UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

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**.

For Examiner's Use

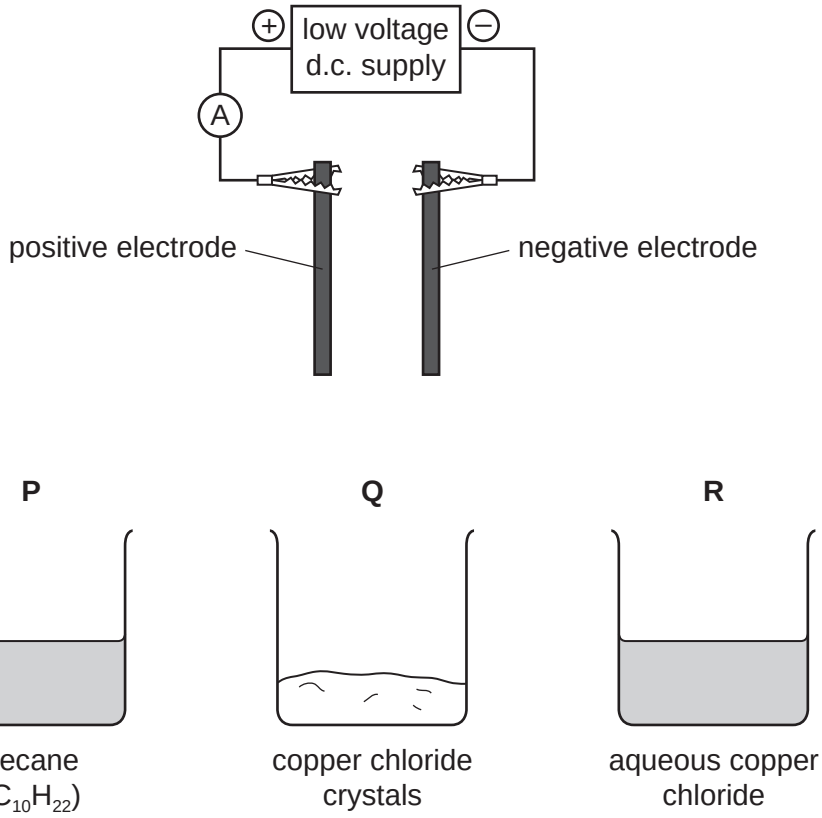

Fig. 1.1

(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.

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.....

..... [3]

For Examiner's Use

(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.

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..... [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.

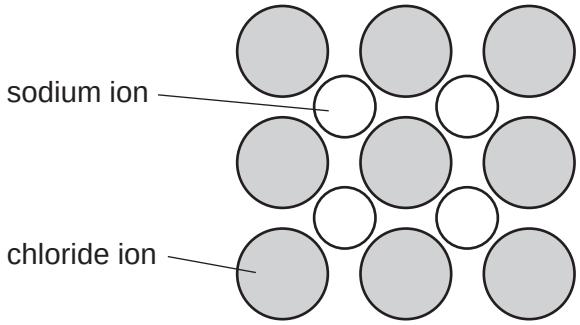

Fig. 1.2

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

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..... [2]

