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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.

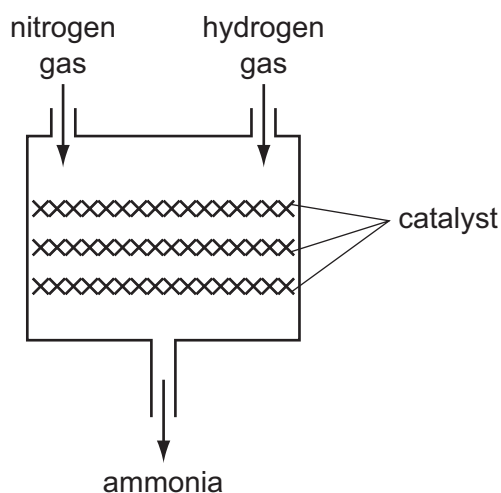
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
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7	
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Total	

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

- 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.



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Fig. 1.1

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

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.....
 [2]

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

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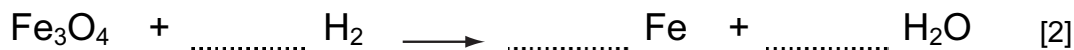
Name this family of metals. [1]

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

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

Complete the balancing of the equation.



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

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.....

 [2]

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

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Show your working.

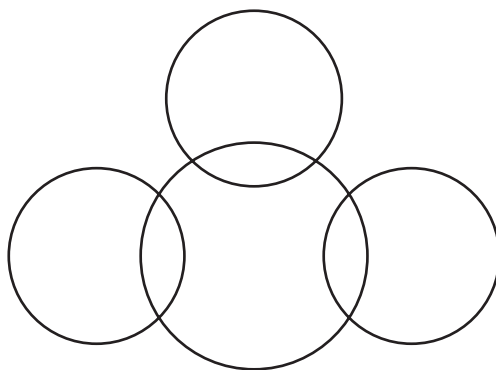
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[2]

1 (b) Complete the bonding diagram below to show

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

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[3]

- 2 a (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.

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.....

[2]

- 2 (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.

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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.

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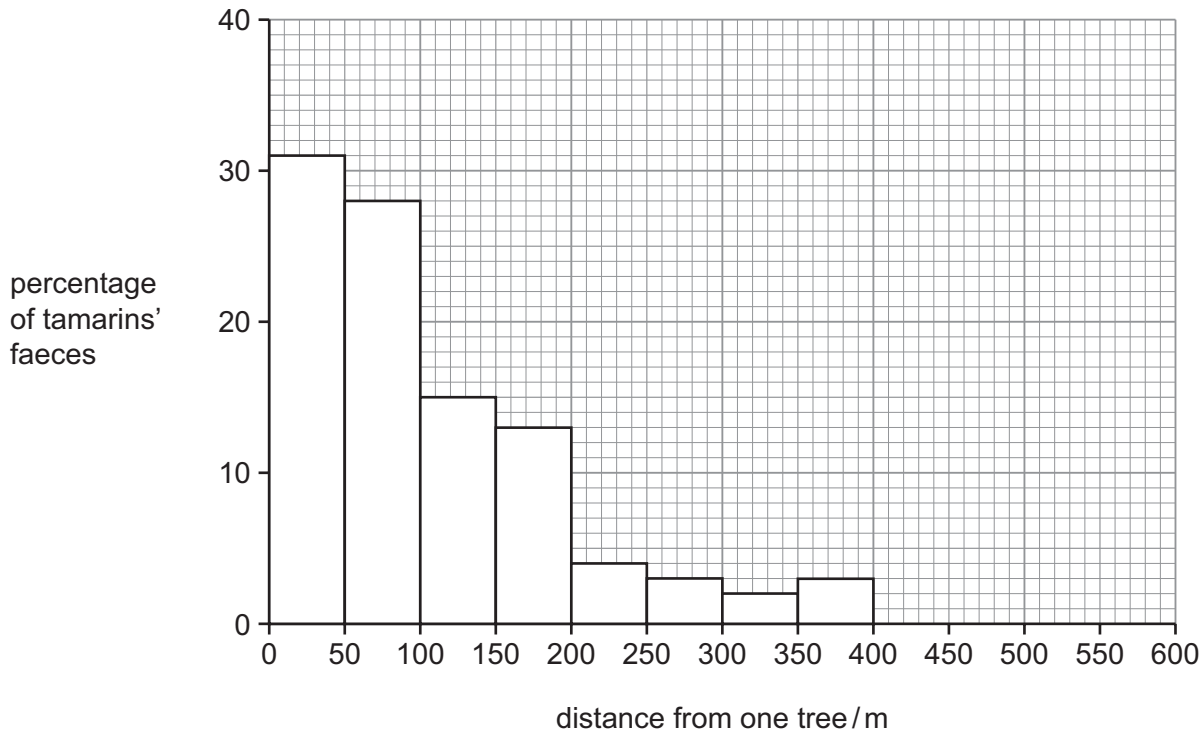


