



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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* 5 9 0 8 0 7 6 9 0 2 *

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 catalyst.

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

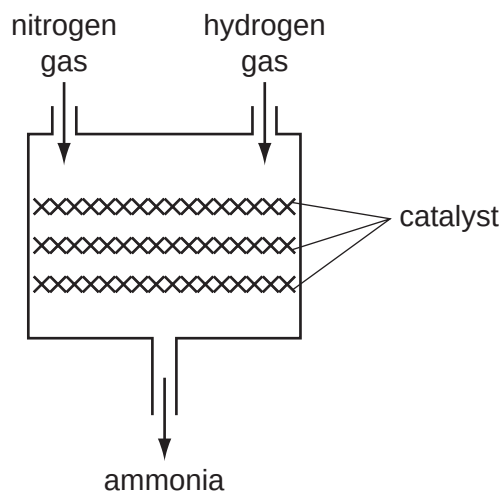


Fig. 1.1

- (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.



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

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

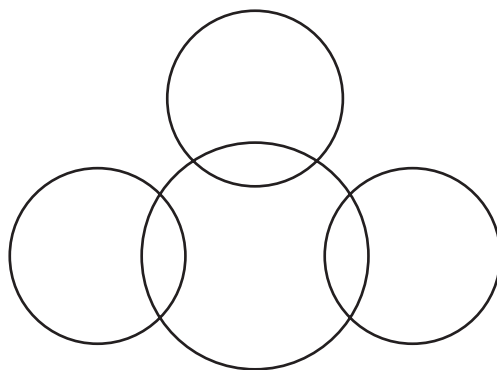
- (v) Calculate the relative formula mass of iron oxide, Fe_3O_4 .

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. It feeds on fruits and nectar from trees. Its predators include snakes, bamboo rats and owls.



- (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 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.

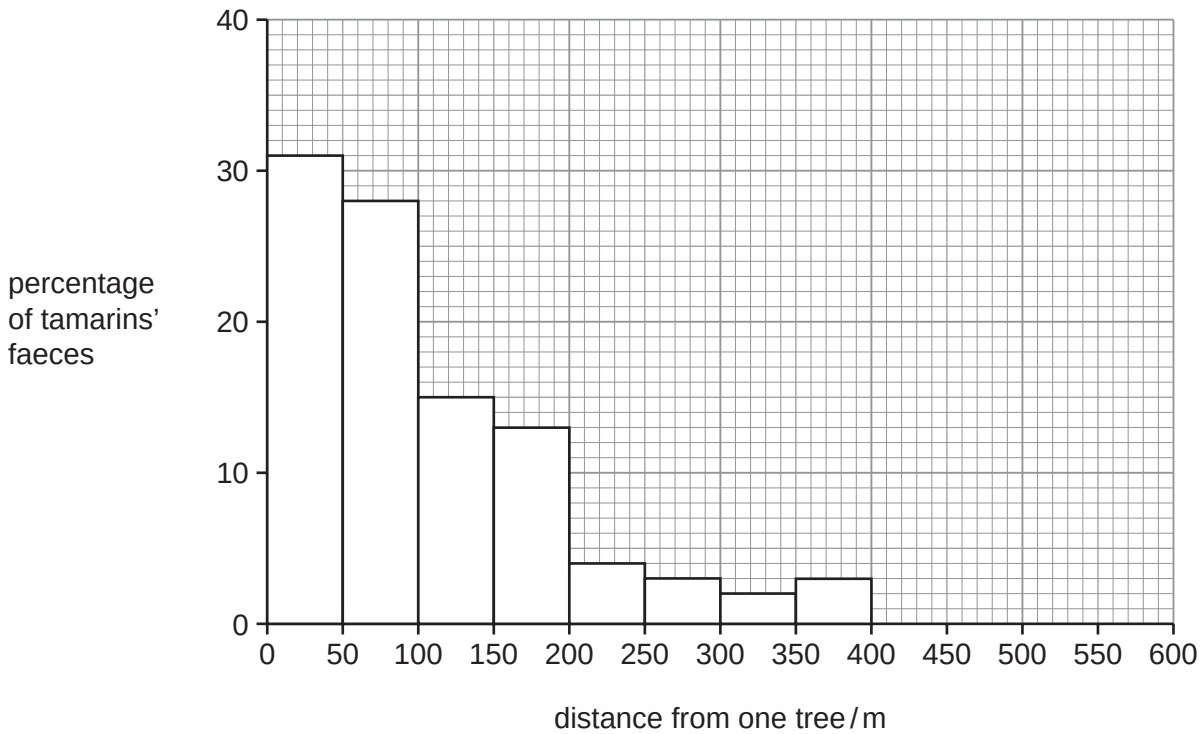


Fig. 2.1

- (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]

3 Fig. 3.1 shows two cars.

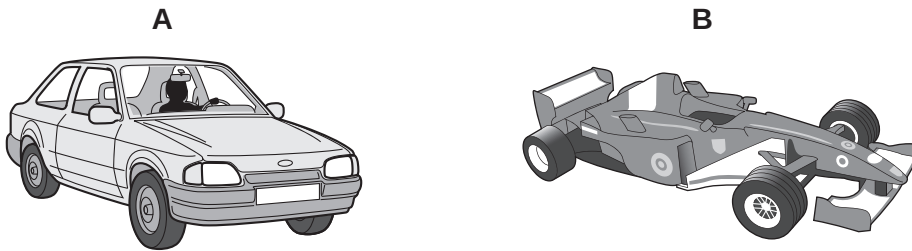


Fig. 3.1

- (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.

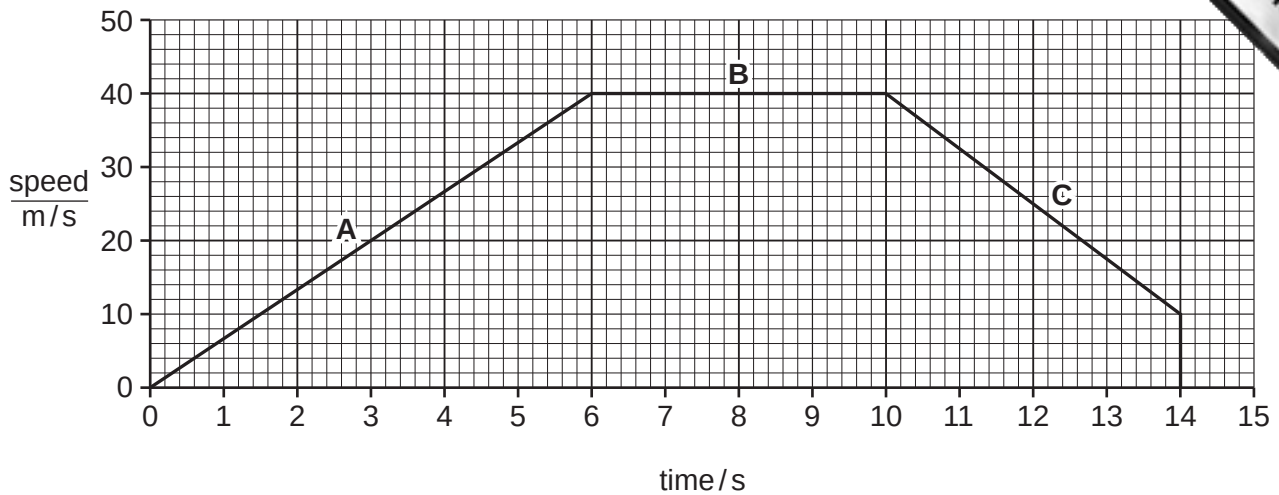


Fig. 3.2

(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.

