



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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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.

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



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

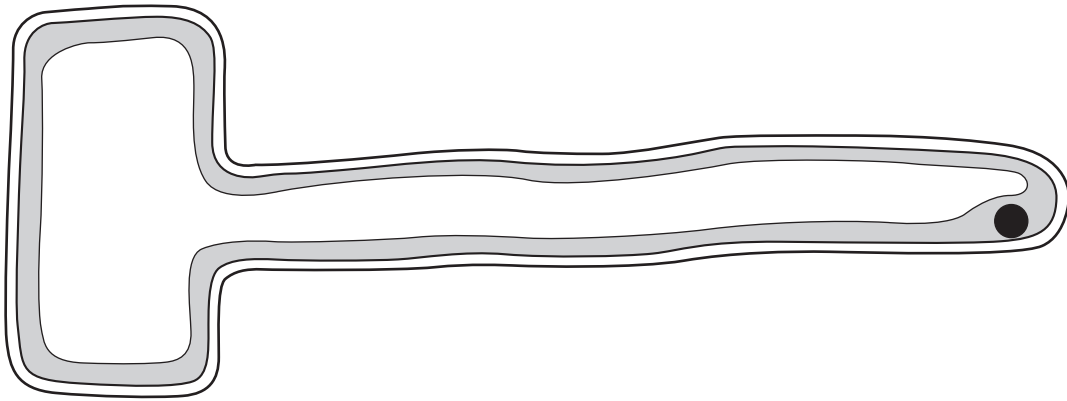


Fig. 1.1

(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.

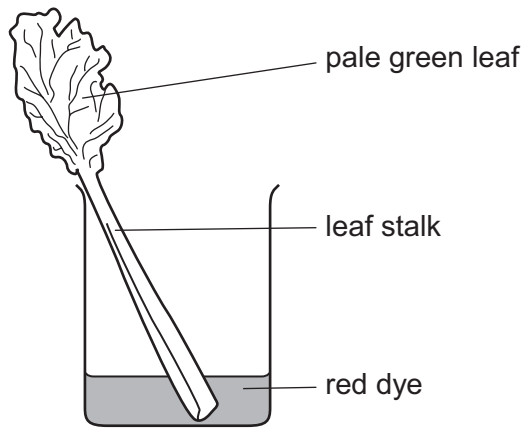


Fig. 1.2

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.

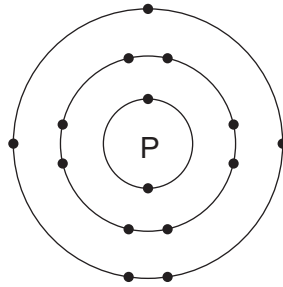


Fig. 2.1

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.

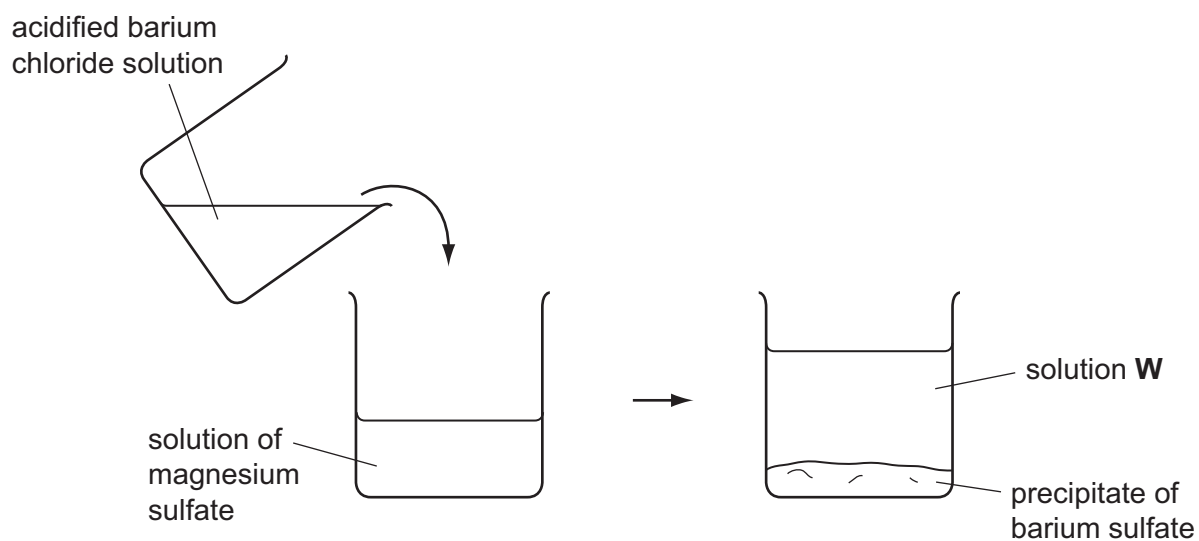
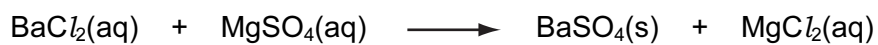


