



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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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.



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.

.....
 [1]

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

.....

 [2]

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

Table 1.1

| positive ions | | negative ions | |
|---------------|------------------------------|---------------|-------------------------------|
| name | symbol | name | symbol |
| potassium | K ⁺ | fluoride | F ⁻ |
| ammonium | NH ₄ ⁺ | oxide | O ²⁻ |
| calcium | Ca ²⁺ | nitride | N ³⁻ |
| aluminium | Al 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.

..... [1]

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

Show how you obtained your answer.

For
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..... [2]

(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.

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

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

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

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

2 Fig. 2.1 shows the inside of a refrigerator.

The temperature inside the freezing compartment is $-20\text{ }^{\circ}\text{C}$ and the temperature in the rest of the refrigerator is $+5\text{ }^{\circ}\text{C}$.

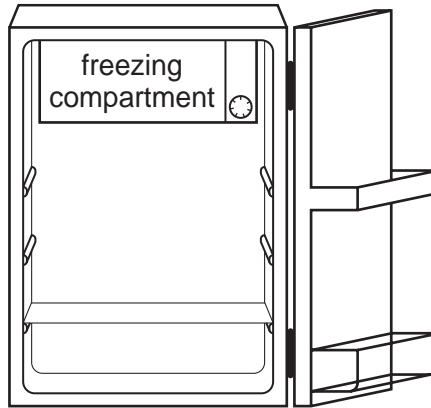


Fig. 2.1

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

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]

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

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.

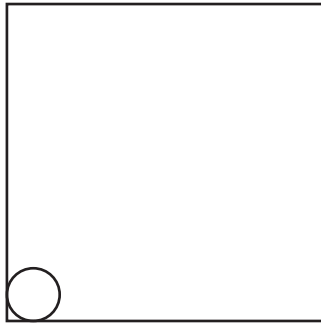
formula

working

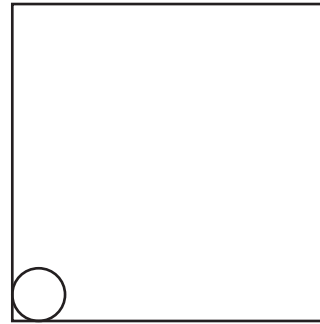
..... unit [2]

- (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.

For
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Use



solid ice



liquid water

[2]

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

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]

- (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.