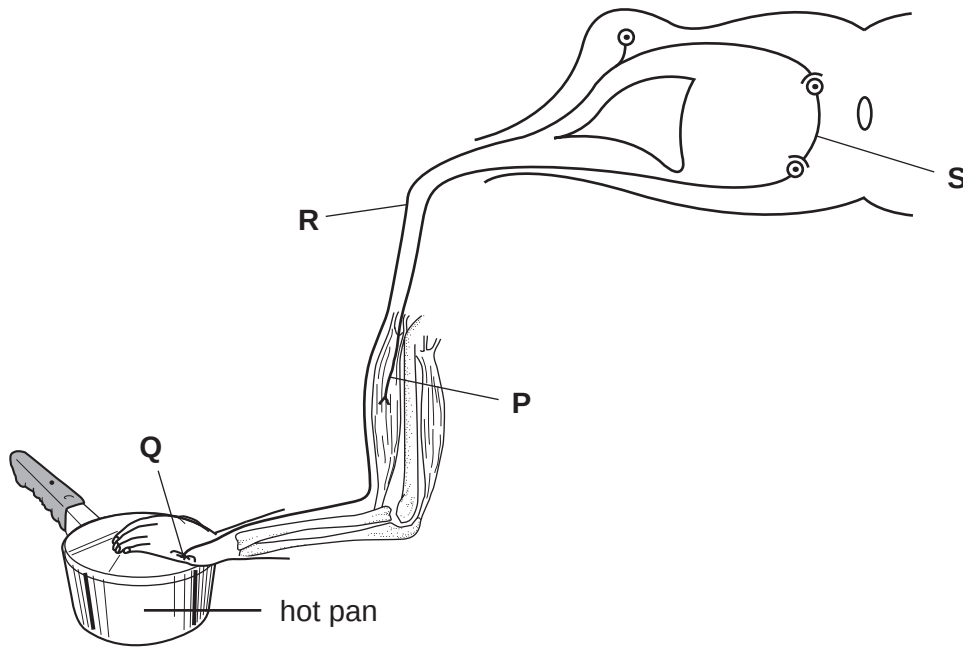


Fig. 4.1

- (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 into a container of dilute sulfuric acid.

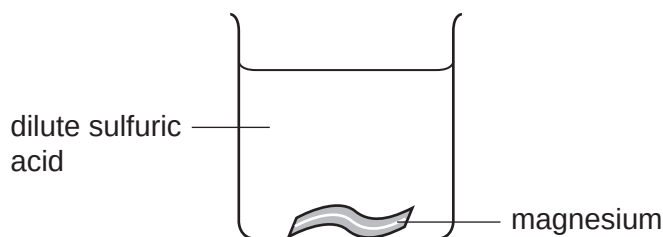


Fig. 5.1

- (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]

- 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.

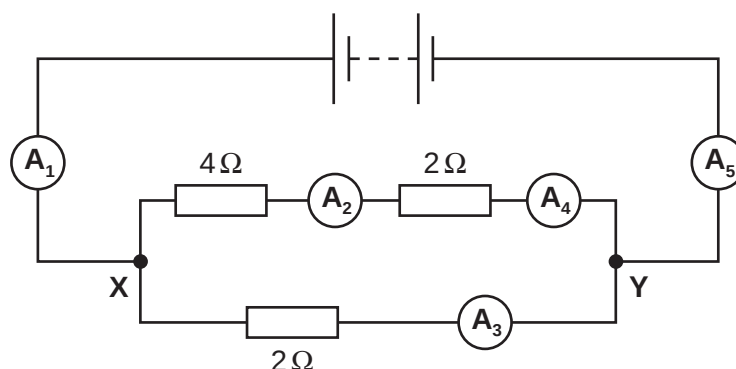


Fig. 6.1

- (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 2Ω 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 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 100g of white rice and 100g 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.

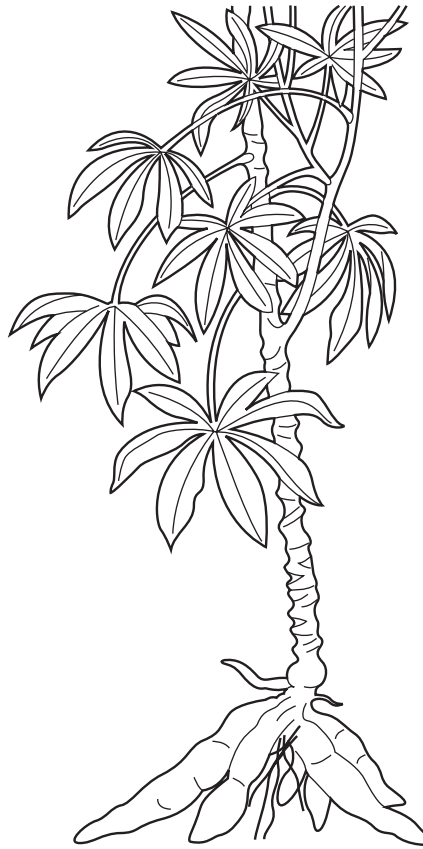
.....

.....

.....

..... [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 crust.

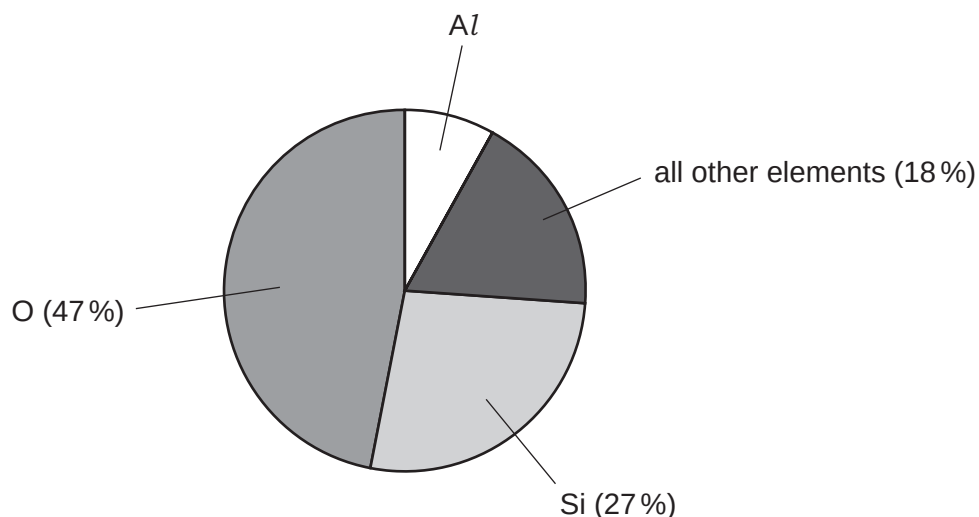


Fig. 8.1

- (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.

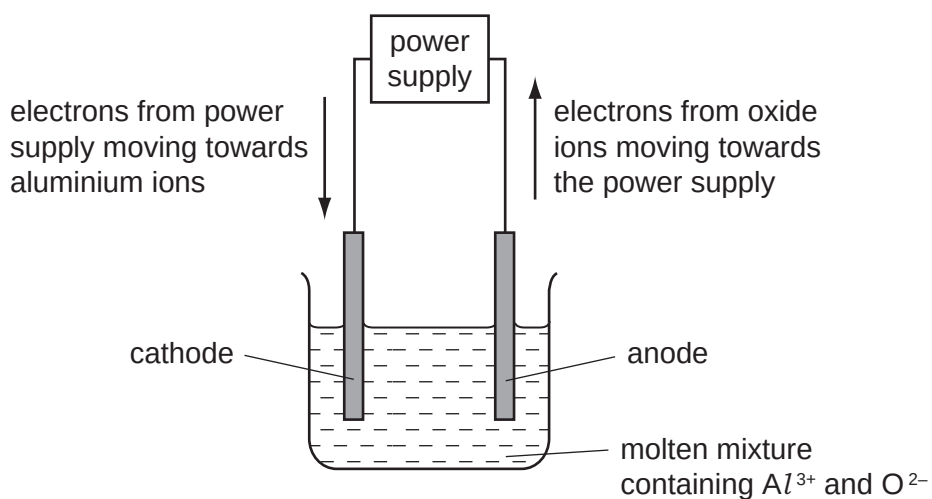


Fig. 8.2

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 speed 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

of protons

different numbers

and

the same number

of neutrons.

different numbers

[1]