Fig. 2.2

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, $\text{H}_2\text{O}(\text{g})$.

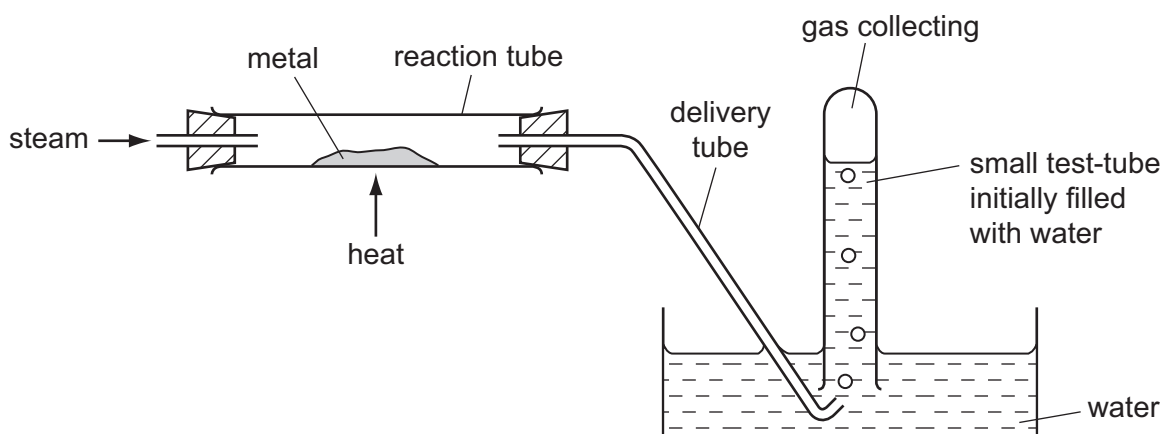


Fig. 2.3

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.

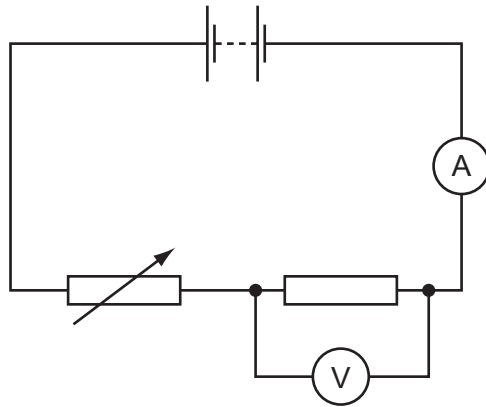


Fig. 3.1

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.

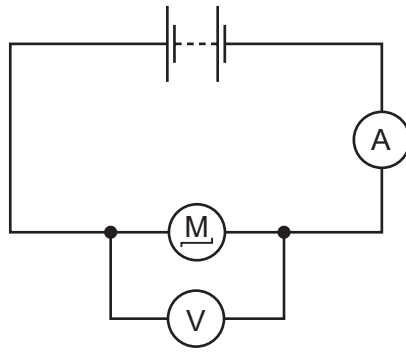


Fig. 3.2

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.

