



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--	--

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

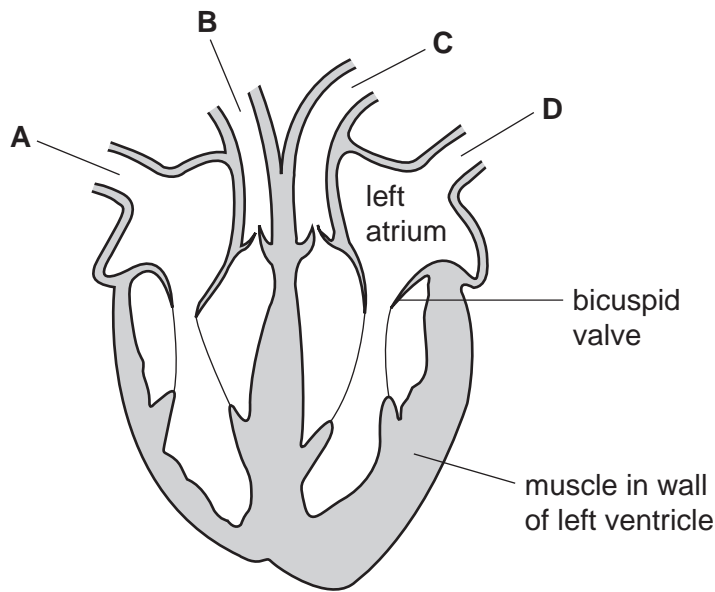


Fig. 1.1

(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]

(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]

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.

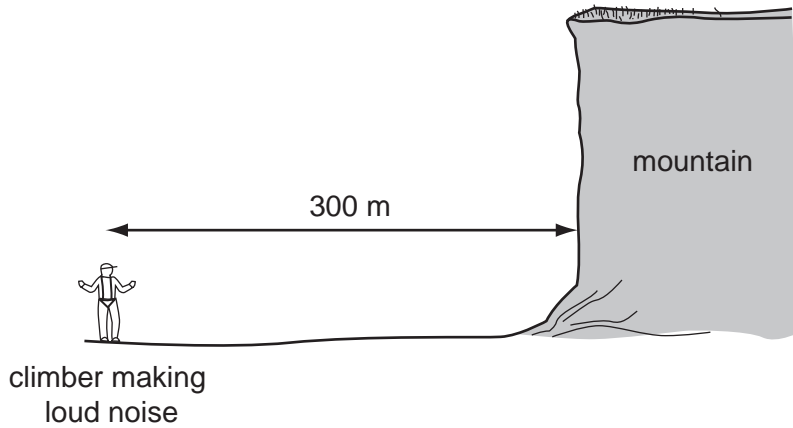


Fig. 2.1

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 1.5V.

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

..... [1]

- (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.

.....

.....

.....

.....

..... [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]

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.

