UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

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.

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

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

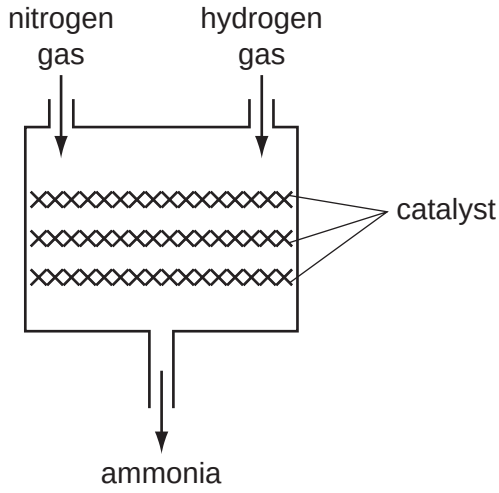


Fig. 1.1

(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]

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

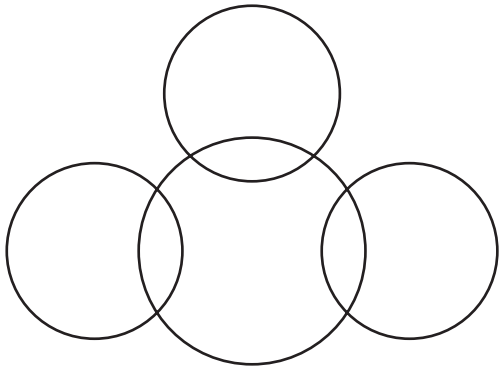
Show your working.

.....

[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. T… includes fruits and nectar from trees. Its predators include snakes, bamboo rats and owl…

(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]

(b) Golden lion tamarins are important for the dispersal of seeds from many d… 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.

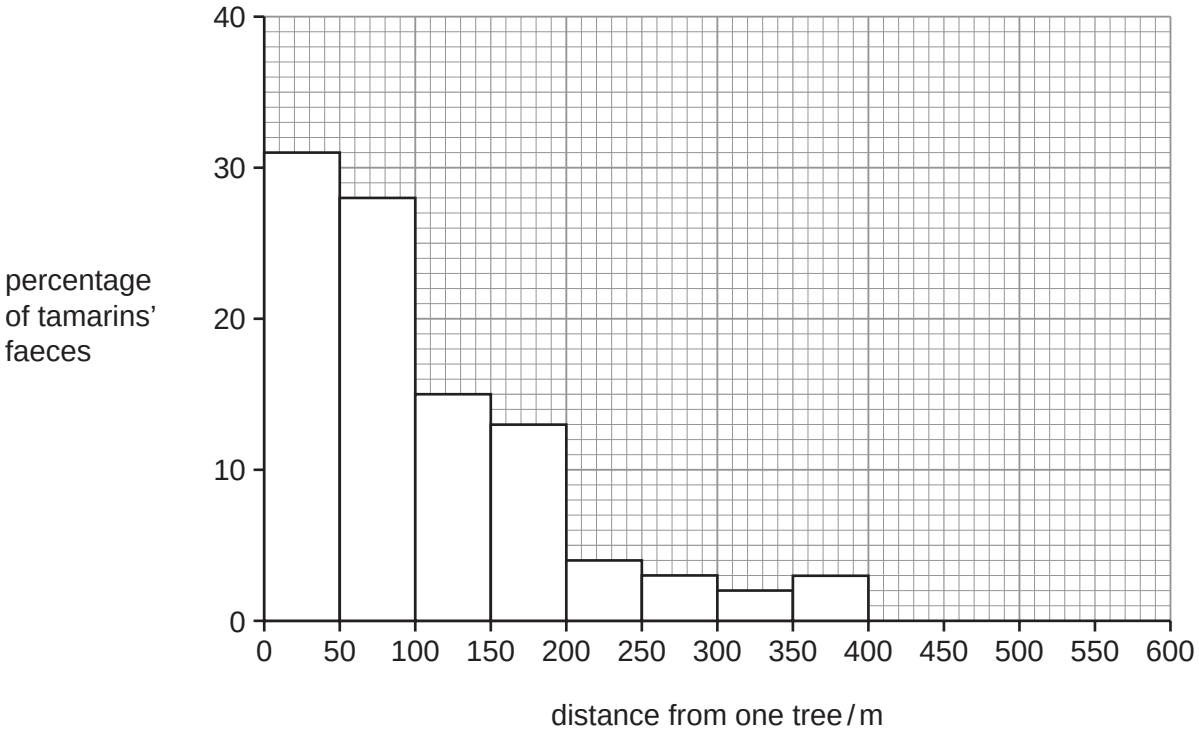


Fig. 2.1

(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.

