



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

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**COMBINED SCIENCE**

**0653/31**

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 20.

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 |  |
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This document consists of **19** printed pages and **1** blank page.



- 1 Dung beetles live in places where large herbivores, such as elephants, buffalo or horses, also live. The beetles collect dung produced by the herbivores and make it into a ball, which they roll away and bury.

They lay eggs on the buried ball of dung, so that when their larvae hatch they can feed on the dung. The adults also feed on the dung.

Fig. 1.1 shows a dung beetle rolling a ball of dung.

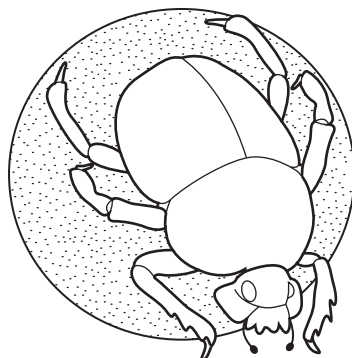


**Fig. 1.1**

- (a)** Dung beetles play an important role in the carbon cycle.

Using the information above, suggest how dung beetles can help a carbon atom in animal dung to become part of a carbohydrate molecule within a plant.

.....

.....

.....

.....

.....

..... [3]

- (b)** The buried dung adds nitrates to the soil.

Explain how this can help plants to grow better.

.....

.....

.....

..... [2]

(c) Farmers may use insecticides (pesticides that kill insects) on their land.

(i) Explain why farmers use insecticides.

.....

.....

..... [2]

(ii) Using the information above, explain why using insecticides on land where cattle graze could reduce the growth of grass.

.....

.....

..... [2]

- 2 The chemical formulae for some compounds (minerals) found in rocks are shown below.

|                              |                    |
|------------------------------|--------------------|
| $\text{CaMg}(\text{CO}_3)_2$ | dolomite           |
| $\text{KAlSi}_3\text{O}_8$   | potassium feldspar |
| $\text{NaAlSi}_3\text{O}_8$  | sodium feldspar    |
| $\text{CaCO}_3$              | calcite            |

- (a) A white powder is known to be either potassium feldspar or sodium feldspar.

Describe a test and its results which would enable a chemist to find out which of these minerals is contained in the white powder.

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

- (b) Calculate the relative formula mass of calcite.

Show your working.

..... [1]

- (c) When dolomite is strongly heated, carbon dioxide gas is given off and a mixture of calcium and magnesium oxides remains.

- (i) The symbolic equation for this reaction which is shown below is **not** balanced.

Balance the equation.



[1]

- (ii) Name the type of chemical reaction in (i) and state the evidence you have to decide your answer.

type of reaction .....

evidence .....

..... [2]

- (d) A student adds some water to some calcium oxide. She observes that an exothermic reaction occurs and an **alkaline** solution is formed.

- (i) State the ion whose concentration increases when calcium oxide reacts with water.

..... [1]

- (ii) The student then adds dilute hydrochloric acid to the solution from (i).

Write a **word** equation for the neutralisation reaction which occurs.

..... [2]

- 3 In an experiment, weights were hung on a spring and the length of the spring measured.

Fig. 3.1 shows a graph of the results.

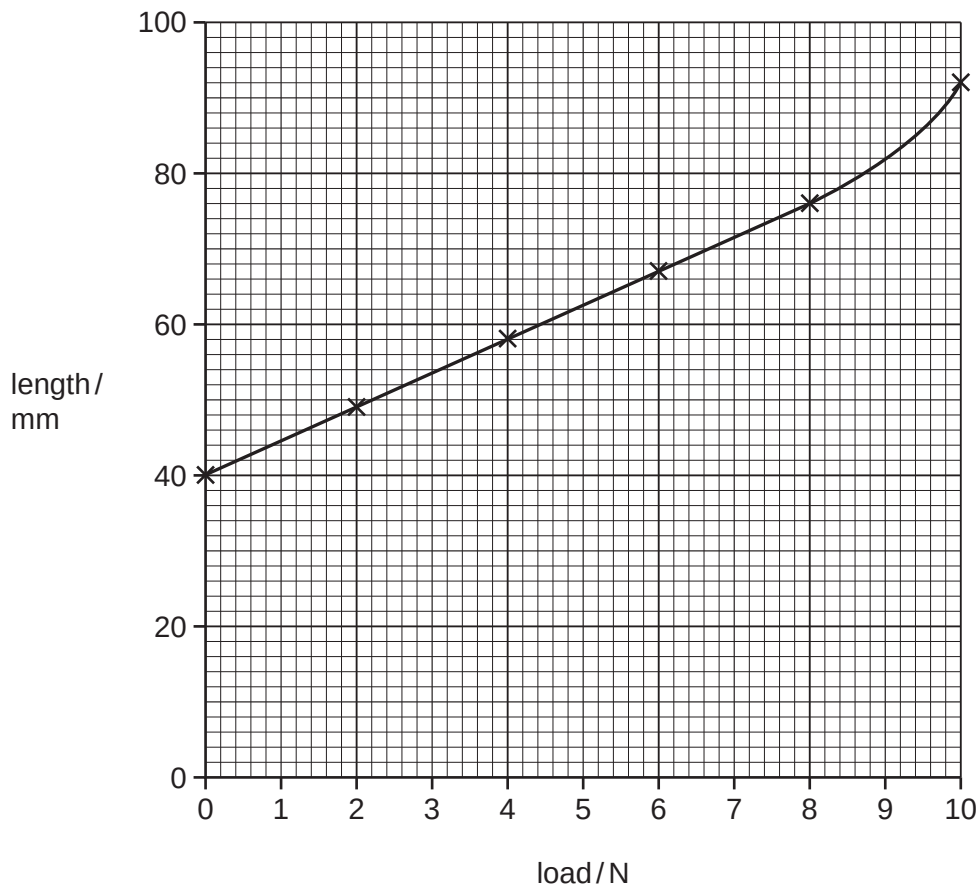


Fig. 3.1

- (a) Calculate the **extension** of the spring when a 4 N load is hung from it.

Show your working.

..... [1]

- (b) Explain the relationship between the load on the spring and the length of the spring when the load is increased from 0 to 10 N.

.....

.....

.....

..... [3]

- (c) Fig. 3.2 shows a wooden bird suspended from an identical spring.



**Fig. 3.2**

The total length of the spring is 51 mm.

- (i) Use the graph in Fig. 3.1 to find the weight of the bird. Show your working.

