Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CO-ORDINATED SCIENCES **0654/23**

Paper 2 (Core) **October/November 2015**

2 hours

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 an HB pencil for any diagrams, graphs, tables or rough working.
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 32.

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 **30** printed pages and **2** blank pages.

DC (AC/CGW) 102950/4

CAMBRIDGE International Examinations

[Turn over

1 Table 1.1 shows the composition of 100 cm^3 cow's milk and goat's milk.

Table 1.1

amount per 100 cm^3	cow's milk	goat's milk
energy (kJ)	290	320
fat (g)	3.4	3.9
protein (g)	3.4	3.5
carbohydrate (g)	4.9	4.7
calcium (mg)	110	120
iron (mg)	0.020	0.010
vitamin C (mg)	1.50	1.48
vitamin D (mg)	0.001	0.001

(a) Using the information in Table 1.1,

(i) name **two** substances that are present in goat's milk at higher concentrations than in cow's milk,

1 .....

2 ..... [2]

(ii) name **one** mineral ion that is present in cow's milk at higher concentration than in goat's milk,

..... [1]

(iii) suggest why goat's milk provides more energy per 100 cm^3 than cow's milk.

.....

..... [1]

(b) (i) A healthy adult has to consume 90 mg of vitamin C per day to meet their dietary vitamin C requirement. An adult could get all their daily vitamin C requirement from drinking cow's milk.

Use the information in Table 1.1 to calculate how much cow's milk would be needed.

..... mg vitamin C is present in 100 cm^3 cow's milk

so, ... mg vitamin C is present in 1 litre (1000 cm^3) milk

so, 90 mg vitamin C is present in ..... litres of milk.

milk required = ... litres per day
[2]

(ii) Use your answer to state whether cow's milk is a good dietary source of vitamin C.

Explain your answer.

.....

..... [1]

(iii) State the deficiency symptoms that result from a diet that does not contain enough vitamin C.

.....

.....

..... [2]

(c) (i) Milk contains no dietary fibre (roughage).

State the importance of fibre in the diet.

.....

..... [1]

(ii) Name a food that is a good source of dietary fibre.

..... [1]

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2 Fig. 2.1 shows apparatus a student uses to investigate the reaction between dilute hydrochloric acid and sodium hydroxide solution.

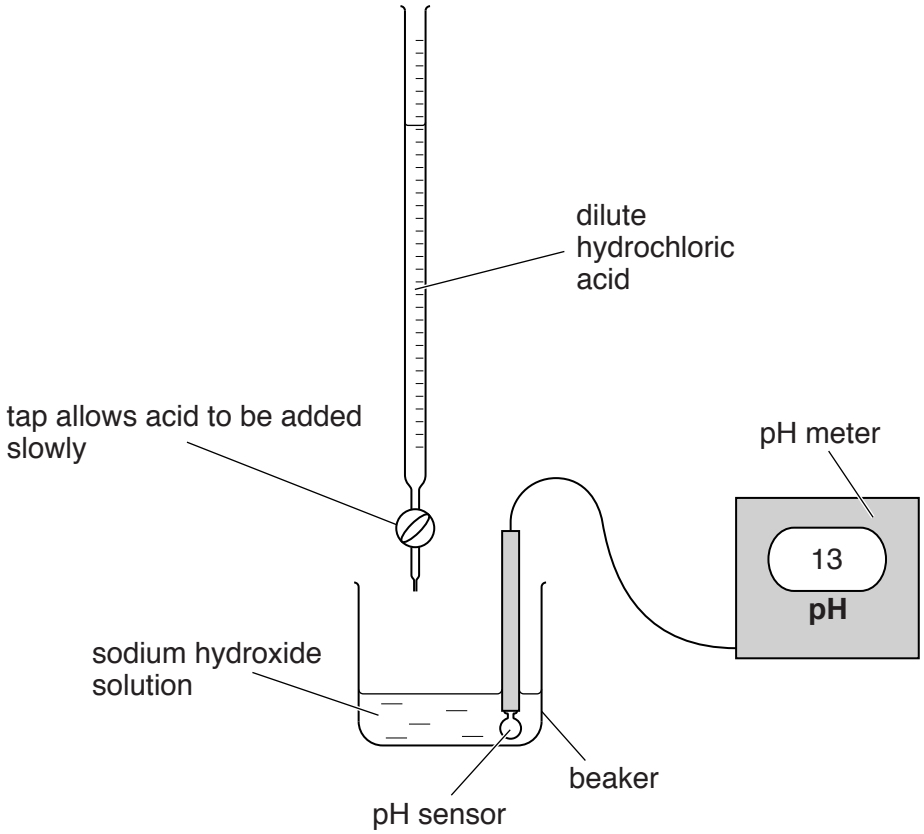

Fig. 2.1

(a) (i) Suggest **one** advantage of using an electronic pH meter to measure pH rather than using a coloured indicator such as litmus solution.

.....

..... [1]

(ii) Name the type of chemical reaction which occurs between dilute acids and alkalis (bases).

..... [1]

(iii) Complete the general word equation for the reaction between acids and bases.

acid	+	base	→		+	

[2]

(b) The student places 20.0 cm^3 of sodium hydroxide solution into the beaker.

He then adds hydrochloric acid carefully, in stages, and records the pH of the mixture after each addition.

Fig. 2.2 shows a graph of the results.

