UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **October/November 2013**

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 pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
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.

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

For Examiner's Use

1 Sodium chloride is obtained from underground deposits in the Earth's crust.

Low-sodium salt is a mixture containing both sodium chloride and potassium chloride.

(a) (i) Explain why the Earth's crust contains the compound sodium chloride and not the uncombined elements, sodium and chlorine.

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.....

..... [1]

1 (a) **(ii)** State **one** difference between a compound, such as potassium chloride, and a mixture, such as low-sodium salt.

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.....

.....

..... [2]

1 **(b)** Table 1.1 contains the names and symbols of some positive and negative ions.

Table 1.1

positive ions	
name	symbol
potassium	K^+
ammonium	NH_4^+
calcium	Ca^{2+}
aluminium	Al^{3+}

negative ions	
name	symbol
fluoride	F^-
oxide	O^{2-}
nitride	N^{3-}
sulfate	SO_4^{2-}

(i) Use the information shown in Table 1.1 and the Periodic Table on page 24 to determine the ions that have an electron configuration of 2, 8, 8.

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..... [1]

1b **(ii)** Deduce the chemical formula of the compound calcium fluoride.

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Show how you obtained your answer.

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.....[2]

1 **(c)** The element calcium is formed during the electrolysis of molten calcium chloride.

During this process, calcium ions are converted to calcium atoms on the surface of the cathode.

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1 c **(i)** Explain why calcium atoms form on the cathode and **not** on the anode.

.....

.....

.....[2]

1c **(ii)** Describe what happens at the surface of the cathode to convert calcium ions to calcium atoms.

0653/31/O/N/13

.....

.....

.....[2]

2 Fig. 2.1 shows the inside of a refrigerator.

The temperature inside the freezing compartment is -20 °C and the temperature in the rest of the refrigerator is +5 °C.

0653/31/O/N/13

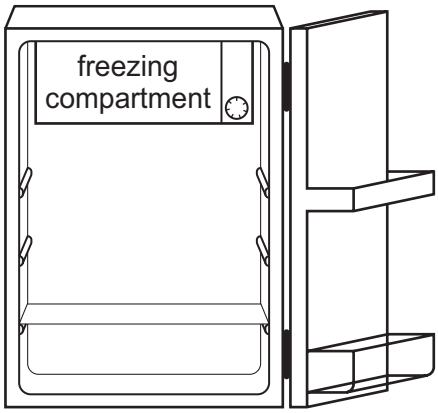

Fig. 2.1

2 **(a)** **(i)** The air in the refrigerator is cooled by convection.

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Draw **one** arrow on Fig. 2.1 to show the movement of the air cooled by the freezing compartment. [1]

(ii) Explain this movement in terms of particles and density.

.....

.....

..... [2]

2 **(b)** The volume of air in the refrigerator is 0.15 m^3.

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The density of air is 1.26 kg/m^3.

Calculate the mass of air in the refrigerator.

State the formula that you use, show your working and state the unit of your answer.

formula

working

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

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For Examiner's Use

2 **(c) (i)** Complete the diagrams to show the arrangement of water molecules in solid ice and in liquid water. One molecule has been drawn for you in each box. Each diagram should contain at least twelve water molecules.

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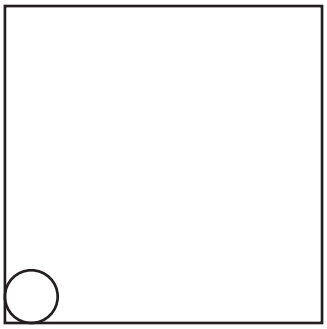
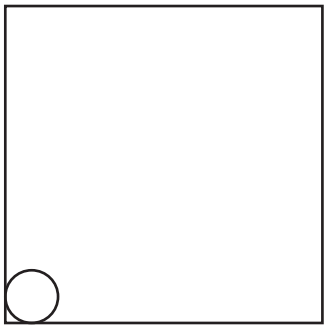


solid ice



liquid water

[2]

(ii) Each sentence describes either a solid, a liquid or a gas.

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In the right hand column write the letter **S** for solid, **L** for liquid or **G** for gas to match the description.

description	**S, L** or **G**
It cannot flow.	
It cannot transfer heat by convection.	
It contains particles which are widely separated.	
It expands the most when heated.	
It fills a closed container.	
It has a fixed volume but not a fixed shape.	

