



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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COMBINED SCIENCE

0653/21

Paper 2 (Core)

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 **20** printed pages.



- 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.

For
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Use

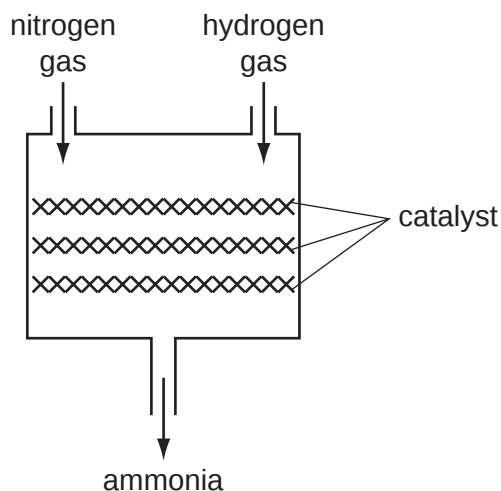


Fig. 1.1

- (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 balanced symbolic equation for this reaction is shown below.



State the total number of atoms shown on the **left hand side** of this equation.

..... [1]

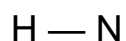
- (iv) State the number of hydrogen molecules shown in the equation in (iii).

..... [1]

- (v) Explain why the reaction in (iii) is an example of a *redox reaction*.

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

- (b) (i) Complete the displayed (graphical) chemical formula of an ammonia molecule, NH_3 , which has been started below.



[2]

- (ii) A student states that an ammonia molecule contains **covalent** chemical bonds between its atoms.

Explain whether or not the student is correct.

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

- 2 (a) The arrows in Fig. 2.1 show the horizontal forces acting on a car moving forwards. In each case the length of the arrow indicates the size of the force.

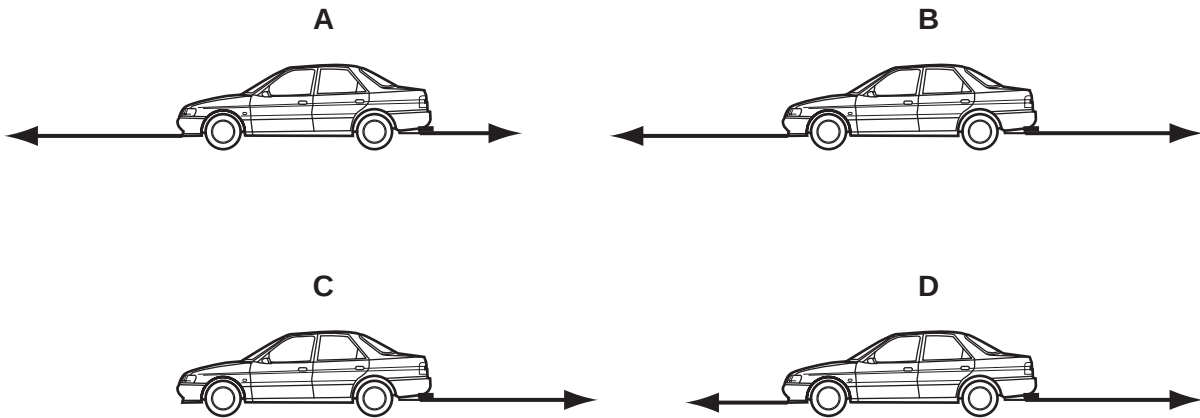


Fig. 2.1

- (i) State which of the diagrams out of **A**, **B**, **C** and **D** show a car that is slowing down.

..... [2]

- (ii) Explain how you decided on your answer to (i).

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

- (iii) There are other forces acting on the cars that are **not** horizontal.

Name **one** of these forces. [1]

- (b) The car has a radiator. This contains hot water that has been heated by passing it through the hot car engine.

The purpose of the radiator is to cool down the water. The radiator is painted black.

- (i) State the method by which heat is transferred from the hot water to the radiator.

..... [1]

- (ii) Explain why the radiator is painted black.

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

(c) Fig. 2.2 shows a racing car.

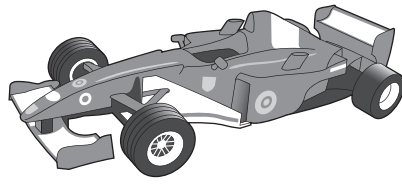


Fig. 2.2

The car 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

..... km/h [2]

(d) Fig. 2.3 shows the speed–time graph for the racing car over a short period of time.

