



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CO-ORDINATED SCIENCES

0654/21

Paper 2 (Core)

May/June 2010

2 hours

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 | |
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| 9 | |
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| Total | |

This document consists of **22** printed pages and **2** blank pages.



1 Fig. 1.1 shows the structure of part of the human nervous system.

For
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Use

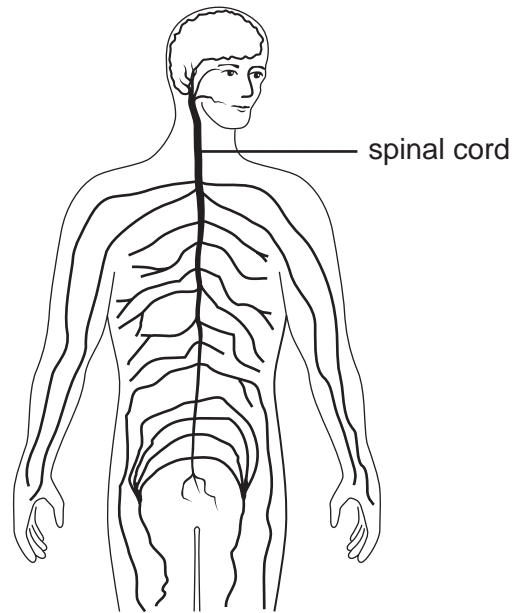


Fig. 1.1

(a) The spinal cord is part of the central nervous system.

On Fig. 1.1, label and name **one** other part of the central nervous system. [1]

(b) Complete the following sentences, using some of these words.

capillaries **current** **effectors** **feelings** **hormones**
nerves **receptors** **responses** **stimuli**

External are picked up by These generate electrical impulses which travel along to the central nervous system.

Electrical impulses are then sent to muscles or glands, which take action. Muscles and glands are [4]

- (c) Humans can only reproduce by sexual reproduction. Many plants, and also some animals, can also reproduce by asexual reproduction.

For
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Complete the table to show which statements are **always** true for sexual reproduction, and which are **always** true for asexual reproduction.

Put a tick (✓) where the statement is **always** true.

| | sexual reproduction | asexual reproduction |
|--|------------------------|-------------------------|
| This involves gametes. | | |
| There is only one parent. | | |
| The offspring are genetically identical. | | |

[3]

2 Rocks **A**, **B** and **C**, shown in Fig. 2.1, represent the three main classes of rock which are found in the Earth's crust.

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Use

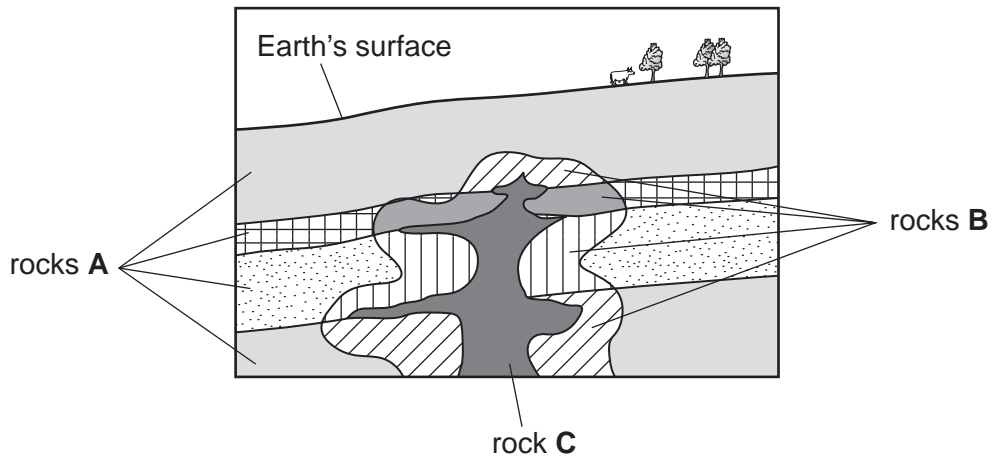


Fig. 2.1

After rocks **A** had formed, molten material from within the Earth moved up through cracks.

