



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

COMBINED SCIENCE

0653/32

Paper 3 (Extended)

October/November 2014

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 Fig. 1.1 is a diagram of the blast furnace used to extract iron from iron ore.

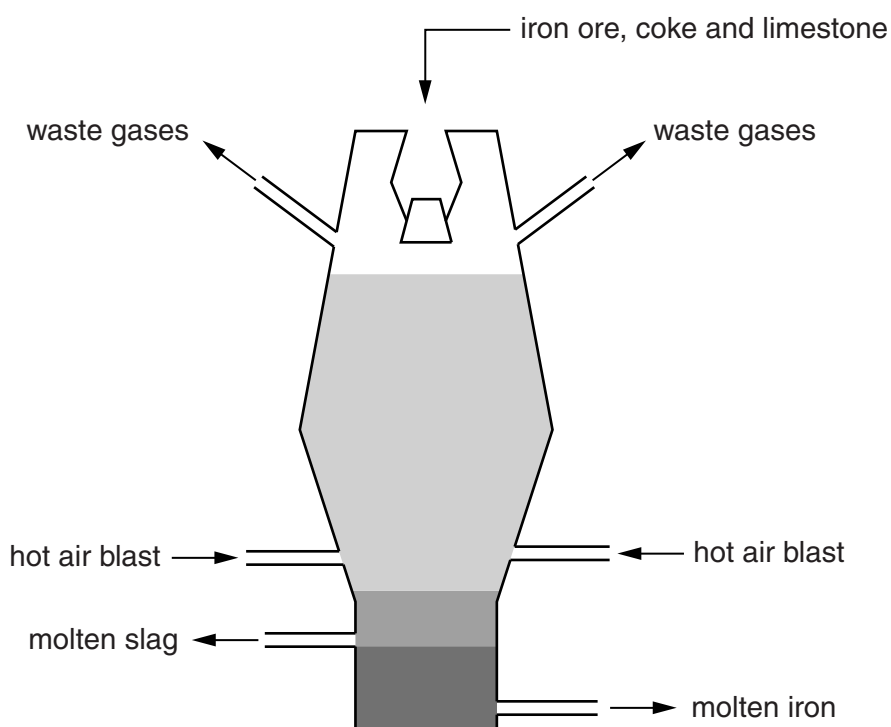


Fig. 1.1

- (a) Table 1.1 lists the raw materials used in the furnace.

Choose words or phrases from the list to show which chemical substance is provided by each raw material used in the blast furnace.

Complete Table 1.1 by writing your choices in the right hand column.

You may use each term once, more than once or not at all.

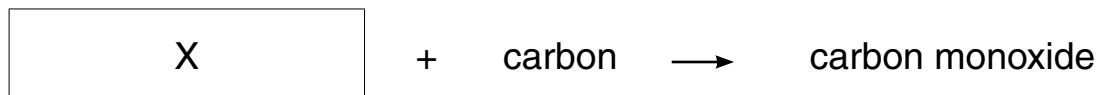
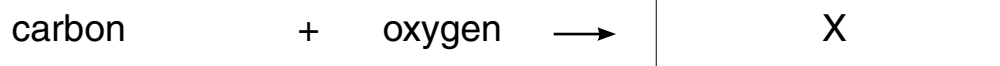
calcium carbonate calcium silicate carbon carbon dioxide
iron iron oxide nitrogen oxygen

Table 1.1

raw material	chemical substance
iron ore	
coke	
air	
limestone	

[2]

- (b) (i) The word equations for two of the reactions occurring in the furnace are shown below.



Name substance **X**.

..... [1]

- (ii) The word equation for another reaction occurring in the furnace is shown below.



Explain why this reaction is an example of a redox reaction.

.....

 [2]

- (iii) Carbon dioxide produced by a blast furnace escapes into the atmosphere.

Describe how the addition of carbon dioxide to the atmosphere is affecting the environment.

.....

 [2]

- (c) An iron nail is placed into some blue copper sulfate solution.

- (i) Describe the observations that provide evidence that a chemical reaction is occurring.

.....

 [2]

- (ii) Explain the observations in (i) in terms of the particles reacting and formed.

.....