..... [1]

- (ii) The density of the wood used to make the bird is  $0.8 \text{ g/cm}^3$ .

Use your answer to (i) to calculate the volume of the bird in cubic centimetres.

The gravitational field strength of the Earth is  $10 \text{ N/kg}$ .

State any formula that you use and show your working.

formula used

working

..... [3]

4 Fig. 4.1 shows a sperm cell.



**Fig. 4.1**

(a) On Fig. 4.1, use label lines to label and name **two** structures that are found in **all** animal cells. [2]

(b) Name the organ in which sperm are produced. .... [1]

(c) An investigation was carried out into the oxygen use and energy use of sperm while they were at rest and while they were swimming.

For each measurement, the researchers calculated the amount of oxygen and the amount of energy used by  $10^9$  (one thousand million) sperm.

The results are shown in Table 4.1.

**Table 4.1**

|                | oxygen use / units per<br>$10^9$ sperm per hour | energy use / joules per<br>$10^9$ sperm per hour |
|----------------|-------------------------------------------------|--------------------------------------------------|
| resting sperm  | 24                                              | 46                                               |
| swimming sperm | 83                                              | 164                                              |

(i) Suggest why the researchers measured the oxygen use and energy use for  $10^9$  sperm, rather than for a single sperm.

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

- (ii) Explain why more oxygen is used when the sperm are using more energy.

.....

.....

.....

..... [2]

- (iii) Calculate the total power output of a group of  $10^9$  swimming sperm.

State the formula that you use and show your working.

formula

working

..... [3]

- (iv) In order to reach an egg, a human sperm has to swim from the top of the vagina to an oviduct, through a thin layer of liquid.

Explain how the shape of the sperm, shown in Fig. 4.1, reduces the energy required to swim this distance.

.....

.....

..... [2]

- 5 (a) Nuclear reactors can be used in power stations to produce energy for generating electricity.

(i) Suggest **one** advantage and **one** disadvantage of generating electricity in this way.

advantage .....

.....

disadvantage .....

..... [2]

(ii) Describe what happens to an atom during nuclear fission.

.....

..... [1]

(iii) Below is a newspaper article written by someone who has a poor understanding of radioactivity.

There was a leak of radiation from our local nuclear power station yesterday.

The radiation blew across farmland.

It emits gamma particles which are harmful to wildlife.

Write down **one** mistake reported in the article. Explain why this is a mistake.

mistake .....

explanation .....

.....

.....

..... [2]

- (b) A badge made from photographic film can be used to check the exposure of workers to radiation. A simple badge has two sections **A** and **B** for the detection of  $\alpha$  and gamma radiation.

Fig. 5.1 shows a worker wearing his badge.

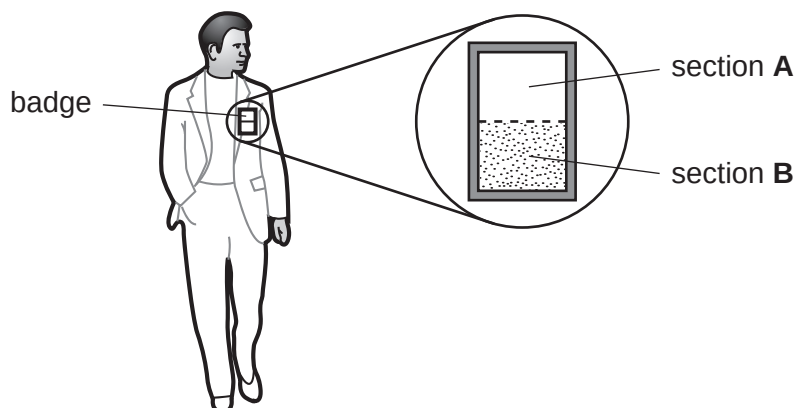


**Fig. 5.1**

Fig. 5.2 shows the side view through the badge.

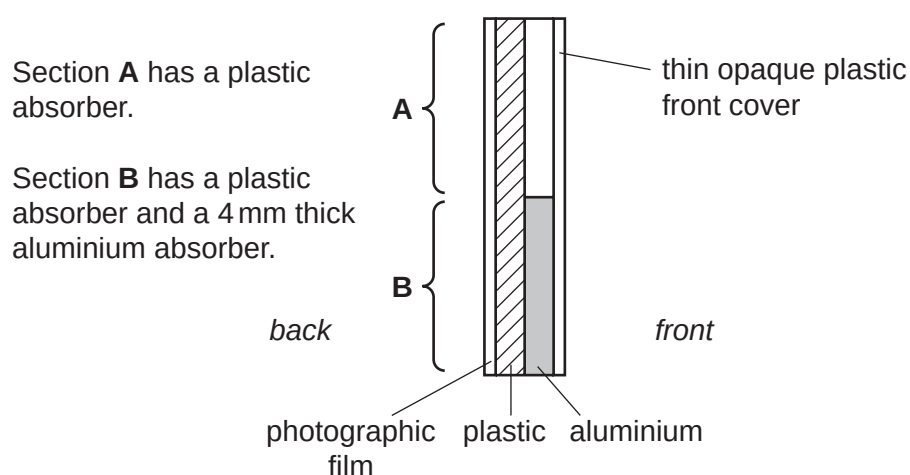


**Fig. 5.2**

When the photographic film from the badge is developed, it turns black where it has been exposed to radiation.

- (i) Complete Table 5.1 to show whether the photographic film will turn black when exposed to beta or gamma radiations.

**Table 5.1**

| radiation | will section A turn black? | will section B turn black? |
|-----------|----------------------------|----------------------------|
| beta      |                            |                            |
| gamma     | yes                        |                            |

- (ii) Explain why the badge can **not** be used to detect alpha radiation.

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

- (c) Alpha, beta and gamma radiations behave differently when they are passed through an electric field.

- (i) Explain why gamma radiation is **not** deflected.

..... [1]

- (ii) Explain why alpha and beta radiation are deflected in opposite directions.

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

- 6 (a) Air is a mixture of elements and compounds. The two main elements in air are nitrogen and oxygen. Nitrogen dioxide,  $\text{NO}_2$ , is a compound of nitrogen and oxygen.
- (i) Complete Table 6.1 by writing **M** in the right hand column if the description refers to a **mixture** of nitrogen and oxygen or **C** if it refers to the **compound**, nitrogen dioxide.