For
Examiner's
Use

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

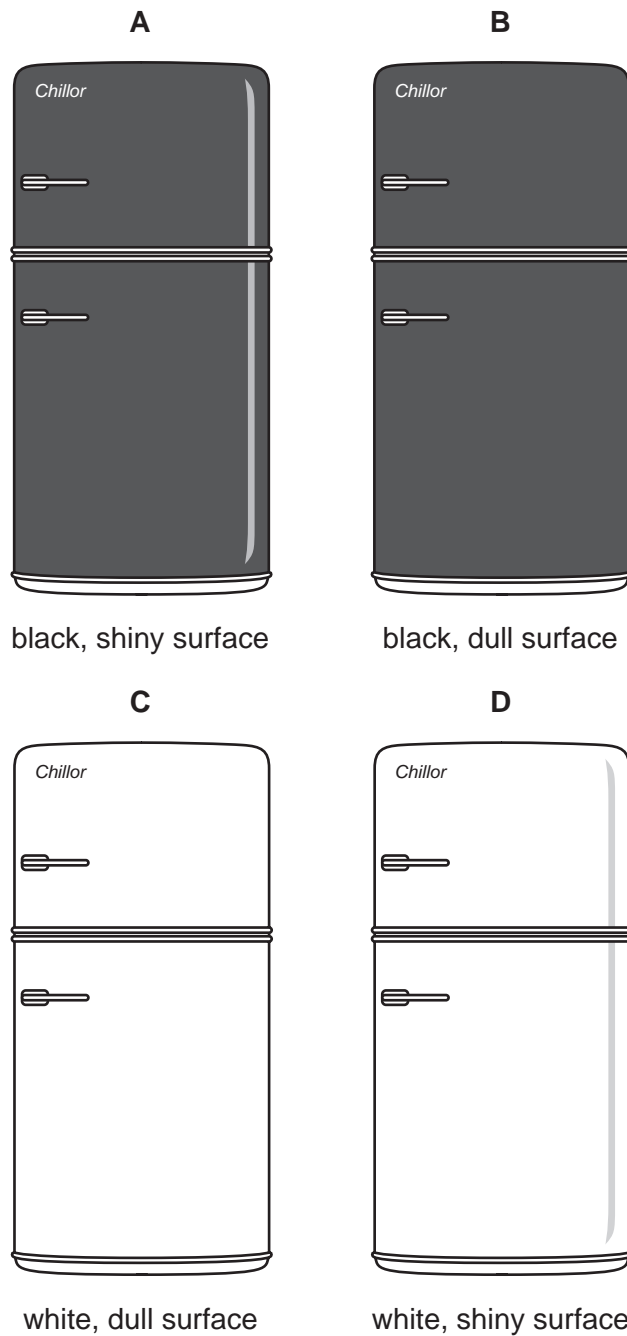


Fig. 2.2

State which refrigerator is most effective at keeping the contents cool.

Explain your answer.

.....

.....

.....

[2]

Please turn over for Question 3.

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

For
Examiner's
Use

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.