 [2]

- 2 Fig 2.1 shows a special bicycle used to break the speed record for a human-powered bicycle.

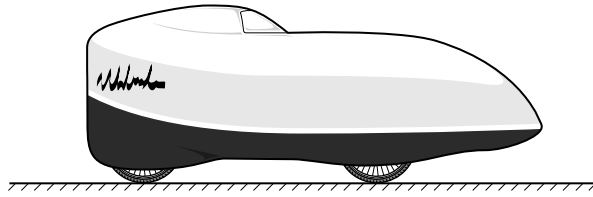


Fig. 2.1

- (a) The rider sets a new speed record of 135 km/h.

Calculate the rider's speed in metres per second (m/s).

speed = m/s [2]

- (b) The record-breaking run has three stages.

Stage 1: the rider accelerates the bicycle from rest for the first 500 m.

Stage 2: he maintains a constant speed for the next 200 m.

Stage 3: he applies the brakes to slow the bicycle for the last 300 m.

The acceleration is not constant, but the braking involves constant deceleration to rest.

On the axes below, complete the sketch of the speed/time graph for this record-breaking run.



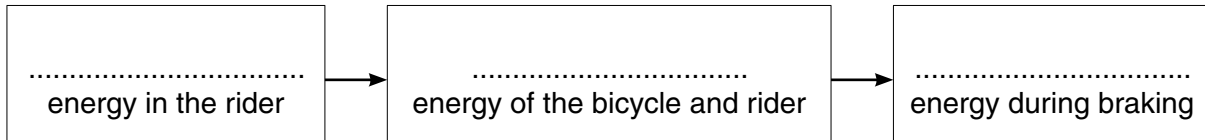
[3]

(c) Throughout the run, the cyclist exerts a constant force to move the bicycle against the opposing forces.

(i) Identify the stage in the run during which the driving force of the cyclist is greater than the opposing forces. Give a reason for your answer.

.....
.....[1]

(ii) Complete the sequence of energy transfers that occurs during the run.



[2]

3 (a) Fig. 3.1 shows the human gas exchange system.

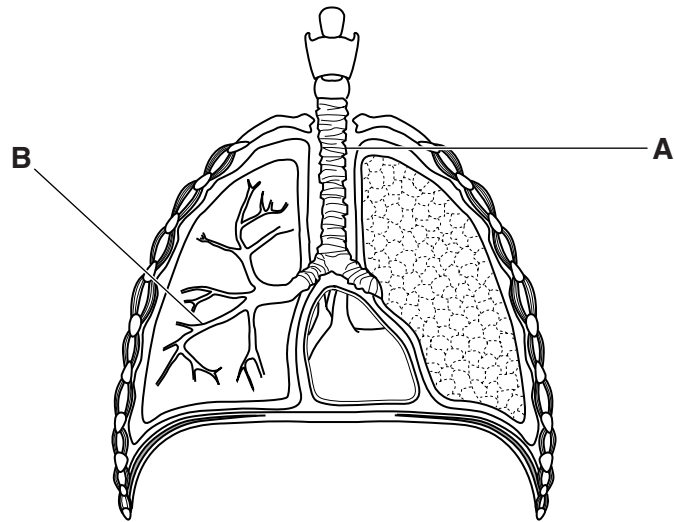


Fig. 3.1

Name structures **A** and **B**.

A

B

[2]

(b) Fig. 3.2 shows an alveolus where gas exchange takes place in the lungs.