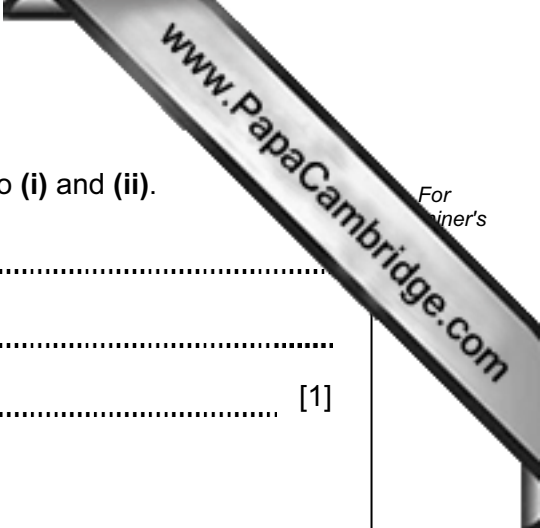
Calculate the power output of the motor.

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.

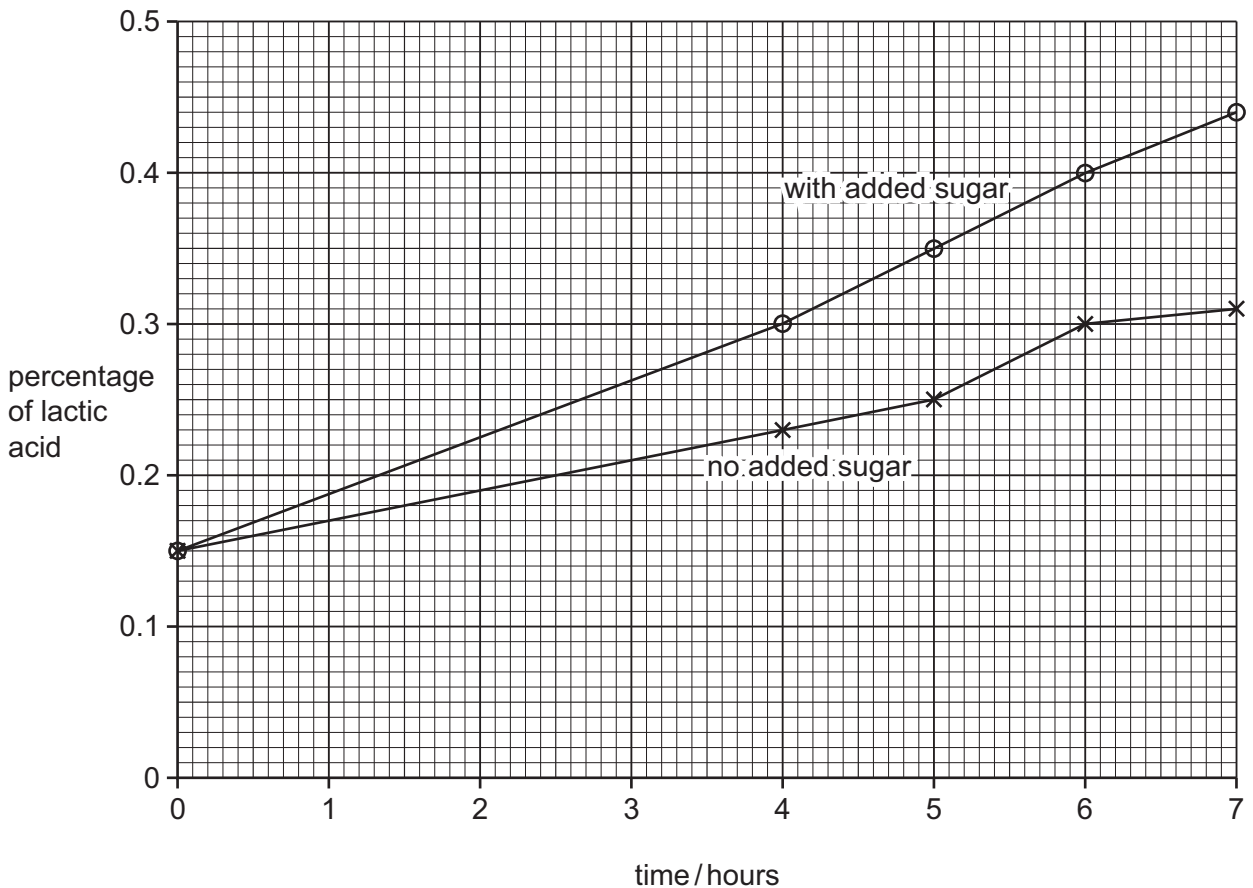
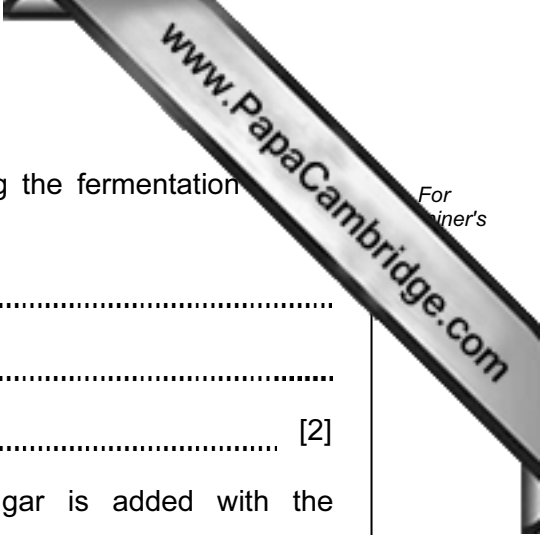


