UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0316013424

COMBINED SCIENCE **0653/32**

Paper 3 (Extended) **May/June 2011**

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	
10	
Total	

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

1 Guanacos are relatives of camels and live in the Andes mountains in South America. They feed on grasses and other plants. They are killed and eaten by pumas.

For Examiner's Use

Fig. 1.1 shows a guanaco.

Fig. 1.1

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

(i) all the guanacos that live in a particular area

..... [1]

(ii) all the species of animals and plants that live in a particular area

..... [1]

(iii) an organism, such as a guanaco or a puma, that feeds on other organisms

..... [1]

For Examiner's Use

(b) Guanacos can live at very high altitudes, above 4000 metres. The atmosphere is less dense than at sea level, and it can become very cold.

(i) The blood of a guanaco contains four times as many red blood cells per cm^3 as the blood of a human. This helps the guanaco to survive in its environment.

Suggest an explanation for this.

.....

.....

.....

..... [2]

(ii) Explain how the hair of a guanaco can help it to survive in its environment.

.....

.....

.....

..... [2]

(c) Guanacos are an endangered species. Their numbers have fallen because of damage to their natural habitat, caused by humans.

(i) Suggest **two** types of human activity that may damage the natural habitat of guanacos.

1 .....

2 ..... [2]

(ii) Several countries in South America have conservation programmes to try to increase the numbers of guanacos.

Suggest why it is important to conserve guanacos.

.....

.....

.....

..... [2]

For Examiner's Use

2 **(a)** A man has dropped a torch (flashlight) down a drain. The torch has disappeared into the horizontal part of the drain as shown in Fig. 2.1.

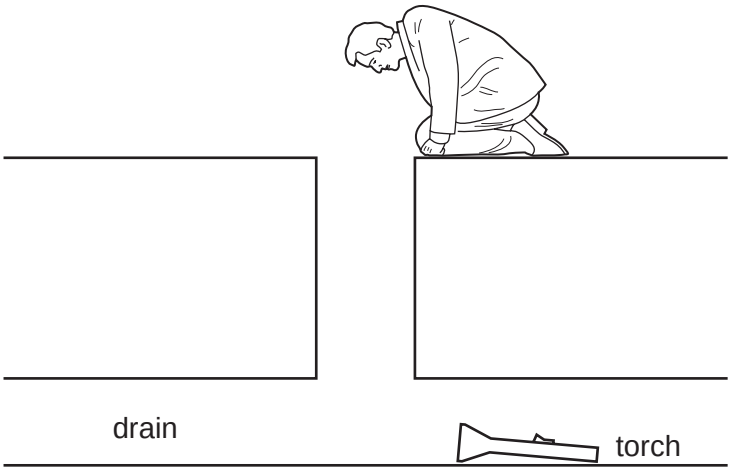


Fig. 2.1

The torch is still switched on but the man cannot see it.

The man lowers a mirror down the drain in order to find his torch.

(i) On Fig. 2.1 draw a mirror at the correct place and angle so that the man can see light from the torch.

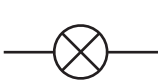
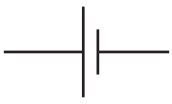
Use this symbol for the mirror.

[1]

(ii) On Fig. 2.1 draw a ray of light from the torch to the man. [1]

(b) The diagrams below show the symbols for three parts of the electrical circuit in the torch.

(i) On the line below each diagram state the name of the part.


....

[1]

(ii) Draw a circuit diagram to show how these three parts are connected in the torch.

For Examiner's Use

[1]

(c) Fig. 2.2 shows a torch standing on a table. **M** shows the position of the centre of mass of the torch.

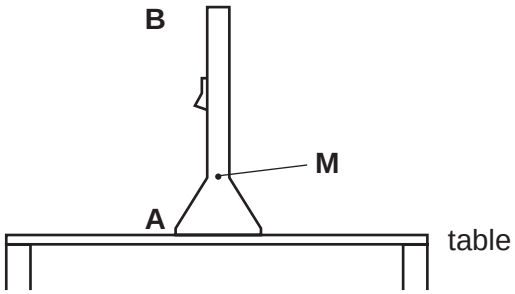


Fig. 2.2

Explain why the torch is more stable if it stands on end **A** rather than on end **B**. You may use diagrams to help your answer.

