UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3227885338

CO-ORDINATED SCIENCES **0654/31**

Paper 3 (Extended) **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	
Total	

This document consists of **23** printed pages and **1** blank page.

1 Fig. 1.1 shows a section through a human heart.

For Examiner's Use

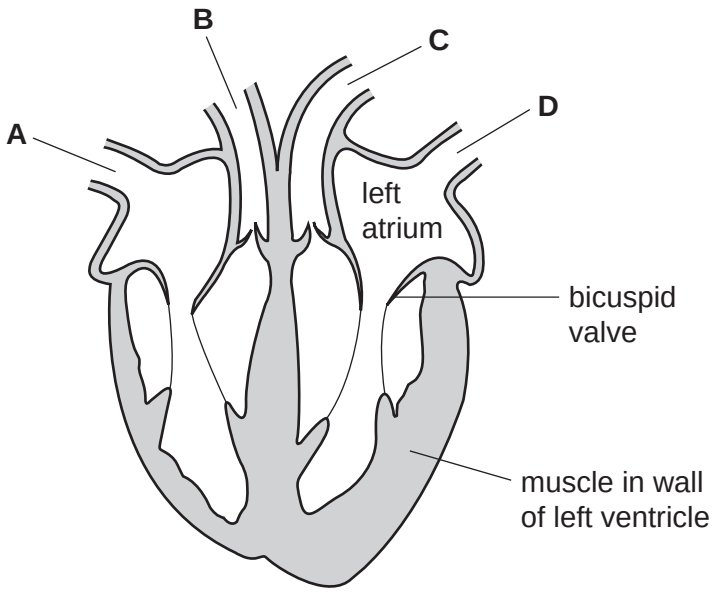

Fig. 1.1

(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]

(iii) Describe what happens to the bicuspid valve during one heartbeat.

.....

.....

.....

..... [2]

For Examiner's Use

(b) In an adult, blood is oxygenated in the lungs. In a fetus, the lungs do not work and its blood is oxygenated in the placenta.

- The blood of the fetus is carried to the placenta in the umbilical artery, which comes from the left ventricle of its heart.
- The blood of the fetus is returned to its heart from the placenta in the umbilical vein, which carries it to the right atrium.

Explain how this system will affect the oxygen content of the blood in the right side of the heart in a fetus, compared with an adult.

.....

.....

..... [2]

(c) Red blood cells contain a pigment (coloured substance) that transports oxygen.

(i) Name this pigment. ..... [1]

(ii) What type of substance is this pigment? ..... [1]

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

..... [1]

(iv) Most nutrients in the food we eat need to be digested. Explain why inorganic ions do not need to be digested.

.....

.....

..... [2]

(v) Explain why body cells need oxygen.

.....

.....

..... [2]

For Examiner's Use

2 **(a)** A climber is exposed to ultraviolet radiation from the Sun. He knows that ultraviolet radiation is harmful.

(i) State how ultraviolet radiation is harmful to humans.

.....

..... [1]

(ii) Describe **one** way in which the climber could protect himself from the ultraviolet radiation.

.....

..... [1]

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

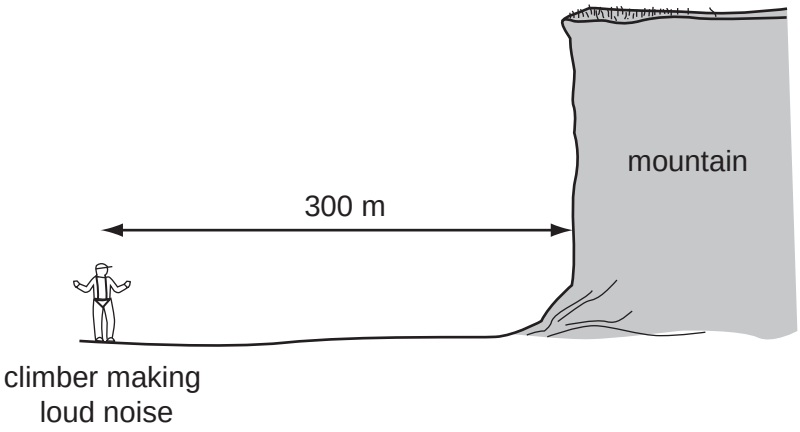

Fig. 2.1

Calculate the speed of sound in air using these results.