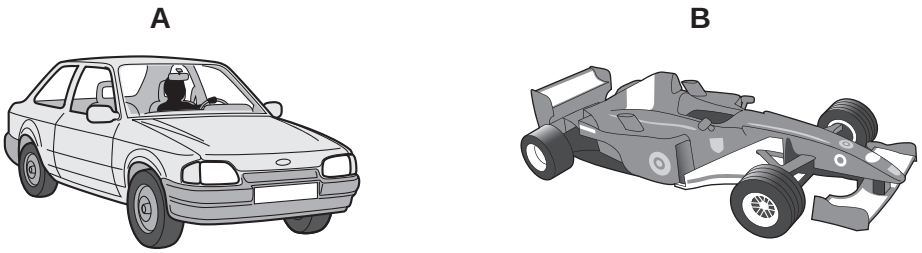


Fig. 3.1

(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]

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

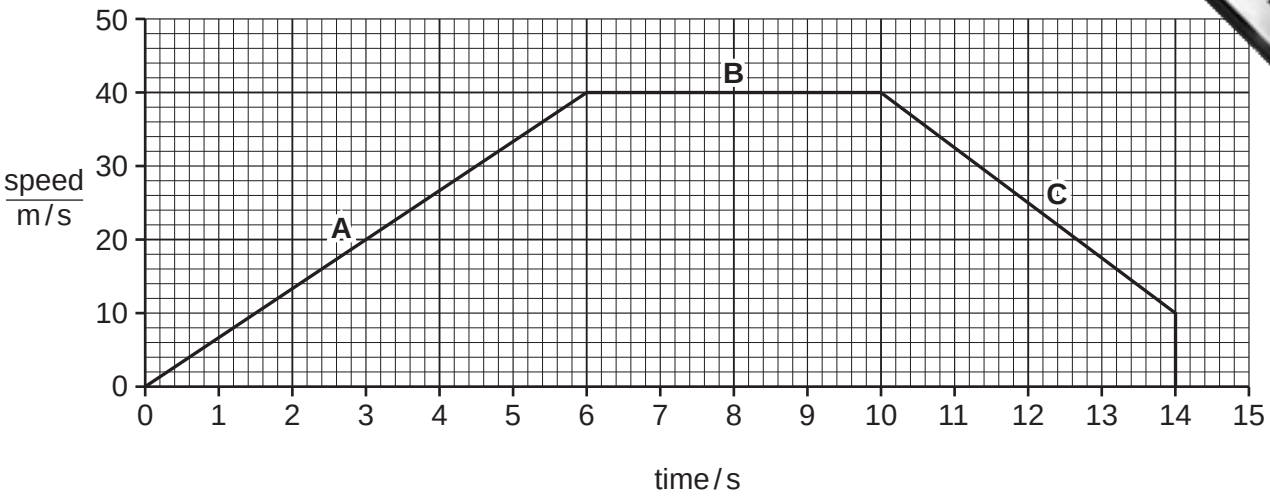


Fig. 3.2

(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]

(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]