Table 6.1

| description                                                           | M or C |
|-----------------------------------------------------------------------|--------|
| nitrogen atoms are bonded to oxygen atoms                             |        |
| relative amounts of nitrogen and oxygen can vary                      |        |
| little or no energy change when formed from nitrogen and oxygen       |        |
| chemical properties are very different from either nitrogen or oxygen |        |

[2]

- (ii) The gases nitrogen and oxygen can be separated by fractional distillation from air which has been cooled and pressurised so that it turns into a liquid.

Explain briefly how fractional distillation separates nitrogen and oxygen from liquefied air.

.....

.....

..... [2]

- (b) Nitrogen and hydrogen can be made to react together to form ammonia,  $\text{NH}_3$ . This reaction requires a solid iron catalyst and a high temperature.

Explain, in terms of molecular collisions, why increasing the temperature increases the rate of reaction.

.....

.....

..... [2]

- (c) The diagrams in Fig. 6.1 show the outer electron shells of atoms of the elements hydrogen and sulfur.

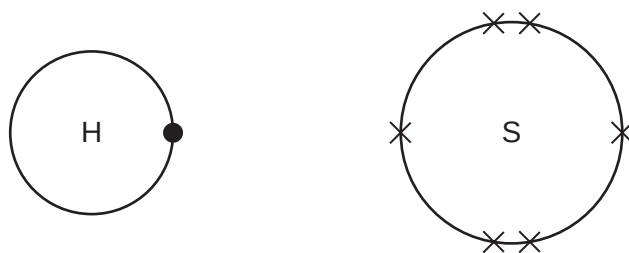


**Fig. 6.1**

When these atoms bond together, they form a covalent compound whose formula is  $\text{H}_2\text{S}$ .

Use the information shown in these diagrams to explain why the formula of the compound is  $\text{H}_2\text{S}$ .

You may wish to draw a diagram to help your explanation.

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



The smell of food cooking can cause a person's salivary glands to secrete saliva.

(a) (i) Name this type of response to a stimulus. .... [1]

(ii) Describe how the information about the smell of the food travels from the nose to the salivary glands.

.....

.....

.....

..... [3]

(b) When food has been taken into a person's mouth, it is chewed by teeth and mixed with saliva.

Describe how the molar teeth help in the digestion of food.

.....

.....

.....

..... [3]

(c) Saliva contains the enzyme amylase.

What is an *enzyme*?

.....

.....

..... [2]

- 8 A student carried out an experiment to find which substances in the environment cause nails made of mild steel to become rusty.

She selected three identical nails and placed them in sealed test-tubes, **A**, **B** and **C**, as shown in Fig. 8.1.

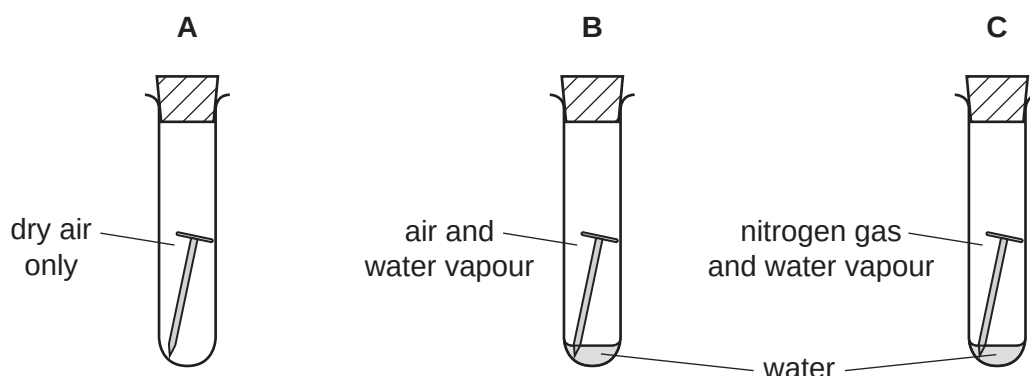


Fig. 8.1

- (a) Predict in which tube, **A**, **B** or **C**, the nail became rusty, and explain why the nail did **not** rust in either of the other two tubes.

.....

.....

.....

.....

..... [3]

- (b) Stainless steel does not rust because it is protected by a very thin layer which contains chromium oxide.

- (i) Chromium oxide contains chromium ions,  $\text{Cr}^{3+}$ , and oxide ions,  $\text{O}^{2-}$ .

Deduce the chemical formula of chromium oxide.

Explain how you obtained your answer.

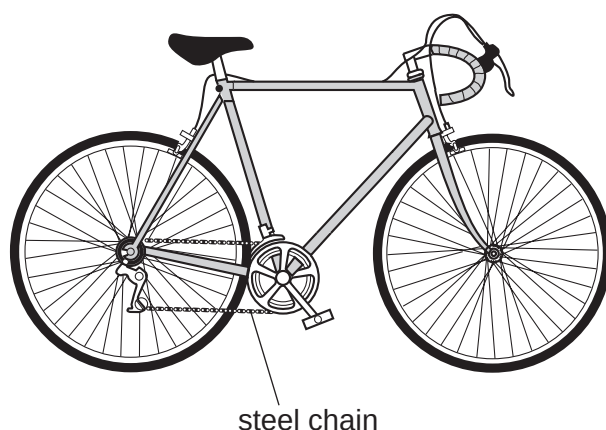
..... [2]

- (ii) Explain why an oxide ion carries a double negative (2-) electrical charge.

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

- (c) Steel is used to make the chain of a bicycle. To prevent rusting, the chain is covered by oil made of hydrocarbon molecules.

The oil used to protect the bicycle chain contains mainly hydrocarbon molecules which do **not** contain any double bonds.



- (i) Describe a chemical test and its result that would show whether or not a hydrocarbon oil contained molecules with double bonds.

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

- (ii) Suggest **one** property of a hydrocarbon oil which makes it suitable for use as a barrier to prevent rusting.

..... [1]

9 The speakers of three MP3 music players are being compared.

(a) The speakers are tested to find the range of frequencies they produce.

Table 9.1 shows the results.

Table 9.1

| speaker  | range of frequencies / Hz |
|----------|---------------------------|
| <b>A</b> | 100 to 10 000             |
| <b>B</b> | 20 to 25 000              |
| <b>C</b> | 20 to 40 000              |

(i) What is meant by the term *frequency*?

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

(ii) Use the information in Table 9.1 to suggest why the music played through speaker **A** might not sound as good as the other two speakers.

