Cambridge
O Level

**Cambridge International Examinations**
Cambridge Ordinary Level

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|---|---|
| CANDIDATE NAME | |
| CENTRE NUMBER | |
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*4000027720 1*

**COMBINED SCIENCE** **5129/22**

Paper 2 **May/June 2017**

**2 hours 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 an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 28.

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.

This document consists of **27** printed pages and **1** blank page.



CAMBRIDGE
International Examinations

**[Turn over**

**1** The boxes on the left-hand side of Fig. 1.1 show some elements and the boxes on the right-hand side show some uses of elements.

Draw one line from each element to link it with its use. [5]

| element | use |
|---|---|
| copper | making food containers |
| aluminium | making electrical wiring |
| chlorine | making light bulbs |
| nitrogen | treating water |
| argon | making ammonia |

**Fig. 1.1**

**2** Use the words from the list to complete the sentences about blood.

Each word may be used once, more than once, or not at all.

| | | | |
|---|---|---|---|
| **amylase** | **antibodies** | **haemoglobin** | **hormones** |
| **kidneys** | **lungs** | **cytoplasm** | **plasma** |
| | **platelets** | **urea** | |

The blood contains cells. These are transported by the liquid part of blood

called ..... .

The substance called ..... is made in the liver. It is transported in the

blood to the ..... where it is excreted.

Red blood cells absorb oxygen because they contain ..... .

The white blood cells produce ..... . [5]



**[Turn over**

**3** A golfer hits a ball.

The ball moves along a track that curves upwards, as shown in Fig. 3.1.

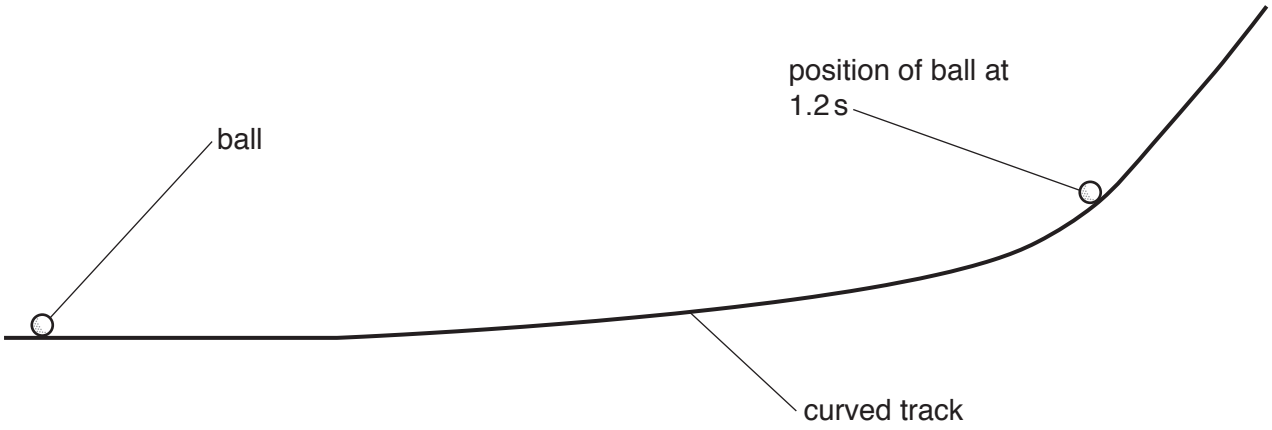



**Fig. 3.1**

The speed of the ball is recorded between time $t = 0.2\,s$ and time $t = 1.2\,s$, as shown in Table 3.1.

**Table 3.1**

| time $t$/s | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 |
|---|---|---|---|---|---|---|
| $\frac{\text{speed}}{\text{m/s}}$ | 8.0 | 6.8 | 5.4 | 4.4 | 2.4 | 0.1 |

**(a)** Use the information in Table 3.1 to suggest the changes in the future motion of the ball from time $t = 1.2\,s$ to time $t = 1.8\,s$.

.....

.....

.....

.....[3]

**(b)** Describe how the potential energy and the kinetic energy of the ball change from time $t = 0.2\,s$ to time $t = 1.2\,s$.

.....

.....[1]

**4** Copper(II) carbonate decomposes to produce copper(II) oxide and carbon dioxide.

The equation for the reaction is

$$CuCO_3 \longrightarrow CuO + CO_2$$

**(a)** The relative molecular mass of copper(II) carbonate is 124.

[$A_r$: O, 16; C, 12; Cu, 64]

Complete the following sentences.

124 g of copper(II) carbonate produce ..... g of copper(II) oxide and ..... g of carbon dioxide.

3.1 g of copper(II) carbonate produce ..... g of copper(II) oxide. [3]

**(b)** Copper(II) oxide is an ionic compound. Carbon dioxide is a covalent compound.

State **two** ways in which the properties of a covalent compound differ from the properties of an ionic compound.

1 .....

.....

2 .....

.....

[2]

**(c)** State the test for carbon dioxide and the result of the test.

test .....

result .....

.....

[2]

**5** **(a)** Define *osmosis*.

.....

.....

.....

.....[3]