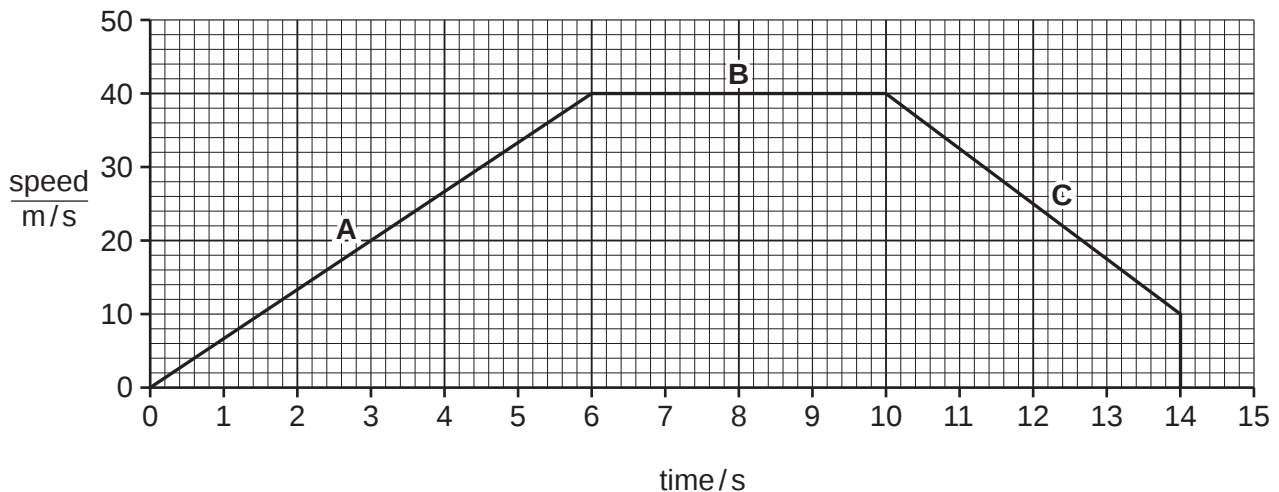


Fig. 2.3

Describe the motion of the racing car during

section **B**,

section **C**. [2]

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3 Rice and cassava are important parts of a person's diet in some parts of the world.

(a) Table 3.1 shows the main nutrients present in 100g of white rice and 100g of cassava.

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Table 3.1

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

(i) Which of the nutrients listed in Table 3.1 can provide energy?

..... [1]

(ii) 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 3.1 to explain **one** reason why this is so.

.....

 [2]

(iii) 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]

(b) Fig. 3.1 shows a cassava plant.

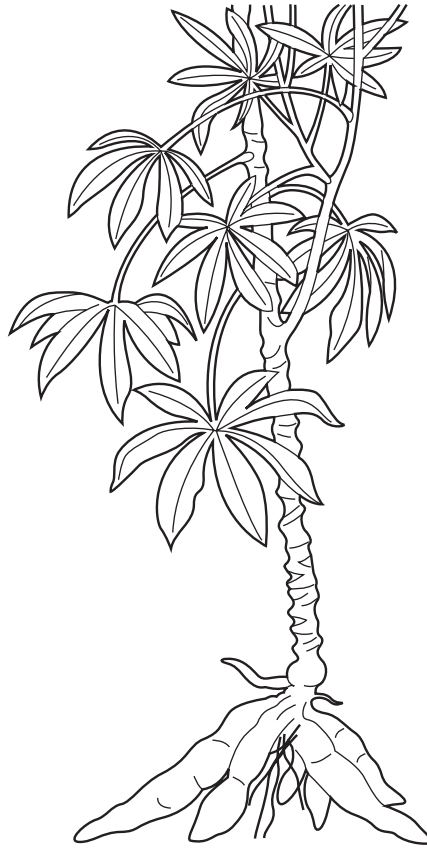


Fig. 3.1

The cassava plant makes food in its leaves.

(i) Describe how food is made by photosynthesis in a plant's leaves.

.....

.....

..... [2]

(ii) Suggest and explain **one** way, visible in Fig. 3.1, in which the structure of a cassava plant's leaves helps them to carry out photosynthesis.

.....

.....

