UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

*6686015037*

**COMBINED SCIENCE** **0653/31**

Paper 3 (Extended) **May/June 2010**

**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 soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

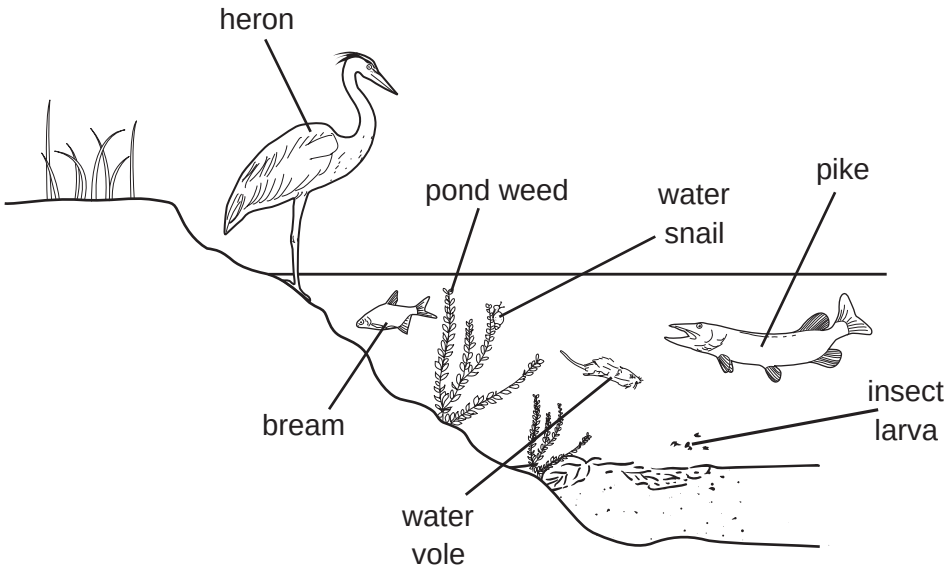
Answer **all** questions.
A copy of the Periodic Table is printed on page 24.

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.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| Total | |

This document consists of **24** printed pages.

**1** Fig. 1.1 shows some of the animals and plants that live in or close to a pond.




not to scale

**Fig. 1.1**

**(a)** Give the correct term for each of the following.

all the animals and plants that live in and around the pond .....

all the living things, and their environment, interacting with each other

..... [2]

**(b)** The pond weed is a producer. Water snails and water voles are primary consumers. The heron and pike are secondary consumers.

Draw a food web that includes only these five organisms.

[3]

**(c)** The pond is at the bottom of a sloping field which was ploughed.

During very heavy rain, a lot of soil from the field was washed into the pond. It mad the water cloudy, and stopped the light from reaching the leaves of the water plants, so that the plants died.

After a while, the fish and other animals also died.

**(i)** Give **two** reasons why the fish and other animals died.

1 .....

.....

2 .....

..... [2]

**(ii)** Suggest **one** way in which the farmer could stop the soil erosion from the field.

.....

.....

..... [1]

**2** **(a)** Fig. 2.1 shows a bicycle with a front lamp and a rear lamp powered by a battery.

**Fig. 2.1**

Fig. 2.2 shows how the lamps are connected.

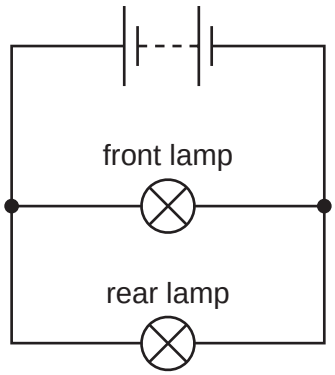



**Fig. 2.2**

**(i)** What name is given to this type of circuit?

.....  [1]

**(ii)** The resistance of each lamp in the circuit is 4 Ω.

Calculate the combined resistance of the two lamps.

State the formula that you use and show your working.

formula

working

.....  [3]

**(b)** Fig. 2.3 shows a metal nut on a bicycle wheel which is difficult to unscrew.

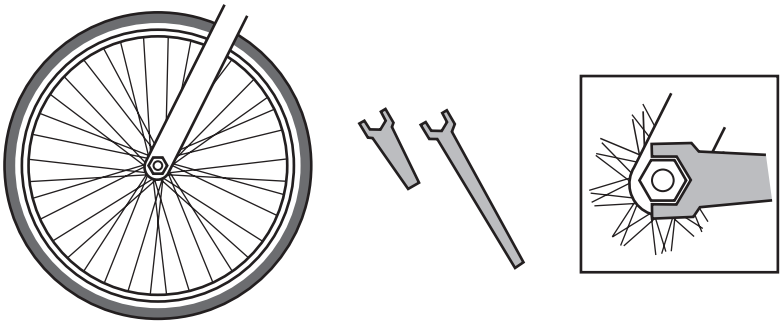


**Fig. 2.3**

Explain why a long spanner is better than a short spanner to unscrew the nut.

