Cambridge IGCSE

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.

CAMBRIDGE International Examinations

[Turn over

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

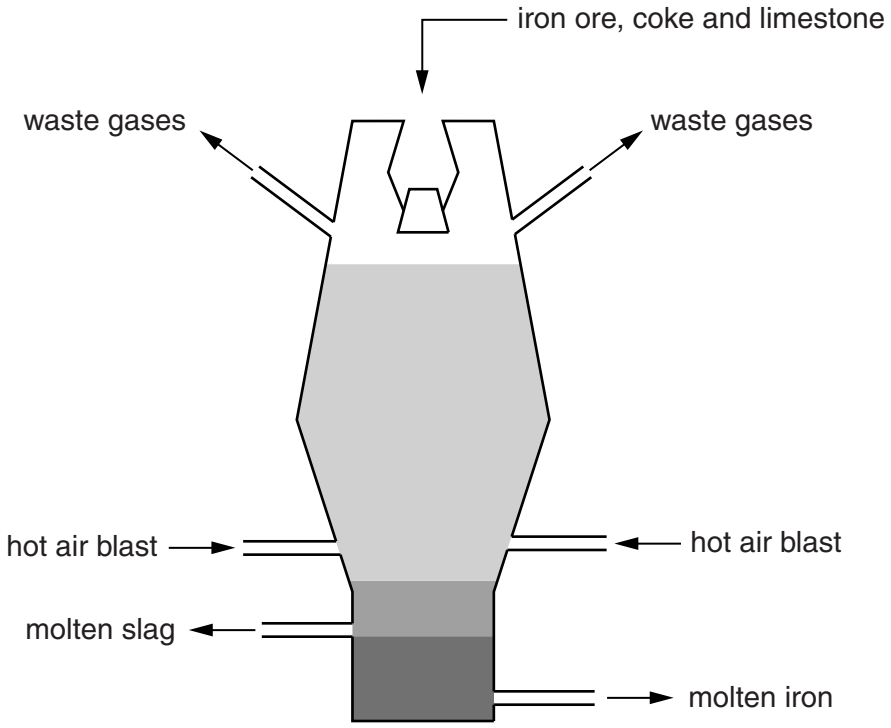


Fig. 1.1

(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.

carbon + oxygen ⟶ X

X + carbon ⟶ carbon monoxide

Name substance **X**.

..... [1]

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

iron oxide + carbon monoxide ⟶ iron + carbon dioxide

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.

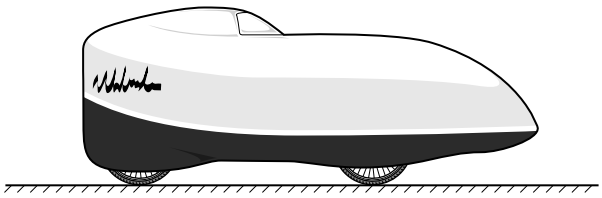


Fig. 2.1

(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]

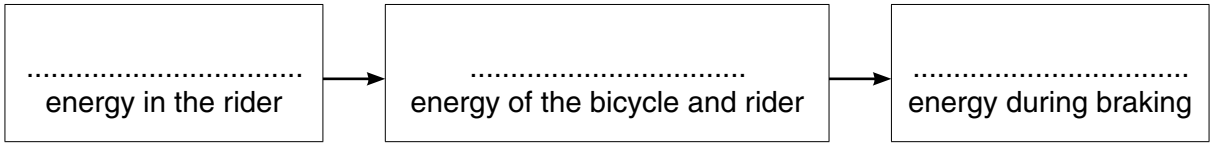
(c) Throughout the run, the cyclist exerts a constant force to move the bicycle against the opposing forces.

(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.

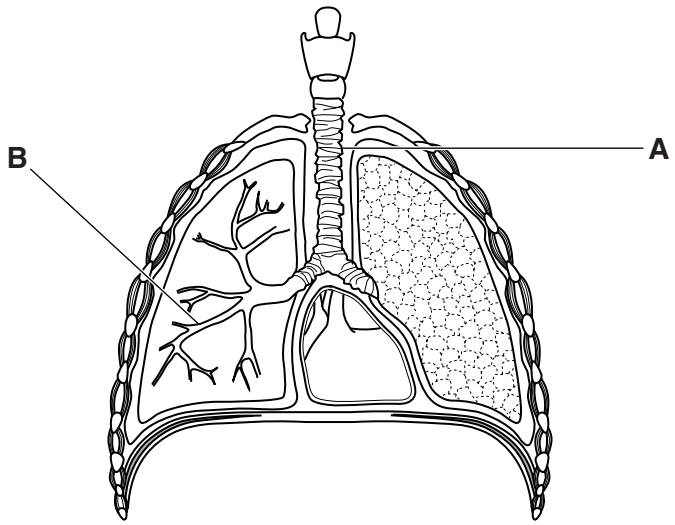


Fig. 3.1

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

A .....