..... [2]

For
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- 4 (a) Fig. 4.1 shows an incomplete diagram of the electromagnetic spectrum.

radio waves		infra-red	visible light		X-rays	
-------------	--	-----------	---------------	--	--------	--

Fig. 4.1

- (i) Complete the diagram using terms from the list:

gamma radiation

microwaves

ultraviolet

[2]

- (ii) State **one** use for

infra-red radiation,

.....

microwaves.

..... [2]

- (b) Gamma radiation and X-rays are two examples of ionising radiation.

- (i) Explain the meaning of the term *ionising radiation*.

.....

..... [2]

- (ii) Explain why ionising radiation can be harmful to living things.

.....

.....

..... [2]

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(c) Some types of food are treated with gamma radiation. The radiation kills 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) Fig. 4.2 shows how a conveyor belt can be used to move the boxes of fresh fruit past the radioactive source.

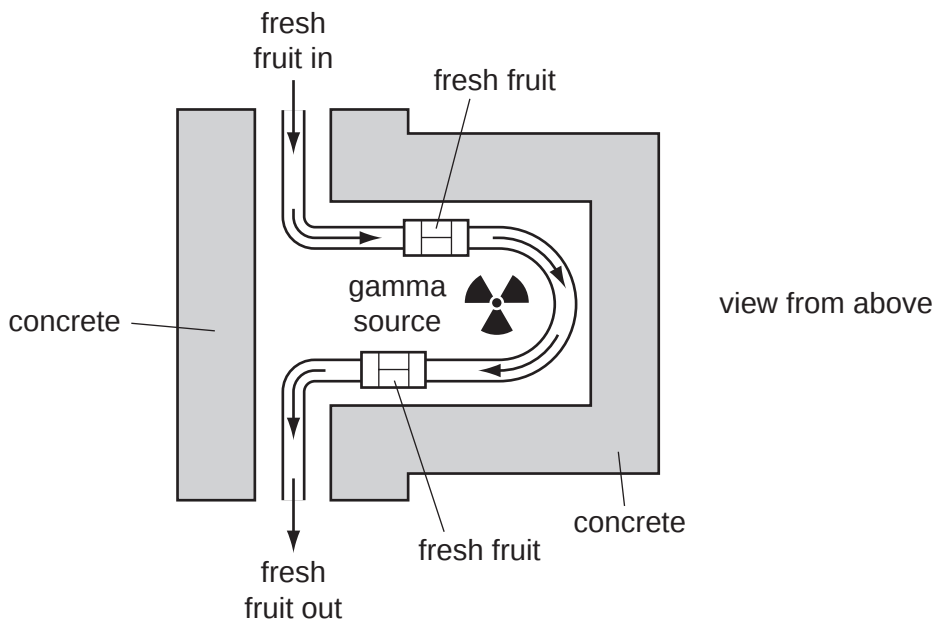


Fig. 4.2

Suggest why concrete is used to surround the radioactive source.

.....
 [1]

- 5 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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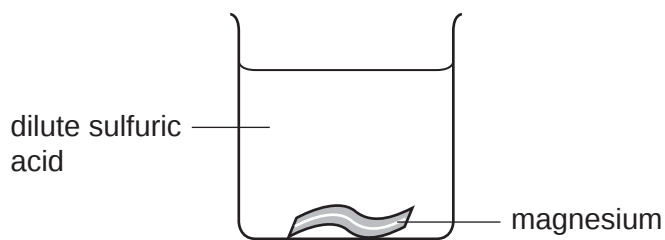


Fig. 5.1

- (a) (i) Describe **two** observations about this reaction which the student could make.

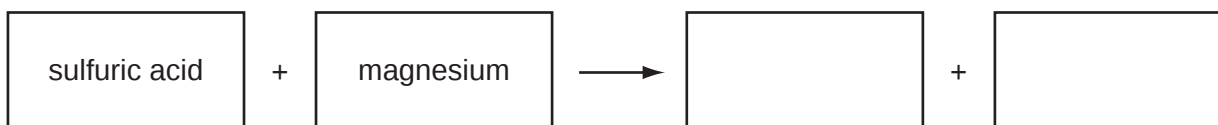
1

.....

2

..... [2]

- (ii) Complete the **word** chemical equation for the reaction in (i).



[2]

- (iii) State the **name** of the element which is present in both hydrochloric acid and sulfuric acid.

..... [1]

(b) Containers for dilute sulfuric acid 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) One method of dealing with waste poly(ethene) is to burn it.

Predict **two** compounds which will be produced when poly(ethene) is burnt.

