Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1789132479

COMBINED SCIENCE **5129/21**

Paper 2 **May/June 2018**

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 **26** printed pages and **2** blank pages.

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1 A list of words about human reproduction is shown below.

cervix **fertilisation** **fetus** **menstruation**

nucleus **prostate gland** **testes** **urethra**

uterus **vagina**

Use words from the list to complete the sentences about human reproduction.

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

Sperm cells are produced by the ..... of the male.

During sexual intercourse, sperm cells are released into the ..... of the female.

The sperm cells then travel to the oviduct where ..... takes place.

The zygote formed travels to the ..... where it implants in the wall and develops into a ..... . [5]

[Turn over

2 Copper(II) nitrate decomposes on heating to produce copper(II) oxide, nitrogen dioxide and oxygen.

The equation for the reaction is

$$2Cu(NO_3)_2 \longrightarrow 2CuO + 4NO_2 + O_2$$

Four separate weighed samples of copper(II) nitrate are heated and the mass of nitrogen dioxide produced is measured.

The results are shown in Table 2.1.

Table 2.1

mass of copper(II) nitrate / g	mass of nitrogen dioxide / g
1.41	0.69
1.55	0.76
2.00	0.98
2.55	1.25

(a) (i) On Fig. 2.1, plot a graph of these results and draw the best-fit line.

Two of the points have been plotted for you.

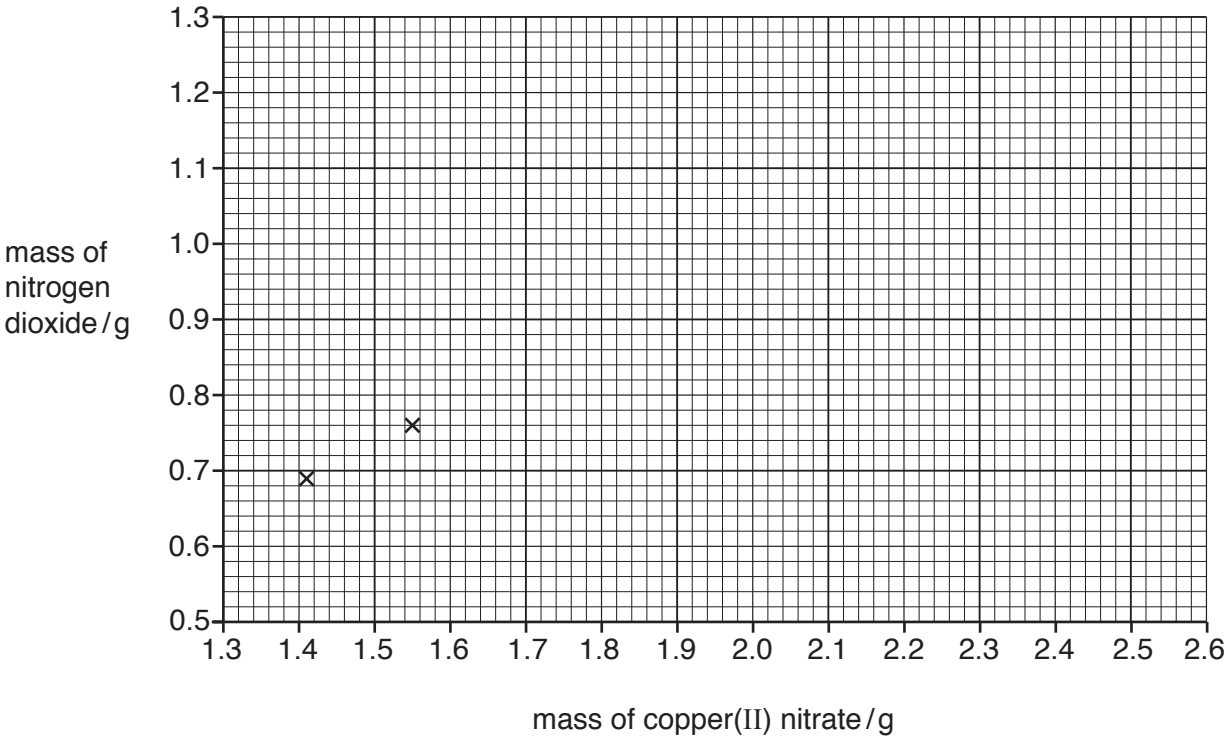


Fig. 2.1

[2]