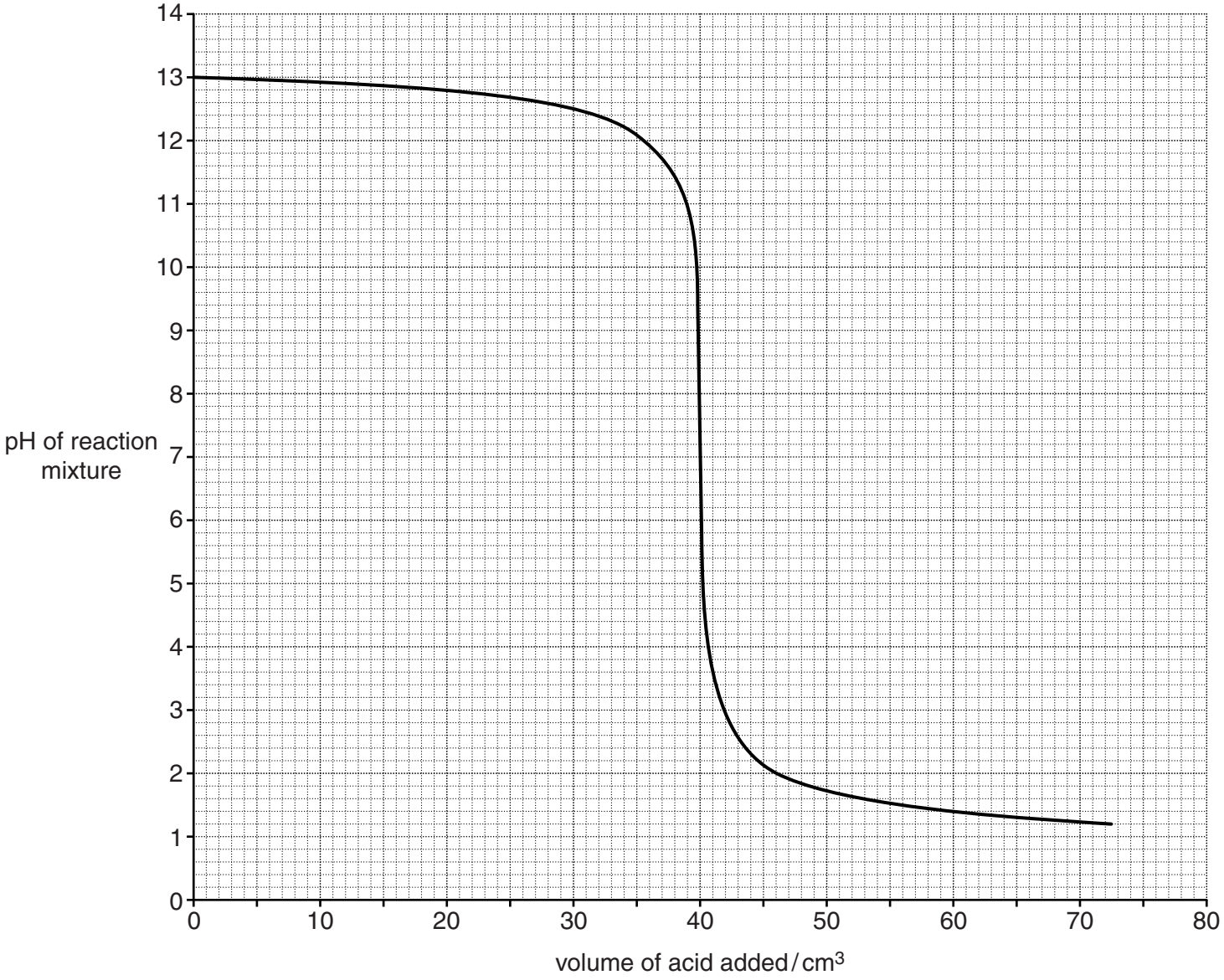

Fig. 2.2

(i) Describe how the pH of the mixture changes

- as the first 35 cm^3 of acid are added, ...

.....

- as the next 10 cm^3 of acid are added. .....

.....

[2]

(ii) Use the graph to find the volume of acid that reacted with the alkali to produce an exactly neutral solution.

Show your working on the graph.

volume of acid = ... cm^3 [2]

(iii) Explain how the student can use his results to produce an exactly neutral mixture using the same acid and alkali as he used in his first experiment.

.....

.....

..... [2]

(iv) Predict what would be observed if the student heated the neutral mixture he makes in **(b)(iii)** until the water in the mixture has evaporated.

.....

..... [1]

[Turn over

3 **(a)** A boy, sitting on a beach, is exposed to many forms of electromagnetic radiation.

(i) Fig. 3.1 shows an incomplete electromagnetic spectrum.

On Fig. 3.1 write the names infra-red, radio waves, ultraviolet and X-rays in their correct positions.

gamma radiation			visible light		microwaves	

Fig. 3.1 [2]

(ii) The boy is using his mobile phone (cell phone). Name the part of the electromagnetic spectrum used for mobile phone communications.

..... [1]

(b) Someone has left some broken glass on the beach. The curved glass acts like a lens focussing the Sun's rays onto a piece of paper and setting it alight.

Fig. 3.2 shows a lens focussing the rays of light. Fig. 3.2 is drawn to actual size.

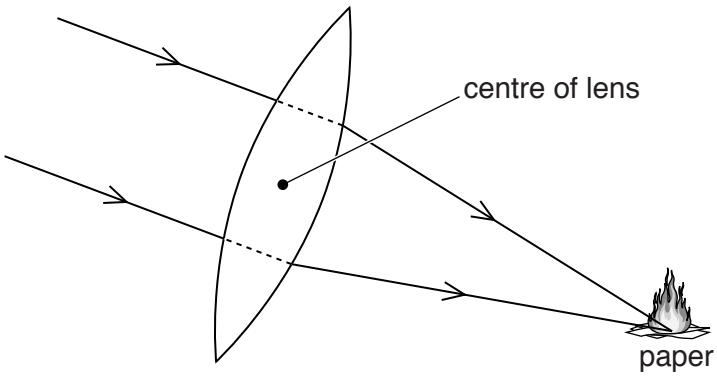

Fig. 3.2

(i) On Fig. 3.2 use a label line and the letter **P** to label the principal focus of the lens. [1]

(ii) Measure, in millimetres, the focal length of the lens in Fig. 3.2.

focal length = ... mm [1]

(c) A scuba diver is swimming in the sea near the beach. Fig. 3.3 shows a scuba diver.

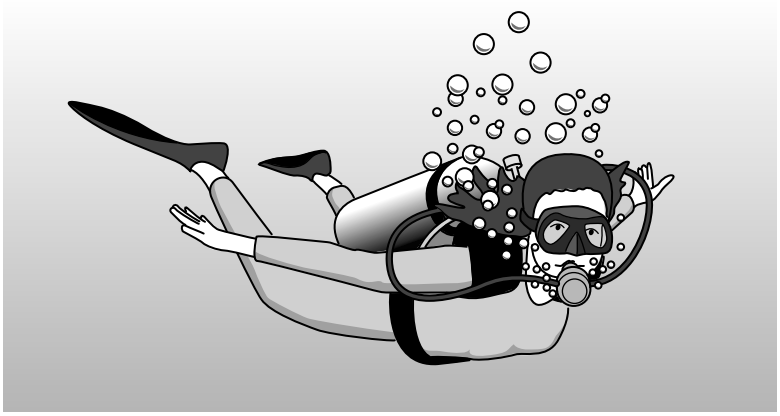

Fig. 3.3

The scuba diver can breathe underwater because she carries a cylinder of air on her back. Air is a mixture of gases. The molecules of gas in the cylinder move randomly.