1

2 [2]

- (iii) Suggest **one** advantage of burning as a means of dealing with waste poly(ethene).

.....

..... [1]

6 Fig. 6.1 shows part of the human nervous system.

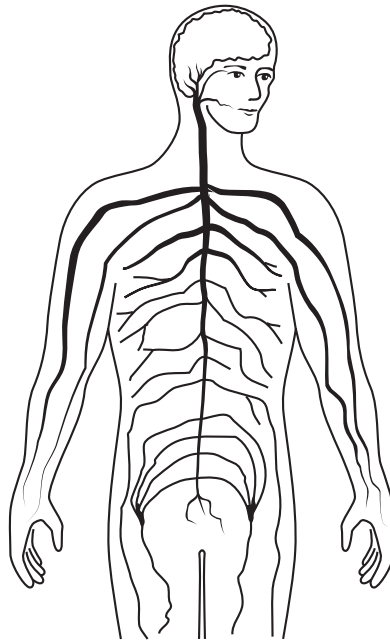


Fig. 6.1

(a) On Fig. 6.1, use label lines to indicate and name the **two** parts of the central nervous system. [2]

(b) If a person touches a hot pan with his finger, signals pass from his hand, through the central nervous system, to a muscle in his arm. The muscle contracts and moves the arm away.

State the correct biological term for each of the following descriptions.

(i) the cells in the finger that detect the hot pan and send signals to the central nervous system

..... [1]

(ii) an organ such as a muscle that responds to the signals

..... [1]

(c) A nerve cell has a nucleus and a cell surface membrane.

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

..... [1]

(ii) The nucleus contains DNA. State the function of DNA.

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

(iii) Outline **one** function of the cell surface membrane.

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

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- 7 Fig. 7.1 shows some data about the percentage by mass of elements in the Earth's crust.

For
Examiner's
Use

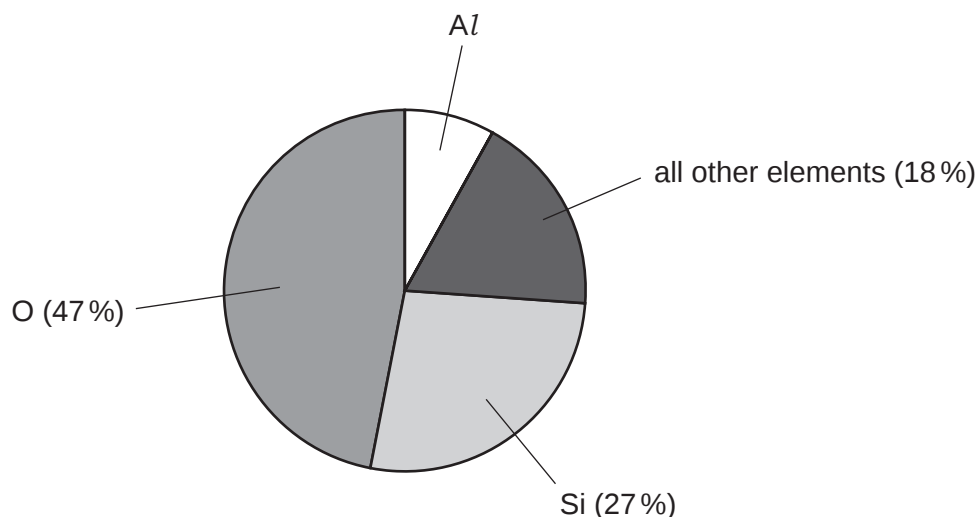


Fig. 7.1

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

..... [1]

- (b) Fig. 7.2 shows a diagram of an ion of element E.

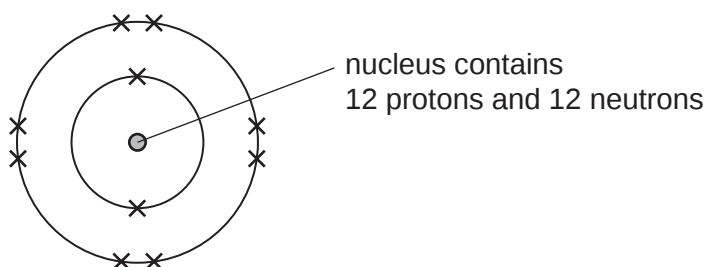


Fig. 7.2

- (i) Name element E and explain how the diagram shows that the ion has a positive electrical charge.

name of element E

.....

