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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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5908076902

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **October/November 2011**

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 20.

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.

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1	
2	
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4	
5	
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7	
8	
9	
Total	

This document consists of **19** printed pages and **1** blank page.

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1 The chemical reaction involved in the manufacture of ammonia requires an iron catalyst.

Fig.1.1 shows a simplified diagram of the reaction vessel in which ammonia is made.

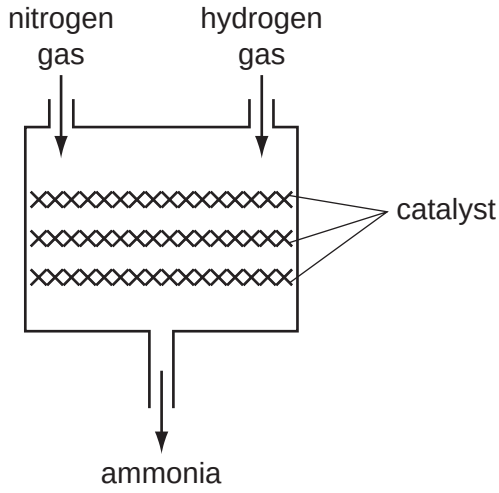

Fig. 1.1

(a) (i) Explain the meaning of the term *catalyst*.

.....

..... [2]

(ii) Iron is a member of the family of metals which lies between scandium and zinc in the Periodic Table.

Name this family of metals. ..... [1]

(iii) The iron catalyst is prepared by reacting iron oxide with hydrogen gas.

The symbolic equation below for this reaction is **not** balanced.

Complete the balancing of the equation.

Fe_3O_4 + ... H_2 ⟶ ..... Fe + ... H_2O [2]

(iv) Explain, in terms of the loss or gain of electrons, whether iron is oxidised or reduced in the reaction in **(iii)**.

.....

.....

..... [2]

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(v) Calculate the relative formula mass of iron oxide, Fe_3O_4.

Show your working.

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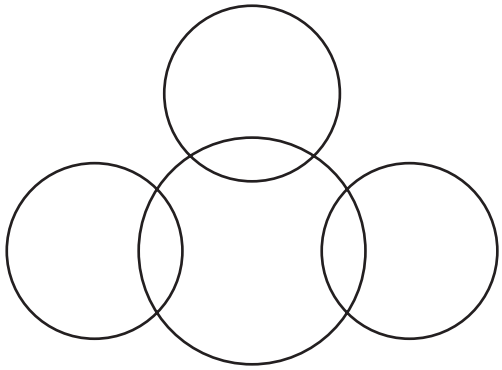
..... [2]

(b) Complete the bonding diagram below to show

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



[3]

2 The golden lion tamarin is a species of monkey that lives in forests in Brazil. Its diet includes fruits and nectar from trees. Its predators include snakes, bamboo rats and owls.

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(a) (i) In the space below, construct a food web involving golden lion tamarins.

[3]

(ii) Using your knowledge of energy flow through food chains, explain why predators such as owls are usually rarer than the prey on which they feed.

.....

.....

.....

..... [2]

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(b) Golden lion tamarins are important for the dispersal of seeds from many different species of trees. They eat the fruits and then egest the seeds in their faeces.

An investigation was carried out into the distances that golden lion tamarins dispersed seeds from trees.

Fig. 2.1 shows the results of a study in which the distances of the tamarin's faeces from one tree were measured.

