

$$2K_2O_2 + 2H_2O \longrightarrow 2KOH + O_2$$

His teacher said this attempt was incorrect. Explain why this attempt is incorrect, and write down the correct equation.

.....

.....

..... [2]

(ii) Describe how the student should test the gas given off to confirm that it is oxygen.

.....

..... [1]

(iii) The student found that the pH of the final mixture was 13.

Write the formula and charge of the ion present in the mixture which is responsible for this pH value.

..... [1]

For Examiner's Use

5 A space rocket is launched to the Moon.

(a) After launch, the empty fuel tanks are released and fall back to Earth. As a tank falls, two forces act on it as shown in Fig. 5.1.

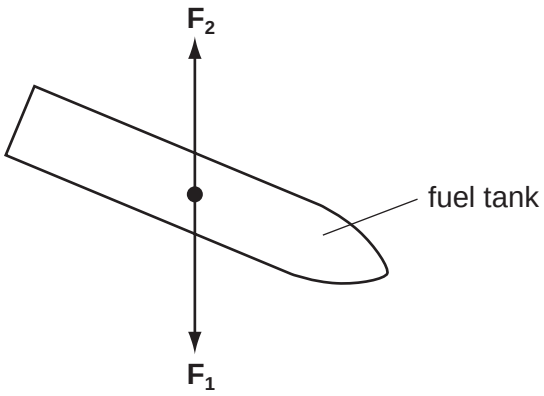


Fig. 5.1

(i) Name forces F_1 and F_2.

F_1 .....

F_2 ..... [2]

(ii) As it falls, the tank accelerates because F_1 is greater than F_2.

What will happen to the size of force F_2 as the tank goes faster?

..... [1]

(iii) Eventually the two forces will balance each other.

How will this affect the speed of the falling tank?

Explain your answer.

.....

.....

..... [2]

For Examiner's Use

(b) The rocket travels 400 000 km to the Moon in 80 hours.

Calculate the average speed of the rocket.

State the formula that you use and show your working.

formula used

working

..... [2]

(c) One of the astronauts on the rocket has a mass of 90 kg. The gravitational field strength of the Moon is about one-sixth that of the Earth.

State the differences, if any, between

(i) the mass of the astronaut on the Earth and on the Moon,

..... [1]

(ii) the weight of the astronaut on the Earth and on the Moon.

..... [1]

For Examiner's Use

6 Tuberculosis (TB) is an infectious disease caused by a bacterium. HIV/AIDS is caused by a virus.

(a) Name the cells in the body that help to destroy harmful bacteria and viruses by

(i) producing antibodies,

..... [1]

(ii) phagocytosis

..... . [1]

(b) Table 6.1 shows the percentage of people with TB and HIV/AIDS in four parts of the world in 2005.

Table 6.1

part of the world	percentage of people with TB	percentage of people with HIV/AIDS
sub-Saharan Africa	0.51	7.2
Southeast Asia	0.35	1.1
Americas	0.07	0.7
Europe	0.06	0.5

(i) Describe any pattern that seems to link the percentages of people with TB and with HIV/AIDS.

.....

..... [1]

(ii) The virus that causes AIDS infects white blood cells.

Explain how this could be responsible for the pattern that you have described in **(i)**.

.....

.....

..... [2]

(c) In many countries, young people are vaccinated against TB. They are given an injection of weakened TB bacteria.

For Examiner's Use

Explain how this vaccination could make a person immune to TB.

.....

.....

..... [2]

For Examiner's Use

7 Aluminium, iron, sodium and chlorine are important elements produced by the chemical industry.

(a) State which of the elements above

(i) has atoms which are converted into ions by **gaining** an electron,

..... [1]

(ii) has atoms which contain 3 electrons in their outer shells.

..... [1]

(b) When chlorine gas is bubbled into a colourless solution of sodium bromide, the solution turns orange.

Explain this observation.

.....

.....

..... [2]

(c) Fig. 7.1 shows a blast furnace which is used to convert iron(III) oxide into iron.