Fig. 2.1

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

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.....

.....

..... [2]

- 2 b (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.

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..... [3]

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3 Fig. 3.1 shows two cars.

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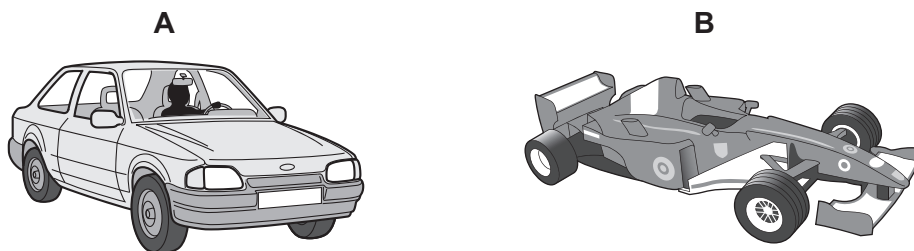


Fig. 3.1

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

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.....

..... [2]

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

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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]

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

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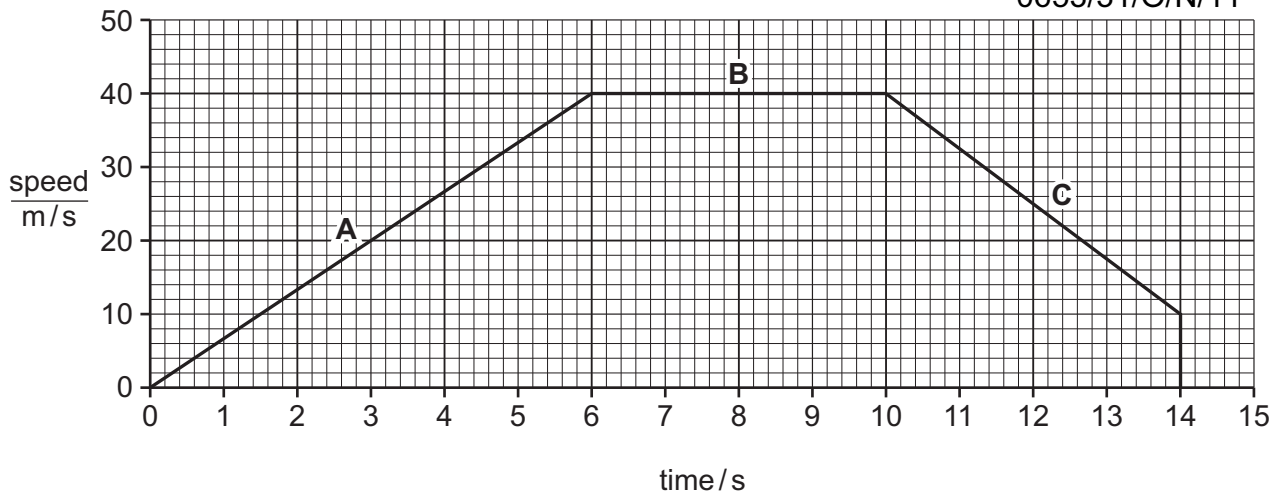


Fig. 3.2

3 c (i) Describe the motion of the racing car during

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section **B**,

section **C**. [2]

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

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Show your working.