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

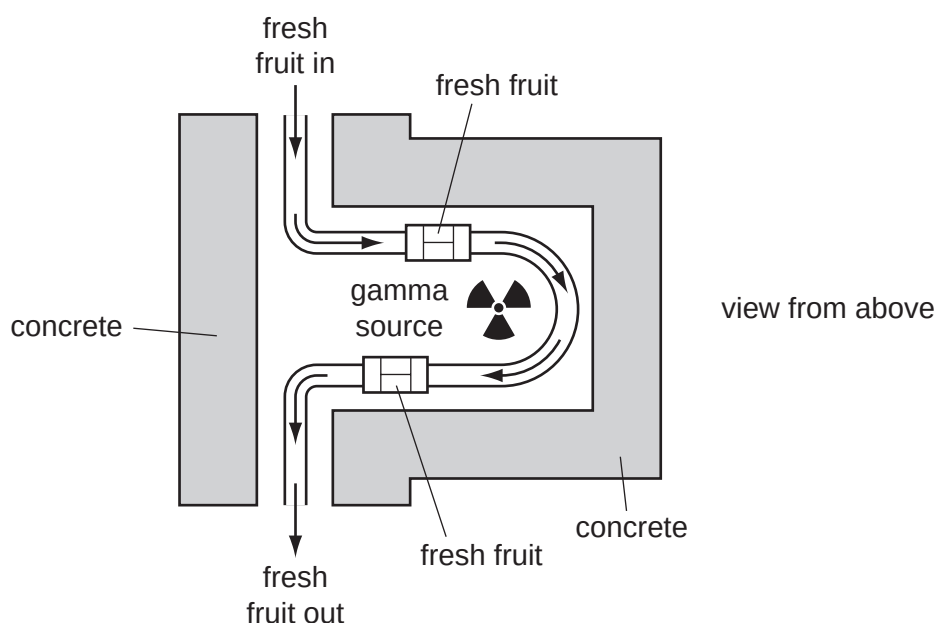


Fig. 9.1

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 radioactive isotopes. 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																																								
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	98 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 Cesium 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	210 Po Polonium 84	210 At Astatine 85	222 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	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	238 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103
Key	X	a	a = relative atomic mass X = atomic symbol b = proton (atomic) number																																							

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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For Examiner's Use	
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9	
Total	

This document consists of **22** printed pages and **2** blank pages.



- 1 Coral reefs are found in shallow seawater. Limestone is a common type of rock found in Earth's crust. Both coral reefs and limestone are made mainly of the ionic compound calcium carbonate.

(a) A student uses the apparatus shown in Fig. 1.1 to test a rock sample to discover whether or not it is limestone.

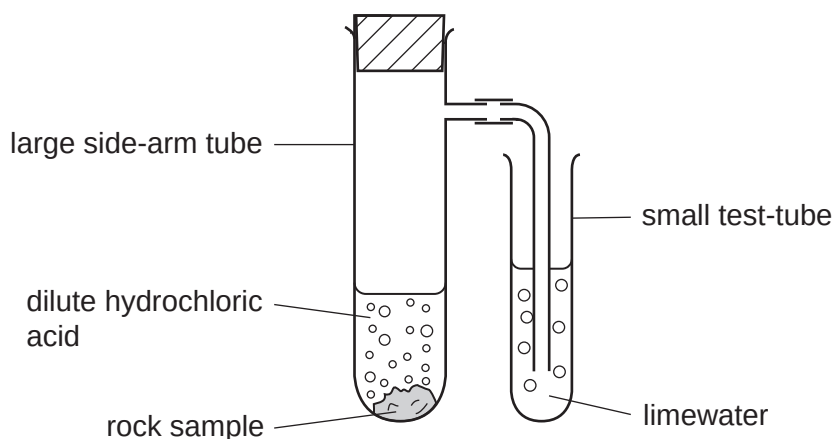


Fig. 1.1

The student observed that a gas was given off and that the limewater in the small test-tube became cloudy.

(i) Name the gas that was given off. [1]

(ii) Explain whether or not the student gained enough evidence from the result of his test to show that the rock sample is made of limestone.

.....

.....

..... [2]

(b) In recent years, the amount of carbon dioxide in the atmosphere has increased. This has contributed to a decrease in the average pH of seawater.

During this period, many coral reefs have become weakened and damaged.

(i) Explain why increased levels of carbon dioxide in the atmosphere could cause the average pH of the sea to decrease.

.....

.....

..... [2]

- (ii) Suggest why a decrease in the average pH of seawater could damage coral.

.....

..... [1]

2 Most cells obtain energy from carbohydrates and other nutrients by aerobic respiration.

(a) Write the word equation for aerobic respiration.

..... [2]

(b) Describe how oxygen is transported from the lungs to a cell in a human muscle.

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

(c) When a person runs, muscles generate heat energy, which increases the body temperature. Body temperature can be lowered by sweating.

The core temperature of an athlete was measured as she ran steadily for 120 minutes, drinking no fluids while running. She repeated the run the next day, but this time drank fluids throughout the run. The environmental temperature and humidity were the same on both days.

The results are shown in Fig. 2.1.

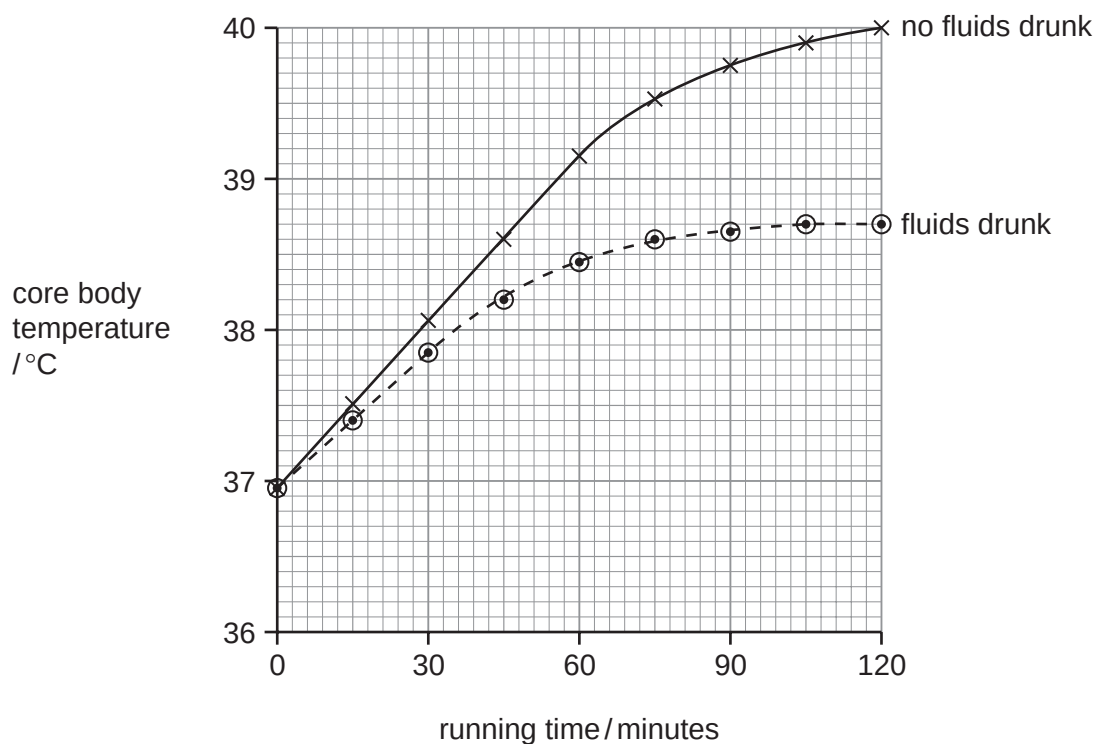


Fig. 2.1

- (i) Explain how sweating can reduce body temperature.

.....

.....

..... [2]

- (ii) Compare the body temperature of the athlete when she ran without drinking fluids to her body temperature when she ran while drinking fluids.

.....

.....

..... [2]

- (iii) Suggest an explanation for the differences you have described in (ii).

.....

.....

..... [2]

- 3 Yaks are animals that live in the cold mountainous region of the Himalayas.

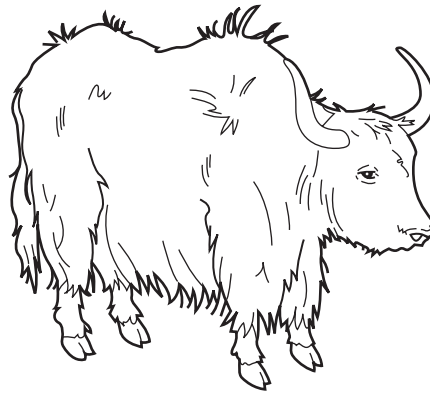


Fig. 3.1

Fig. 3.1 shows a yak.

- (a) Explain how the long hair of the yak keeps it warm during the cold weather.

.....

.....

..... [2]

- (b) Yak dung is commonly burned as a fuel in the Himalayas. However, it is slowly being replaced by kerosene.

State and explain **one** environmental reason why yak dung is a better fuel to use than kerosene.

.....

.....