.....

.....

..... [2]

**(c)** As the bicycle moves along the road at 4 m/s, the brakes are suddenly applied. The bicycle comes to a stop after 10 m. The average frictional force stopping the bicycle is 250 N. As the bicycle slows down, work is done.

Calculate the work done as the bicycle slows down from 4 m/s to a stop.

State the formula that you use and show your working.

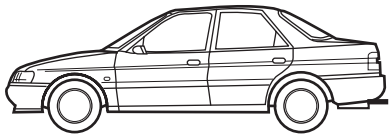
formula

working

..... [2]

**3** Aluminium, iron and sodium are metallic elements. Aluminium and iron are widely us… no useful objects can be made out of metallic sodium.

aluminium alloys are used in aircraft



iron is used to make steel for cars

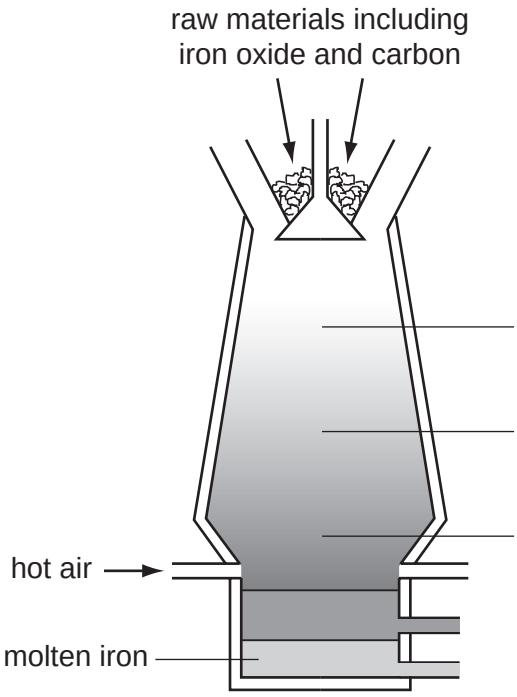
**(a)** Use your knowledge of the alkali metals to state **one** reason why no useful objects can be made out of metallic sodium.

.....

..... [1]

**(b)** The diagram in Fig. 3.1 shows a cross section through a blast furnace in which iron is extracted from iron oxide.

Symbolic equations for three important chemical reactions which occur in the blast furnace are also shown in Fig. 3.1. **One** of these equations is not balanced.




$Fe_2O_3 + CO \rightarrow 2Fe + CO_2$

$CO_2 + C \rightarrow 2CO$

$C + O_2 \rightarrow CO_2$

**Fig. 3.1**

**(i)** Balance the incorrect equation in Fig. 3.1 by writing the required numbers in the equation on the diagram. [1]

**(ii)** The three equations in Fig. 3.1 all represent redox reactions.

State **two** substances shown in Fig. 3.1 which have been **reduced**.

Explain your answer briefly.

.....

.....

..... [2]

**(c)** Aluminium is produced from aluminium oxide using electrolysis as shown in Fig. 3.2.

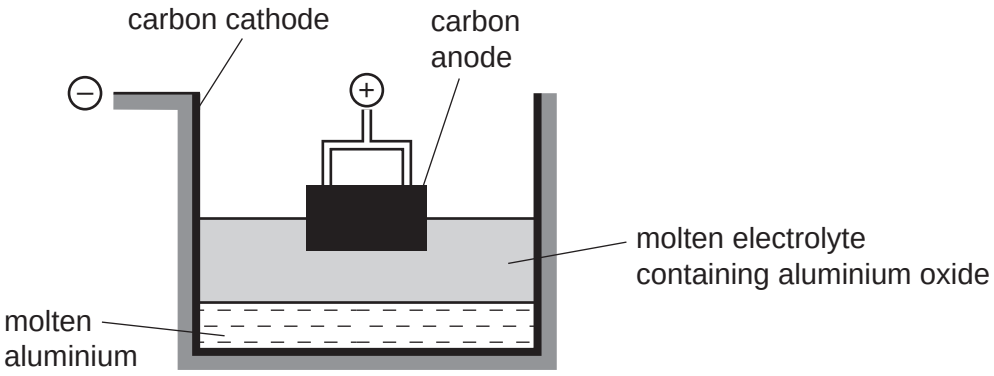



**Fig. 3.2**

**(i)** The lining of the apparatus acts as the cathode in this process.

Describe what happens to aluminium ions when they meet the cathode surface.