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

(iii) Music played through speakers **B** and **C** sounds the same. Suggest a reason for this.

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

(b) Two speakers each with a resistance of  $8\Omega$  are connected in parallel.

Calculate their combined resistance.

State the formula that you use and show your working.

formula used

working

..... [3]



**DATA SHEET**  
**The Periodic Table of the Elements**

| Group                      |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
|----------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|------------------------------|----------------------------|---------------------------|---------------------------|--|--|--|--|--|--|--|--|--|--|--|--|
| I                          | II                          |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            | III                         | IV                          | V                            | VI                         | VII                       | 0                         |  |  |  |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            | 1<br>H<br>Hydrogen<br>1     |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
| 7<br>Li<br>Lithium<br>3    | 9<br>Be<br>Beryllium<br>4   |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
| 23<br>Na<br>Sodium<br>11   | 24<br>Mg<br>Magnesium<br>12 |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
| 39<br>K<br>Potassium<br>19 | 40<br>Ca<br>Calcium<br>20   | 45<br>Sc<br>Scandium<br>21   | 48<br>Ti<br>Titanium<br>22  | 51<br>V<br>Vanadium<br>23   | 52<br>Cr<br>Chromium<br>24   | 55<br>Mn<br>Manganese<br>25  | 56<br>Fe<br>Iron<br>26     | 59<br>Co<br>Cobalt<br>27     | 59<br>Ni<br>Nickel<br>28    | 64<br>Cu<br>Copper<br>29   | 65<br>Zn<br>Zinc<br>30     | 70<br>Ga<br>Gallium<br>31   | 73<br>Ge<br>Germanium<br>32 | 75<br>As<br>Arsenic<br>33    | 79<br>Se<br>Selenium<br>34 | 80<br>Br<br>Bromine<br>35 | 84<br>Kr<br>Krypton<br>36 |  |  |  |  |  |  |  |  |  |  |  |  |
| 85<br>Rb<br>Rubidium<br>37 | 88<br>Sr<br>Strontium<br>38 | 89<br>Y<br>Yttrium<br>39     | 91<br>Zr<br>Zirconium<br>40 | 93<br>Nb<br>Niobium<br>41   | 96<br>Mo<br>Molybdenum<br>42 | 101<br>Ru<br>Ruthenium<br>44 | 101<br>Rh<br>Rhodium<br>45 | 106<br>Pd<br>Palladium<br>46 | 108<br>Ag<br>Silver<br>47   | 112<br>Cd<br>Cadmium<br>48 | 115<br>In<br>Indium<br>49  | 119<br>Sn<br>Tin<br>50      | 122<br>Sb<br>Antimony<br>51 | 127<br>Te<br>Tellurium<br>52 | 131<br>I<br>Iodine<br>53   | 131<br>Xe<br>Xenon<br>54  |                           |  |  |  |  |  |  |  |  |  |  |  |  |
| 133<br>Cs<br>Caesium<br>55 | 137<br>Ba<br>Barium<br>56   | 139<br>La<br>Lanthanum<br>57 | 178<br>Hf<br>Hafnium<br>72  | 181<br>Ta<br>Tantalum<br>73 | 184<br>W<br>Tungsten<br>74   | 186<br>Re<br>Rhenium<br>75   | 190<br>Os<br>Osmium<br>76  | 192<br>Ir<br>Iridium<br>77   | 195<br>Pt<br>Platinum<br>78 | 197<br>Au<br>Gold<br>79    | 201<br>Hg<br>Mercury<br>80 | 204<br>Tl<br>Thallium<br>81 | 207<br>Pb<br>Lead<br>82     | 209<br>Bi<br>Bismuth<br>83   |                            | At<br>Astatine<br>85      | Rn<br>Radon<br>86         |  |  |  |  |  |  |  |  |  |  |  |  |
| Fr<br>Francium<br>87       | 226<br>Ra<br>Radium<br>88   | 227<br>Ac<br>Actinium<br>89  |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
| 58-71 Lanthanoid series    |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
| 90-103 Actinoid series     |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |  |  |  |
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The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).



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**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**

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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.

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]

(b) Guanacos can live at very high altitudes, above 4000 metres. The atmosphere is denser 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  $\text{cm}^3$  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]

- 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.

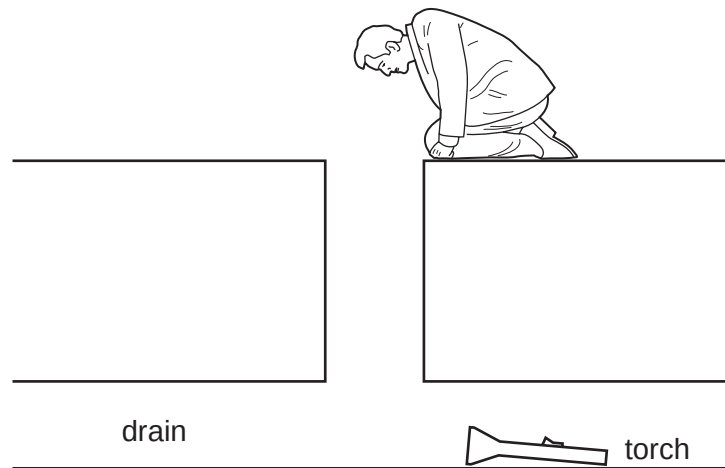


Fig. 2.1

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 te

For  
inner's

[1]

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

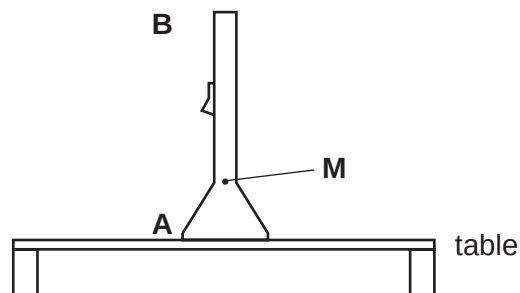


Fig. 2.2

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.