**(b)** Fig. 5.1 shows a plant cell.

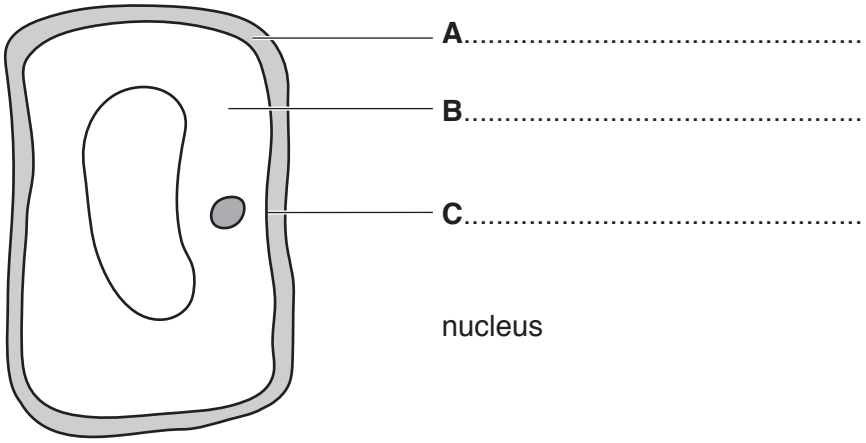



**Fig. 5.1**

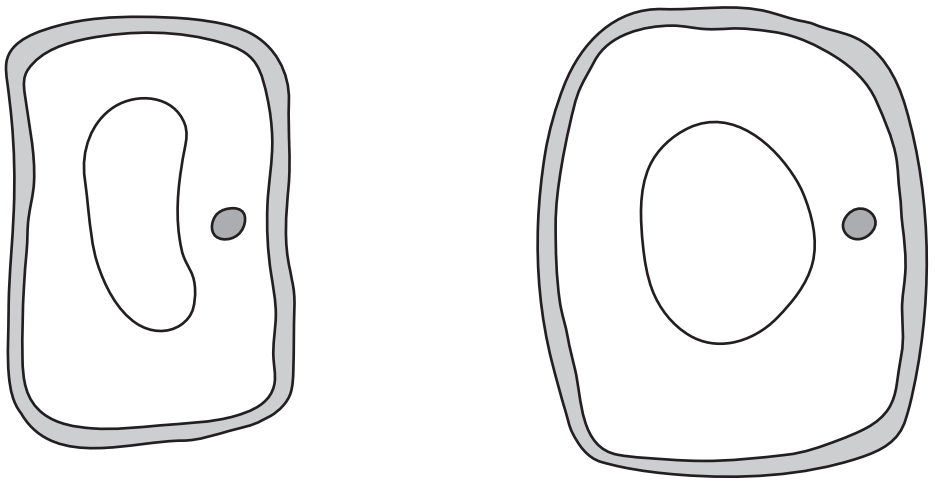
**(i)** Name structures **A**, **B** and **C**.

Write your answers on Fig. 5.1. [3]

**(ii)** On Fig. 5.1, draw a line from the label to show the position of the nucleus. [1]

**(c)** A plant cell is placed in distilled water and left for 20 minutes.

Fig. 5.2 shows the cell before placing in distilled water and after 20 minutes in distilled water.



before placing in distilled water

after 20 minutes in distilled water

**Fig. 5.2**

**(i)** Describe **one** difference in the plant cell after the 20 minutes.

.....

.....[1]

**(ii)** Explain how, in terms of diffusion **and** osmosis, the plant cell changes.

.....

.....

.....

.....

.....

.....[3]

**6** A beam rests on a pivot.

The weight of the beam is negligible.

Masses **W**, **X** and **Y** are placed on the beam, as shown in Fig. 6.1.

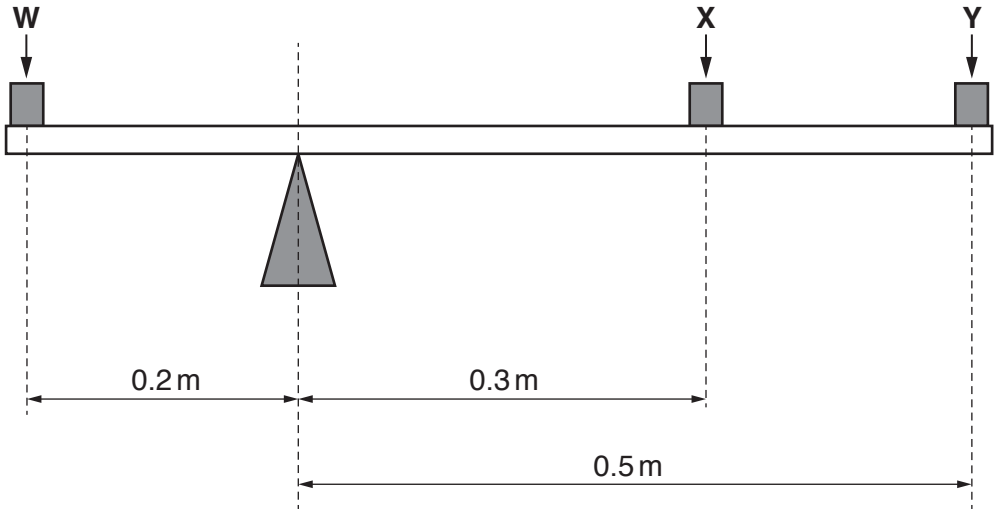



**Fig. 6.1**

The weight of mass **W** is 12 N and the weight of mass **X** is 4 N.

Calculate the weight of mass **Y** that balances the beam.

weight = ..... N [3]

**7** Lithium, sodium and potassium are elements in Group I of the Periodic Table.

**(a)** **(i)** State the name given to the elements in Group I.

.....[1]

**(ii)** State the trend in the melting point of the Group I elements down the group from lithium to potassium.

.....[1]

**(b)** An atom of potassium has the proton number 19 and the nucleon number 39.

**(i)** State the number of neutrons in the nucleus of this atom of potassium.

..... [1]

**(ii)** Complete Fig. 7.1 to show the electronic structure of a potassium atom. [1]

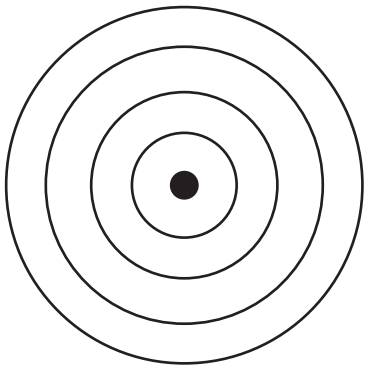


**Fig. 7.1**

**(c)** Potassium reacts violently with oxygen to produce potassium oxide.

Potassium oxide dissolves in water to produce a solution that turns Universal Indicator purple.