..... [2]

(c) Yaks communicate with each other using low frequency sounds that humans can hear.

(i) Suggest a possible frequency for this sound.

..... [1]

(ii) Explain what is happening when this sound travels through the air. You may use a diagram to help you answer this question.

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

- 4 Nordic gold is an alloy of four metals used to make coins.



Table 4.1 shows information about the metals contained in Nordic gold.

Table 4.1

metal	% by mass in Nordic gold	compound from which the metal is extracted
aluminium	5	Al_2O_3
copper	89	CuFeS_2
tin	1	SnO_2
zinc	5	ZnS

- (a) In the right hand column, the elements present in compounds can be identified by their symbols.

Name a metallic element present in one of the compounds in Table 4.1 which is **not** present in Nordic gold.

..... [1]

- (b) The method used to extract a metal from its compound depends on the reactivity of the metal.

- (i) Tin may be extracted from tin oxide, SnO_2 , by heating a mixture of tin oxide and carbon. The other product of this reaction is carbon monoxide, CO .

Construct a balanced, symbolic equation for this reaction.

..... [2]

- (ii) When aluminium oxide is heated with carbon, no reaction occurs.

Explain why it is possible to extract tin but **not** aluminium by heating their oxides with carbon.

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

- (iii) Aluminium is extracted from the insoluble compound aluminium oxide by electrolysis.

Outline the stages by which solid aluminium oxide, containing aluminium **ions**, is converted into metallic aluminium, made of aluminium **atoms**, using electrolysis.

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

- (c) (i) Calculate the formula mass of the compound, CuFeS_2 .

Show your working.

..... [1]

- (ii) A coin made of Nordic gold has a mass of 7.80 g.

Calculate the mass of copper in the coin.

Show your working.

..... [1]

- 5 Fig. 5.1 shows a flower from a sugar cane plant.

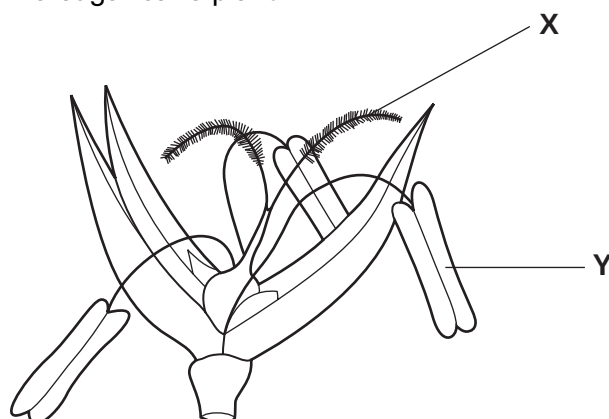


Fig. 5.1

- (a) (i) Name the parts labelled **X** and **Y**.

X

Y

[2]

- (ii) Describe **two** features of the sugar cane flower which indicate that it is wind-pollinated.

1

2

[2]

- (iii) Flowers are involved in sexual reproduction.

State **two** ways in which sexual reproduction differs from asexual reproduction.

1

.....

2

.....

[2]

- (b) In many parts of the world, fields of sugar cane are burned before harvesting. Burning the sugar cane plants releases nitrogen oxides into the air.

Explain how this could harm the environment.

.....

.....

.....

.....

[3]

Please turn over for Question 6.

- 6 Sea anemones are animals that live attached to rocks or the sea bed. Fig. 6.1 shows a section through a sea anemone.

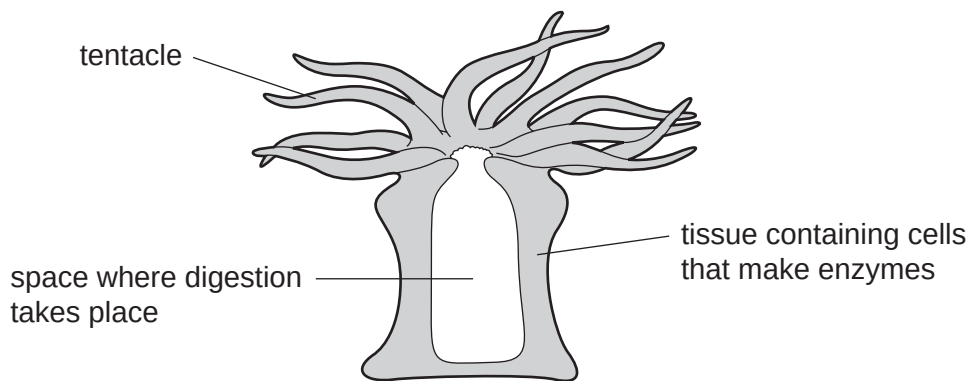


Fig. 6.1

- (a) Explain the meaning of the term *tissue*.

.....
 [2]

- (b) Sea anemones feed by capturing small animals with their tentacles. The tentacles push the small animal into the space in the middle of the body. The cells lining the space secrete enzymes, which digest the animal.

- (i) One of the enzymes that is secreted is protease. This breaks down large molecules to small, soluble molecules.

State the name of

the large molecules that are broken down by protease,

.....
 the small, soluble molecules produced.
 [2]

- (ii) Because sea anemones are small, they do not need a blood system to transport nutrients to all the different cells in their body.

Suggest how the small, soluble molecules produced by digestion can spread to all the cells in the sea anemone's body.

.....

 [2]

- (c) Sea anemones usually stay firmly fixed to rocks. Because sea anemones do not move around, some people think they are plants.

A student looks at a small part of a sea anemone through a microscope.

Suggest what the student would observe that would show that a sea anemone is an animal and not a plant.

.....

.....

..... [2]

7 Fig. 7.1 shows an electric hairdryer.

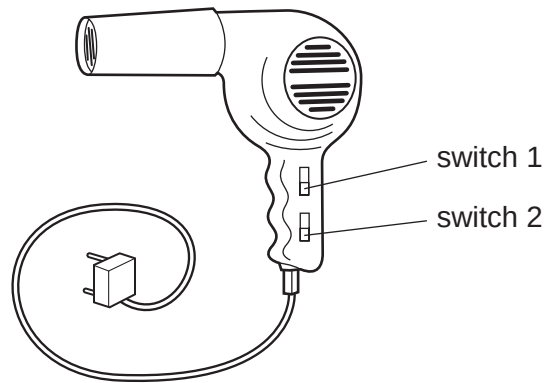


Fig. 7.1

(a) Fig. 7.2 shows the circuit diagram for the hairdryer.

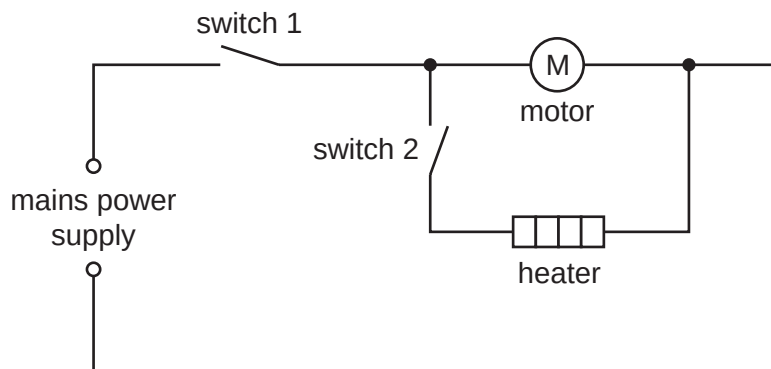


Fig. 7.2

- (i) State which of the switches must be closed (on) for the heater in the hairdryer to work.

..... [1]

- (ii) A student wanted to determine the resistance of the heater.

Fig. 7.3 shows the circuit he built to measure the current passing through the heater and the potential difference across the heater.

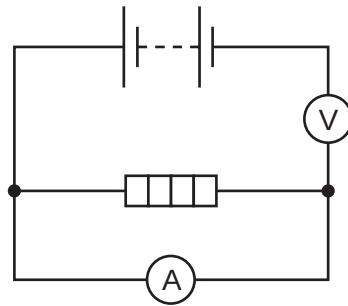


Fig. 7.3

His experiment did not work because his circuit was incorrect.

Draw the correct circuit in the space below.

[1]

- (b) (i)** The electricity used in the hairdryer was generated at a power station.

Power is transmitted from the power station over large distances.

A high voltage is always used. Explain why.

.....

..... [1]

- (ii) The high voltage is produced by a transformer.

Fig. 7.4 shows a diagram of a simple transformer.

