



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
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.

..... [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°C and the temperature in the rest of the refrigerator is $+5^{\circ}\text{C}$.

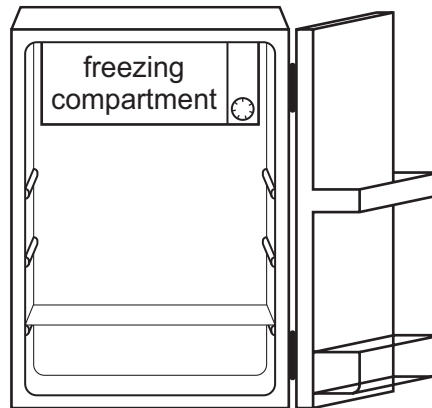


Fig. 2.1

- (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.

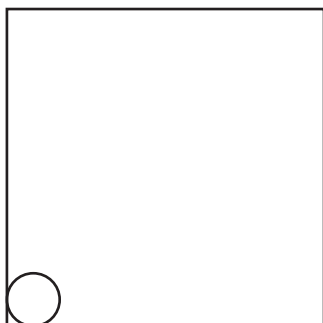
State the formula that you use, show your working and state the unit of your answer.

formula

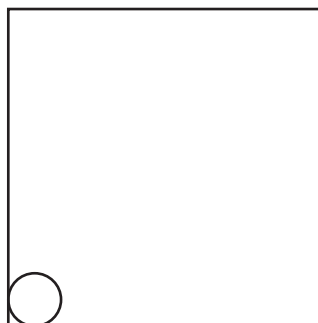
working

..... 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.



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.

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

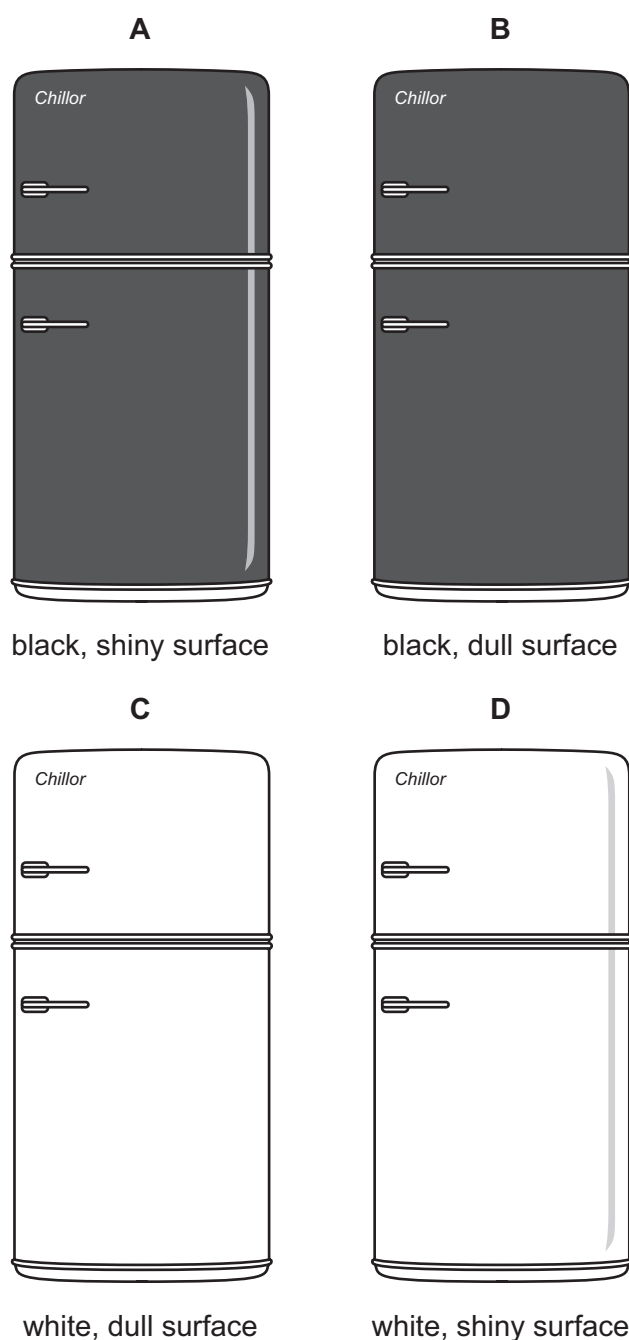


Fig. 2.2

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.

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.

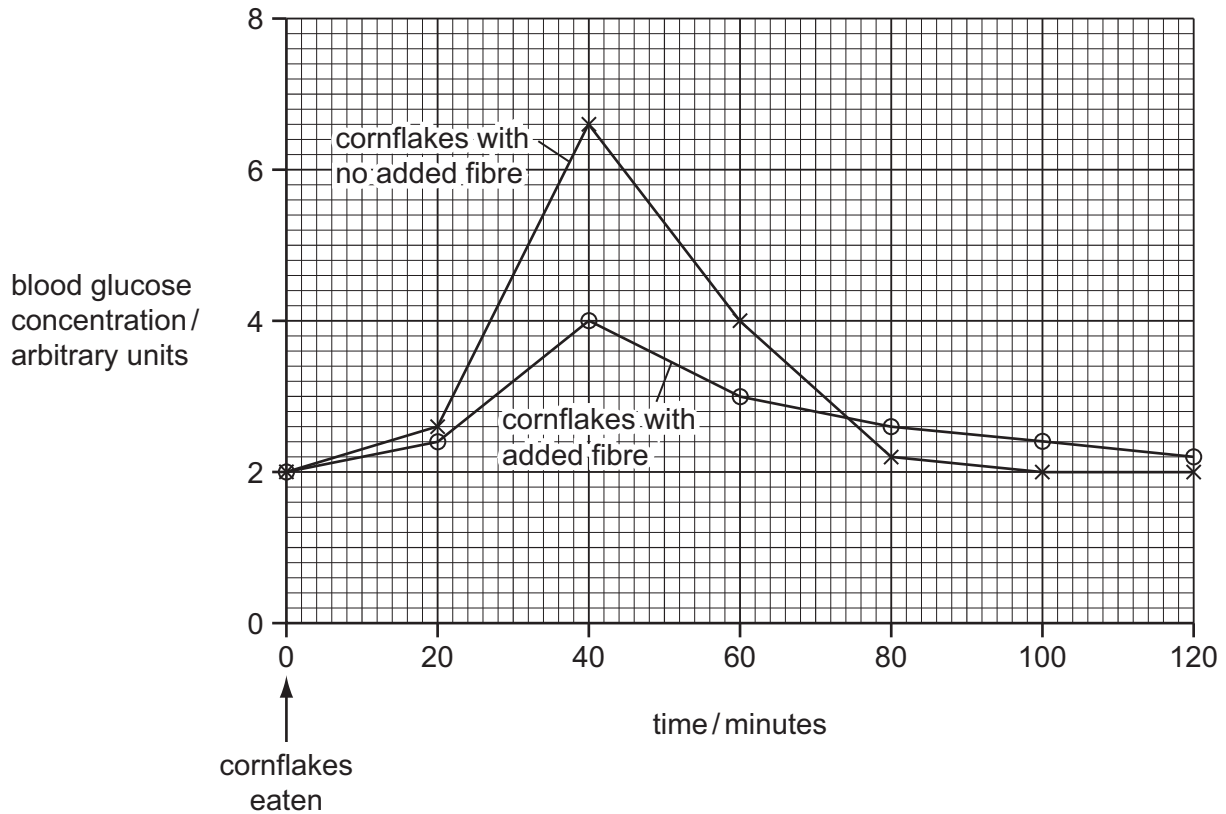


Fig. 3.1

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 second period of the Periodic Table .

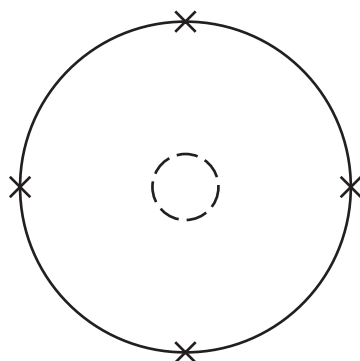


Fig. 4.1

- (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 in the Periodic Table.

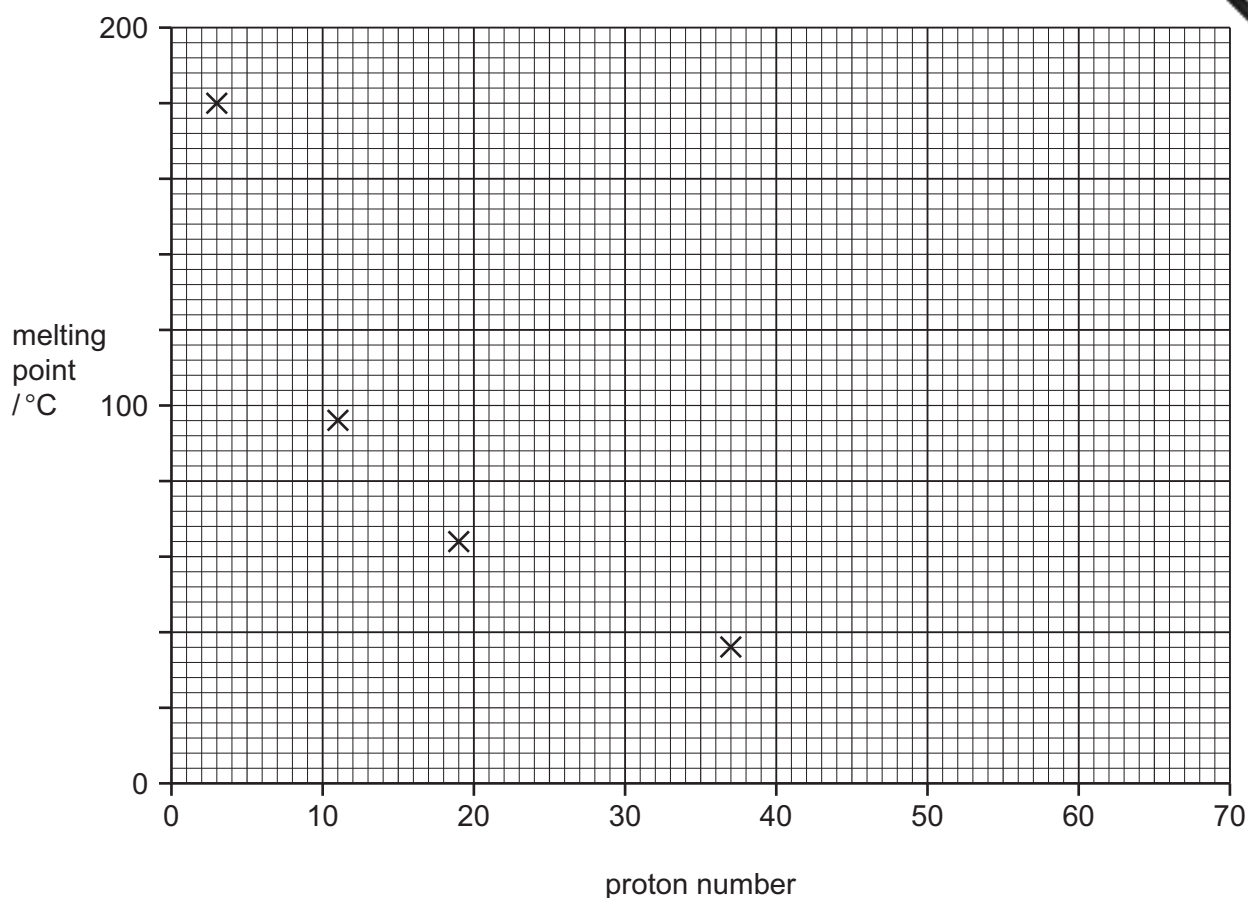


Fig. 4.2

- (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.