Rock **C** formed when this molten material cooled.

(a) (i) Rocks **A** are sedimentary rocks.

Name the classes to which rocks **B** and rock **C** belong.

B

C

[2]

(ii) Suggest what caused rocks **B** to be formed.

.....

..... [1]

- (b) Weathering and erosion are processes which cause rocks on the Earth's surface to break up. Eventually, soil may form which contains compounds which were once part of rocks.

For
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Use

In an investigation of some soil, a chemistry student carried out two experiments as shown in Fig. 2.2.

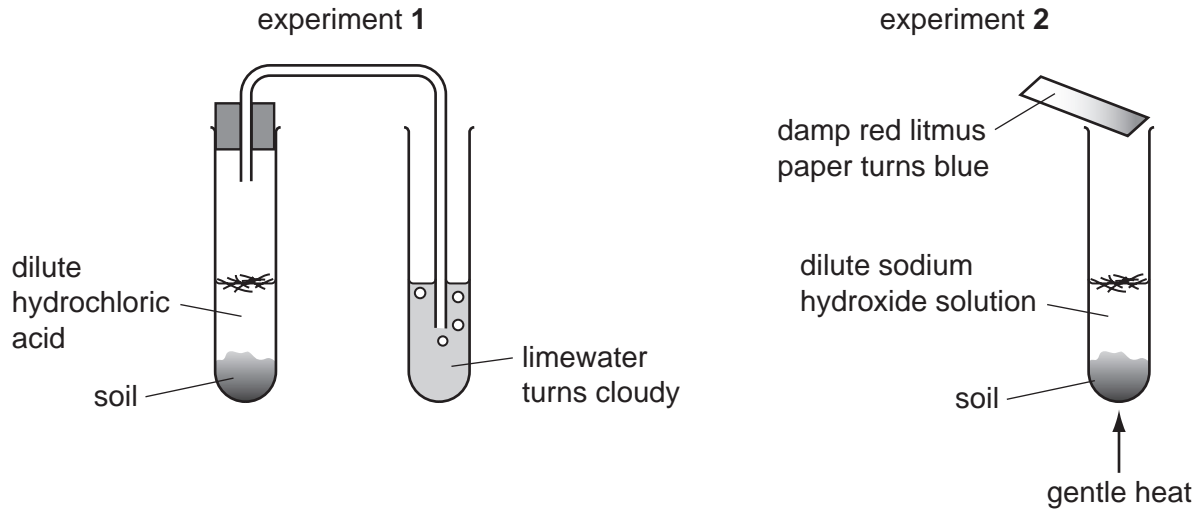


Fig. 2.2

- (i) Explain why the result in experiment 1 provides evidence that the soil may have contained material eroded from limestone rock.

.....

 [2]

- (ii) Name the gas given off in experiment 2.

..... [1]

- (iii) Name an ion present in the soil sample which would give the result in experiment 2.

..... [1]

- 3 (a) A climber does 12000 J of work in 1 minute as he climbs a mountain.

Calculate the power output of the climber.

State the formula that you use and show your working.

formula

working

..... W [2]

- (b) The climber makes a loud noise. The echo from a mountain 300 m away reaches him 2 seconds later.

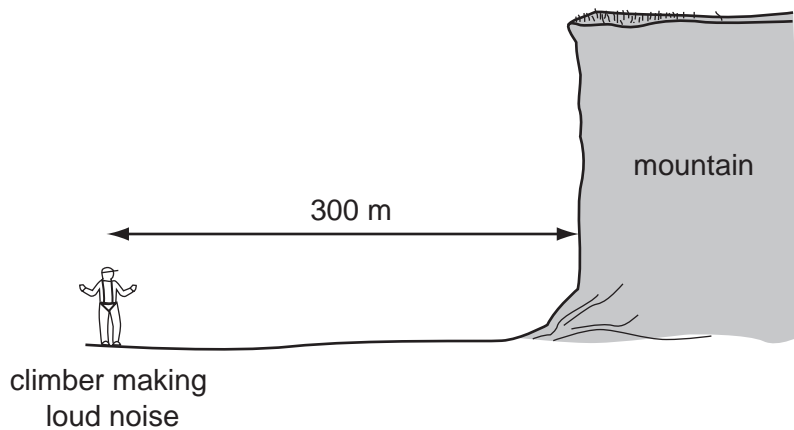


Fig. 3.1

Calculate the speed of sound in air using these results.