State the formula that you use and show your working.

formula

working

..... [2]

(c) It can be dangerous to make loud noises when there is melting snow on mountains. The weight of the snow makes the snow slide down the mountain and become an avalanche.

The mass of snow in an avalanche is 400 000 kg and it is travelling at 60 m / s.

Calculate the momentum of the avalanche.

State the formula that you use and show your working.

formula

working

..... [2]

(d) 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.

[2]

(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.

..... [1]

[Turn over

(e) The climber carries a nylon tent. As he walks, the tent rubs against his clothing. The fabric gains a negative static charge.

Explain how this happens.

.....

.....

.....

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..... [3]

(f) The climber is able to start a fire by focusing rays of sunlight onto some dried twigs and grass, using a lens (magnifying glass).

On Fig. 2.2, draw two rays of light from the Sun entering the lens and being brought to a focus.

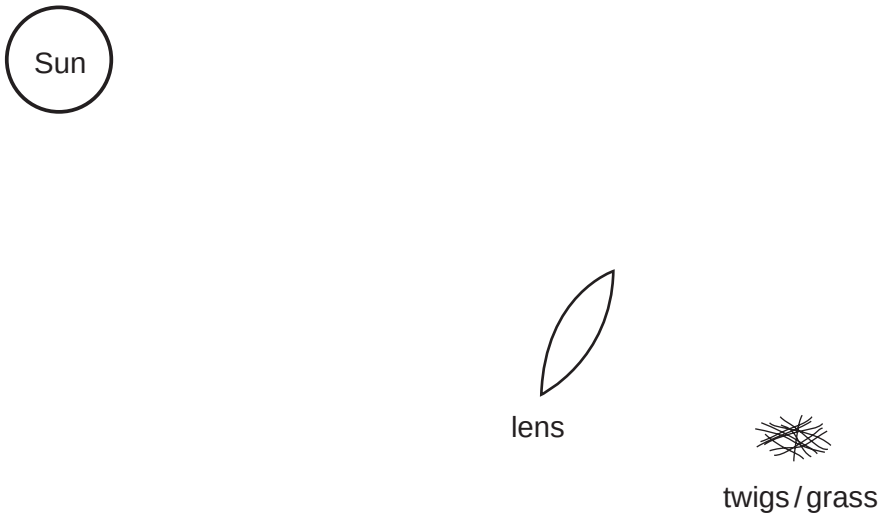

Fig. 2.2

[3]

For Examiner's Use

3 **(a)** A person swallows a radioactive substance.

Explain why this could be harmful.

.....

.....

.....

..... [3]

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

(i) State what happens to the uranium atoms.

..... [1]

(ii) Describe **one** problem associated with this process.

.....

.....

..... [2]

4 A student used the apparatus shown in Fig. 4.1 to investigate the reaction between a solution of an acid **A** and 20.0 cm^3 of a solution of the alkali, potassium hydroxide.

