UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

7179923589

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	
5	
6	
7	
8	
9	
10	
Total	

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

For Examiner's Use

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

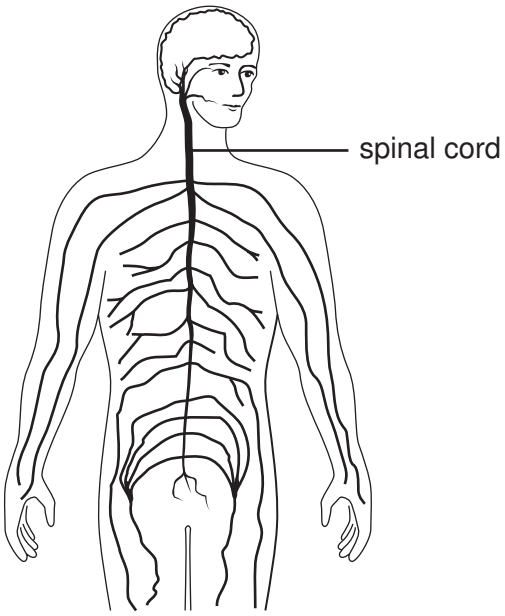


Fig. 1.1

(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]

For Examiner's Use

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

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]

For Examiner's Use

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.

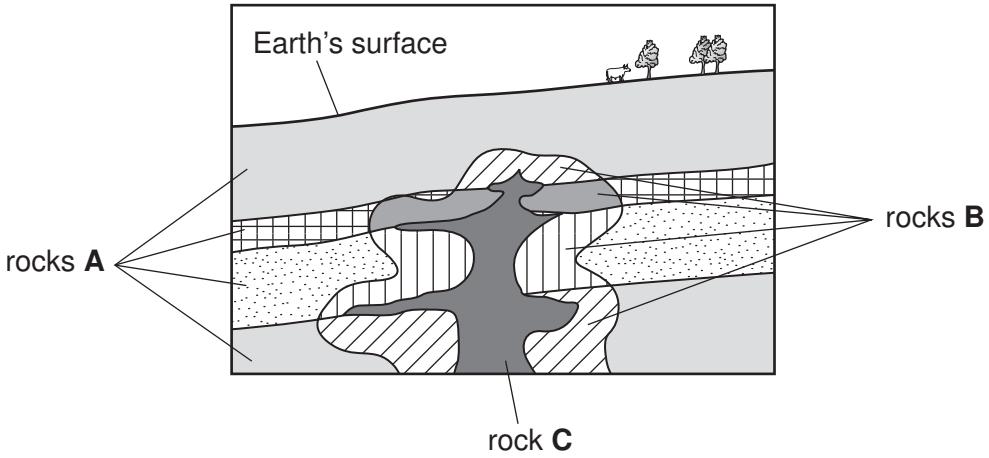


Fig. 2.1

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]

For Examiner's Use

(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.