**(i)** State the formulae of the two ions present in potassium oxide.

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

**(ii)** Suggest the pH of the solution.

.....[1]

**8** Fig. 8.1 shows a food web.

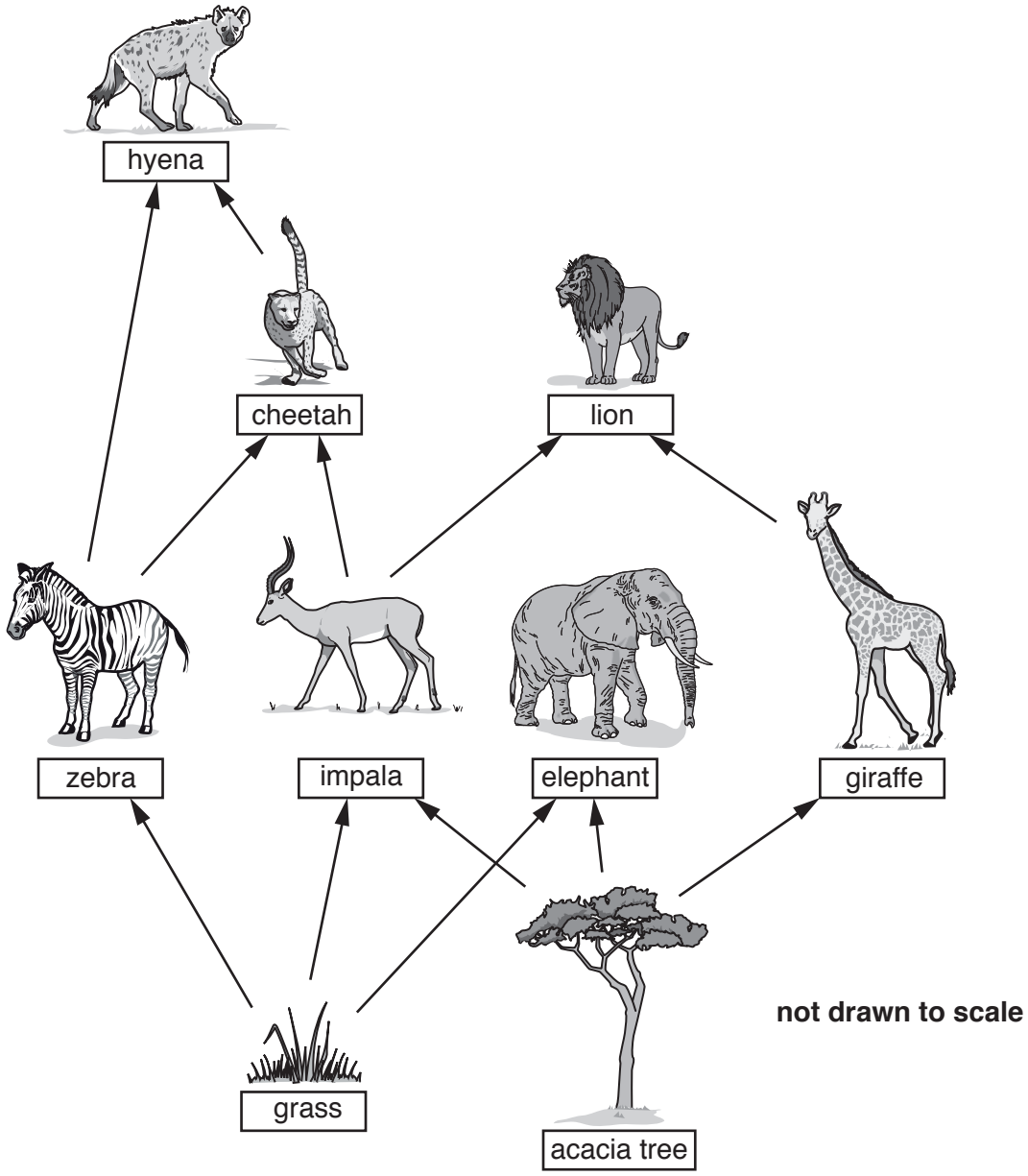



**Fig. 8.1**

**(a)** State what the arrows in the food web represent.

.....

.....[1]

**(b)** Name a producer in this food web

.....[1]

**(c)** State the number of herbivore species and the number of carnivore species shown in Fig. 8.1.

Number of herbivore species .....

Number of carnivore species ..... [2]

**(d)** Dead animals are not always eaten by other animals.

Name **one** other type of organism that acts on the bodies of dead animals.

.....[1]



**[Turn over**

**9** A candle flame emits light in all directions.

Two rays from point **P** on the flame are incident on a mirror, as shown in Fig. 9.1.

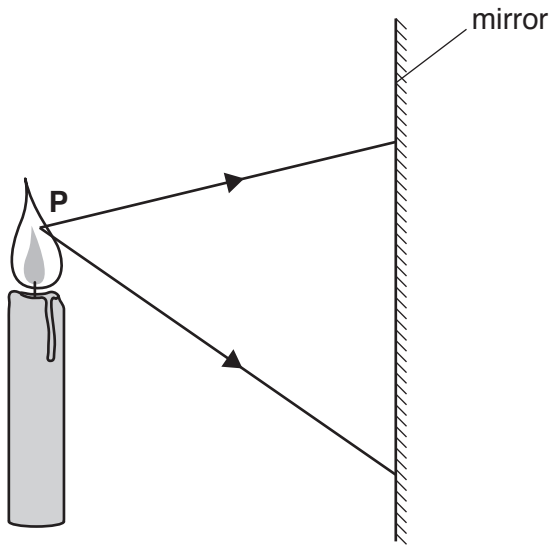



**Fig. 9.1**

**(a) (i)** On Fig. 9.1,

1. draw a normal at each point where a ray is incident on the mirror,

2. draw the reflected rays from the mirror,

3. complete the diagram to show how the virtual image of point **P** is formed. [3]

**(ii)** Comment on the distance from point **P** to the mirror and the distance from the virtual image of point **P** to the mirror.

.....[1]

**(b)** A thermometer is placed near the candle flame, as shown in Fig. 9.2.

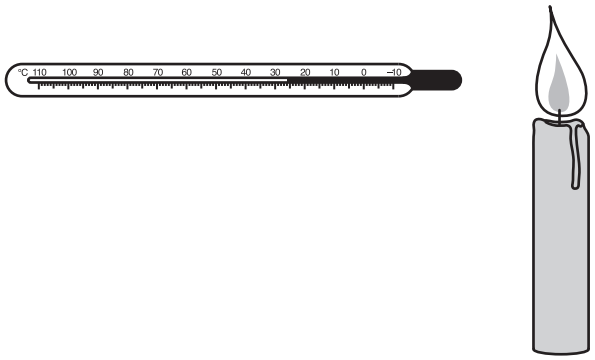



**Fig. 9.2**

**(i)** State the method of heat transfer from the flame to the thermometer.

.....[1]

**(ii)** State one method of decreasing the initial rate of temperature rise of the thermometer.

Explain how this method works.

method .....

.....

explanation .....

.....

[2]

**(iii)** Suggest why a clinical thermometer may **not** be suitable for this experiment.

.....

.....[1]

**10** The alkanes are a homologous series of compounds.

Fig. 10.1 shows the relationship between the boiling point and the number of carbon atoms in alkane molecules.