.....

.....

..... [2]

**(ii)** Explain why aluminium cannot be extracted in a blast furnace in the same way as iron.

.....

.....

..... [2]

**(iii)** The chemical formula of aluminium oxide is $Al_2O_3$ and the electrical charge
oxide ion is -2.

Deduce the electrical charge of an aluminium ion.

Explain your answer.

.....

.....

..... [2]

**4** Fig. 4.1 shows samples of three of the elements in Group VII (Group 7) of the P... Table.

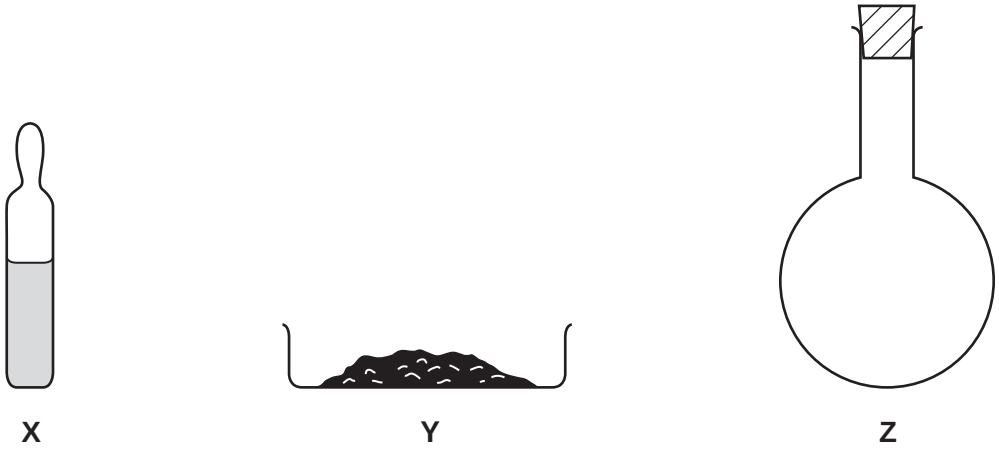



**Fig. 4.1**

**(a)** The elements in Fig. 4.1 are at the same temperature. One element is a solid, one is a liquid and one is a gas.

**(i)** State which element, **X**, **Y** or **Z**, has the highest melting point. ..... [1]

**(ii)** Suggest the names of the elements, **X**, **Y** and **Z**.

**X** .....

**Y** .....

**Z** ..... [1]

**(b)** An atom of fluorine has a proton (atomic) number of 9 and a nucleon (mass) number of 19.

**(i)** State the number of neutrons in one atom of fluorine.

..... [1]

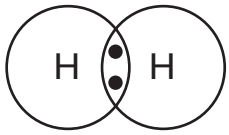
**(ii)** Calculate the relative molecular mass of a fluorine molecule.

..... [1]

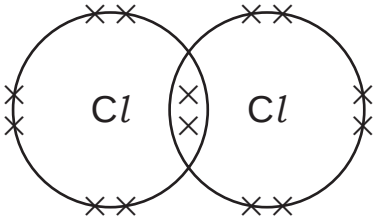
**(c)** Hydrogen chloride gas may be produced by combining the gases hydroge
chlorine.

**(i)** Fig. 4.2 shows the chemical bonding in hydrogen and chlorine molecules.

In the space in Fig. 4.2 draw a similar diagram to show the bonding in one molecule of hydrogen chloride.




hydrogen molecule




chlorine molecule

hydrogen chloride molecule

**Fig. 4.2**

[2]

**(ii)** Hydrochloric acid is produced when hydrogen chloride gas reacts with water.

Write the symbol and electrical charge of an ion which forms in the mixture when hydrogen chloride gas reacts with water.

..... [1]

**(d)** A student is asked to try and produce some bromine by mixing two solutions from the list below.

**potassium bromide**

**potassium chloride**

**potassium iodide**

**chlorine**

**iodine**

When the student mixed her chosen solutions, she successfully produced bromine.

**(i)** State which solutions the student chose.

.....