.....

..... [2]

3 Lithium and its compounds have many important uses.

(a) Fig. 3.1 shows how pieces of lithium metal are stored.

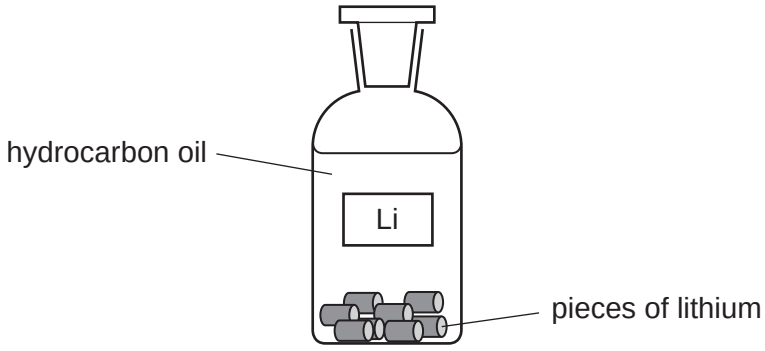


Fig. 3.1

State and explain why it is necessary to store lithium in this way.

.....

.....

..... [2]

(b) The production of lithium metal involves three main stages.

1 Lithium compounds found in the Earth's crust are first converted into lithium carbonate, Li_2CO_3.

2 Lithium carbonate is then converted into lithium chloride, LiC*l*.

3 Lithium chloride and potassium chloride are melted together and the molten mixture is electrolysed.

Fig. 3.2 shows the apparatus and materials which could be used to produce a **neutral** solution of lithium chloride from lithium carbonate and dilute hydrochloric acid.

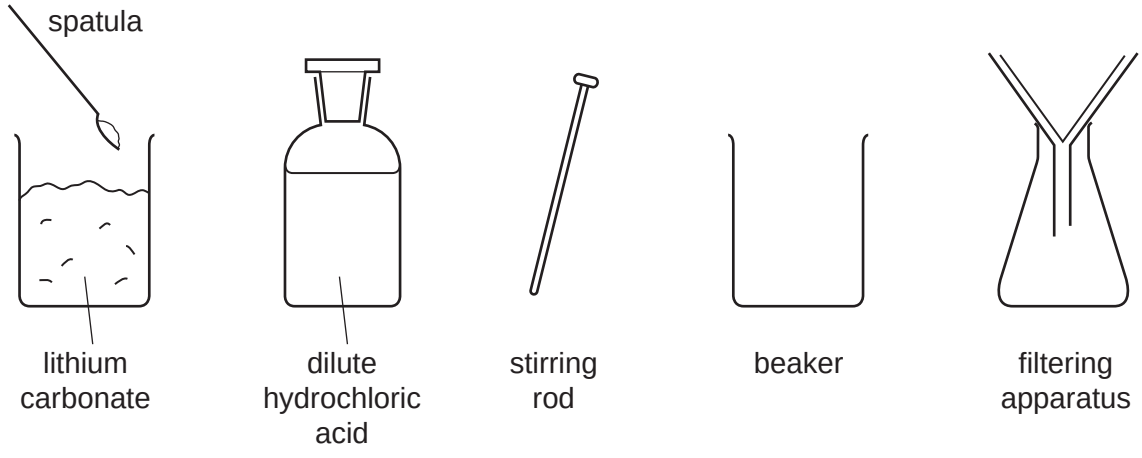


Fig. 3.2

(i) Describe how this apparatus should be used to produce a neutral solution of lithium chloride.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Suggest the **word** equation for the reaction between lithium carbonate and dilute hydrochloric acid.

..... [1]

(c) Fig. 3.3 shows a simplified diagram of the electrolysis of a molten electrolyte containing lithium chloride.