[2]

2 **(d)** A refrigerator can be warmed up by radiation energy absorbed by the outside surface of the refrigerator. Such absorption needs to be kept as low as possible. 0653/31/O/N/13

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The four refrigerators shown in Fig. 2.2 are identical except for the outside surface.

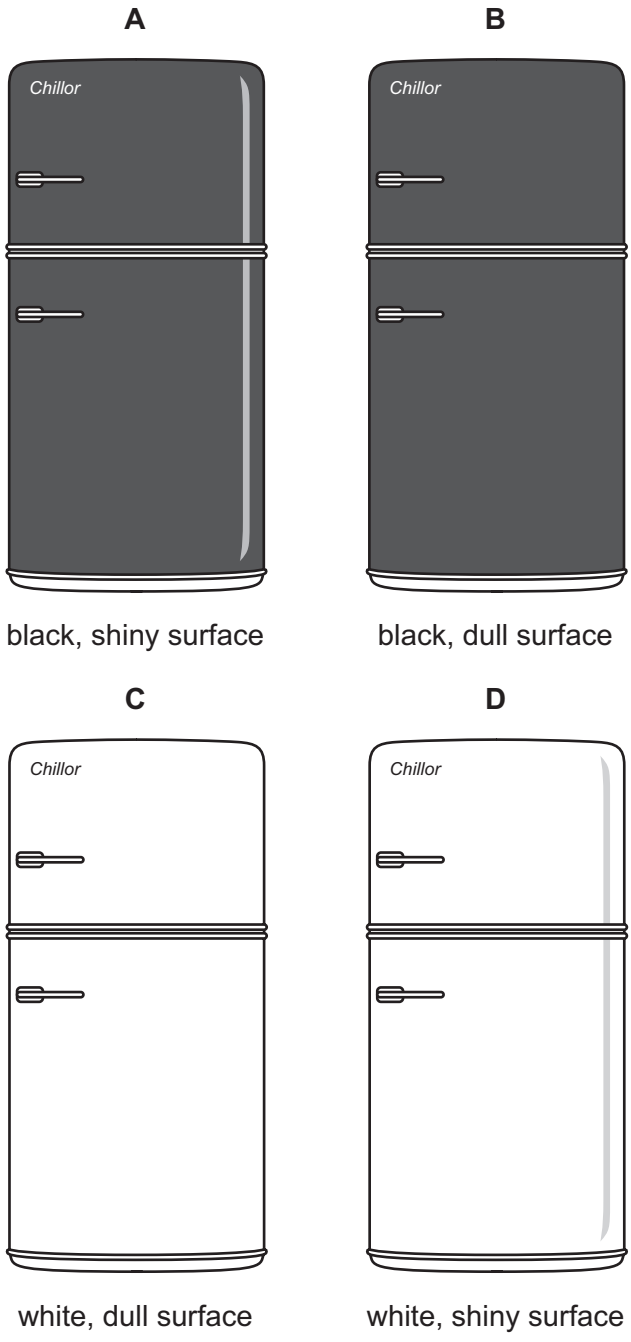

Fig. 2.2

State which refrigerator is most effective at keeping the contents cool. 0653/31/O/N/13

Explain your answer.

.....

.....

..... [2]

Please turn over for Question 3.

For Examiner's Use

3 The concentration of glucose in the blood does not normally vary much.

Researchers investigated how adding fibre to foods affected the concentration of glucose in the blood after eating.

Fig. 3.1 shows the results that they obtained for two different types of cornflakes. Cornflakes contain a lot of starch.