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

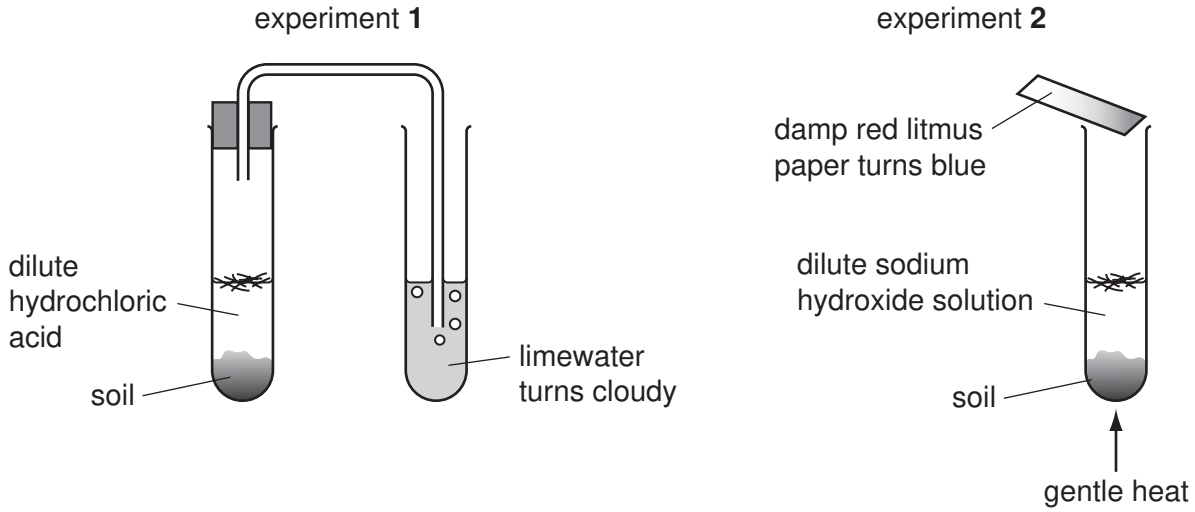


Fig. 2.2

(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]

For Examiner's Use

3 **(a)** A climber does 12 000 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.

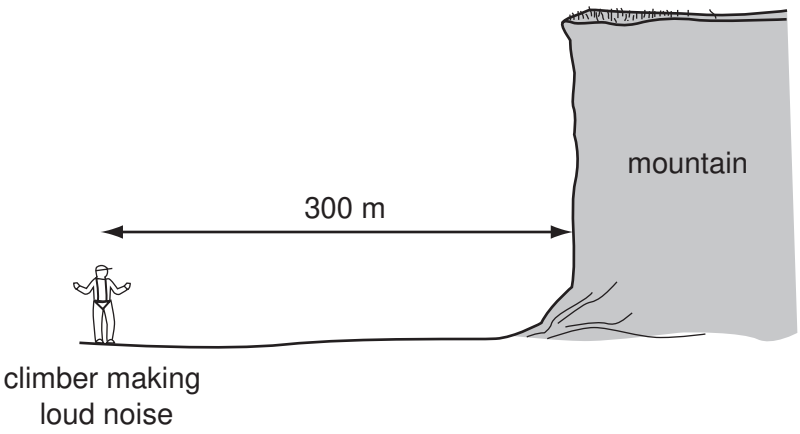


Fig. 3.1

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]

For Examiner's Use

(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]

(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).

For Examiner's Use

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

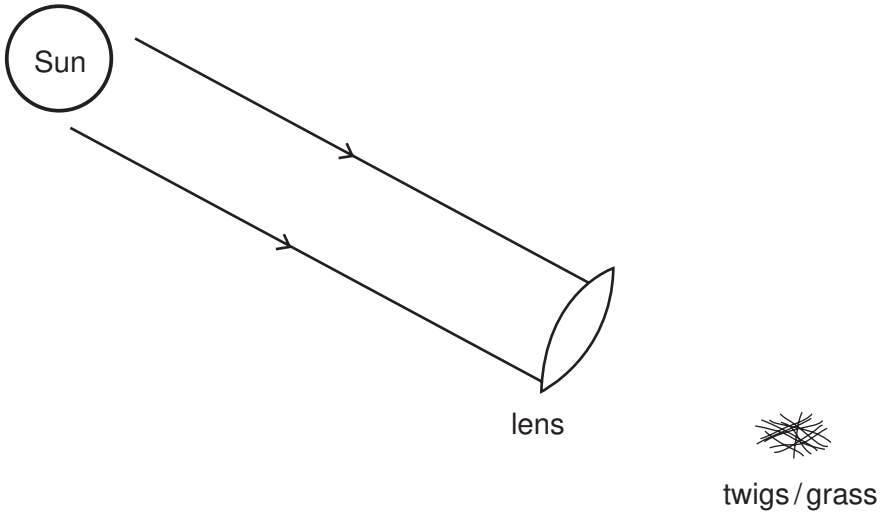


Fig. 3.2

[1]