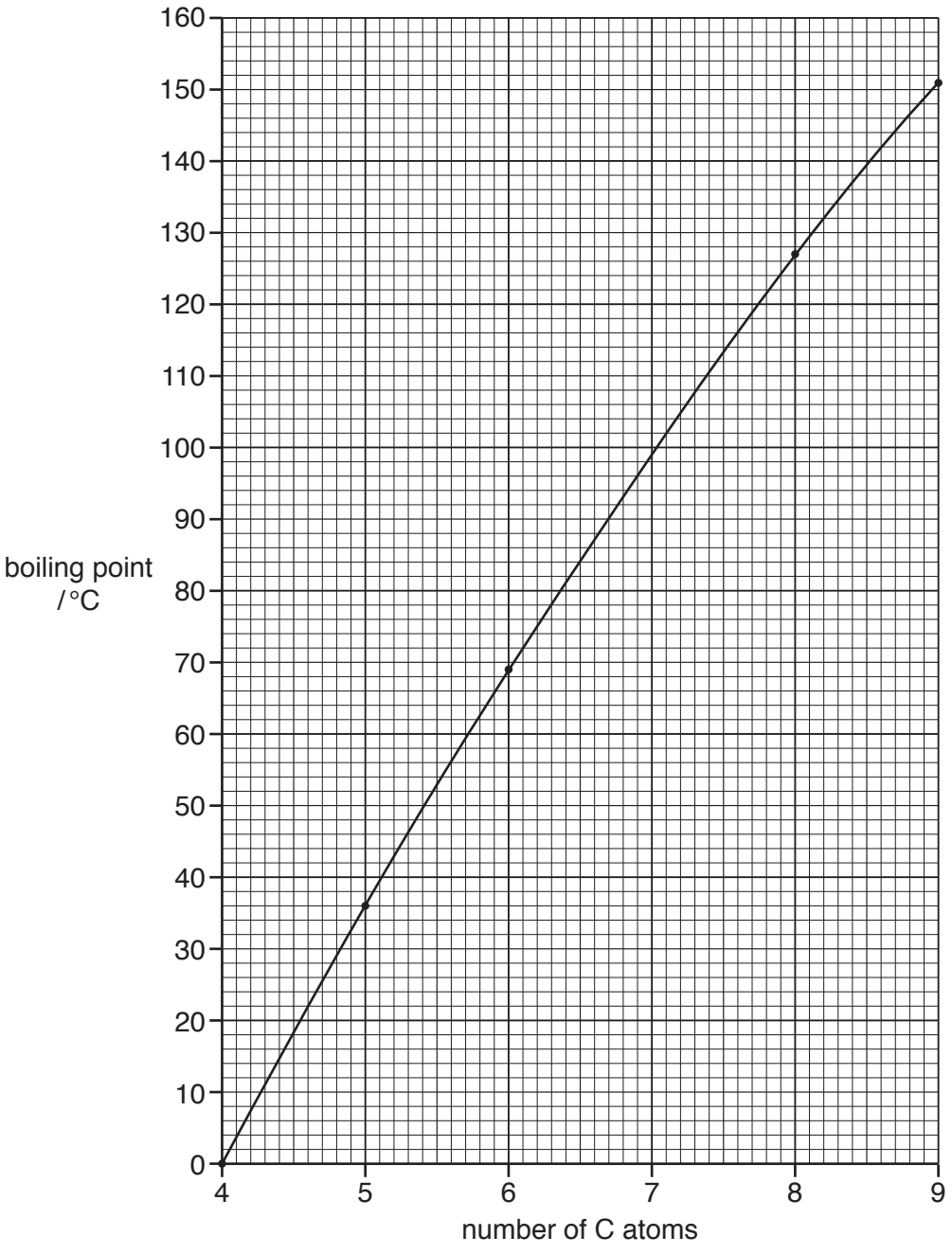



**Fig. 10.1**

**(a)** Use Fig. 10.1 to predict the boiling point of heptane, $C_7H_{16}$.

boiling point = .....°C [1]

**(b)** State the general formula of the alkane homologous series.

.....[1]

**(c)** Balance the equation for the complete combustion of heptane.

$$C_7H_{16} + .....O_2 \longrightarrow ..... CO_2 + .....H_2O$$

[1]

**(d)** Heptane forms two different hydrocarbons and hydrogen when it is heated in the presence of a catalyst.

The equation for the reaction is

$$C_7H_{16} \longrightarrow 2C_2H_4 + C_3H_6 + H_2$$

**(i)** Name the process that heptane undergoes in this reaction.

.....[1]

**(ii)** Complete the diagram to show the bonds in a molecule that has the formula $C_2H_4$.


[1]

**(iii)** Hydrogen used to be used to fill balloons.

Explain why hydrogen is no longer used to fill balloons.

.....[1]

**11** Some students investigate their breathing rates.

The students count the number of breaths per minute when at rest and immediately after running 400 m.

Their results are shown in Fig. 11.1.