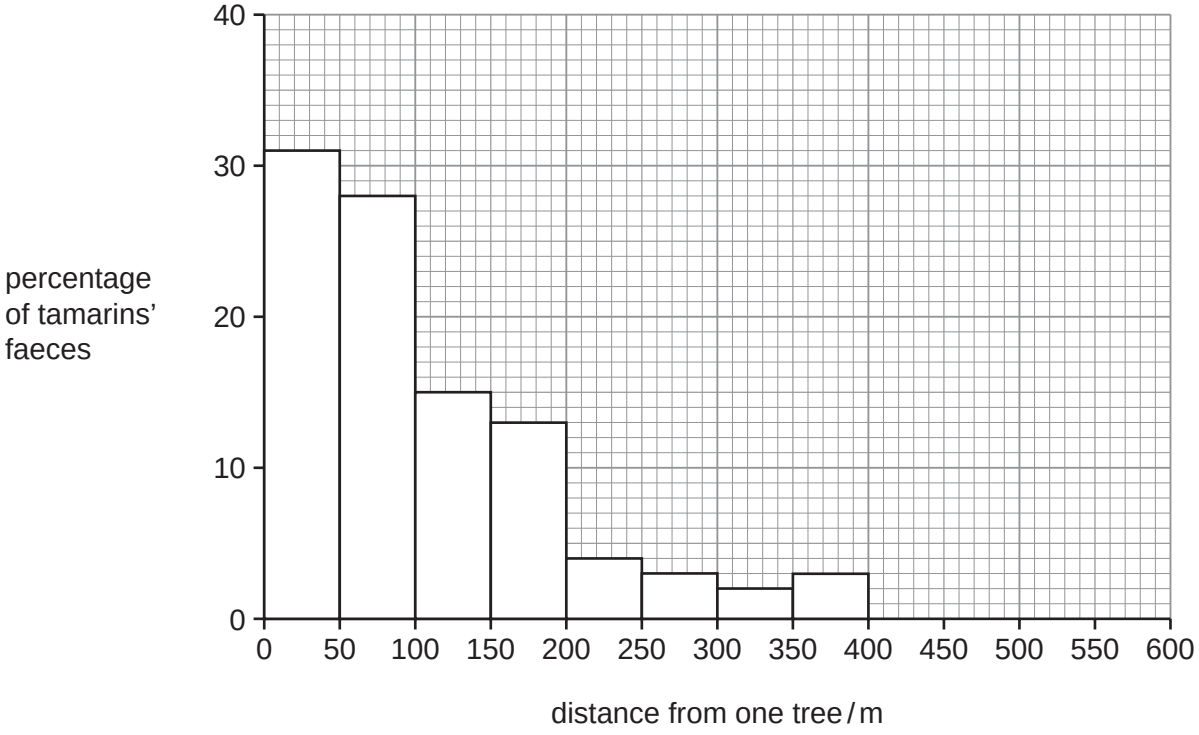

Fig. 2.1

(i) Describe the distribution of golden lion tamarin faeces in relation to this tree.

.....

.....

..... [2]

(ii) Suggest how the dispersal of seeds away from the tree, in golden lion tamarin faeces, could benefit the young plants that grow from the seeds.

.....

.....

.....

.....

..... [3]

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3 Fig. 3.1 shows two cars.

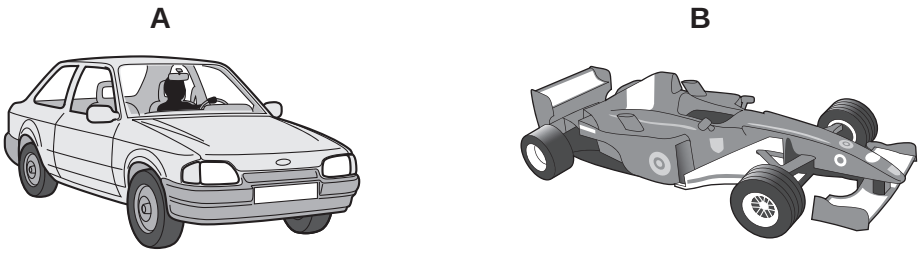

Fig. 3.1

(a) Explain which of these cars, **A** or **B**, is less likely to overturn if it goes round a corner at high speed.

.....

.....

..... [2]

(b) Car **B** took 1.5 hours to complete a race of 330 kilometres.

Calculate the average speed of the car in kilometres per hour.