..... [2]

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

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Calculate the acceleration.

Show your working.

..... [2]

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

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Use*

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

State the formula that you use and show your working.

formula used

working

..... [2]

- 4 (a) Fig. 4.1 shows some of the structures involved in a reflex action. 0653/31/O/N/11

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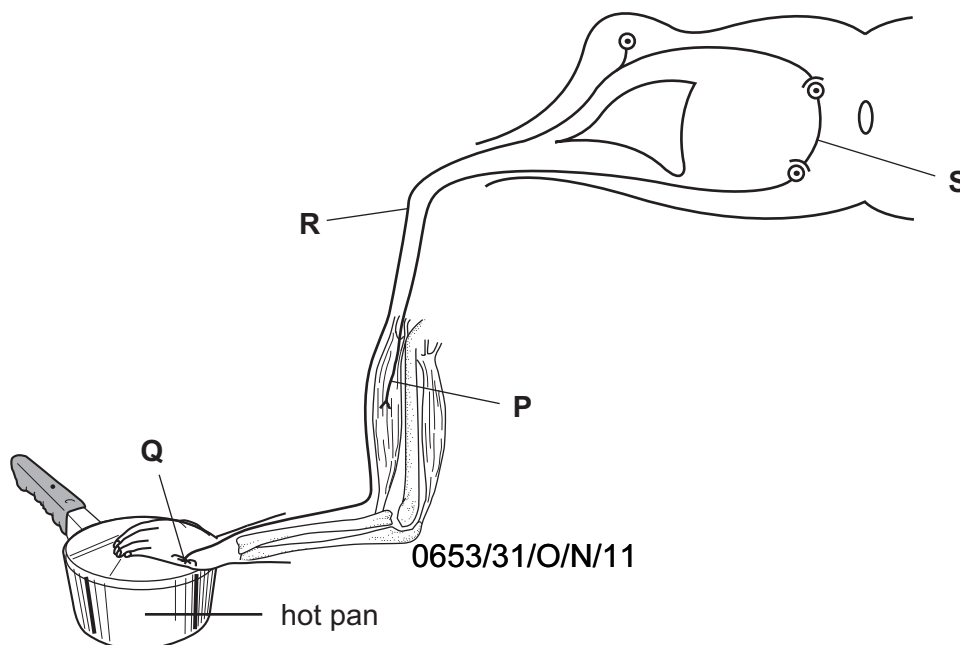


Fig. 4.1

- 4 a (i) State the **letter** that is labelling each of these structures. 0653/31/O/N/11

a receptor

a sensory neurone [2]

- 4 a (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. 0653/31/O/N/11 [1]

- 4 a (iii) On Fig. 4.1, label **one** structure that is part of the central nervous system. [1]
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- 4 a (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. 0653/31/O/N/11

..... [1]

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

- 4 b (i) Name **one** type of cell in the human body that does **not** contain a nucleus. 0653/31/O/N/11

..... [1]

- 4 b (ii) In humans, a sperm cell has 23 chromosomes. 0653/31/O/N/11

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

..... [1]

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

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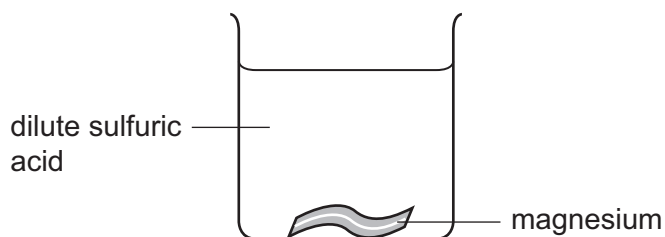
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Fig. 5.1

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

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..... [1]

- 5 a (ii) Explain your answer to (i) in terms of particles.

