Centre Number	Candidate Number

Candidate Name _____

International General Certificate of Secondary Education
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

CO-ORDINATED SCIENCES 0654/3

PAPER 3

MAY/JUNE SESSION 2000 2 hours

Candidates answer on the question paper.
No additional materials are required.

TIME 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 24.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 21 printed pages and 3 blank pages.

[Turn over

1 Fig. 1.1 shows a motor neurone.

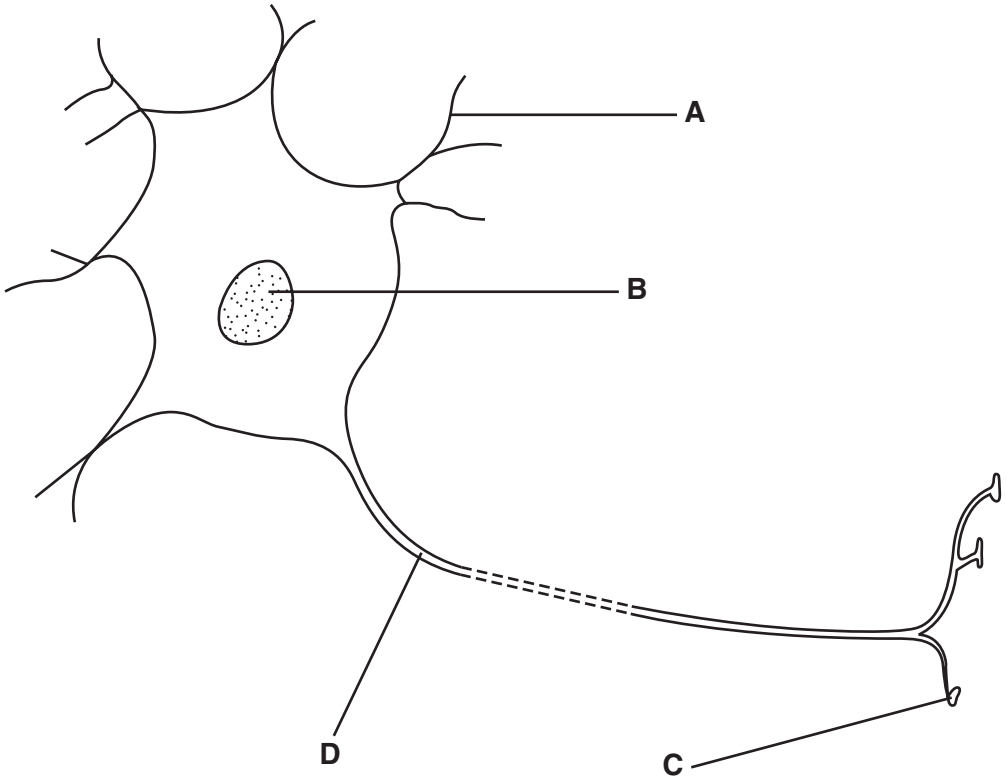

Fig. 1.1

(a) (i) Name the parts labelled **A**, **B**, **C** and **D**.

A .....

B .....

C .....

D .....[4]

(ii) Where in the human body is the cell body of the motor neurone found?

.....[1]

(b) A motor neurone may be part of a spinal reflex arc.

(i) Give **one** example of a reflex action.

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.....[2]

(ii) With reference to some of the parts labelled on Fig. 1.1, describe the role of the motor neurone in this reflex action.

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.....[3]

(iii) Describe the value of reflex actions to an organism.

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.....[2]

(c) Discuss the similarities and differences between the ways in which an animal and the shoot of a plant respond to light.

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[Turn over

2 **(a)** Fig. 2.1 shows an incomplete nucleus of a fluorine atom. The nucleon number of this fluorine atom is 19.