B .....

[2]

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

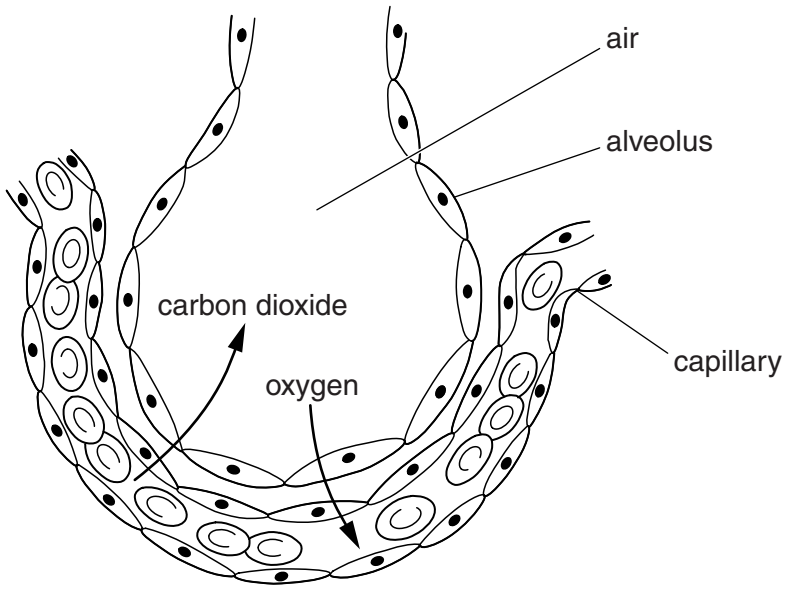


Fig. 3.2

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 = ... dm^3

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

volume = ... dm^3 [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 1.5 V cells. When the push-switch is on, and the bell is ringing, there is a current of 2 A.

(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, CH_4.

[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.

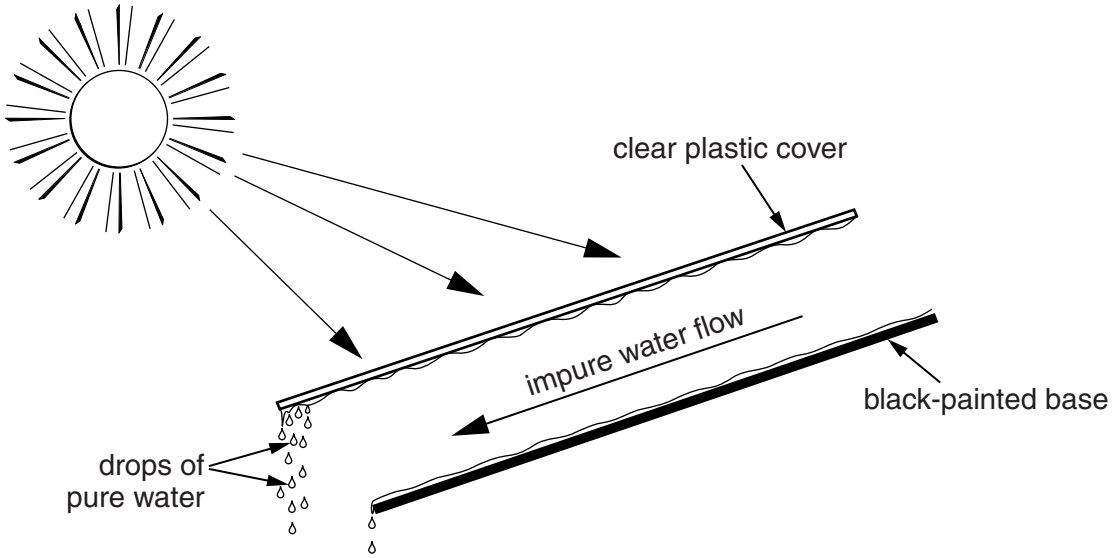


Fig. 6.1

(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.