(ii) Use Fig. 2.1 to find the mass of nitrogen dioxide produced by 1.88 g of copper(II) nitrate.

mass of nitrogen dioxide = ... g [1]

(iii) Use your answer to **(ii)** to calculate the mass of nitrogen dioxide produced by 376 g of copper(II) nitrate.

mass of nitrogen dioxide = ... g [1]

(b) State a test and the result of the test to show that oxygen is produced.

test .....

result .....[2]

3 A circuit containing a resistor is shown in Fig. 3.1.

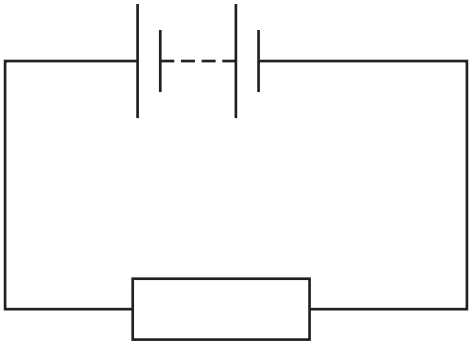


Fig. 3.1

(a) State how an ammeter and a voltmeter are each connected in the circuit so that the resistance of the resistor may be calculated.

voltmeter .....

.....

ammeter .....

.....[2]

(b) **(i)** The two meters in Fig. 3.2 show the readings obtained when they are connected in the circuit.

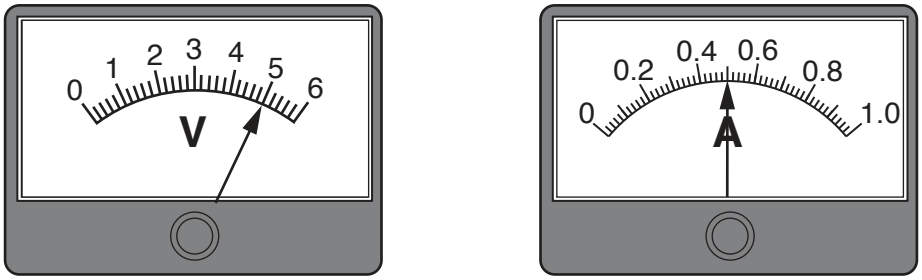


Fig. 3.2

Record the potential difference and the current shown on the meters.

potential difference = ...

current = ...[2]

(ii) Use your answers in **(b)(i)** to calculate the resistance *R* of the resistor.

State the unit.

R = ... unit ..... [3]

4 Three requirements of a balanced diet are

- carbohydrate
- minerals
- fibre.

(a) Name **four** other requirements of a balanced diet.

1 .....

2 .....

3 .....

4 .....

[4]

(b) Fibre is not digested or absorbed in the alimentary canal.

Describe why fibre is an essential part of a balanced diet.

.....

.....

.....

.....[2]

5 Magnesium is a metal in Group II of the Periodic Table.

(a) Describe a test that shows that magnesium is a metal.

.....

.....[1]

(b) The proton number of magnesium is 12.

Complete Fig. 5.1 to show the electronic structure of a magnesium atom.

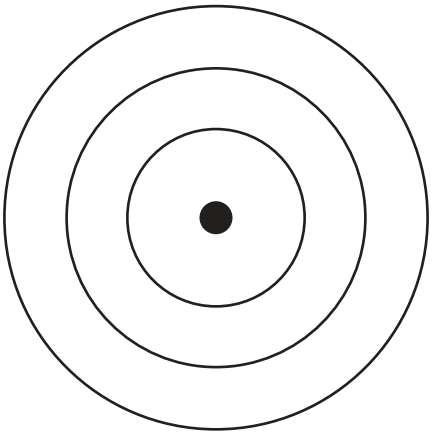


Fig. 5.1

[1]

(c) Magnesium reacts with dilute phosphoric acid, producing magnesium phosphate and hydrogen.