State the formula that you use and show your working.

formula

working

..... m/s [2]

(c) The climber uses a torch at night. His torch contains four cells, a switch and a lamp all connected in series.

(i) Draw a circuit diagram for this circuit using the correct symbols.

[3]

(ii) The potential difference across each of the cells in the circuit is 1.5 V.

State the total potential difference across the four cells, connected in series.

..... V [1]

(d) The climber has a small tent of mass 5 kg which packs tightly into a bag of volume 10 dm^3 .

Calculate the density of the packed tent.

State the formula that you use and show your working.

formula

working

..... kg/dm^3 [2]

For
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- (e) The climber is able to start a fire by focusing the Sun's rays onto some dried twigs and grass, using a lens (magnifying glass).

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Complete Fig. 3.2 to show what happens to the rays of light after they have passed through the lens.

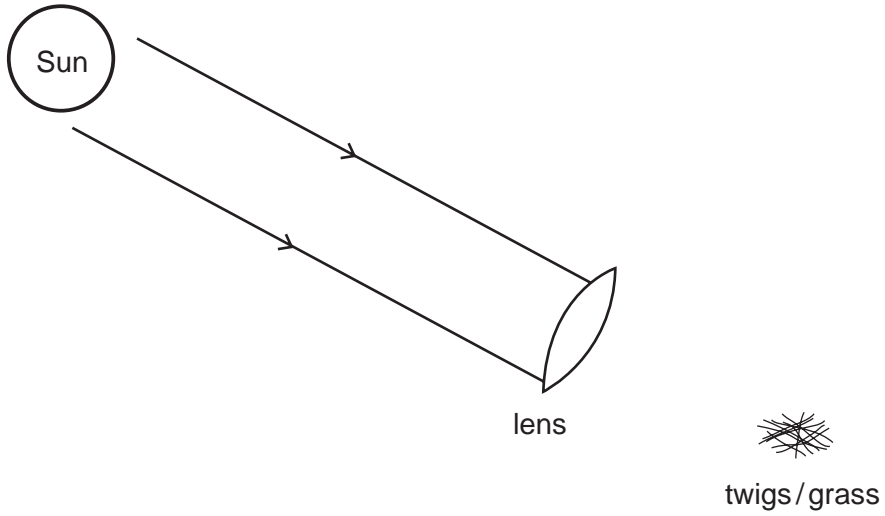


Fig. 3.2

[1]

4 Large molecules called polymers exist in both natural substances and in materials which have been made in industry.

(a) Starch, cellulose and proteins are all natural substances made of polymer molecules.

(i) State which one of the substances in (a) could contain the element sulfur.

..... [1]

(ii) Polymer molecules are made when smaller molecules join together.

What is the general name used for small molecules which join to form polymers?

..... [1]

(iii) State the name of the small molecules which join to form starch.

..... [1]

(b) Cellulose is one of the main substances in wood. Large numbers of trees are cut down each year to provide wood. Some of these trees are grown on plantations but others are taken from the rain forests.

(i) State **two** important uses for wood.

1

2 [2]

(ii) Suggest **one** disadvantage of taking trees from the rain forests rather than from plantations.

.....

..... [1]

(c) Nylon and melamine resin are polymers produced industrially. Nylon is a **thermoplastic** and melamine resin is a **thermoset**.

Describe what would be observed when nylon and melamine resin are heated, cooled and then heated for a second time.

observations for nylon

.....

.....

observations for melamine resin

.....