Describe how the gas molecules exert a pressure on the wall of the cylinder.

.....

.....

.....

..... [2]

(d) Fig. 3.4 shows a penguin walking on a beach.

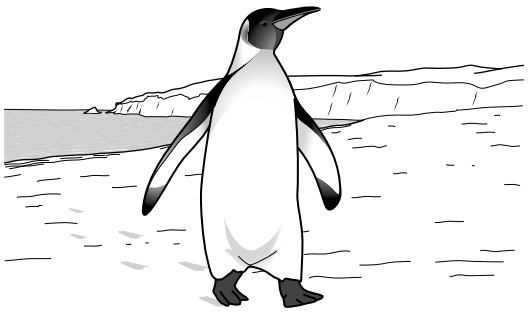

Fig. 3.4

The boy wants to calculate the pressure exerted by the penguin through its feet onto the beach.

State the **two** quantities which the boy needs to know to calculate the pressure.

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

(e) Fig. 3.5 shows three different ways in which particles may be arranged in substances.

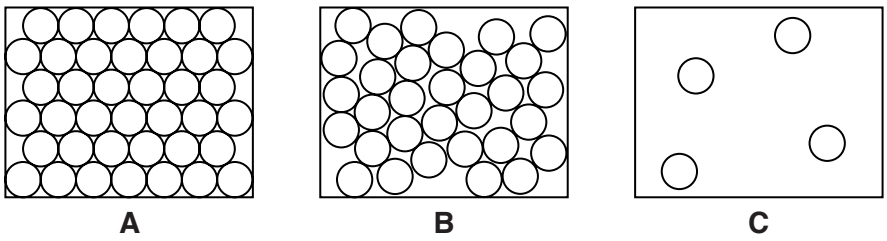

Fig. 3.5

Water in the sea is a liquid.

State which diagram from Fig. 3.5 best represents the way particles are arranged in liquid water.

Explain your answer.

diagram .....

explanation .....

..... [1]

4 Magnesium is a metal found in Group II of the Periodic Table.

(a) When burning magnesium is placed into a gas jar filled with carbon dioxide, it continues to burn as shown in Fig. 4.1.

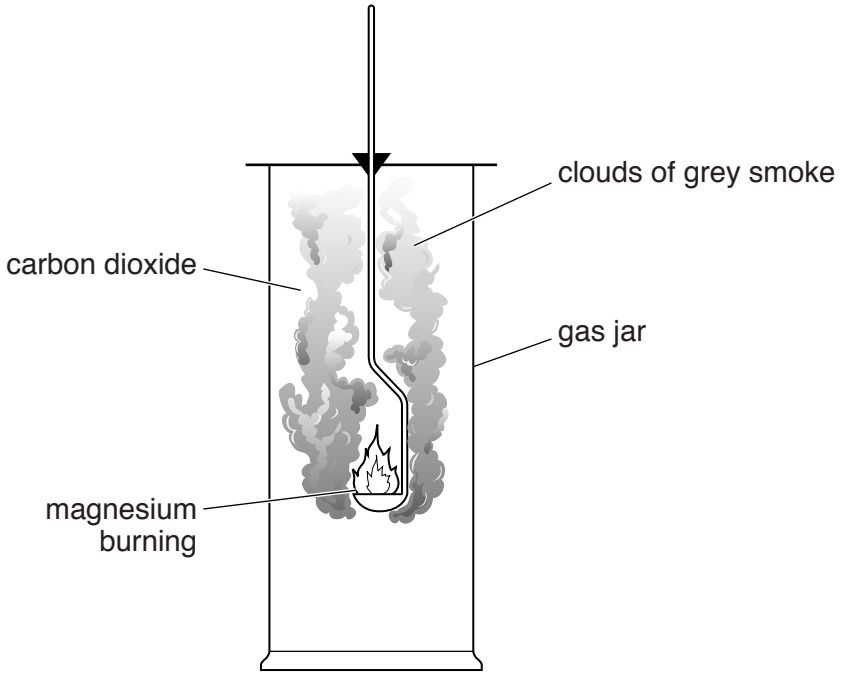

Fig. 4.1

The clouds of grey smoke formed in this reaction are a mixture of magnesium oxide and carbon.

(i) Construct the word equation for the reaction between magnesium and carbon dioxide.

[ ] + [ ] → [ ] + [ ]

[1]

(ii) Explain why the reaction in **(a)(i)** can be described as reduction and oxidation (redox).

.....

.....

..... [2]

(b) Magnesium is produced by the electrolysis of magnesium chloride.

Fig. 4.2 shows a simplified diagram of the process.

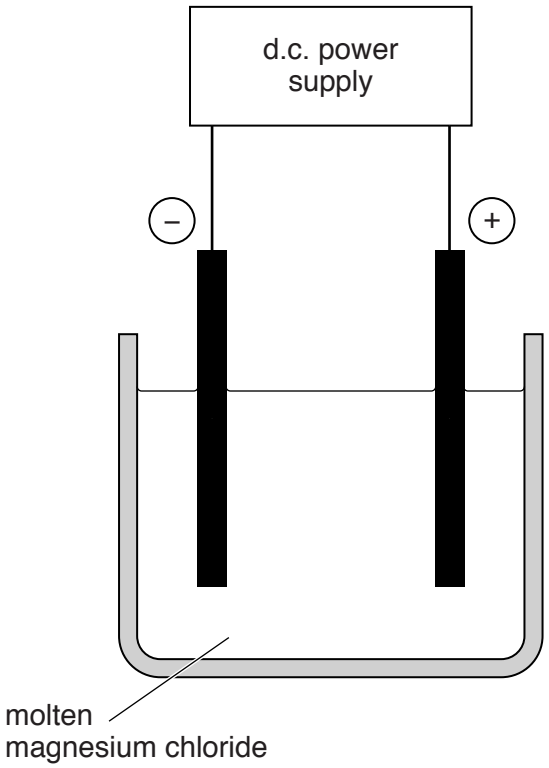

Fig. 4.2

(i) On Fig. 4.2 label the anode. [1]

(ii) Electrolysis of magnesium chloride separates the elements that are bonded together.