(i) Balance the equation for this reaction.

..... Mg + ... H_3PO_4 ⟶ $Mg_3(PO_4)_2$ + ... H_2

[1]

(ii) Magnesium phosphate is an ionic compound.

The formula of a magnesium ion is Mg^{2+}.

Deduce the formula of the phosphate **ion**.

.....[1]

(iii) Universal Indicator is added to phosphoric acid in a beaker and then an excess of magnesium is added and allowed to react.

State the colour of the solution in the beaker before and after an excess of magnesium is added and allowed to react.

colour before .....

colour after ..... [2]

Question 6 starts over the page.

6 Vernier calipers are used to measure lengths.

Vernier calipers are used to measure the external diameter of the test-tube as shown in Fig. 6.1.

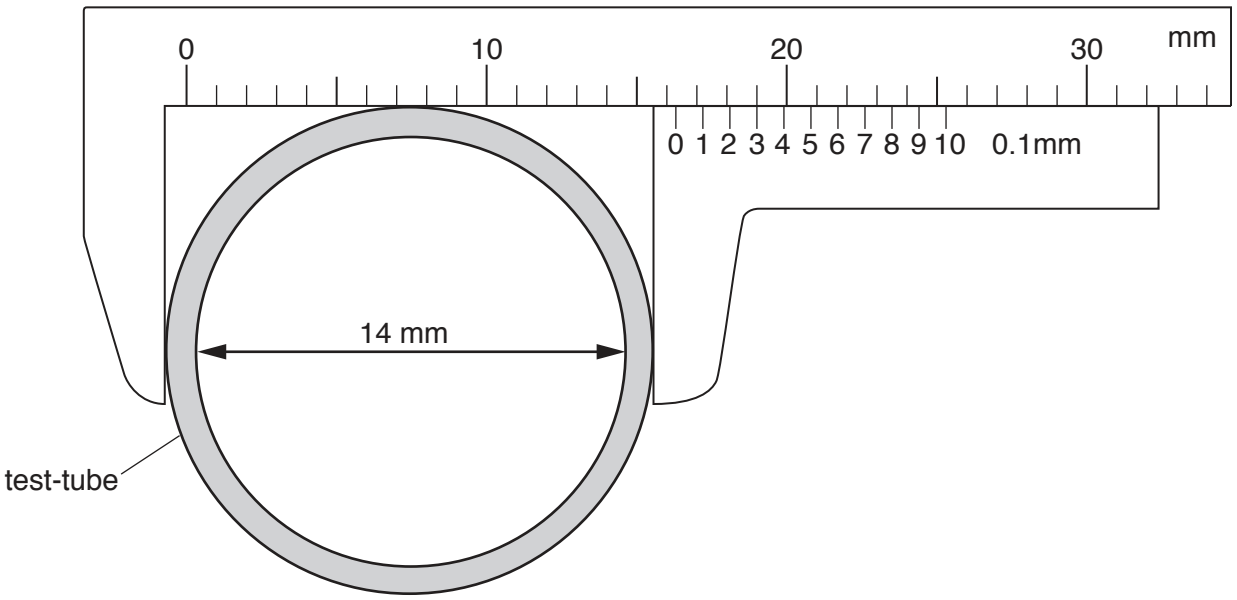


Fig. 6.1

(a) (i) Determine the external diameter *d* of the test-tube.

d = ...mm [1]

(ii) The glass test-tube has an internal diameter of 14 mm.

Calculate the thickness *t* of the glass wall of the test-tube.

t = ... mm [2]

(b) The test-tube is placed in water in a measuring cylinder.

Fig. 6.2 shows the water level in the measuring cylinder before and after the test-tube is placed in the water.