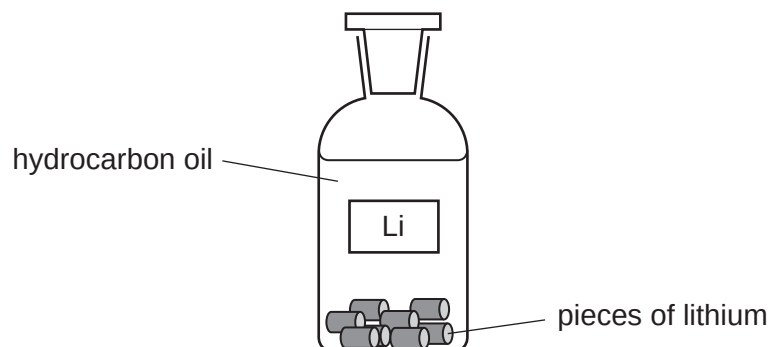


Fig. 3.1

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,  $\text{Li}_2\text{CO}_3$ .
- 2 Lithium carbonate is then converted into lithium chloride,  $\text{LiCl}$ .
- 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.

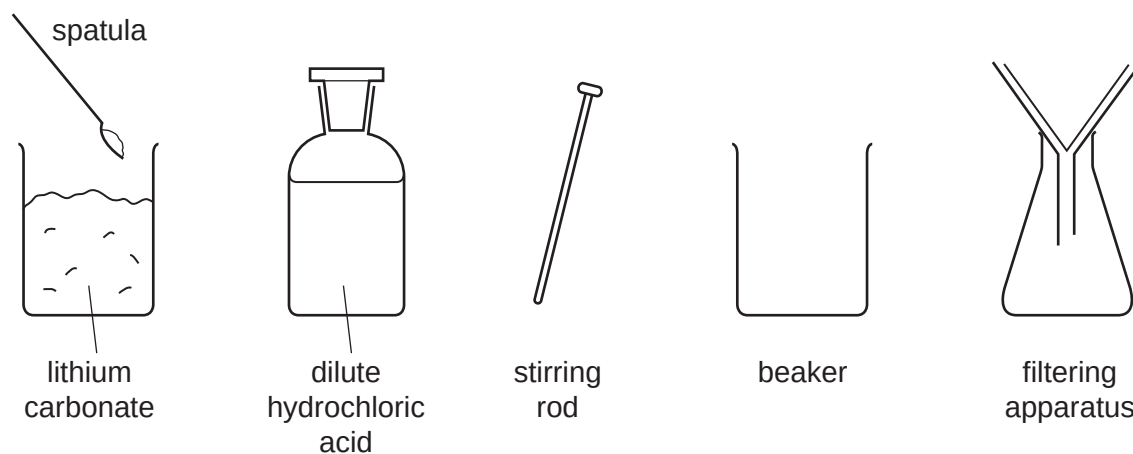


Fig. 3.2

- (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.

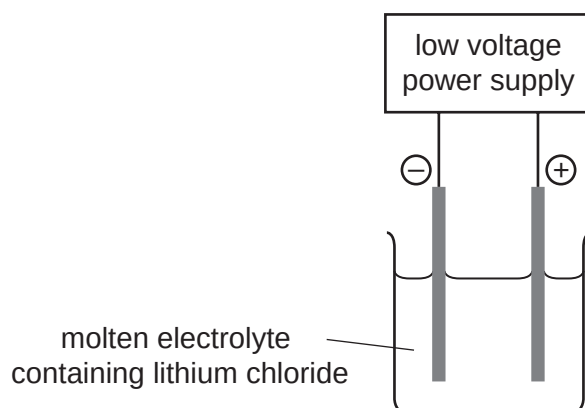


**Fig. 3.3**

- (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 is reduced at the cathode.

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

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

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

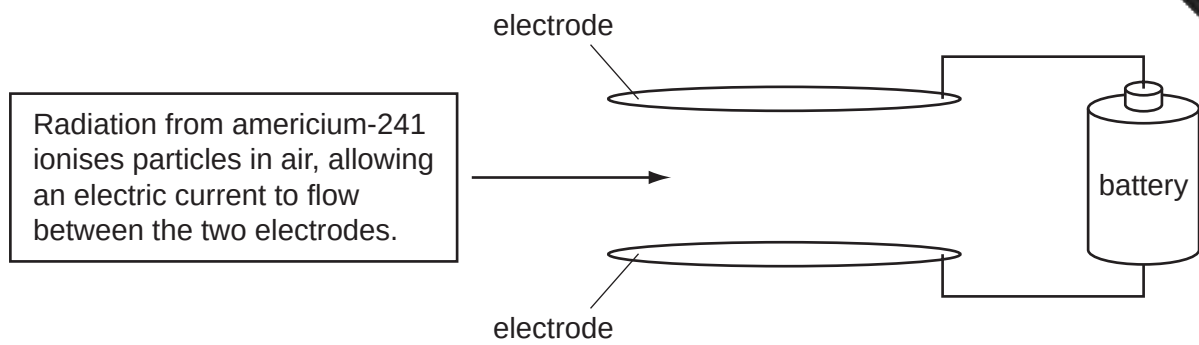


**Fig. 4.1**

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 smoke detector decreases over time.

