UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8316460039

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.

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

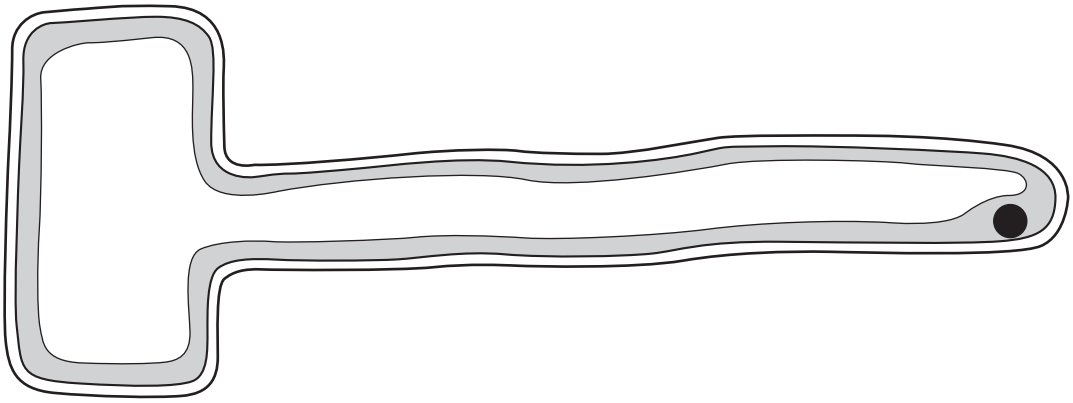

Fig. 1.1

(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.

.....

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..... [3]

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

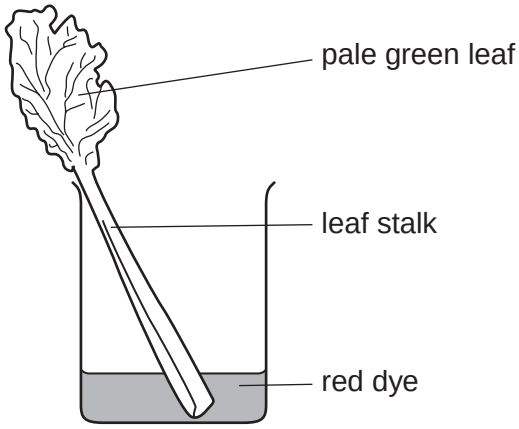

Fig. 1.2

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]

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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]

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

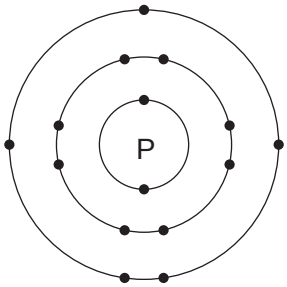

Fig. 2.1

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]

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

Fig. 2.2 shows the procedure followed.