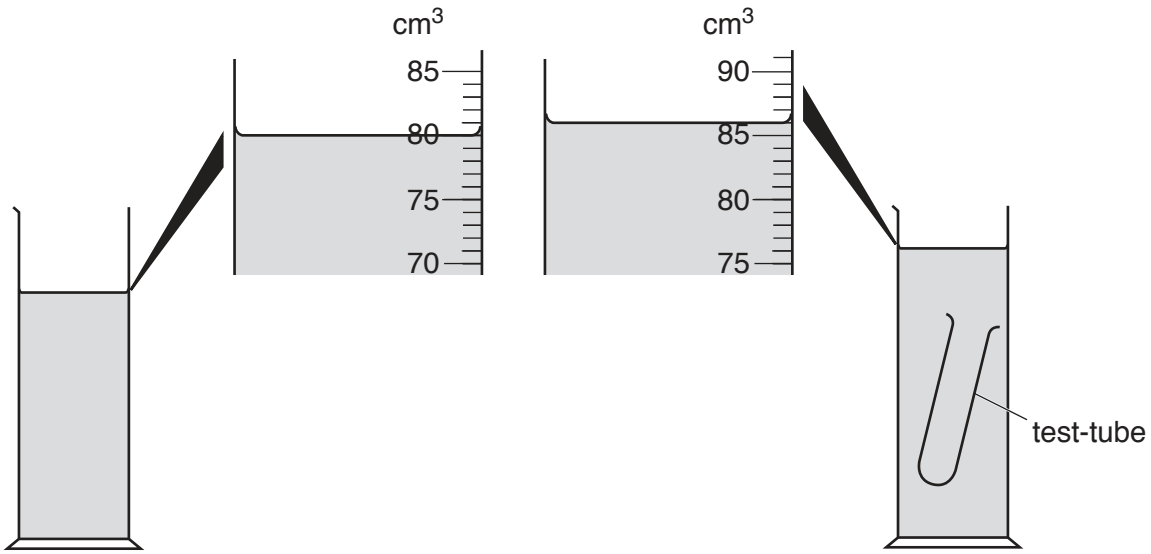


Fig. 6.2

(i) Determine the volume V of glass used to make the test-tube.

V = ... cm^3 [1]

(ii) The mass of the test-tube is 15.2 g.

Calculate the density D of the glass used to make the test-tube.

D = ... g/cm^3 [2]

7 **(a)** Fig. 7.1 shows a section through a root hair cell.

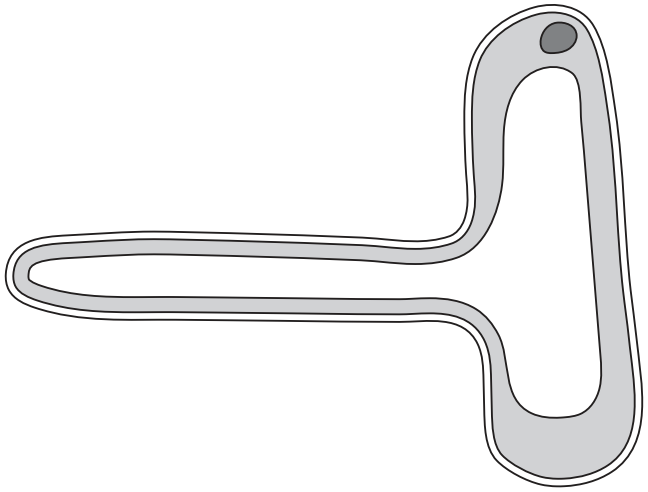


Fig. 7.1

Name **two** structures present in this cell that are **not** present in a red blood cell.

1 .....

2 .....[2]

(b) **(i)** State **two** functions of a root hair cell.

1 .....

.....

2 .....

.....[2]

(ii) Explain how the shape of the root hair cell helps the cell to perform these functions.

.....

.....

.....

.....[2]

8 Petroleum is separated into useful fractions by fractional distillation using a fractionating column.

Complete the sentences about this process using the words in the list.

bottom **cooler** **halogens**

hotter **hydrocarbons** **top**

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

Petroleum is a mixture of ..... which can be separated into useful fractions.