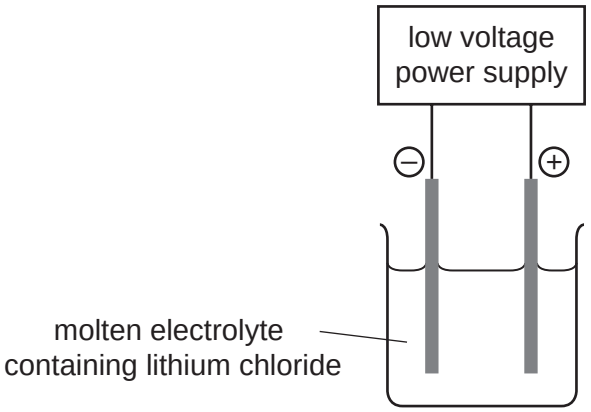


Fig. 3.3

(i) Explain why the process of electrolysis would **not** work if the electrolyte was allowed to solidify.

.....

.....

..... [2]

(ii) Describe how the electron configuration of each lithium ion changes when it arrives at the cathode.

For Examiner's Use

You may draw a diagram to help you answer this question.

.....

..... [1]

For Examiner's Use

4 Fig. 4.1 shows a smoke detector that uses the isotope americium-241, which emits alpha radiation.

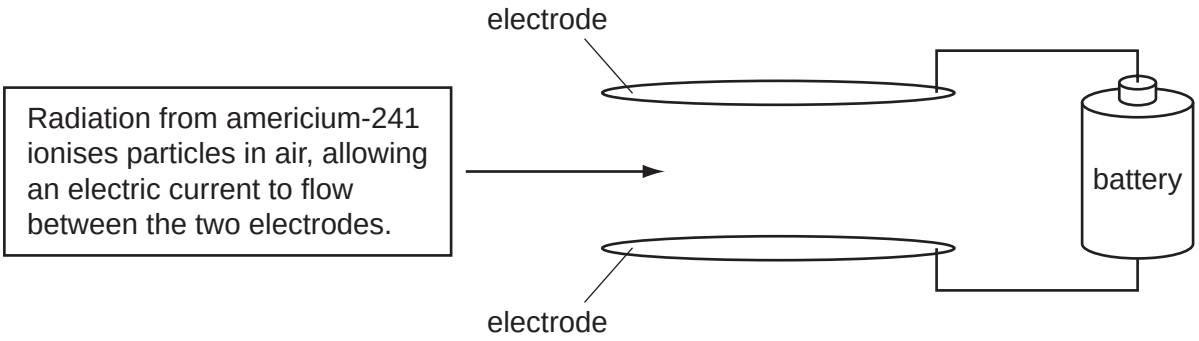


Fig. 4.1

Smoke particles stop radiation from reaching the air particles. This causes the current to stop flowing, causing the alarm to sound.

(a) Explain why beta or gamma radiation sources would **not** be suitable for this smoke detector.

.....

.....

..... [2]

(b) Fig. 4.2 is a graph to show how the number of americium-241 atoms inside a source decreases over time.