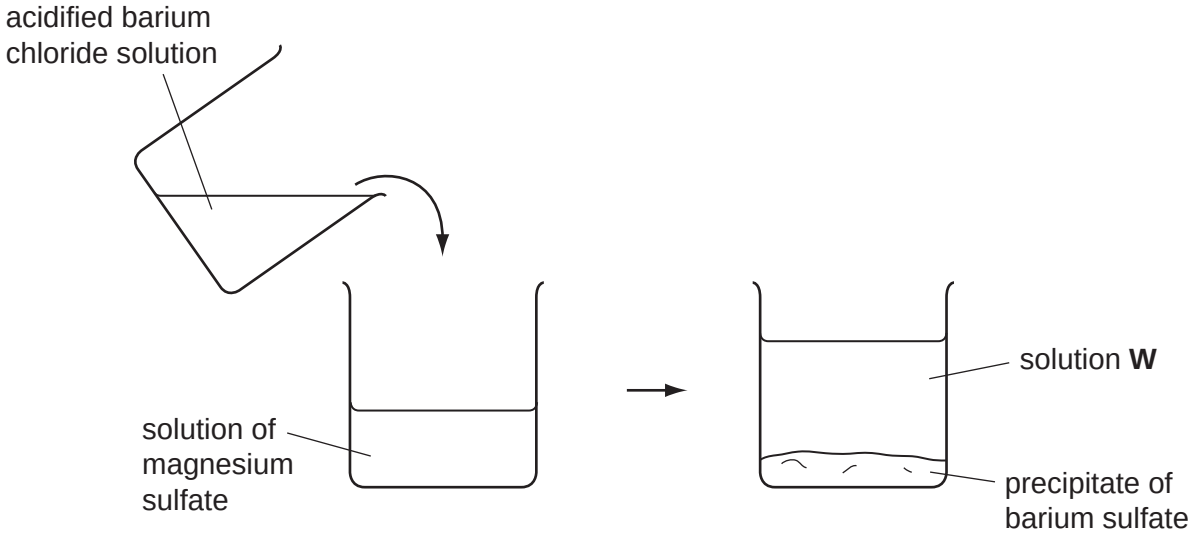

Fig. 2.2

A white precipitate of barium sulfate was produced.

The chemical equation for the reaction is

$$BaCl_2(aq) + MgSO_4(aq) \longrightarrow BaSO_4(s) + MgCl_2(aq)$$

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

1 .....

2 .....

3 ..... [2]

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(d) Fig. 2.3 shows apparatus used by the student to investigate the reaction between different metals and steam, $H_2O(g)$.

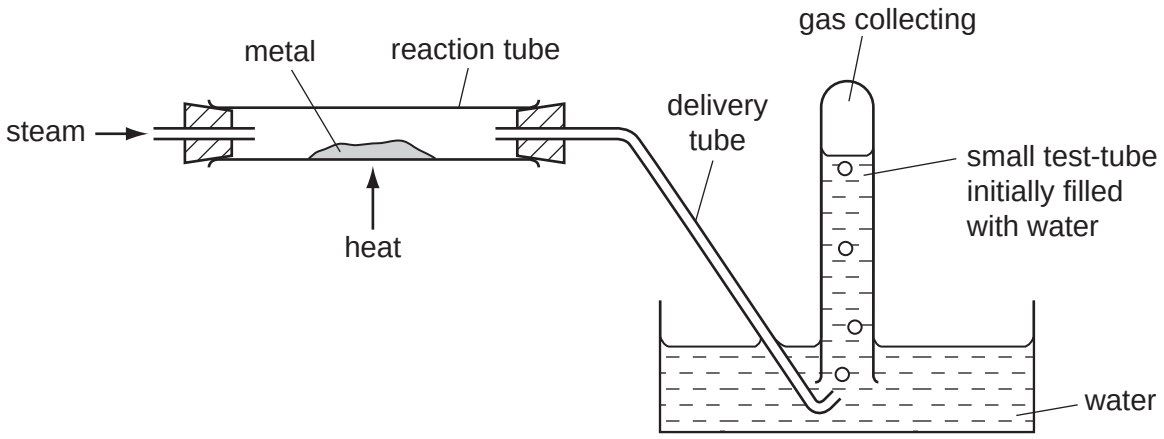

Fig. 2.3

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]

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

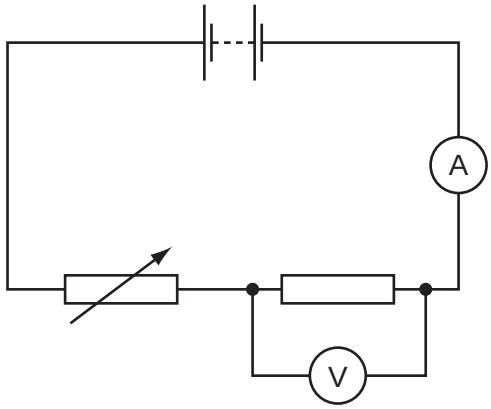

Fig. 3.1

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]

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

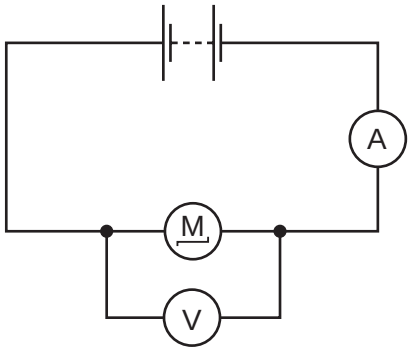

Fig. 3.2

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]

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

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.....