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.....

 [2]

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

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

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..... [1]

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

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Outline the process of cracking.

.....

 [2]

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

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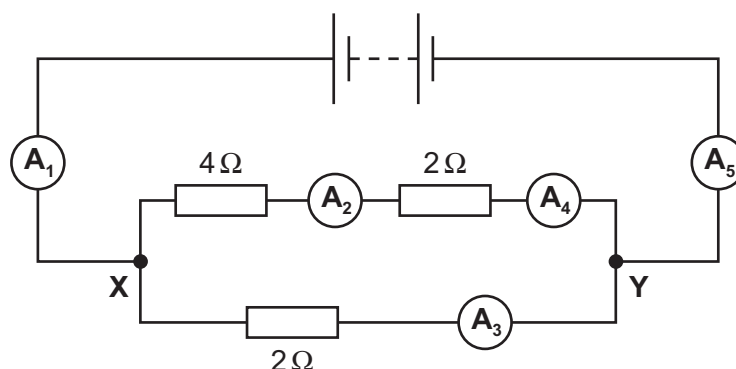
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Fig. 6.1

- 6 a (i) The readings on A_2 , A_3 and A_5 are shown in Table 6.1.

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Table 6.1

Ammeter	Reading
A_2	2 A
A_3	6 A
A_5	8 A

State the readings on A_1 and A_4 .

A_1 A_4 [2]

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

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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]

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

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Examiner's
Use

State the formula that you use and show your working.

formula used

working

..... [3]

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

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- 6 b (i)** State why this is done.

.....
..... [1]

- 6 b (ii)** A transformer changes the voltage from 25 000 V to 600 000 V.

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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]

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

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For
Examiner's
Use

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]

- 7 (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 100g of white rice and 100g of cassava.

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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

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

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

.....

.....

..... [2]

- 7 b (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. 0653/31/O/N/11

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Examiner's
Use

.....

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.....

..... [3]

- 7 b (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.

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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. 0653/31/O/N/11

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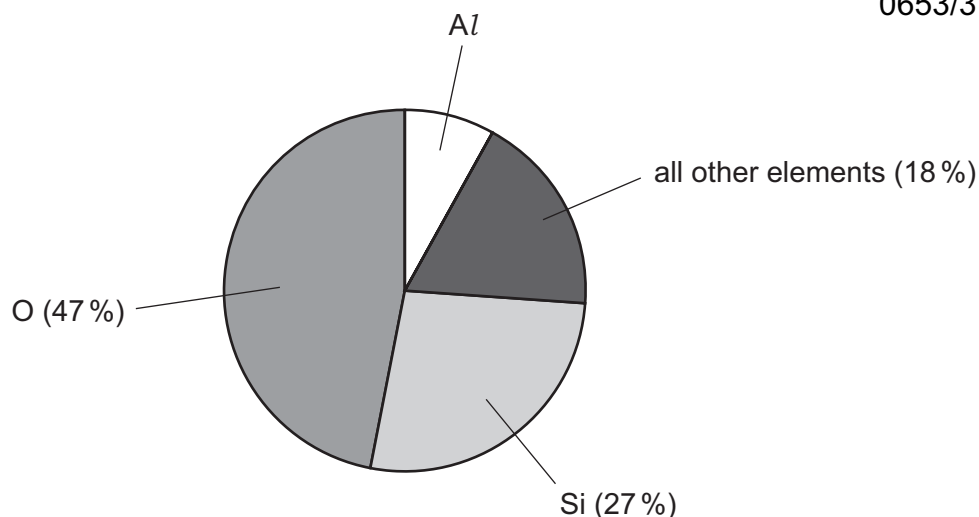


Fig. 8.1

- 8 (a) (i) State the percentage by mass of aluminium in the Earth's crust. 0653/31/O/N/11

..... [1]

- 8 a (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. 0653/31/O/N/11

39 89 139 1089

Explain briefly how you chose your answer.

number

explanation

..... [1]

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

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Fig. 8.2 shows a simplified diagram of this process.