..... [3]

5 Fig. 5.1 shows a section through a human heart.

For
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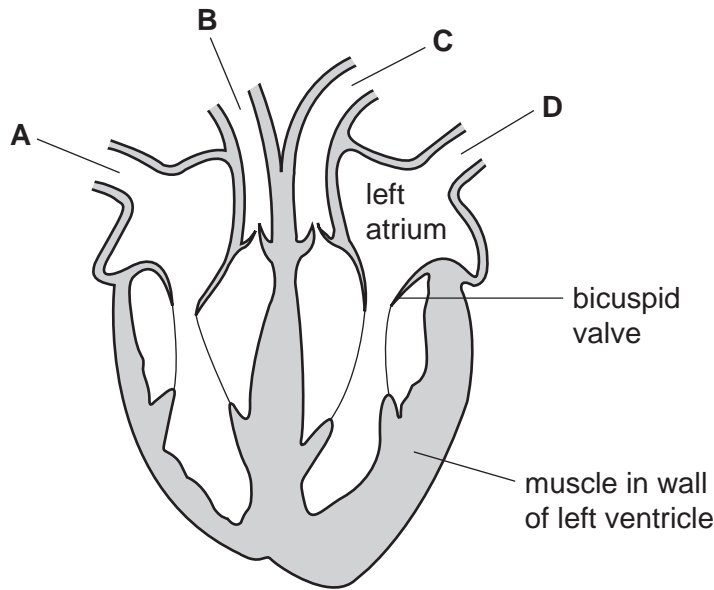


Fig. 5.1

(a) (i) Which **two** of the blood vessels **A**, **B**, **C** and **D** contain oxygenated blood?

..... and [1]

(ii) Which **two** of the blood vessels **A**, **B**, **C** and **D** are veins?

..... and [1]

(b) When the heart beats, the thick muscle in the walls of the ventricles contracts. This squeezes blood out of the heart, into the pulmonary artery and the aorta.

Explain why the blood does not go up into the atria when the ventricles contract.

.....

 [2]

(c) Red blood cells contain a protein that transports oxygen.

(i) Name this protein.

..... [1]

(ii) Name the inorganic ion (mineral) that is needed in the diet to enable the body to make this protein.

..... [1]

(iii) Explain why body cells need oxygen.

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

(d) In the disease AIDS, the HIV virus invades white blood cells.

Explain why this makes a person with AIDS more likely to suffer from infectious diseases such as tuberculosis.

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

(e) Blood plasma contains dissolved glucose and urea.

(i) A boy ate a bar of chocolate. This made his blood glucose level rise above normal.

Explain what would happen in his body, to bring the level of glucose in the blood back to normal.

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

(ii) Name the organ in which urea is made.

..... [1]

- 6 Fig. 6.1 shows how a pH meter is used to measure the pH of a liquid contained in a test-tube.

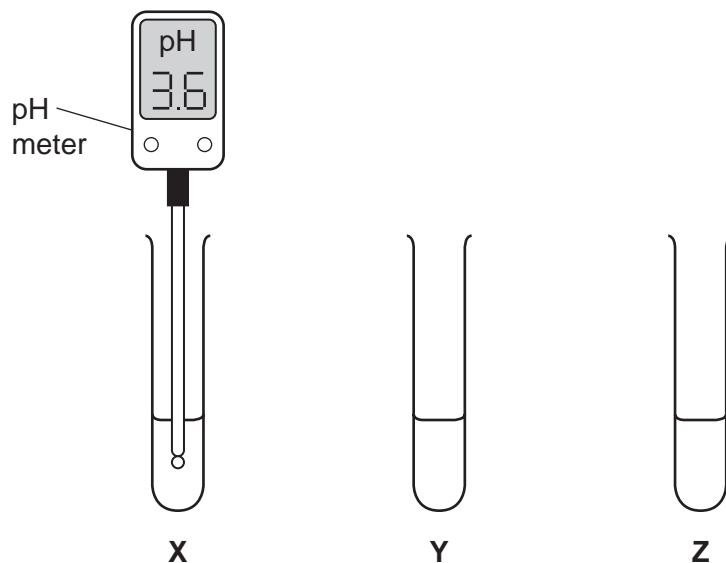


Fig. 6.1

A pH meter was used to measure the pH values of three solutions, **X**, **Y** and **Z**. The results are shown in Table 6.2.