For Examiner's Use

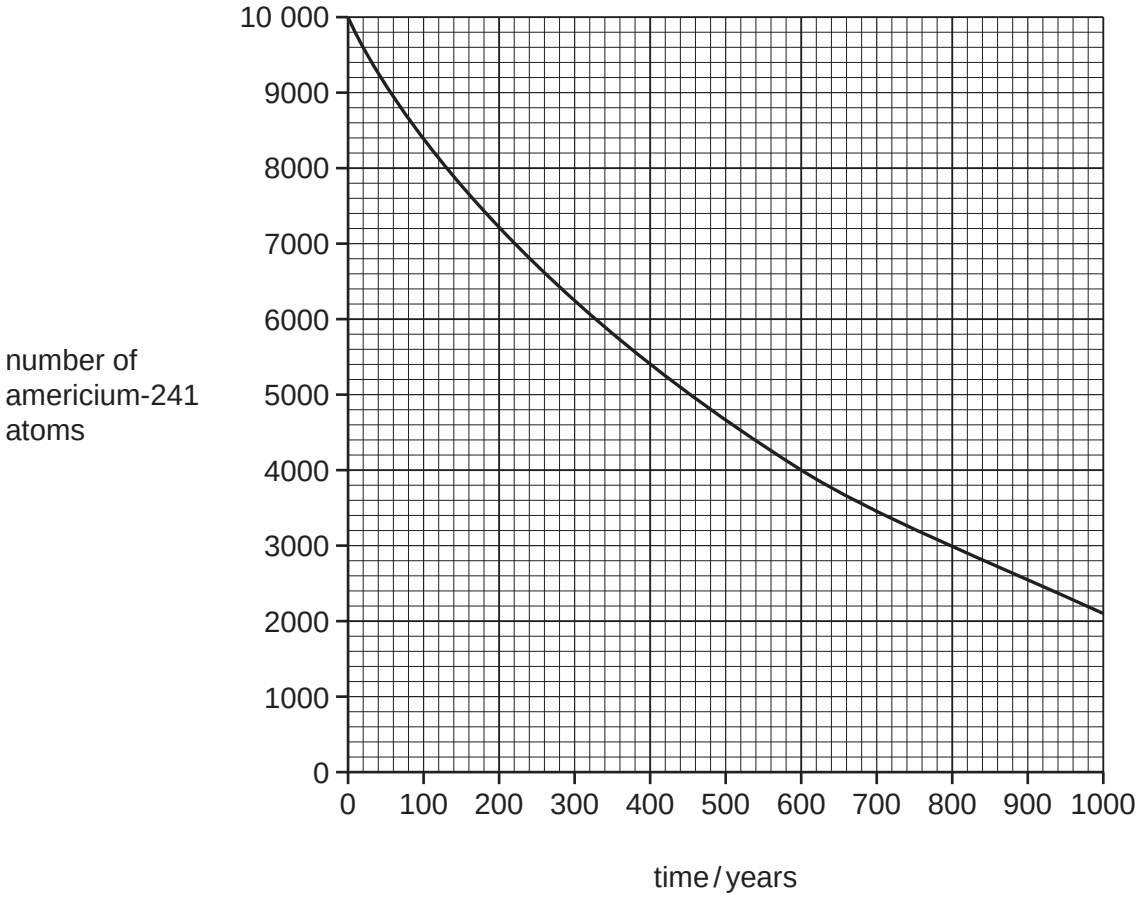


Fig. 4.2

(i) Calculate the half-life of the americium-241.

Show your working.

..... [2]

(ii) The battery inside the smoke detector has to be replaced each year.

Explain why the americium-241 source will never have to be replaced.

.....

..... [1]

For Examiner's Use

5 Fig. 5.1 shows crude oil and natural gas trapped in underground rocks. The diagram is not drawn to scale.

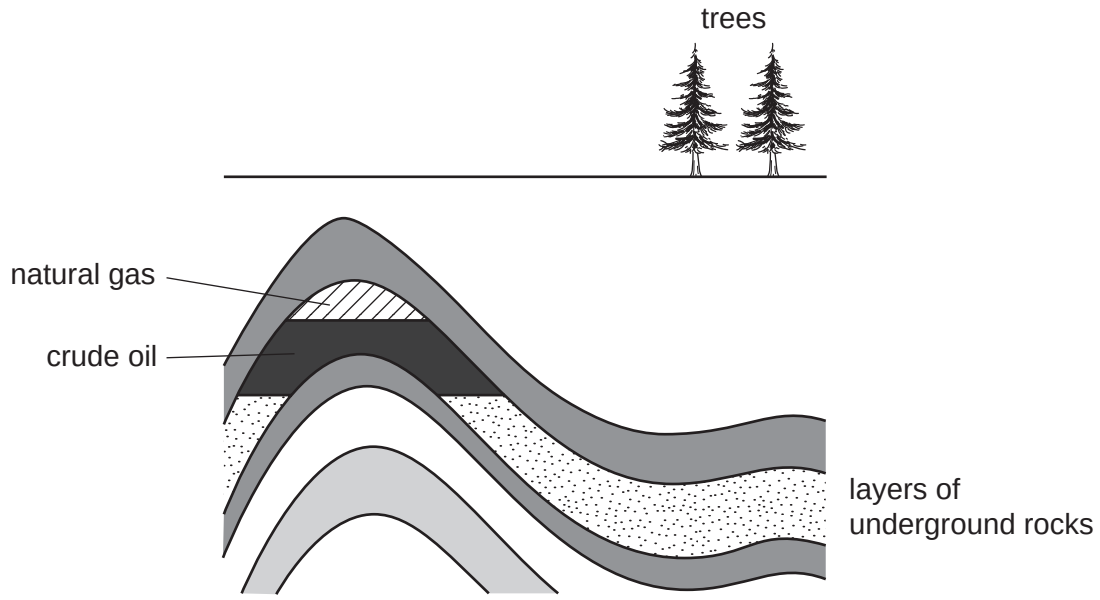


Fig. 5.1

(a) Wood obtained from trees and compounds obtained from crude oil and natural gas can be used as fuels.