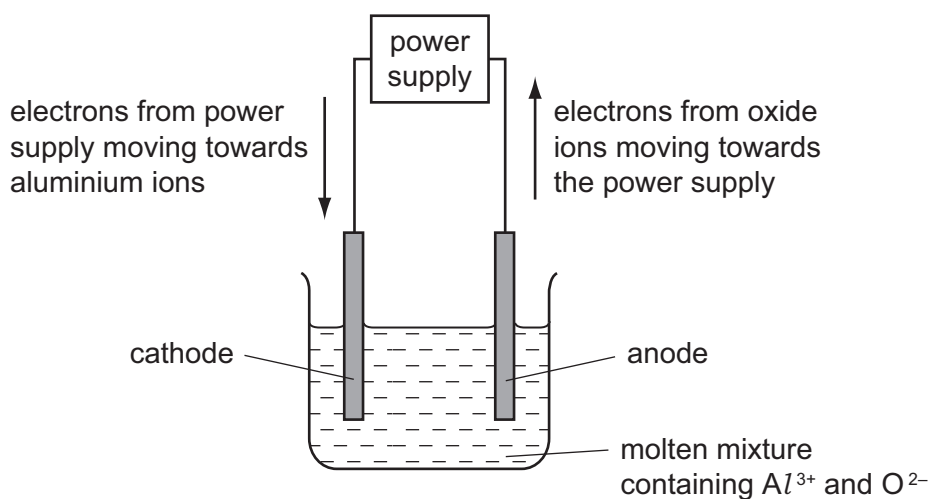


Fig. 8.2

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.

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

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.....
..... [1]

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

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.....
.....
..... [2]

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

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.....
.....
.....
.....
..... [3]

- 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.

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

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.....
 [1]

- 9 a (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.

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[1]

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

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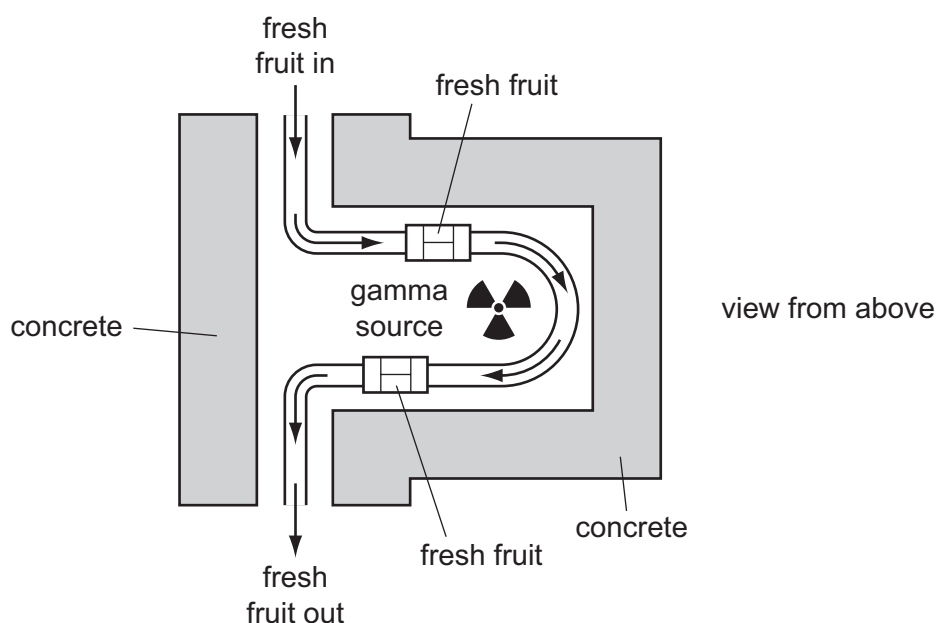


Fig. 9.1

Suggest why concrete is used to surround the radioactive source.