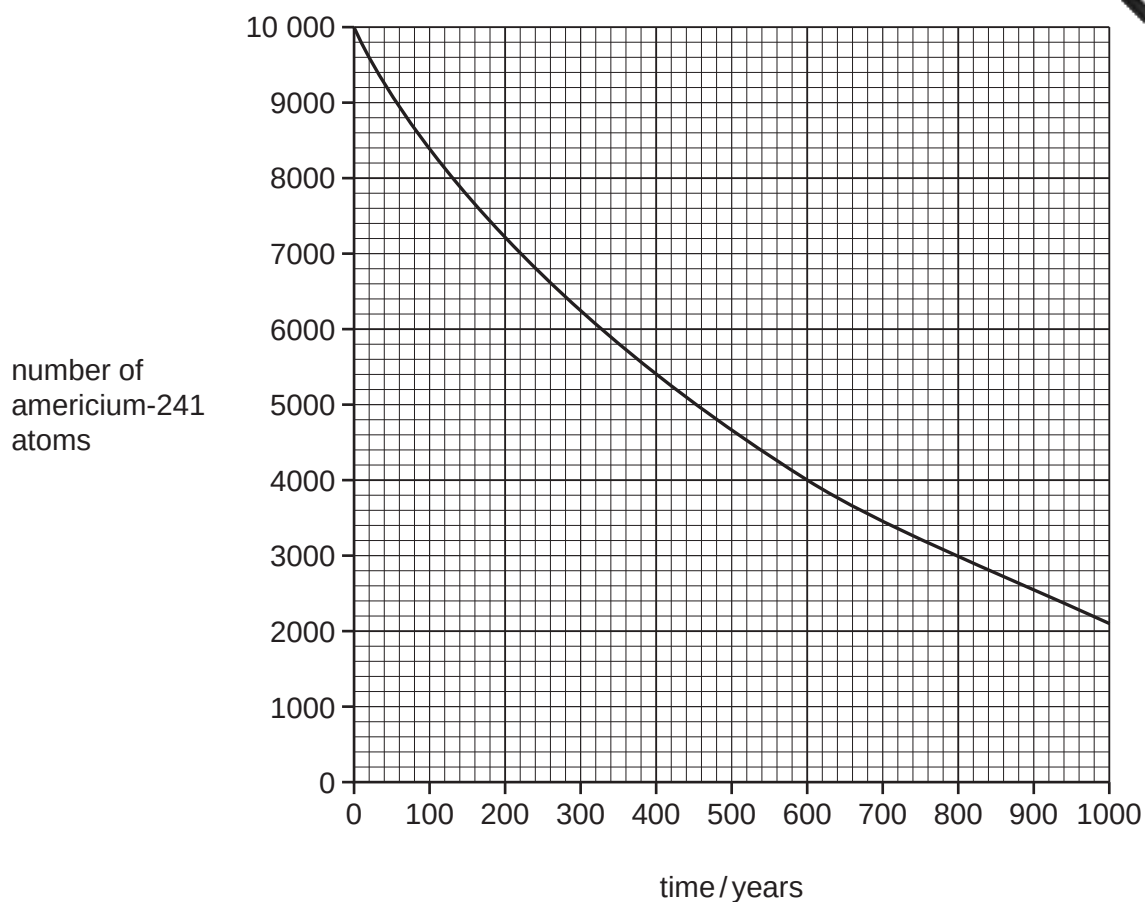


**Fig. 4.2**

- (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]

- 5 Fig. 5.1 shows crude oil and natural gas trapped in underground rocks. The diagram is drawn to scale.

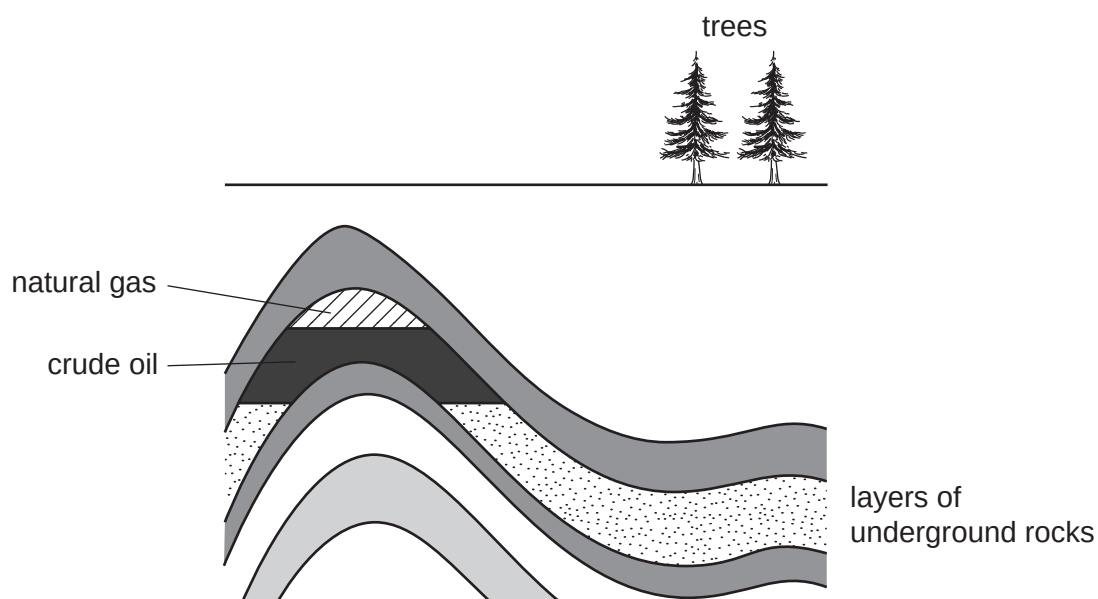


Fig. 5.1

- (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.

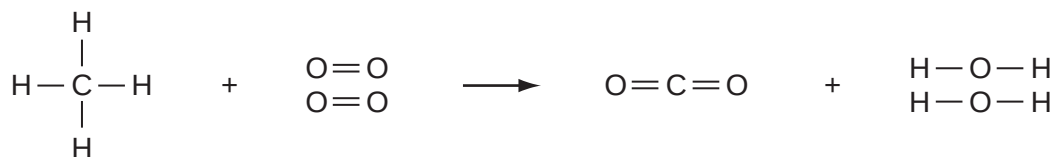


**Fig. 5.2**

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.

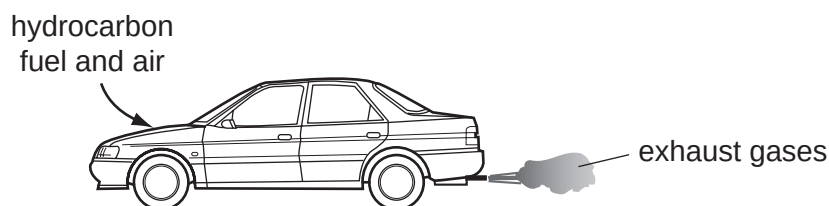


Table 5.1 shows information about some of the gases in a car's exhaust.

**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]

- 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°C.

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  $\text{cm}^3$  of bone. Some of the results are shown in Fig. 6.1.