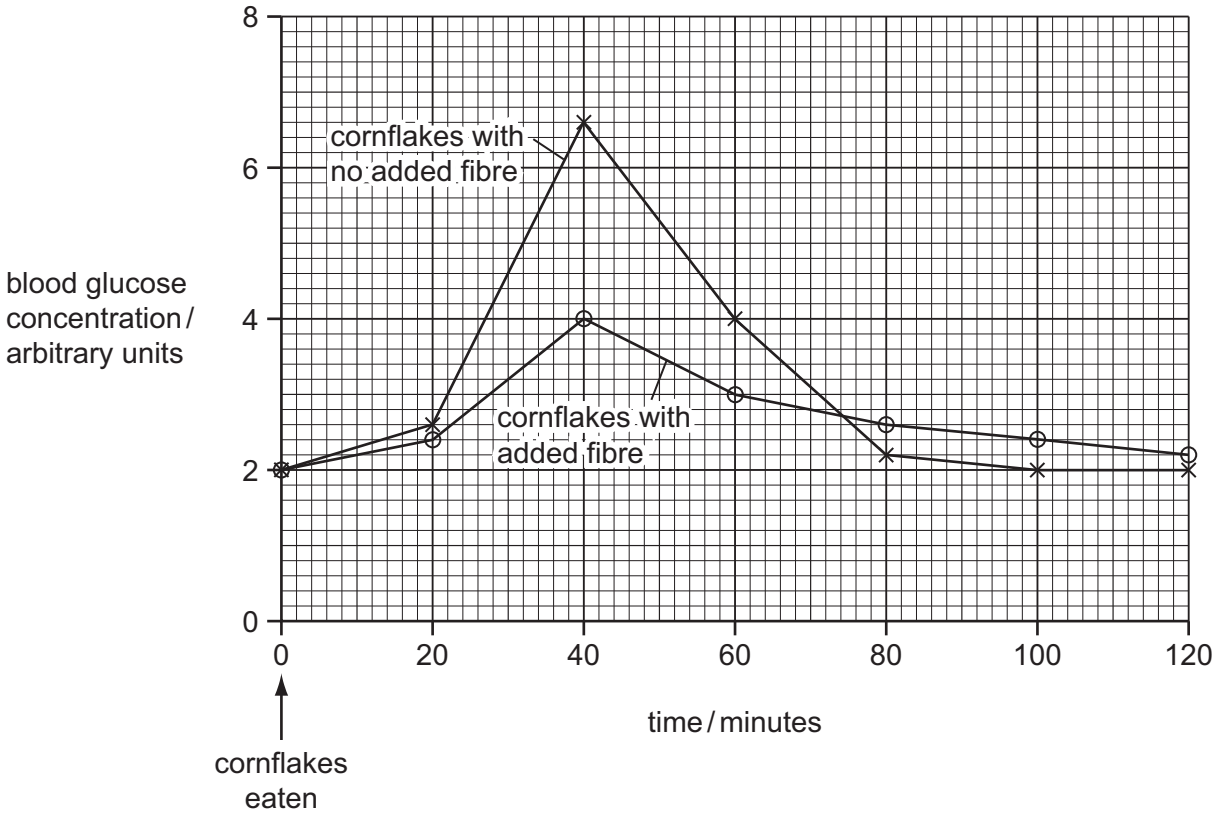

Fig. 3.1

Use the information in Fig. 3.1 to help you to answer the following questions.

3 **(a)** Describe how the blood glucose concentration changed after eating cornflakes with no added fibre.

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.....

.....

.....

.....

..... [3]

3 **(b)** Suggest explanations for these changes in blood glucose concentration.

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.....

.....

.....

.....

..... [3]

3 **(c)** **(i)** Describe how adding fibre to the cornflakes affected the changes in blood glucose concentration after eating.

.....

.....

.....

.....

..... [3]

3(c) **(ii)** Outline **one** other way in which fibre in the diet affects health.

.....

..... [1]

4 Fig. 4.1 shows the nucleus and **outer** electron shell of an atom of an element from the **third** period of the Periodic Table .

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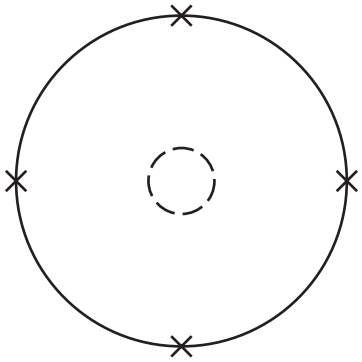

Fig. 4.1

4 **(a)** Deduce the name of the element and explain your answer briefly.

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name of element .....

explanation .....

..... [2]

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(b) Fig. 4.2 shows the melting points of four metallic elements from the same group of the Periodic Table.