For Examiner's Use

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]

For Examiner's Use

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

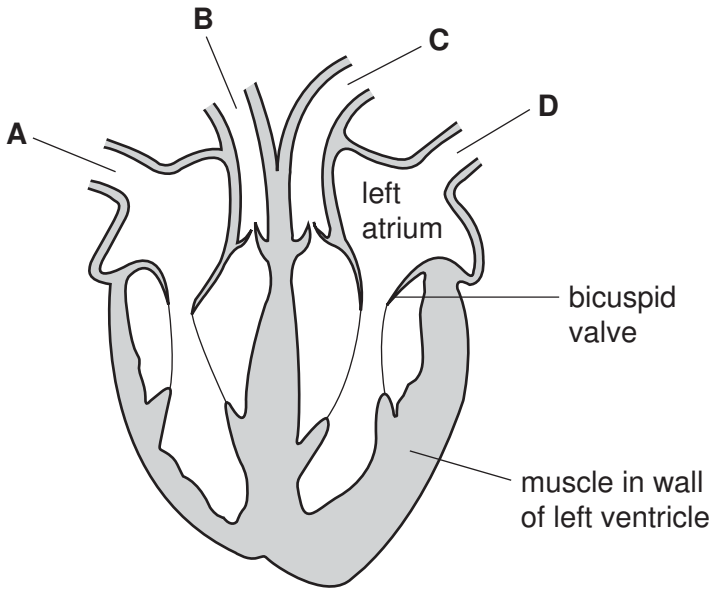


Fig. 5.1

(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]

For Examiner's Use

(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]

For Examiner's Use

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

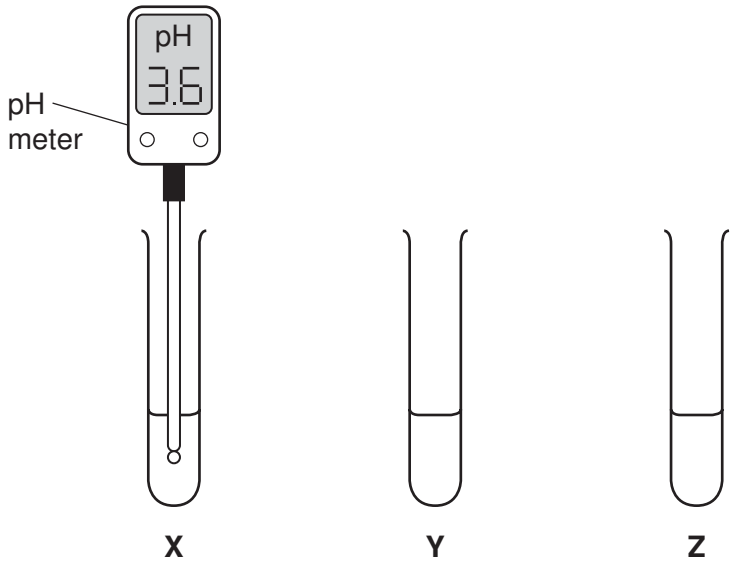


Fig. 6.1

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]

(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**

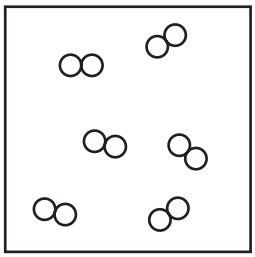
[2]

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

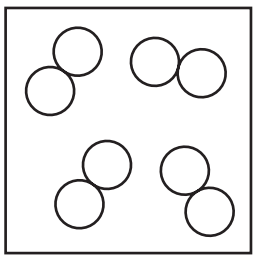
.....