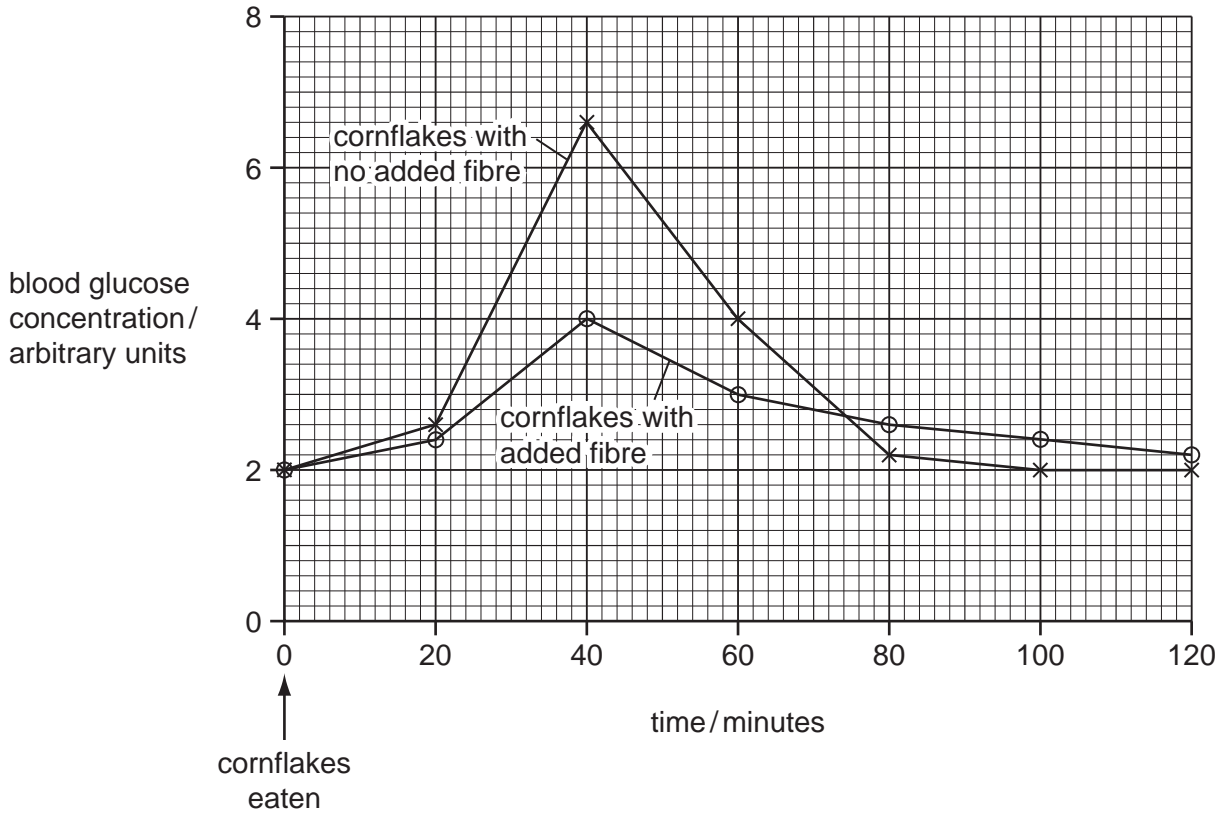


Fig. 3.1

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

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

.....

.....

.....

.....

.....

[3]

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

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

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

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

(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 .

For
Examiner's
Use

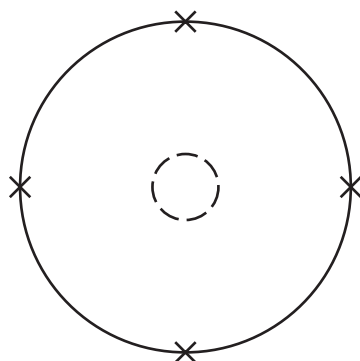


Fig. 4.1

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

name of element

explanation

..... [2]