.....
 [1]

9 (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.

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

0653/31/O/N/11

.....
..... [1]

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

0653/31/O/N/11

.....
..... [1]

DATA SHEET
The Periodic Table of the Elements

Group																								
I	II											III	IV	V	VI	VII	0							
		<div>1 H Hydrogen</div>																						
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	101 Ru Ruthenium 44	101 Rh Rhodium 45	103 Pd Palladium 46	106 Ag Silver 47	108 Cd Cadmium 48	112 In Indium 49	115 Sn Tin 50	119 Sb Antimony 51	122 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										
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																						
58-71 Lanthanoid series																								
90-103 Actinoid series																								
<div><div><div>a</div><div>X</div><div>b</div></div><div>a = relative atomic mass X = atomic symbol b = proton (atomic) number</div></div>																								
Key												162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71							
												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			
												140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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
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												146 Ce Cerium 58	147 Pr Praseodymium 59	148 Nd Neodymium 60	154 Sm Samarium 62	156 Eu Europium 63	161 Gd Gadolinium 64	163 Tb Terbium 65	166 Dy Dysprosium 66	169 Ho Holmium 67	171 Er Erbium 68	173 Tm Thulium 69	178 Lu Lutetium 71	
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												151 Ce Cerium 58	152 Pr Praseodymium 59	153 Nd Neodymium 60	159 Sm Samarium 62	161 Eu Europium 63	166 Gd Gadolinium 64	168 Tb Terbium 65	171 Dy Dysprosium 66	174 Ho Holmium 67	176 Er Erbium 68	178 Tm Thulium 69	183 Lu Lutetium 71	
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												163 Ce Cerium 58	164 Pr Praseodymium 59	165 Nd Neodymium 60	171 Sm Samarium 62	173 Eu Europium 63	178 Gd Gadolinium 64	180 Tb Terbium 65	183 Dy Dysprosium 66	186 Ho Holmium 67	188 Er Erbium 68	190 Tm Thulium 69	195 Lu Lutetium 71	
												164 Ce Cerium 58	165 Pr Praseodymium 59	166 Nd Neodymium 60	172 Sm Samarium 62	174 Eu Europium 63	179 Gd Gadolinium 64	181 Tb Terbium 65	184 Dy Dysprosium 66	187 Ho Holmium 67	189 Er Erbium 68	191 Tm Thulium 69	196 Lu Lutetium 71	
												165 Ce Cerium 58	166 Pr Praseodymium 59	167 Nd Neodymium 60	173 Sm Samarium 62	175 Eu Europium 63	180 Gd Gadolinium 64	182 Tb Terbium 65	185 Dy Dysprosium 66	188 Ho Holmium 67	190 Er Erbium 68	192 Tm Thulium 69	197 Lu Lutetium 71	
												166 Ce Cerium 58	167 Pr Praseodymium 59	168 Nd Neodymium 60	174 Sm Samarium 62	176 Eu Europium 63	181 Gd Gadolinium 64	183 Tb Terbium 65	186 Dy Dysprosium 66	189 Ho Holmium 67	191 Er Erbium 68	193 Tm Thulium 69	198 Lu Lutetium 71	
												167 Ce Cerium 58	168 Pr Praseodymium 59	169 Nd Neodymium 60	175 Sm Samarium 62	177 Eu Europium 63	182 Gd Gadolinium 64	184 Tb Terbium 65	187 Dy Dysprosium 66	190 Ho Holmium 67	192 Er Erbium 68	194 Tm Thulium 69	199 Lu Lutetium 71	