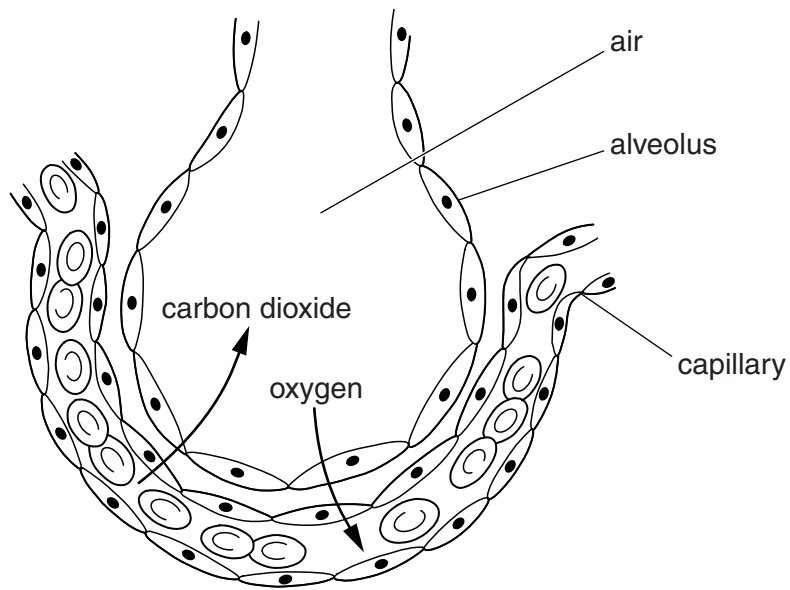


Fig. 3.2

Describe **two** features of the alveolus visible in Fig. 3.2 that adapt it for gaseous exchange.

- 1
-
- 2
-[2]

- (c) A student investigates his breathing before and after exercise. He measures the number of breaths taken during one minute. He also measures the average volume of one breath during this minute.

His results are shown in Table 3.1.

Table 3.1

	number of breaths per minute	average volume of one breath/dm ³	total volume of air breathed per minute/dm ³
at rest	20		10
immediately after exercise	35	1.2	

- (i) Calculate

the average volume of one breath at rest,

volume = dm³

the total volume of air breathed per minute immediately after exercise.

volume = dm³ [2]

- (ii) Explain fully why the changes in breathing rate and volume (depth) are needed by the body during exercise.

.....

 [3]

- 4 Fig. 4.1 shows the circuit symbols for an electric bell and a push-switch.

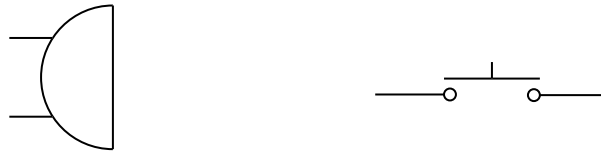


Fig. 4.1

- (a) (i) Draw a circuit diagram for a circuit for a battery-powered door-bell with a push-switch for the front door of a house.

Label the switch 'front door'.

[2]

- (ii) The owner of the house wishes the bell to be rung **either** from the front door **or** from the back door.

Add to your circuit diagram in (i) a second push-switch for the back door.

Use the label 'back door' to label the second push-switch.

[1]

(b) The ringing bell emits a sound of frequency 400 Hz.

(i) State the meaning of the term *frequency*.

.....
[1]

(ii) The speed of sound in air is 330 m/s.

Calculate the wavelength of the sound made by the bell in air.

State the formula you use and show your working.

formula

working

wavelength = m [2]

(c) The bell uses four 1.5V cells. When the push-switch is on, and the bell is ringing, there is a current of 2A.

(i) Calculate the resistance of the bell.

State the formula you use, show your working and state the unit of your answer.

formula

working

resistance = unit [3]

(ii) A visitor arrives at the door and rings the bell for 10 seconds.

Calculate the electrical energy transferred by the bell in 10 seconds.

State the formula you use, show your working and state the units of your answer.

formula

working

energy = unit [3]

5 (a) An atom of the element silicon has a proton number 14 and nucleon number 28.

(i) Complete Table 5.1 to show the structure of this silicon atom.

Table 5.1

	in nucleus	outside nucleus
number of protons		
number of neutrons		
number of electrons		

[2]

(ii) Use the Periodic Table to predict how many electrons are in the outer shell of a silicon atom. Describe how you made your prediction.

.....

 [2]

(b) (i) Draw a diagram showing the arrangement of the outer electrons of the atoms bonded in a methane molecule, CH₄.

[2]

(ii) Write a balanced symbol equation for the complete combustion of methane in air.

..... [2]

- 6 Fig. 6.1 shows a method that uses solar energy to purify drinking water. The method is used in hot desert countries.

The impure water is heated by the sun and distilled. The pure water is collected separately, while the impurities are left behind.