[1]

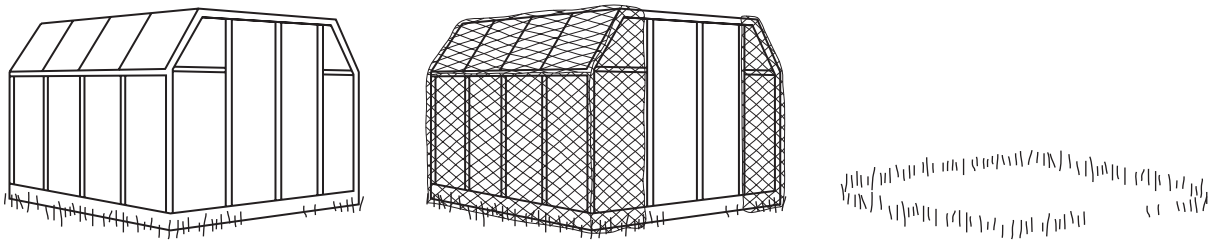
**(ii)** Explain your answer to **(i)**.

.....

.....

[1]

**5** An investigation was carried out in Tamil Nadu, India, into the best conditions for g tomatoes. The tomato plants were grown in unheated glasshouses or outside. Netting used to provide shade in one of the glasshouses.



glasshouse **A**
no shade

glasshouse **B**
all four side walls shaded with netting

outside
no shade

In each glasshouse, and outside, the mean temperature in each month between January and October was measured. Fig. 5.1 shows the results.

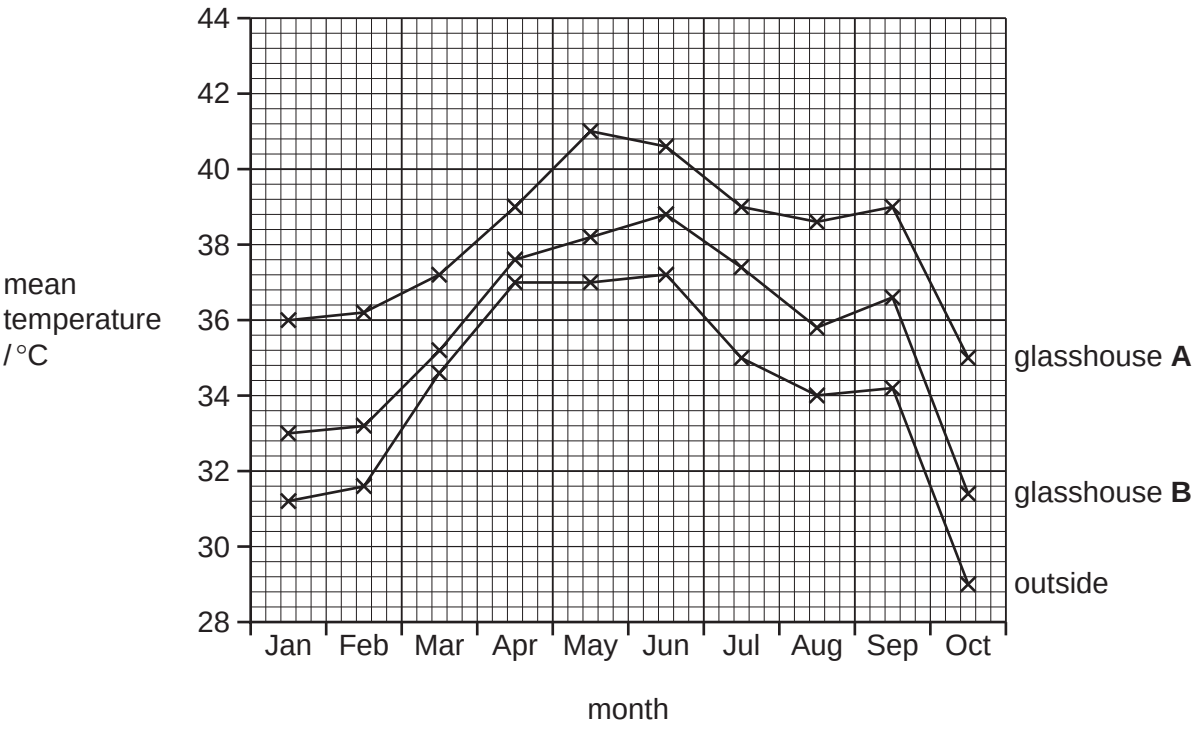



**Fig. 5.1**

**(a)** State the month in which the highest mean temperature was reached

in glasshouse **A**, .....

outside. ..... [1]

**(b)** Light from the Sun passes through the glass of the glasshouse, into the air insi
soil and other surfaces in the glasshouse re-emit some of this radiation as lo
wavelength, infra-red, radiation. Some of this radiation cannot pass through glass.