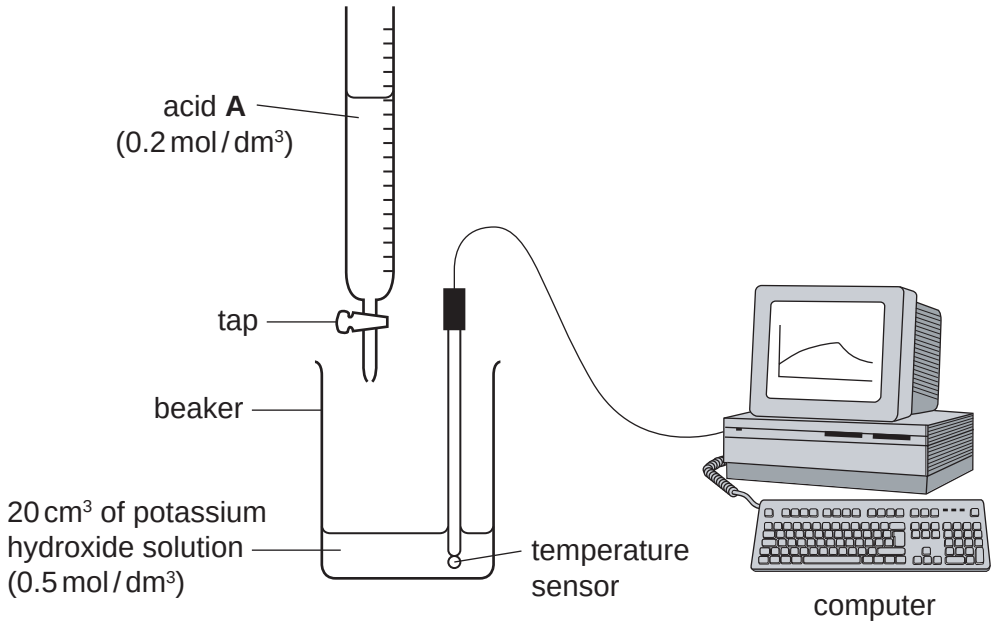

Fig. 4.1

Fig. 4.2 shows how the temperature of the mixture changed as the acid was added to the alkali in the beaker.

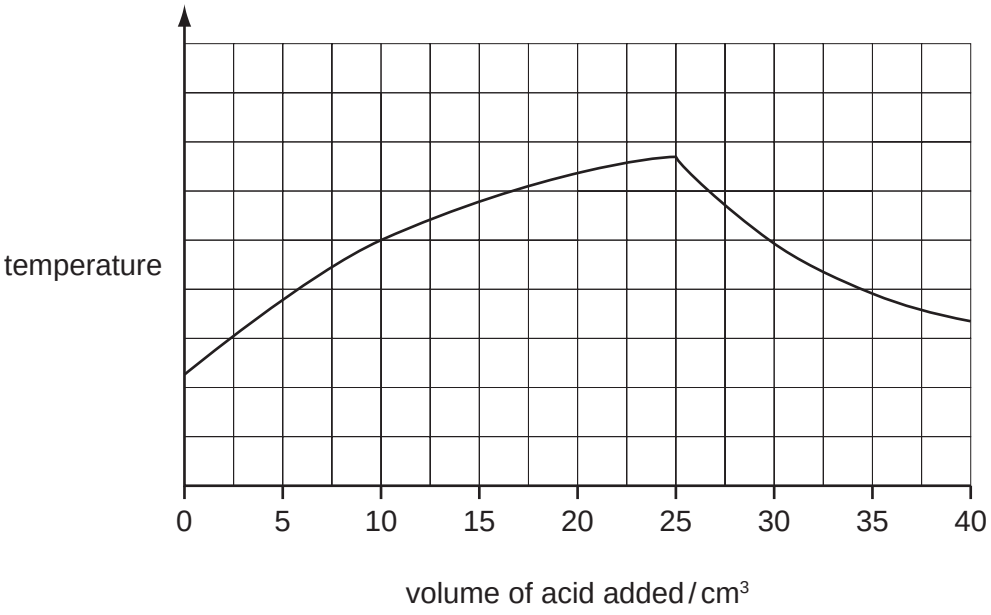

Fig. 4.2

(a) (i) State why the temperature of the mixture increased when the acid was first added to the alkali.

.....

[1]

(ii) Explain how the information in Fig. 4.2 shows that it took 25.0 cm^3 of the acid to neutralise 20.0 cm^3 of the potassium hydroxide solution.

.....

.....

.....

[2]

(b) In the experiment, the concentrations of acid **A** and the potassium hydroxide solution were 0.2 mol/dm^3 and 0.5 mol/dm^3 respectively.

(i) Use the equation

moles (dissolved) = volume (dm^3) x concentration (mol/dm^3)

to calculate the number of moles of both acid **A** and potassium hydroxide which neutralised each other in this reaction.

moles of acid **A**

.....

moles of potassium hydroxide

.....