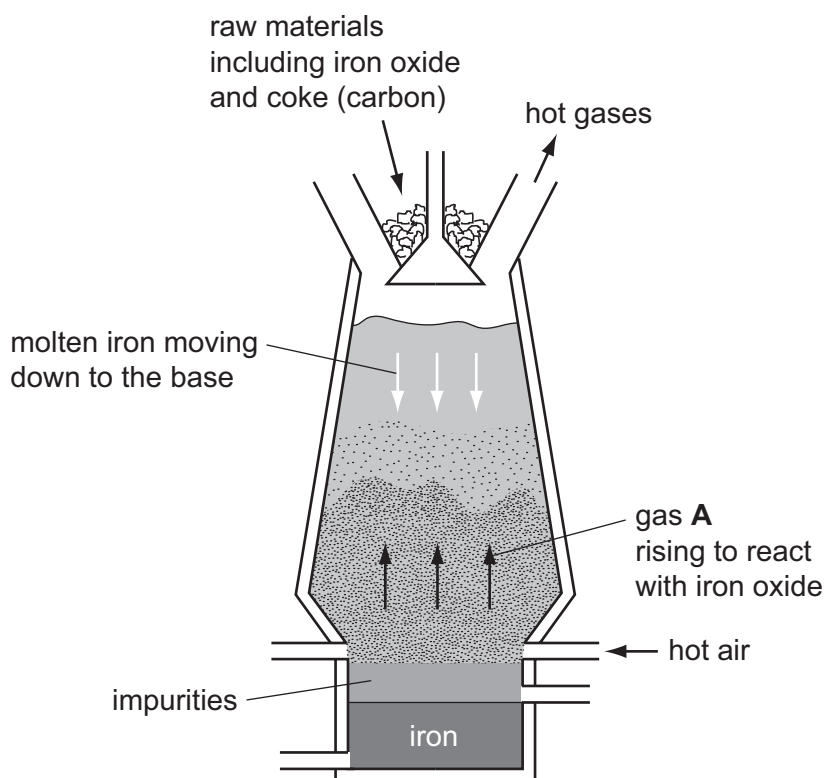


Fig. 4.3

- (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.

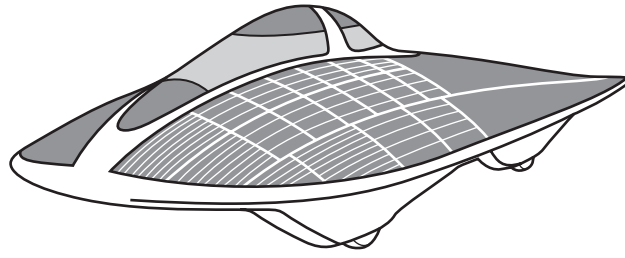


Fig. 5.1

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

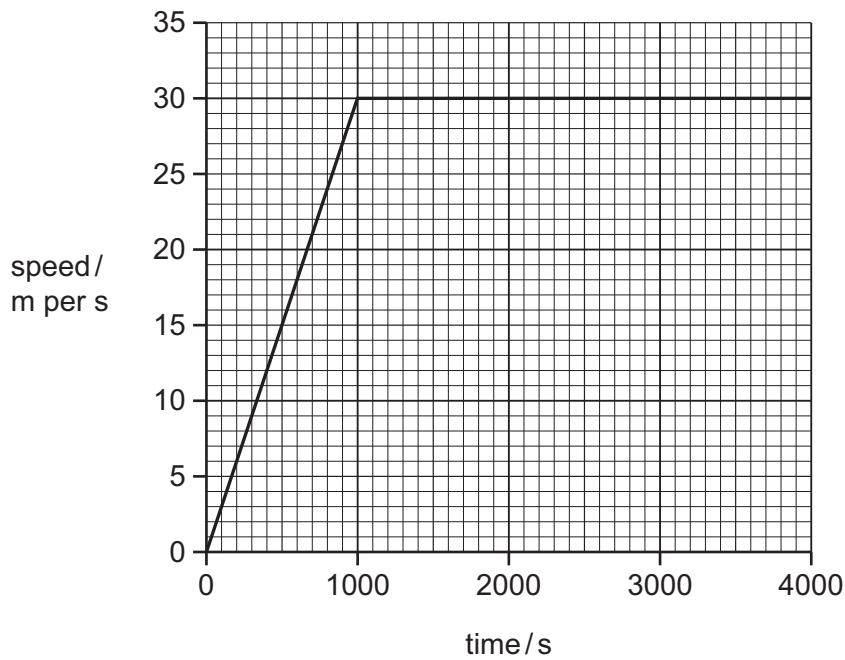


Fig. 5.2

- (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/s^2 [2]

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

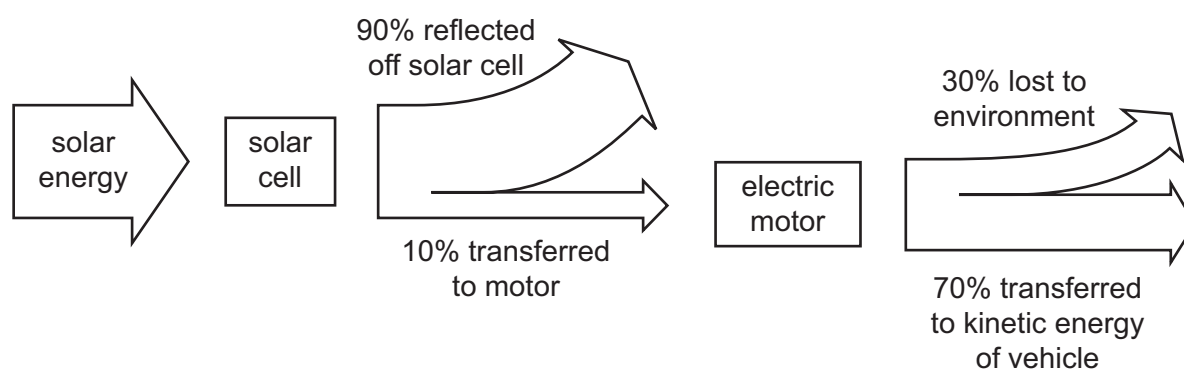


Fig. 5.3

- (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

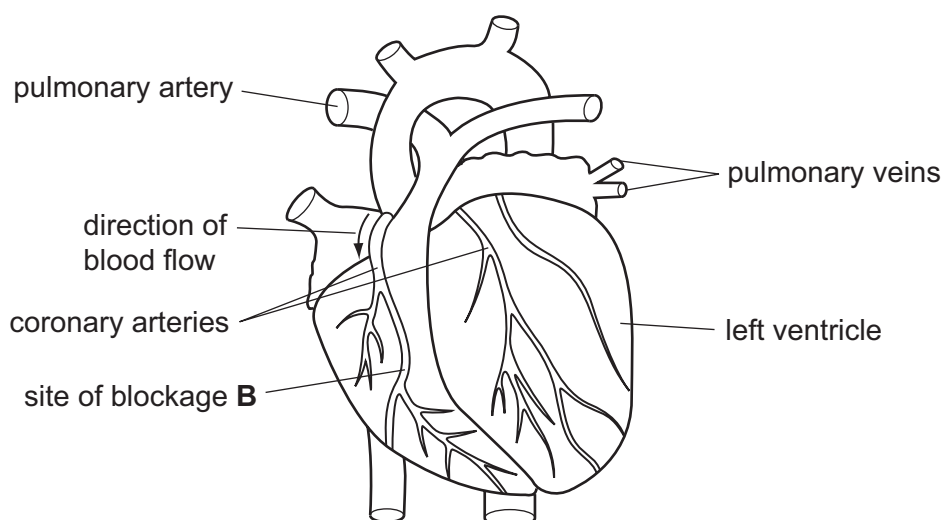


Fig. 6.1

- (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]

7 Ethene, C_2H_4 , is an unsaturated hydrocarbon.

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

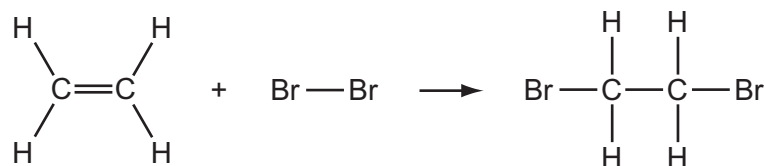


Fig. 7.1

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

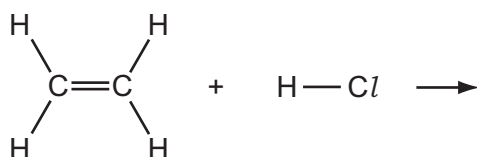
from to [1]

(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, CH_4 , 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, 2 A passes through it.

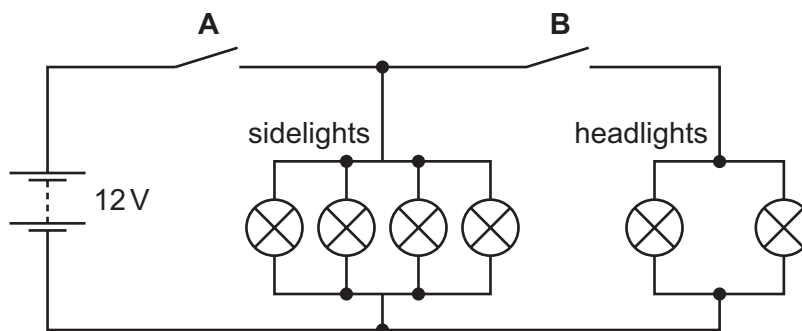


Fig. 8.1

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]

- (b) Each sidelight has a resistance of $24\ \Omega$.

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.