Magnesium is formed at the cathode.

State the name and chemical formula of the substance produced at the anode.

name .....

formula ..... [2]

(c) Lead is less reactive than magnesium.

Lead can be separated from lead oxide by heating it with substance **Z**.

Fig. 4.3 shows a drop of limewater suspended on a glass rod held above a heated mixture of lead oxide and substance **Z**.

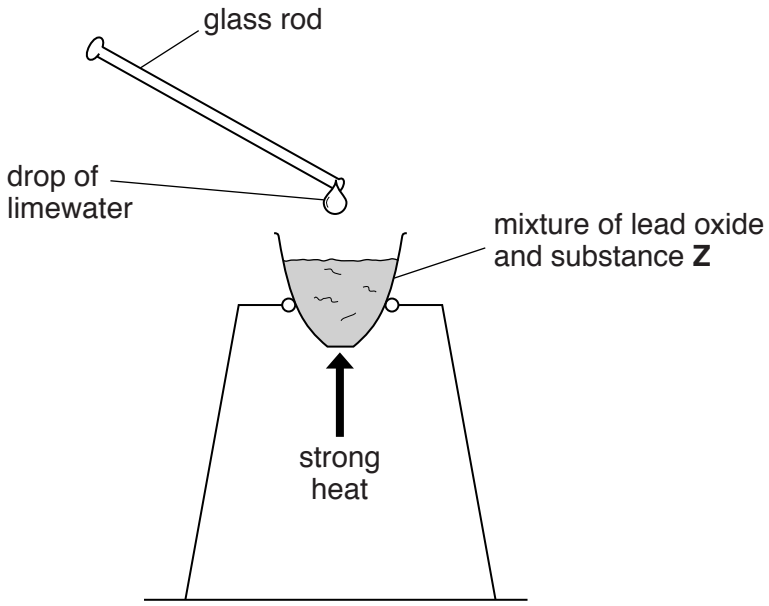

Fig. 4.3

During the reaction, a gas is given off that turns the drop of limewater cloudy.

(i) Name substance **Z** and the gas that is given off.

substance **Z** .....

gas .....[2]

(ii) Suggest **one** way of showing that the reaction has produced some metallic lead.

.....

..... [1]

5 Fig. 5.1 shows a strawberry plant.

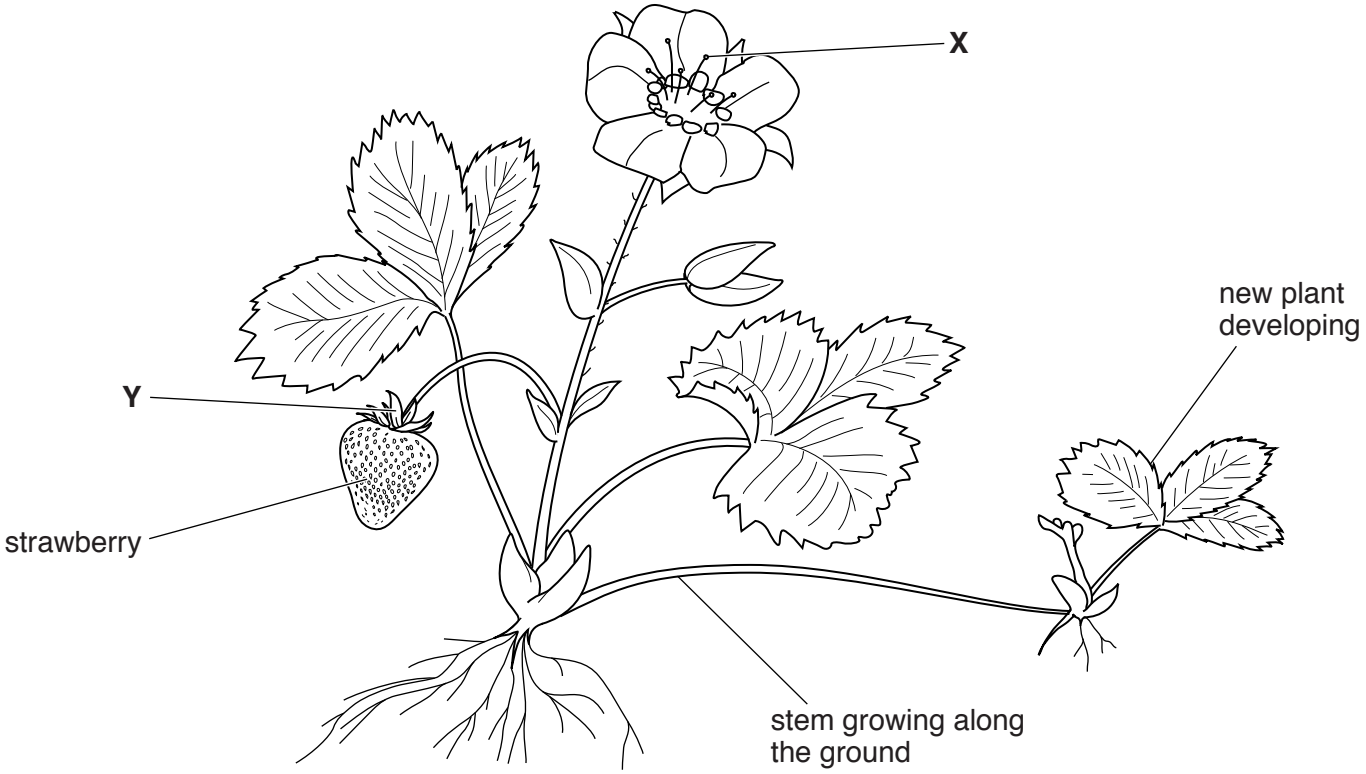

Fig. 5.1

(a) A stem of the strawberry plant is growing along the ground, with a new plant developing at the end of this stem.

(i) Name the type of reproduction shown by this process.

..... [1]

(ii) Explain why the new plant will produce exactly the same type of strawberries as the parent plant.

.....

..... [1]

(b) The strawberry plant has leaves and flowers.

State the main function of

(i) the leaves, ...

..... [1]

(ii) the flowers. .....

..... [1]

(c) Using Fig. 5.1, name

(i) the part of the flower labelled **X**,

..... [1]

(ii) the leaf-like structure above the strawberry, labelled **Y**.