State **two** reasons why crude oil and natural gas are examples of *fossil fuels* but wood is not.

1 .....

.....

2 .....

..... [2]

(b) Hexane, C_6H_{14}, is a hydrocarbon which is found in gasoline (car fuel).

Show that the relative formula mass of hexane is 86.

[1]

(c) Fig. 5.2 shows the balanced equation for the complete combustion of methane. The reactants and products are shown using displayed (graphical) chemical formulae.

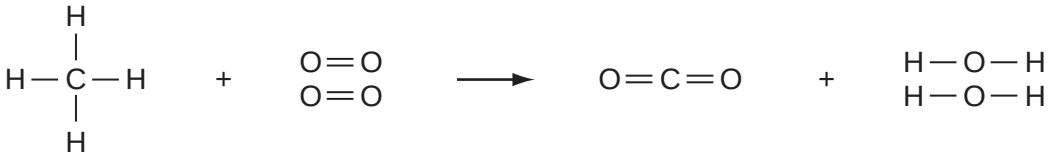


Fig. 5.2

During the reaction, chemical bonds are both broken and formed.

(i) On the equation in Fig. 5.2 draw a cross (**X**) on **one** of the **single** covalent bonds which is broken. [1]

(ii) When bonds are broken, energy is absorbed. When bonds are formed, energy is released to the surroundings.

Explain, in terms of the breaking and formation of chemical bonds, why some chemical reactions are exothermic.

.....

.....

..... [2]

(d) In a car engine, the combustion of hydrocarbons produces a mixture of waste (exhaust) gases which are released into the atmosphere.

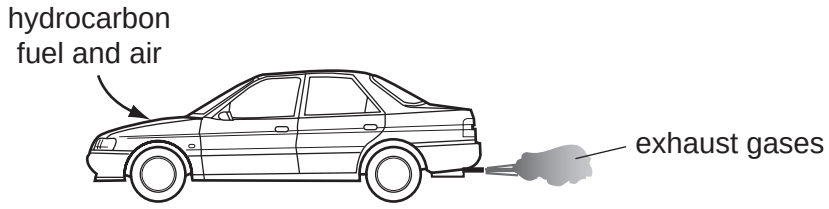


Table 5.1 shows information about some of the gases in a car's exhaust.

Table 5.1

substance in exhaust gases	% by volume
nitrogen	67
carbon dioxide	12
water vapour	11
carbon monoxide	0.2

(i) Explain why the mixture of exhaust gases contains carbon monoxide.

.....

..... [1]

(ii) Suggest why the exhaust gas mixture contains a significant amount of nitrogen.

.....

.....

..... [2]

[Turn over

For Examiner's Use

6 The human body contains organs made up of many different types of cells and tissues.

(a) Write each of these structures in the correct column in the table.

eye **heart** **sperm** **stomach**

cell	tissue	organ

[2]

(b) The internal environment of the human body is kept at a constant temperature of about 37 ºC.

Explain why cells work best at this temperature.

.....

.....

..... [2]

(c) Bone tissue is made up of cells surrounded by the mineral calcium phosphate.

A study was carried out in Brazil into the mineral content of the leg bones of school children between the ages of 10 and 19 years. The mineral content was measured as the mass of mineral per cm^3 of bone. Some of the results are shown in Fig. 6.1.