.....

..... [1]

(iv) Calculate the efficiency of the motor.

Show your working.

..... [2]

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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.

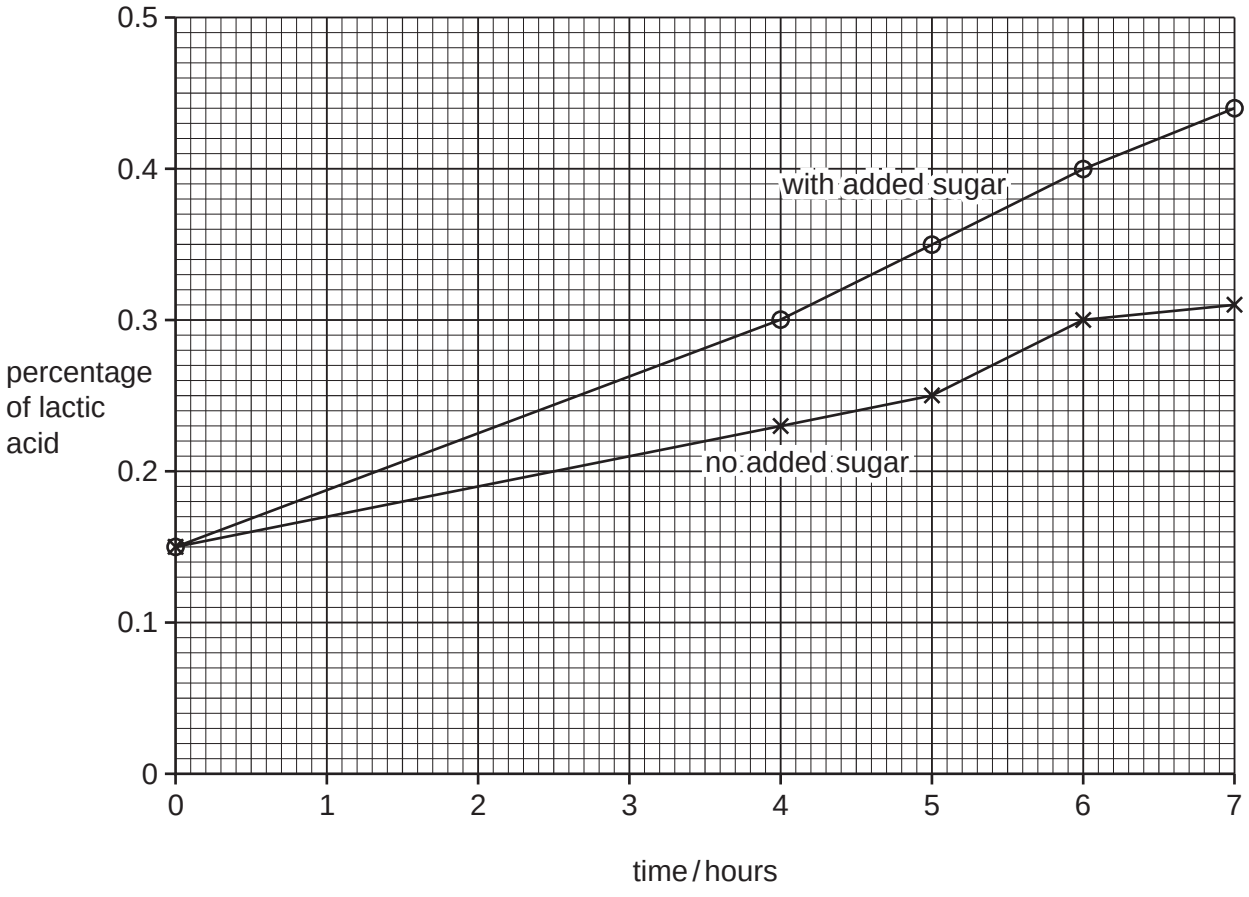

Fig. 4.1

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

.....

.....

..... [2]

(ii) Compare the concentration of lactic acid when sugar is added with the concentration of lactic acid when 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.