For Examiner's Use

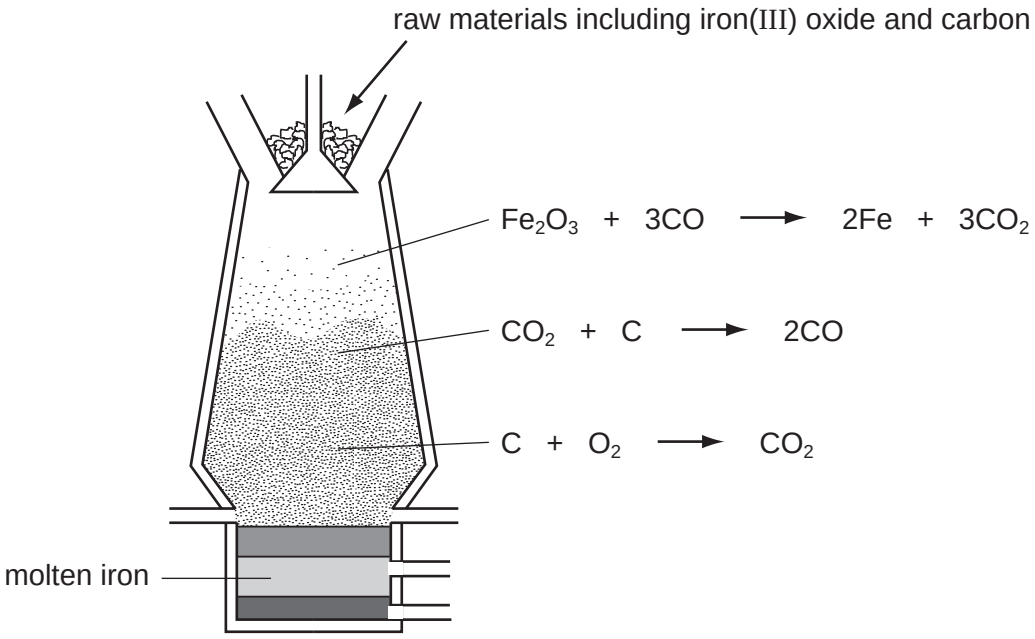


Fig. 7.1

The balanced equations of the three main chemical reactions in the blast furnace are shown in Fig. 7.1. Each reaction is a redox reaction.

(i) State **two** substances, shown in Fig. 7.1, which are reduced.

Explain your answer briefly.

.....

.....

..... [3]

(ii) Use the relative atomic masses shown on the Periodic Table to calculate the relative formula mass of iron(III) oxide.

Show your working.

..... [1]

For Examiner's Use

8 A student is having a medical examination.

(a) A dentist checks the student's teeth using a dental mirror. This is shown in Fig. 8.1.

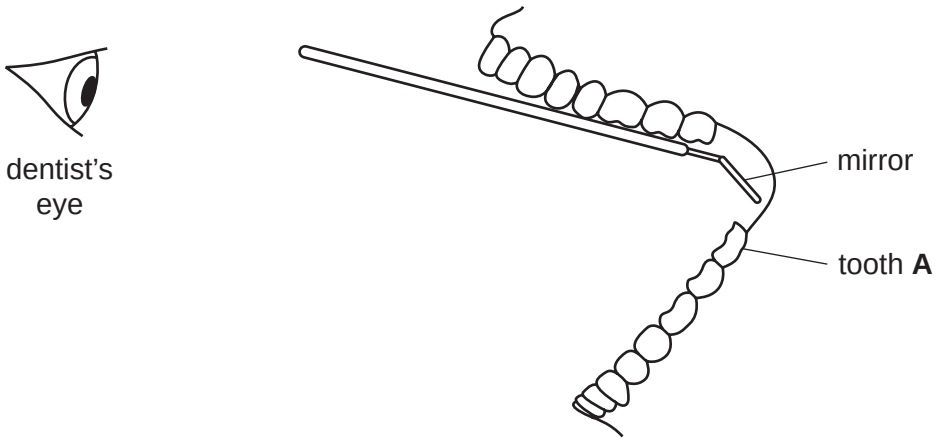


Fig. 8.1

(i) Draw a ray of light from the back of tooth **A** to the dentist's eye to show how the dentist is able to see the back of the tooth.