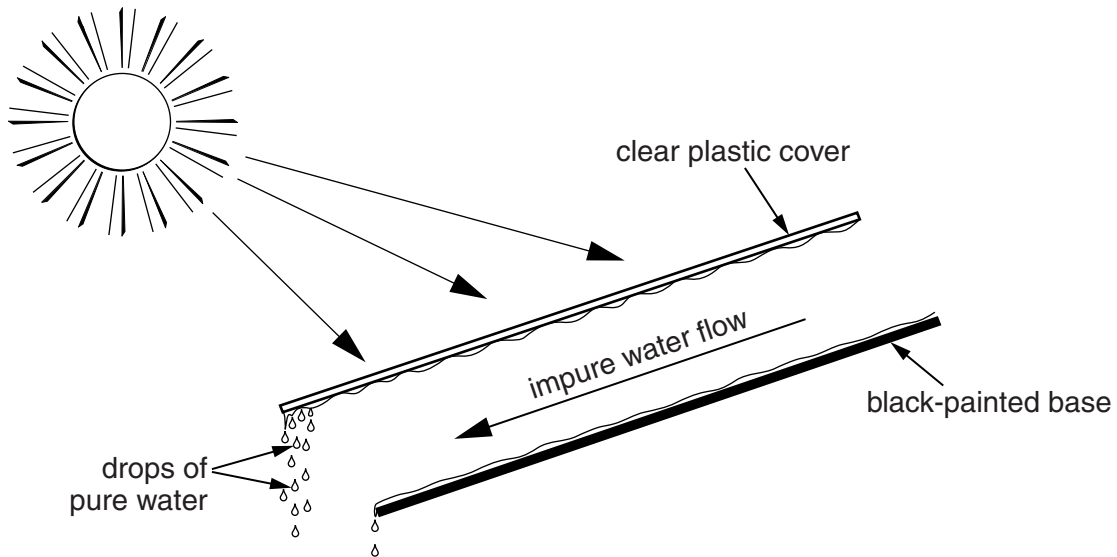


Fig. 6.1

- (a) (i) State the part of the Sun's electromagnetic spectrum that heats the water.

.....[1]

- (ii) The impure water flows down over a black-painted base.

Explain why a black-painted base is used.

.....

.....[1]

- (b) Solar energy produces water vapour from the impure water.

Explain in terms of water molecules why heating the impure water produces water vapour.

.....

.....

.....[2]

(c) Fig. 6.2 shows a ray of sunlight incident on the clear plastic cover just before sunset.

The refracted ray passes through the plastic. At the lower face of the plastic, part of the ray is reflected and part is refracted.

Draw the path of the ray from the point where it reaches the lower face of the plastic.

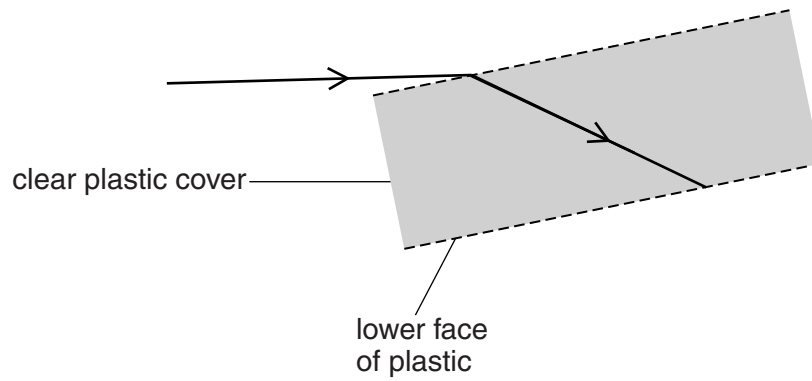


Fig. 6.2

[3]

- 7 Fig. 7.1 shows what happens when a plant is placed near a window where bright light is coming from one side.