The fractions with larger molecules condense at the ..... of the fractionating column.

Fractions with lower boiling points condense near the ..... of the fractionating column.

The fractionating column is ..... near the bottom.

The fraction collected at the ..... of the fractionating column is used to make roads. [5]

9 The inside of a mains electrical plug is shown in Fig. 9.1.

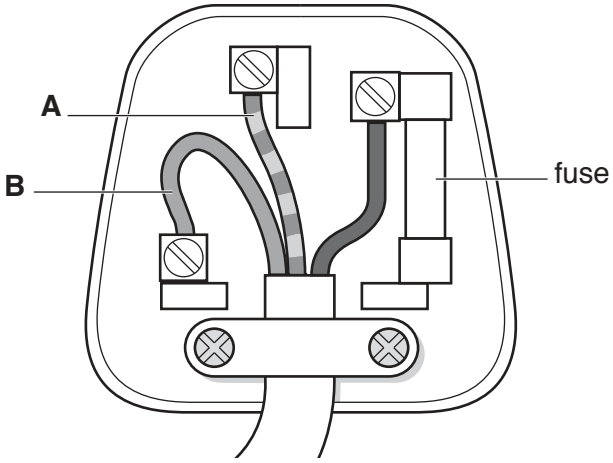


Fig. 9.1

(a) State the name of wire **A**.

.....[1]

(b) Wire **B** is the neutral wire.

Explain the function of the neutral wire.

.....

.....[2]

(c) **(i)** The plug is used to connect a television to the 230 V mains supply.

The power produced in the television is 300 W.

Calculate the current I in the fuse.

I = ... A [2]

(ii) Draw a circle around the value of a suitable rating for the fuse in **(c)(i)**.

0.5 A **3 A** **13 A** **0.5 Ω** **3 Ω** **13 Ω**

[1]

10 Specialised cells carry out different processes in living organisms.

On Fig. 10.1, draw a straight line from each process to the cell where the process takes place.

One line has been done for you.