Table 6.2

| solution | pH |
|----------|------|
| X | 3.6 |
| Y | 4.1 |
| Z | 12.6 |

- (a) (i) State **one** pair of solutions shown in Table 6.2 that could be used to neutralise each other.

Explain your answer.

solutions and

explanation

..... [1]

- (ii) In order to make a neutral mixture, the solutions in (i) must be mixed carefully.

Suggest how the pH meter should be used to show when a neutral solution has been formed.

.....

.....

..... [2]

For
Examiner's
Use

- (iii) Suggest **one** advantage of using a pH meter rather than litmus paper when determining the acidity of a solution.

.....
 [1]

- (b) (i) Hard water contains small amounts of soluble salts.

In the list below, underline the compounds which cause hardness when dissolved in water.

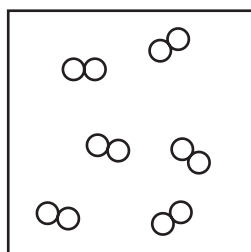
sodium chloride **magnesium chloride** **potassium sulfate**
calcium sulfate **potassium nitrate** **sodium sulfate**

[2]

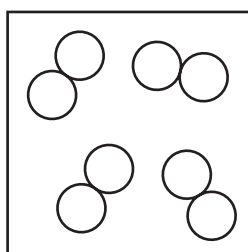
- (ii) State **one** method which can be used to remove hardness from water.

.....
 [1]

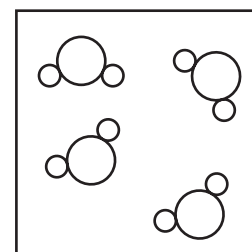
- (c) The three diagrams in Fig. 6.3 represent molecules of the elements hydrogen and oxygen, and the compound water.



hydrogen molecules



oxygen molecules



water molecules

Fig. 6.3

Use Fig. 6.3 to explain the difference between an element and a compound.

.....

 [2]

- 7 (a) Many houses are built with cavity walls with a gap between the outside wall and the inside wall. This gap is often filled with insulating board made of foam between two shiny metal foil surfaces.

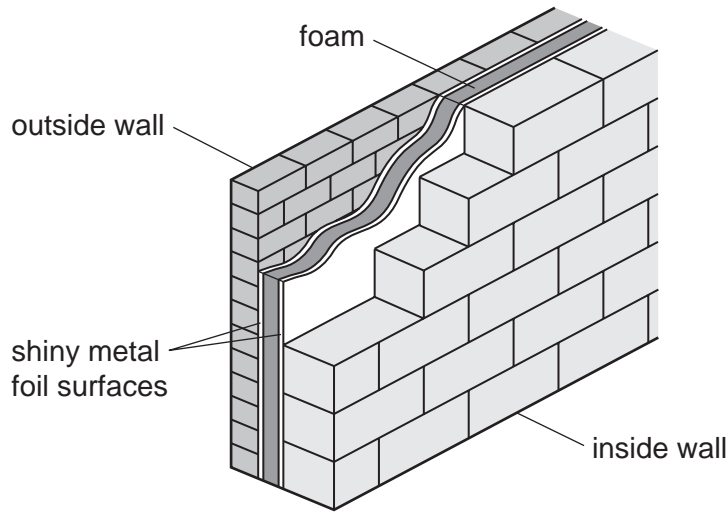


Fig. 7.1

The cavity wall insulation helps to reduce heat transfer through the wall.

Use the ideas of conduction, convection and radiation to explain how cavity wall insulation helps reduce heat transfer.

.....

.....

.....

.....

..... [2]

- (b) Why is it dangerous to use electrical appliances in bathrooms?

..... [1]

- (c) There are many light bulbs in a house. One light bulb is marked '230 V, 60 W'. It contains a length of tungsten wire about 50 cm long. The wire is wound into a coil as shown in Fig. 7.2.