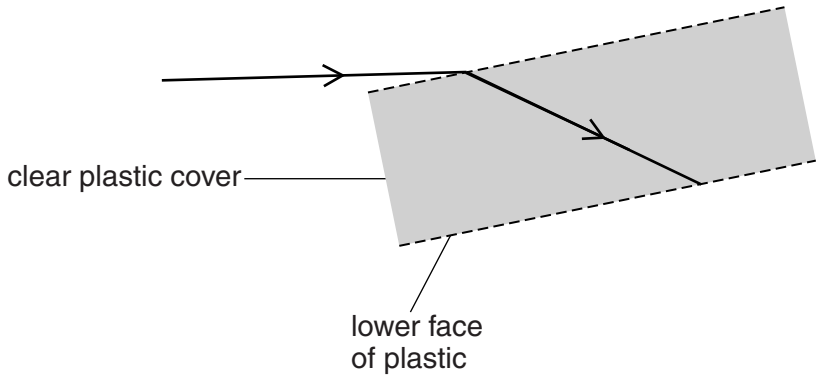


Fig. 6.2

[3]

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

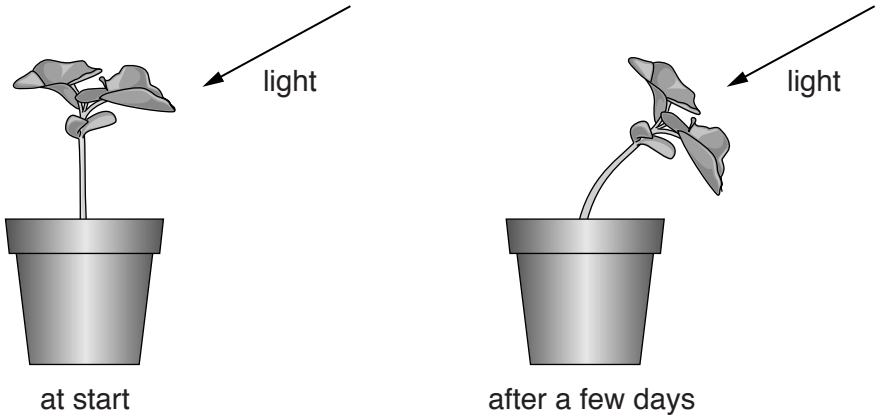


Fig. 7.1

(a) Name the response shown by the plant.

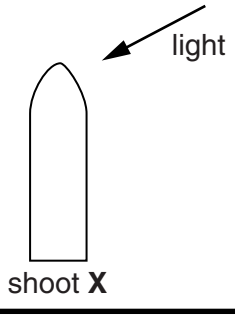
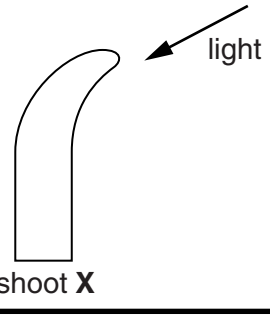
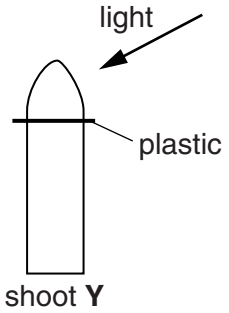
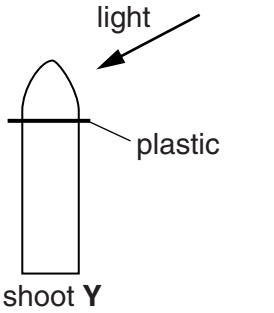
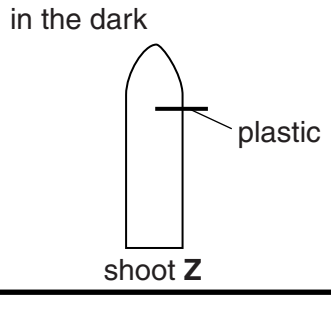
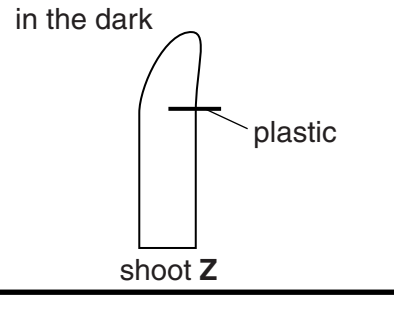
.....[1]

(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
	
	
	

(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]

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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**.