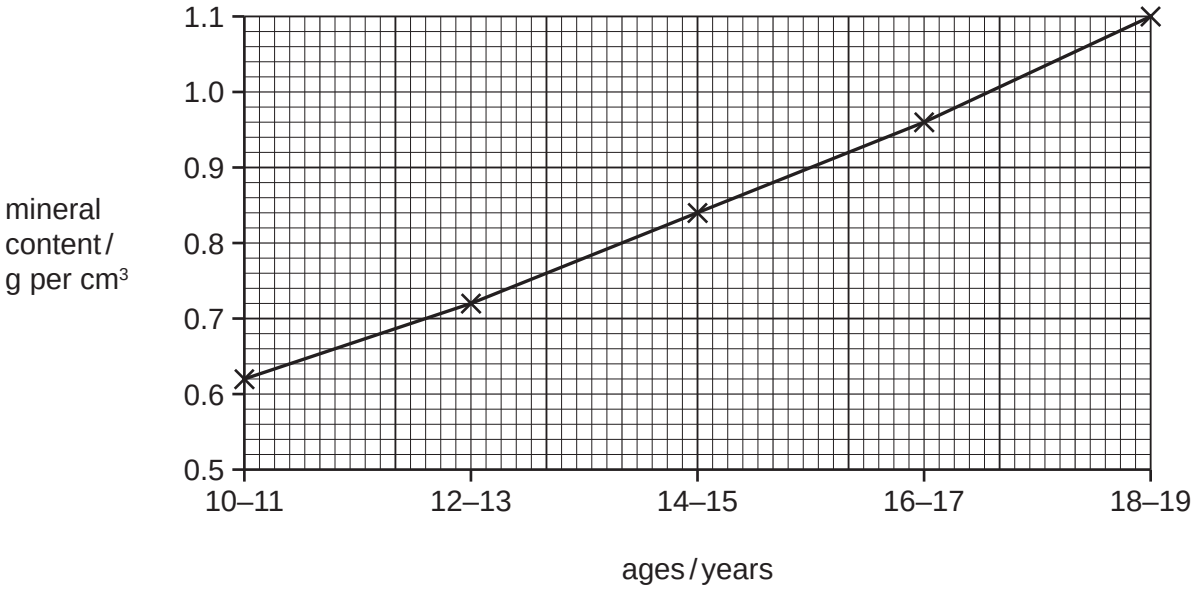


Fig. 6.1

(i) Describe how the mineral content of bone changes between the ages of 10 and 19 years.

.....

.....

..... [2]

(ii) Use the information in Fig. 6.1 to explain why a teenager should have a diet containing plenty of dairy products such as milk and cheese.

.....

.....

..... [2]

(iii) Bone also contains a protein called collagen. Vitamin C is required to make collagen.

Name **one** food that contains large amounts of vitamin C.

..... [1]

[Turn over

For Examiner's Use

7 A man wearing a parachute jumps from an aeroplane.

There is an upward force and a downward force acting on the man as he begins to fall before using his parachute.

The man then opens his parachute.

(a) (i) Name the force which remains the same when his parachute opens.

..... [1]

(ii) Explain in terms of forces why the man's speed of fall decreases when the parachute opens.

.....

.....

.....

..... [3]

(b) Fig. 7.1 shows the speed-time graph of his fall.