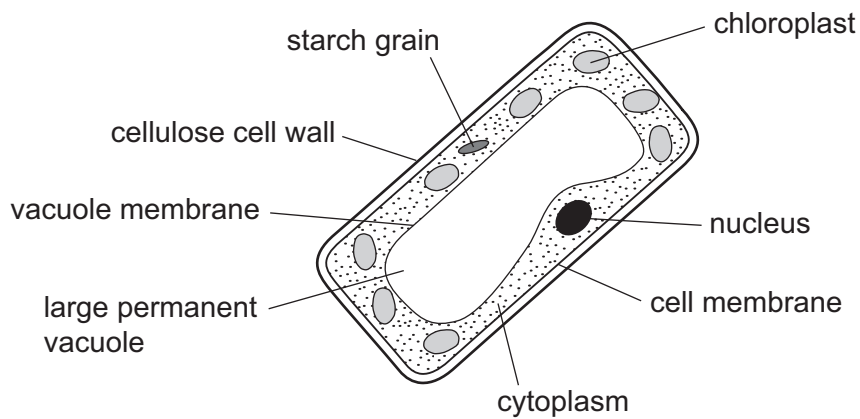


Fig. 9.1

- (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.

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.

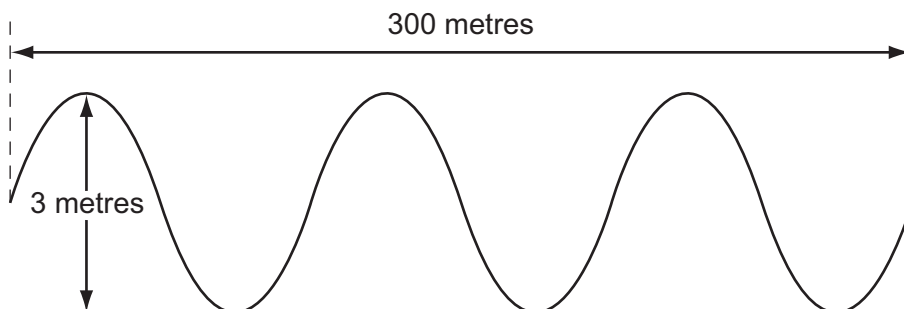


Fig. 10.2

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																	
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon		
11 Na Sodium	12 Mg Magnesium											13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon		
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton		
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon		
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon		
87 Fr Francium	88 Ra Radium	89 Ac Actinium																	
58-71 Lanthanoid series																			
90-103 Actinoid series																			
a X b a = relative atomic mass X = atomic symbol b = proton (atomic) number																			
				140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	150 Sm Samarium		152 Eu Europium	157 Gd Gadolinium	159 Tb Terbium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium		
				232 Th Thorium	238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium		
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				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 Bk Berkelium	
				238 Th Thorium		238 Pa Protactinium		238 U Uranium		238 Np Neptunium		238 Pu Plutonium		238 Am Americium		238 Cm Curium		238 B	

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

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.).



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/32

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 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.

This document consists of **20** printed pages.



- 1 Fig. 1.1 shows apparatus that can be used to test the electrical conductivity of materials contained in beakers **P**, **Q** and **R**.

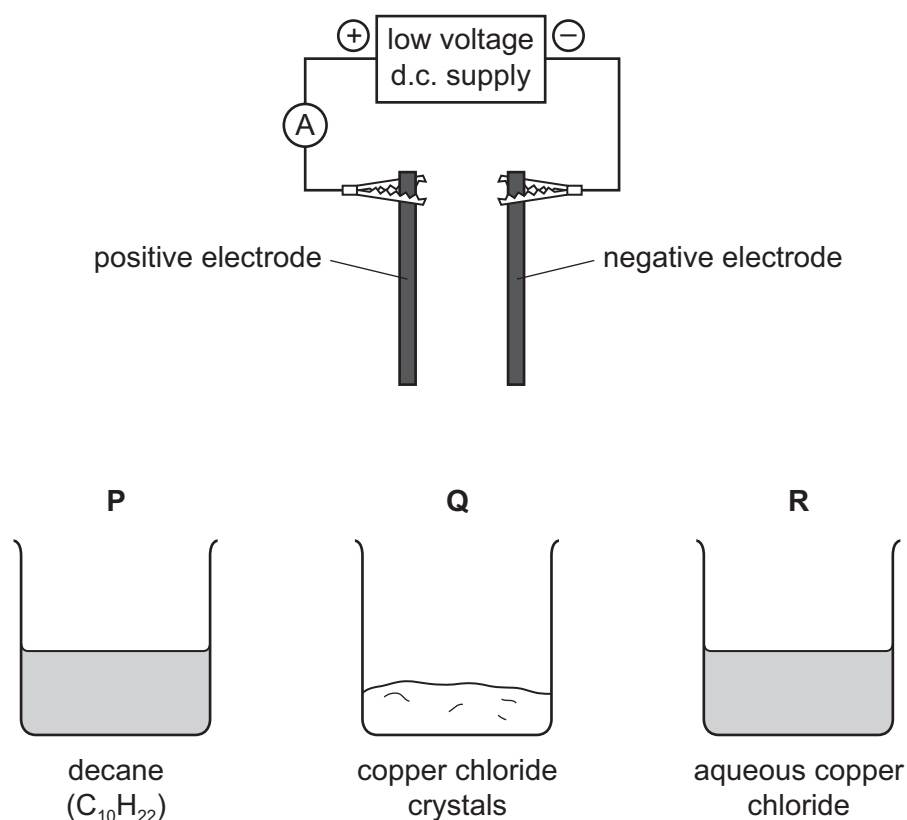


Fig. 1.1

- (a) The material in beaker **R** is a good electrical conductor.

The materials in beakers **P** and **Q** are insulators.

Explain these statements in terms of ions.

.....

.....

.....

..... [3]

- (b) The material in beaker **R** is tested using the apparatus in Fig. 1.1. Bubbles of gas form on the surface of **one** of the electrodes.

(i) Name the gas that forms. [1]

(ii) A layer of an orange solid is formed on the other electrode.

Explain, in terms of ions, electrons and atoms, what is happening at the surface of this electrode.

.....

 [3]

- (c) Sodium chloride is a hard, crystalline solid at room temperature.

Fig. 1.2 shows a diagram that represents the structure of sodium chloride.

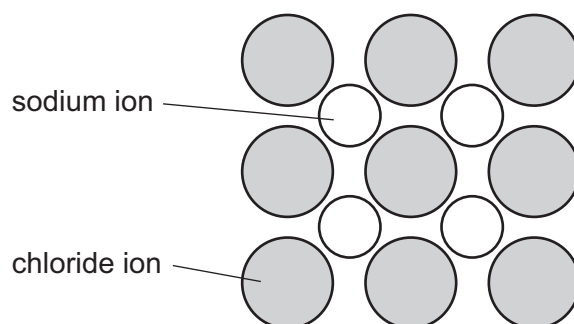


Fig. 1.2

Explain, in terms of forces, why sodium and chloride particles stay strongly bonded.

.....

 [2]

- 2 (a) Fig. 2.1 shows two means of communication between Singapore and Sydney.

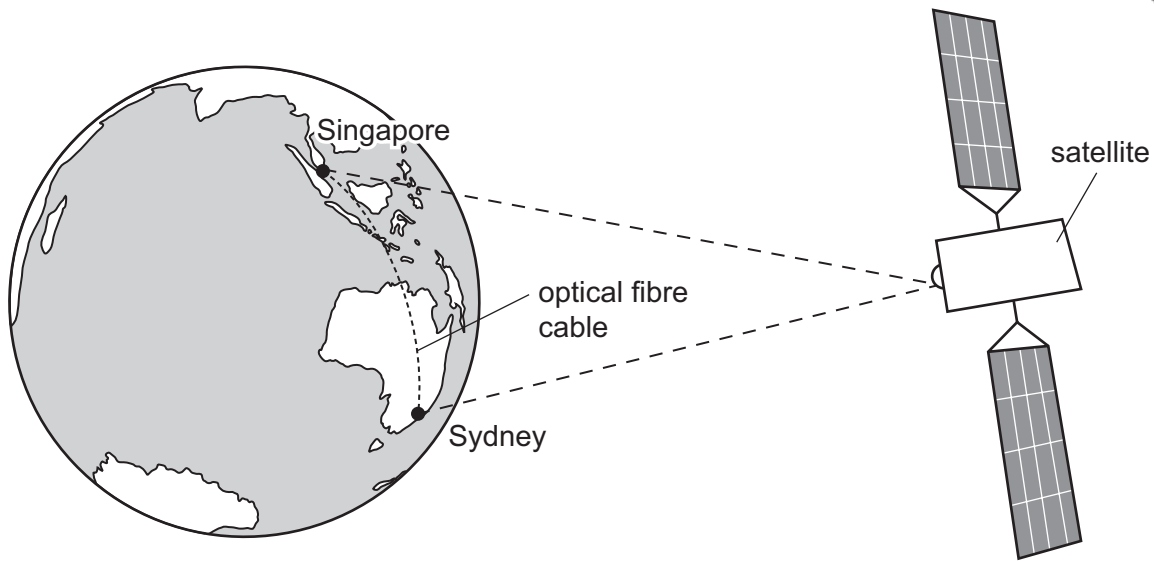


Fig. 2.1

Method 1 Microwave signals are sent by satellite.

Method 2 Infra-red waves carrying a signal are sent through an optical fibre cable.

Fig. 2.2 shows an infra-red ray entering an optical fibre.

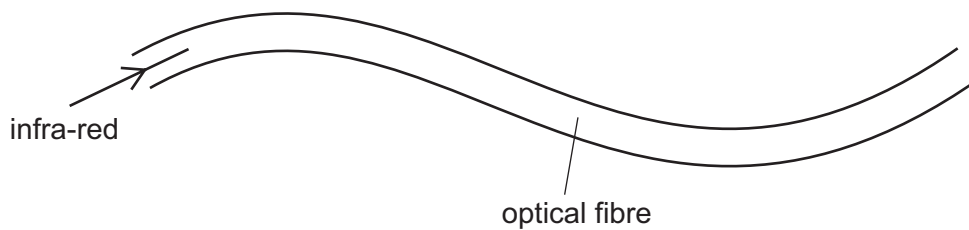


Fig. 2.2

The infra-red ray travels all the way through the optical fibre.

- (i) Explain why the infra-red ray stays inside the optical fibre. You may draw on the diagram if it helps your answer.

.....

.....

.....

..... [3]

- (ii) The length of an optical fibre cable between Singapore and Sydney is 6.3×10^8 m.

The speed of infra-red waves in an optical fibre is 2.1×10^8 m/s.

Calculate the time taken for the signal to travel from Singapore to Sydney.

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

formula

working

..... unit [2]

- (iii) The speed at which microwaves travel through space is greater than the speed at which infra-red waves travel through an optical fibre.

Suggest why the time taken by infra-red signals is less than the time taken by the microwave signals to travel from Singapore to Sydney.

.....

..... [1]

(b) Fig. 2.3 shows a demonstration of sound transmission using a bell jar.

