



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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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**.

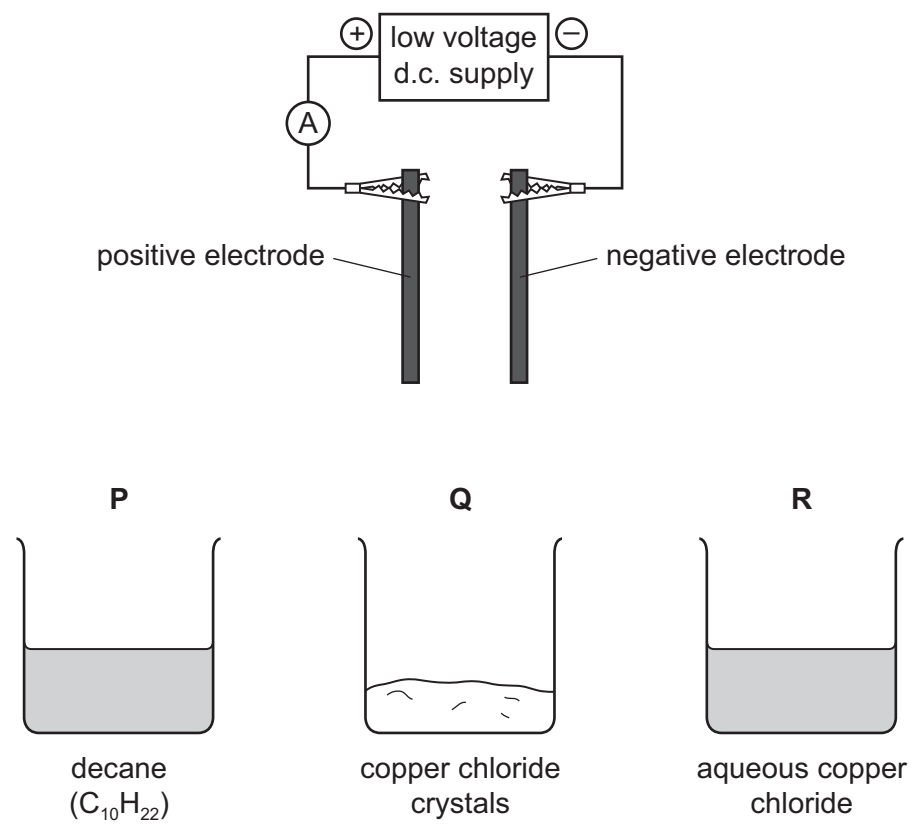


Fig. 1.1

(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.

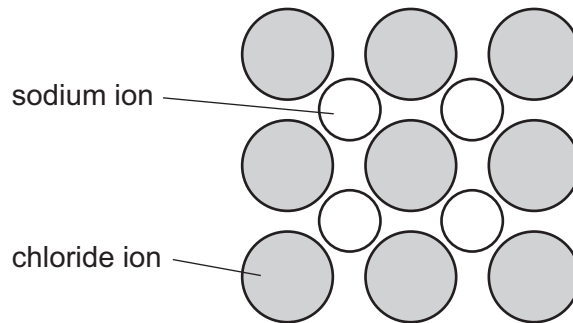


Fig. 1.2

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.

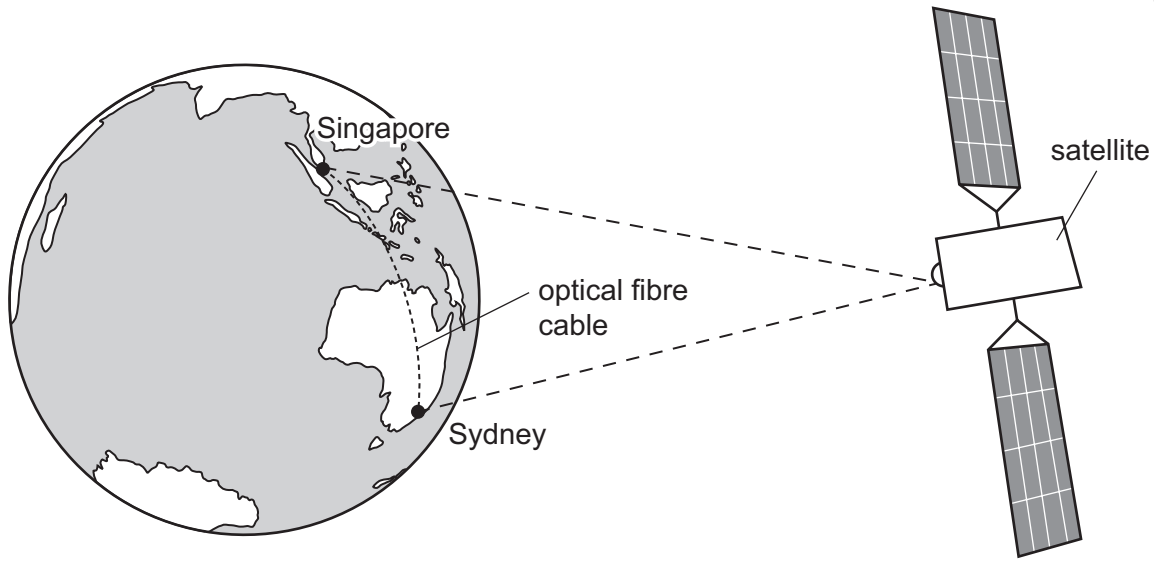


Fig. 2.1

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.