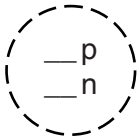

Fig. 2.1

(i) Write the number of protons and the number of neutrons in the nucleus of this fluorine atom. Use the Periodic Table on page 24 to help you with this question. [1]

(ii) Show on Fig. 2.1, the number, and arrangement, of electrons in a fluorine atom. [2]

(iii) Fluorine molecules have the formula F_2.

Draw a diagram which shows how the outer electrons are arranged in a fluorine molecule.

[1]

(iv) Fluorine is produced industrially by the electrolysis of an electrolyte which contains fluoride ions.

At which electrode, the anode or the cathode, is fluorine formed? Explain your answer.

.....

.....

.....[2]

(b) Bacteria in dental plaque produce acids that attack teeth, causing decay.

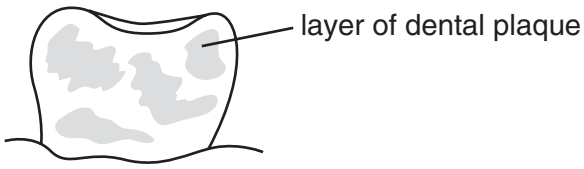

Fig. 2.2

Brushing teeth with toothpaste which contains fluoride ions is known to decrease tooth decay.

(i) Fluorine is a highly reactive and corrosive element.

Explain, in terms of electron configuration, why it is safe to use toothpaste containing fluoride **ions**.

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.....[2]

(ii) Toothpaste may also contain a detergent such as sodium lauryl sulphate, $C_{11}H_{23}SO_4^-Na^+$. This helps to remove particles of fatty food.

Explain how a detergent such as sodium lauryl sulphate helps to remove fatty food from teeth. You may draw some **simple** diagrams if it helps your answer.

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.....[3]

(iii) Some toothpastes are <u>colloids</u> called <u>sols</u>.

Explain briefly the underlined words.

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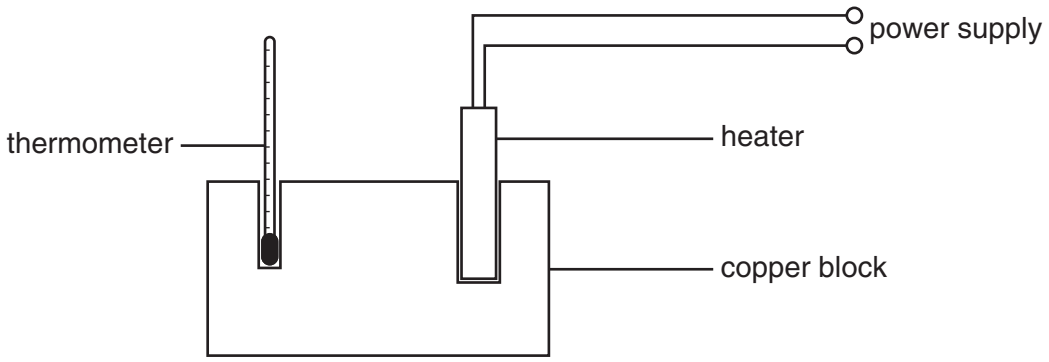
3 An electric heater is used to heat a copper block. Energy is supplied to the block at the rate of 40 J/s.



(a) State, in watts, the power input to the block. .....[1]

(b) The block has a mass of 2 kg.
The heater is switched on for 500 s.
The temperature of the block increases from 20 °C to 40 °C.

(i) Calculate the energy supplied to the block.

.....[2]

(ii) Calculate the energy apparently required to raise the temperature of 1 kg of copper by 1 °C.

.....[2]

(c) In theory, only 400 J of energy is required to raise the temperature of 1 kg of copper by 1 °C.

(i) Suggest why the answer calculated in **(b)(ii)** is greater than 400 J.

.....

.....[1]

(ii) Suggest how the apparatus could be changed to make the measured amount of energy more nearly equal to the theoretical amount.

.....

.....[1]

(d) When electricity flows through a wire, it creates a magnetic field around the wire.

Describe how an electromagnet can be used as part of a relay in a circuit.