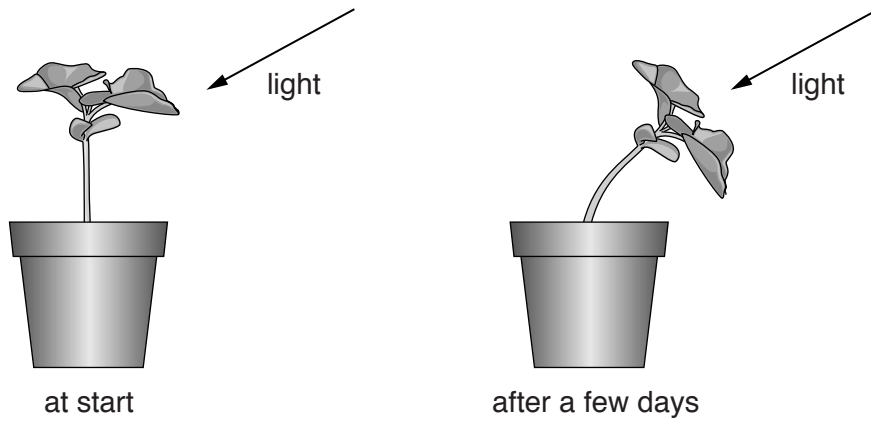


Fig. 7.1

- (a) Name the response shown by the plant.

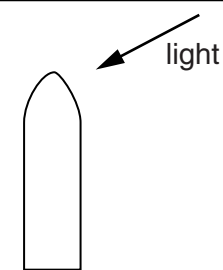
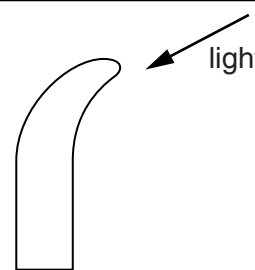
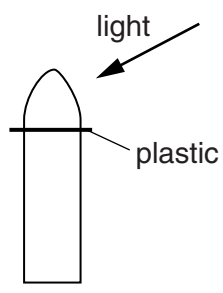
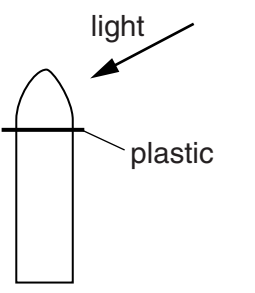
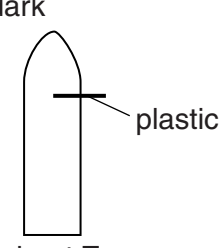
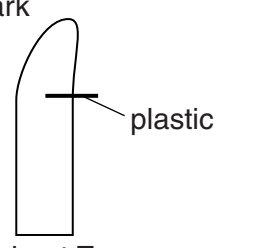
.....[1]

- (b) The response shown in Fig. 7.1 is caused by plant hormones called auxins which are produced at the tip of the shoot of the plant.

A student sets up three experiments using young shoots. In two experiments a lamp produces light from one side. Some shoots have pieces of plastic inserted into their stems.

Table 7.1 shows the shoots at the start and after a few days.

Table 7.1

at the start	after a few days
 <p>shoot X</p>	 <p>shoot X</p>
 <p>shoot Y</p>	 <p>shoot Y</p>
<p>in the dark</p>  <p>shoot Z</p>	<p>in the dark</p>  <p>shoot Z</p>

- (i) Explain fully what causes the response shown by shoot X.

.....

.....

.....

.....[3]

(ii) Explain why there is no response shown by shoot Y.

.....
.....[1]

(iii) Shoot Z has grown less than shoot X but has bent in the same direction.

Explain these two observations.

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

(c) Hormones are also present in animals. An example is adrenaline.

Adrenaline is secreted into the blood when an athlete starts to run a race.

Suggest how this helps the athlete to run fast.

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

BLANK PAGE

- 8 (a) Table 8.1 shows physical properties of some substances.

Table 8.1

substance	solubility in water	boiling point/°C
ethanol	soluble	78
potassium nitrate	soluble	decomposes on heating
sodium chloride	soluble	1413
water	–	100
zinc carbonate	insoluble	decomposes on heating

Some mixtures of these substances and some methods that could be used to separate them are shown below.

mixture	method of separation
<u>zinc carbonate</u> from zinc carbonate and water	crystallisation
<u>potassium nitrate</u> from potassium nitrate and water	distillation
<u>water</u> from sodium chloride and water	filtration
<u>ethanol</u> from ethanol and water	fractional distillation

Draw straight lines to connect each mixture with the most suitable method of separating the **underlined** substance. [2]

(b) Some types of ink are made from different combinations of dyes dissolved in water.