State the formula that you use and show your working.

formula used

working

..... [2]

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(c) Fig. 3.2 shows the speed-time graph for the racing car over a short period.

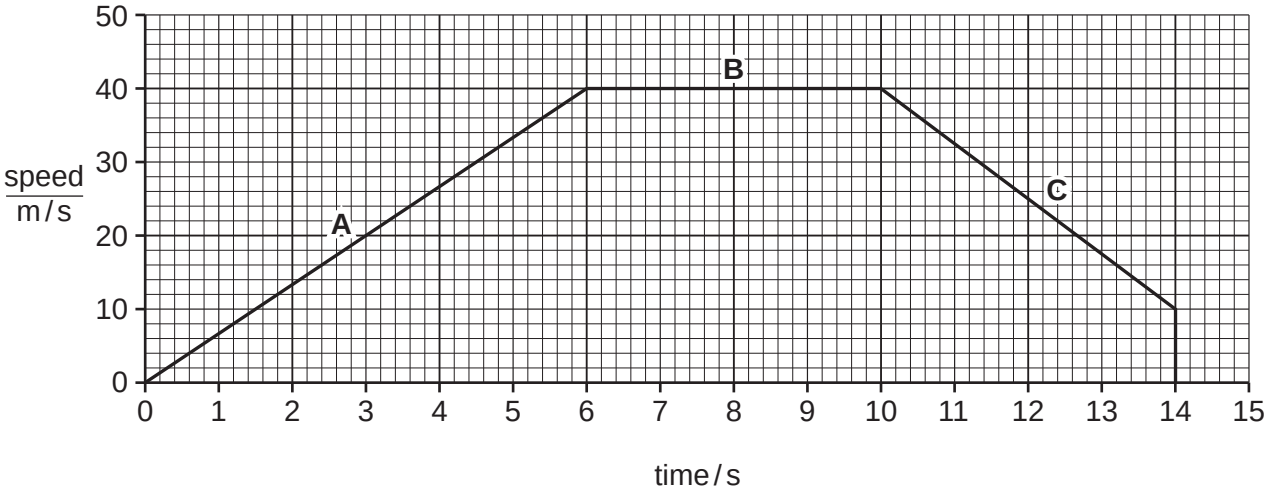

Fig. 3.2

(i) Describe the motion of the racing car during

section **B**, ...

section **C**. ..... [2]

(ii) Calculate the distance travelled over the first 10 seconds.

Show your working.

..... [2]

(iii) The car is accelerating during section **A**.

Calculate the acceleration.

Show your working.

..... [2]

For Examiner's Use

(iv) The car and driver have a total mass of 1500 kg.

Calculate the force that produced the acceleration during section **A**.

State the formula that you use and show your working.

formula used

working

..... [2]

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4 **(a)** Fig. 4.1 shows some of the structures involved in a reflex action.