Fig. 4.1



(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.

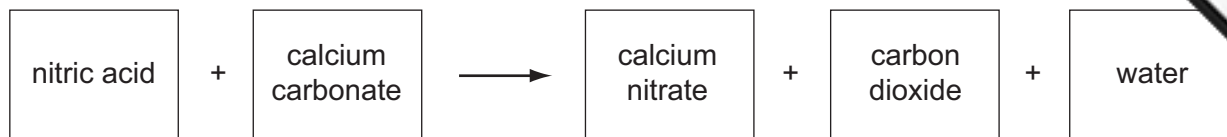
.....
.....
..... [2]

(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.

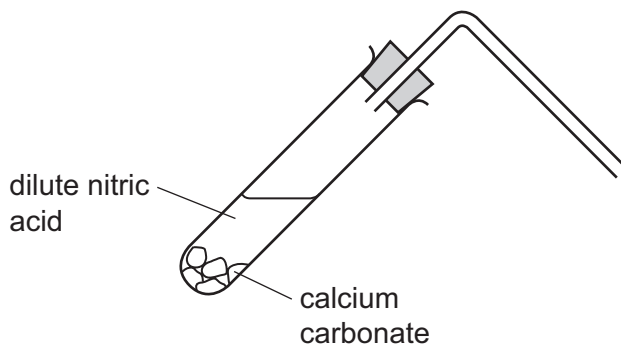


Fig. 5.1

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.