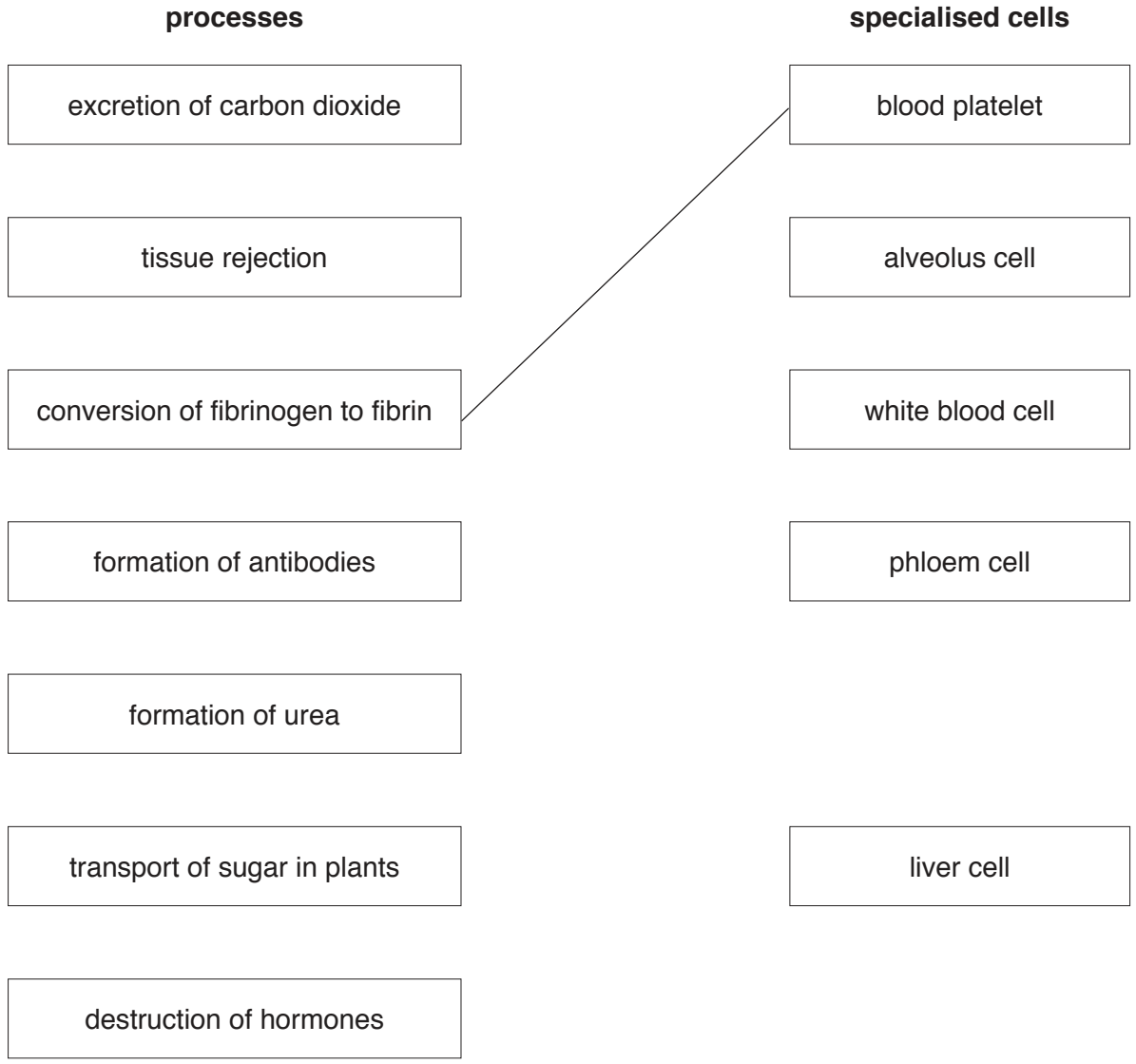


Fig. 10.1

[6]

11 Study the reaction scheme shown in Fig. 11.1.

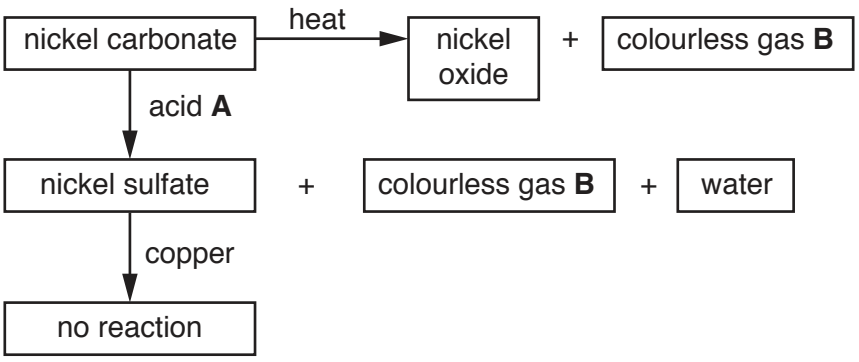


Fig. 11.1

(a) Identify acid **A** and colourless gas **B**.

acid **A** .....

colourless gas **B** ..... [2]

(b) Explain why nickel is not displaced from a nickel sulfate solution by copper.

.....

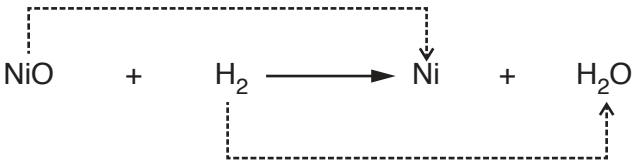
.....[1]

(c) **(i)** Nickel oxide reacts with hydrogen to form nickel and water.

The equation for the reaction is shown in Fig. 11.2. The dashed arrows show the process changing NiO to Ni and the process changing H_2 to H_2O.

Complete the labels on Fig. 11.2 to name these processes.

NiO to Ni: .....