.....

.....

.....

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.....

..... [3]

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

nitric acid	+	calcium carbonate	→	calcium nitrate	+	carbon dioxide	+	water

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

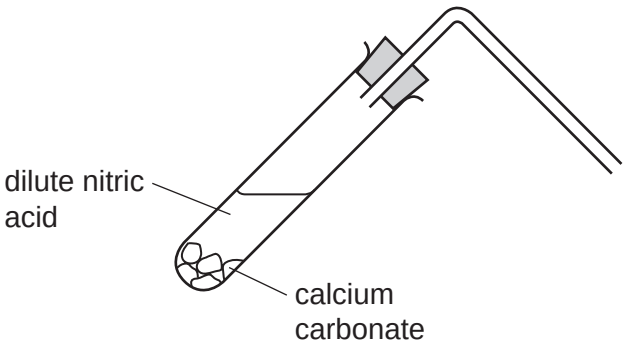

Fig. 5.1

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.

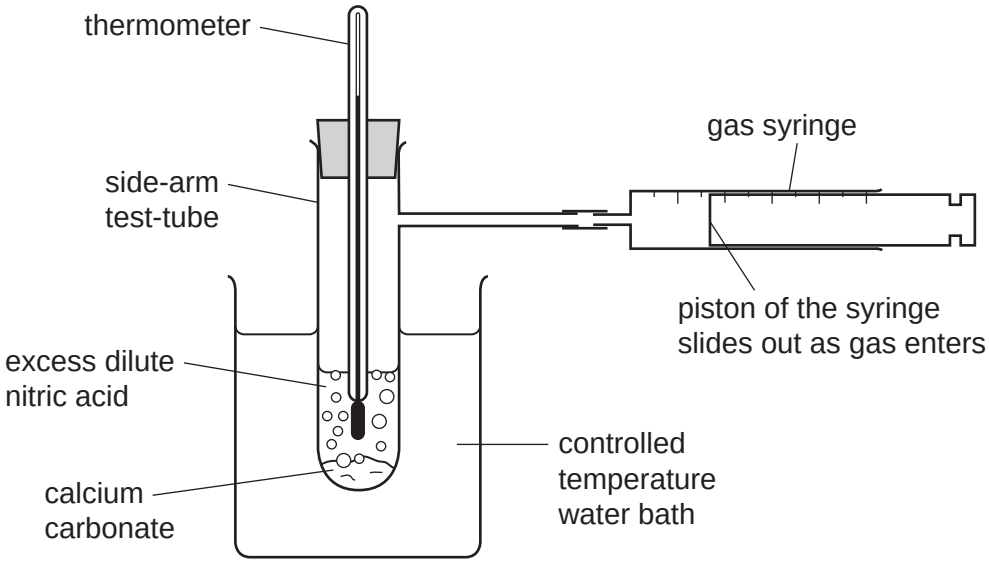

Fig. 5.2

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The student measured the rate of reaction by finding the time it took for the gas syringe 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.