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

For
Examiner's
Use

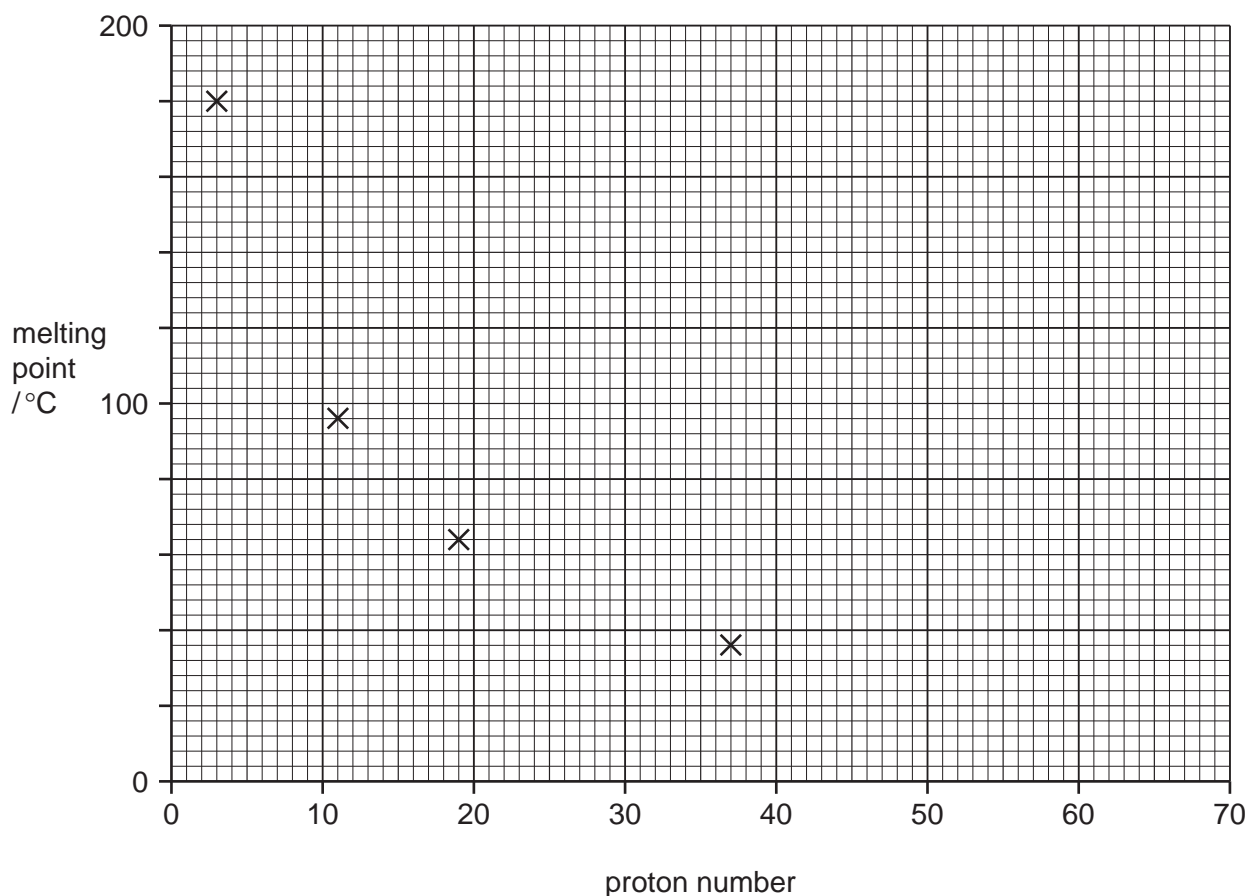


Fig. 4.2

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

Explain your answer briefly.

group number

explanation

..... [2]

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

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

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

For
Examiner's
Use

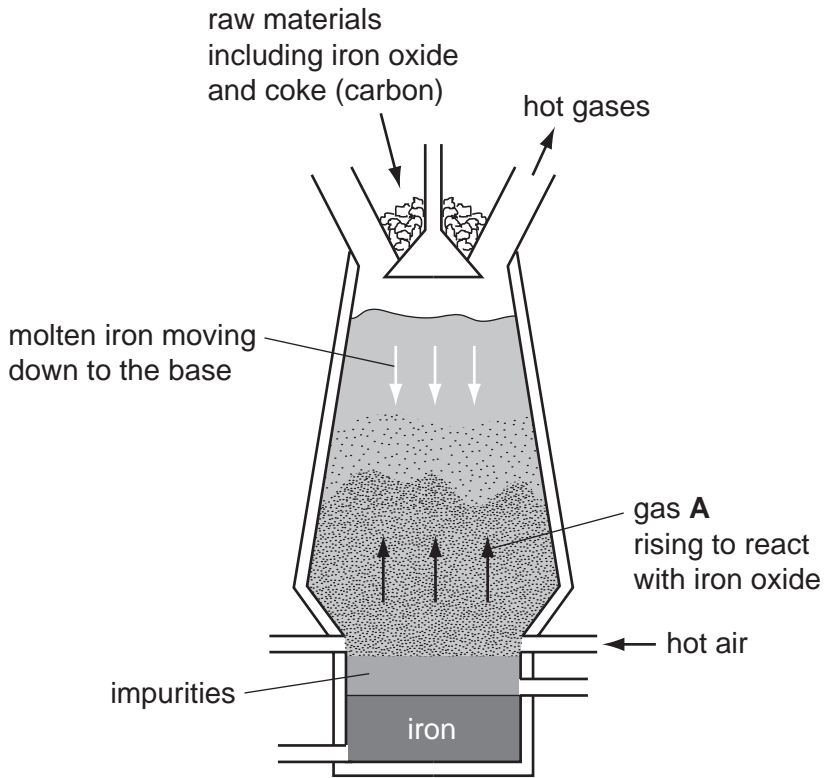


Fig. 4.3

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

..... [1]

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

Explain your answer briefly.

type of chemical reaction

explanation

.....

..... [2]

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

..... [1]

Please turn over for Question 5.