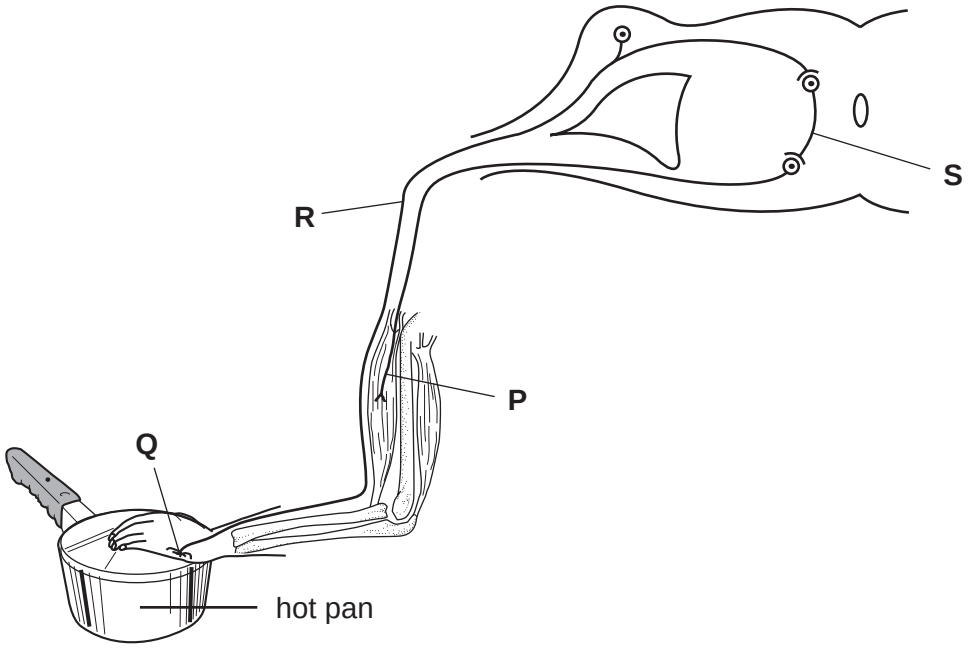

Fig. 4.1

(i) State the **letter** that is labelling each of these structures.

a receptor .....

a sensory neurone ..... [2]

(ii) On Fig. 4.1, draw **one** arrow on structure **R** and **one** arrow on structure **S** to show the direction in which a nerve impulse travels. [1]

(iii) On Fig. 4.1, label **one** structure that is part of the central nervous system. [1]

(iv) In this reflex action, touching the hot pan causes arm muscles to contract and move the arm away.

Describe **one** advantage of this being a reflex action, rather than a voluntary action.

..... [1]

(b) Each neurone has a nucleus, which contains chromosomes made of DNA.

(i) Name **one** type of cell in the human body that does **not** contain a nucleus.

..... [1]

(ii) In humans, a sperm cell has 23 chromosomes.

Suggest the number of chromosomes that is present in a neurone.

..... [1]

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5 **(a)** Fig. 5.1 shows a piece of magnesium ribbon which a student has just dropped into a container of dilute sulfuric acid.

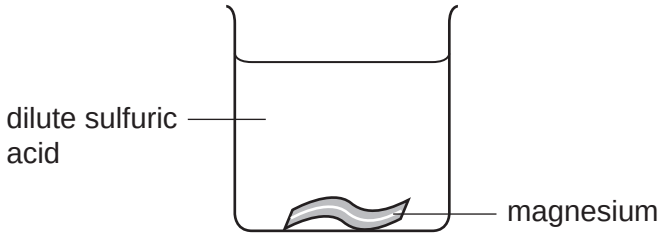

Fig. 5.1

(i) State how an increase in temperature will change the rate at which the magnesium and acid react.

.....

[1]

(ii) Explain your answer to **(i)** in terms of particles.

.....

.....

.....

[2]

(b) Sulfuric acid containers are often made of poly(ethene). Poly(ethene) is a polymer which is formed from hydrocarbon monomers.

(i) Suggest **one** property of poly(ethene) which makes it suitable for making sulfuric acid containers.

.....

[1]

(ii) Ethene is an unsaturated hydrocarbon which is manufactured from saturated hydrocarbons by cracking.

Outline the process of cracking.

.....

.....

.....

[2]

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6 **(a)** Fig. 6.1 shows the circuit diagram of a circuit constructed by a student. Ammeters $\mathbf{A_1}$, $\mathbf{A_2}$, $\mathbf{A_3}$, $\mathbf{A_4}$ and $\mathbf{A_5}$ are used to measure current.