..... [1]

(d) Fig. 5.2 shows an insect called a strawberry blossom weevil.

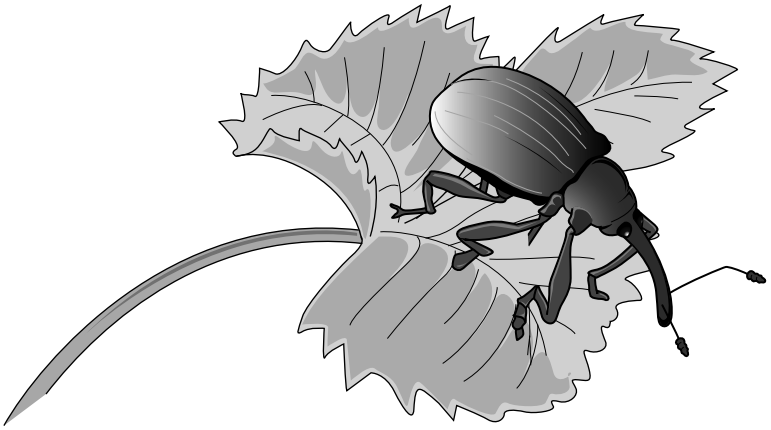

Fig. 5.2

The strawberry blossom weevil destroys some of the strawberry flowers.

Explain why these blossom weevils will reduce the amount of fruit produced by a strawberry plant.

.....

..... [1]

6 **(a)** A motorcyclist begins a journey on a motorcycle. The motorcycle starts from rest and stops at a road junction after 80 seconds. The motorcycle then moves off again and completes the journey.

Fig. 6.1 shows a speed/time graph for the journey.

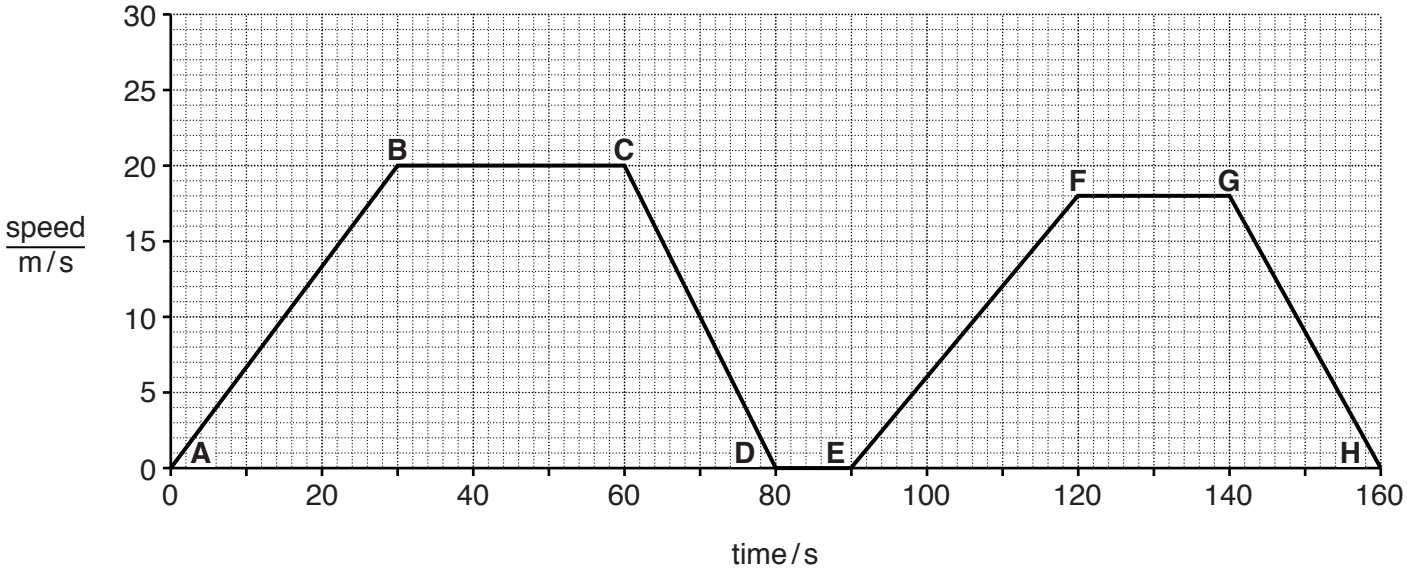

Fig. 6.1

(i) The motorcyclist travels at 9 m/s four times during the journey. On Fig. 6.1, indicate with a cross (X), the four times when the motorcyclist has a speed of 9 m/s.

[1]

(ii) State how long it takes the motorcyclist to reach 9 m/s for the first time.

..... s [1]

(iii) State for how long the motorcyclist travels at a constant speed of 18 m/s.

..... s [1]

(iv) Using the letters, **A** to **H** on Fig. 6.1, state a section of the graph showing the motorcycle slowing down.

Explain your answer.

part of journey .....

explanation .....

.....

[2]

(b) One of the lamps on the motorcycle is a simple filament lamp.

A simple filament lamp is shown in Fig. 6.2.

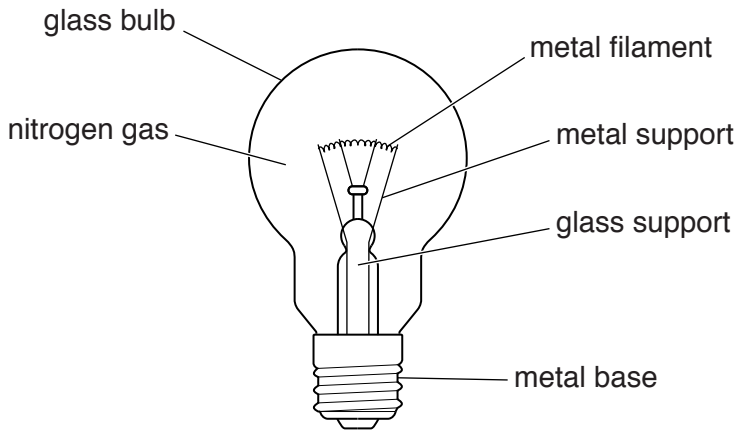

Fig. 6.2

The hot lamp loses thermal energy by conduction, convection and radiation.

(i) Thermal energy is transferred through the metal base by conduction.