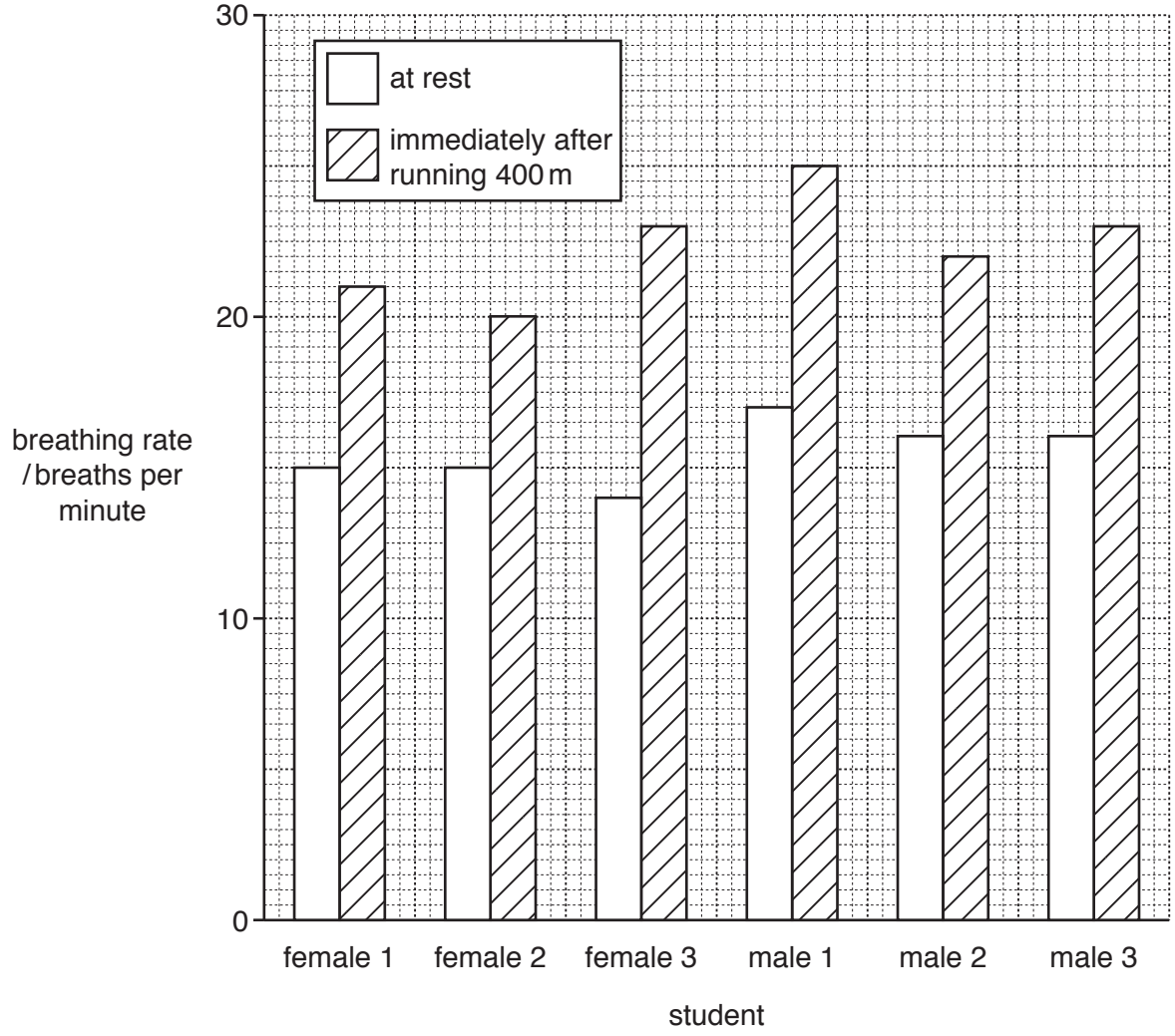



**Fig. 11.1**

**(a) (i)** Identify the student who has the highest breathing rate when at rest.

student .....[1]

**(ii)** Identify the student who has the smallest increase in breathing rate immediately after running 400 m.

student .....[1]

**(b)** Exercise increases breathing rate.

Suggest **one** other way in which breathing changes as a result of exercise.

.....

.....[1]

**(c)** Explain why the breathing rate increases during exercise.

.....

.....

.....

.....[2]

**12** A power station produces hot waste gases, as illustrated in Fig. 12.1.

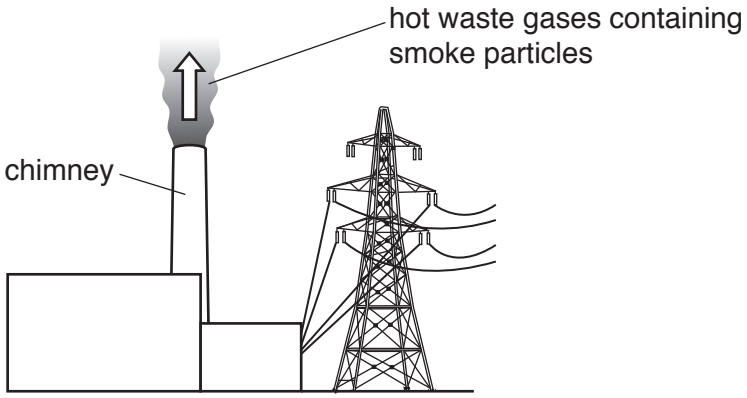



**Fig. 12.1**

**(a)** Suggest why the hot waste gases rise up the chimney.

.....

.....[2]

**(b)** The hot waste gases contain smoke particles.

Fig. 12.2 shows how the smoke particles may be removed from the hot waste gases as they rise to the top of the chimney.

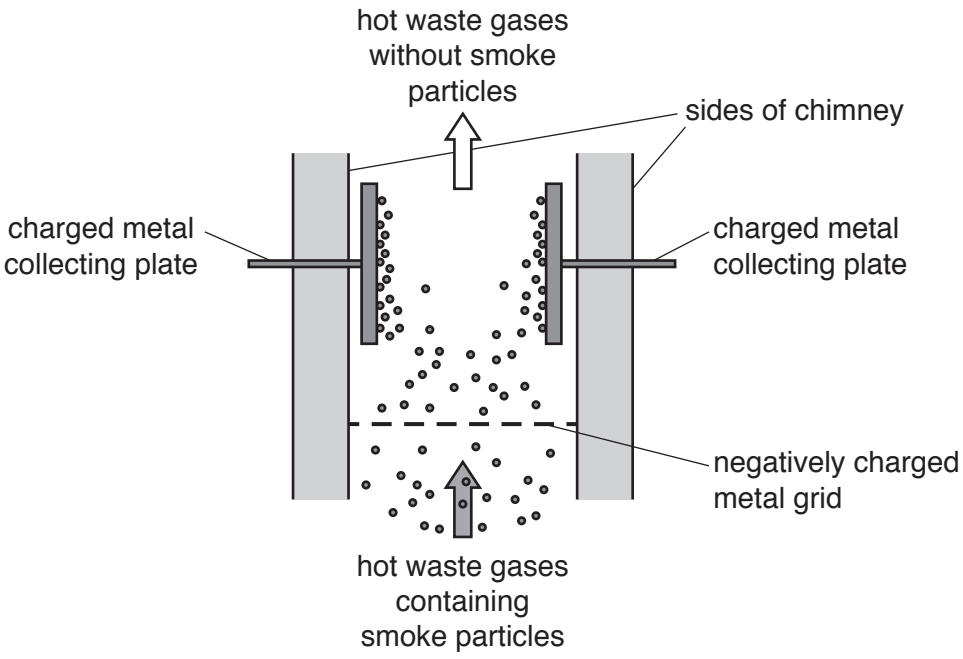



**Fig. 12.2**

The metal grid gives the smoke particles a negative charge as they pass through it.