												168 Ce Cerium 58	169 Pr Praseodymium 59	170 Nd Neodymium 60	176 Sm Samarium 62	178 Eu Europium 63	183 Gd Gadolinium 64	185 Tb Terbium 65	188 Dy Dysprosium 66	191 Ho Holmium 67	193 Er Erbium 68	195 Tm Thulium 69	200 Lu Lutetium 71	
												169 Ce Cerium 58	170 Pr Praseodymium 59	171 Nd Neodymium 60	177 Sm Samarium 62	179 Eu Europium 63	184 Gd Gadolinium 64	186 Tb Terbium 65	189 Dy Dysprosium 66	192 Ho Holmium 67	194 Er Erbium 68	196 Tm Thulium 69	201 Lu Lutetium 71	
												170 Ce Cerium 58	171 Pr Praseodymium 59	172 Nd Neodymium 60	178 Sm Samarium 62	180 Eu Europium 63	185 Gd Gadolinium 64	187 Tb Terbium 65	190 Dy Dysprosium 66	193 Ho Holmium 67	195 Er Erbium 68	197 Tm Thulium 69	202 Lu Lutetium 71	
												171 Ce Cerium 58	172 Pr Praseodymium 59	173 Nd Neodymium 60	179 Sm Samarium 62	181 Eu Europium 63	186 Gd Gadolinium 64	188 Tb Terbium 65	191 Dy Dysprosium 66	194 Ho Holmium 67	196 Er Erbium 68	198 Tm Thulium 69	203 Lu Lutetium 71	
												172 Ce Cerium 58	173 Pr Praseodymium 59	174 Nd Neodymium 60	180 Sm Samarium 62	182 Eu Europium 63	187 Gd Gadolinium 64	189 Tb Terbium 65	192 Dy Dysprosium 66	195 Ho Holmium 67	197 Er Erbium 68	199 Tm Thulium 69	204 Lu Lutetium 71	
												173 Ce Cerium 58	174 Pr Praseodymium 59	175 Nd Neodymium 60	181 Sm Samarium 62	183 Eu Europium 63	188 Gd Gadolinium 64	190 Tb Terbium 65	193 Dy Dysprosium 66	196 Ho Holmium 67	198 Er Erbium 68	200 Tm Thulium 69	205 Lu Lutetium 71	
												174 Ce Cerium 58	175 Pr Praseodymium 59	176 Nd Neodymium 60	182 Sm Samarium 62	184 Eu Europium 63	189 Gd Gadolinium 64	191 Tb Terbium 65	194 Dy Dysprosium 66	197 Ho Holmium 67	199 Er Erbium 68	201 Tm Thulium 69	206 Lu Lutetium 71	
												175 Ce Cerium 58	176 Pr Praseodymium 59	177 Nd Neodymium 60	183 Sm Samarium 62	185 Eu Europium 63	190 Gd Gadolinium 64	192 Tb Terbium 65	195 Dy Dysprosium 66	198 Ho Holmium 67	200 Er Erbium 68	202 Tm Thulium 69	207 Lu Lutetium 71	
												176 Ce Cerium 58	177 Pr Praseodymium 59	178 Nd Neodymium 60	184 Sm Samarium 62	186 Eu Europium 63	191 Gd Gadolinium 64	193 Tb Terbium 65	196 Dy Dysprosium 66	199 Ho Holmium 67	201 Er Erbium 68	203 Tm Thulium 69	208 Lu Lutetium 71	
												177 Ce Cerium 58	178 Pr Praseodymium 59	179 Nd Neodymium 60	185 Sm Samarium 62	187 Eu Europium 63	192 Gd Gadolinium 64	194 Tb Terbium 65	197 Dy Dysprosium 66	200 Ho Holmium 67	202 Er Erbium 68	204 Tm Thulium 69	209 Lu Lutetium 71	
												178 Ce Cerium 58	179 Pr Praseodymium 59	180 Nd Neodymium 60	186 Sm Samarium 62	188 Eu Europium 63	193 Gd Gadolinium 64	195 Tb Terbium 65	198 Dy Dysprosium 66	201 Ho Holmium 67	203 Er Erbium 68	205 Tm Thulium 69	210 Lu Lutetium 71	
												179 Ce Cerium 58	180 Pr Praseodymium											

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

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

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

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