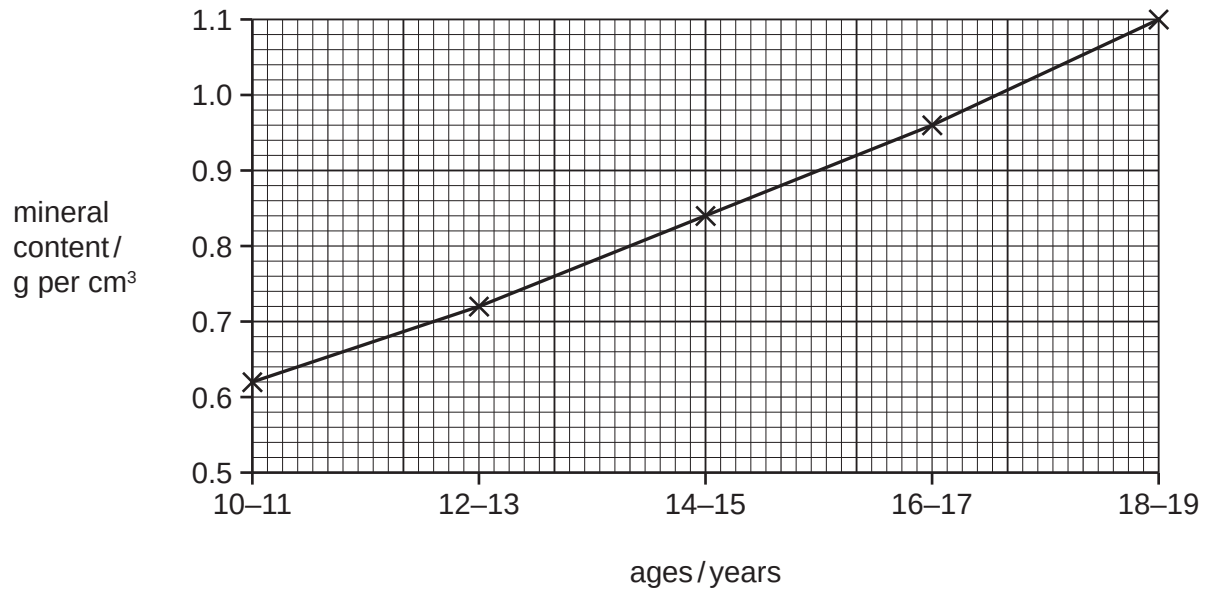


**Fig. 6.1**

- (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]

- 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.

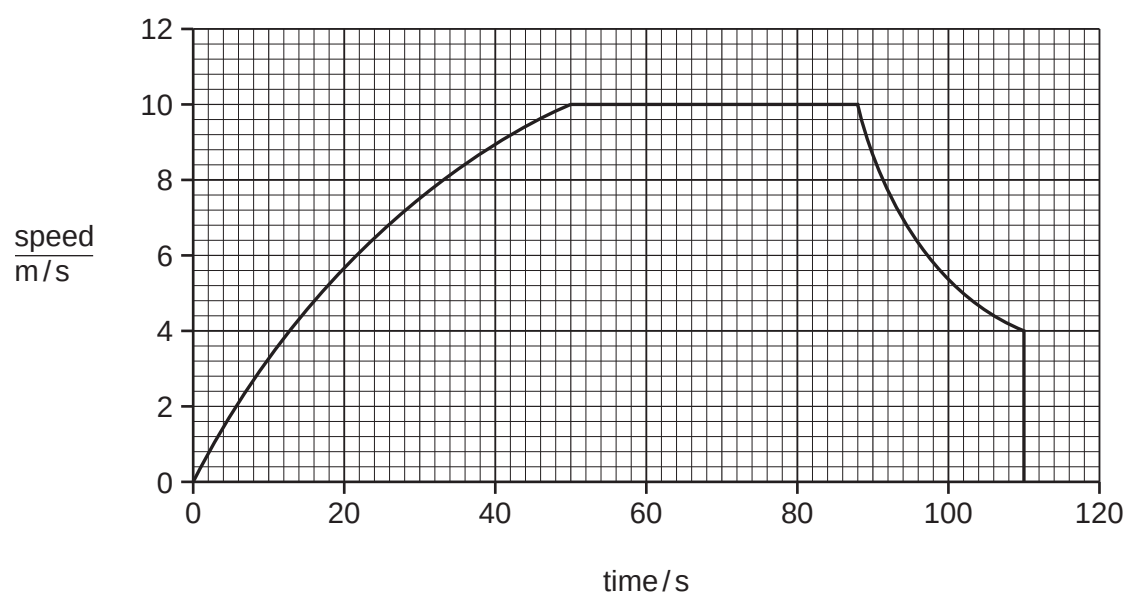


Fig. 7.1

- (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 0 and 80 seconds. For  
marker's

Show your working.

..... [2]

- 8 A student investigated the reactivity of four metals, calcium, copper, magnesium and 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.

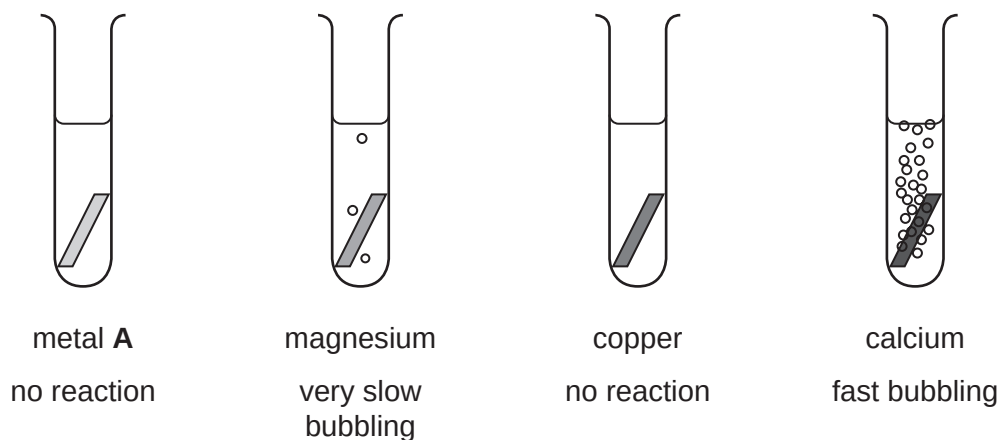


Fig. 8.1

- (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 reaction 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.

.....

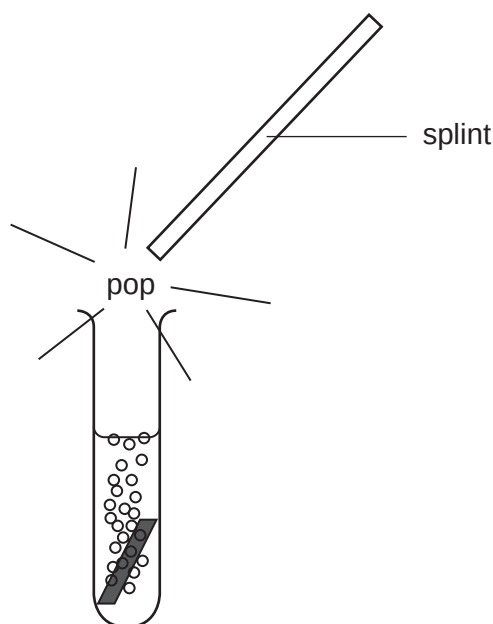
.....