You will need to

- describe the apparatus you would use,
- draw a suitable circuit diagram,
- explain how the relay works.

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[6]

4 Read the passage below and then use the information and your own knowledge to answer the questions which follow.

> In 1998, forest fires burning over much of the island of Borneo in south east Asia released large amounts of smoke into the atmosphere. Many of the fires were begun by people trying to clear forested land for growing crops. However, the weather was unusually dry that year, so the fires raged out of control. Huge areas of forest were destroyed. The smoke spread across Borneo and also to neighbouring countries, such as Singapore.
>
> The smoke caused the atmosphere to appear hazy, reducing the amounts of light reaching plants. The haze contained tiny particles of carbon, which irritated the lungs of people who breathed it. Many schools were closed, so that students could stay indoors rather than having to go outside and breathe the polluted air.
>
> The fires also harmed local wildlife. The forests of Borneo are the main habitat for the orang-utan, a large ape. Orang-utans trying to escape from the burning forests moved closer to the towns, where many were killed by poachers.

(a) The haze from the fires was a pollutant.

(i) Suggest a definition of the term *pollutant*.

.....

.....[1]

(ii) The haze affected people in a similar way to cigarette smoke.

Describe and explain two effects the haze could have on people's health.

1. .....

.....

.....

2. .....

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.....[4]

(iii) Explain how the haze might affect the growth of plants.

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.....[2]

(b) Suggest how the forest fires might affect the levels of carbon dioxide in the atmosphere. Explain your answer.

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.....[3]

(c) Explain why biologists believe that it is important that habitats such as the rainforests of Borneo should be conserved.

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.....[2]

5 **(a)** Brass is an alloy of copper and zinc. A piece of brass has a mass of 12.9 g and contains 6.5 g of zinc.

Calculate how many moles of copper are present in the piece of brass. Show your working.

.....[3]

(b) The apparatus in Fig. 5.1 is used to react zinc with dilute sulphuric acid. Dilute sulphuric acid is an aqueous solution containing sulphate ions, SO_4^{2-}.

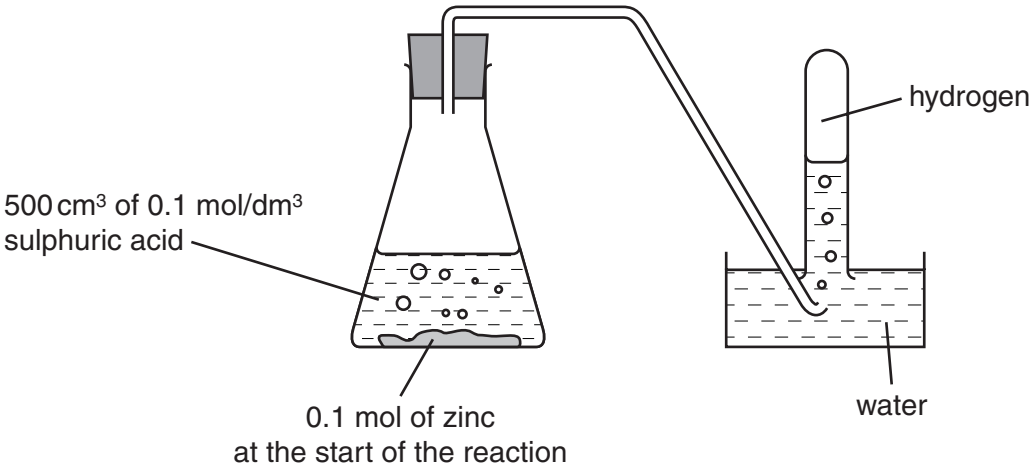

Fig. 5.1

The balanced equation for the reaction is shown.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

(i) Write the symbol and charge of another ion present in dilute sulphuric acid.

.....[1]

(ii) Use the information above to deduce the charge on a zinc ion. Explain your answer.

.....

.....