The dyes must not be toxic because they are used in colouring pens for children.

Fig. 8.1 shows a chromatogram used to test if three inks **A**, **B** and **C** contain a toxic dye **X**.

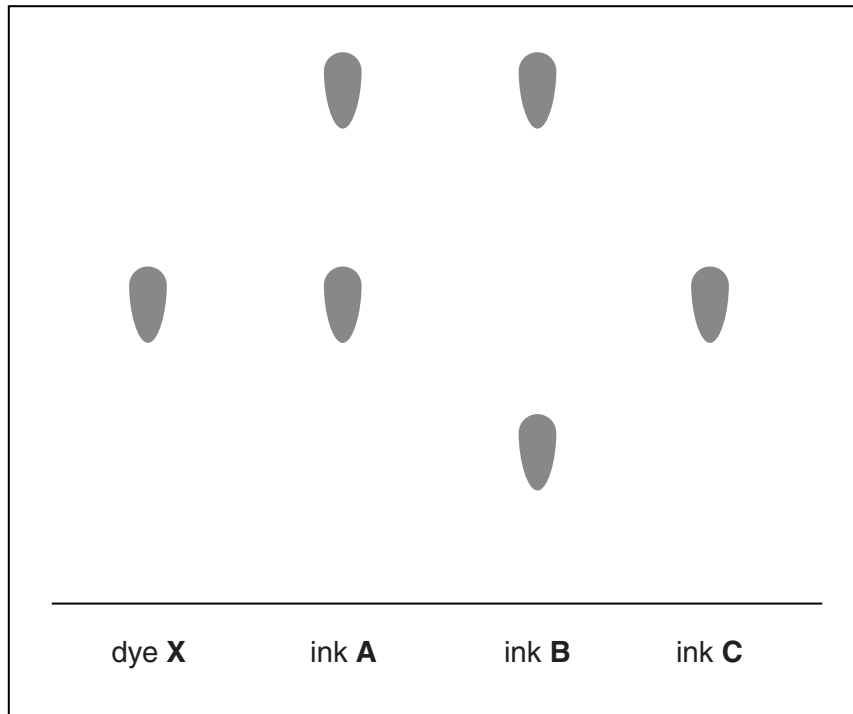


Fig. 8.1

(i) Describe and explain the procedure used to obtain this chromatogram.

You may draw a diagram to support your description.

.....

.....

.....

.....

.....[3]

(ii) State which ink(s) must not be used in the colouring pens.

.....[1]

(iii) Explain your answer to (ii).

.....
.....[1]

- 9 (a) Fig. 9.1 shows how the emission of acidic gases from a power station can lead to the formation of acid rain.

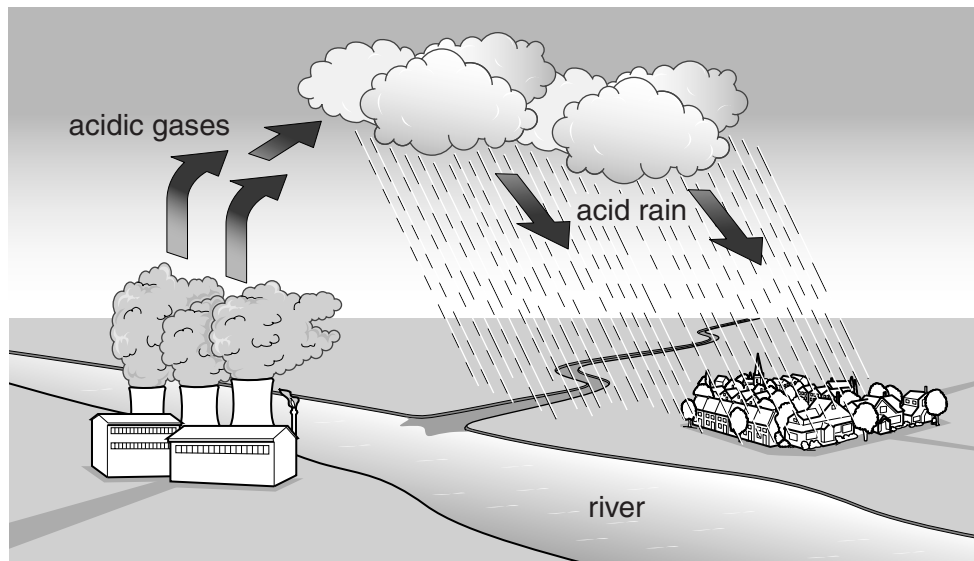


Fig. 9.1

- (i) State how the acidic gases are produced in the power station.