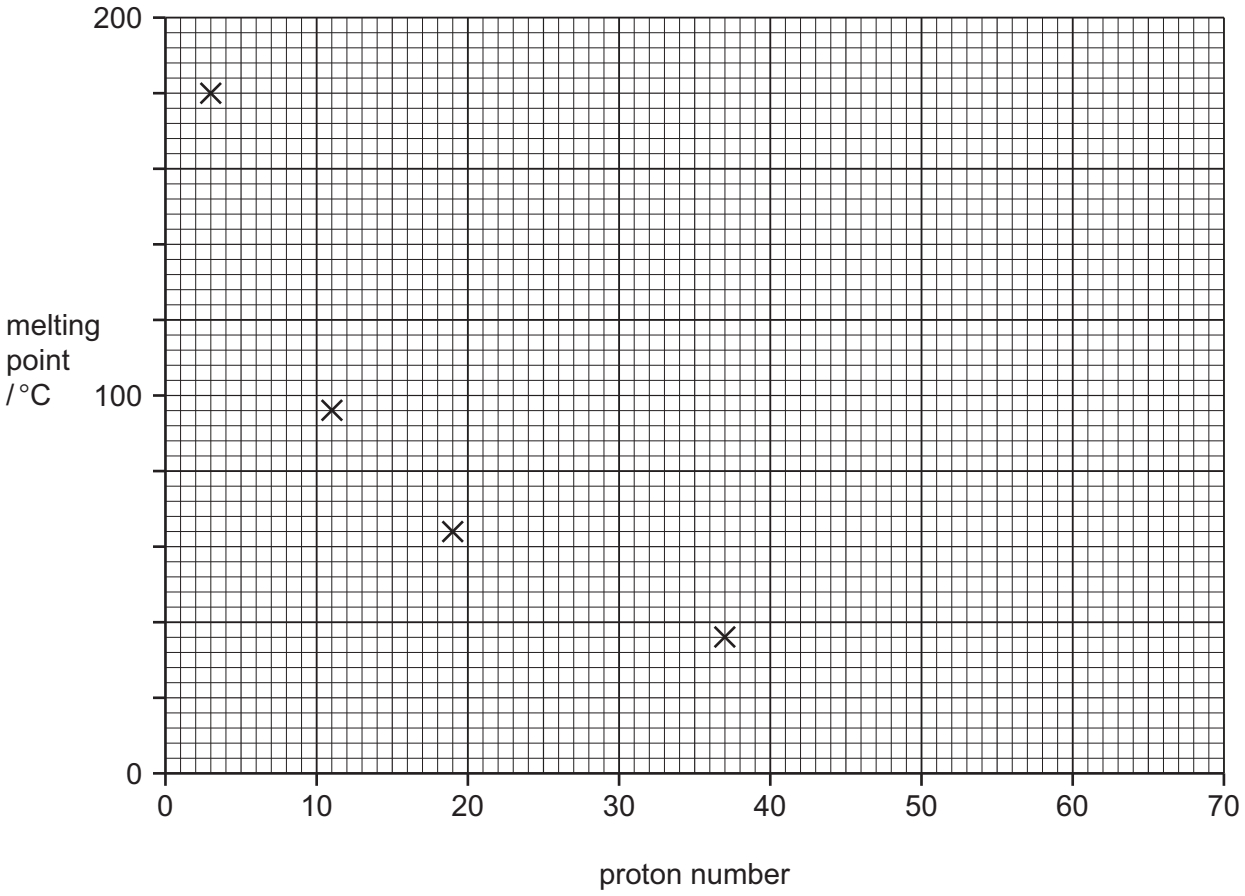

Fig. 4.2

4b **(i)** State the number of the group that contains the elements whose melting points are shown in Fig. 4.2.

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Explain your answer briefly.

group number .....

explanation .....

..... [2]

4b **(ii)** Estimate the melting point of the next element in the same group of the Periodic Table.

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Use the symbol **X** to mark your estimate on the grid in Fig. 4.2. [2]

4 **(c)** Fig. 4.3 shows a cross section through a blast furnace which is used to extract iron from iron oxide.