For
Examiner's
Use

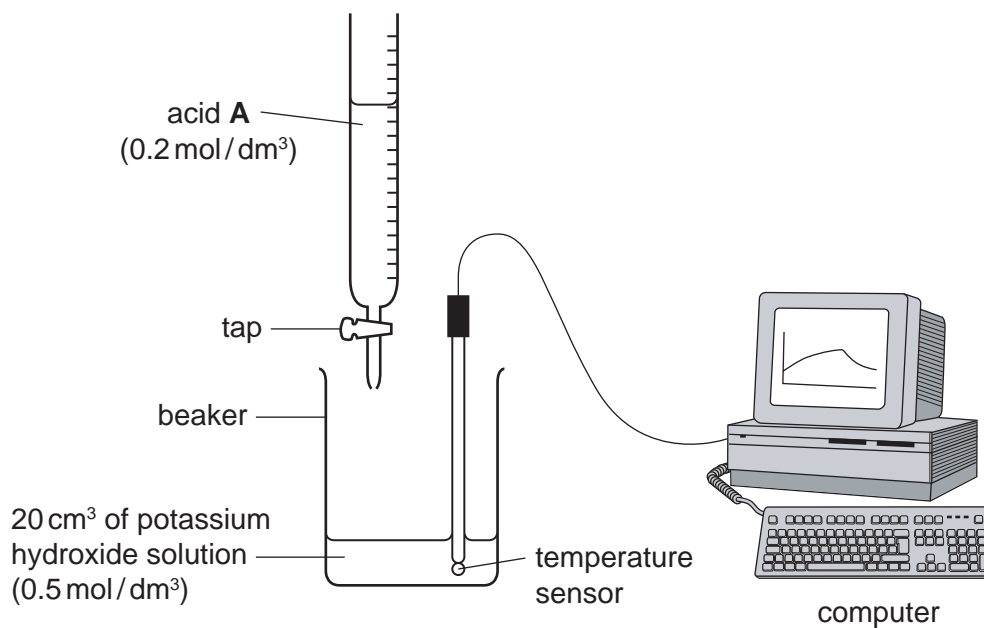


Fig. 4.1

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

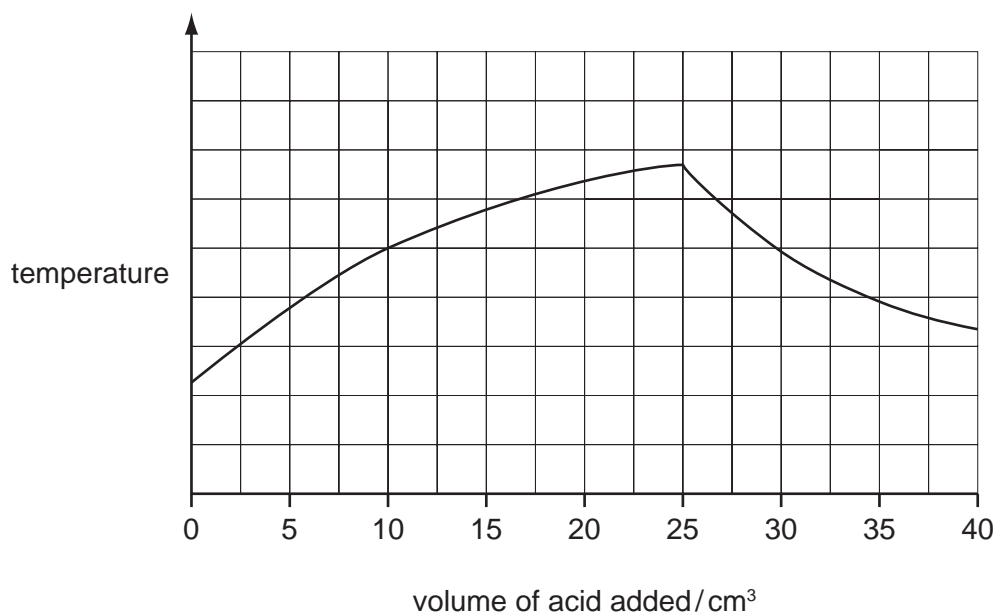


Fig. 4.2

- (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 cm³ of the acid to neutralise 20.0 cm³ of the potassium hydroxide solution.

.....

 [2]

- (b) In the experiment, the concentrations of acid **A** and the potassium hydroxide solution were 0.2 mol/dm³ and 0.5 mol/dm³ respectively.

- (i) Use the equation

$$\text{moles (dissolved)} = \text{volume (dm}^3\text{)} \times \text{concentration (mol/dm}^3\text{)}$$

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]

(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.

For
Examiner's
Use

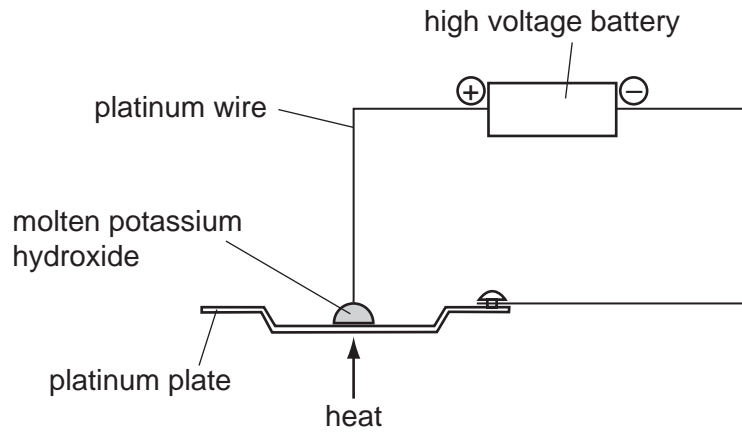


Fig. 4.3

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.

.....

 [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.