[2]

(ii) State the number of moles of acid **A** which would be needed to neutralise **one** mole of potassium hydroxide.

Explain your answer briefly.

moles of acid **A** .....

explanation .....

.....

[1]

(iii) Write the **ionic** chemical equation which represents what happens when an aqueous acid reacts with aqueous alkali.

.....

[2]

[Turn over

(c) In the year 1807, metallic potassium was obtained from potassium hydroxide. Fig. 4.3 shows a simplified diagram of the apparatus that was used.

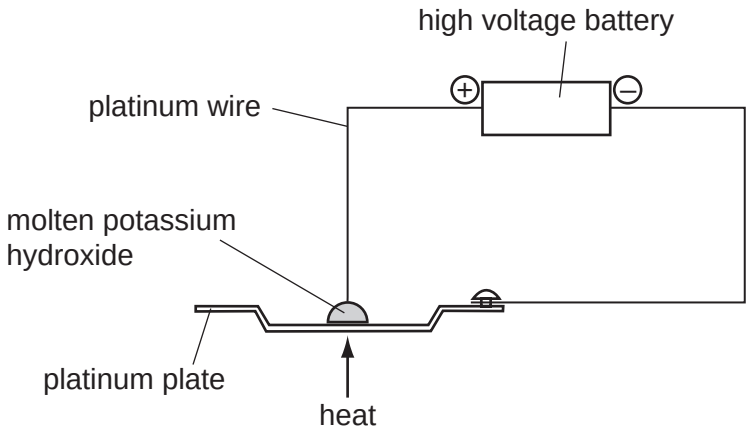

Fig. 4.3

Bubbles of gas were seen where the platinum wire touched the top of the potassium hydroxide. Shiny beads of molten potassium were seen where the potassium hydroxide rested on the platinum plate.

(i) Name the process shown in Fig. 4.3.

.....

[1]

(ii) Explain why the potassium metal formed where the potassium hydroxide touched the platinum plate.

Your answer should include the ideas of electrical charge, atoms, ions and electrons.

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[3]

5 **(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.

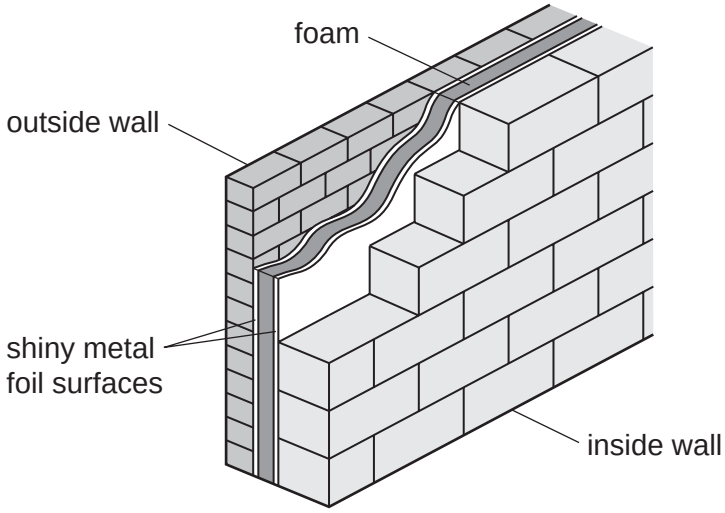

Fig. 5.1

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.

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..... [3]

For Examiner's Use

(b) Transformers are used to change the voltage of an a.c. supply. Fig. 5.2 shows a shaver unit, which contains a transformer, of the type found in many European homes.

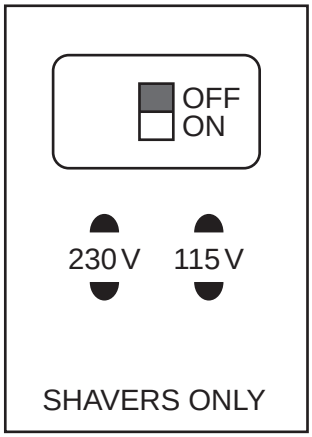

Fig. 5.2

The shaver unit has two sockets, one for shavers working at 115 V, the other for shavers working at 230 V. Fig. 5.3 shows how the sockets are wired to the output / secondary coils of a transformer.