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Use

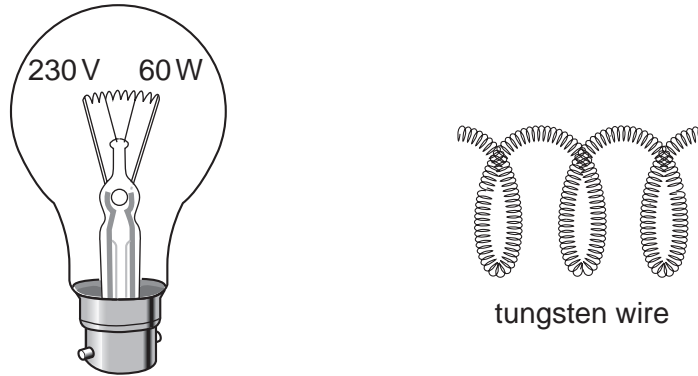


Fig. 7.2

- (i) State the power consumption of the light bulb.

..... [1]

- (ii) When the bulb is switched on, the resistance of the wire is about $1200\ \Omega$.

If the bulb was made with twice the length of tungsten wire, what effect would it have on the resistance?

..... [1]

- (iii) State the type of energy transfers occurring in the light bulb when it is switched on.

type of energy input to light bulb

types of energy output from light bulb and [3]

- (iv) The visible light emitted by the light bulb is one part of the electromagnetic spectrum.

Name **one** other part of the electromagnetic spectrum and give a use for it.

part of the electromagnetic spectrum

use [2]

(d) Fig. 7.3 shows an electromagnet being used in a door lock.

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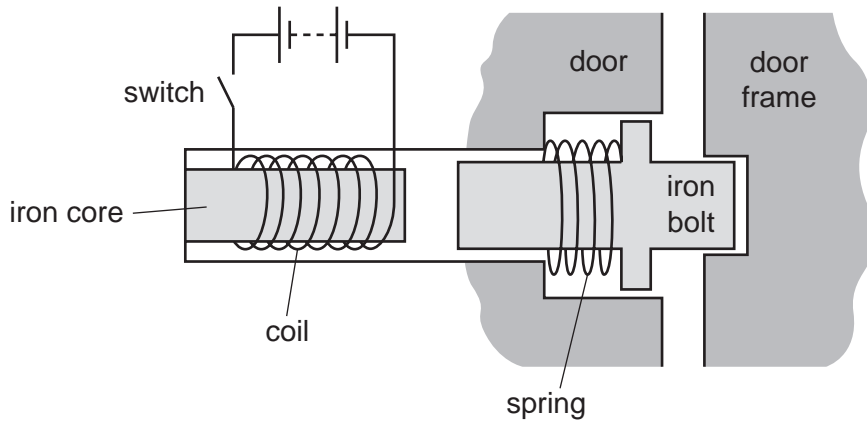


Fig. 7.3

(i) When the switch is pressed, the iron bolt moves to the left.

Explain why this happens.

.....

 [3]

(ii) Would this door lock work if the bolt was made of aluminium?

Explain your answer.

.....
 [1]

(iii) The electrical connections to the coil were accidentally reversed.

Would the door lock with the iron bolt still work?

Explain your answer.

.....
 [1]

(iv) Suggest how the strength of the electromagnet could be increased.

..... [1]

- 8 (a) Alpha, beta and gamma radiation are three types of radiation emitted during radioactive decay.

Name a suitable detector for these three types of radiation.

..... [1]

- (b) Alpha radiation is described as ionising radiation.

(i) Explain the meaning of the term *ionising radiation*.

..... [1]

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

..... [2]

- (c) In a nuclear power station, nuclear fuel such as uranium gives out energy.

State what happens to the uranium atoms.

..... [1]

- (d) At a nuclear power station, technicians will be working close to radioactive sources.

Describe **one** way in which these workers can be protected from the radiation emitted.

..... [1]

- 9 An experiment was carried out in Sweden into the effects of different types of fertiliser on the mass of potatoes harvested.

The land was divided into three plots. Two plots were treated with different fertilisers. The third plot had no fertiliser added.