**(i)** Use this information to explain why the air inside the glasshouses **became** warmer than the air outside.

.....

.....

..... [2]

**(ii)** Use your knowledge of convection to explain why the air inside the glasshouses **stayed** warmer than the air outside.

.....

.....

..... [2]

**(c)** Table 5.2 shows the mass of tomatoes produced by each plant in the two glasshouses and outside.

**Table 5.2**

| | **mass of tomatoes produced per plant / g** |
|---|---|
| glasshouse **A** | 1020 |
| glasshouse **B** | 2310 |
| outside | 1380 |

**(i)** Tomatoes are a fruit, produced from the fertilised flowers of tomato plants. Tomato flowers are pollinated by bees.

Use the information in Fig. 5.1 to suggest why the plants produced more tomatoes in glasshouse **B** than in glasshouse **A**.

.....

..... [2]

**(ii)** Suggest **two** factors, other than temperature, that could be different in the glasshouses compared to outside, and that could have affected the results.

1 .....

2 ..... [2]

**(d) (i)** Tomato fruits are red and juicy. Explain how this helps tomato seeds dispersed away from the parent plant.

.....

.....

..... [2]

**(ii)** Explain why it is useful to plants for their seeds to be dispersed away from the parent plant.

.....

.....

..... [2]

**6** Fig.6.1 shows two dolphins communicating with each other using sound waves.

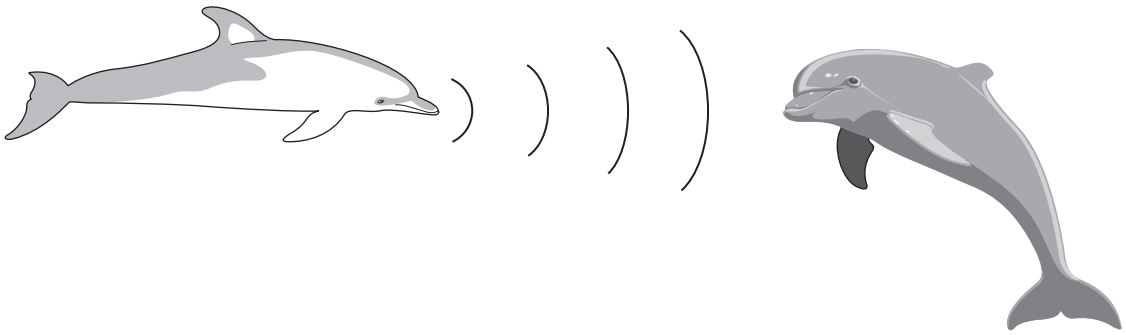


**Fig. 6.1**

**(a)** Sound travels at 1500 m/s though water. It takes 0.5 seconds for the sound wave to travel from one dolphin to the other dolphin.

Calculate the distance between the two dolphins.

State the formula that you use and show your working.

formula

working

..... [2]