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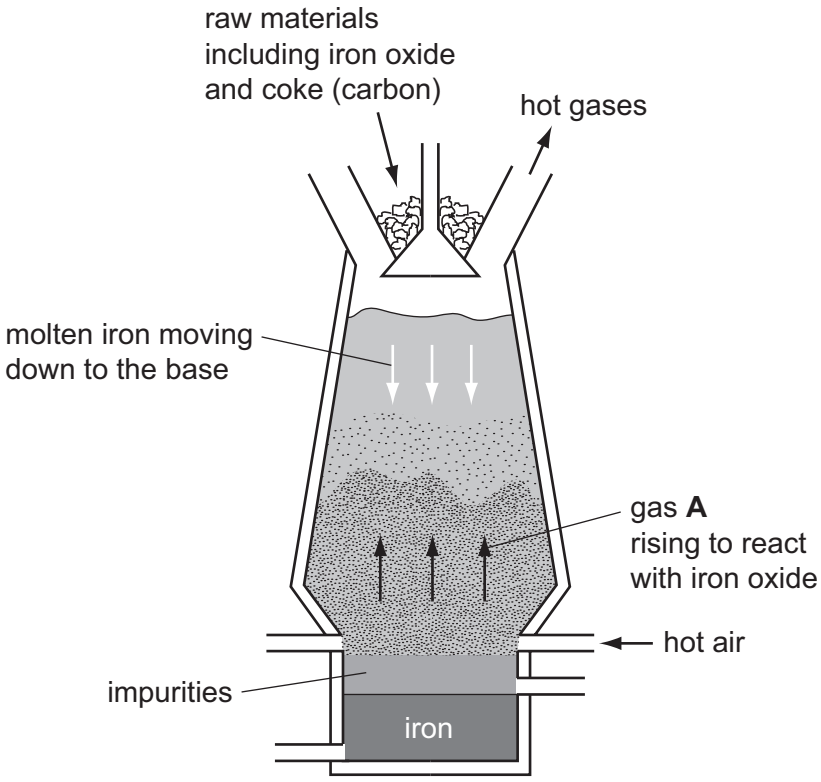

Fig. 4.3

4c **(i)** Name gas **A** which reacts with iron oxide to produce iron.

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..... [1]

4c **(ii)** Name the type of chemical change that the iron oxide undergoes in **(i)**.

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Explain your answer briefly.

type of chemical reaction .....

explanation .....

.....

..... [2]

4c **(iii)** State the **word** chemical equation for the reaction that occurs in **(i)**.

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..... [1]

For Examiner's Use

METALS

Please turn over for Question 5.

5 Fig. 5.1 shows a solar-powered vehicle.

MOTION

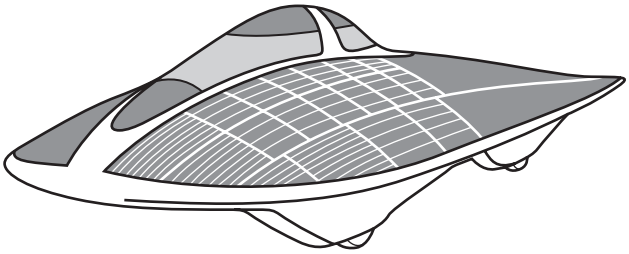

Fig. 5.1

(a) Fig. 5.2 shows a speed / time graph for the vehicle for the first hour of a journey.

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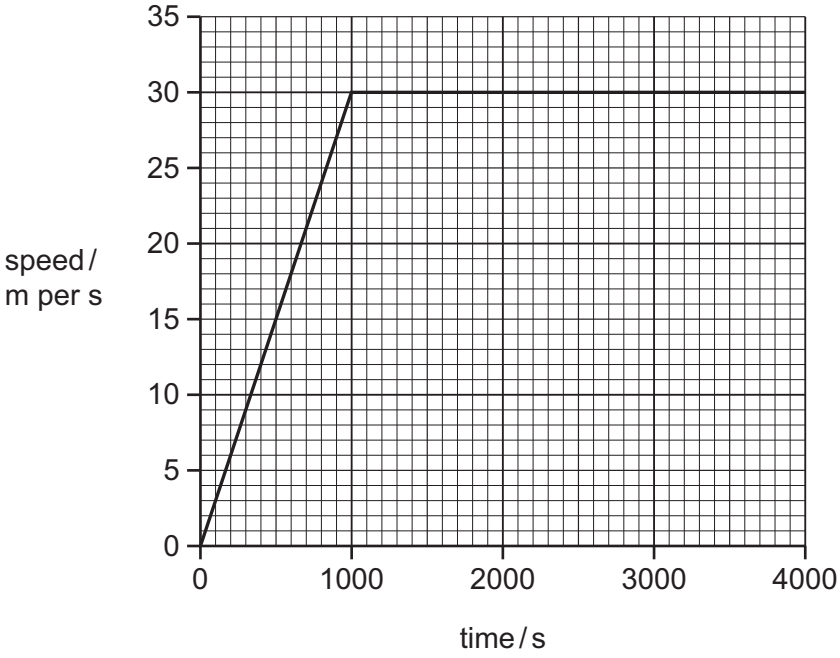