..... [1]

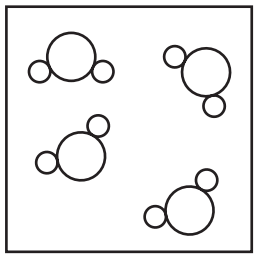
(c) The three diagrams in Fig. 6.3 represent molecules of the elements hydrogen and oxygen, and the compound water.



hydrogen molecules



oxygen molecules



water molecules

Fig. 6.3

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

.....

.....

.....

..... [2]

For Examiner's Use

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.

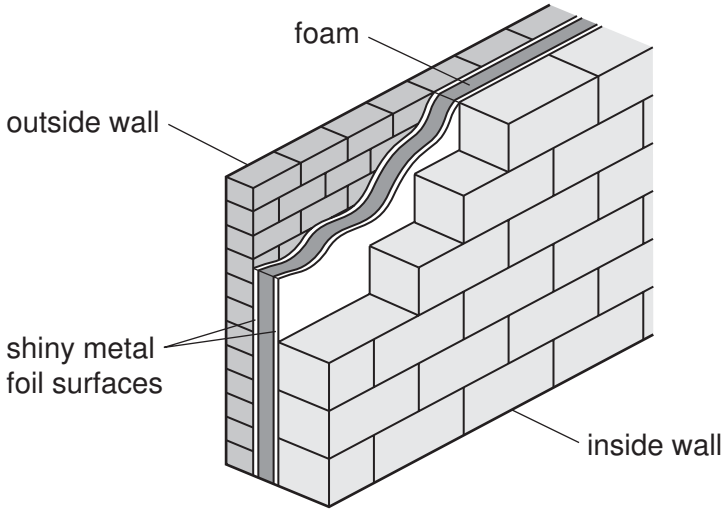


Fig. 7.1

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]

For Examiner's Use

(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.

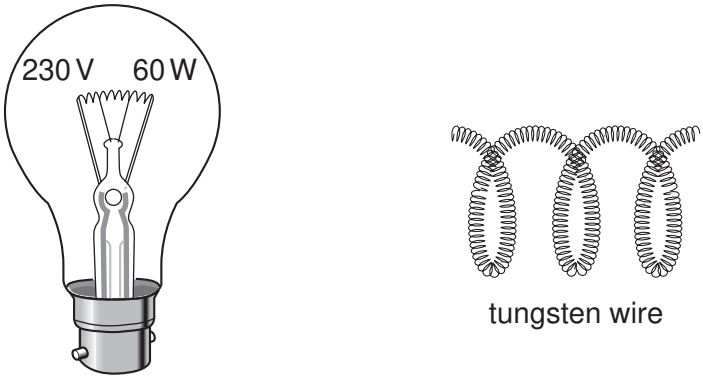


Fig. 7.2

(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 Ω.

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]

For Examiner's Use

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

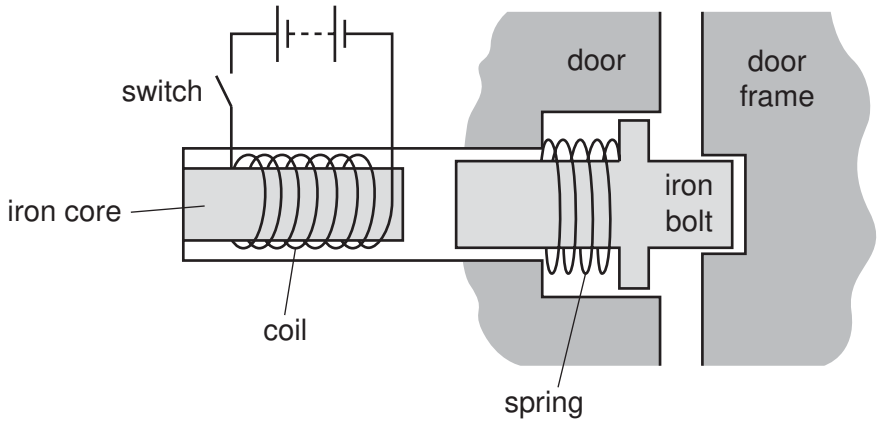


Fig. 7.3

(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]

For Examiner's Use

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]

For Examiner's Use

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]

For Examiner's Use

(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.