.....[2]

(iii) Use the information in Fig. 5.1 to predict whether any zinc metal remains in the mixture at the end of the reaction. Show your working.

.....[3]

(c) Barium nitrate solution is used to test for the presence of sulphate ions.

Describe and explain, in terms of the particles involved, what is seen when barium nitrate solution is added to zinc sulphate solution.

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6

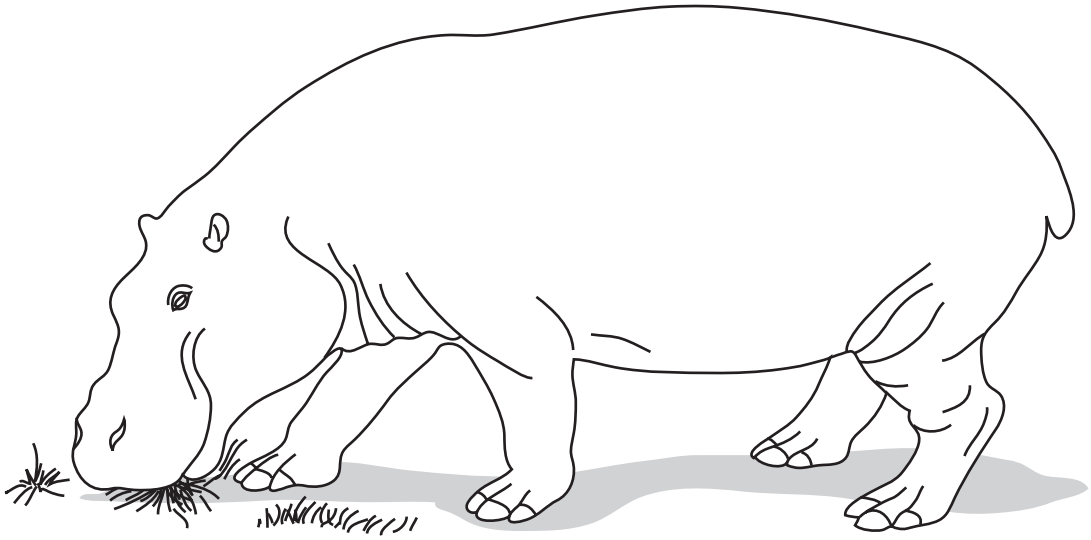

Fig. 6.1

A hippopotamus has a mass of 2000 kg. It has four feet, each of area 100 cm^2.

(a) (i) Use the formula

pressure = force/area

to calculate the average pressure that the hippopotamus exerts on the ground.

.....[3]

(ii) The hippopotamus stands with one foot off the ground.

Does the average pressure exerted by the hippopotamus on the ground change? Explain your answer.

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.....[2]

(b) To determine the density of the hippopotamus, its volume must be measured.

Suggest a method for measuring the volume of an irregularly shaped object, such as a hippopotamus.

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.....[2]

(c) The volume of the hippopotamus is 2.5 m^3.

Calculate the density of the hippopotamus. Show your working and state any formula that you use.

.....[3]

7 An investigation was carried out into the activity of amylase in two different parts of the alimentary canal. Fig. 7.1 shows the two parts, **A** and **B**, that were tested.

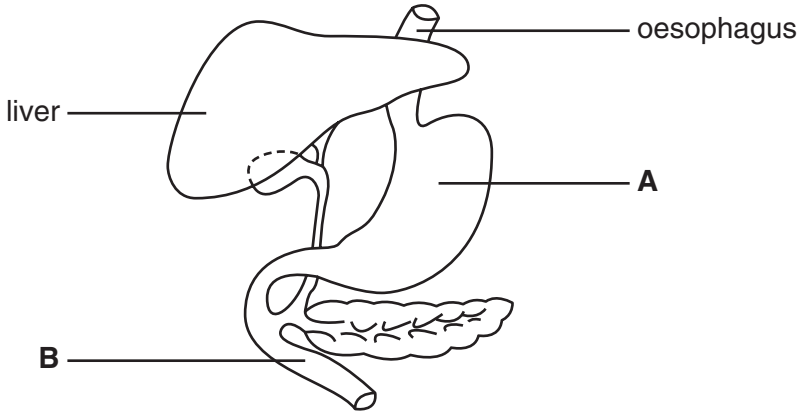

Fig. 7.1

Samples of the contents of these two parts of the alimentary canal were placed on to agar jelly in two separate petri dishes. The agar jelly contained starch.