5 Fig. 5.1 shows a solar-powered vehicle.

For
Examiner's
Use

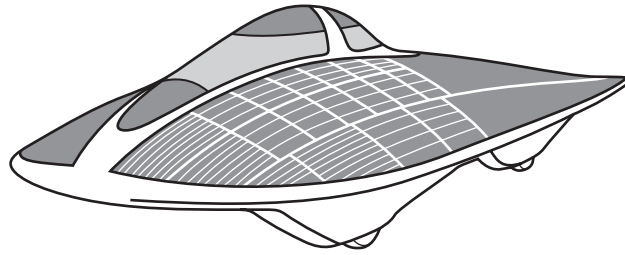


Fig. 5.1

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

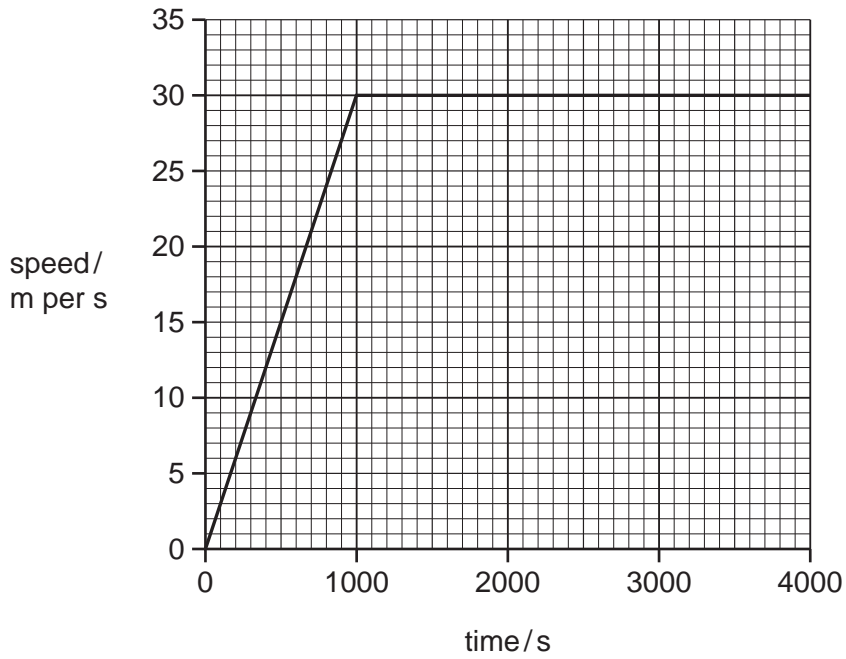


Fig. 5.2

(i) Calculate the distance travelled during 4000 s.

Show your working and state the unit of your answer.

..... unit [2]

(ii) Calculate the acceleration of the vehicle during the first 1000s.

Show your working.

..... m/s² [2]

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

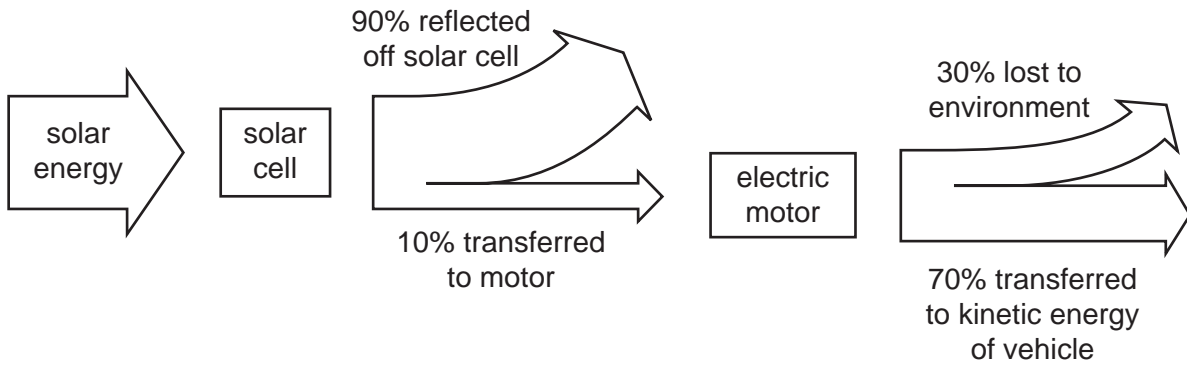


Fig. 5.3

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

..... % [1]

(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**.

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.