Plot **A** manure (cattle droppings and straw)

Plot **B** NPK fertiliser (inorganic fertiliser containing nitrate, phosphate and potassium)

Plot **C** no fertiliser added

Table 9.1 shows some of the results of the experiment.

Table 9.1

| plot | treatment | mass of potatoes harvested per hectare per year / tonnes |
|----------|----------------|--|
| A | manure | 35.5 |
| B | NPK fertiliser | 36.2 |
| C | no fertiliser | 28.7 |

- (a) (i) The inorganic fertiliser contained nitrate ions, NO_3^- .

Name the part of the plant through which nitrate ions are absorbed.

..... [1]

- (ii) Explain why plants can use nitrate ions, but not nitrogen gas, N_2 .

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

- (iii) Explain why plants need nitrogen.

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

- (iv) Suggest why potato plants that were given NPK fertiliser produced a greater mass of potatoes than potato plants given no fertiliser.

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

(v) The effects on the plants of adding NPK fertiliser to the field could be seen almost straight away. The effects of adding manure took longer.

Suggest why the plants took longer to respond to the addition of manure than to the addition of NPK fertiliser.

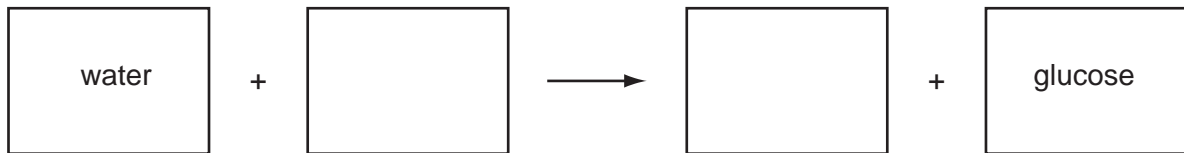
.....
.....
.....
..... [2]

(b) Plants absorb water from the soil, through their root hairs.

(i) Name the process by which the water is absorbed.

..... [1]

(ii) Complete the word equation to show how water is used in photosynthesis.



[2]

(iii) Name the type of cell, in a plant leaf, in which photosynthesis takes place.

..... [1]

(iv) Describe how water vapour is lost from the leaves of a plant.

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

- 10 (a) The grid in Fig. 10.1 shows the arrangement of the first twenty elements in the Periodic Table.

For
Examiner's
Use

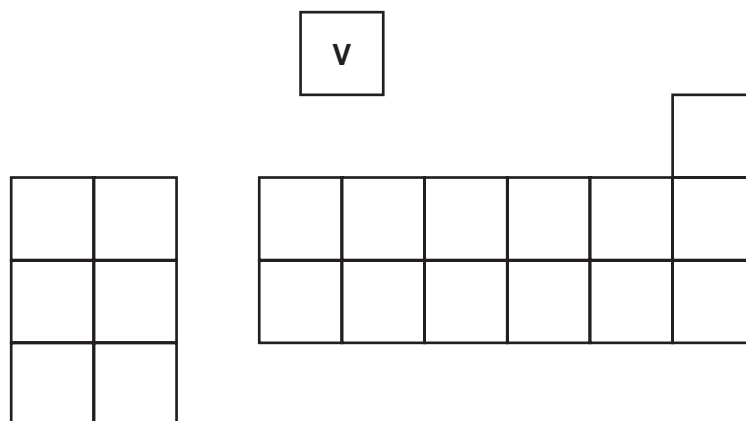


Fig. 10.1

For each of the elements described below, write the letter for each element in the correct box in Fig. 10.1. The first one has been done as an example.

Element **V** is made of the lightest atoms.

Element **X** is the most reactive in Group 7 (Group VII).

Element **Y** is in Period 3 and atoms of **Y** have two outer electrons.

[2]

- (b) Iron is a transition metal which occurs in the Earth's crust in the form of iron oxide.

- (i) State **one** property of the element iron which is different from an alkali metal such as sodium.

..... [1]

- (ii) Iron oxide must be reduced in order to extract iron.

Describe briefly **one** way that iron oxide can be reduced.

.....