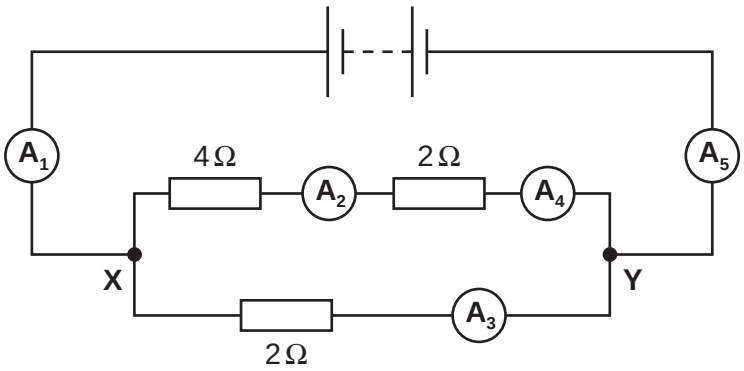

Fig. 6.1

(i) The readings on $\mathbf{A_2}$, $\mathbf{A_3}$ and $\mathbf{A_5}$ are shown in Table 6.1.

Table 6.1

Ammeter	Reading
$\mathbf{A_2}$	2 A
$\mathbf{A_3}$	6 A
$\mathbf{A_5}$	8 A

State the readings on $\mathbf{A_1}$ and $\mathbf{A_4}$.

$\mathbf{A_1}$ ..... $\mathbf{A_4}$ ..... [2]

(ii) The power input to one of the 2 Ω resistors is 72 W.

Calculate how many joules of energy are transferred in 20 seconds.

State the formula that you use and show your working.

formula used

working

..... [2]

For Examiner's Use

(iii) Calculate the total resistance between **X** and **Y**.

State the formula that you use and show your working.

formula used

working

..... [3]

(b) Transformers increase the voltage of the electricity generated at a power station before transmission through power lines.

(i) State why this is done.

.....

..... [1]

(ii) A transformer changes the voltage from 25 000 V to 600 000 V.

Use the equation

$$V_p / V_s = N_p / N_s$$

to calculate the ratio of the number of turns on the primary coil to the number on the secondary coil.

..... [2]

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7 **(a)** Table 7.1 shows some information about enzymes found in the human alimentary canal.

Complete the table.

Table 7.1

enzyme	one site of action	type of nutrient that is broken down	product that is formed
	mouth		
		protein	

[3]

(b) In some parts of the world, people are unable to get enough food or to eat a balanced diet. Young children in some regions of Asia may have a diet that consists mostly of rice, while in some parts of Africa a young child's diet may consist mostly of cassava.

Table 7.2 shows the main nutrients present in 100 g of white rice and 100 g of cassava.

Table 7.2

nutrient	white rice	cassava
protein / g	5.0	1.2
carbohydrate / g	58.6	34.7
fat / g	0.4	0.3

(i) A diet that consists mostly of rice is better for a young child than a diet that consists mostly of cassava.

Use the information in Table 7.2 to explain **one** reason why this is so.

.....

.....

..... [2]

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(ii) Carbohydrates include sugars and starch. Describe how a student could test a sample of cooked rice to find out if it contains reducing sugar.

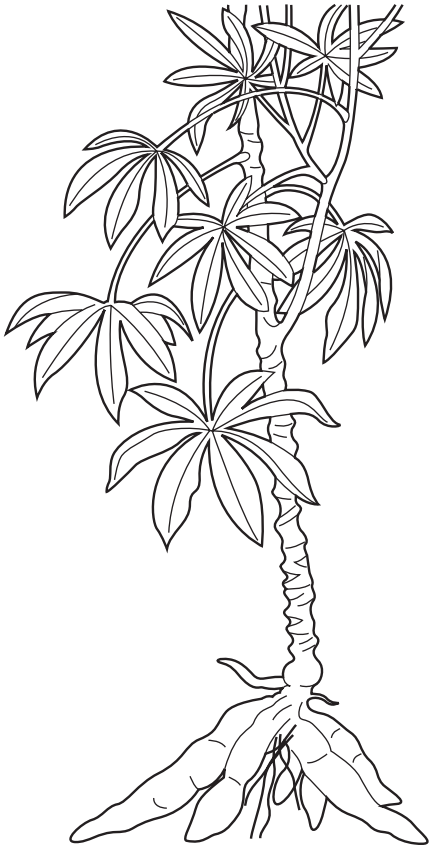
.....