Describe the process of conduction.

.....

.....

..... [2]

(ii) Describe how thermal energy is transferred between the hot metal filament and the glass bulb by convection.

.....

.....

..... [2]

(iii) The lamp loses energy by emitting visible light and infra-red radiations. These are both part of the electromagnetic spectrum but they have different wavelengths and frequencies.

State the meaning of the terms *wavelength* and *frequency*.

wavelength .....

.....

.....

frequency .....

.....

[3]

(c) (i) The lamp has a resistance of 4 Ω.

The motorcycle battery has a potential difference of 12 V.

Calculate the current in the lamp.

State the formula that you use and show your working.

formula

working

current = ... A [2]

(ii) Two of these lamps are connected together in a series circuit. Each lamp has a resistance of 4 Ω.

Calculate the combined resistance of the two lamps in series.

..... Ω [1]

7 Part of a plant shoot was cut, and then placed in a beaker of coloured water, as shown in Fig. 7.1.

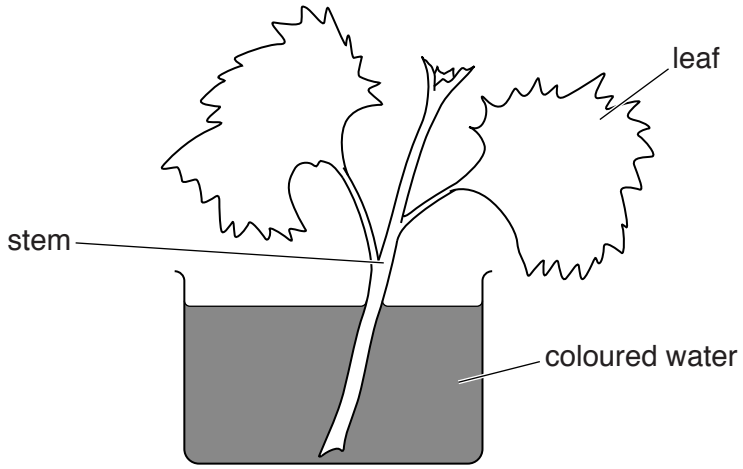

Fig. 7.1

After two hours, the shoot was removed. Fig. 7.2 shows what the shoot looked like.

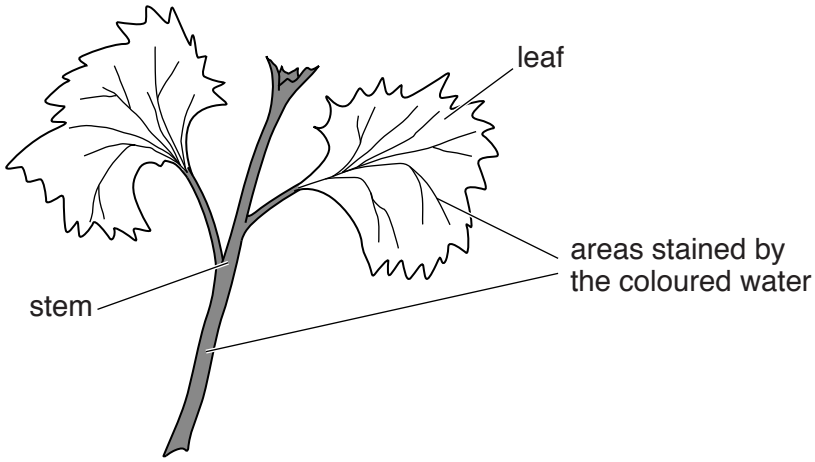

Fig. 7.2

(a) Name the main tissue that has been stained by the coloured water.

..... [1]

(b) The movement of the coloured water is caused by transpiration. Describe the process of transpiration.

You should use these terms in your explanation.

evaporation **mesophyll** **stomata** **vapour**

.....

.....

.....

.....

.....

..... [4]

(c) Suggest how the result shown in Fig. 7.2 on page 19, would have been different if the cut shoot had been left for the two hours in more humid conditions.

.....

..... [1]

8 Gasoline (petrol) is a mixture of hydrocarbons used as car fuel.

(a) Complete the sentence using words chosen from the list. You may use each word once, more than once, or not at all.

biogas	**catalytic**	**coal**	**cracking**
distillation	**fractional**	**peat**	**petroleum**

Gasoline is separated from the raw material known as .....

using the process of .... [2]

(b) Waste gases produced by the burning of gasoline in car engines are released into the air.

(i) Name **two** gaseous compounds that are produced by the complete combustion of the hydrocarbons in gasoline.

1 .....

2 .....

[2]

(ii) Explain why the exhaust gases from cars should never be allowed to build up in a garage or other confined space where there are people.

.....

.....

..... [2]

(c) **(i)** Describe how a solution of bromine is used to test whether a hydrocarbon is saturated or unsaturated.

.....

.....

..... [2]

(ii) Complete the diagram below to show the molecular structure of one molecule of ethene.

[2]

9 **(a)** Fig. 9.1 shows two forces acting on a submarine as it travels at constant speed.

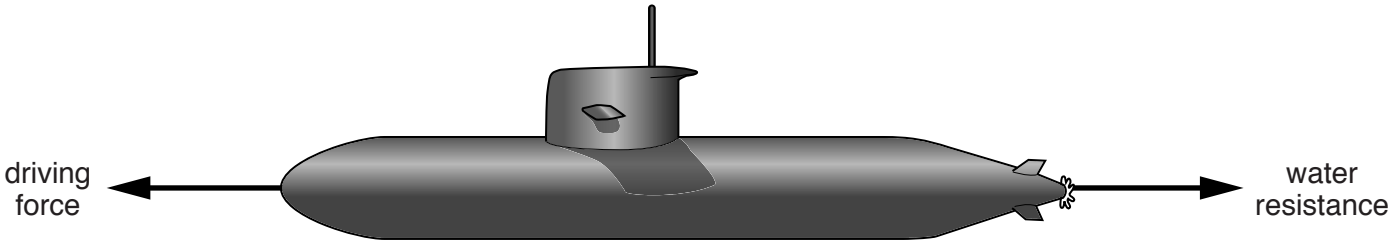

Fig. 9.1

Explain why you know that the driving force and water resistance are equal and opposite.

.....

..... [1]

(b) Some submarines use periscopes to view ships on the surface of the sea when the submarine is submerged.

A simple periscope is shown in Fig. 9.2.