For
Examiner's
Use

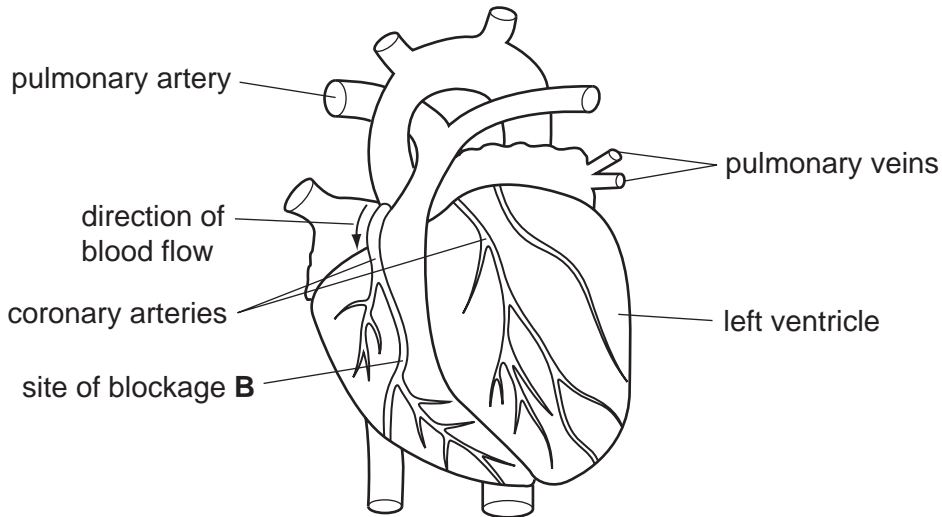


Fig. 6.1

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

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

.....

 [2]

(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]

(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]

(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.

1

2

3 [3]

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Use

7 Ethene, C₂H₄, is an unsaturated hydrocarbon.

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

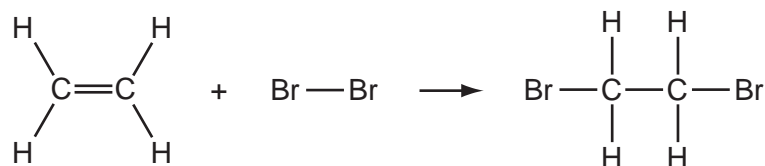


Fig. 7.1

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

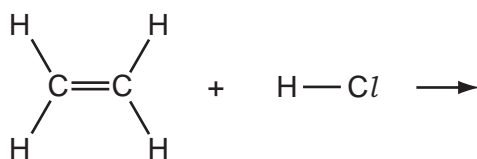
from to [1]

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

..... [1]

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

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



[2]

(b) Methane, CH₄, reacts with steam in the presence of a catalyst to produce carbon monoxide, CO, and hydrogen gas.

Construct a balanced symbol chemical equation for this reaction.

..... [3]

- 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.

For
Examiner's
Use

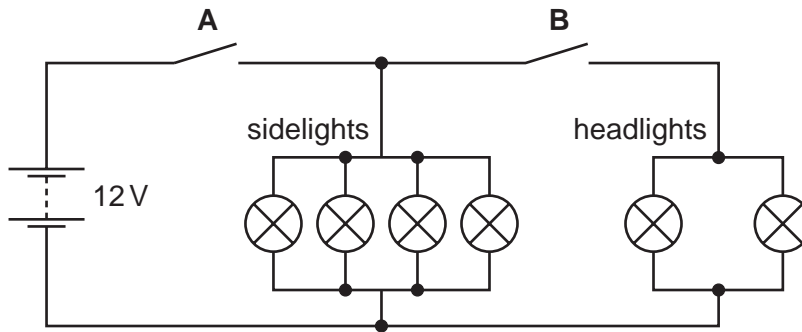


Fig. 8.1

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]

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

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.