Fig. 5.2

5 (a) **(i)** Calculate the distance travelled during 4000 s.

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Show your working and state the unit of your answer.

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

5 (a) **(ii)** Calculate the acceleration of the vehicle during the first 1000 s. 0653/31/O/N/13

Show your working.

..... m / s^2 [2]

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5 **(b)** Fig. 5.3 shows the energy flow diagram for the solar-powered vehicle.

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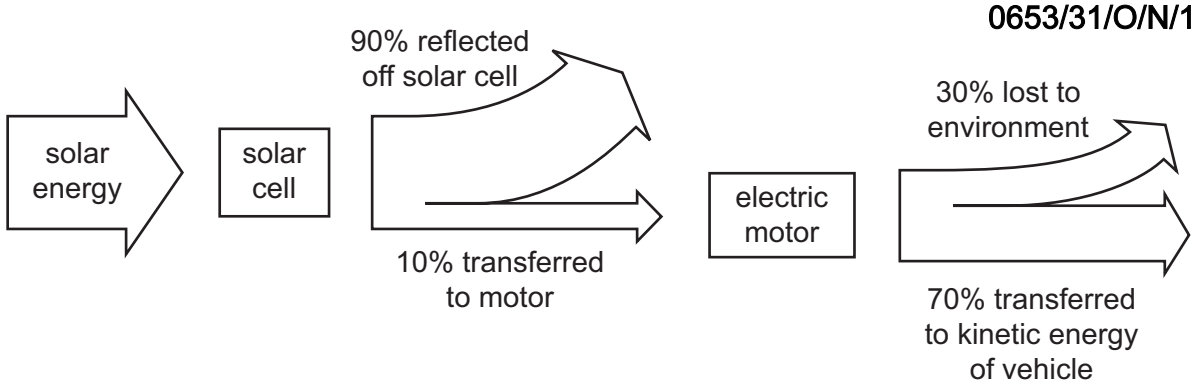

Fig. 5.3

0653/31/O/N/13

5 (b) **(i)** State the efficiency of the **solar cell**.

..... % [1]

5 (b) **(ii)** During part of the journey, the solar cell receives 1 000 000 joules of solar energy.

Calculate the number of joules transferred as kinetic energy to the **vehicle**.

0653/31/O/N/13

Show your working.

..... J [2]