.....

.....

.....

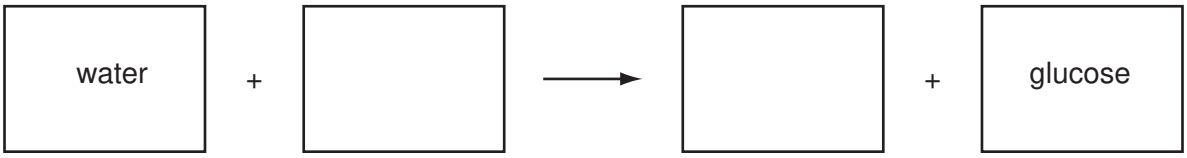
..... [2]

(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]

For Examiner's Use

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

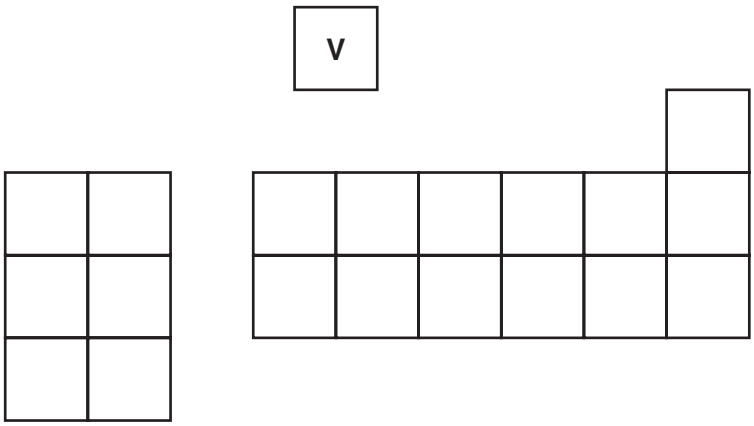


Fig. 10.1

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]

For Examiner's Use

(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.

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

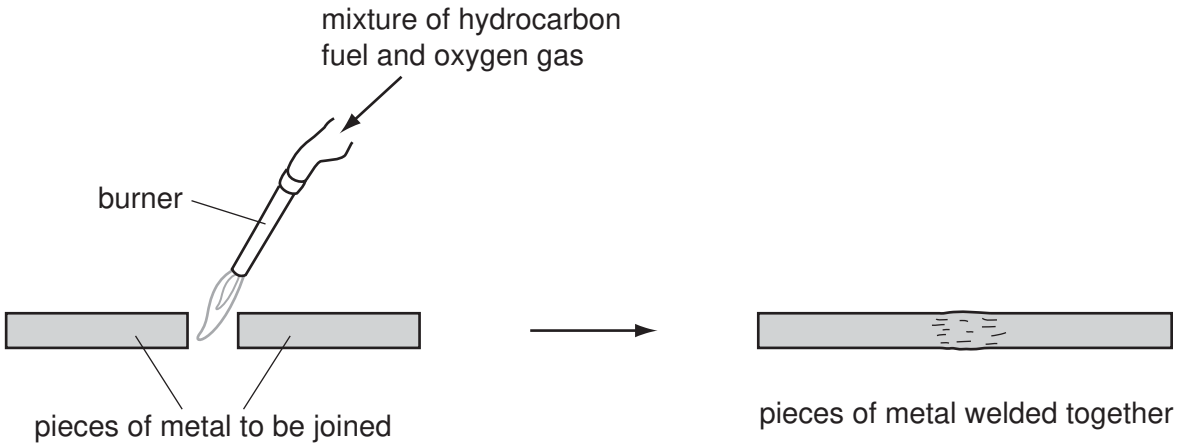


Fig. 10.2

(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]

BLANK PAGE

BLANK PAGE

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** Radium 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 over **X** over b

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.).