For
Examiner's
Use

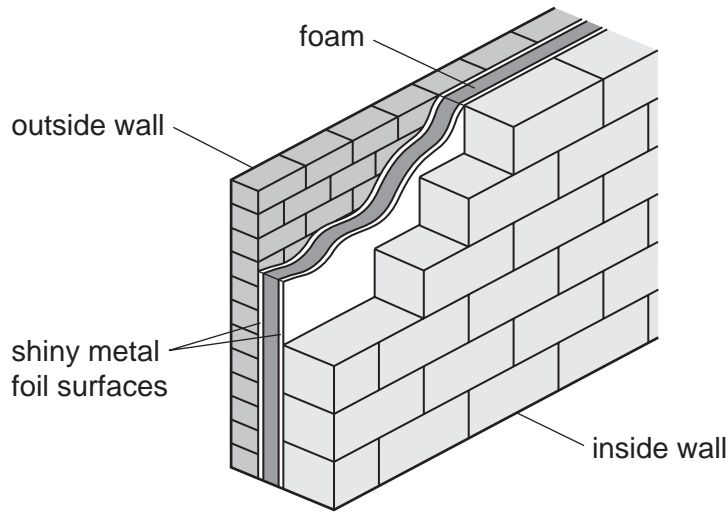


Fig. 5.1

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.

.....

.....

.....

.....

..... [3]

- (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.

For
Examiner's
Use

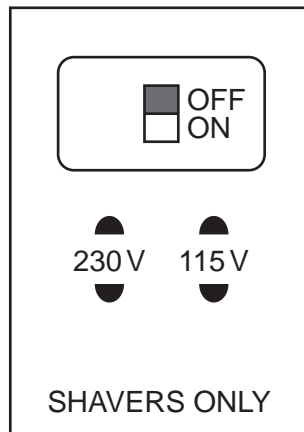


Fig. 5.2

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.

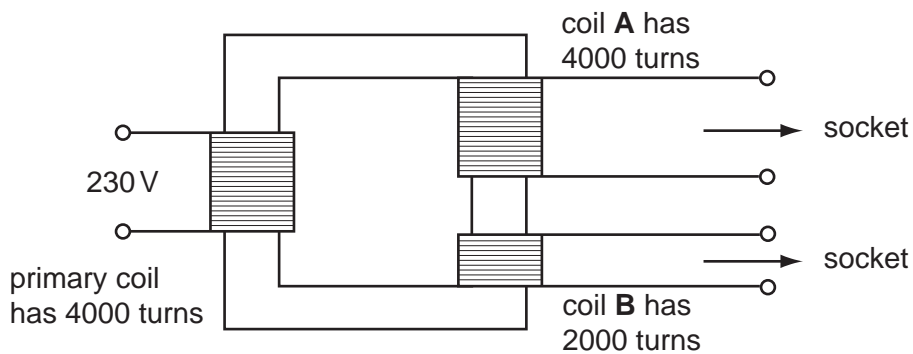


Fig. 5.3

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

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.

For
Examiner's
Use

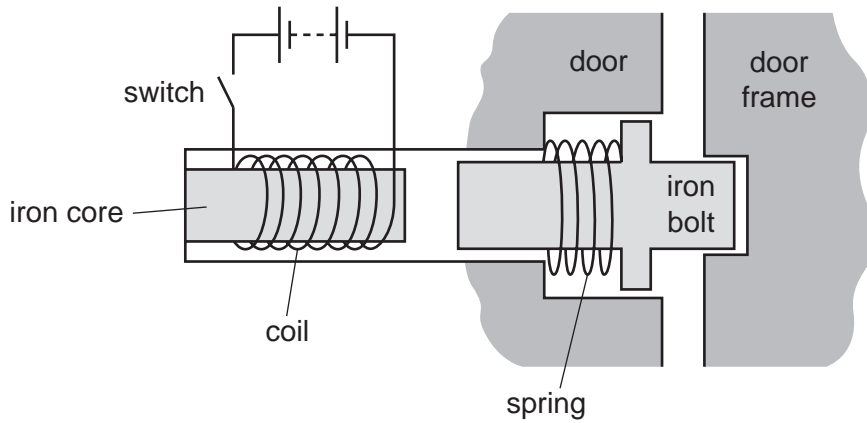


Fig. 5.4

(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]

- 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.

.....

 [3]

(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**.

.....

.....

.....

..... [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.

.....

.....

.....

.....

..... [3]

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.

.....

 [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.