6 Fig. 6.1 shows an external view of the heart and the blood vessels that are connected to it.

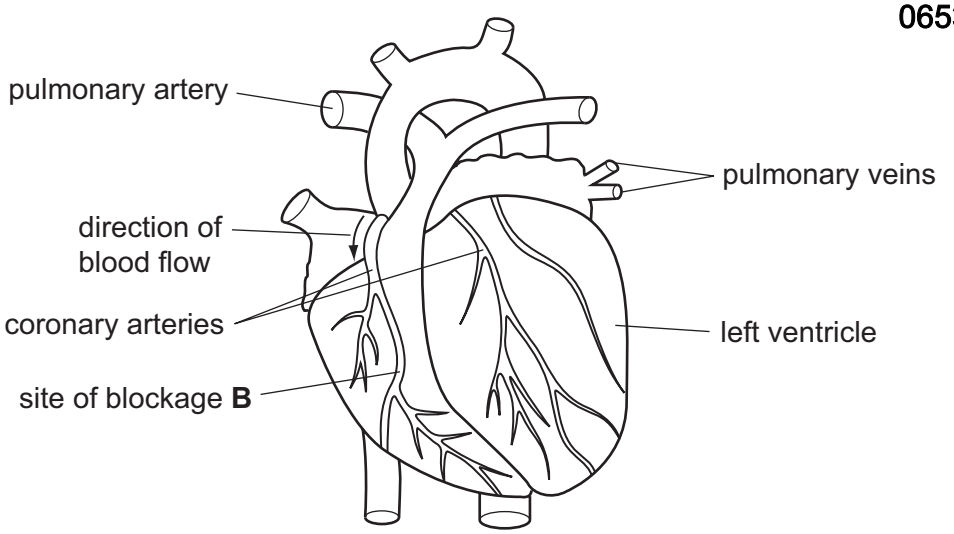

Fig. 6.1

(a) The muscles in the walls of the ventricles contract and relax rhythmically.

6 (a) **(i)** Describe how contraction of the muscles in the wall of the left ventricle affects the blood inside the ventricle.

.....

.....

..... [2]

6 (a) **(ii)** Describe how contraction of the muscles in the wall of the left ventricle affects the valve between the left atrium and the left ventricle.

..... [1]

6 **(b)** The coronary arteries supply the muscles of the heart with oxygen and nutrients.

(i) Explain why these muscles require a constant supply of oxygen.

.....

.....

..... [2]

For Examiner's Use

(ii) A blockage occurs in the coronary artery at site **B**.

On Fig. 6.1, shade the area of the heart wall that will be affected by this blockage. [1]

(iii) List **three** lifestyle factors that **increase** the chance that a blockage will develop in a coronary artery.

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1 .....

2 .....

3 ..... [3]

7 Ethene, C_2H_4, is an unsaturated hydrocarbon.

For Examiner's Use

(a) Fig. 7.1 shows structures of the molecules involved when ethene reacts with bromine.

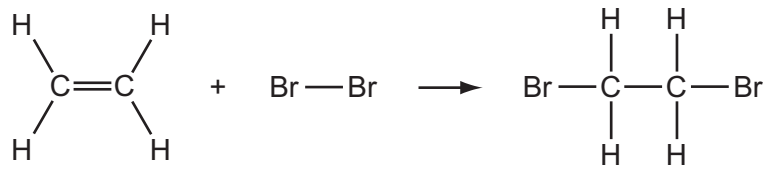

Fig. 7.1

0653/31/O/N/13

7 (a) **(i)** Describe the colour change that is observed when ethene reacts with bromine.

from ..... to ..... [1]

7(a) **(ii)** Name the type of chemical reaction shown in Fig. 7.1.

..... [1]

7 (a) **(iii)** The reaction between ethene and hydrogen chloride, HCl(g), is similar to the reaction shown in Fig. 7.1.

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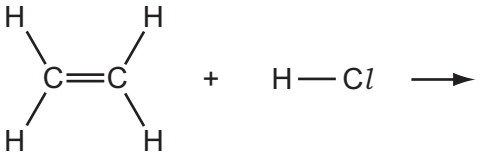
Complete the equation below to suggest the structure of the molecule that is produced.



[2]

7 **(b)** Methane, CH_4, reacts with steam in the presence of a catalyst to produce carbon monoxide, CO, and hydrogen gas.

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Construct a balanced symbol chemical equation for this reaction.

..... [3]

For Examiner's Use

8 **(a)** Fig. 8.1 shows a circuit which could be used for the lights on a car. When each headlight bulb is fully lit, 6 A passes through it. When each sidelight is fully lit, 0.5 A passes through it.

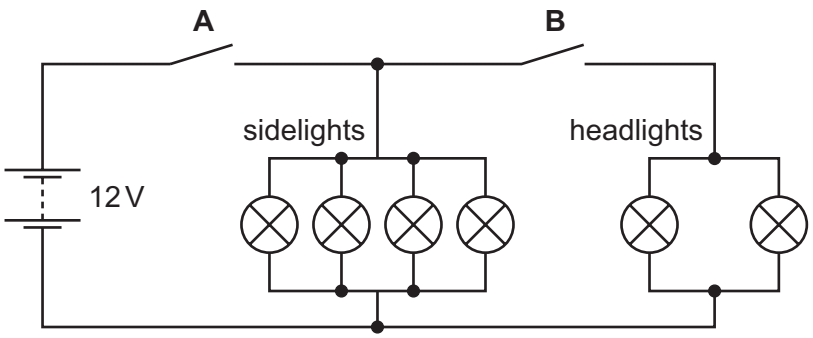

Fig. 8.1

Calculate the total current flowing from the battery when

switch **A** is closed and switch **B** is open,

.....

switches **A** and **B** are both closed.