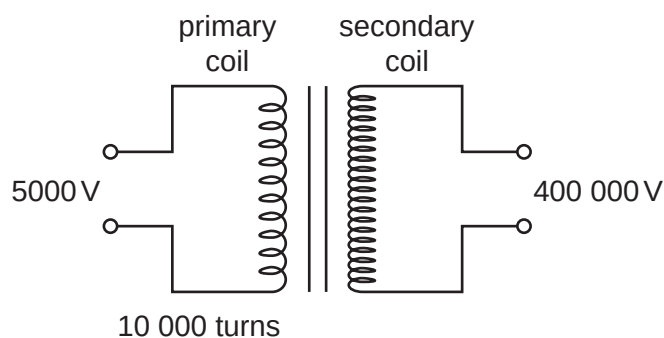


Fig. 7.4

Calculate the number of turns in the secondary coil.

State the formula that you use and show your working.

formula used

working

number of turns = ... [2]

- (iii) Explain how a transformer changes the voltage of an electrical supply. Your explanation should include the terms *induced voltage* and *magnetic field*.

.....

.....

.....

.....

..... [3]

8 Hydrocarbons are compounds which contain only the elements hydrogen and carbon.

(a) The simplest hydrocarbon is methane, CH_4 , which is an important fuel.

(i) State **one** natural source of methane.

..... [1]

(ii) A free (unbonded) carbon atom has four electrons in its outer shell.

State the number of electrons in the outer shell of a carbon atom in a methane molecule. Describe their arrangement.

You may wish to draw a diagram to help you answer this question.

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

- (b) Table 8.1 shows the displayed formulae and boiling points of four hydrocarbons, **C** and **D**.

Table 8.1

	displayed formula	boiling point/°C
A	<pre> H H H H H H | | | | | H — C — C — C — C — C — C — H | | | | | H H H H H H </pre>	69
B	<pre> H H H H | | | | H — C — C — C — C — H | | | | H H H H </pre>	-0.5
C	<pre> H H H H | | | | H — C — C — C = C — H | | H H </pre>	-6.3
D	<pre> H H H H H H | | | | | H — C — C — C — C — C = C — H | | | | H H H H </pre>	63

- (i) Name a process which could be used to separate a mixture of the four compounds in Table 8.1.

..... [1]

- (ii) Use the information in Table 8.1 to suggest **one** way in which the boiling point of a hydrocarbon is affected by its molecular structure.

.....

.....

..... [2]

- (iii) A bottle contains a colourless liquid which is thought to be either hydrocarbon **A** or **D**.

Describe a **chemical** test, and its result, which could be used to identify which hydrocarbon is in the bottle.

Explain your choice of test.

.....

.....

.....

..... [3]

- 9 (a) An aircraft has a mass of 400 000 kg. It has four engines each capable of producing a maximum force of 300 000 N.

Calculate the maximum acceleration of the aircraft.

State the formula that you use and show your working.

formula

working

[3]

- (b) Potato snacks are packed in airtight packets and filled with an unreactive gas at atmospheric pressure.



- (i) Suggest why an unreactive gas is used, rather than air.

[1]

- (ii) A passenger has a packet of potato snacks in his hand luggage on the aircraft. During the flight, the aircraft cabin is at a pressure less than normal atmospheric pressure.

The passenger notices that the packet has expanded.

Explain why this happens.

[1]

- (c) A skydiver jumps from an aircraft and falls through the air. Eventually she reaches a constant terminal velocity. When she opens her parachute, her velocity decreases and she falls slowly to the ground. Fig. 9.1 shows how her velocity varies during the fall.

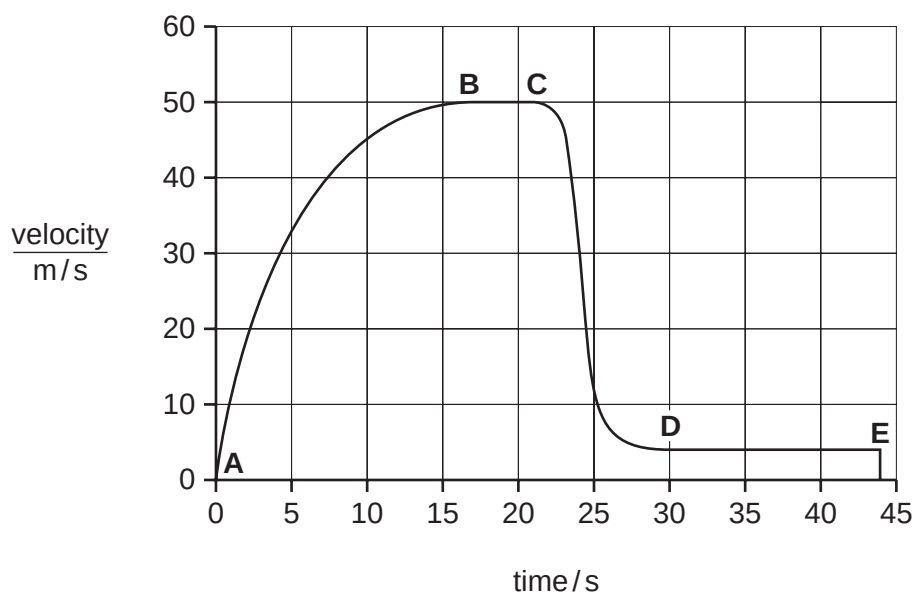


Fig 9.1

- (i) State the difference between speed and velocity.

.....
 [1]

- (ii) State **one** region on the graph when she is accelerating.

..... [1]

- (iii) Is this acceleration constant over this region?

Explain your answer.

..... [1]

- (iv) Give the letter of the point at which the parachute opens.

..... [1]

- (v) State the terminal velocity before the parachute opens.

..... [1]

- (vi) Explain why the skydiver reaches a terminal velocity.

.....

.....

.....

..... [2]

- (vii) Explain why the open parachute slows down the skydiver.

.....

..... [1]

DATA SHEET
The Periodic Table of the Elements

Group																													
I	II											III	IV	V	VI	VII	0												
												1 H Hydrogen 1																	
7 Li Lithium 3	9 Be Beryllium 4																												
23 Na Sodium 11	24 Mg Magnesium 12																												
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	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	127 Te Tellurium 52	131 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		210 Po Polonium 84	222 Rn Radon 86												
Fr Francium 87	88 Ra Radium	226 Ac Actinium																											
58-71 Lanthanoid series																													
90-103 Actinoid series																													

Key

a	X	a = relative atomic mass
b	X	X = atomic symbol
	b	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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COMBINED SCIENCE

0653/33

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 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 **20** printed pages.



- 1 There are three states of matter – solid, liquid and gas.

Fig. 1.1 shows the arrangement of particles in a solid.

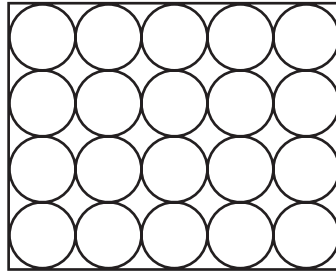
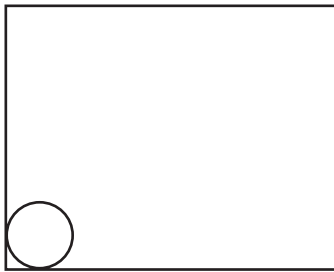
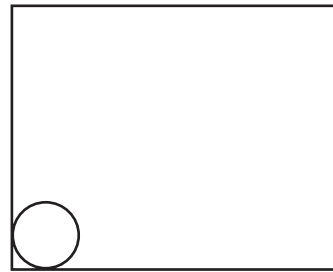


Fig. 1.1

- (a) (i) Draw similar diagrams for a liquid and a gas.



liquid



gas

[2]

- (ii) Explain the arrangements you have drawn in terms of the forces between the particles.

.....

 [2]

(b) Explain the following using the ideas of conduction, convection and radiation.

(i) Houses in hot climates are often painted white.

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

(ii) A saucepan has a metal base but a plastic or wooden handle.

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

(iii) In a kettle, the water is heated at the bottom but all of the water in the kettle becomes hot.

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

- 2 (a) Fig. 2.1 shows a flowering plant, and two cells from the plant.