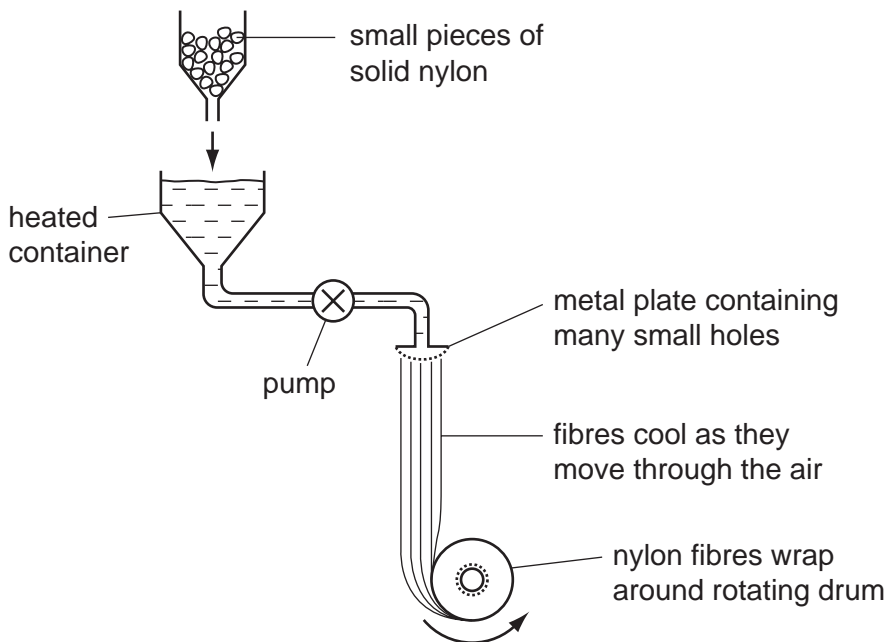


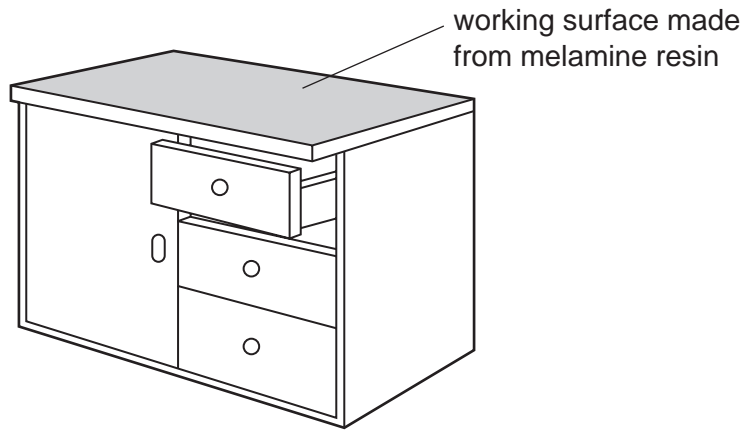
Fig. 7.1

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

.....
.....
.....
..... [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.

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

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

For
Examiner's
Use

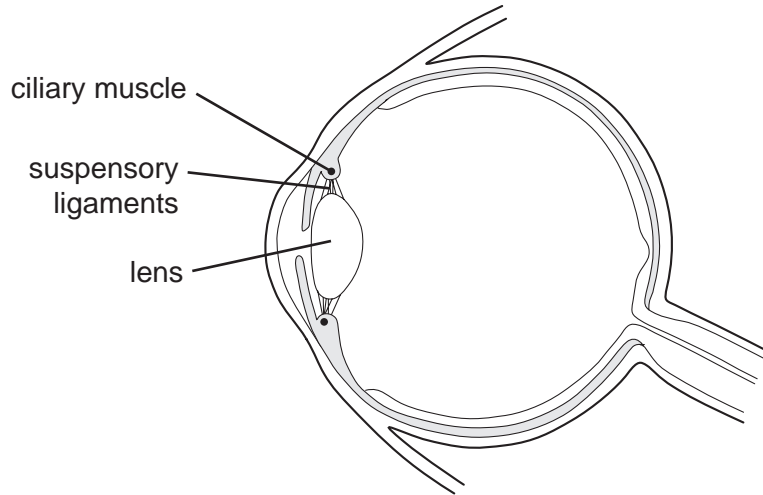


Fig. 8.1

(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.

.....

.....

.....

.....

.....

..... [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

.....

.....

.....

..... [3]

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

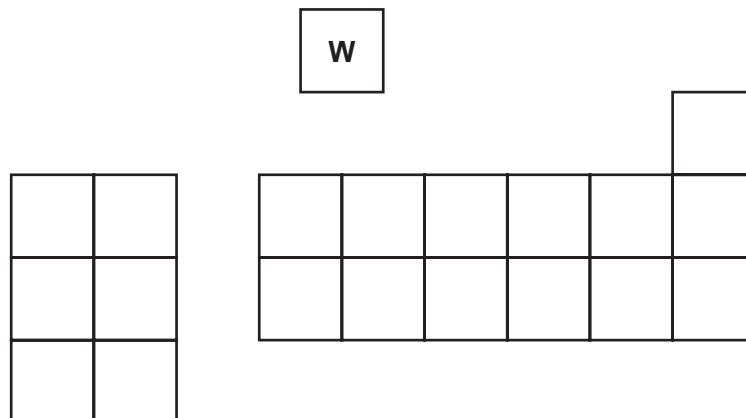


Fig. 9.1

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.