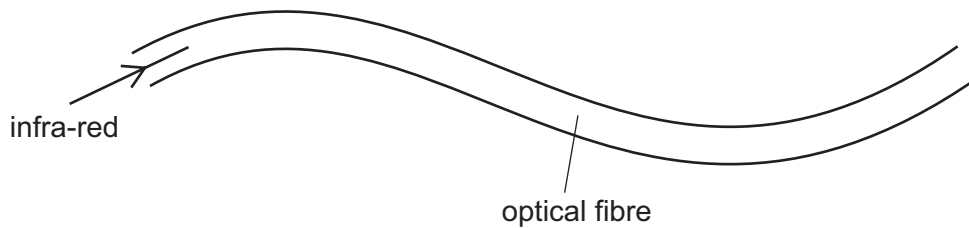


Fig. 2.2

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 6.3×10^7 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.

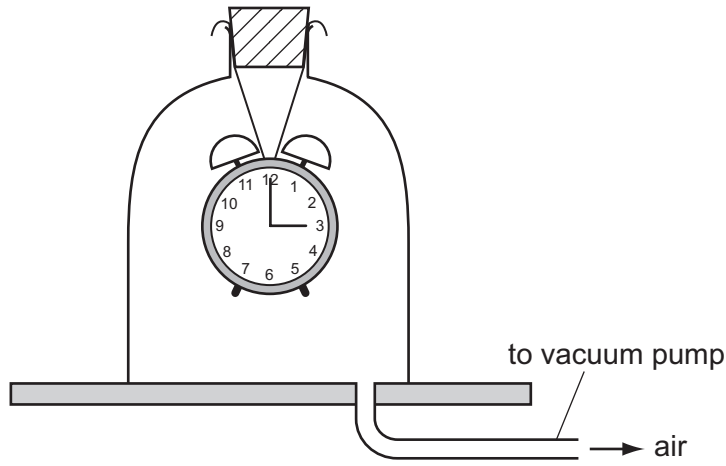


Fig. 2.3

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.

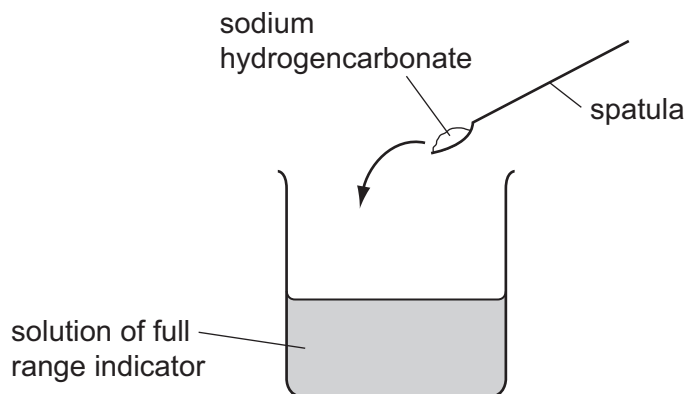
.....

.....

.....

..... [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.