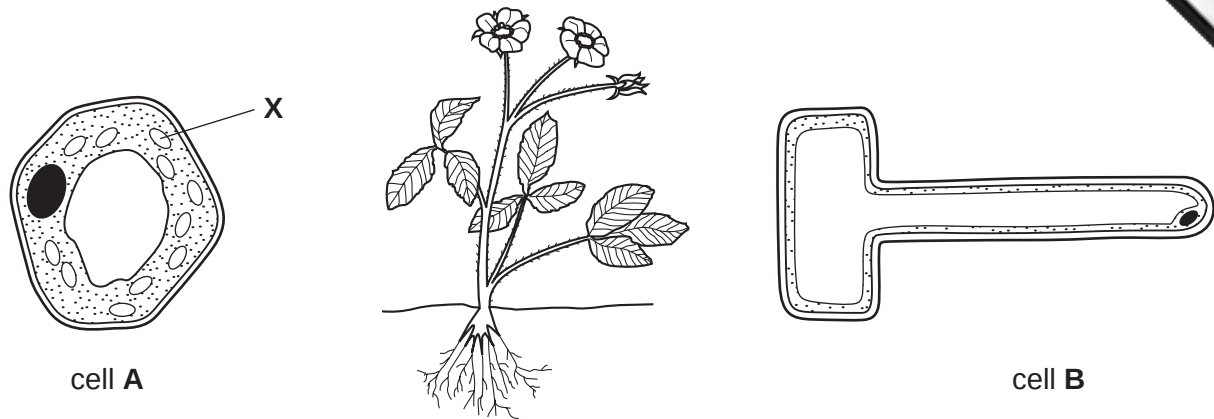


Fig. 2.1

- (i) On Fig. 2.1, draw a line from each cell to a part of the plant in which it could be found. [2]

- (ii) Explain why cell **A** contains the structures labelled **X**, but cell **B** does not.

.....

.....

.....

.....

..... [3]

- (iii) Suggest how the shape of cell **B** adapts it for its function.

.....

.....

..... [2]

- (b) The colour of the flower petals is determined by a gene with two alleles, **R** and **r**. **R** is dominant and produces red flowers, and allele **r** produces white flowers.
- (i) Complete Table 2.1 to show the phenotype produced by each of the three possible genotypes.

Table 2.1

genotype	phenotype
RR	
Rr	
rr	

[1]

- (ii) On Table 2.1, draw a circle around **one heterozygous** genotype. [1]
- (iii) Predict the ratio of red to white flowers that would be produced if two plants with the genotypes **Rr** were crossed.

..... [1]

- (c) A grower has a rare variety of orchid with unusual flowers. She decides to produce new plants from this orchid using an asexual method of propagation.

Suggest the advantages to the grower of using asexual propagation to produce new plants, rather than sowing seeds she has collected from the orchid plant.

.....

.....

..... [2]

- 3 (a) Fig. 3.1 shows apparatus a student used to investigate the electrolysis of a solution of potassium sulfate.

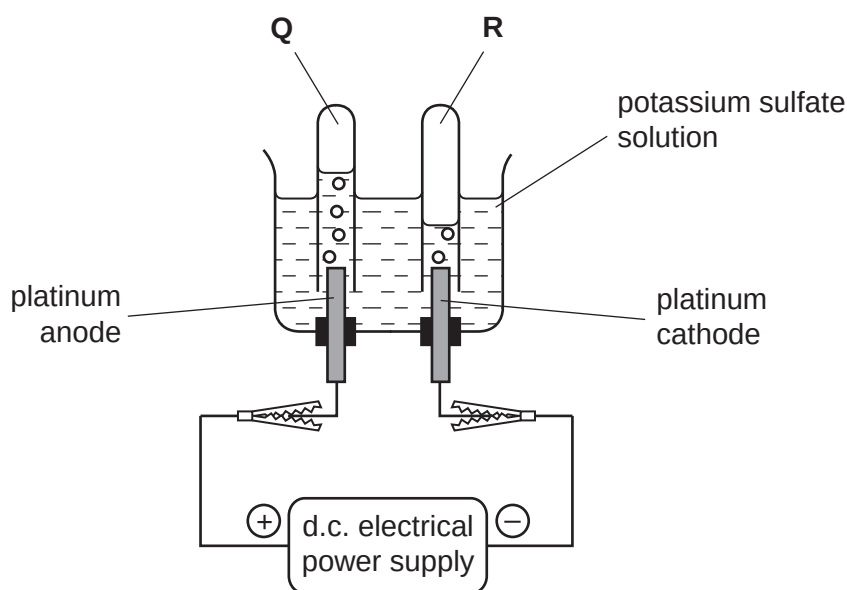


Fig. 3.1

During the experiment shown in Fig. 3.1, two different colourless gases, **Q** and **R**, collected in the small test-tubes. Neither of these gases contained any sulfur.

- (i) Name gases **Q** and **R**.

Q

R [2]

- (ii) Choose **one** of the gases, **Q** or **R**, and describe how the student should test it for the gas you have named.

chosen gas

test

..... [1]

- (b) Potassium sulfate solution is made in a neutralisation reaction between an acid and an alkali.

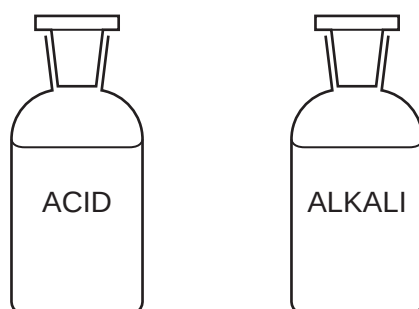
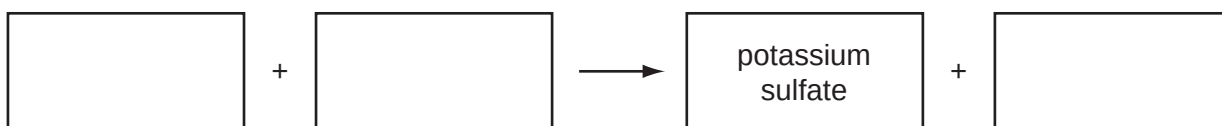


Fig. 3.2

- (i) Suggest a **word** chemical equation for a reaction between a suitable acid and alkali that would produce potassium sulfate.



[2]

- (ii) Describe how a **neutral** solution of potassium sulfate could be obtained using suitable solutions of an acid and an alkali.

.....

.....

.....

.....

.....

[3]

- (iii) State the **ionic** equation which describes the neutralisation reaction between any aqueous acid and any aqueous alkali.

.....

[2]

- 4 (a) Five types of radiation are listed below.

alpha radiation

beta radiation

gamma radiation

infra-red radiation

ultraviolet radiation

- (i) State which of these types of radiation is a stream of electrons.

..... [1]

- (ii) State which of these types of radiation are forms of electromagnetic radiation.

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

- (iii) State **one** use for gamma radiation.

..... [1]

- (iv) Complete Table 4.1 to compare alpha, beta and gamma radiations.

Tick **one** box in each row of the table.

Table 4.1

	alpha	beta	gamma
most penetrating			
most ionising			
not deflected by an electric field			

[2]

- (b) Some students measured the level of radiation from a radioactive source for 42 days. Table 4.2 shows the results corrected for background radiation.

Table 4.2

time / days	0	7	14	21	28	35	42
level of radiation / average counts per minute	64	45	33	23	16	12	8

Describe and explain the pattern in these results.

.....

.....

..... [2]

- 5 PTFE is an important plastic which has many uses in the home and industry. PTFE is made from a polymer of polymer molecules.

Fig. 5.1 shows the displayed formula of the monomer that reacts to produce PTFE.

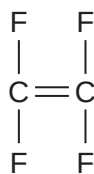


Fig. 5.1

- (a) (i) Explain why the molecule shown in Fig. 5.1 is **not** a hydrocarbon.

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

- (ii) Fig. 5.2 shows the outer shell electrons in a carbon atom and a fluorine atom.

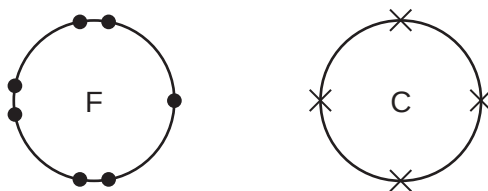
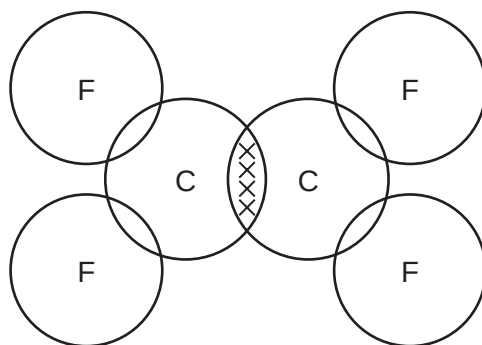


Fig. 5.2

Complete the bonding diagram below to show how the outer electrons are arranged in the molecule whose displayed formula is shown in Fig. 5.1.