.....

.....

.....

.....

[2]

- (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.

For
Examiner's
Use

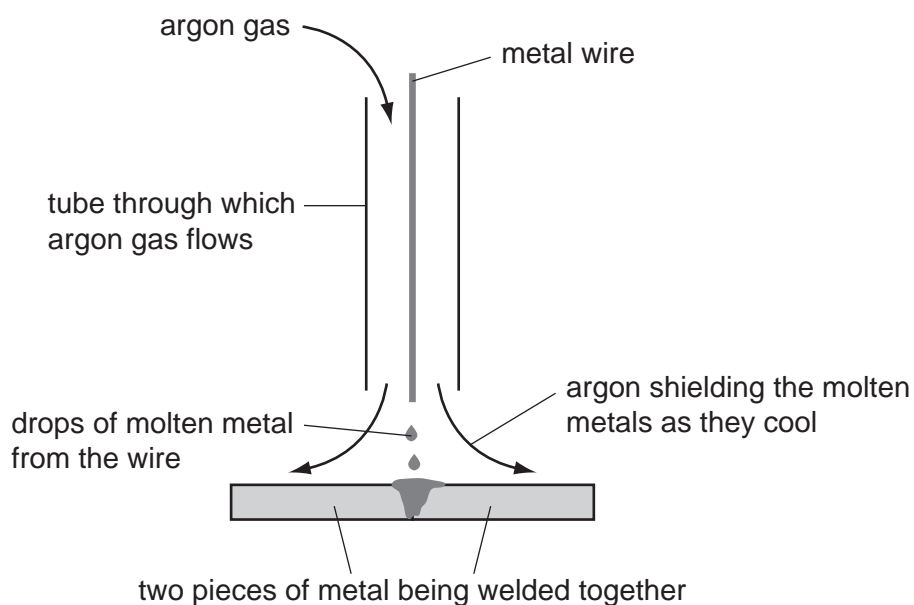


Fig. 9.2

- (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*

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

DATA SHEET
The Periodic Table of the Elements

		Group											
I	II	III	IV	V	VI	VII	0						0
		1 H Hydrogen 1										4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4											20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18			35.5 Cl Chlorine 17	
39 K Potassium 19	40 Ca Calcium 20	27 Al Aluminium 13	28 Si Silicon 14	29 Co Cobalt 27	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	84 Kr Krypton 36	
85 Rb Rubidium 37	88 Sr Strontium 38	56 Fe Iron 26	57 Co Cobalt 27	58 Ni Nickel 28	59 Cu Copper 29	60 Zn Zinc 30	61 Ga Gallium 31	62 Ge Germanium 32	63 As Arsenic 33	64 Se Selenium 34	65 Br Bromine 35	84 Kr Krypton 36	
133 Cs Caesium 55	137 Ba Barium 56	70 Ga Gallium 31	71 Ge Germanium 32	72 As Arsenic 33	73 Se Selenium 34	74 Br Bromine 35	75 Kr Krypton 36	76 Rn Radon 86				131 Xe Xenon 54	
226 Ra Radium 88	227 Ac Actinium 89	115 In Indium 49	116 Sn Tin 50	117 Sb Antimony 51	118 Te Tellurium 52	119 I Iodine 53	120 Xe Xenon 54					131 Xe Xenon 54	
		101 Ru Ruthenium 44	102 Rh Rhodium 45	103 Pd Palladium 46	104 Ag Silver 47	105 Cd Cadmium 48	106 In Indium 49	107 Sn Tin 50	108 Sb Antimony 51	109 Te Tellurium 52	110 I Iodine 53	131 Xe Xenon 54	
		140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67	175 Lu Lutetium 71	
		140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67	175 Lu Lutetium 71	
		232 Th Thorium 90	233 Pa Protactinium 91	234 U Uranium 92	235 Np Neptunium 93	236 Pu Plutonium 94	237 Am Americium 95	238 Cm Curium 96	239 Bk Berkelium 97	240 Cf Californium 98	241 Es Einsteinium 99	261 Lr Lawrencium 103	
		232 Th Thorium 90	233 Pa Protactinium 91	234 U Uranium 92	235 Np Neptunium 93	236 Pu Plutonium 94	237 Am Americium 95	238 Cm Curium 96	239 Bk Berkelium 97	240 Cf Californium 98	241 Es Einsteinium 99	261 Lr Lawrencium 103	

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

a	X
b	X

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.