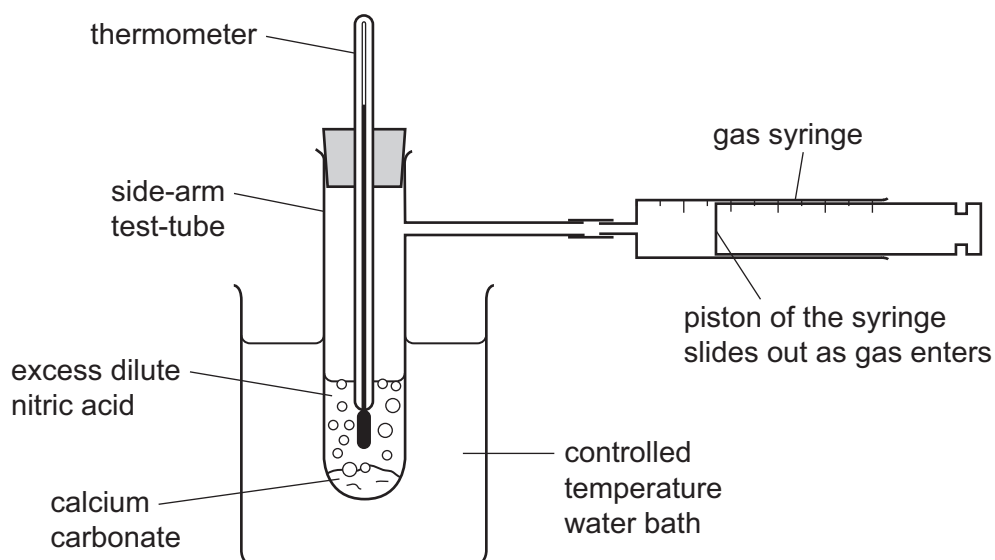


Fig. 5.2

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.

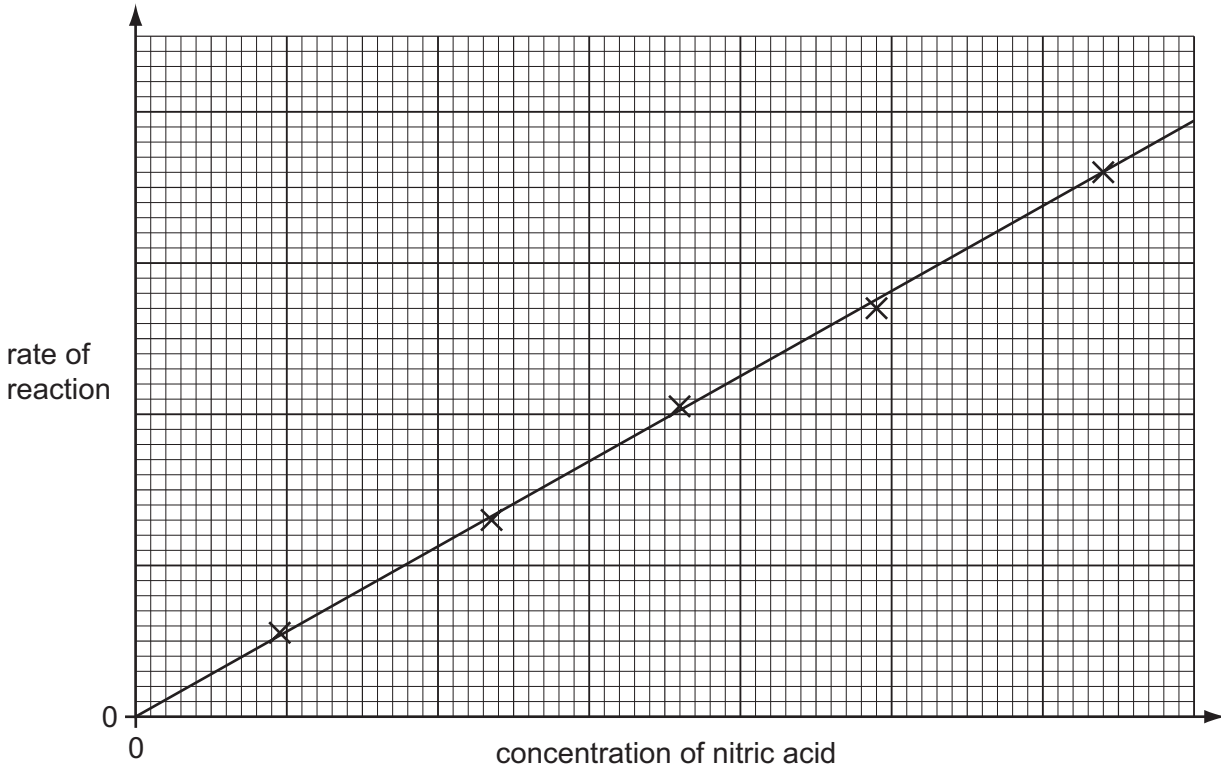


Fig. 5.3

(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.