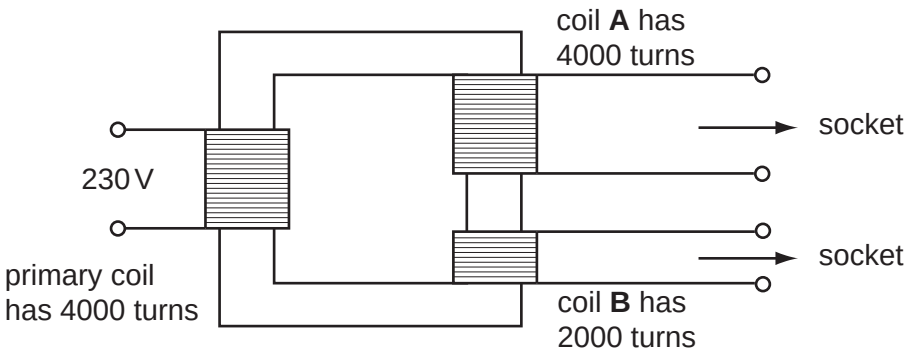

Fig. 5.3

(i) Use Fig. 5.3 to explain which coil, **A** or **B**, gives an output of 115 V.

coil .....

explanation .....

..... [1]

(ii) The transformer in a shaver unit is known as an isolating transformer and is designed to make the electrical appliance plugged into it safer to use in a bathroom.

Explain why it is dangerous to use electrical appliances in bathrooms unless they have such safety protection.

.....

..... [2]

(c) Fig. 5.4 shows an electromagnet being used in a door lock.

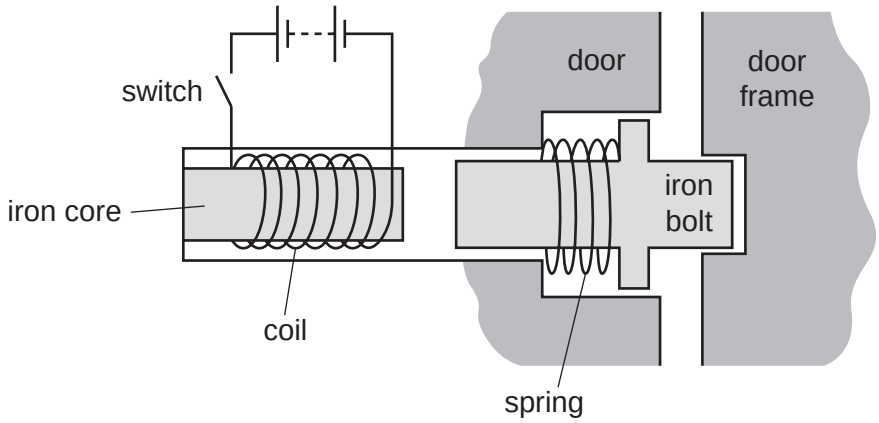

Fig. 5.4

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

Explain why this happens.

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..... [3]

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

Explain your answer.

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..... [1]

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

Would the door lock with the iron bolt still work?

Explain your answer.

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..... [1]

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

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..... [1]

[Turn over

6 An experiment was carried out in Sweden into the effects of different types of fertiliser on the crop yield. The experiment lasted 32 years, from 1958 to 1990.

The land was divided into four plots. Three plots were treated with different fertilisers. The fourth plot had no fertiliser added.

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

Plot **B** manure sprayed with a liquid containing bacteria that act as decomposers

Plot **C** NPK fertiliser (a mix of inorganic ions containing nitrogen, phosphorus and potassium)

Plot **D** no fertiliser added

Table 6.1 shows some of the results of the experiment.

Table 6.1

plot	treatment	mean yield per hectare per year / tonnes	
		wheat	potatoes
A	manure	2.98	35.5
B	manure + bacteria	3.27	46.7
C	NPK fertiliser	3.28	36.2
D	no fertiliser	2.49	28.7

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

Give the name or formula of one other ion containing nitrogen that could be found in the inorganic fertiliser.