**(b)** Fig. 6.2 shows the motion of a dolphin travelling through water for 30 seconds.

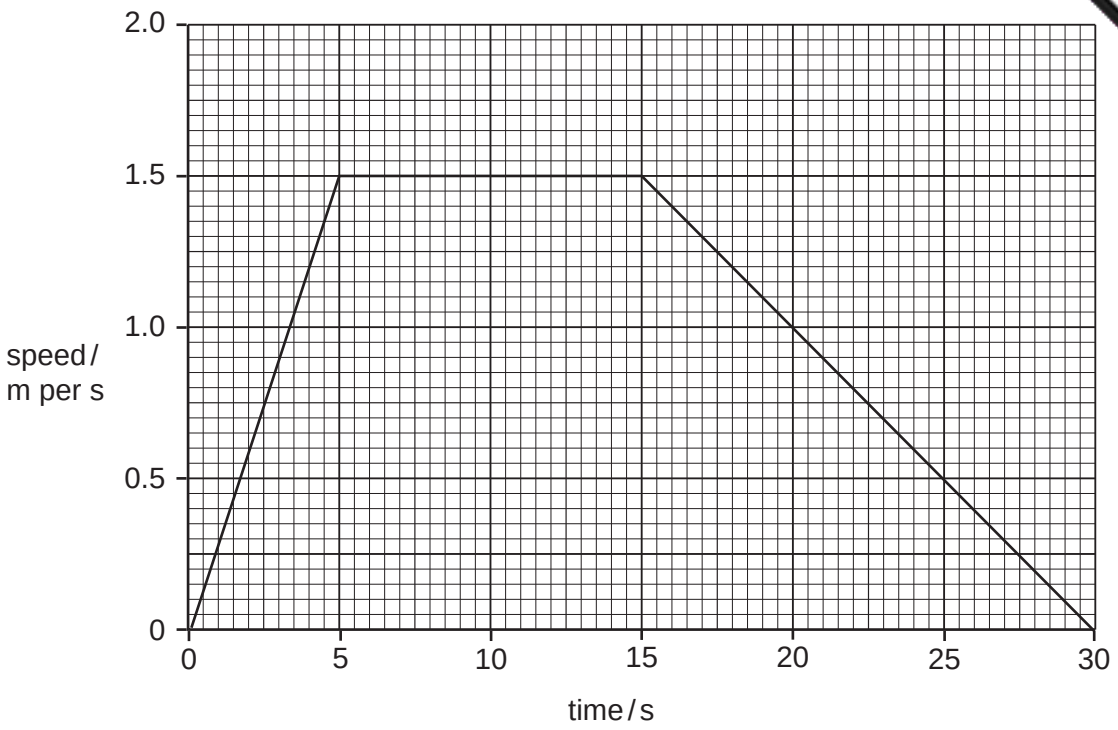



**Fig. 6.2**

**(i)** On the graph, use a letter **A** to label a period when the dolphin was accelerating.[1]

**(ii)** Describe the motion of the dolphin between 5 and 15 seconds.

.....

[1]

**(iii)** Calculate the total distance travelled by the dolphin.

Show your working.

.....

[2]

**(c)** Rays of light from the Sun hit the surface of the water. Some light rays are refra
the surface and some are reflected. The incident and refracted rays are shown on
diagram in Fig. 6.3.

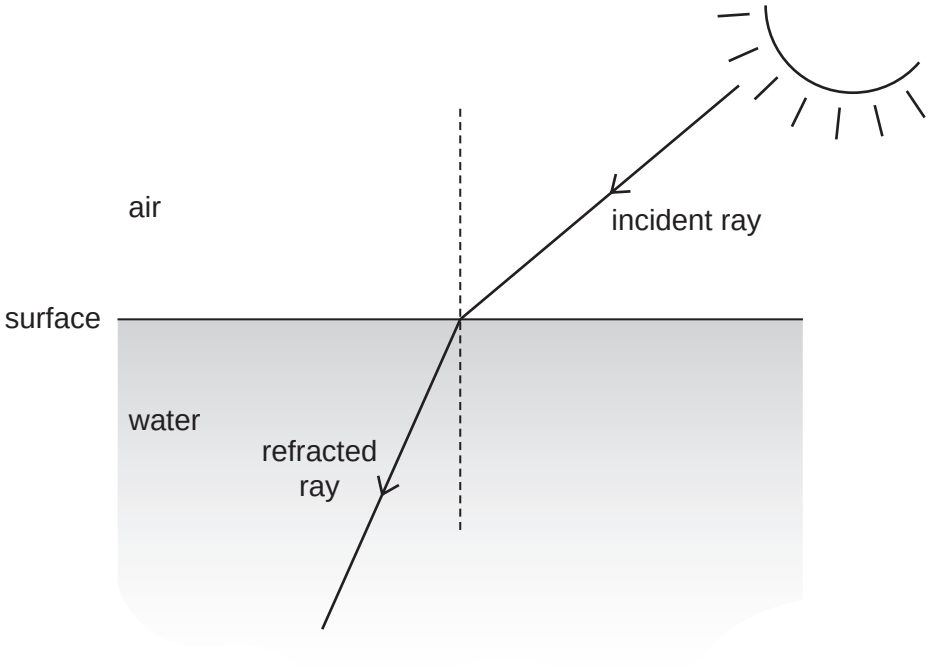



**Fig. 6.3**

**(i)** On Fig. 6.3 use a ruler to draw a ray which is reflected from the surface. [1]

**(ii)** Label clearly the angle of incidence, **i**, and angle of reflection, **r**. [1]

**7** The skin helps to regulate the body temperature. This is an important part of homeost

**(a)** The skin is an organ.

Explain the meaning of the term *organ*.

.....