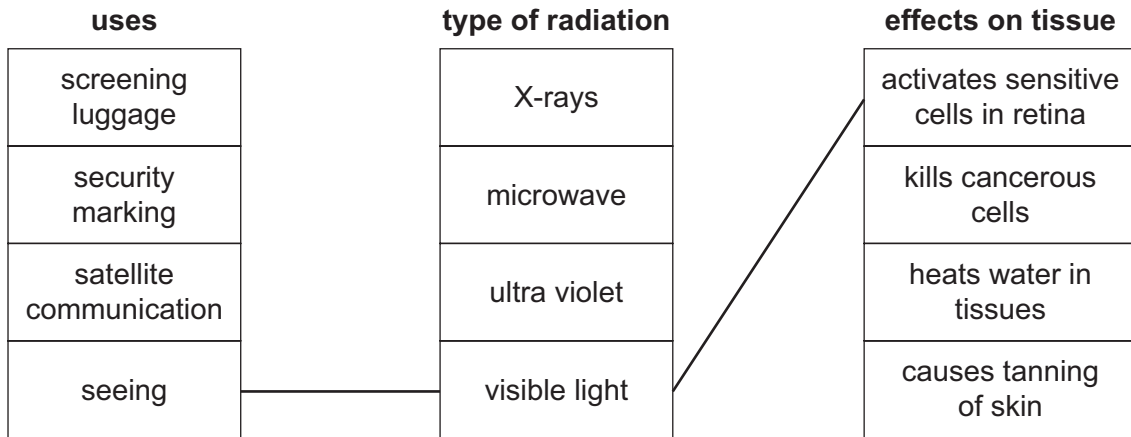


Fig. 6.1

[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.

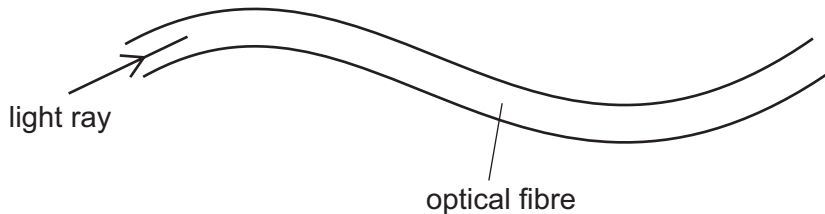


Fig. 6.2

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.

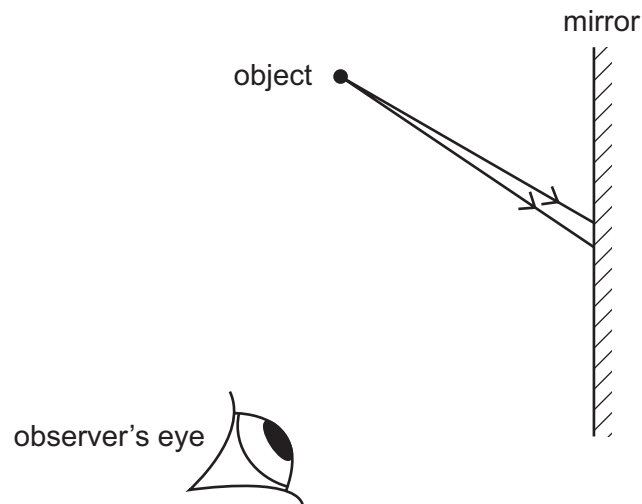


Fig. 6.3

- (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).