 [2]

- (c) Welding is a process used to join pieces of metal together. A very hot flame from a burner causes the edges of the metal to melt together. When the molten parts cool, the pieces of metal are permanently joined.

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A simplified diagram of the process is shown in Fig. 10.2.

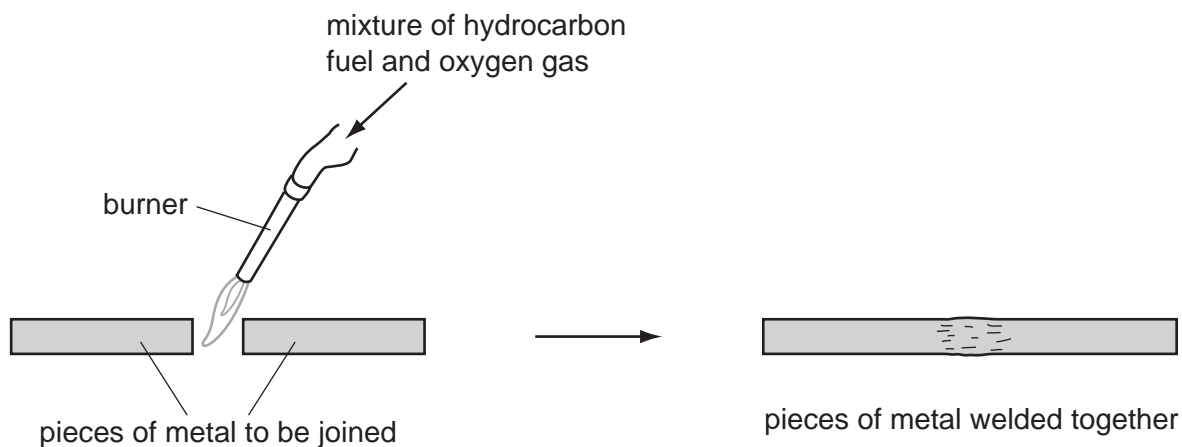


Fig. 10.2

- (i) State **two** compounds which are formed when any hydrocarbon burns completely in oxygen.

1

2

[2]

- (ii) Suggest why oxygen gas rather than air is used in the burner shown in Fig. 10.2.

.....

..... [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 | | | | | | | | | | | 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 | 56 Fe Iron 26 | 55 Mn Manganese 25 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 64 Cu Copper 29 | 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 | 101 Ru Ruthenium 44 | 101 Rh Rhodium 45 | 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 | 127 I Iodine 53 | 131 Xe Xenon 54 | | | | | | | | | | | | | | | | | | | | | | | | |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 186 Os Osmium 76 | 186 Re Rhenium 75 | 184 W Tungsten 74 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 Po Polonium 84 | 210 Rn Radon 86 | | | | | | | | | | | | | | | | | | | | | | | | |
| 226 Fr Francium 87 | 226 Ra Radium 88 | 227 Ac Actinium 89 | | | | | | | | | | | 227 Fr Francium 87 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | 167 Er Erbium 68 | 168 Fm Fermium 100 | 169 Md Mendelevium 101 | 171 No Nobelium 102 | 173 Lr Lawrencium 103 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 166 Es Einsteinium 99 | 167 Cf Californium 98 | 168 Bk Berkelium 97 | 169 Cm Curium 96 | 170 Am Americium 95 | 171 Pu Plutonium 94 | 172 Np Neptunium 93 | 173 U Uranium 92 | 174 Pa Protactinium 91 | 175 Pr Praseodymium 59 | 176 Ce Cerium 58 | 177 Pm Promethium 61 | 178 Sm Samarium 62 | 179 Eu Europium 63 | 180 Gd Gadolinium 64 | 181 Tb Terbium 65 | 182 Dy Dysprosium 66 | 183 Ho Holmium 67 | 184 Er Erbium 68 | 185 Tm Thulium 69 | 186 Yb Ytterbium 70 | 187 Lu Lutetium 71 |

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

Key

| | | |
|---|----------|--------------------------|
| a | X | = relative atomic mass |
| b | X | = atomic symbol |
| | X | = 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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