[2]

- (iii) Complete the diagram below to show the displayed formula of a small section of a PTFE molecule.

Your completed formula must contain eight fluorine atoms.



[3]

- (b) The element, fluorine, is a halogen in Group 7 of the Periodic Table.

- (i) Use your knowledge of the physical states of the other halogens to predict and explain whether fluorine is a solid, a liquid or a gas at room temperature.

prediction

explanation

.....

..... [2]

- (ii) Use your knowledge of the reactivities of the other halogens to predict and explain whether or not the following halogen displacement reaction will occur.

bromine + sodium fluoride $\rightarrow$ sodium bromide + fluorine

.....

.....

..... [2]

6 Fig. 6.1 shows the human digestive system.

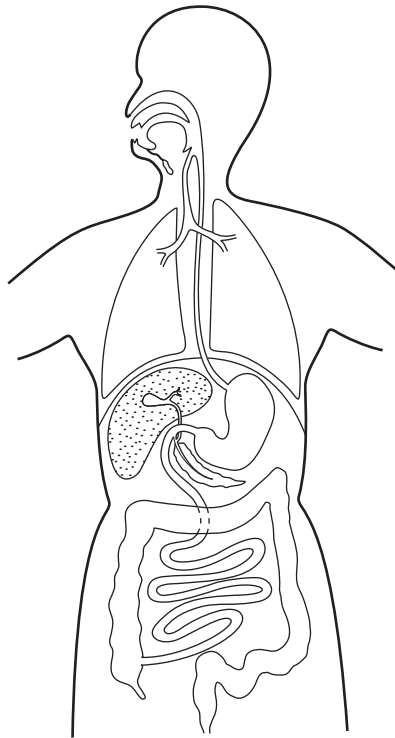


Fig. 6.1

(a) On Fig. 6.1, use label lines to label

the stomach,

the colon.

[2]

(b) On Fig. 6.1, label and name **one** part of the digestive system that food does **not** pass through on its way from mouth to anus. [1]

(c) Describe how digestion takes place inside the stomach.

.....

.....

..... [2]

(d) Fig. 6.2 shows a food web involving humans.

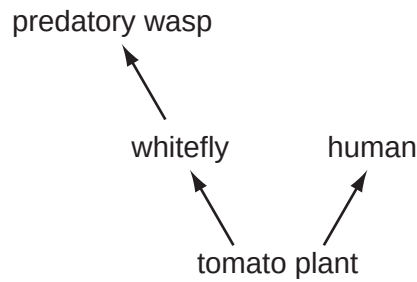


Fig. 6.2

If there are a lot of whitefly feeding on the tomato plants, there will be fewer tomatoes for humans to eat.

- (i) Use the information in Fig. 6.2 to suggest how biological control could be used to control the whitefly population.

.....
 [1]

- (ii) State **two** reasons, other than cost, why this could be a better way of controlling the whitefly than using pesticides.

1

 2
 [2]

- 7 Some coffee drinks are sold in self-heating cans.

Fig. 7.1 shows a cross-sectional diagram of one design of self-heating can.

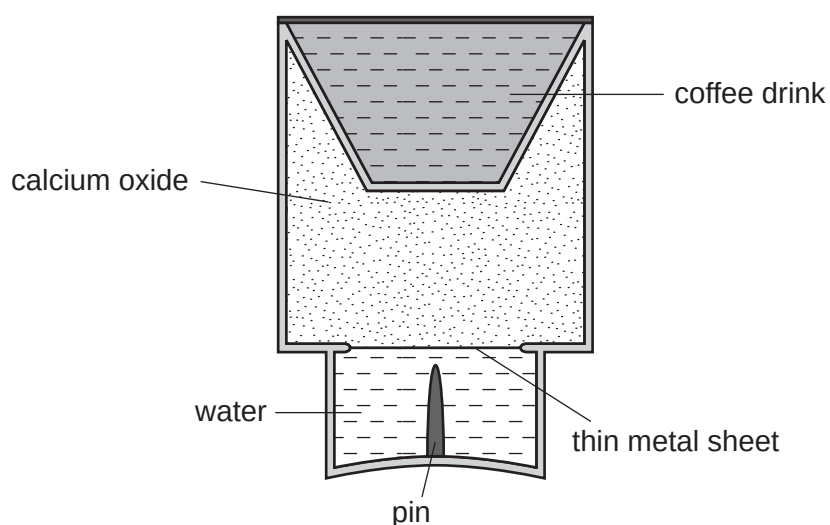


Fig. 7.1

Fig. 7.2 shows the can after it has been turned upside down and the pin pushed through the thin metal sheet. This allows the water to fall into the calcium oxide.

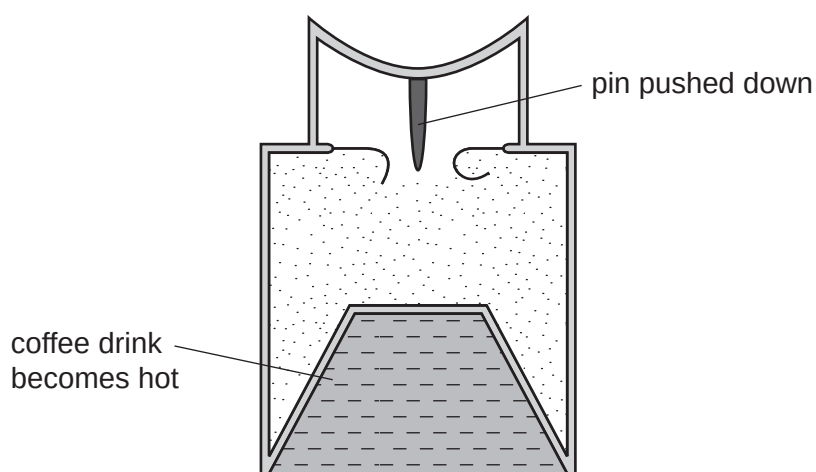


Fig. 7.2

- (a) Explain briefly why the coffee drink in the self-heating can becomes hot when the water and calcium oxide mix.

.....

.....

.....

..... [2]

- (b) (i) Use the position of calcium in the Periodic Table to explain why the electrical charge of a calcium ion is +2.

.....

.....

.....

.....

..... [3]

- (ii) The reaction between calcium oxide and water produces the ionic compound calcium hydroxide, $\text{Ca}(\text{OH})_2$.

Deduce the electrical charge of the hydroxide ion.

Show how you obtained your answer.

.....

..... [2]

- 8 (a) A student set up the circuit shown in Fig. 8.1 to investigate the relationship between voltage across resistor **R** and the current through resistor **R**.

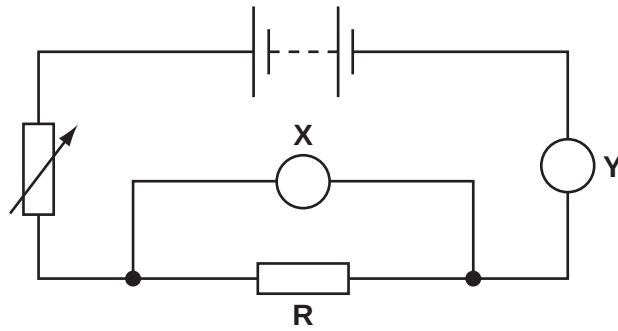


Fig. 8.1

- (i) Name the meters labelled **X** and **Y**.

X

Y

[1]

- (ii) Explain the purpose of the variable resistor in the circuit.

.....

..... [1]

(iii) Fig. 8.2 shows a graph of the results.