..... [1]

(ii) Explain why wheat given NPK fertiliser gave a higher yield than wheat given no fertiliser.

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..... [3]

For Examiner's Use

(iii) Compare the results from using manure + bacteria (plot **B**) with the results from using NPK fertiliser (plot **C**), for both wheat and potatoes.

wheat .....

.....

potatoes .....

.....

..... [3]

(iv) Using your knowledge of the nitrogen cycle, suggest why the yield of potatoes on plot **B** was greater than the yield on plot **A**.

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..... [2]

(b) Leaching of fertilisers from the soil may cause pollution of nearby waterways.

Explain how the leaching of fertiliser into a river can cause the concentration of dissolved oxygen in the water to decrease to very low levels.

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..... [3]

For Examiner's Use

7 Polymer molecules exist in both natural substances and in materials which have been made in industry.

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

(i) State the name of the monomer which forms starch.

..... [1]

(ii) A sample of one of the natural substances was burned in pure oxygen. The mixture of gases which was formed was analysed and found to contain carbon dioxide, water vapour, nitrogen dioxide and sulfur dioxide.

Which one of the three natural substances had been burned?

Explain your answer.

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..... [3]

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

(i) Nylon is often formed into fibres which are used to make clothing, rope and guitar strings. Fig. 7.1 shows a simplified diagram of an industrial process which is used to produce nylon fibres.

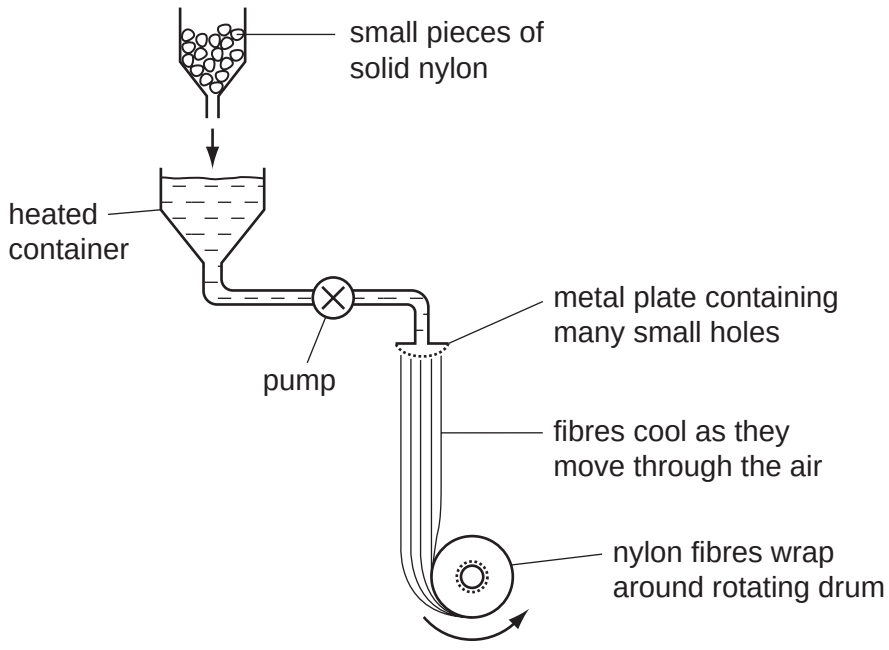

Fig. 7.1

Explain, in terms of the forces between molecules, why it is possible to form nylon fibres from solid nylon using the process in Fig. 7.1.