For Examiner's Use

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

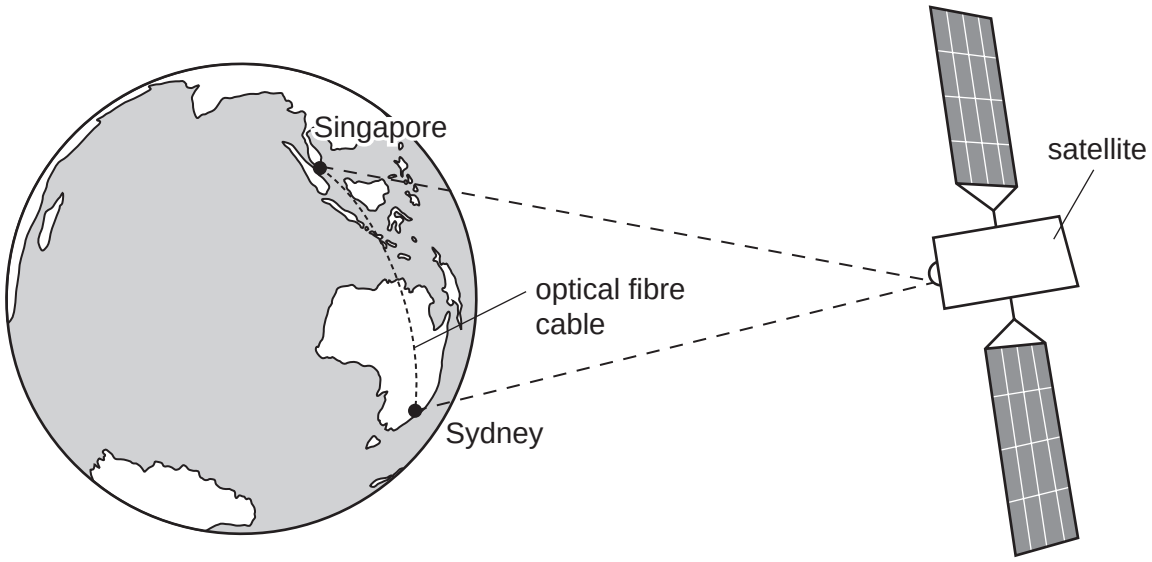

Fig. 2.1

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.

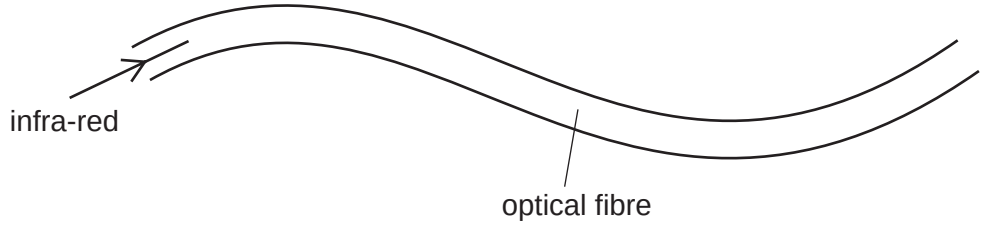

Fig. 2.2

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.

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..... [3]

For Examiner's Use

(ii) The length of an optical fibre cable between Singapore and Sydney is 6.3×10^6 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.

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..... [1]

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

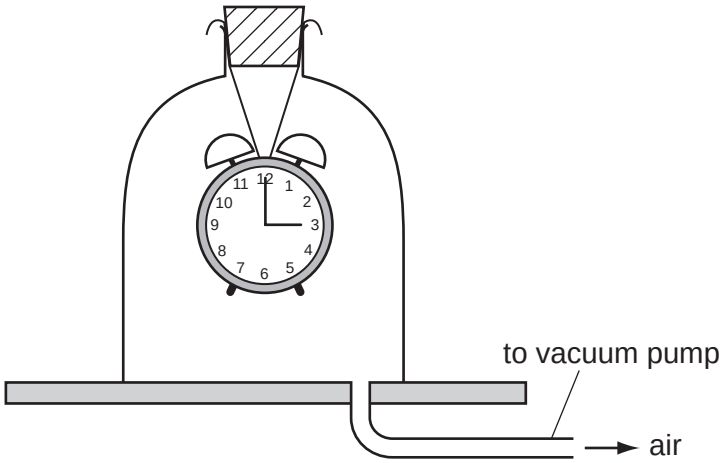

Fig. 2.3

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.

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.....

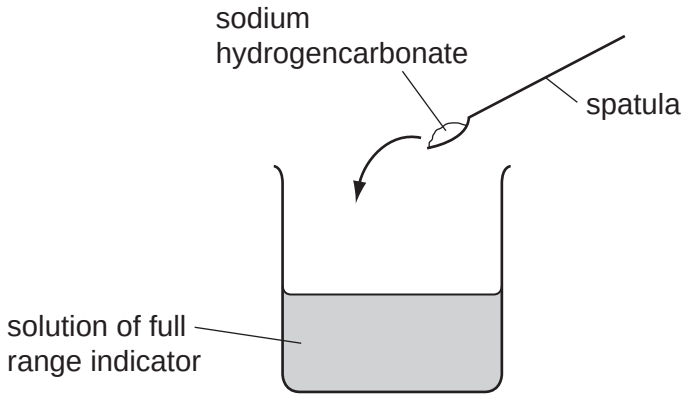
.....

..... [2]

For Examiner's Use

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]