Fig. 7.2 shows the petri dish containing the sample from part **A** at the beginning of the experiment.

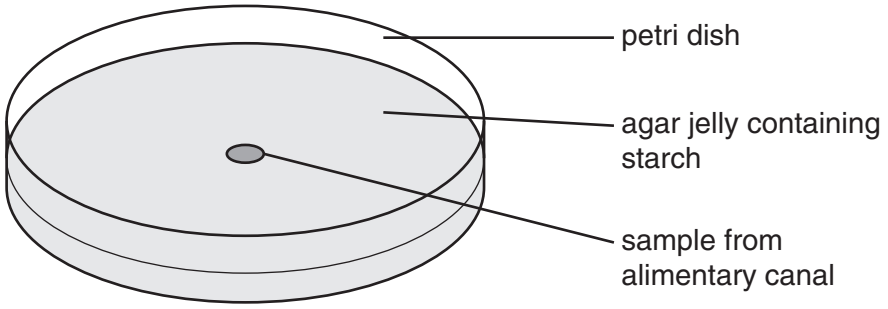

Fig. 7.2

(a) Describe the effect that amylase has on starch.

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.....[3]

(b) If any amylase was present in the samples, it would spread into the agar jelly. To see if this had happened, each of the dishes was left for 1 hour, and then iodine solution was poured over the jelly.

(i) Explain how the amylase would spread into the agar jelly.

.....

.....

.....[2]

(ii) Suggest suitable conditions in which the dishes should be left for 1 hour, before testing with iodine solution. Give a reason for your answer.

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.....[2]

(c) Fig. 7.3 shows the two petri dishes after iodine solution was poured over them.

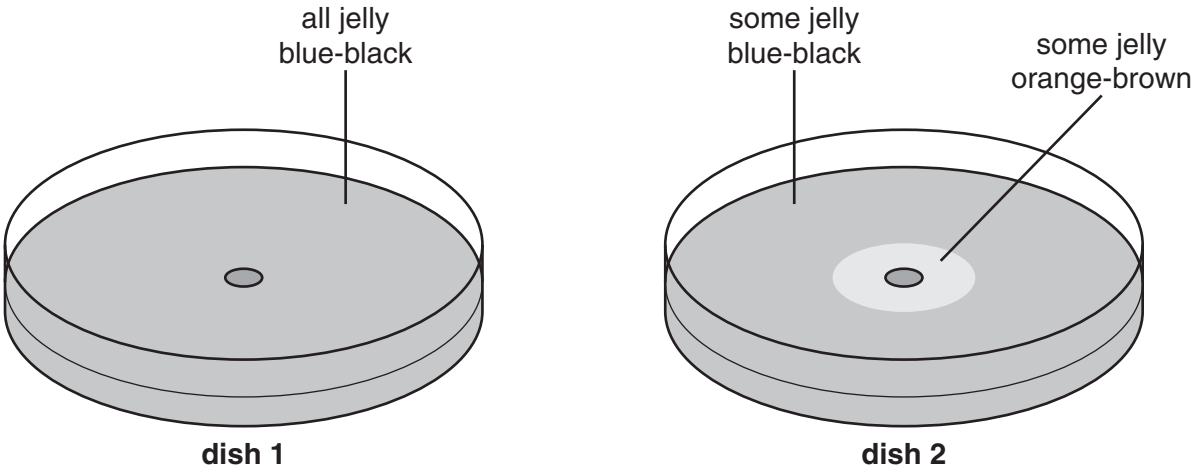

Fig. 7.3

(i) Explain why some areas were blue-black, while other areas were orange-brown.