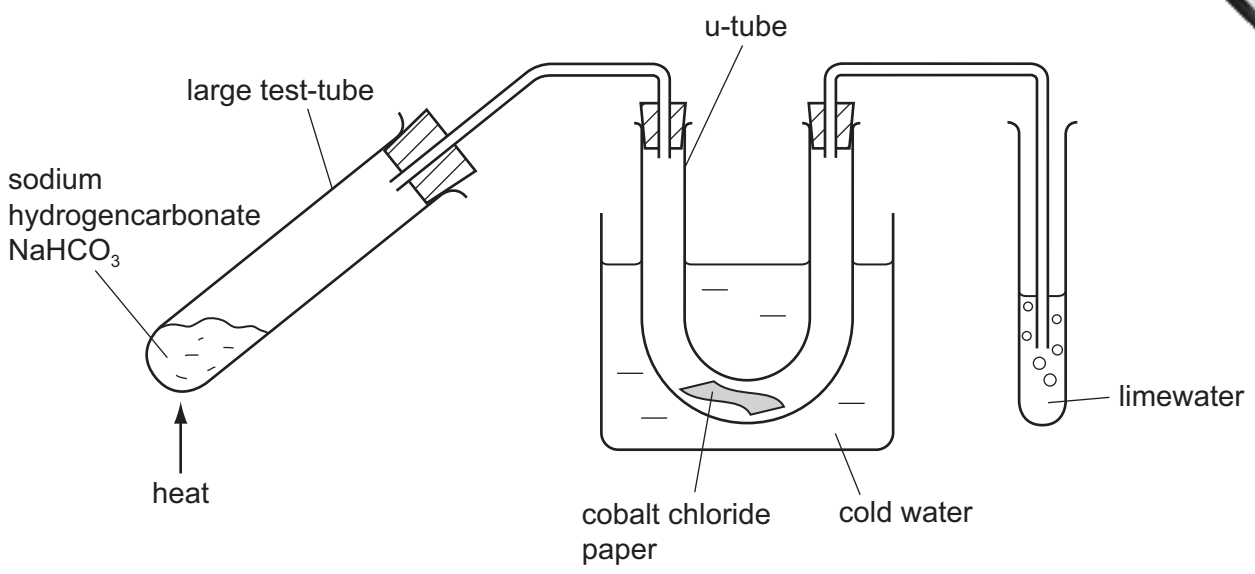


Fig. 3.1

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]

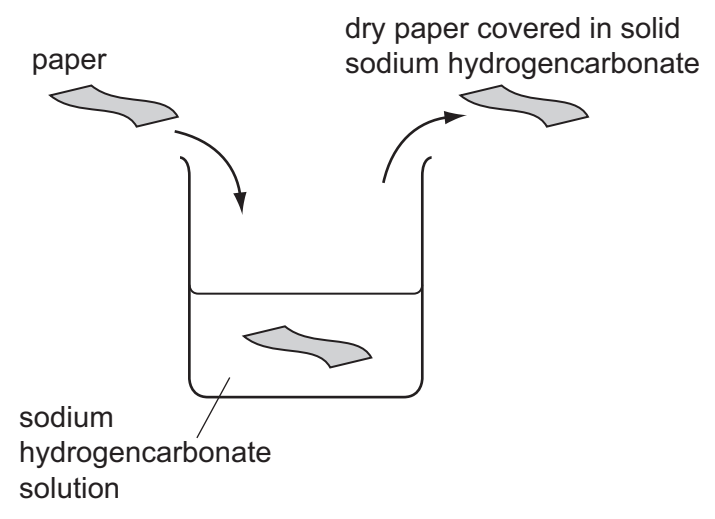
(ii) The teacher tells her students that

- sodium hydrogencarbonate has been decomposed (broken down into simpler compounds),
- the white solid which remains in the large test-tube is sodium carbonate, Na₂CO₃.

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 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.

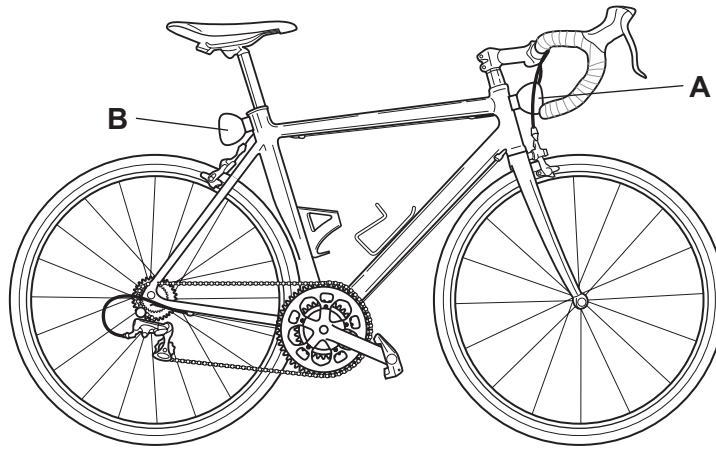


Fig. 5.1

Fig. 5.2 shows how the lights are connected.

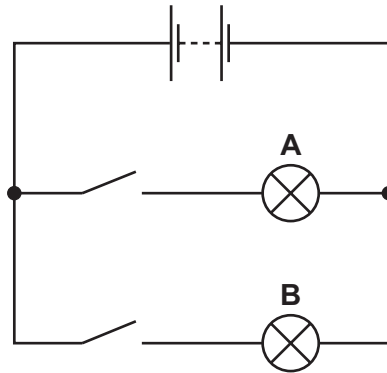
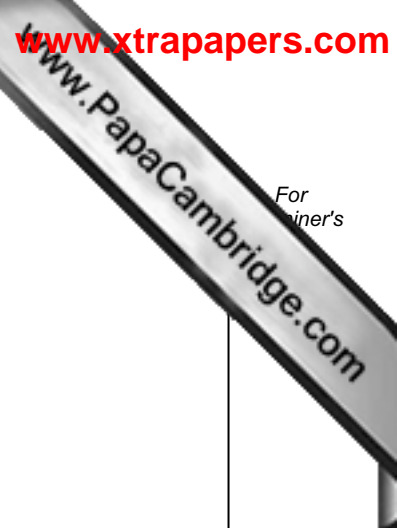


Fig. 5.2

(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.