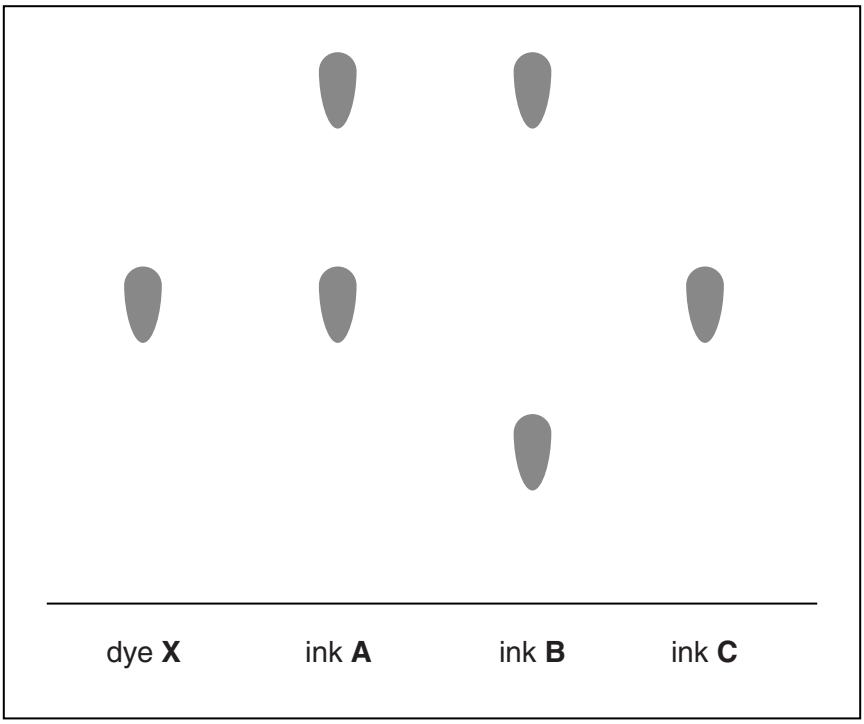

Fig. 8.1

(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.

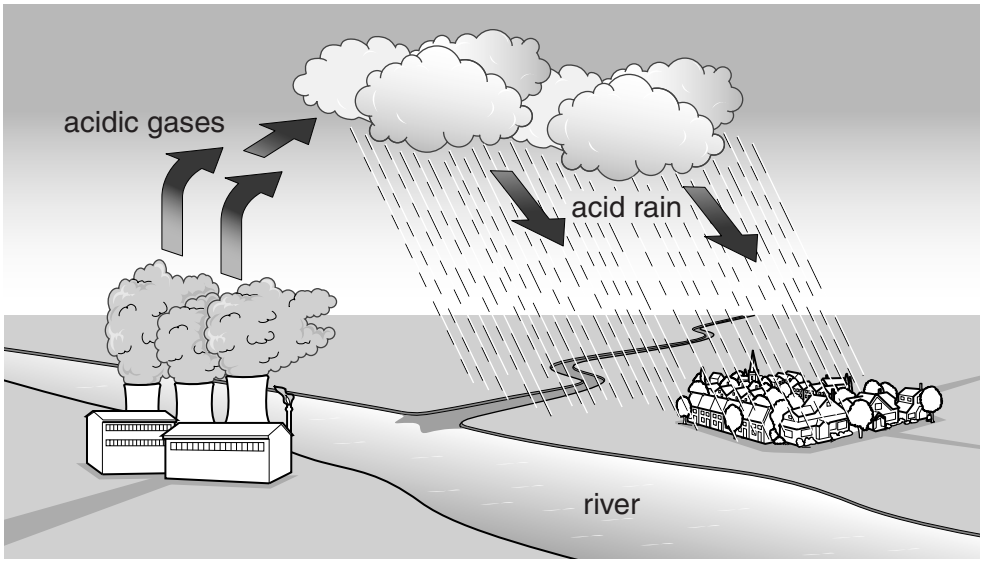

Fig. 9.1

(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.

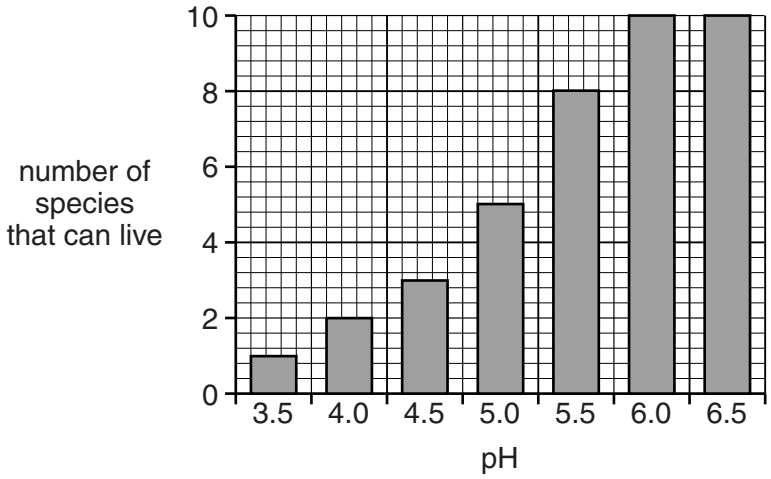

Fig. 9.2

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										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 †															

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

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

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.).