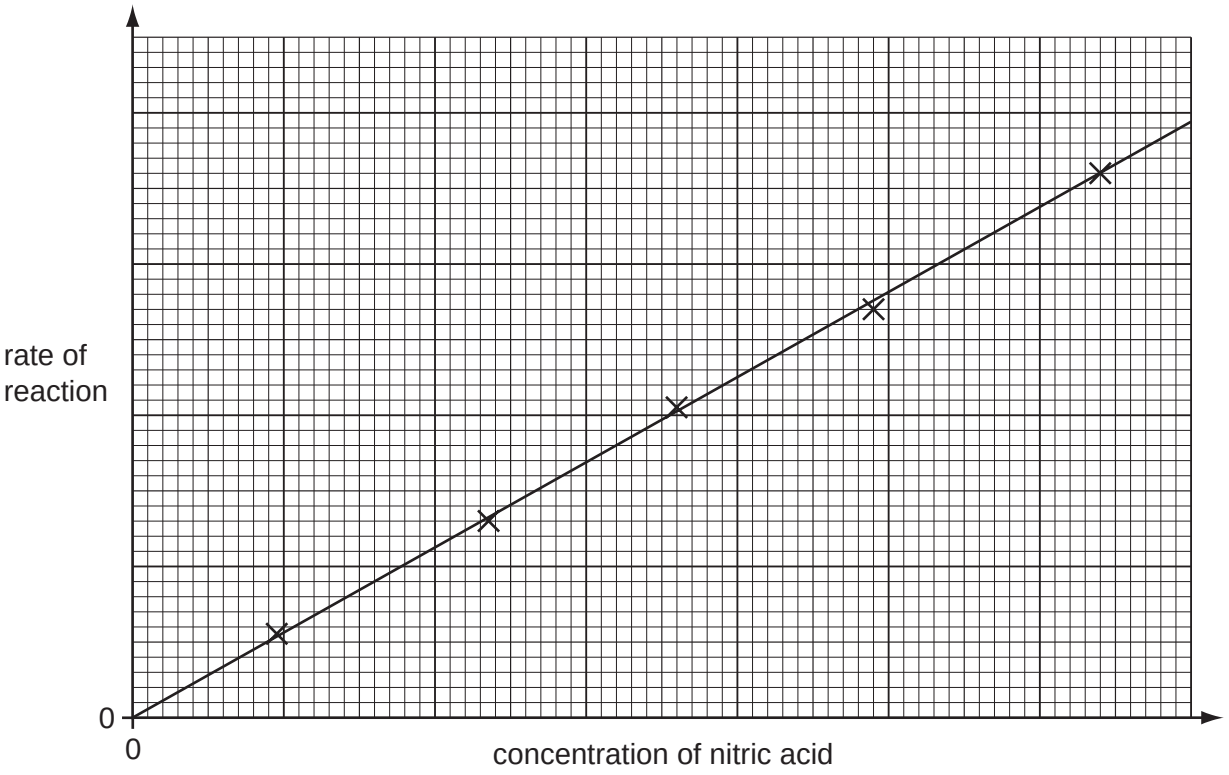

Fig. 5.3

(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]

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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.

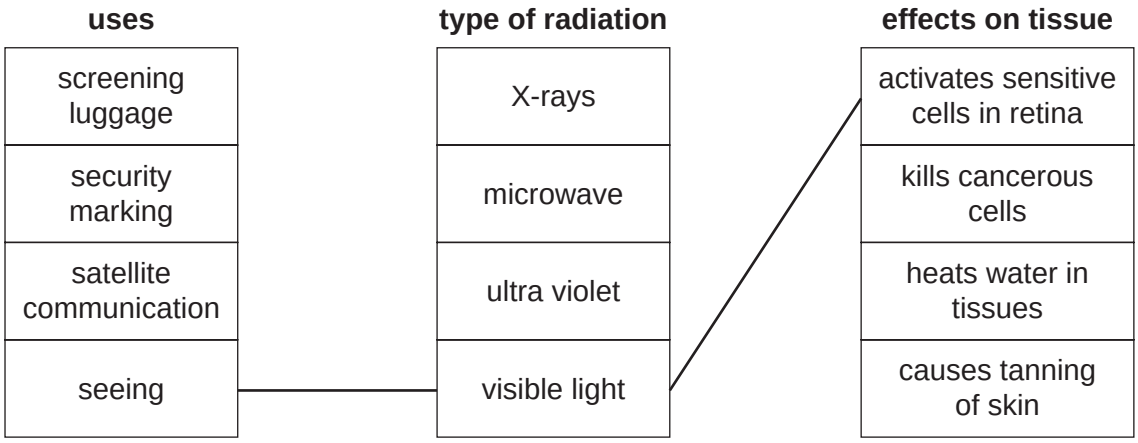

Fig. 6.1

[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.

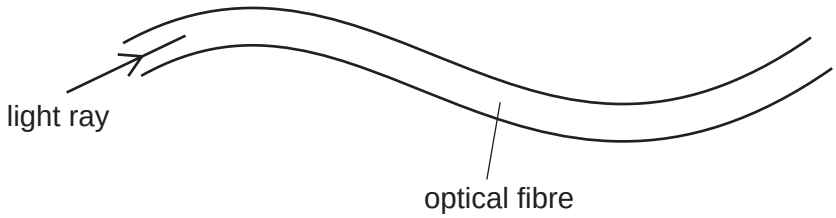

Fig. 6.2

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.