Explain how this causes the smoke particles to separate from the waste gases.

.....

.....

.....[2]

**(c)** The potential difference between the grid and the collecting plates in Fig. 12.2 is 45 000 V.

The collecting plates receive a total charge of 1.5 C each second.

**(i)** Draw a circle around one of the numbers below to show the current between the grid and the collecting plates.

0.15 A  1.5 A  15 A  150 A  [1]

**(ii)** Use your answer to **c(i)** to calculate the electrical resistance between the grid and the collecting plates. State the unit.

resistance = ..... unit ..... [3]

**13** Fig. 13.1 shows the electronic structure of an atom of oxygen.

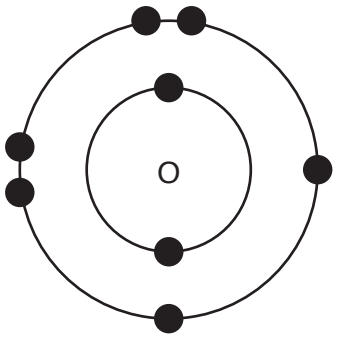



**Fig. 13.1**

**(a)** Complete Fig. 13.2 to show the arrangement of the outer electrons in an oxygen molecule. [2]

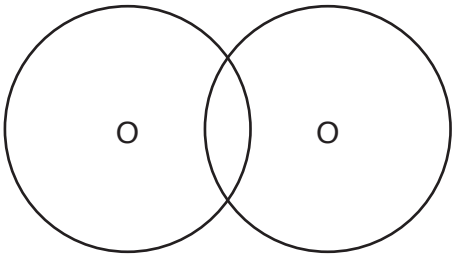



**Fig. 13.2**

**(b)** When a hydrocarbon fuel burns in air, oxygen in the air is used and energy is released.

**(i)** State the approximate percentage of oxygen in the air.

.....[1]

**(ii)** State the name given to reactions that produce energy.

.....[1]

**(c)** Name the gas that reacts with oxygen during welding.

.....[1]

**(d)** Iron rusts in the presence of oxygen and water.

One method of preventing iron from rusting is galvanising.

State the name of the metal used to galvanise iron. .....[1]

**14** Fig. 14.1 shows a section through a leaf.

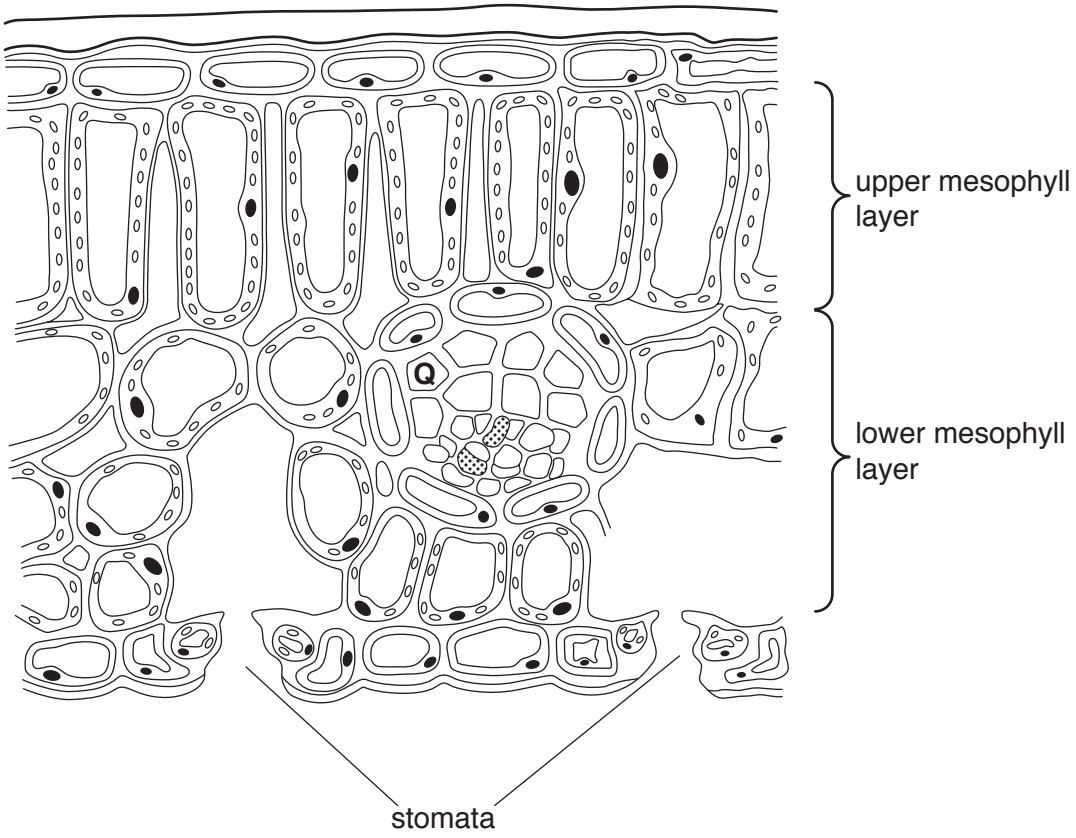



**Fig. 14.1**

**(a)** State why the cells in the upper mesophyll layer contain more chloroplasts than the cells in the lower mesophyll layer.

.....

.....[1]

**(b)** State why the cells in the lower mesophyll layer have large air spaces between them.

.....

.....[1]

**(c)** Stomata are usually found on the lower surface of the leaf.

Suggest a reason for this.

.....