For Examiner's Use

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

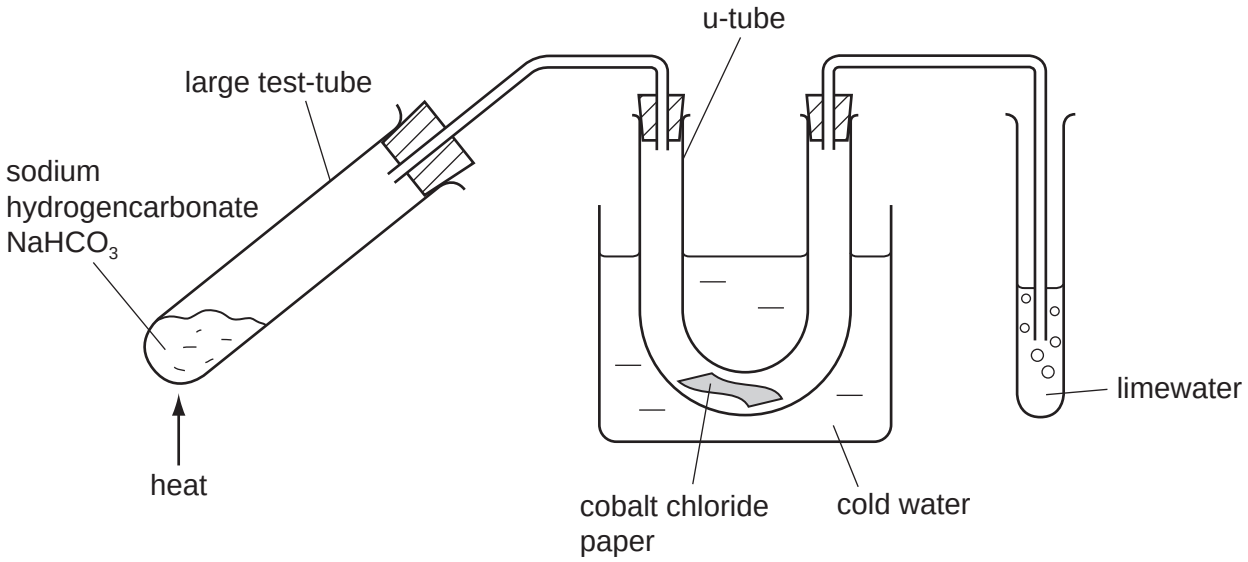


Fig. 3.1

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.

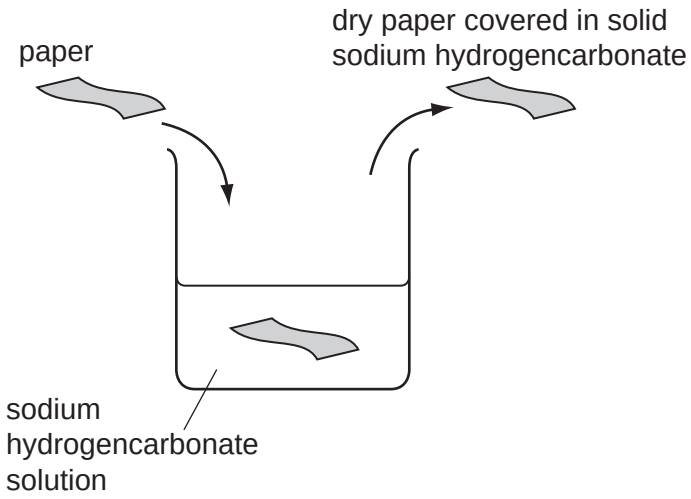
Construct a balanced symbol equation for the decomposition of sodium hydrogencarbonate.

..... [2]

For Examiner's Use

(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.

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..... [2]

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

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..... [2]

[Turn over

For Examiner's Use

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.

.....

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..... [2]

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

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..... [2]

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

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..... [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.

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..... [4]

[Turn over

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

For Examiner's Use

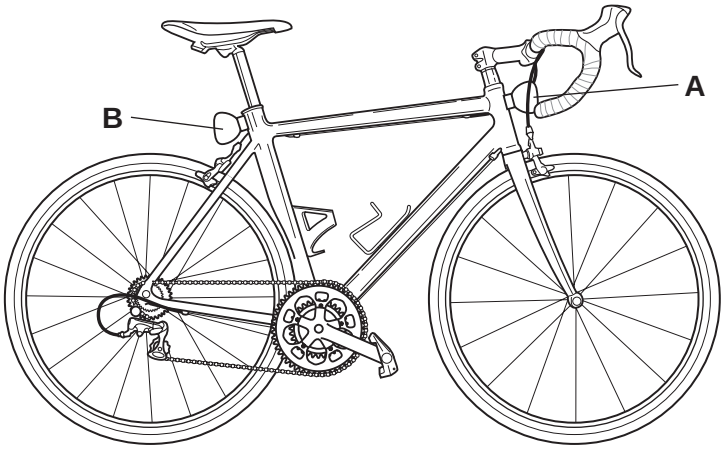

Fig. 5.1

Fig. 5.2 shows how the lights are connected.

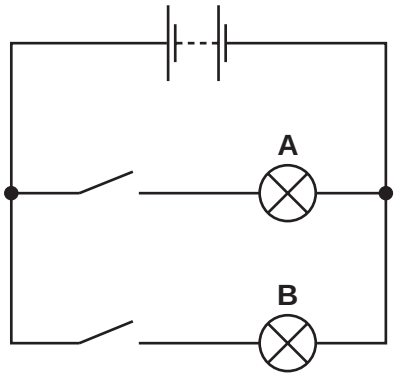

Fig. 5.2

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

..... [1]

For Examiner's Use

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

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 9 V.