For Examiner's Use

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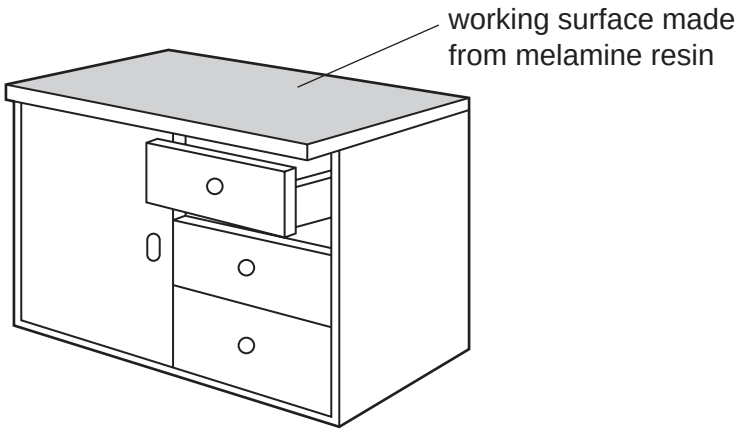
..... [3]

(ii) Melamine resin is made into flat sheets for use as working surfaces in kitchens, where hot saucepans may come into contact with the surface.



Explain, in terms of molecules, why melamine resin is a suitable material for working surfaces.

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..... [2]

For Examiner's Use

8 Fig. 8.1 shows a section through a human eye.

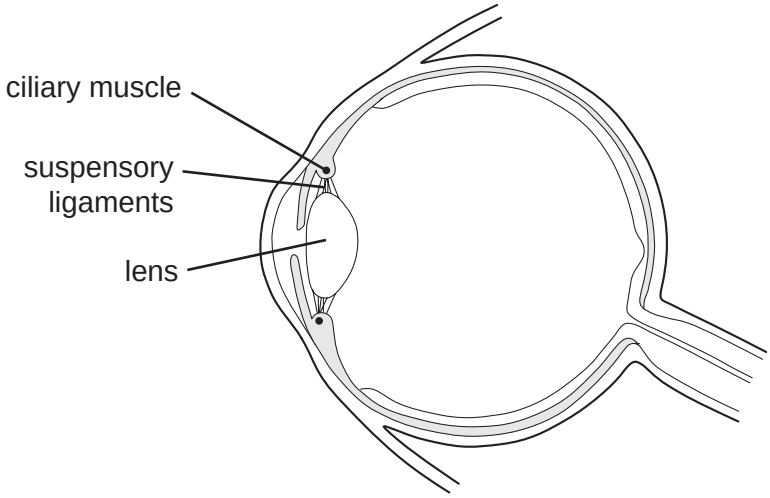

Fig. 8.1

(a) On Fig. 8.1, use the letters and label lines to label each of these parts of the eye.

A the part that contains rods and cones

B the part that transmits nerve impulses to the brain

C the part that controls the amount of light that enters the eye [3]

(b) Explain how the ciliary muscle, suspensory ligaments and lens help the eye to focus on a nearby object.

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..... [3]

(c) Eye colour is determined by genes, and is inherited. There are many different alleles for eye colour.

For Examiner's Use

Some genes have alleles that cause disease. Give **one** example of an inherited disease, and describe how it can be passed from parents to offspring.

name of disease .....

how it is passed on .....

.....

.....

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..... [3]

For Examiner's Use

9 **(a)** The grid in Fig. 9.1 shows the arrangement of the first twenty elements in the Periodic Table.

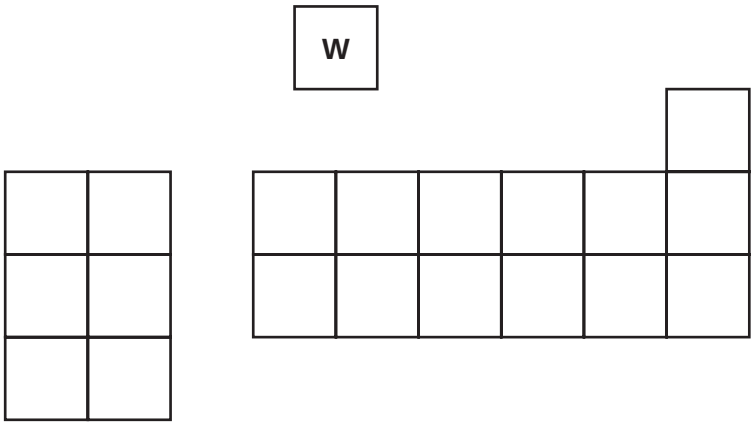


Fig. 9.1

For each of the elements described below, write the letter for each element in the correct box in Fig. 9.1. The first one has been done as an example.