.....

.....

..... [3]

(iii) The parts of a cassava plant that are used as food are the roots, which store carbohydrate in the form of starch. The cells in the cassava roots are provided with carbohydrates that have been made by photosynthesis in the leaves.



Describe how carbohydrates that have been made in the cassava plant's leaves are transported to the roots.

.....

.....

..... [2]

8 Fig. 8.1 shows some data about the percentage composition by mass of the Earth's crust.

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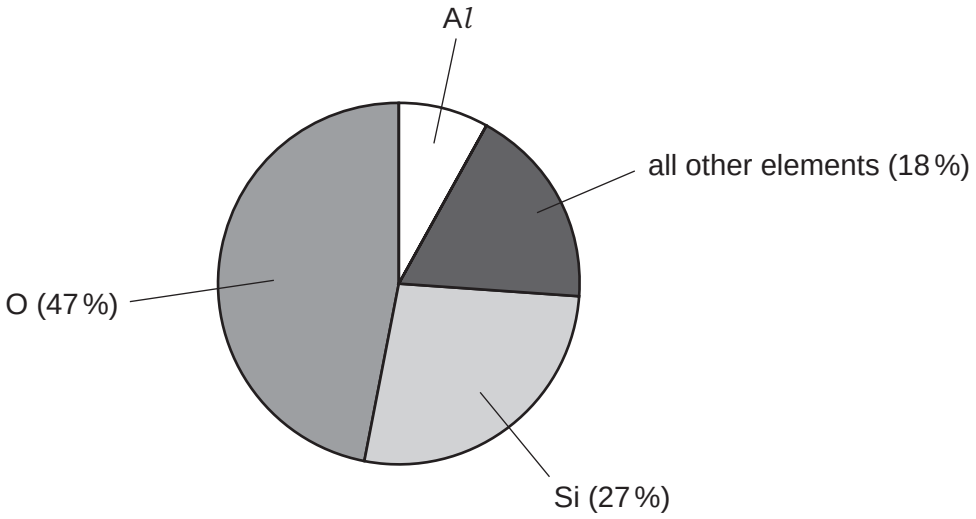

Fig. 8.1

(a) (i) State the percentage by mass of aluminium in the Earth's crust.

..... [1]

(ii) State which of the following numbers is most likely to represent the number of elements in the section labelled *all other elements* in Fig. 8.1.

39 89 139 1089

Explain briefly how you chose your answer.

number .....

explanation .....

..... [1]

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(b) Aluminium metal may be obtained by the electrolysis of molten aluminium oxide.

Fig. 8.2 shows a simplified diagram of this process.

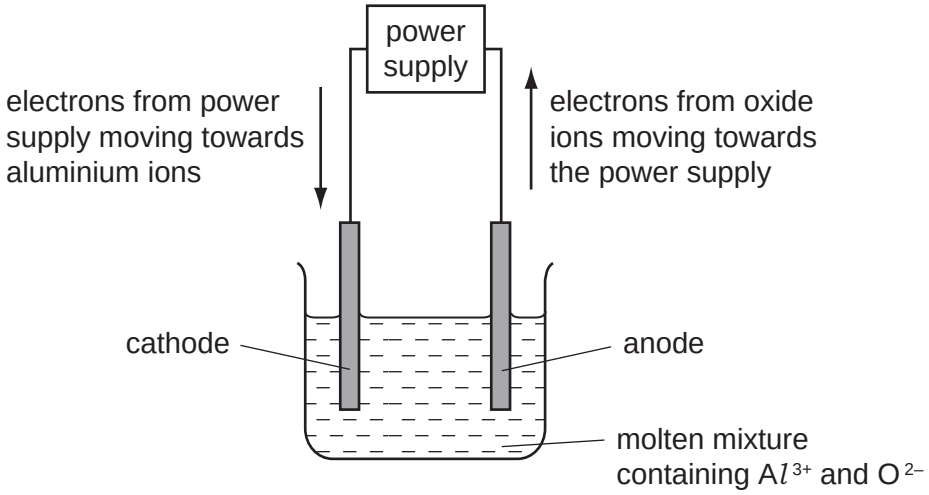

Fig. 8.2

Electrons move through the connecting wires in the directions shown in Fig. 8.2, and ions are converted into uncharged atoms at the surfaces of the electrodes.