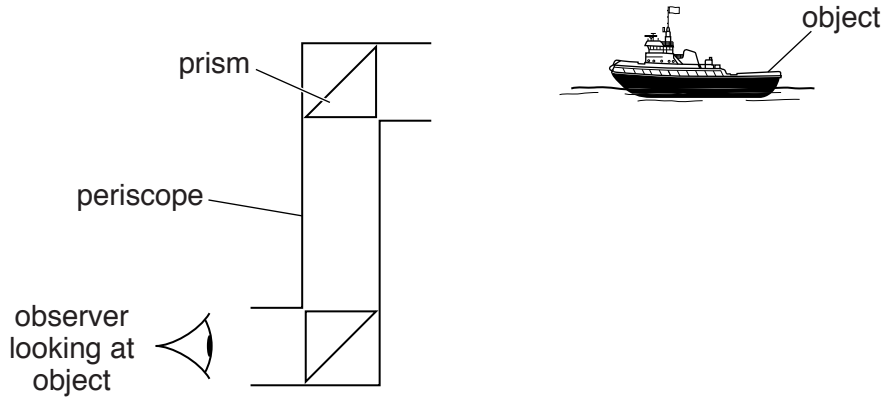

Fig. 9.2

By drawing a ray of light from the object to the observer's eye on Fig. 9.2, show what happens to light from an object as it passes through the periscope. [3]

(c) A nuclear-powered submarine contains a small nuclear reactor.

Radiation is released from the reactor during nuclear fission in the reactor. The reactor has to be shielded to protect the crew from this radiation.

(i) Suggest a material which could be used to shield a nuclear reactor to stop β-radiation escaping.

..... [1]

(ii) Suggest an instrument that could be used to check the radiation level outside the shielding of the reactor.

..... [1]

10 Fig. 10.1 shows an okapi. Okapis are rare animals. Their habitat is in the forests of central Africa.

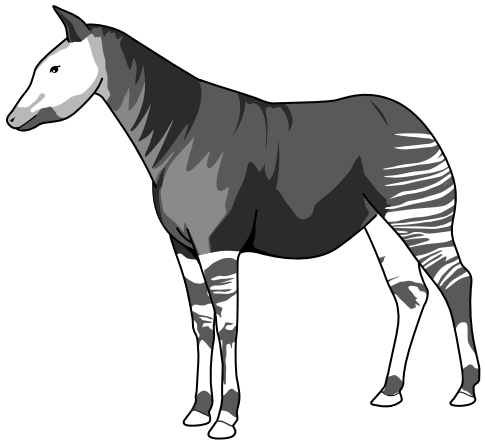

Fig. 10.1

Okapis are threatened with extinction. The two main causes of this are hunting and the cutting down of trees by humans.

(a) (i) State the term for the cutting down of large numbers of trees by humans.

..... [1]

(ii) Suggest **two** reasons why humans cut down large numbers of trees in the forests of central Africa.

1 .....

2 ..... [2]

(b) Suggest **two** ways in which the extinction of the okapi could be prevented.

1 .....

2 ..... [2]

(c) Fig. 10.2 shows a food chain that includes the okapi.

tree leaves ⟶ okapi ⟶ leopard

Fig. 10.2

If the okapi becomes extinct, explain how this would affect

(i) the trees in the forest, ...

..... [1]

(ii) the leopards. .....

..... [1]

11 **(a)** Table 11.1 shows some data about the elements in the second period of the Periodic Table. The numbers in the second row of Table 11.1 refer to a particular property, **X**, of the atoms of the elements.

Table 11.1

symbol	**Li**	**Be**	**B**	**C**	**N**	**O**	**F**	**Ne**
melting point/°C	181	1283	2027	3727	–210	–219	–220	–248
atomic property **X**	3	4	5	6	7	8	9	10

(i) State the **name** of the element shown in Table 11.1 that has the lowest melting point.

..... [1]

(ii) Suggest the identity of *atomic property* **X**.

..... [1]

(iii) An atom of fluorine, F, has a nucleon (mass) number of 19.

State the composition of the nucleus of this fluorine atom.

.....

..... [2]

(b) Sodium in Group I of the Periodic Table reacts with chlorine in Group VII to form crystals of an ionic compound.

(i) Name the ionic compound formed when sodium reacts with chlorine.

..... [1]

(ii) Describe how the structure of a sodium atom is changed when it is converted into a sodium ion.

.....

..... [1]

(iii) Explain, in terms of protons and electrons, why a chlorine atom is electrically neutral but a chloride ion has a negative electrical charge.

.....

.....

.....

..... [2]

[Turn over

(c) Fig. 11.1 shows solution **C** and three reagents.

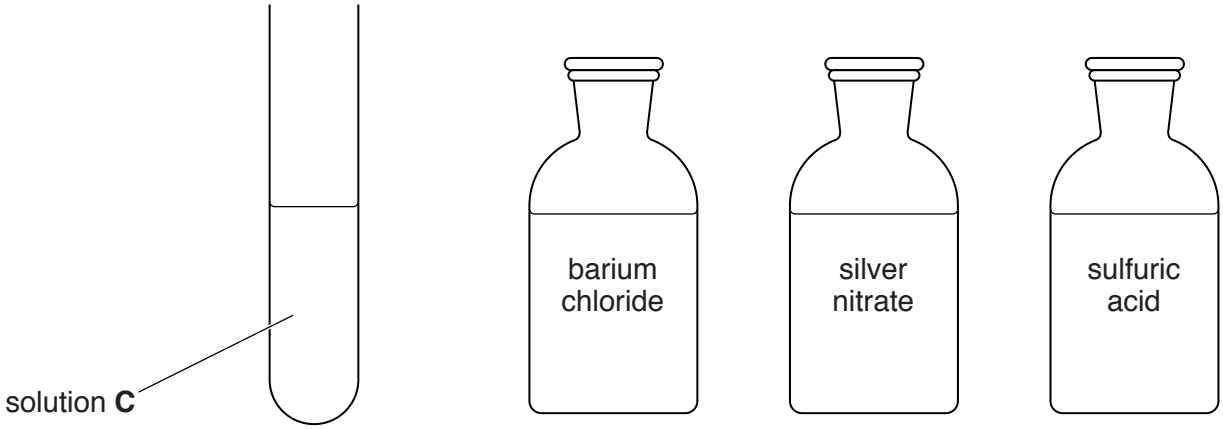

Fig. 11.1

A student wants to find out whether solution **C** contains chloride ions.