.....[1]

**15** A cross-section of a coffee-maker is shown in Fig. 15.1.

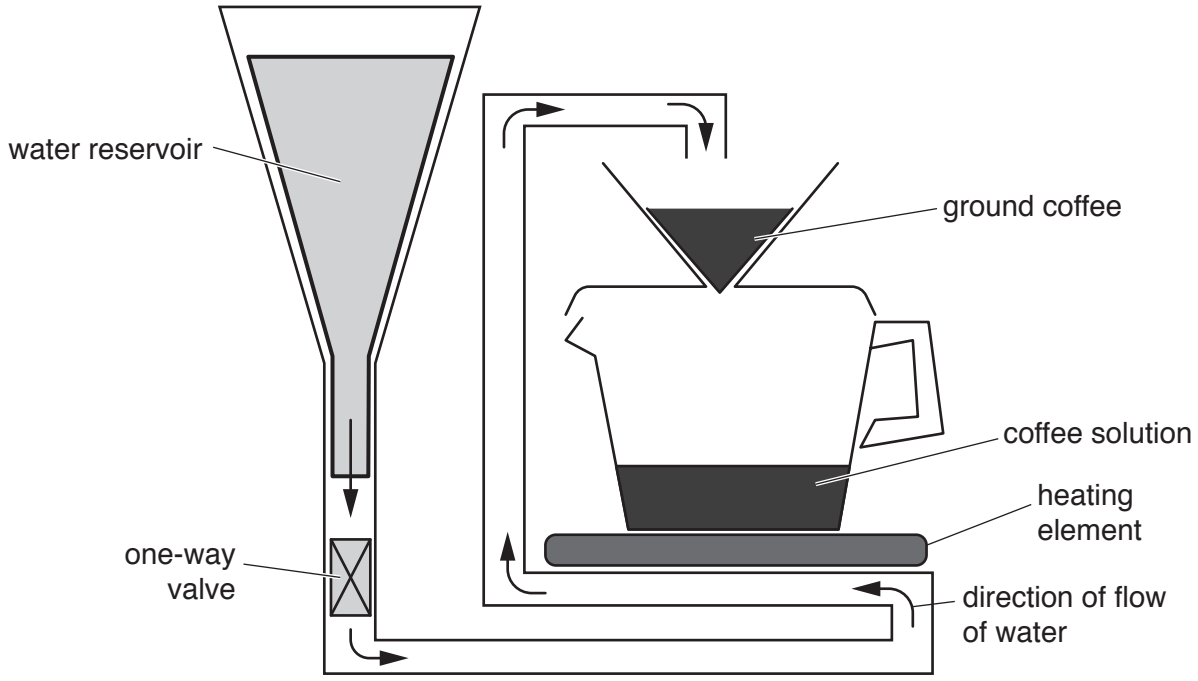



**Fig. 15.1**

Water flows through a one-way valve in the direction shown by the arrows.

It flows through a tube close to a heating element and drips onto the ground coffee.

**(a)** A mass of 55 g of coffee dissolves in 1000 g of water to produce a coffee solution. The volume of the coffee solution is 1000 $cm^3$.

Calculate the density of the coffee solution. State the unit.

density ..... unit .....[3]

**(b)** The heating element is connected to a 230 V mains power supply.

The current through the heating element is 9.0 A.

Draw a circle around one of the numbers below to show the power used by the heating element.

2.1 W  2.6 W  2.1 kW  26 kW

[1]



**[Turn over**

**16** Table 16.1 shows data about five substances **A**–**E**.

**Table 16.1**

| substance | conducts electricity when solid | conducts electricity when molten | melting point /°C | boiling point /°C |
|---|---|---|---|---|
| **A** | no | no | –51 | –45 |
| **B** | yes | yes | 1903 | 2642 |
| **C** | no | no | –7 | 58 |
| **D** | yes | yes | 181 | 1331 |
| **E** | no | yes | 772 | 1407 |

**(a)** Choose letters from Table 16.1 to fill in the blanks below.

Each letter may be used once, more than once, or not at all.

**(i)** The substance that is a liquid at room temperature is ..... . [1]

**(ii)** A substance that is a metal is ..... . [1]

**(iii)** The substance that is an ionic compound is ..... . [1]

**(b)** A chemist makes a sample of substance **E** and finds that it melts between 755 °C and 768 °C.

Suggest why the melting point of this sample of substance **E** is lower than the melting point shown in Table 16.1.

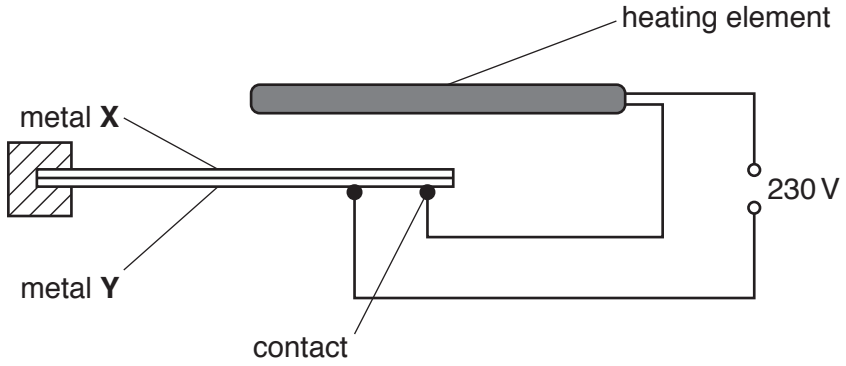
.....

.....[1]

**17** Electrical heating equipment frequently contains a device to prevent the heating element becoming too hot.

Two different metals **X** and **Y** are joined together and placed in the circuit near to the heating element.

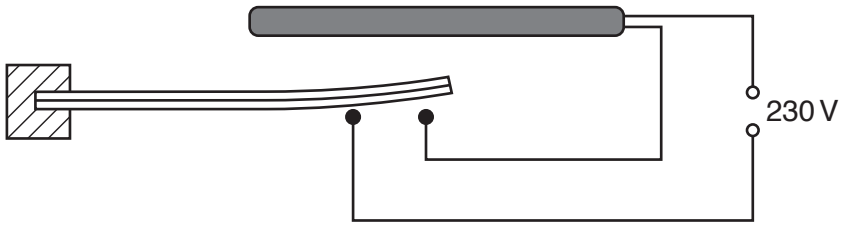
Fig. 17.1. shows the device when the temperature is in the normal operating range for the equipment.




temperature in operating range

**Fig. 17.1**

When the temperature is too high, the two metals bend and the circuit breaks, as shown in Fig. 17.2.




temperature too high

**Fig. 17.2**

**(a) (i)** Suggest why the heating element must be prevented from getting too hot.

.....

.....[1]

**(ii)** Put a tick (✓) in the box next to the difference between metals **X** and **Y** that explains why the circuit breaks when the temperature is too high.

They have different densities. ☐

They have different electrical conductivities. ☐

They have different resistances. ☐

They have different thermal expansions. ☐ [1]

**(b)** The power supply to the heating element is controlled by a switch at the mains socket, as shown in Fig. 17.3.

The electrical equipment is protected by a fuse inside the plug.

The switch and the fuse are in the live lead to the heating element, as shown in Fig. 17.4.