..... [1]

**(b)** Fig. 7.1 shows the skin when the body is too cold and when it is too hot.

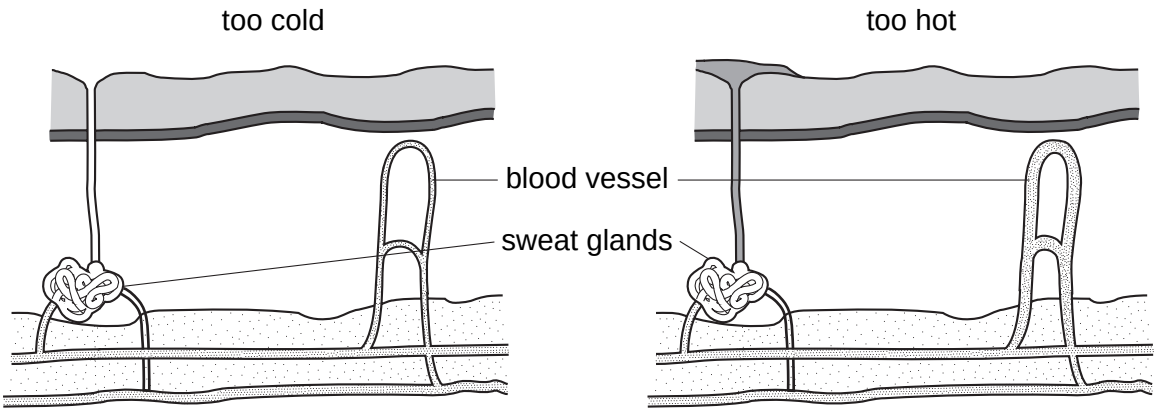



**Fig. 7.1**

Explain how each of the changes shown in Fig. 7.1 helps the body to cool down when it is too hot.

**(i)** the change in the activity of the sweat gland

.....

.....

..... [2]

**(ii)** the change in the width of the blood vessels

.....

.....

..... [2]

**(c)** Another example of homeostasis is keeping the blood sugar level constant.

**(i)** Name the sugar that is transported in the blood.

.....[1]

**(ii)** Name the hormone that reduces the blood sugar level if it gets too high.

.....[1]

**(iii)** Suggest why it is harmful to the body if the blood sugar level falls very low.

.....

.....

.....[2]

**8** The bar charts in Fig. 8.1 show the approximate percentages of the main gases in the atmospheres of three planets, **X**, **Y** and **Z**, in our solar system.

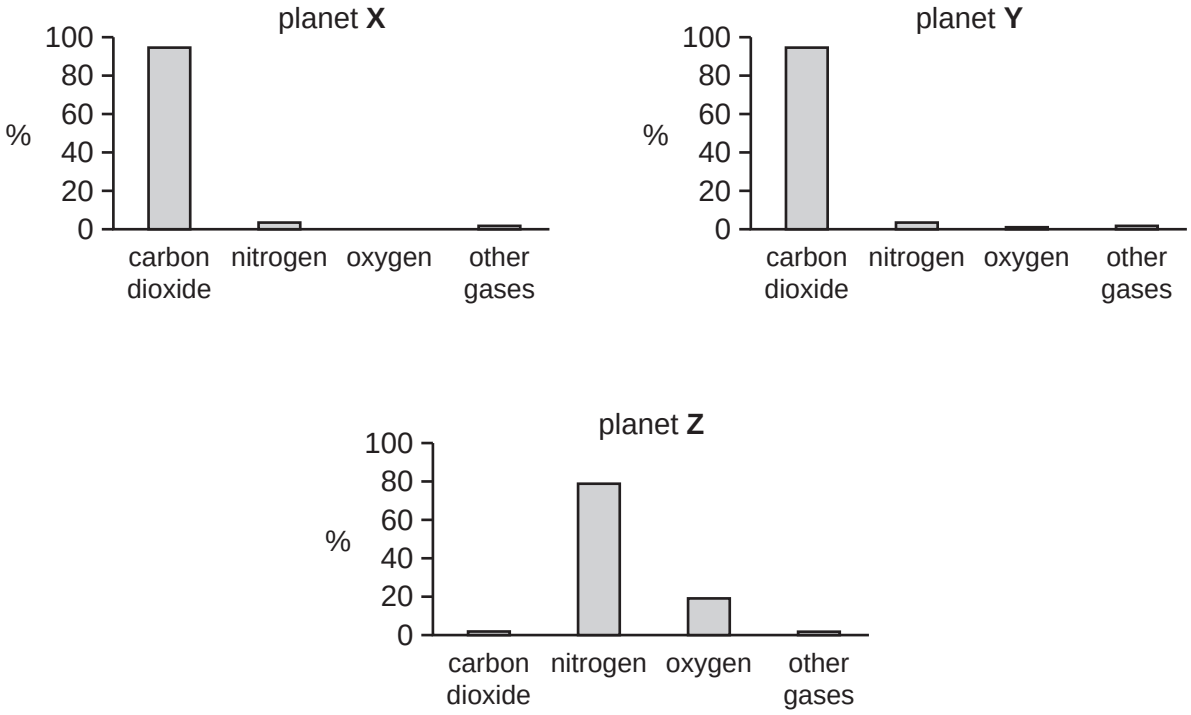



**Fig. 8.1**

**(a) (i)** Explain briefly how the information in Fig. 8.1 shows that planet **Y** is **not** the Earth.

.....