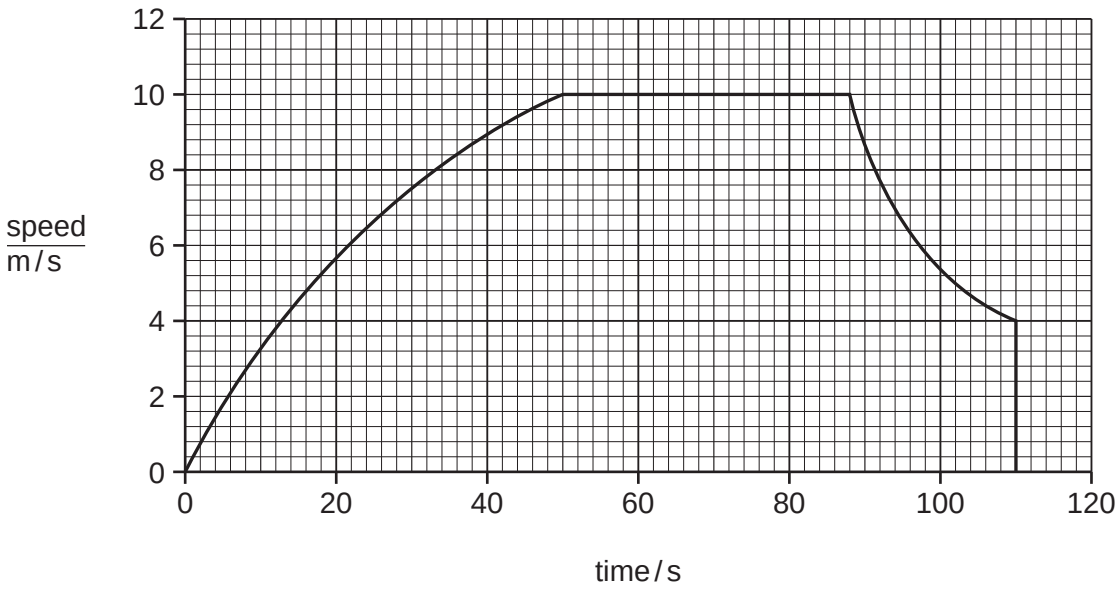


Fig. 7.1

(i) Mark on the graph with the letter **Z** the point at which the parachute opened. [1]

(ii) Mark on the graph with the letter **S** a point where the man is travelling at constant speed. [1]

(iii) Use Fig. 7.1 to calculate the distance travelled by the man between 60 and 80 seconds.

For Examiner's Use

Show your working.

..... [2]

8 A student investigated the reactivity of four metals, calcium, copper, magnesium and an unknown metal **A**, by comparing the rate at which these metals reacted in water.

Fig. 8.1 shows what the student observed during the experiment.

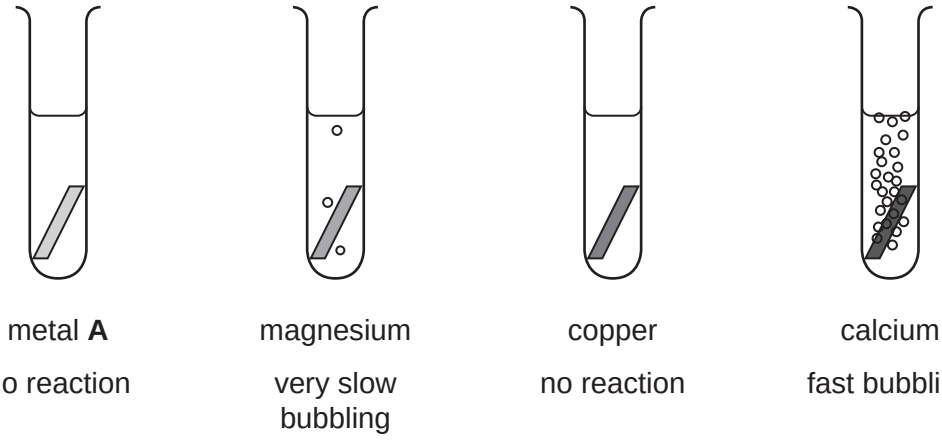


Fig. 8.1

(a) (i) State and explain **one** variable which the student must keep the same if her assessment of the relative reactivity of the four metals is to be reliable.

variable .....

explanation .....

.....

..... [3]

(ii) The student found that the pH of the mixture produced when calcium reacted was 12.

State the name or formula of the **ion** whose concentration has increased and which is responsible for the change in pH.

Explain your answer briefly.

ion .....

explanation .....

..... [2]

(iii) The student then carried out a second experiment to compare the reactivity of unknown metal **A** with that of copper.

For her experiment she used a piece of metal **A** and a solution of the salt, copper nitrate, contained in a beaker.

Outline how the student could use these materials to find out which metal, **A** or copper, is the more reactive.

.....

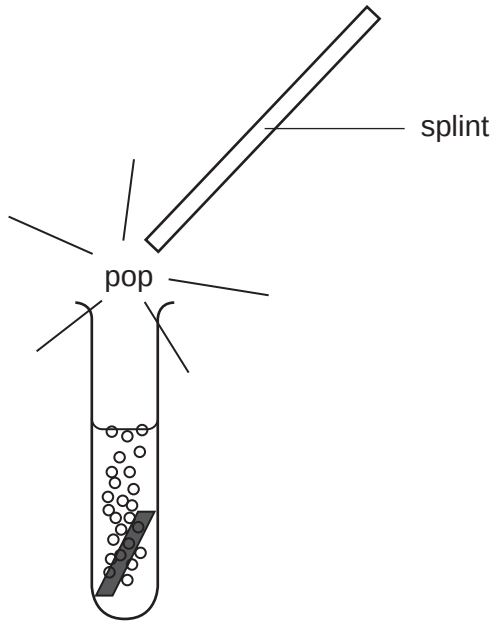
.....