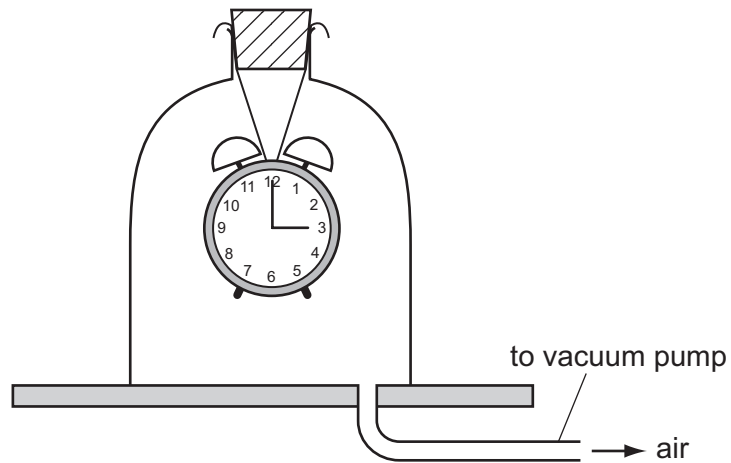


Fig. 2.3

As the air is removed from the bell jar, the ringing sound from inside the bell jar gets quieter. When all the air has been removed, the bell cannot be heard.

Explain these observations.

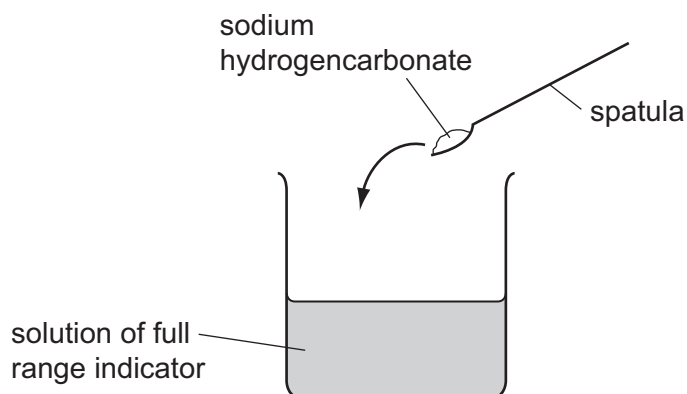
.....

.....

.....

..... [2]

- 3 Sodium hydrogencarbonate, NaHCO_3 , is a white solid compound which is soluble in water.
- (a) A student adds some sodium hydrogencarbonate to a beaker which contains an aqueous solution of full range indicator (Universal Indicator).



When the sodium hydrogencarbonate dissolves, the solution changes colour from green to blue.

- (i) State how the pH of the mixture changes when the sodium hydrogencarbonate dissolves.

..... [1]

- (ii) The student then adds excess dilute hydrochloric acid to the solution.

Apart from an increase in volume, state **two** observations that are made when the acid is added.

1

.....

2

..... [2]

- (b) Fig. 3.1 shows apparatus a teacher uses to demonstrate the heating of sodium hydrogencarbonate.

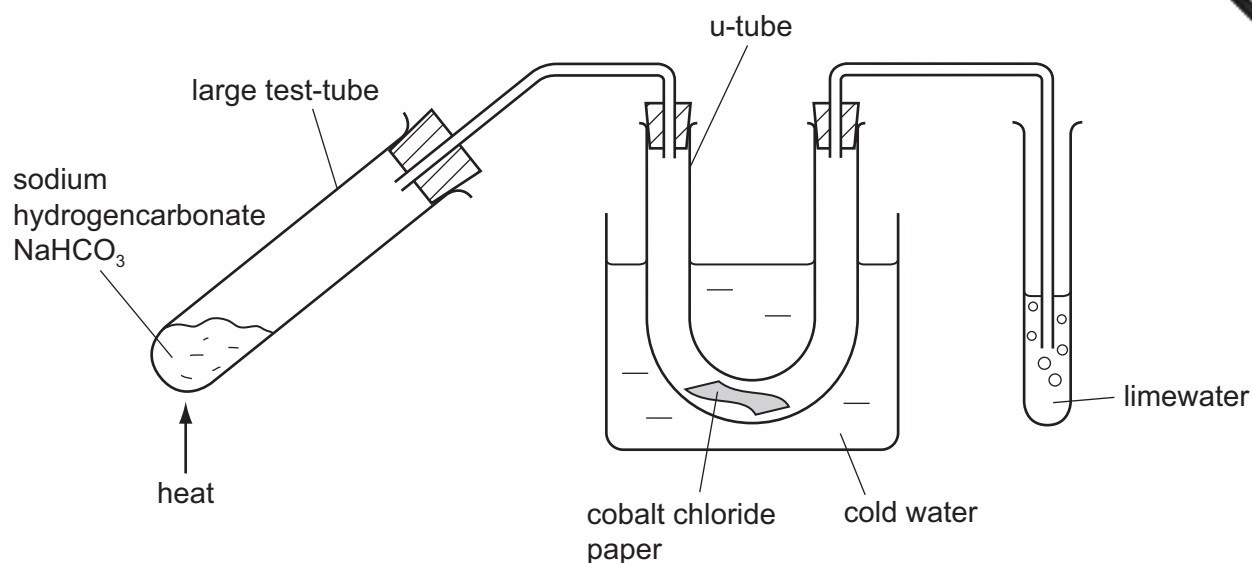


Fig. 3.1

The solid is heated strongly for a few minutes.

- The cobalt chloride paper changes colour from blue to pink.
- A gas bubbles out through the limewater, turning it cloudy.

After the reaction a white solid remains in the large test-tube.

- (i) Explain how the observations show that both water and carbon dioxide are produced.

.....

 [1]

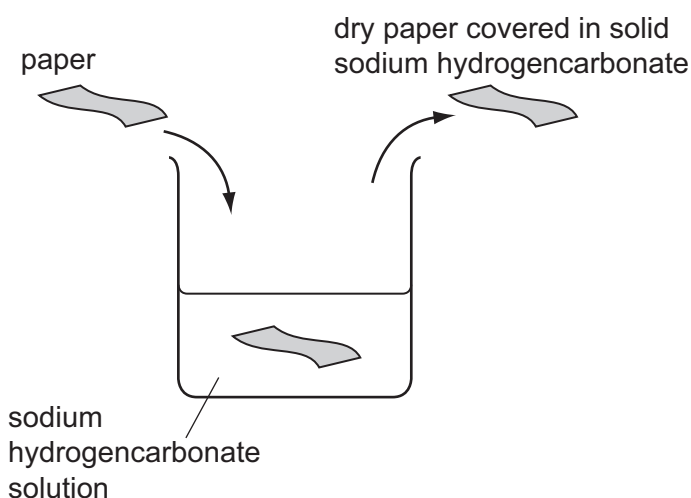
- (ii) The teacher tells her students that

- sodium hydrogencarbonate has been decomposed (broken down into simpler compounds),
- the white solid which remains in the large test-tube is sodium carbonate, Na_2CO_3 .

Construct a balanced symbol equation for the decomposition of sodium hydrogencarbonate.

..... [2]

- (iii) A student places a piece of paper into a solution of sodium hydrogencarbonate. She removes the paper and allows it to dry. She notices that crystals of solid sodium hydrogencarbonate are left on the paper.



The student finds that it is now difficult to set fire to the paper.

Use the results of the experiment in Fig. 3.1 to suggest why the student finds it difficult to get the paper to burn.

.....

 [2]

- (iv) Suggest, with a reason, whether the decomposition of sodium hydrogencarbonate is an exothermic or an endothermic reaction.

.....
 [2]

- 4 (a) Most plants have root hairs near the tips of their roots.

Researchers grew two different types of crop plants, **A** and **B**, in soil with different concentrations of phosphate ions. They measured the mean number of root hairs in a small area of the roots, and also the mean length of the root hairs.

Table 4.1 shows their results.

Table 4.1

type of plant	phosphate concentration	mean number of root hairs per unit area	mean length of root hairs / micrometres
A	low	1.26	175
	high	1.70	149
B	low	1.41	225
	high	1.85	52

- (i) Describe how the addition of phosphate ions to the soil affects the root hairs in Type **A** plants.

.....

 [2]

- (ii) Compare the effect of adding phosphate ions to the soil for type **A** plants and type **B** plants.

.....

 [2]

- (iii) Predict and explain how a reduction in the length of its root hairs would affect the growth of a plant.

.....

.....

.....

.....

..... [3]

- (b) Farmers often add fertilisers containing phosphate ions, potassium ions and nitrate ions to the soil in which they grow crops.

Explain how careless use of fertilisers can cause harm to living organisms in rivers and lakes.

.....

.....

.....

.....

.....

..... [4]

- 5 Fig. 5.1 shows a bicycle with a front light **A** and a rear light **B** powered by the same battery.

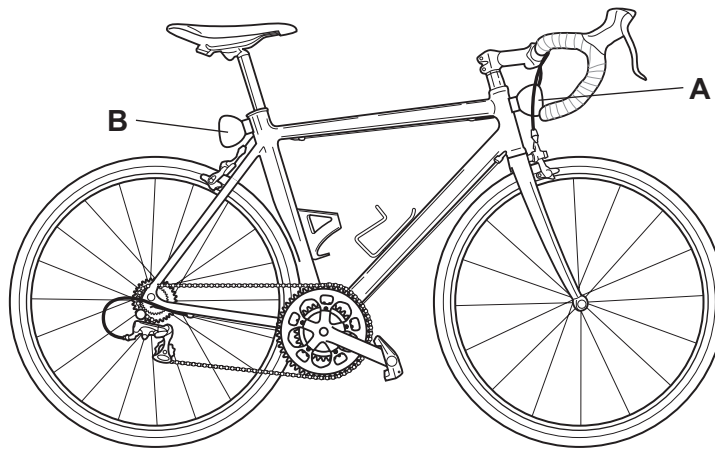


Fig. 5.1

Fig. 5.2 shows how the lights are connected.

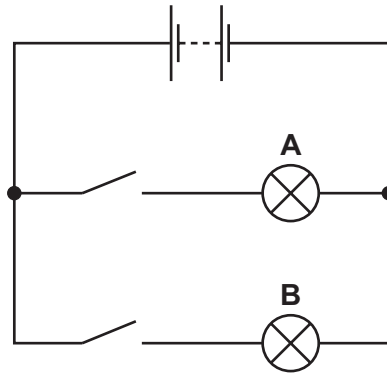


Fig. 5.2

- (a) State the name given to this type of circuit arrangement.

..... [1]

- (b) (i) The resistance of light **A** is 10Ω and the resistance of light **B** is 5Ω .

Calculate the combined resistance of the two lights in this circuit.

State the formula that you use and show your working.

formula

working

..... Ω [3]

- (ii) The voltage supplied by the battery is $9V$.

Calculate the current passing through light **A**.

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

formula

working

..... unit [2]

- (c) The bicycle was made from a block of aluminium alloy of mass $9000g$ and volume $3000cm^3$.

Calculate the density of aluminium in g/cm^3 .

State the formula that you use and show your working.

formula

working

..... g/cm^3 [2]

- 6 Fig. 6.1 shows a fetus in the uterus just before it is born.