..... [1]

**(ii)** Name **one** of the 'other gases' in unpolluted air on the Earth.

..... [1]

**(b)** Fig. 8.2 shows apparatus which can be used to measure the percentage of oxy… the atmosphere of planet **Z**.

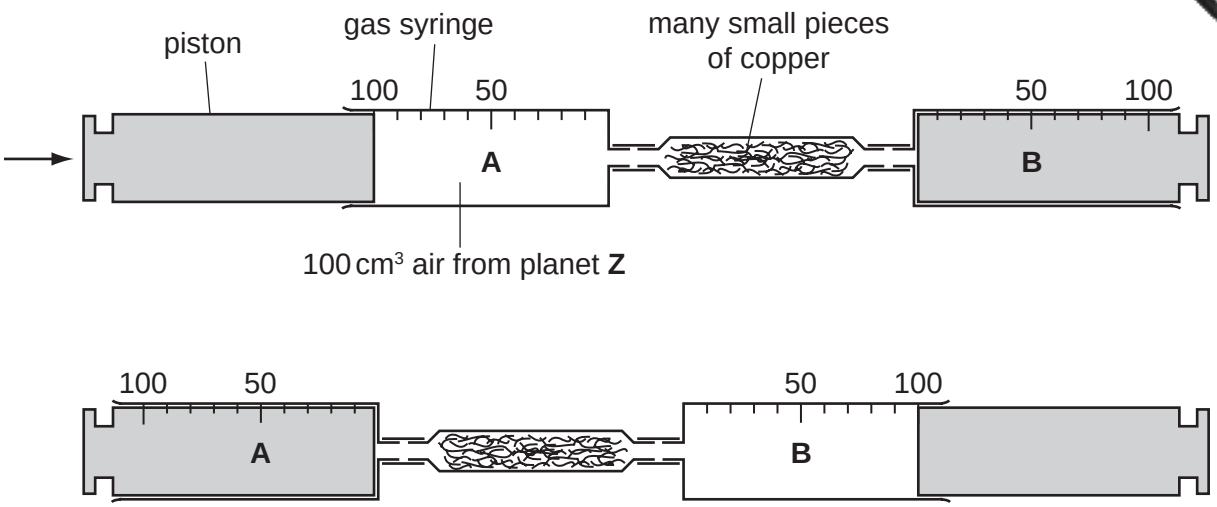



**Fig. 8.2**

When the piston of gas syringe **A** is pushed in the direction of the arrow, the air flows through the pieces of copper into syringe **B**. The lower diagram in Fig. 8.2 shows how the apparatus appears when this is done.

The pieces of copper are then heated very strongly. The air is pushed many times between **A** and **B** over the hot copper. The copper reacts with all the oxygen in the air.

The apparatus is then allowed to cool to room temperature.

**(i)** Predict the volume of gas which remains in the apparatus at the end of the experiment.

Explain your answer.

volume .....

explanation .....

.....

.....

..... [3]

**(ii)** In the experiment, many small pieces of copper, rather than a single large[illegible] are used.

Explain, in terms of particles, the effect this has on the rate of the oxidation reaction.

.....

.....

.....

..... [3]

9 **(a)** Alpha, beta and gamma are three types of radiation emitted during radioactive de

**(i)** State the meaning of the term *radioactive decay*.

.....

.....

[1]

**(ii)** Alpha radiation is described as ionising radiation.

Explain the meaning of the term *ionising radiation*.

.....

.....

.....

[1]

**(b)** **(i)** Explain why alpha radiation is deflected by an electric field but gamma radiation is not.

.....

.....

.....

[1]

**(ii)** Explain why beta radiation is deflected the opposite way to alpha radiation by an electric field.

.....

.....

.....

[1]

**(iii)** Explain why it is more dangerous to swallow a substance that emits alpha radiation than one that emits gamma radiation.

.....

.....

.....

.....

[2]

**(c)** We are exposed to radiation all the time and we receive it in various ways.

What name is given to the radiation that is around us all the time?

.....

.....

[1]

## 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 Radius 88 | 227 Ac Actinium 89 † | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

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

Key: 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.).