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

Element **X** is in Period 3 and atoms of **X** have 2 outer electrons.

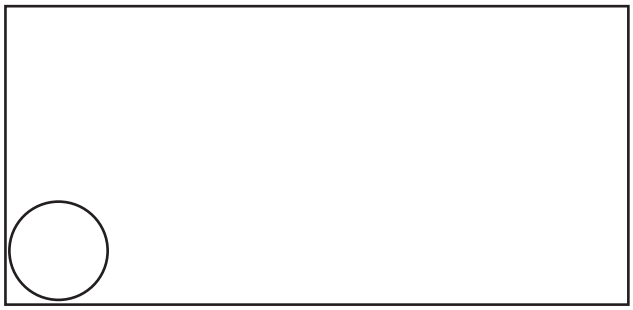
Element **Y** is the most reactive in Group 7 (Group VII).

Element **Z** is made of atoms which have 10 protons in their nuclei.

[3]

(b) Metals have giant structures and are good conductors of electricity.

(i) Complete and label the diagram of the structure of a typical metal. Your diagram should show how the atoms are arranged.



[1]

(ii) Use your diagram to explain why metals are good conductors of electricity.

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.....

.....

..... [2]

For Examiner's Use

(c) Welding is a process used to join pieces of metal together. Fig. 9.2 shows a simplified diagram of a method known as metal inert gas (MIG) welding. The metal wire and the pieces of metal to be joined are heated electrically, and melt together. When the molten metal cools, the pieces are permanently joined.

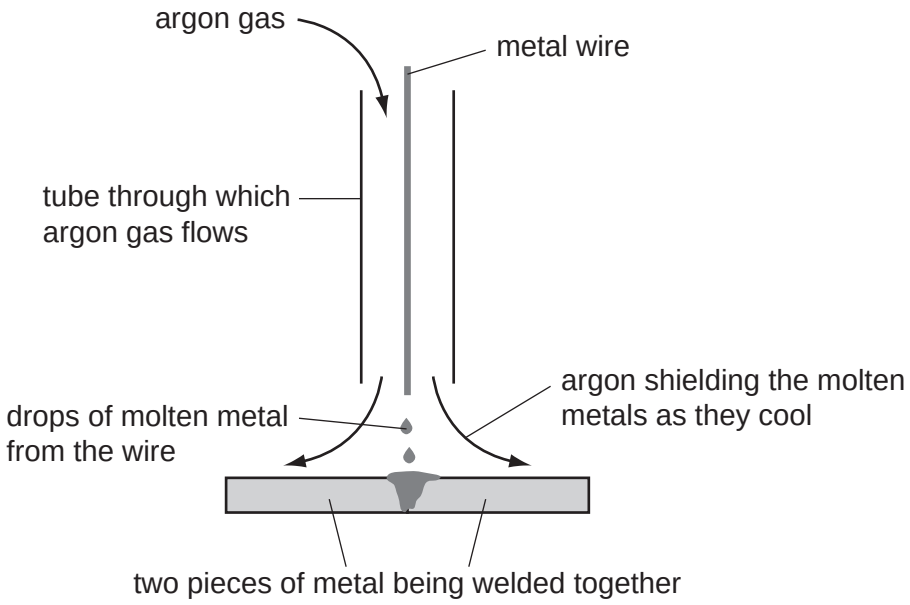

Fig. 9.2

(i) Argon is often used in MIG welding as shown in Fig. 9.2.

Suggest a chemical reaction which is being prevented by the presence of argon.

.....

.....

..... [2]

(ii) Draw a diagram of one atom of argon showing how all of its electrons are arranged.

[2]

(iii) Explain, in terms of their electron arrangement, why argon atoms do not react with the hot metals in MIG welding.

For Examiner's Use

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..... [2]

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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 **X** 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.).