 [3]

- (ii) Name the noble gas whose **atoms** have the same number of electrons as the ion shown in Fig. 7.2

..... [1]

- (iii) Explain, in terms of electron configuration, why the atoms of all the noble gases are unreactive.

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

- (c) Fig. 7.3 shows a simplified diagram of a process which could be used to produce the reactive metal, sodium.

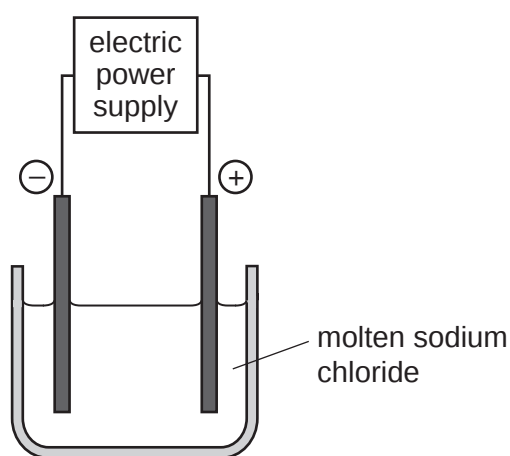


Fig. 7.3

- (i) Name the process shown in Fig. 7.3.

..... [1]

- (ii) Name the element which forms at the anode.

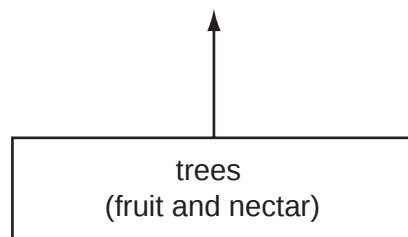
..... [1]

- 8 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, complete the food web, using the information above.



[3]

- (ii) On your food web, draw a circle around the producer.

[1]

- (b) The nectar that the monkeys eat is made by flowers that grow on some of the trees in the forests. The fruits that the monkeys eat develop from the flowers.

For
Examiner's
Use

Fig. 8.1 shows a section through a flower.

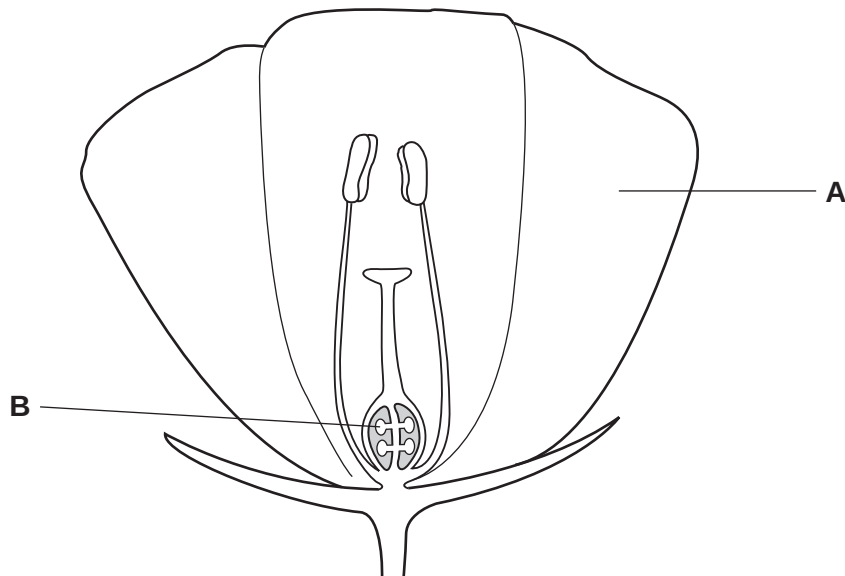


Fig. 8.1

- (i) Name the parts labelled **A** and **B**.

A

B [2]

- (ii) On Fig. 8.1, label the part that produces pollen, using a label line and the letter **P**. [1]

- (iii) On Fig. 8.1, label the part that will develop into a fruit, using a label line and the letter **F**. [1]

- (iv) Explain why the flower produces nectar.

.....

 [2]

- 9 (a) Fig. 9.1 shows the circuit diagram of a circuit which a student set up. He measured the current passing through the 2Ω resistor. The ammeter reading was 6 A.