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.....[2]

(ii) Suggest which petri dish contained the sample from part **A** and which contained the sample from part **B**. Explain your answer.

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.....[1]

8 Fig. 8.1 shows a large crane used on a building site.

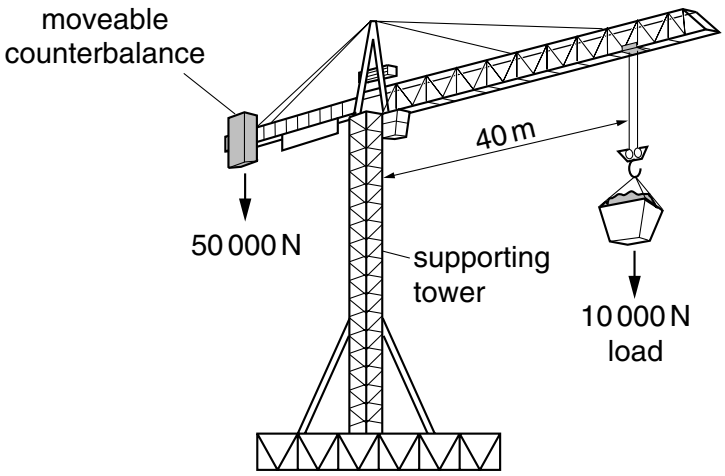

Fig. 8.1

(a) The crane in Fig. 8.1 is balanced.

(i) Calculate the moment of the load about the crane's supporting tower. Show your working.

.....[2]

(ii) Calculate the distance of the crane's counterbalance from the crane's supporting tower. Show your working.

.....[1]

(b) Explain, in terms of forces and moments, why the crane needs a counterbalance.

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.....[2]

(c) The graph in Fig. 8.2 shows the speed of the load as it is raised by the crane.

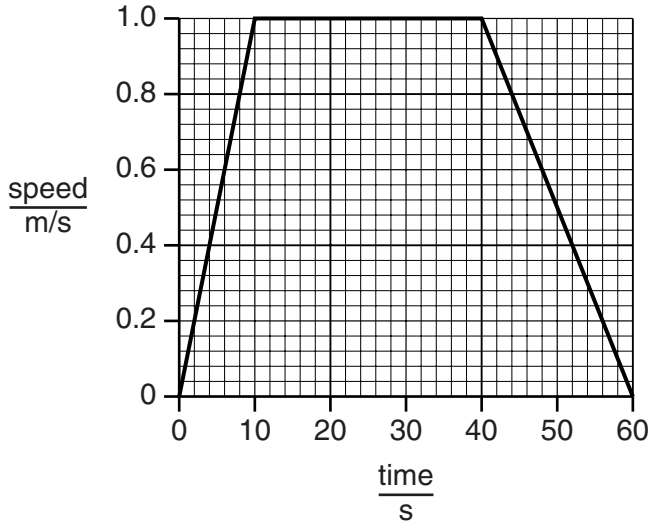

Fig. 8.2

Use Fig. 8.2 to calculate the distance the load has been raised by the crane. Show your working.

.....[3]

(d) Calculate the work done in raising the load by the distance you have calculated in **(c)**. Show your working and state any formula that you use.

.....[2]

9 Fig. 9.1 shows a catalytic converter fitted to a car. The exhaust gases from the car pass through the converter before they are emitted into the air.