.....

..... [2]

(b) If a lighted wooden splint is held in the mouth of the test-tube in which calcium is reacting with water, the hydrogen given off burns with a small explosive pop.

The explosive pop is caused by the rapid oxidation of hydrogen gas, H_2.



Suggest the balanced symbolic equation for the oxidation of hydrogen.

..... [2]

For Examiner's Use

9 **(a)** Name the part of a flower that carries out each of the following functions.

(i) attracts insects to the flower ..... [1]

(ii) makes pollen ..... [1]

(b) Complete the table to describe the differences between the stigmas of insect-pollinated and wind-pollinated flowers.

feature	insect-pollinated flower	wind-pollinated flower
shape of stigma		
position of stigma		

[2]

(c) The cells in the petals of most flowers do not contain chlorophyll and cannot photosynthesise.

(i) Describe how the cells in flowers obtain sugars and other nutrients.

.....

.....

.....

..... [2]

(ii) Suggest **one** reason why the cells in flowers need sugars.

..... [1]

10 (a) Fig. 10.1 shows a room heated by a convector heater, placed in the middle of the floor.

For Examiner's Use

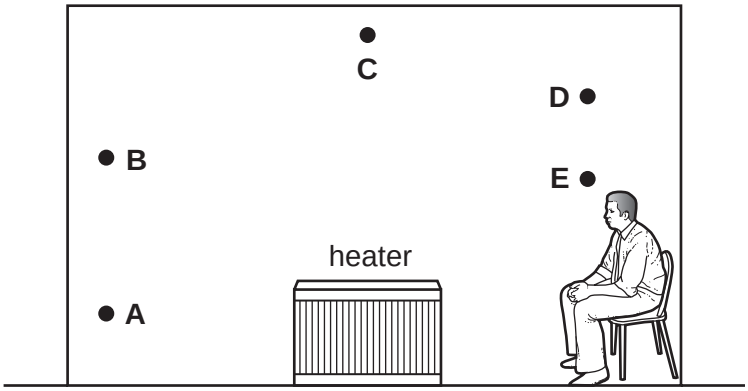


Fig. 10.1

(i) On Fig. 10.1 draw the convection currents of air produced by the heater. Use arrows to show their direction. [1]

(ii) State which labelled part of the room will be the

coldest, ...

hottest. .....

Explain your answers.

.....

.....

..... [3]

(b) Fig. 10.2 shows the structure of the walls of a house in a cold climate. Heat can escape through the walls of the house.

For Examiner's Use

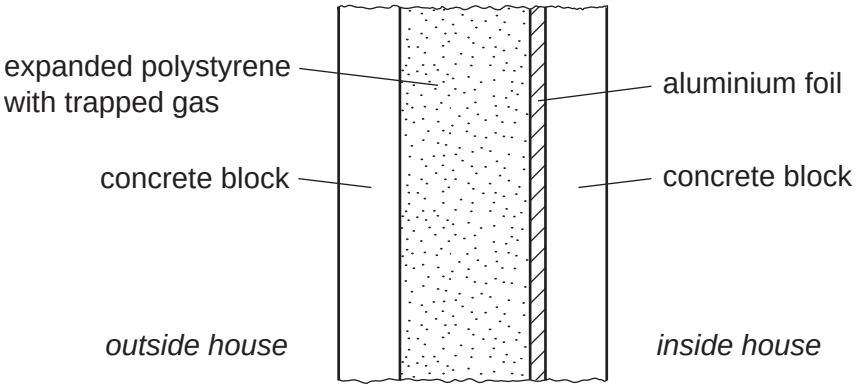


Fig. 10.2

Explain how the structure of the wall in Fig. 10.2 reduces heat loss.

.....

.....

.....

.....

..... [3]

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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.).