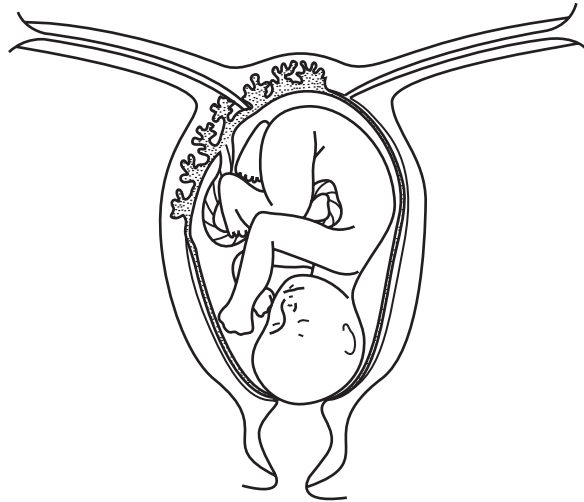


Fig. 6.1

- (a) On Fig. 6.1, use the letters **A**, **B** and **C** to label these parts on the diagram:

A – the placenta

B – amniotic fluid

C – the cervix

[3]

- (b) Describe how the placenta and umbilical cord help to supply the fetus with oxygen.

.....

.....

.....

.....

..... [3]

- 7 (a) Fluorine is one of the halogens in Group 7 of the Periodic Table.

Suggest the physical state at room temperature (solid, liquid or gaseous) of fluorine.

Explain your answer in terms of the relative size of fluorine molecules in comparison with those of the other halogens.

physical state of fluorine

explanation

.....

..... [2]

- (b) Fig. 7.1 shows the structure of one molecule of a type of compound called a CFC (chlorofluorocarbon).

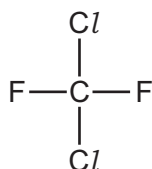


Fig. 7.1

- (i) Name the type of chemical bonds that hold the atoms together in the molecule in Fig. 7.1.

Explain your answer briefly.

type of bonding

explanation

..... [2]

- (ii) State the number of electrons in the outer shells of chlorine and fluorine atoms.

..... [1]

- (iii) State and explain briefly the number of electrons in the outer shells of the chlorine and fluorine atoms in the molecule shown in Fig. 7.1.

number of electrons

explanation

.....

..... [2]

8 (a) Fig. 8.1 shows a car moving along a road.

- (i) Draw and label arrows on Fig. 8.1 to show the directions of the driving and friction forces acting on the car. [1]

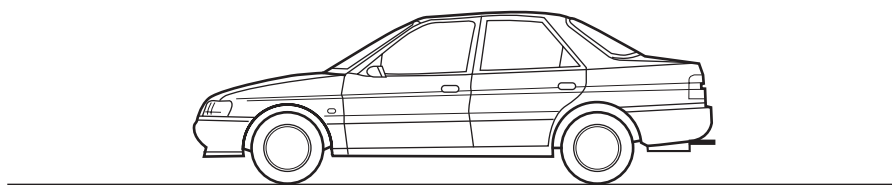


Fig. 8.1

- (ii) The driving and friction forces are balanced.

Explain what is meant by the phrase *forces are balanced*.

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

- (iii) Describe the movement of the car when these forces are balanced.

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

- (iv) The car accelerates.

Compare the relative sizes of the driving and friction forces as the speed increases.

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

- (b) (i) During part of a journey, a car moves 1 km and the driving force is 10 000 N.

Calculate the work done by the driving force.

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

formula

working

..... unit [2]

- (ii) This work is done in 100 s.

Calculate the useful power output from the car's engine during this time.

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

formula

working

..... unit [2]

- (c) The cooling system of the car uses water to remove heat energy from the hot engine. The heated water goes into the radiator. Heat energy is lost from the radiator.

- (i) Name the part of the electromagnetic spectrum that is involved in the transfer of heat by radiation.

..... [1]

- (ii) Fig. 8.2 shows a car radiator.

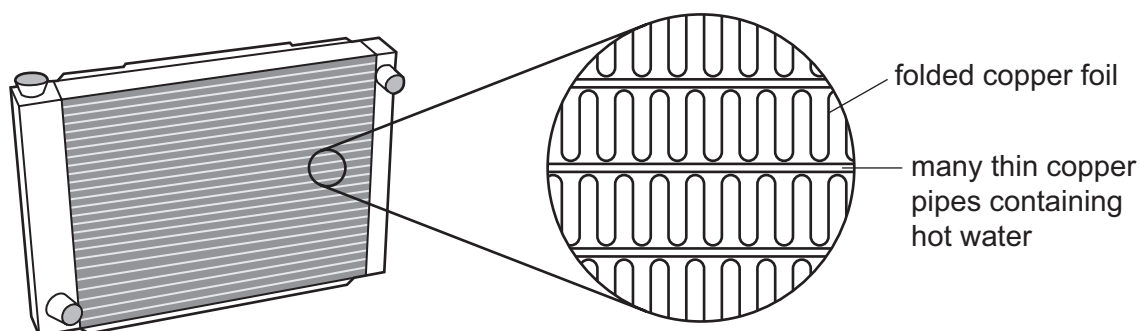


Fig. 8.2

Explain how the features of the radiator that are shown in Fig. 8.2 increase the rate of cooling of hot water.

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

- 9 Fig. 9.1 shows an alveolus and a blood capillary in the lungs.

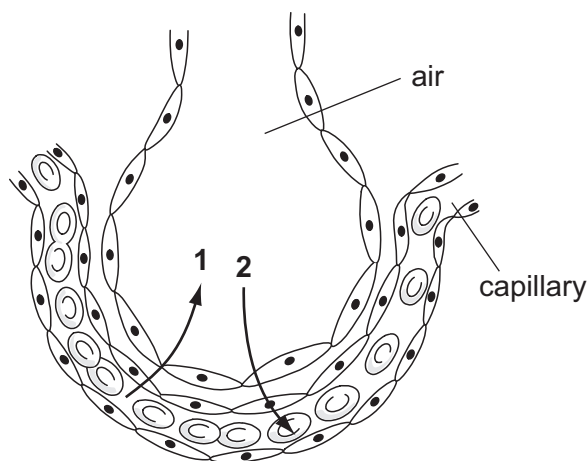


Fig. 9.1

- (a) The arrows labelled 1 and 2 show the direction of diffusion of two gases.

- (i) Name the gases.

gas 1

gas 2 [2]

- (ii) Define the term *diffusion*.

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

- (iii) Explain how the structure of the wall of the capillary and the wall of the alveolus help diffusion of these gases to take place efficiently.

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

(b) Cigarette smoke contains many harmful substances.

(i) List **four** harmful components of cigarette smoke.

- 1
- 2
- 3
- 4 [2]

(ii) Some of the components of cigarette smoke prevent cilia from working properly.

Explain how this can lead to an increase in infections of the lungs by bacteria.

-
-
-
- [2]

DATA SHEET

The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
		1 H Hydrogen																
3 7 Li Lithium	4 9 Be Beryllium											5 11 B Boron	6 12 C Carbon	7 14 N Nitrogen	8 16 O Oxygen	9 19 F Fluorine	2 4 He Helium	
11 23 Na Sodium	12 24 Mg Magnesium											13 27 Al Aluminium	14 28 Si Silicon	15 31 P Phosphorus	16 32 S Sulfur	17 35.5 Cl Chlorine	10 20 Ne Neon	
19 39 K Potassium	20 40 Ca Calcium	21 45 Sc Scandium	22 48 Ti Titanium	23 51 V Vanadium	24 52 Cr Chromium	25 55 Mn Manganese	26 56 Fe Iron	27 59 Co Cobalt	28 59 Ni Nickel	29 64 Cu Copper	30 65 Zn Zinc	31 70 Ga Gallium	32 73 Ge Germanium	33 75 As Arsenic	34 79 Se Selenium	35 80 Br Bromine	36 84 Kr Krypton	
37 85 Rb Rubidium	38 88 Sr Strontium	39 89 Y Yttrium	40 91 Zr Zirconium	41 93 Nb Niobium	42 96 Mo Molybdenum	43 98 Tc Technetium	44 101 Ru Ruthenium	45 103 Rh Rhodium	46 106 Pd Palladium	47 108 Ag Silver	48 112 Cd Cadmium	49 115 In Indium	50 119 Sn Tin	51 122 Sb Antimony	52 128 Te Tellurium	53 127 I Iodine	54 131 Xe Xenon	
55 133 Cs Caesium	56 137 Ba Barium	57 139 La Lanthanum	72 178 Hf Hafnium	73 181 Ta Tantalum	74 184 W Tungsten	75 186 Re Rhenium	76 190 Os Osmium	77 192 Ir Iridium	78 195 Pt Platinum	79 197 Au Gold	80 201 Hg Mercury	81 204 Tl Thallium	82 207 Pb Lead	83 209 Bi Bismuth	84 210 Po Polonium	85 210 At Astatine	86 210 Rn Radon	
87 Fr Francium	88 226 Ra Radium	89 227 Ac Actinium																
58-71 Lanthanoid series																		
90-103 Actinoid series																		
Key		a	X	a = relative atomic mass X = atomic symbol b = proton (atomic) number														

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.).



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
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* 8 3 1 6 4 6 0 0 3 9 *



COMBINED SCIENCE

0653/33

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.

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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 **23** printed pages and **1** blank page.



- 1 (a) Fig. 1.1 shows a root hair cell.

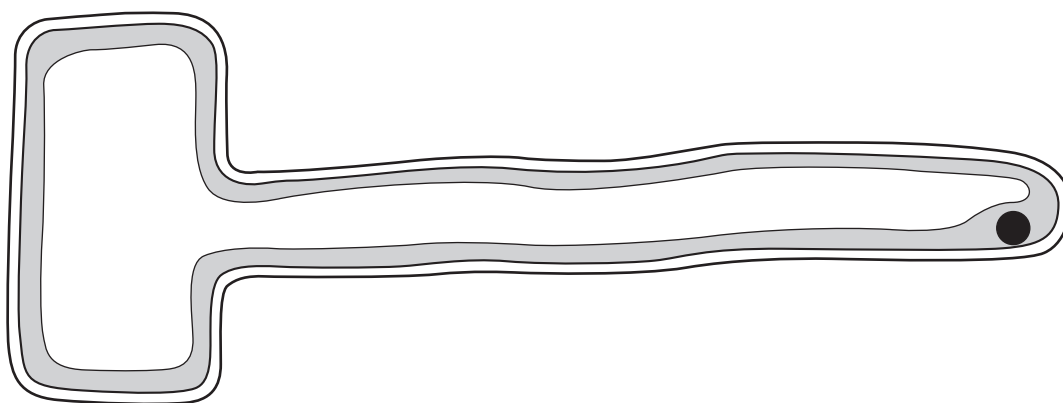


Fig. 1.1

- (a) (i) Use the letters **A** and **B** to label these parts of the root hair cell in Fig. 1.1.