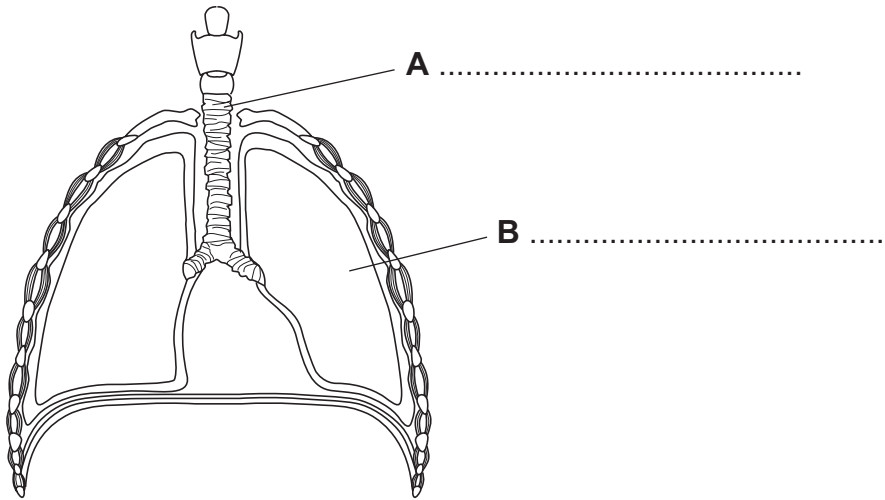


Fig. 7.1

(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.

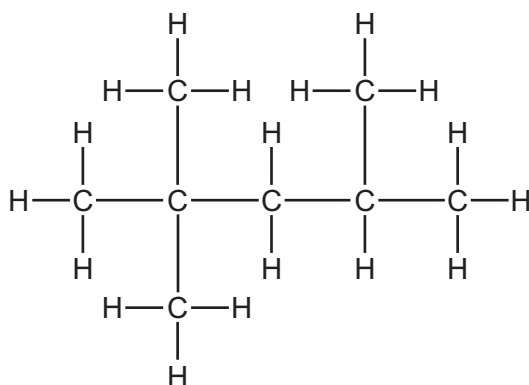


Fig. 8.1

- (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.

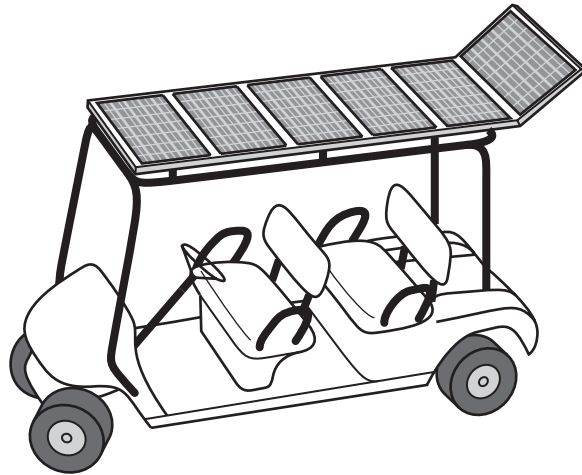


Fig. 9.1

- (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.