.....

..... [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]

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

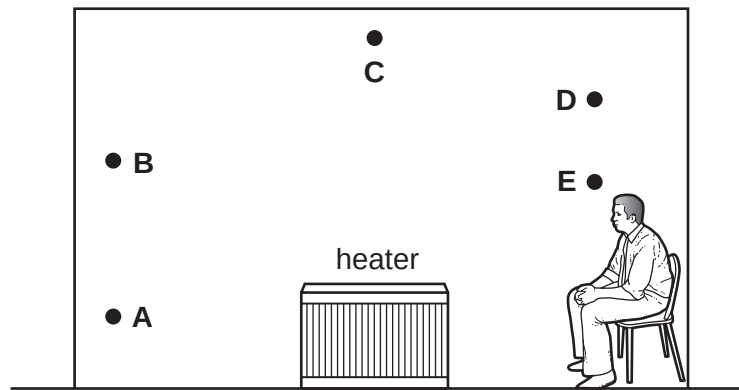


Fig. 10.1

- (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 be lost through the walls of the house.

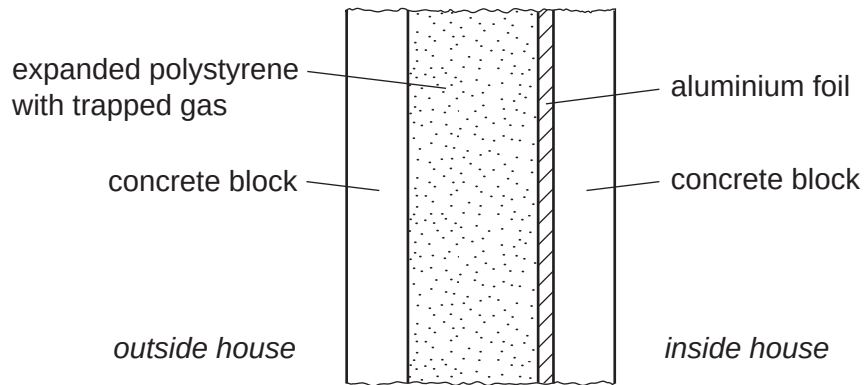


**Fig. 10.2**

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

.....

.....

.....

.....

.....

..... [3]



**DATA SHEET**  
**The Periodic Table of the Elements**

| Group                      |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
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| I                          | II                          |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            | III                         | IV                          | V                            | VI                         | VII                       | 0                         |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            | 1<br>H<br>Hydrogen<br>1     |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
| 7<br>Li<br>Lithium<br>3    | 9<br>Be<br>Beryllium<br>4   |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
| 23<br>Na<br>Sodium<br>11   | 24<br>Mg<br>Magnesium<br>12 |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
| 39<br>K<br>Potassium<br>19 | 40<br>Ca<br>Calcium<br>20   | 45<br>Sc<br>Scandium<br>21   | 48<br>Ti<br>Titanium<br>22  | 51<br>V<br>Vanadium<br>23   | 52<br>Cr<br>Chromium<br>24   | 55<br>Mn<br>Manganese<br>25  | 56<br>Fe<br>Iron<br>26     | 59<br>Co<br>Cobalt<br>27     | 59<br>Ni<br>Nickel<br>28    | 64<br>Cu<br>Copper<br>29   | 65<br>Zn<br>Zinc<br>30     | 70<br>Ga<br>Gallium<br>31   | 73<br>Ge<br>Germanium<br>32 | 75<br>As<br>Arsenic<br>33    | 79<br>Se<br>Selenium<br>34 | 80<br>Br<br>Bromine<br>35 | 84<br>Kr<br>Krypton<br>36 |  |  |  |  |  |  |  |  |  |
| 85<br>Rb<br>Rubidium<br>37 | 88<br>Sr<br>Strontium<br>38 | 89<br>Y<br>Yttrium<br>39     | 91<br>Zr<br>Zirconium<br>40 | 93<br>Nb<br>Niobium<br>41   | 96<br>Mo<br>Molybdenum<br>42 | 101<br>Ru<br>Ruthenium<br>44 | 101<br>Rh<br>Rhodium<br>45 | 106<br>Pd<br>Palladium<br>46 | 108<br>Ag<br>Silver<br>47   | 112<br>Cd<br>Cadmium<br>48 | 115<br>In<br>Indium<br>49  | 119<br>Sn<br>Tin<br>50      | 122<br>Sb<br>Antimony<br>51 | 127<br>Te<br>Tellurium<br>52 | 128<br>I<br>Iodine<br>53   | 131<br>Xe<br>Xenon<br>54  |                           |  |  |  |  |  |  |  |  |  |
| 133<br>Cs<br>Caesium<br>55 | 137<br>Ba<br>Barium<br>56   | 139<br>La<br>Lanthanum<br>57 | 178<br>Hf<br>Hafnium<br>72  | 181<br>Ta<br>Tantalum<br>73 | 184<br>W<br>Tungsten<br>74   | 186<br>Re<br>Rhenium<br>75   | 190<br>Os<br>Osmium<br>76  | 192<br>Ir<br>Iridium<br>77   | 195<br>Pt<br>Platinum<br>78 | 197<br>Au<br>Gold<br>79    | 201<br>Hg<br>Mercury<br>80 | 204<br>Tl<br>Thallium<br>81 | 207<br>Pb<br>Lead<br>82     | 209<br>Bi<br>Bismuth<br>83   |                            |                           |                           |  |  |  |  |  |  |  |  |  |
| Fr<br>Francium<br>87       | 226<br>Ra<br>Radium<br>88   | 227<br>Ac<br>Actinium<br>89  |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
| 58-71 Lanthanoid series    |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
| 90-103 Actinoid series     |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
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|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
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|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |
|                            |                             |                              |                             |                             |                              |                              |                            |                              |                             |                            |                            |                             |                             |                              |                            |                           |                           |  |  |  |  |  |  |  |  |  |

|     |                                                                             |   |
|-----|-----------------------------------------------------------------------------|---|
| a   | X                                                                           | b |
| Key | a = relative atomic mass<br>X = atomic symbol<br>b = proton (atomic) number |   |

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).