A the structure that controls what enters and leaves the cell

B a structure that is **not** present in animal cells

[2]

- (ii) Describe how the structure of the root hair cell helps it to carry out its functions.

.....

.....

.....

.....

.....

..... [3]

- (b) Fig. 1.2 shows a leaf stalk from a celery plant in a beaker containing a solution of red dye.

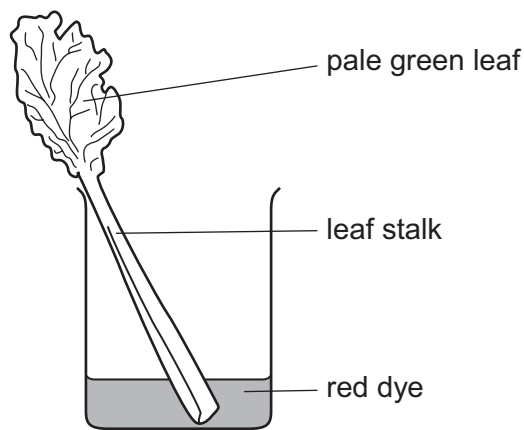


Fig. 1.2

After an hour, the veins in the leaf had become red.

- (i) Suggest why this happened.

.....

 [2]

- (ii) The experiment was repeated at a lower temperature. It took longer for the veins in the leaf to become red.

Suggest an explanation for this result.

.....

 [3]

- 2 (a) Table 2.1 shows information about some chemical elements and their positions in the Periodic Table.

Table 2.1

element	group number in the Periodic Table
oxygen	6
calcium	2
lithium	1
sulfur	6
fluorine	7

Select **two** elements from Table 2.1 whose atoms form covalent bonds with each other and explain your answer.

..... and

explanation

..... [2]

(b) Fig. 2.1 shows the electron arrangement in an atom of phosphorus.

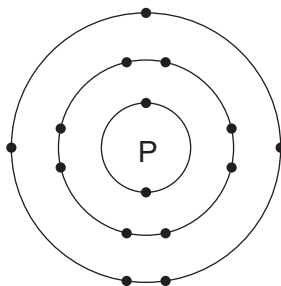


Fig. 2.1

Phosphorus and hydrogen bond together to form the compound phosphine. One molecule of phosphine contains one atom of phosphorus.

Predict and explain the chemical formula of one molecule of phosphine. You may wish to draw a diagram to help you to answer this question.

predicted formula

explanation

.....

..... [3]

- (c) A student added **excess** acidified barium chloride solution to a solution of magnesium sulfate.

Fig. 2.2 shows the procedure followed.

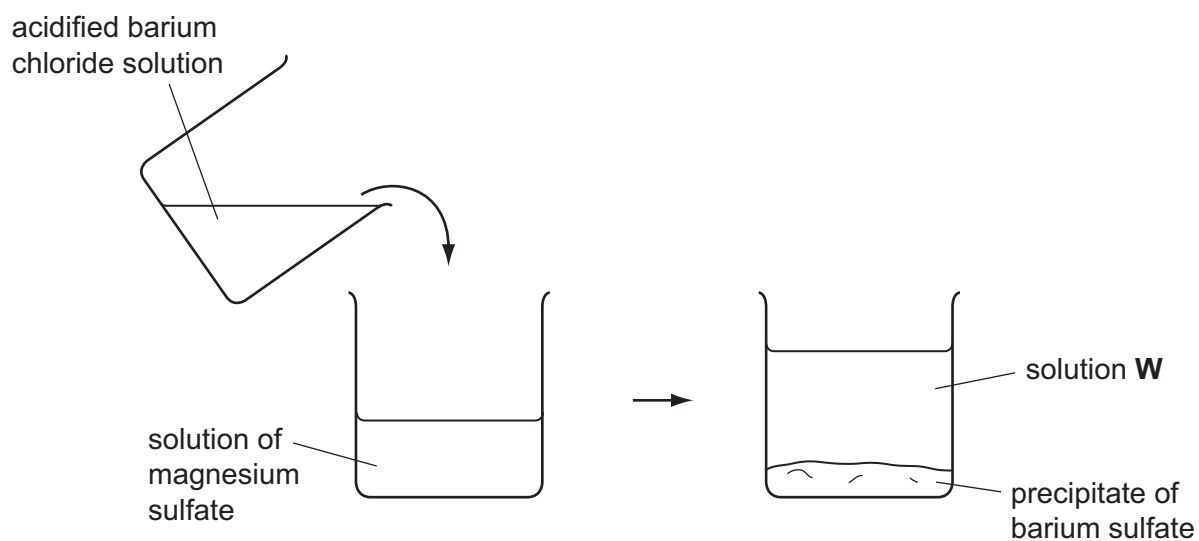
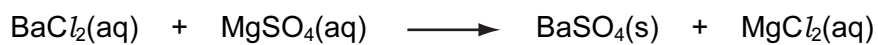


Fig. 2.2

A white precipitate of barium sulfate was produced.

The chemical equation for the reaction is



State **three** ions that are dissolved in solution **W** in Fig. 2.2.

- 1
- 2
- 3

[2]

- (d) Fig. 2.3 shows apparatus used by the student to investigate the reaction between different metals and steam, $\text{H}_2\text{O}(\text{g})$.

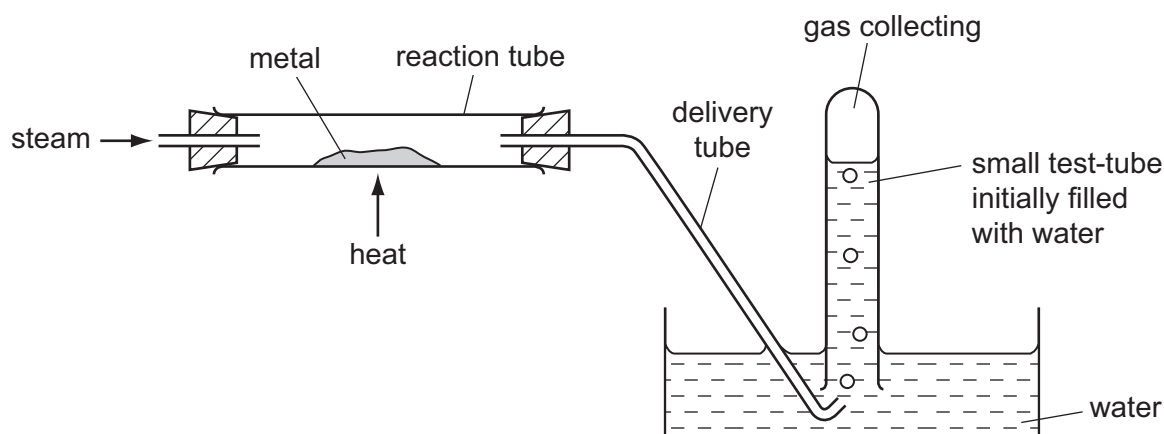


Fig. 2.3

The student carried out experiments using two metals, **P** and **Q**. His results are shown in Table 2.2.

Table 2.2

metal	product in the reaction tube	product in the small test-tube
P	no reaction	no gas produced
Q	oxide of element Q	hydrogen gas

Use the observations to compare the reactivities of the three elements **P**, **Q** and **hydrogen**.

Explain your answer briefly.

most reactive element

.....

least reactive element

explanation

.....

.....

..... [3]

- 3 (a) Fig. 3.1 shows a circuit used to measure the current passing through a resistor. The voltage across it is changed.

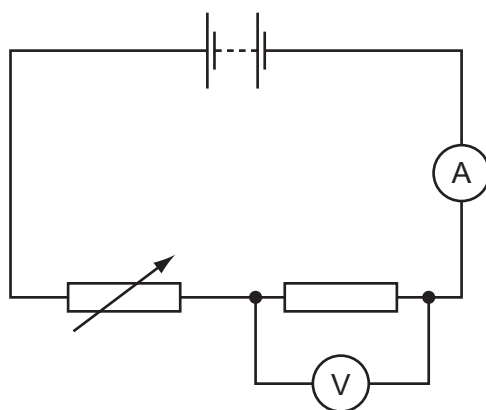


Fig. 3.1

Complete the sentences below using suitable words.

When the voltage across the resistor is reduced, the current through the resistor

.....

When the voltage of the supply is reduced, the voltage across the resistor

.....

[1]

- (b) The resistance of a piece of wire depends on a number of variables such as the temperature of the wire and the material from which it is made.

State **two other** factors which affect the resistance of a piece of wire.

1

2 [2]

- (c) Fig. 3.2 shows a circuit used to power a small motor.

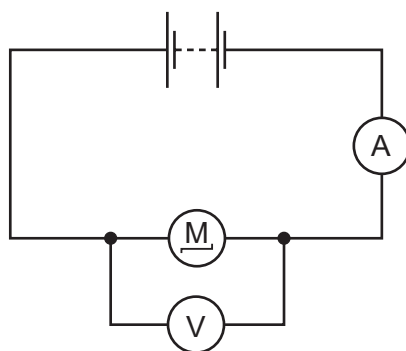


Fig. 3.2

The voltage across the motor is 3 V. The current through the motor is 0.6 A.

- (i) Calculate the power input to the motor.

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

formula

working

..... unit [2]

- (ii) The motor is able to lift a load of 40 N through 1.2 m in 36 seconds.

Calculate the power output of the motor.

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

formula

working

..... unit [3]

- (iii) Explain why there is a difference between your answers to (i) and (ii).

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

- (iv) Calculate the efficiency of the motor.

Show your working.

..... [2]

- 4 Soya beans are an important crop in Brazil. Soya beans can be used to make soya milk, which can be made into yoghurt.

(a) To make yoghurt, microorganisms are added to soya milk. The milk is then kept warm for several hours.

(i) State the type of microorganism that is added to milk to make yoghurt.

..... [1]

(ii) Explain why the milk is kept warm for several hours.

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

(b) Researchers in Brazil investigated whether adding sugar to the soya milk affected the yoghurt that was produced.

They added sugar to one batch of soya milk, but not to another. They measured the percentage of lactic acid in each batch of yoghurt at the start, and after 4, 5, 6 and 7 hours.

Fig. 4.1 shows their results.