..... [1]

8 **(b)** Each sidelight has a resistance of 24 Ω.

Calculate the combined resistance of the four sidelights connected in parallel in this circuit.

State the formula that you use and show your working.

formula

working

..... Ω [3]

9 **(a)** Fig. 9.1 shows a plant cell.

For Examiner's Use

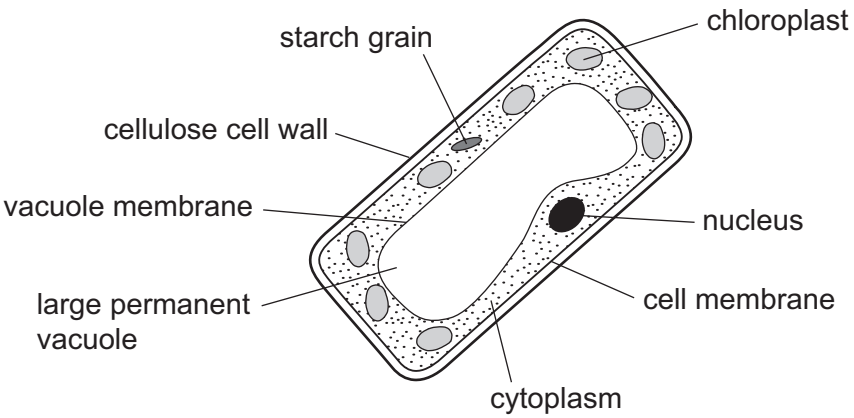

Fig. 9.1

9 (a) **(i)** Name the tissue in the leaf in which this type of cell is found.

0653/31/O/N/13

.....[1]

9(a) **(ii)** Explain how this cell is adapted to carry out photosynthesis.

0653/31/O/N/13

.....

.....

.....

.....

.....

.....[3]

9 **(b)** About one tenth of the Earth's surface is covered by forests in which much photosynthesis takes place.

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Explain how extensive deforestation could lead to an increase in the rate of global warming.

.....

.....

.....

.....

.....

.....[3]

10 (a) Fig. 10.1 represents the electromagnetic spectrum.

gamma rays	X-rays	ultraviolet	visible light	infra red	microwaves	radio waves

Fig. 10.1

Name the type of electromagnetic wave that is used

10a **(i)** to send a signal to a TV from a remote control, 0653/31/O/N/13

..... [1]

10a **(ii)** to send satellite TV information. 0653/31/O/N/13

..... [1]

10 **(b)** Gamma rays travel at a speed of 3×10^8 m/s. 0653/31/O/N/13

State the speed at which X-rays travel. ..... [1]

10 **(c)** Fig. 10.2 represents a wave. 0653/31/O/N/13

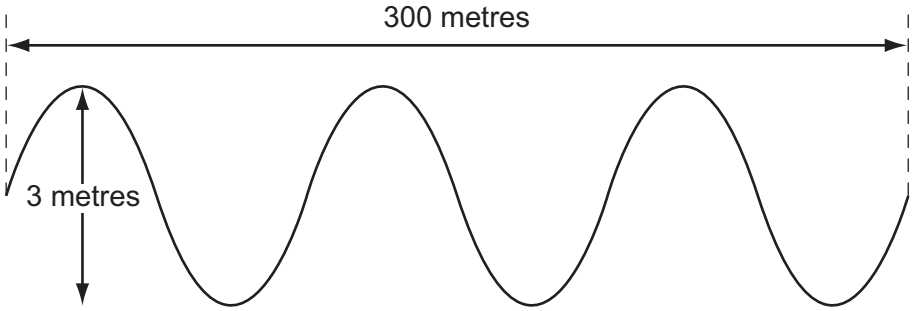

Fig. 10.2

Use Fig. 10.2 to find the

wavelength of the wave, ... m

amplitude of the wave. ..... m

[2]

For Examiner's Use

LIGHT

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II									III	IV	V	VI	VII	0
															4 He Helium 2
					1 H Hydrogen 1										
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 †															

*	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

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

Key: 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.).