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

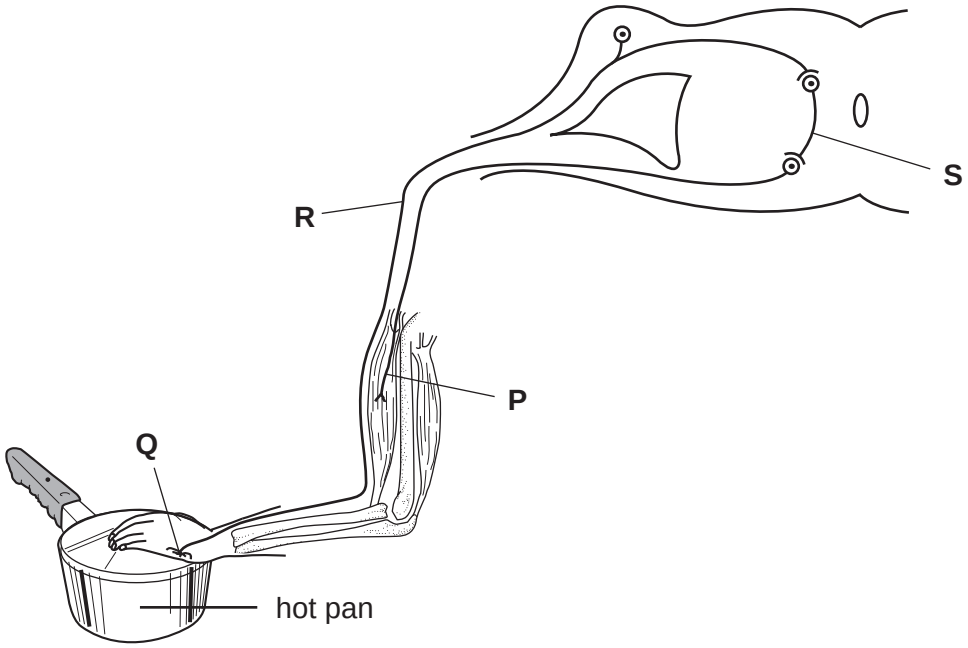


Fig. 4.1

(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]

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

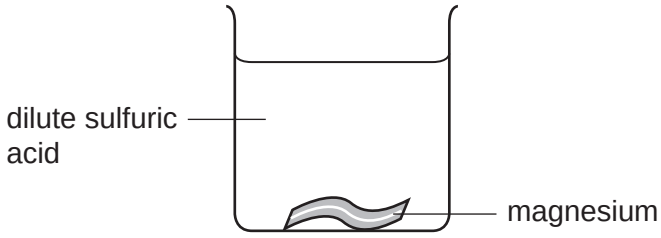


Fig. 5.1

(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]

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

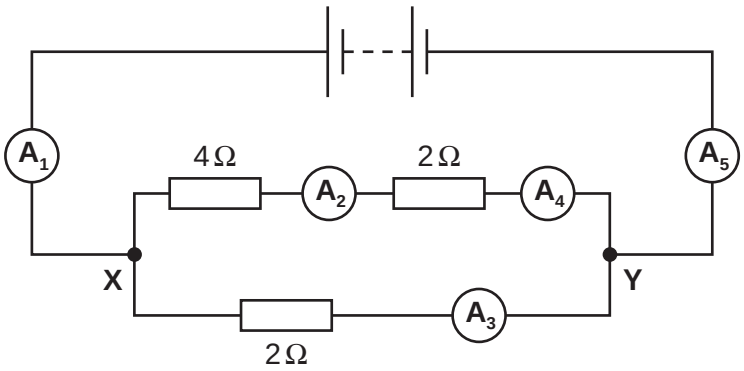


Fig. 6.1

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

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]

(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]

(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]

7 **(a)** Table 7.1 shows some information about enzymes found in the human alim 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]

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

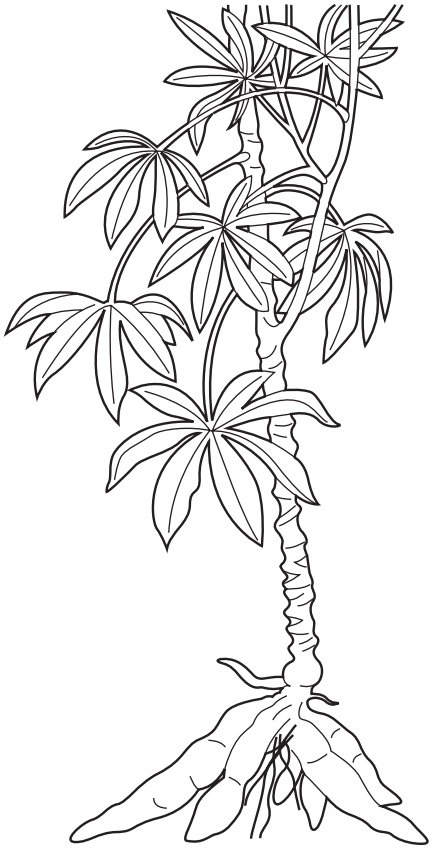
.....

.....

.....