On the ray, draw arrows showing the direction in which light travels. [3]

(ii) Describe how the dentist could find the density of an irregular object such as an extracted tooth.

.....

.....

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..... [4]

(b) The doctor wants to use a small torch to look down the student's throat. When he switches the torch on, it does not work.

Fig. 8.2 shows the circuit diagram for the torch.

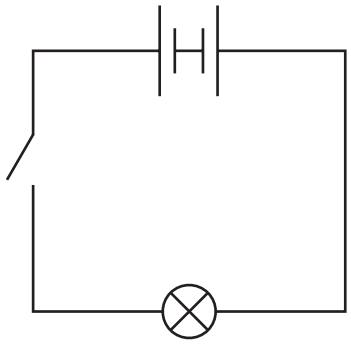

Fig. 8.2

(i) Explain what is wrong with the torch.

.....

..... [1]

(ii) Draw the correct circuit diagram.

[1]

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9 Fig. 9.1 shows part of the carbon cycle.

For Examiner's Use

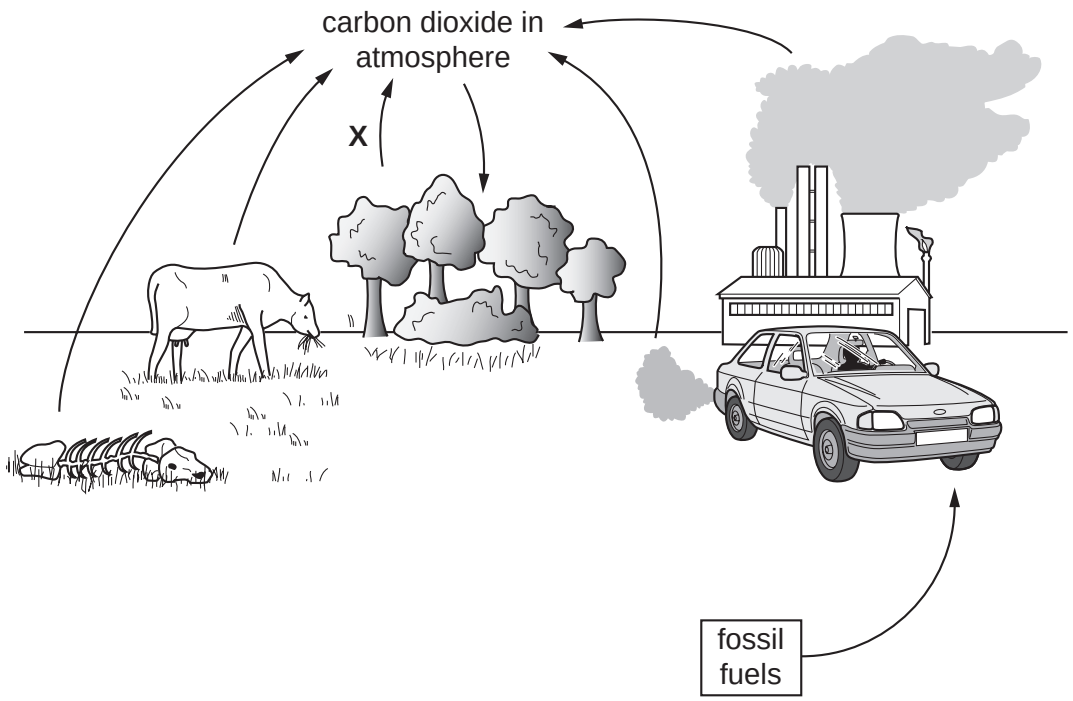

Fig. 9.1

(a) Name the process labelled **X** on Fig. 9.1.

.....

[1]

(b) Explain how carbon dioxide is returned to the air from the bodies of dead organisms.

.....

.....

..... [2]

(c) Describe how fossil fuels are formed.

For Examiner's Use

.....

.....

..... [2]

(d) Fossil fuels are burned in cars, trucks and other vehicles.