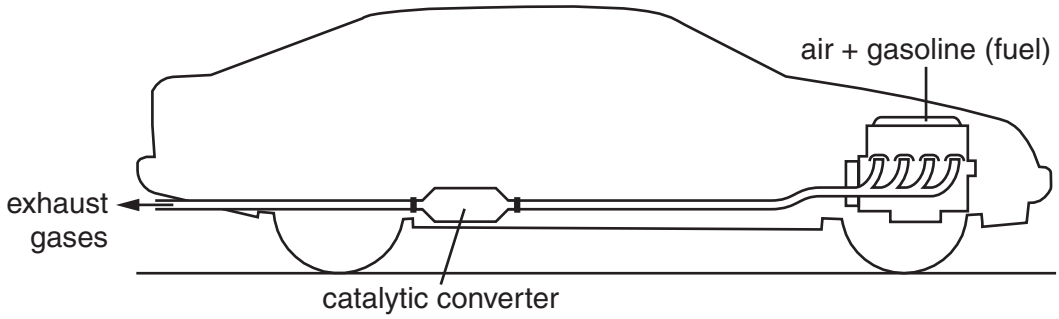

Fig. 9.1

The table in Fig. 9.2 shows some data about the composition of the mixtures of exhaust gases from two identical cars, one with and one without a catalytic converter.

substance in exhaust gases	% by volume	
	car without catalytic converter	car with catalytic converter
nitrogen	67.60	67.65
carbon dioxide	12.00	12.25
water vapour	11.00	11.10
oxygen	9.00	9.00
carbon monoxide	0.20	0
nitrogen dioxide	0.15	0
hydrocarbons	0.05	0

Fig. 9.2

(a) (i) Name the raw material from which gasoline is extracted.

.....[1]

(ii) Gasoline contains heptane, an alkane which contains seven carbon atoms in each of its molecules.

Draw the graphical formula of a heptane molecule.

[2]

(iii) Explain why the exhaust gases contain large amounts of carbon dioxide, water vapour, oxygen and nitrogen.

carbon dioxide

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water vapour

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oxygen

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nitrogen

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.....[4]

(b) Fig. 9.3 shows more detail of the catalytic converter.

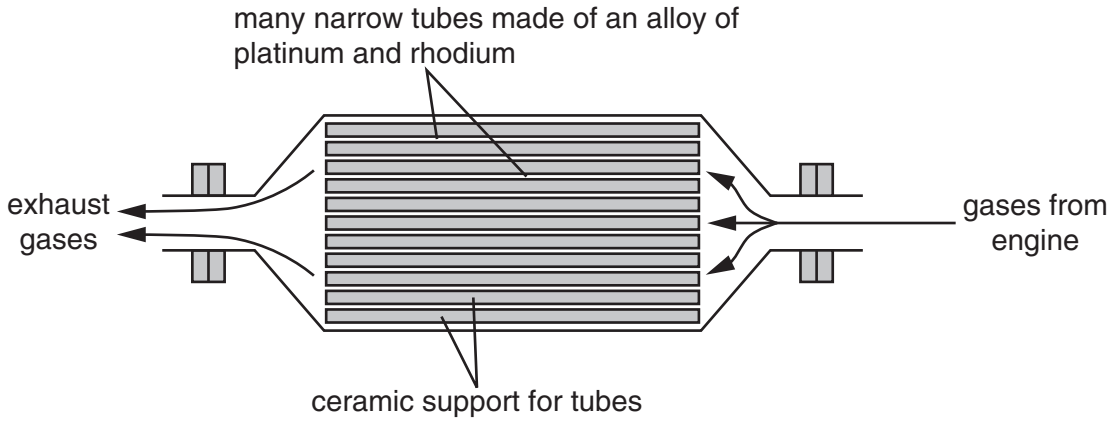

Fig. 9.3

(i) Name the raw material from which ceramic materials are made.

.....[1]

(ii) State **one** property of ceramic materials, other than their strength, that makes them suitable for use in the catalytic converter.

.....[1]

(iii) Use the information in Fig. 9.2 on page 18 to suggest how the catalytic converter helps to reduce air pollution from cars. You should use the idea of oxidation and reduction in your answer.

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.....[6]

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DATA SHEET
The Periodic Table of the Elements

Group																	
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 = 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.).