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 9000 g and volume 3000 cm^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]

For Examiner's Use

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

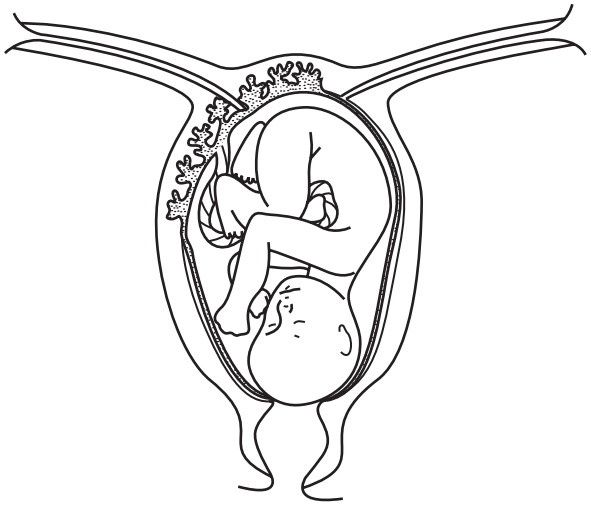

Fig. 6.1

(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.

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..... [3]

For Examiner's Use

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).

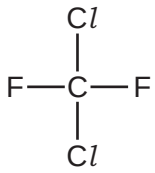

Fig. 7.1

(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]

For Examiner's Use

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]

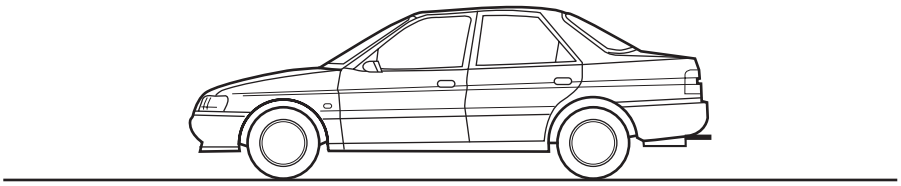

Fig. 8.1

(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.

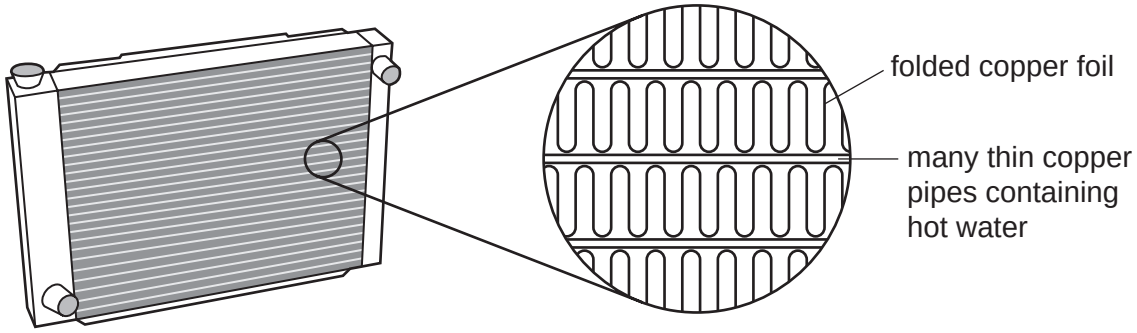

Fig. 8.2

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

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..... [2]

For Examiner's Use

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

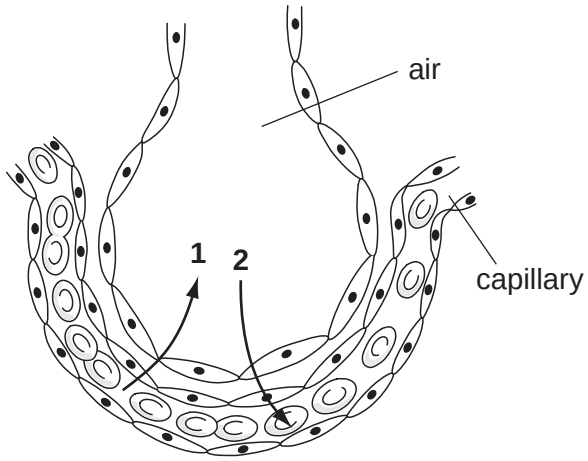

Fig. 9.1

(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.

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.....

..... [2]

For Examiner's Use

(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.

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.....

..... [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	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.).