Fig. 9.2 shows the quantity of sulphur dioxide and nitrogen oxides emitted from vehicles in a European country between 1990 and 2003. Over this period, the country brought in measures to try to decrease the emissions of these gases.

The number of vehicles using the roads increased over this time period.

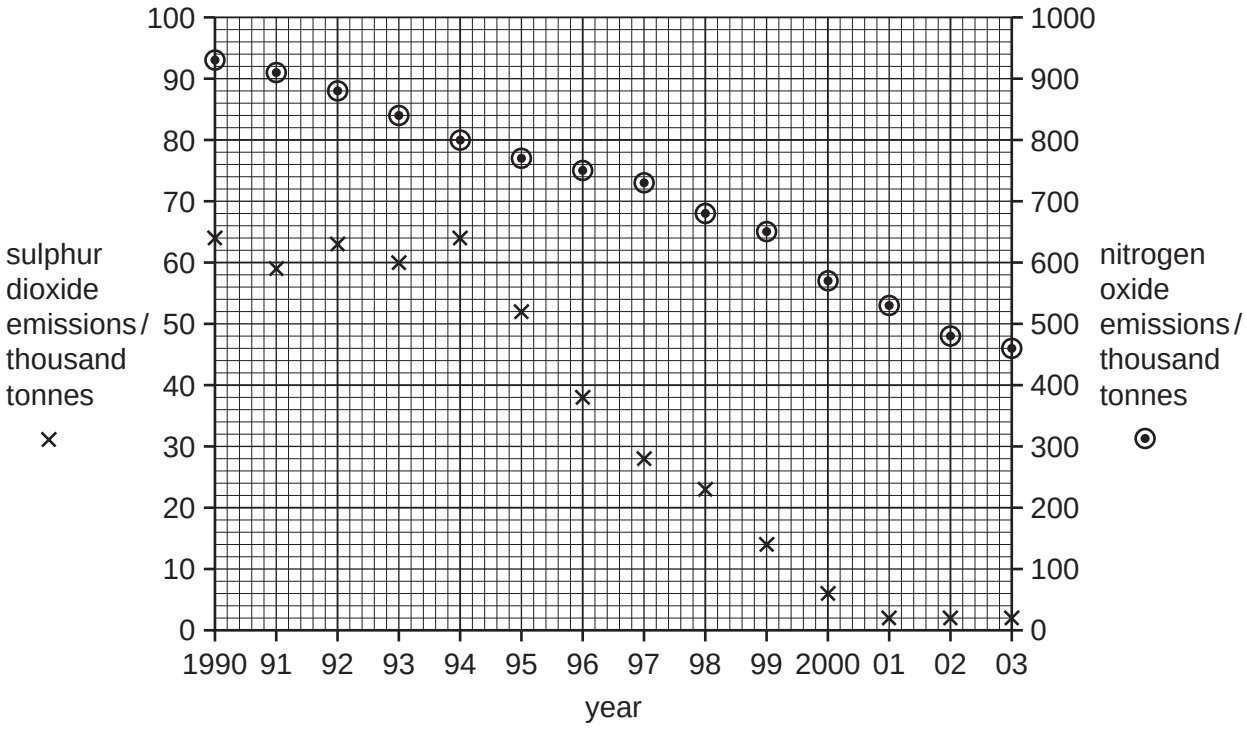

Fig. 9.2

For Examiner's Use

(i) Suggest a reason for the trend in sulphur dioxide emissions between 1990 and 2003.

.....

..... [1]

(ii) Catalytic converters were introduced into this country in 1993. They are fitted onto car exhaust systems, and they contain catalysts that cause nitrogen oxide to be reduced to nitrogen.

Suggest two reasons why nitrogen oxides had not been completely eliminated from car exhaust gases by 2003.

1. .....

.....

2. .....

..... [2]

(iii) Explain how emissions of sulphur dioxide and nitrogen oxides can harm living organisms.

.....

.....

.....

.....

..... [3]

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DATA SHEET
The Periodic Table of the Elements

I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulphur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a over **X** over b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).