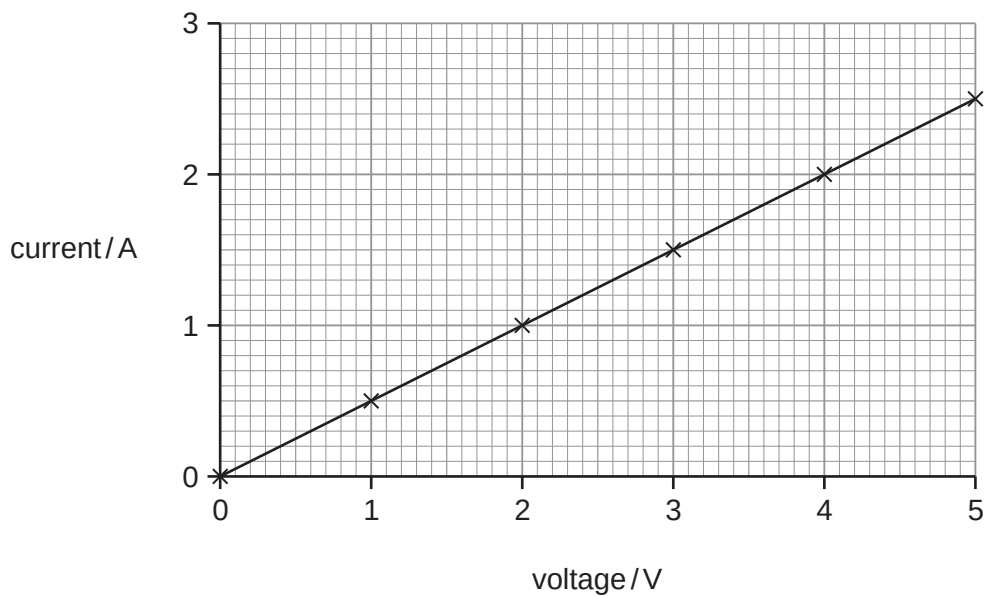


Fig. 8.2

Use the data on the graph to calculate the resistance of resistor **R**.

State the formula that you use and show your working.

formula used

working

..... [2]

(b) Two 10 ohm resistors are placed in parallel in a circuit.

Calculate their total resistance.

State the formula that you use and show your working.

formula used

working

..... [3]

- (c) Fig. 8.3 shows a battery-operated d.c. electric motor driving a fan. When an current passes through the coil it rotates.

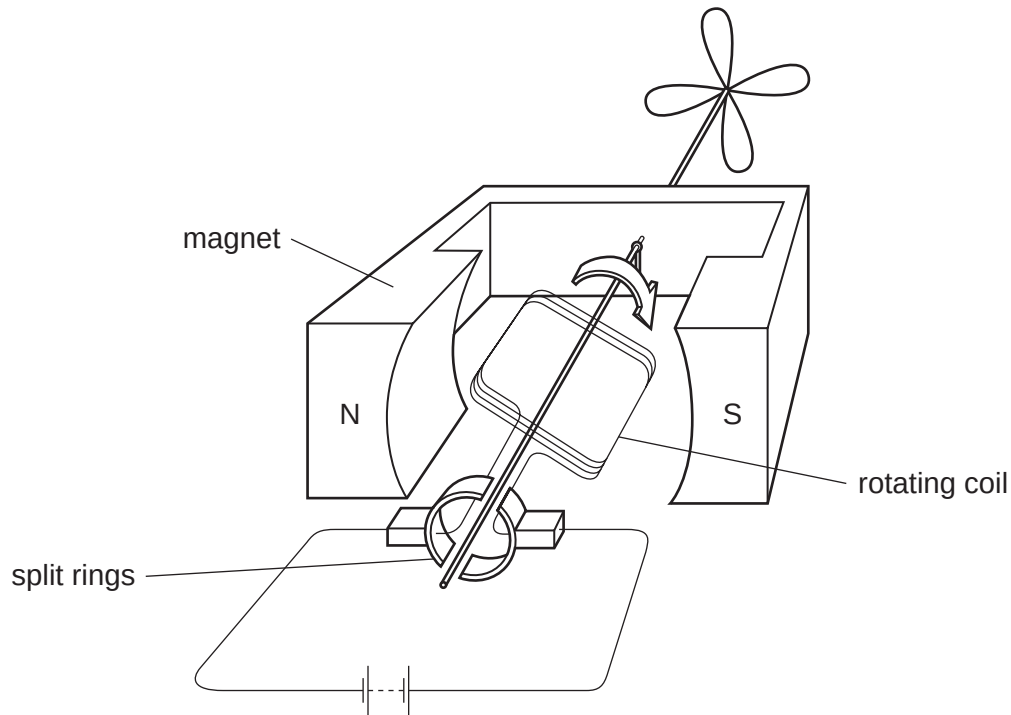


Fig. 8.3

- (i) Describe what happens to the coil if the poles of the magnets are reversed and the rest of the circuit remains the same.
- [1]
- (ii) Describe what happens if a greater electric current is passed through the coil.
- [1]
- (iii) Explain the purpose of the split rings.

.....

.....

..... [2]

- 9 A man walking along a road decided to cross to the other side. As he was walking the road, a car sounded its horn, which made him jump. He then crossed the rest of the road more quickly.

(a) For each of the actions that the man took, state whether it was a **reflex** action or a **voluntary** action.

walking along the road	.....	
walking across the road	.....	
jumping in response to the car horn	.....	
crossing the road more quickly	.....	[2]

(b) Explain **one** advantage and **one** disadvantage of reflex actions over voluntary actions.

advantage	.....	
		
disadvantage	.....	
	.....	[2]

(c) State the roles of each of the following parts of the nervous system in a reflex action.

receptor	.....	
		
motor neurone	.....	
	.....	[2]

DATA SHEET
The Periodic Table of the Elements

Group																
I	II								III	IV	V	VI	VII	0		
1 H Hydrogen																
7 Li Lithium 3 23 Na Sodium 11 39 K Potassium 19 85 Rb Rubidium 37 133 Cs Caesium 55 Fr Francium 87 9 Be Beryllium 4 24 Mg Magnesium 12 40 Ca Calcium 20 88 Sr Strontium 38 137 Ba Barium 56 Ra Radium 88 45 Sc Scandium 21 89 Y Yttrium 39 139 La Lanthanum 57 227 Ac Actinium 89 51 V Vanadium 23 93 Nb Niobium 41 181 Ta Tantalum 73 48 Ti Titanium 22 91 Zr Zirconium 40 178 Hf Hafnium 72 55 Mn Manganese 25 101 Ru Ruthenium 44 190 Os Osmium 76 59 Co Cobalt 27 103 Rh Rhodium 45 192 Ir Iridium 77 64 Cu Copper 29 108 Ag Silver 47 197 Au Gold 79 65 Zn Zinc 30 112 Cd Cadmium 48 201 Hg Mercury 80 70 Ga Gallium 31 115 In Indium 49 204 Tl Thallium 81 73 Ge Germanium 32 119 Sn Tin 50 207 Pb Lead 82 75 As Arsenic 33 122 Sb Antimony 51 209 Bi Bismuth 83 79 Se Selenium 34 128 Te Tellurium 52 210 Po Polonium 84 80 Br Bromine 35 127 I Iodine 53 210 At Astatine 85 14 N Nitrogen 7 31 P Phosphorus 15 51 As Arsenic 33 75 Sb Antimony 51 101 Bi Bismuth 83 16 O Oxygen 8 32 S Sulfur 16 52 Se Selenium 34 74 Te Tellurium 52 84 Po Polonium 84 19 F Fluorine 9 35.5 Cl Chlorine 17 53 Br Bromine 35 85 I Iodine 53 127 At Astatine 85 11 B Boron 5 27 Al Aluminium 13 49 Ga Gallium 31 71 In Indium 49 81 Tl Thallium 81 12 C Carbon 6 28 Si Silicon 14 50 Ge Germanium 32 82 Sn Tin 50 126 Pb Lead 82 13 N Nitrogen 7 31 P Phosphorus 15 51 As Arsenic 33 83 Sb Antimony 51 125 Bi Bismuth 83 15 O Oxygen 8 32 S Sulfur 16 52 Se Selenium 34 84 Te Tellurium 52 128 Po Polonium 84 16 F Fluorine 9 35.5 Cl Chlorine 17 53 Br Bromine 35 85 I Iodine 53 127 At Astatine 85 19 Ne Neon 10 36 Ar Argon 18 54 Kr Krypton 36 86 Xe Xenon 54 136 Rn Radon 86 20 He Helium 2 38 Ne Neon 10 56 Ar Argon 18 84 Kr Krypton 36 118 Xe Xenon 54 136 Rn Radon 86 158-71 Lanthanoid series 90-103 Actinoid series a X b a = relative atomic mass X = atomic symbol b = proton (atomic) number Key																

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

Key

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

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