..... [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 c

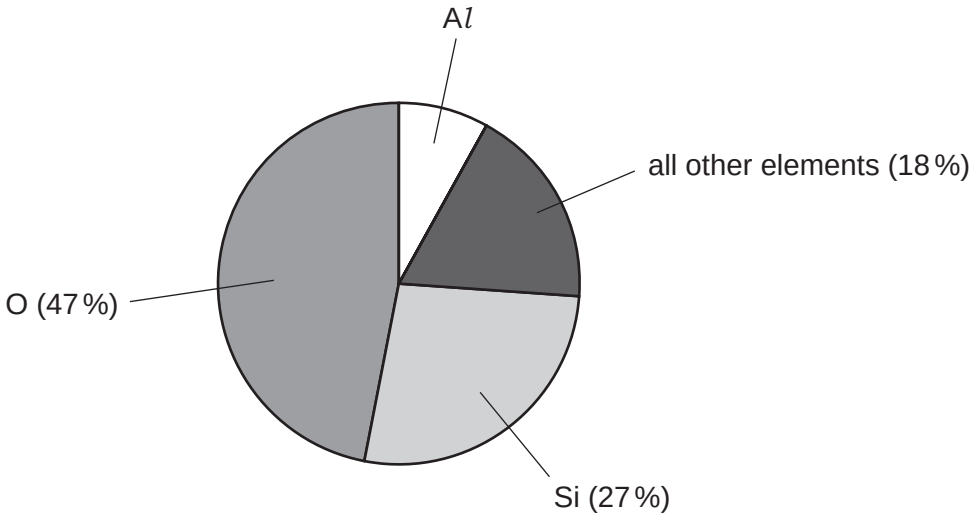


Fig. 8.1

(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]

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

Fig. 8.2 shows a simplified diagram of this process.

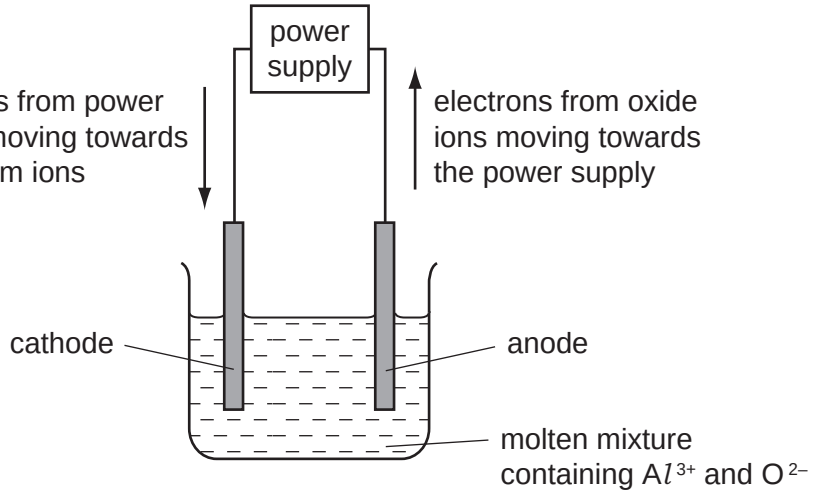


Fig. 8.2

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]

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

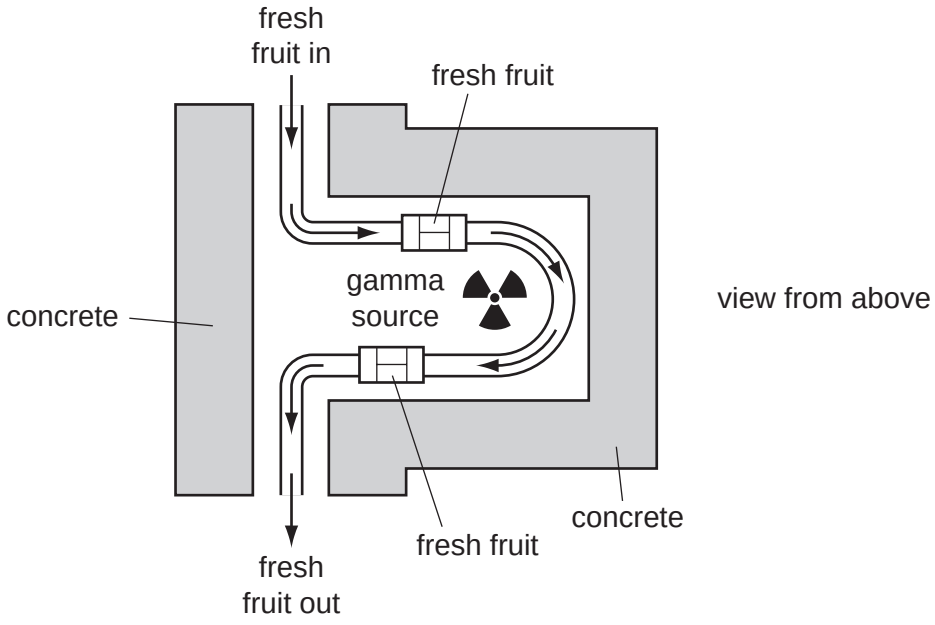


Fig. 9.1

Suggest why concrete is used to surround the radioactive source.

.....

..... [1]

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

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.).