(i) Explain briefly why the mixture containing aluminium oxide must be kept molten.

.....

..... [1]

(ii) Explain briefly why oxygen atoms are formed at the anode and **not** the cathode.

.....

.....

..... [2]

(iii) Explain why, when **six** electrons move around the circuit, **two** aluminium atoms and **three** oxygen atoms are formed.

.....

.....

.....

.....

..... [3]

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9 **(a)** Some types of food are treated with gamma radiation. Low doses of radiation slow down the ripening processes in fresh fruit, whilst higher doses of radiation kill the microbes that make food decay.

(i) Explain why gamma radiation can be used for this, even when the fruit is packed in boxes.

.....

..... [1]

(ii) Complete the sentences below by crossing out the incorrect words in each box.

Isotopes of the same element have atoms with | the same number / different numbers | of protons and | the same number / different numbers | of neutrons.

[1]

(iii) Fig. 9.1 shows how a conveyor belt can be used to move the fresh fruit past the radioactive source.

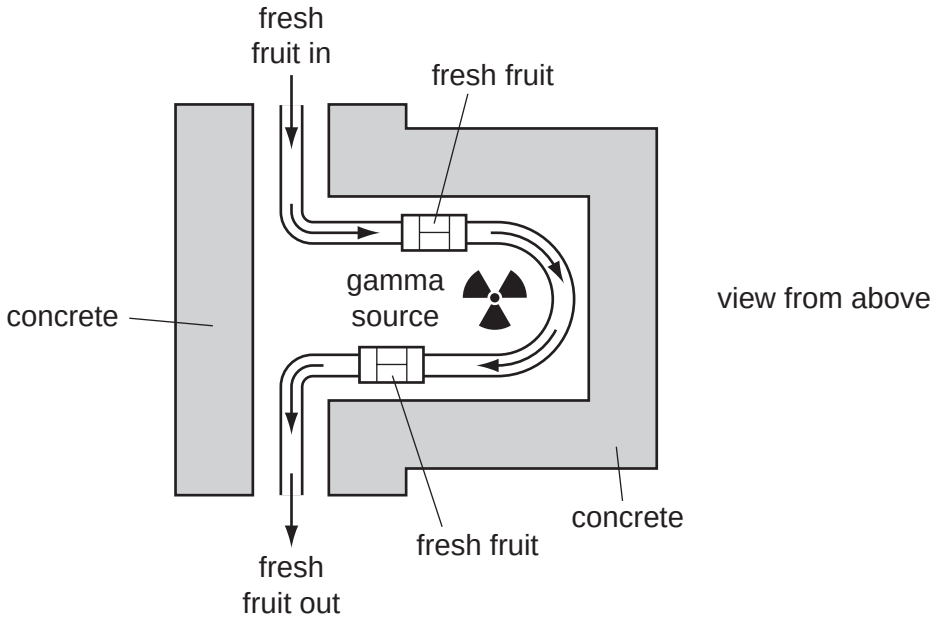

Fig. 9.1

Suggest why concrete is used to surround the radioactive source.

.....

..... [1]

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(b) Some people may not like the idea of eating fruit which has been treated with radiation.

They wrongly think that the food will be radioactive.

(i) Describe **one** way in which a scientist could show that the food is **not** radioactive.

.....

..... [1]

(ii) Explain why the food will **not** be radioactive.

.....

..... [1]

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** Sulfur 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 †															

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

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

Key

a
X
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.).

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