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Examiner's
Use

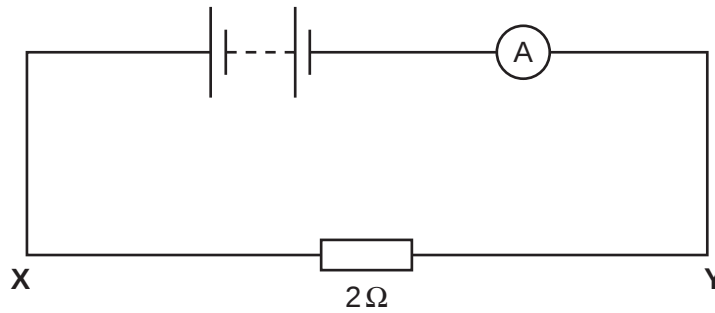


Fig. 9.1

- (i) Show that the voltage across the resistor was 12 V.

State the formula that you use and show your working.

formula used

working

[2]

- (ii) A 4Ω resistor is placed in series with the 2Ω resistor between X and Y.

Calculate the total resistance between X and Y.

State the formula that you use and show your working.

formula used

working

..... Ω [2]

- (b) Many countries are seeking alternatives to fossil fuels as energy sources for generating electricity.

*For
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Explain why is it necessary to find alternative energy sources for generating electricity.

.....

.....

.....

..... [2]

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	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	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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86			
Fr Francium 87	Ra Radium 88	226 Ac Actinium 89																		
58-71 Lanthanoid series																				
90-103 Actinoid series																				
175 Lu Lutetium 71																				
173 Yb Ytterbium 70																				
169 Tm Thulium 69																				
167 Er Erbium 68																				
165 Ho Holmium 67																				
162 Dy Dysprosium 66																				
159 Tb Terbium 65																				
157 Gd Gadolinium 64																				
152 Eu Europium 63																				
150 Sm Samarium 62																				
144 Nd Neodymium 60																				
141 Pr Praseodymium 59																				
140 Ce Cerium 58																				
238 U Uranium 92																				
232 Th Thorium 90																				
239 Pu Plutonium 94																				
244 Am Americium 95																				
254 Cm Curium 96																				
264 Bk Berkelium 97																				
277 Lr Lawrencium 103																				
285 No Nobelium 102																				
289 Md Mendelevium 101																				
293 Fm Fermium 100																				
297 Es Einsteinium 99																				
301 Cf Californium 98																				
303 Bk Berkelium 97																				
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323 W Tungsten 74																				
325 Re Rhenium 75																				
327 Os Osmium 76																				
329 Ir Iridium 77																				
331 Pt Platinum 78																				
333 Au Gold 79																				
335 Hg Mercury 80																				
337 Tl Thallium 81																				
339 Pb Lead 82																				
341 Bi Bismuth 83																				
343 Po Polonium 84																				
345 At Astatine 85																				
347 Rn Radon 86																				
349 Fr Francium 87																				
351 Ra Radium 88																				
353 Ac Actinium 89																				
355 Th Thorium 90																				
357 Pa Protactinium 91																				
359 U Uranium 92																				
361 Np Neptunium 93																				
363 Pu Plutonium 94																				
365 Am Americium 95																				
367 Cm Curium 96																				
369 Bk Berkelium 97																				
371 Cf Californium 98																				
373 Es Einsteinium 99																				
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413 Zr Zirconium 40																				
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419 Tc Technetium 43																				
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819 Sb Antimony 51																				
821 Te Tellurium 52																				
823 I Iodine 53																				
825 Xe Xenon 54																				
827 Kr Krypton 36																				
829 Se Selenium 34																				
831 Br Bromine 35																				
833 As Arsenic 33																				
835 Ge Germanium 32																				
837 Ga Gallium 31																				
839 Zn Zinc 30																				
841 Cu Copper 29																				
843 Ni Nickel 28																				
845 Co Cobalt 27																				
847 Mn Manganese 25																				
849 Cr Chromium 24																				
851 V Vanadium 23																				
853 Ti Titanium 22																				
855 Sc Scandium 21																				
857 Sr Strontium 38																				
859 Y Yttrium 39																				
861 Zr Zirconium 40																				
863 Nb Niobium 41																				
865 Mo Molybdenum 42																				
867 Tc Technetium 43																				
869 Ru Ruthenium 44																				
871 Rh Rhodium 45																				
873 Pd Palladium 46																				
875 Ag Silver 47																				
877 Cd Cadmium 48																				
879 In Indium 49																				
881 Sn Tin 50																				
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1023 Br Bromine 35																				
1025 As Arsenic 33																				
1027																				

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

Key

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

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