.....

.....

.....

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[2]

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

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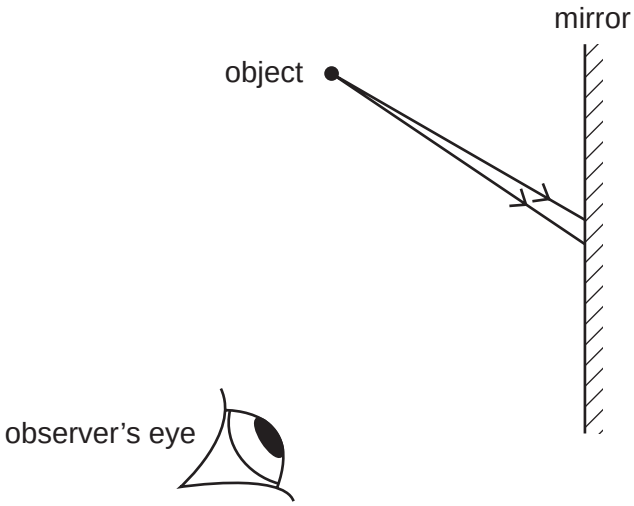

Fig. 6.3

(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.

Label the position of the image with an **X**. [2]

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

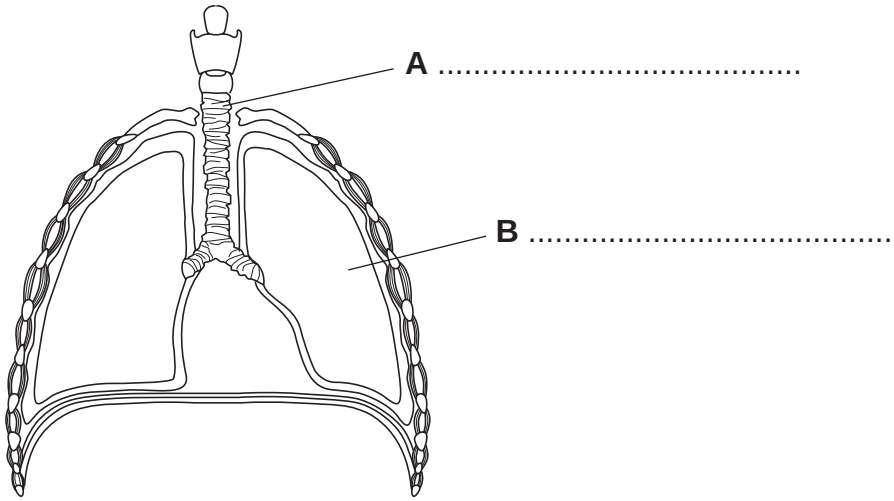

Fig. 7.1

(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.

.....

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..... [3]

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Please turn over for Question 8.

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

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

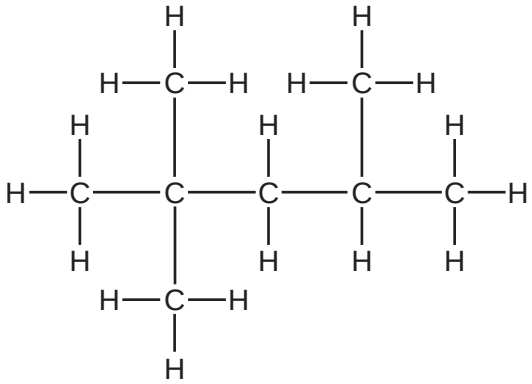

Fig. 8.1

(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]

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(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]