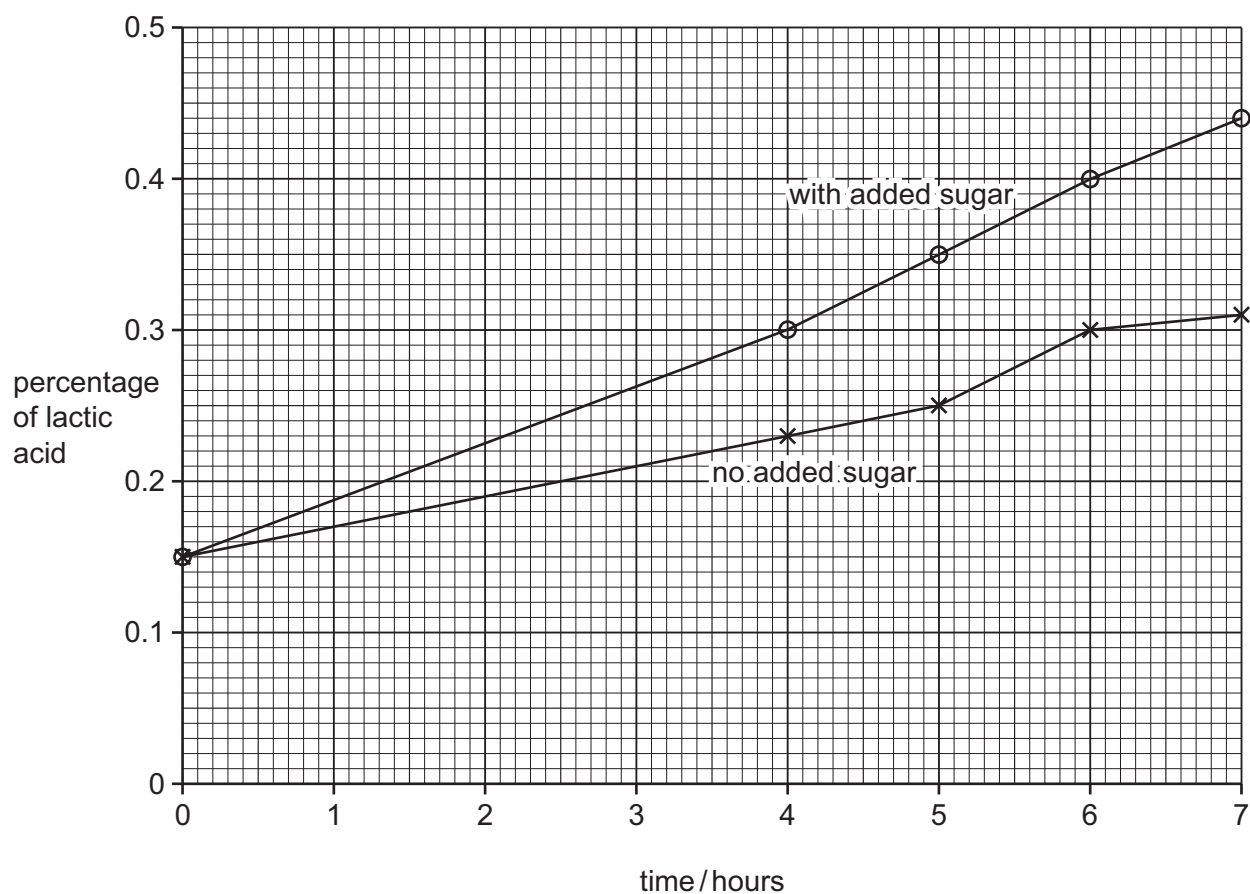


Fig. 4.1

- (i) Describe the change in lactic acid concentration during the fermentation of yoghurt with no added sugar.

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

- (ii) Compare the concentration of lactic acid when sugar is added with the concentration of lactic acid when no sugar is added.

State the difference and explain it.

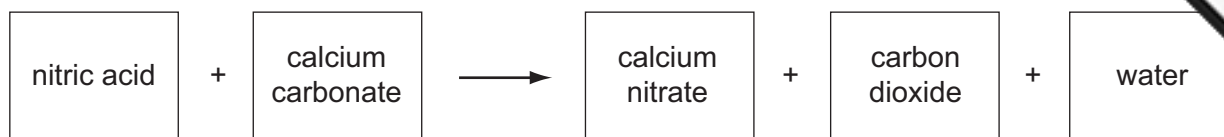
.....
.....
..... [2]

- (c) Large areas of rainforest have been cleared in Brazil, to provide more land for growing soya beans.

Explain how cutting down the rainforest can harm the environment.

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

5 Dilute nitric acid reacts with calcium carbonate according to the equation



- (a) Fig. 5.1 shows apparatus a student used to investigate the reaction between dilute nitric acid and excess calcium carbonate.

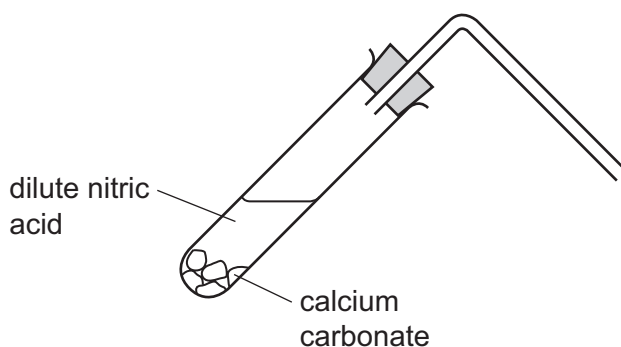


Fig. 5.1

Describe how the student could show that this reaction produces carbon dioxide. You may complete the diagram to help you answer this question.

.....

 [2]

- (b) A student carried out an investigation into the way that the rate of the reaction between calcium carbonate and nitric acid changed when he varied the concentration of the nitric acid.

Fig. 5.2 shows the apparatus the student used to measure the rate of reaction.

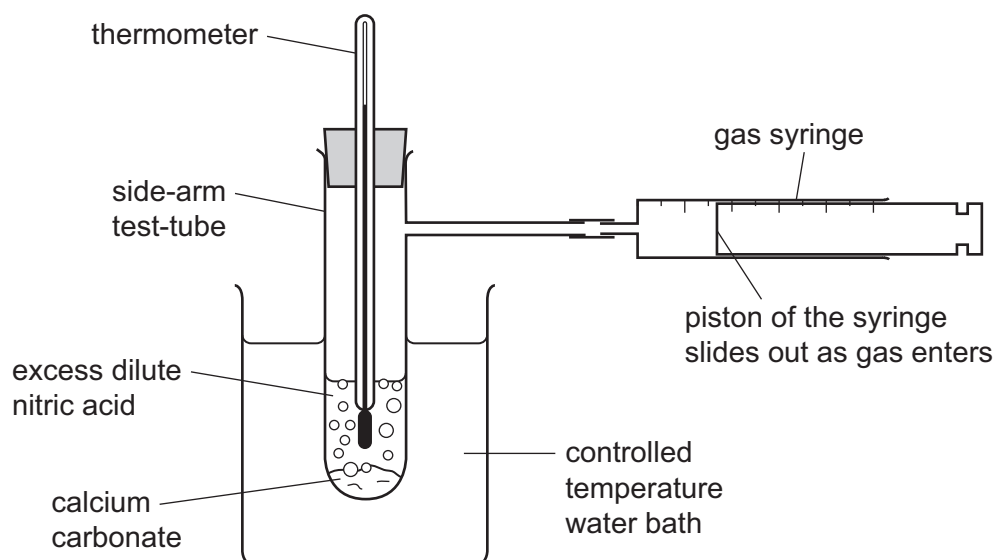


Fig. 5.2

The student measured the rate of reaction by finding the time it took for the gas to fill with gas.

The student measured the rate of reaction using five different concentrations of nitric acid. Fig. 5.3 shows the student's results as a graph of rate of reaction against acid concentration.

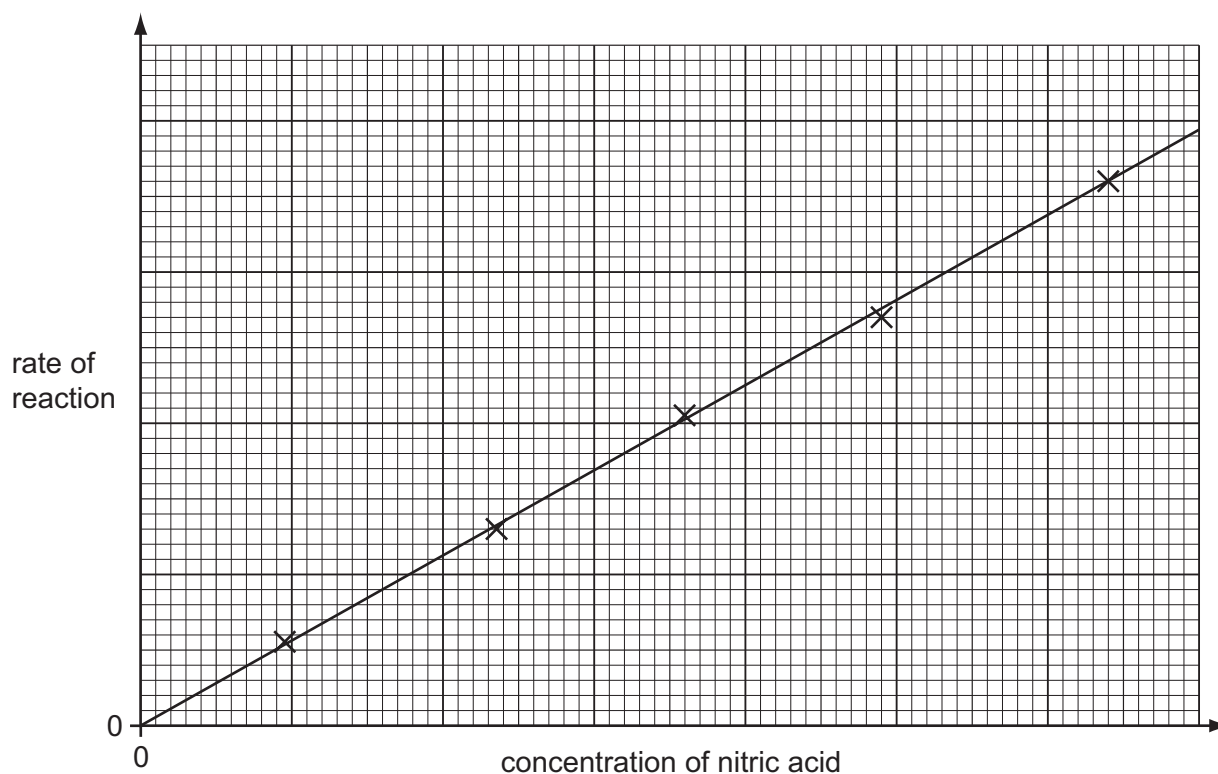


Fig. 5.3

- (i) Describe the relationship shown by the graph.

.....

 [2]

- (ii) Explain these results in terms of particle collisions.

.....

 [2]

- (iii) Explain why the temperature of the reacting mixture needs to be kept constant.

.....

 [2]

- 6 (a) (i) Fig. 6.1 gives information about the uses of different types of electromagnetic waves and their effects on living tissue.

Draw lines to link each electromagnetic wave with its effect on living tissue and its use. One has been completed as an example.

uses	type of radiation	effects on tissue
screening luggage	X-rays	activates sensitive cells in retina
security marking	microwave	kills cancerous cells
satellite communication	ultra violet	heats water in tissues
seeing	visible light	causes tanning of skin

Fig. 6.1

[4]

- (ii) State **one** property that is the same for all electromagnetic waves.