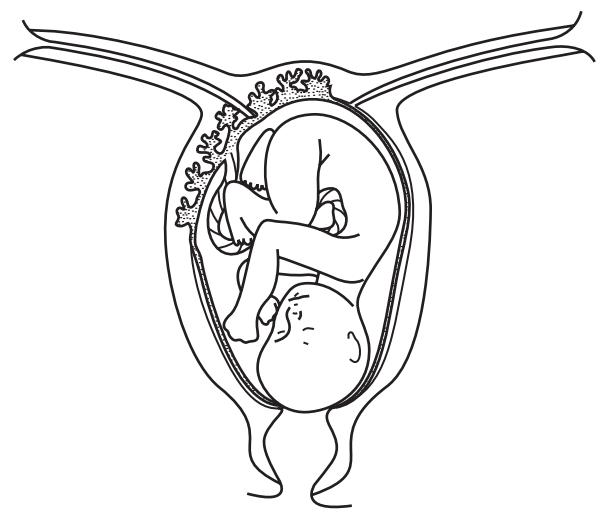


Fig. 6.1

(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).

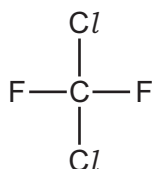


Fig. 7.1

(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]

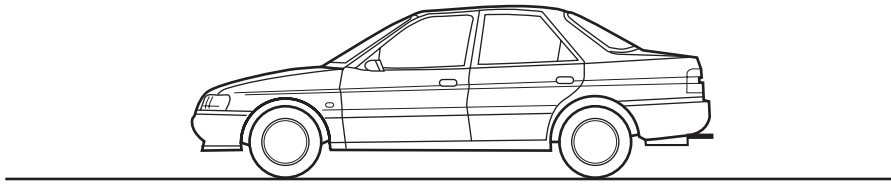


Fig. 8.1

(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 10000 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.

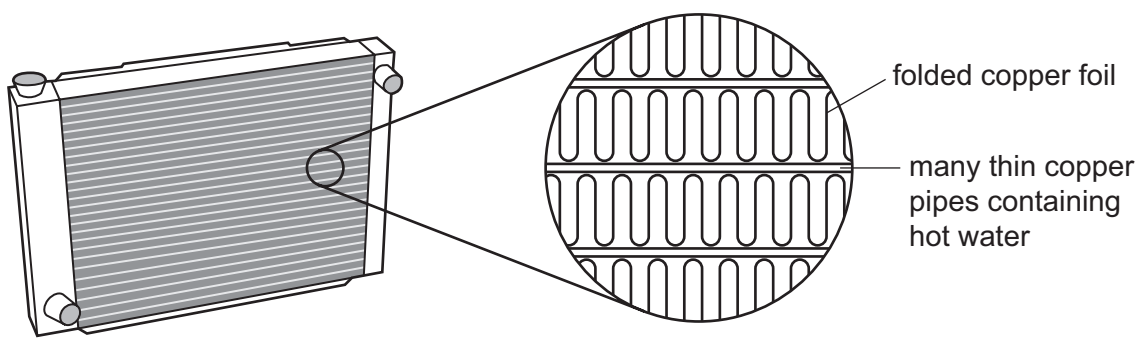


Fig. 8.2

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.

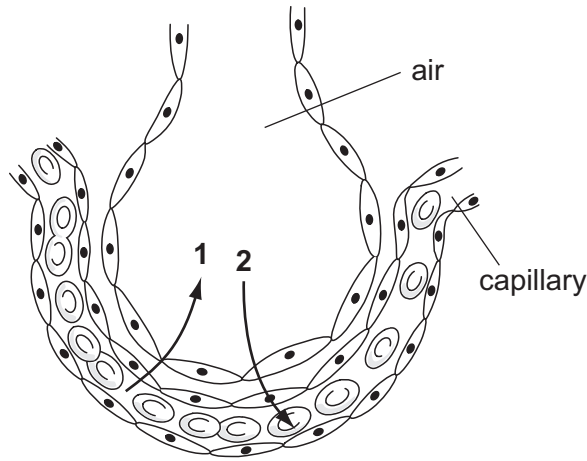


Fig. 9.1

(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					0																																																																															
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	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	49 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	101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	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	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	210 Po Polonium 84	210 At Astatine 85	226 Ra Radium 88	227 Ac Actinium 89	232 Th Thorium 90	232 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71

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

a	X	a = relative atomic mass
b	X	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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