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

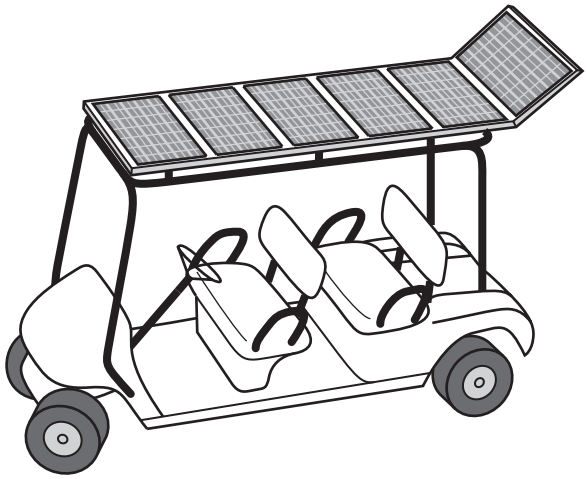

Fig. 9.1

(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.

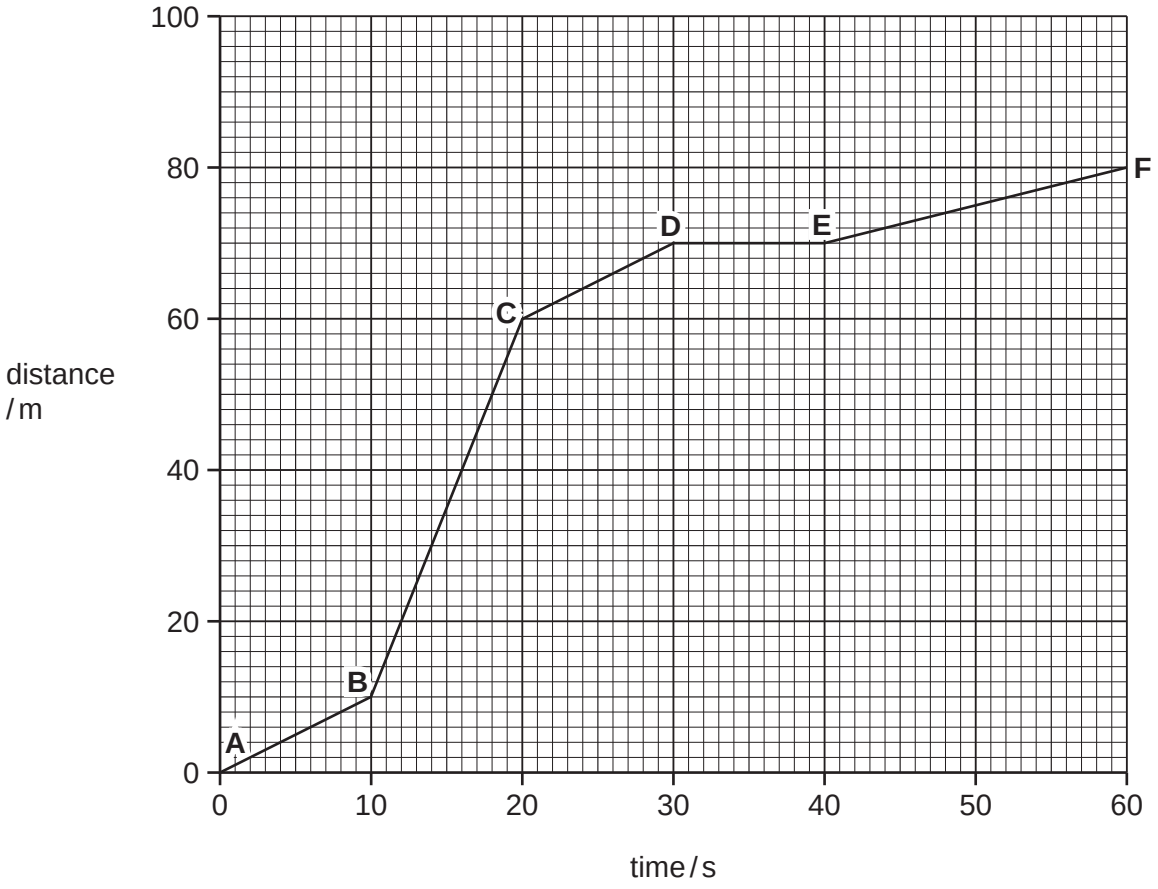

Fig. 9.2

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(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]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**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 †															

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

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

Key

a **X** b

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.).

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