..... [1]

- (b) Fig. 6.2 shows a light ray entering an optical fibre.

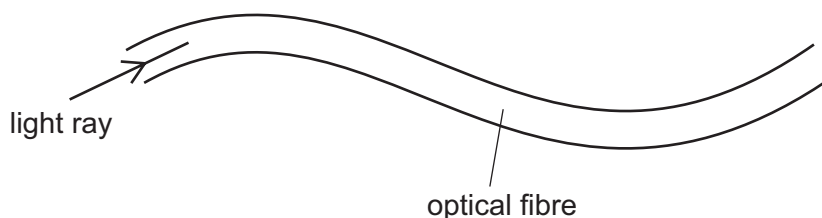


Fig. 6.2

The light ray travels all the way through the optical fibre.

Explain why the light ray is able to stay inside the optical fibre.

You may draw on the diagram if it helps your answer.

.....

 [2]

(c) Fig. 6.3 shows an observer's eye looking at an object in a mirror.

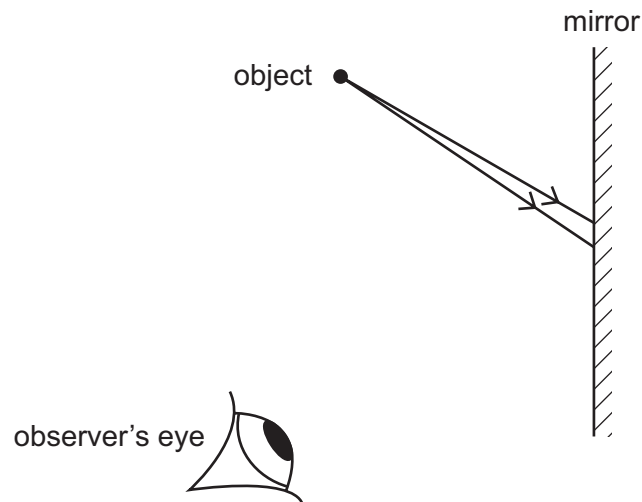


Fig. 6.3

- (i) On Fig. 6.3 complete the ray diagram to show how the two rays of light from the object enter the eye of the observer. [1]
- (ii) On Fig. 6.3 show how the observer sees rays of light which appear to come from the image behind the mirror. [2]

Label the position of the image with an **X**.

- 7 Fig. 7.1 shows the contents of the human thorax (chest).

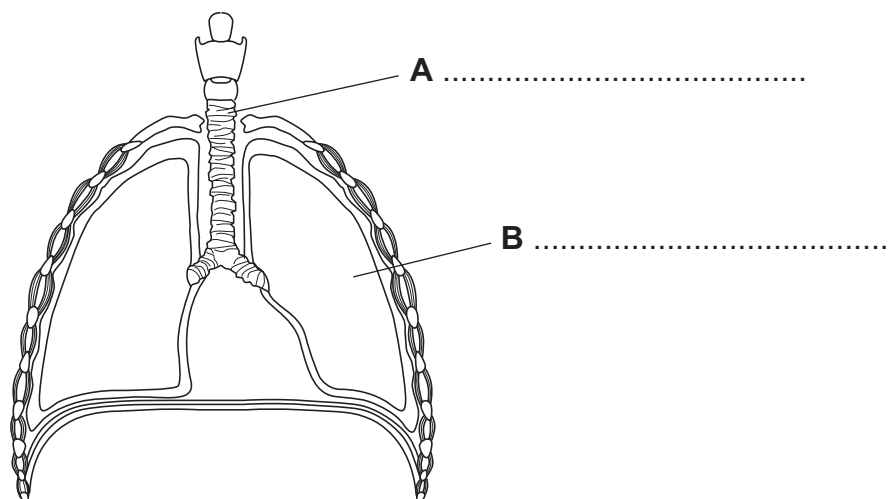


Fig. 7.1

- (a) On Fig. 7.1, name structures **A** and **B**. [2]

- (b) Oxygen diffuses into the blood from the alveoli inside the lungs.

- (i) Define the term *diffusion*.

.....

 [2]

- (ii) When a person is doing vigorous exercise, the concentration of carbon dioxide in the blood increases.

Explain why this happens.

.....

 [3]

Please turn over for Question 8.

- 8 Gasoline and diesel are liquid mixtures of hydrocarbons used as fuels.

Fig. 8.1 shows the structure of a typical molecule in gasoline.

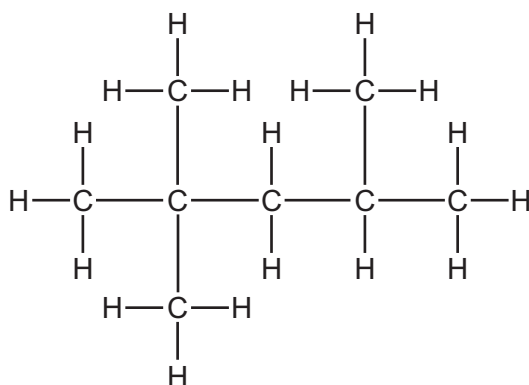


Fig. 8.1

- (a) (i) State the chemical formula of the molecule in Fig. 8.1.

..... [1]

- (ii) Explain briefly why a molecule like the one in Fig. 8.1 is classified as an *alkane* molecule.

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

- (b) Table 8.1 shows some properties of gasoline and diesel.

Table 8.1

fuel	temperature range over which the fuel boils / °C	viscosity (how easily the liquid flows)
gasoline	40 to 205	runny (flows easily)
diesel	250 to 350	less runny

Explain, in terms of molecules and forces, why the properties of these fuels are different.

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

- (c) (i) Describe what is observed when gaseous ethene is passed through a solution of bromine.

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

- (ii) Name the type of chemical reaction that occurs between bromine and ethene.

..... [1]

- (iii) Ethene, C_2H_4 , can be made to undergo **complete** combustion when it reacts with oxygen.

Write the balanced symbol equation for the complete combustion of ethene.

..... [3]

- 9 Fig. 9.1 shows a solar-powered golf cart used to carry golfers around a golf course.

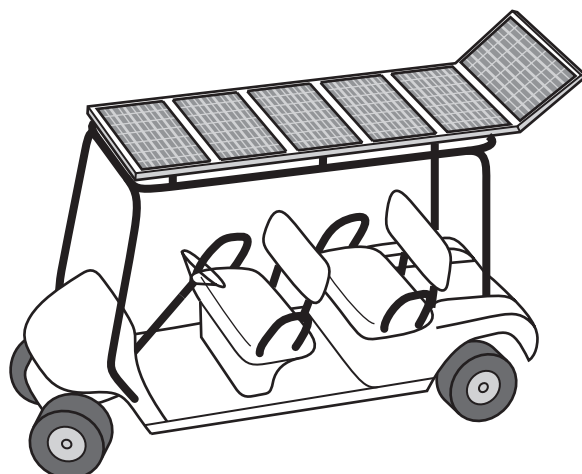


Fig. 9.1

- (a) As the cart moves around the course, the motion of the cart is measured.

Fig. 9.2 shows a distance/time graph for a small part of the journey lasting 60 seconds.

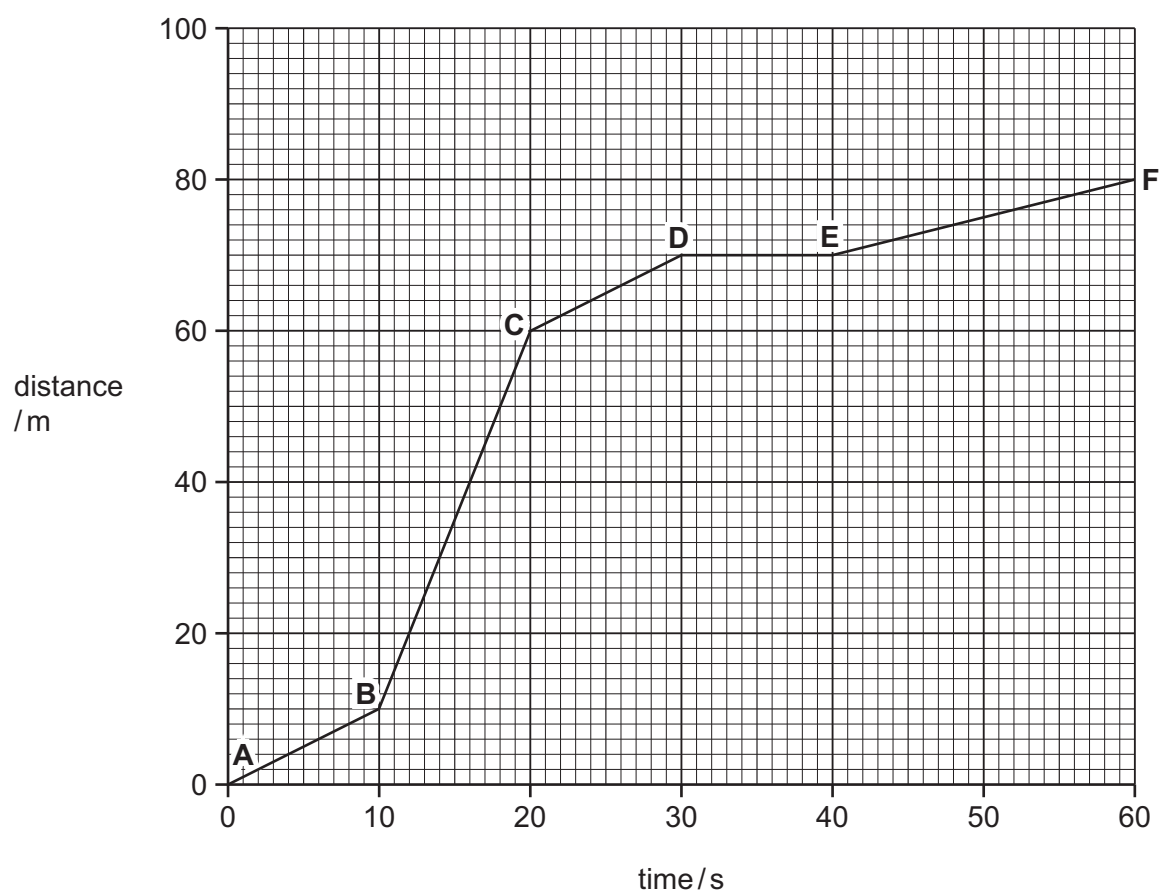


Fig. 9.2

- (i) The speed of the cart between **B** and **C** is 5 m/s.

The mass of the cart is 400 kg.

Calculate the kinetic energy of the cart between **B** and **C**.

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

formula

working

..... unit [2]

- (ii) Describe the motion of the cart between **D** and **E**.

..... [1]

- (b) Sometimes the golfer's hands begin to sweat.

Explain in terms of particles how sweating cools his hands by evaporation.

.....

 [2]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0

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

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.).