.....
.....[1]

- (ii) The water in the river becomes acidic.

Describe how this could have resulted from the power station's activities.

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

- (b) A scientist is concerned about the acidity of the river and the effect it might have on living organisms.

The scientist found ten species of animal that lived in local rivers. He looked up how many of these species were able to live in water of different pH values.

The results are shown in Fig. 9.2.

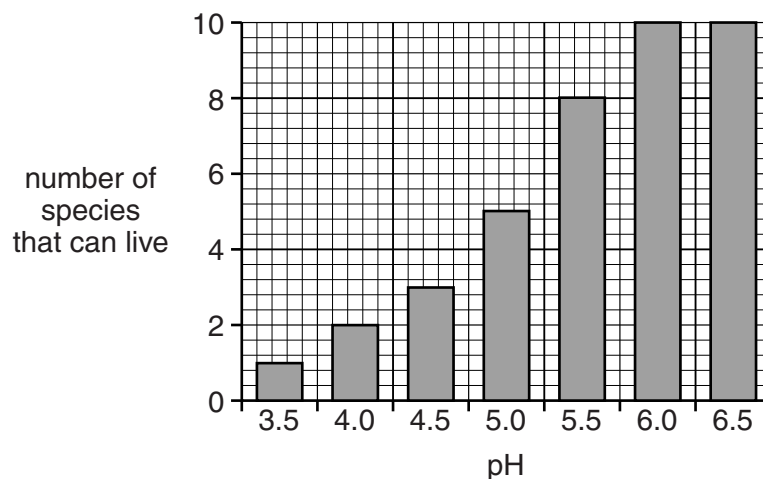


Fig. 9.2

The pH of the river near the factory varies between pH 4.5 and 6.0.

- (i) Suggest **two** reasons why the pH of the river varies.

1

.....

2

.....[2]

- (ii) Use the information in Fig. 9.2 to find how many of the species studied would be able to survive the changes in pH of the river. Explain your answer.

number of species

.....

.....[2]

- (iii) The acid in the water may enter the cells of the animals living in the river. Suggest how this may affect the enzymes in their cells. Explain your answer.

.....

.....

.....[2]

DATA SHEET
The Periodic Table of the Elements

		Group									
		I	II	III	IV	V	VI	VII	0		
		1 H Hydrogen 1									
7 Li Lithium 3	9 Be Beryllium 4										
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 P Phosphorus 15	16 O Oxygen 8	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10
39 K Potassium 19	40 Ca Calcium 20	27 Al Aluminium 13	28 Si Silicon 14	29 Co Cobalt 27	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	56 Fe Iron 26	57 Mn Manganese 25	59 Co Cobalt 27	64 Cu Copper 29	65 Zn Zinc 30	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
133 Cs Caesium 55	137 Ba Barium 56	101 Ru Ruthenium 44	102 Rh Rhodium 45	103 Pd Palladium 46	106 Ag Silver 47	108 Cd Cadmium 48	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
223 Fr Francium 87	226 Ra Radium 88	147 Pm Promethium 61	148 Nd Neodymium 60	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	163 Ho Holmium 67	165 Er Erbium 68	167 Tm Thulium 69	168 Yb Ytterbium 70
		140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67
		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
		175 Lu Lutetium 71	176 Yb Ytterbium 70	177 Tm Thulium 69	178 Pb Lead 82	179 Bi Bismuth 83	180 Po Polonium 84	181 At Astatine 85	182 Rn Radon 86	183 Fr Francium 87	184 Ra Radium 88

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

Key

a	X
---	----------

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.