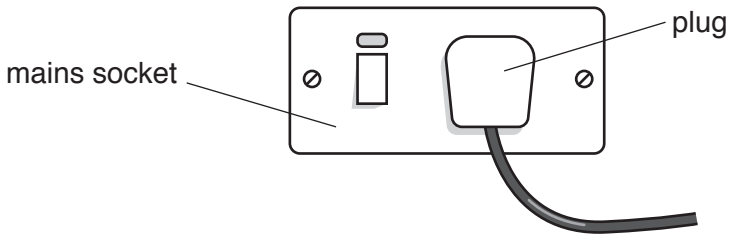



**Fig. 17.3**

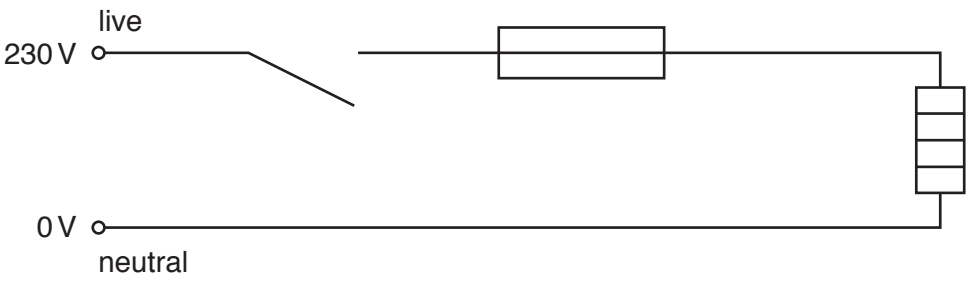



**Fig. 17.4**

**(i)** Explain why a fuse is needed.

.....

.....[2]

**(ii)** Explain why the switch is placed in the live lead.

.....

.....[1]

**(c)** Some electrical appliances have only a live wire and a neutral wire.

A label on these appliances has the symbol for double insulation, as shown in Fig. 17.5.

**Fig. 17.5**

State a reason why these appliances do **not** need an earth wire.

.....

.....[1]



**[Turn over**

**18** Fig. 18.1 shows five birth-control methods and examples of these methods.

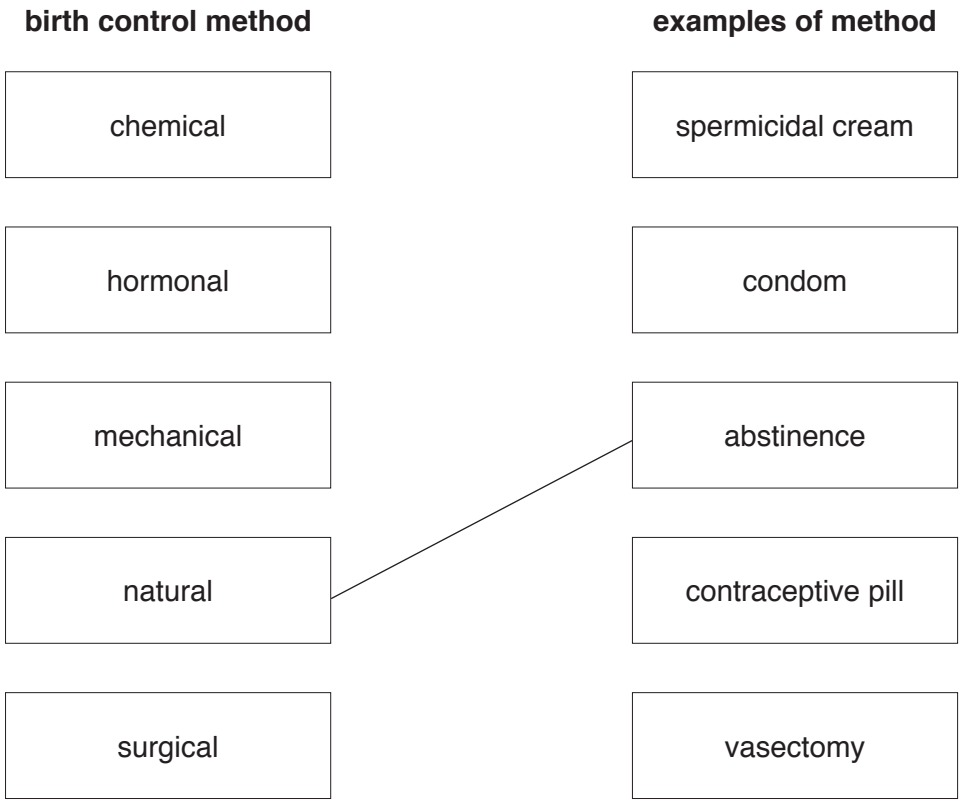



**Fig. 18.1**

Complete Fig. 18.1 by drawing one line from each birth control method to an example of that method.

One has been done for you. [4]

**BLANK PAGE**

## The Periodic Table of Elements

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | | | III | IV | V | VI | VII | VIII |
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 3 Li lithium 7 | 4 Be beryllium 9 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium – | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57–71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium – | 85 At astatine – | 86 Rn radon – |
| 87 Fr francium – | 88 Ra radium – | 89–103 actinoids | 104 Rf rutherfordium – | 105 Db dubnium – | 106 Sg seaborgium – | 107 Bh bohrium – | 108 Hs hassium – | 109 Mt meitnerium – | 110 Ds darmstadtium – | 111 Rg roentgenium – | 112 Cn copernicium – | | 114 Fl flerovium – | | 116 Lv livermorium – | | |

**Key**

atomic number
atomic symbol
name
relative atomic mass

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoids | 57 La lanthanum 139 | 58 Ce cerium 140 | 59 Pr praseodymium 141 | 60 Nd neodymium 144 | 61 Pm promethium – | 62 Sm samarium 150 | 63 Eu europium 152 | 64 Gd gadolinium 157 | 65 Tb terbium 159 | 66 Dy dysprosium 163 | 67 Ho holmium 165 | 68 Er erbium 167 | 69 Tm thulium 169 | 70 Yb ytterbium 173 | 71 Lu lutetium 175 |
| actinoids | 89 Ac actinium – | 90 Th thorium 232 | 91 Pa protactinium 231 | 92 U uranium 238 | 93 Np neptunium – | 94 Pu plutonium – | 95 Am americium – | 96 Cm curium – | 97 Bk berkelium – | 98 Cf californium – | 99 Es einsteinium – | 100 Fm fermium – | 101 Md mendelevium – | 102 No nobelium – | 103 Lr lawrencium – |

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.)