State which one of the reagents she should add to solution **C**.

Describe the result if chloride ions are present.

reagent .....

result ..... [2]

12 (a) An astronaut is planning to travel to Mars in a spaceship powered by a rocket.

The weight of the spaceship including fuel and cargo at take off is 30 000 000 N. When the spaceship blasts off from Earth, it has a thrust force of 35 000 000 N.

(i) Calculate the resultant upward force.

..... N [1]

(ii) Explain why the thrust force must be greater than the weight of the spaceship.

.....

..... [1]

(iii) During a spaceship voyage, there are many energy transformations.

Use words from the list to complete the sentences. You may use each word once, more than once or not at all.

chemical **gravitational** **kinetic** **light** **strain** **thermal**

During the launch, the rocket burns fuel containing ..... energy.

This energy is transformed to ..... energy as the fuel is burned.

As the spaceship moves faster it gains ..... energy. [2]

(b) The astronaut remains in communication with Earth on his journey to Mars, using radio waves.

(i) State **one** reason why it is impossible to use sound waves for communication between the astronaut and Earth.

.....

..... [1]

(ii) When Mars is 225 000 000 km from Earth a radio signal takes 750 s to travel between Mars and Earth.

Calculate the speed of radio waves.

State the formula that you use and show your working.

formula

working

speed = ... km / s [2]

(c) Astronauts have greater exposure to ionising radiation than people who remain on Earth.

The ionising radiation is cosmic radiation from outer space. This is one source of background radiation on Earth.

(i) State what is meant by the term *background radiation*.

.....

..... [1]

(ii) State **one** other source of background radiation on Earth.

..... [1]

13 (a) Fig. 13.1 shows how the volume of air in a person's lungs changed over a two minute period. During this time, the person carried out a brief period of exercise.

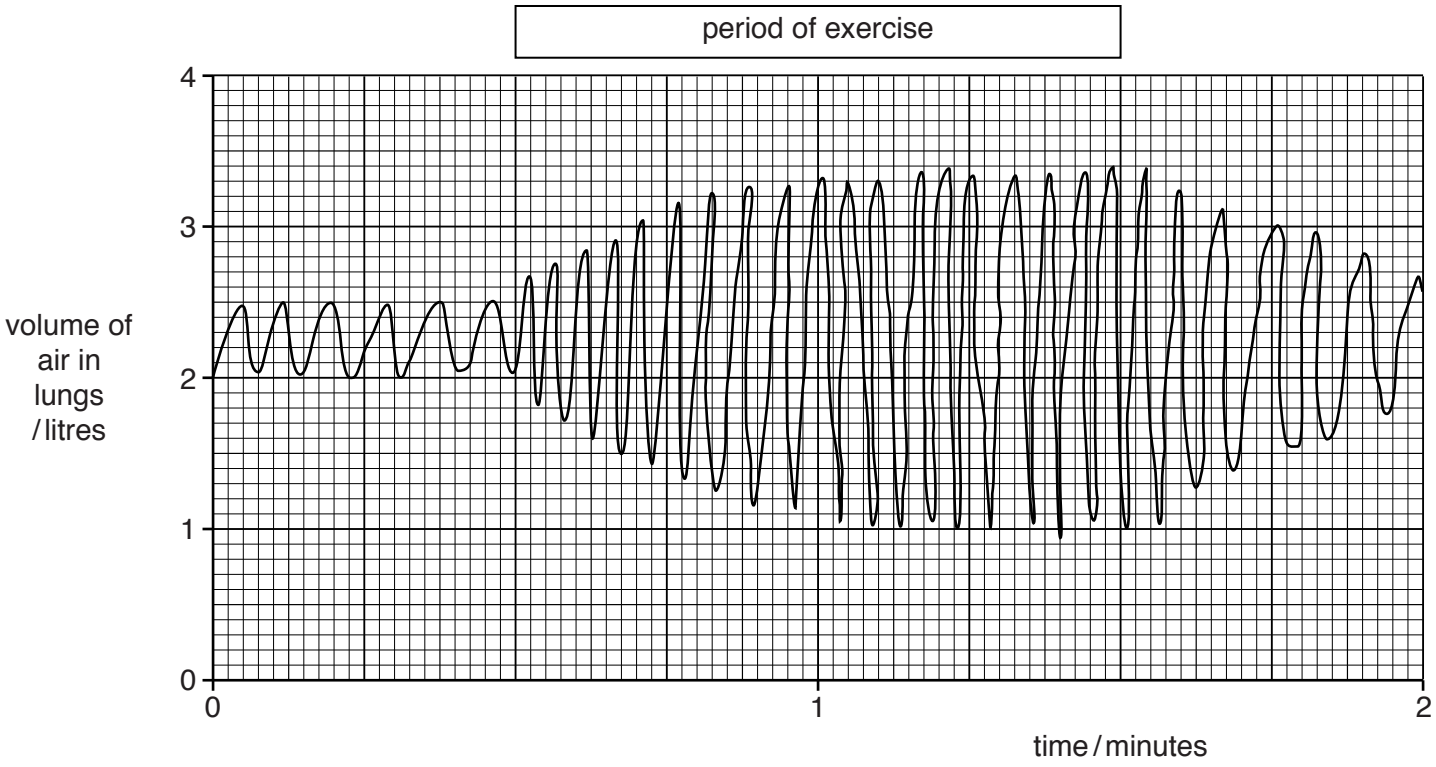

Fig. 13.1

(i) Using the information in Fig. 13.1, state **two** ways in which this person's breathing changed when they carried out the exercise.

1 .....

2 ..... [2]

(ii) Suggest **two** ways in which the air this person breathes out will be different in composition from the air they breathe in.

1 .....

2 ..... [2]

(b) During the period of exercise, the person releases adrenaline.

(i) Suggest **two** effects that the adrenaline would have on the person exercising.

1 .....

2 ..... [2]

(ii) Adrenaline is a hormone. Define the term *hormone*.

.....

.....

.....

..... [3]

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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	209 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **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	147 **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	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103

Key

a **X** b	a = relative atomic mass **X** = atomic symbol b = atomic (proton) number

The volume of one mole of any gas is $24\,dm^3$ at room temperature and pressure (r.t.p.).