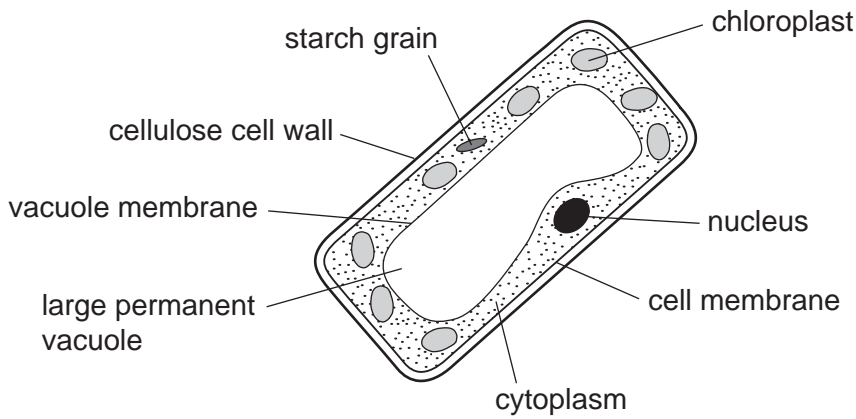


Fig. 9.1

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

..... [1]

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

.....

.....

.....

.....

.....

.....

..... [3]

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

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.

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

Fig. 10.1

Name the type of electromagnetic wave that is used

(i) to send a signal to a TV from a remote control,

..... [1]

(ii) to send satellite TV information.

..... [1]

(b) Gamma rays travel at a speed of 3×10^8 m/s.

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

(c) Fig. 10.2 represents a wave.

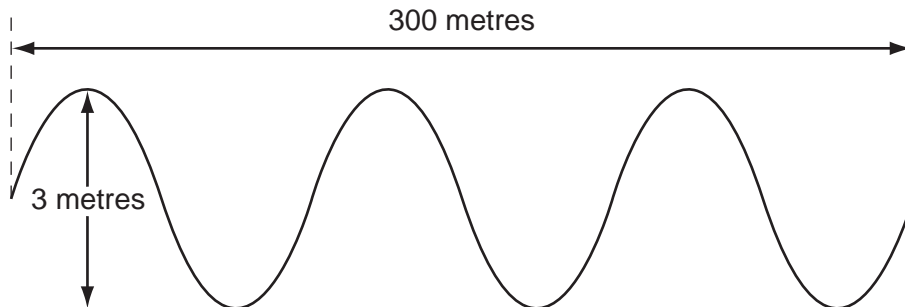


Fig. 10.2

Use Fig. 10.2 to find the

wavelength of the wave, m

amplitude of the wave. m

[2]

DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | |
|----|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|----------------------------------|-----------------------------------|------------------------------------|--------------------------------|------------------------------------|-------------------------------------|------------------------------------|---------------------------------------|----------------------------------|
| | | I | II | III | IV | V | VI | VII | 0 | | | | | | |
| | 1 H Hydrogen 1 | | | | | | | | | | | 2 He Helium 2 | | | |
| 3 | 7 Li Lithium 4 | 9 Be Beryllium 4 | | | | | | | | | | | 19 F Fluorine 9 | | |
| 11 | 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | | 16 O Oxygen 8 | | |
| 19 | 39 K Potassium 19 | 40 Ca Calcium 20 | 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 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 |
| 37 | 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 91 Zr Zirconium 40 | 96 Mo Molybdenum 42 | 101 Ru Ruthenium 44 | 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 | |
| 55 | 133 Cs Caesium 55 | 137 Ba Barium 56 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 190 Os Osmium 76 | 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 | 210 Rn Radon 86 | |
| 87 | 226 Fr Francium 87 | 226 Ra Radium 88 | 227 Ac Actinium 89 | | | | | | | | | | | 103 Lr Lawrencium 103 | |

| | | | | | | | | | | | | | |
|----|-----------------------------------|--|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|------------------------------------|--|-------------------------------------|---------------------------------------|
| 58 | 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 |
| 90 | 232 Th Thorium 90 | 232 Pa Protactinium 91 | 238 U Uranium 92 | 238 Np Neptunium 93 | 241 Am Americium 95 | 241 Cm Curium 96 | 244 Bk Berkelium 97 | 247 Cf Californium 98 | 251 Es Einsteinium 99 | 252 Fm Fermium 100 | 256 Md Mendelevium 101 | 259 No Nobelium 102 | 261 Lr Lawrencium 103 |

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

| | | | |
|-----|---|----------|----------------------------|
| Key | a | X | a = relative atomic mass |
| | 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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