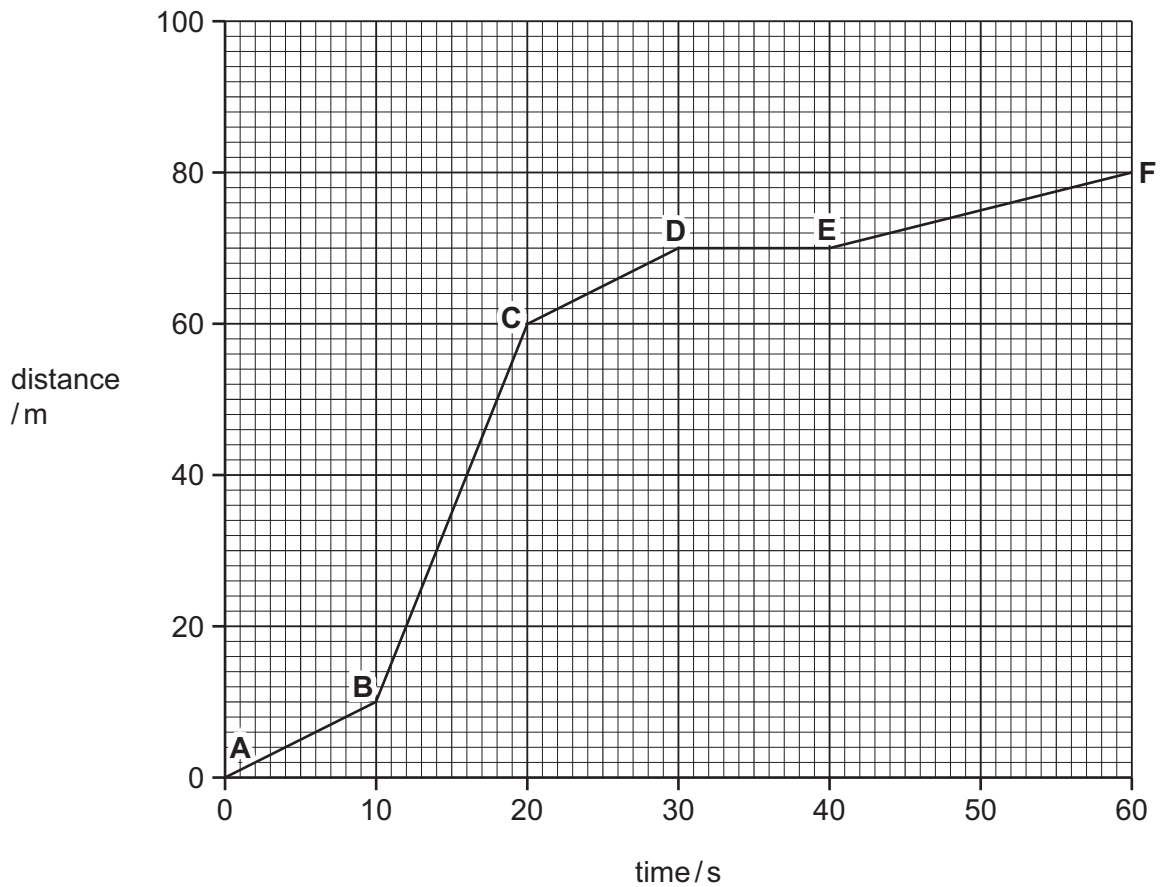


Fig. 9.2

(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						
		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		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		65 Zn Zinc 30	64 Cu Copper 29	59 Ni Nickel 28	59 Co Cobalt 27	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	122 Sb Antimony 51	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56		204 Tl Thallium 81	201 Hg Mercury 80	197 Au Gold 79	195 Pt Platinum 78	192 Ir Iridium 77	190 Os Osmium 76	186 Re Rhenium 75	184 W Tungsten 74	181 Ta Tantalum 73	178 Hf Hafnium 72	209 Po Polonium 84
226 Fr Francium 87	226 Ra Radium 88		207 Pb Lead 82	204 Tl Thallium 81	197 Au Gold 79	195 Pt Platinum 78	192 Ir Iridium 77	190 Os Osmium 76	186 Re Rhenium 75	184 W Tungsten 74	181 Ta Tantalum 73	178 Hf Hafnium 72	209 Po Polonium 84
			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	137 Ba Barium 56	133 Cs Caesium 55	175 Lu Lutetium 71
			169 Tm Thulium 69	167 Er Erbium 68	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	175 Lu Lutetium 71
			103 Lr Lawrencium 103	100 Fm Fermium 100	99 Es Einsteinium 99	97 Bk Berkelium 97	96 Cm Curium 96	95 Am Americium 95	94 Pu Plutonium 94	93 Np Neptunium 93	91 Pa Protactinium 91	90 Th Thorium 90	103 Lr Lawrencium 103

*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.).

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