H_2 to H_2O: .....

Fig. 11.2

[2]

(ii) Explain why nickel oxide is classified as a basic oxide.

.....

.....[1]

12 Fig. 12.1 shows a lens **A**, a glass block **B** and a plane mirror **C**.

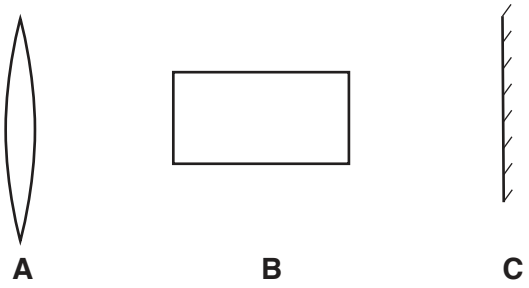


Fig. 12.1

Some of the objects from Fig. 12.1 are placed in the path of parallel rays of light.
The objects are hidden behind screens. Each screen covers one object only.

Fig. 12.2 shows the screens hiding each object and ray diagrams produced by each object.

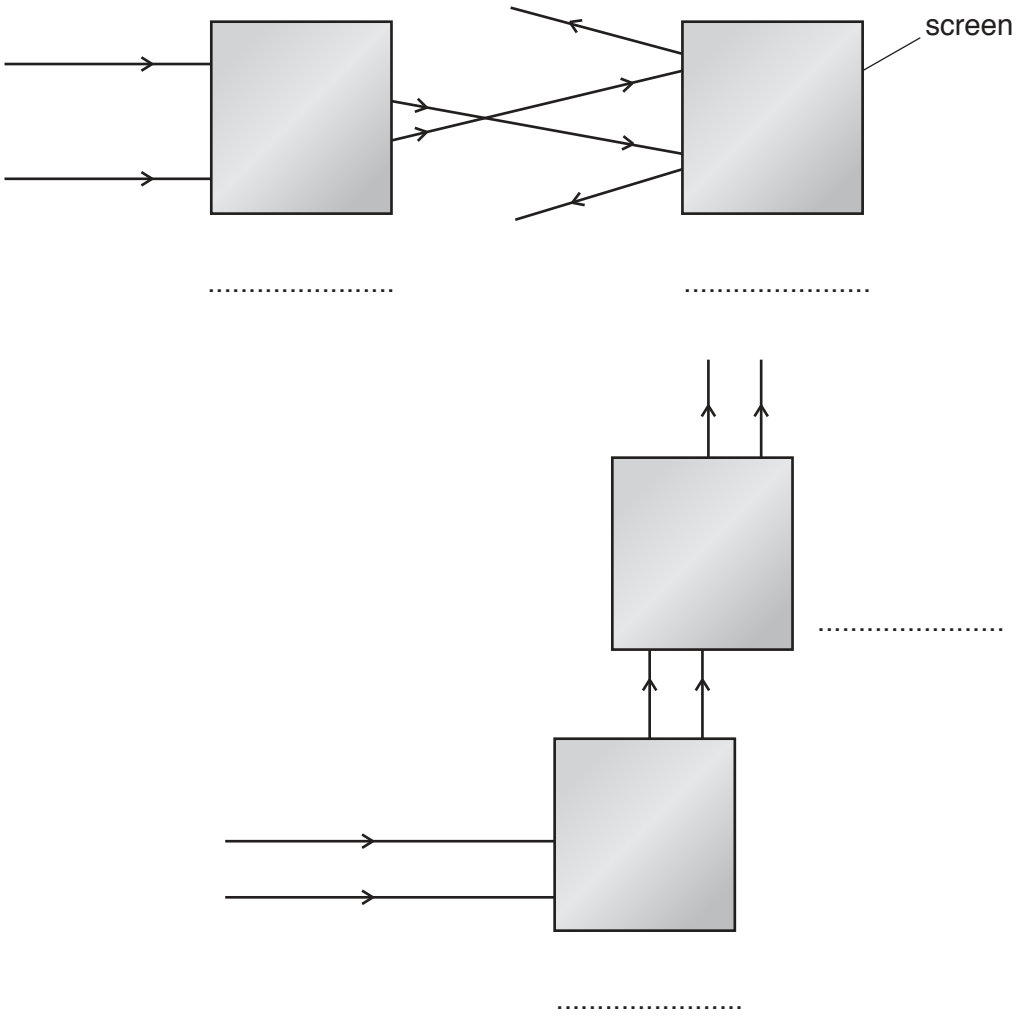


Fig. 12.2

For each of the screens in Fig. 12.2, state the letter of the object **A**, **B** or **C** hidden behind it. Write your answers on the lines provided. [4]

13 Fig. 13.1 shows a section through a leaf.

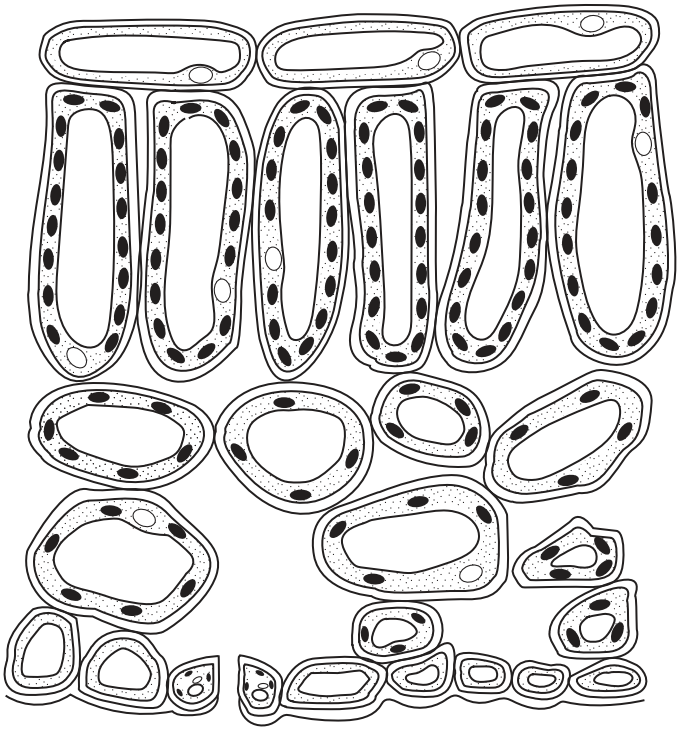


Fig. 13.1

The main function of a leaf is to carry out photosynthesis.

The word equation for photosynthesis is shown below.

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{chlorophyll}} \text{oxygen} + \text{glucose}$$

(a) (i) On Fig. 13.1, the **X** shows the position of a molecule of carbon dioxide.

Draw a line from the **X** to show the path carbon dioxide takes to reach a mesophyll cell in the leaf. [1]

(ii) Name the process by which carbon dioxide molecules move within the leaf.

.....[1]

(b) **(i)** Name the structure in a leaf cell that contains chlorophyll.

.....[1]

(ii) State the role of chlorophyll in photosynthesis.

.....

.....[1]

(c) Suggest **two** ways in which plants enable animals to survive.

1 .....

.....

2 .....

.....[2]

[Turn over

14 Phosphorus reacts with oxygen to produce phosphorus oxide.

Phosphorus oxide dissolves in water forming phosphoric acid.

The solution becomes very hot.

The equation for the reaction is

$$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$$

(a) State the name given to reactions that release energy.

.....[1]

(b) Name the ion that causes the solution to be acidic.

.....[1]

(c) Phosphoric acid reacts with potassium hydroxide to produce potassium phosphate.

(i) State the type of reaction that occurs.

.....[1]

(ii) Name two other substances that react **safely** with phosphoric acid to produce potassium phosphate.

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

(d) Potassium phosphate contains two of the elements in an NPK fertiliser.

State the name of the other element.

.....[1]

Question 15 starts over the page.

15 An experiment to investigate how changing the temperature affects a physical property of air is shown in Fig. 15.1.

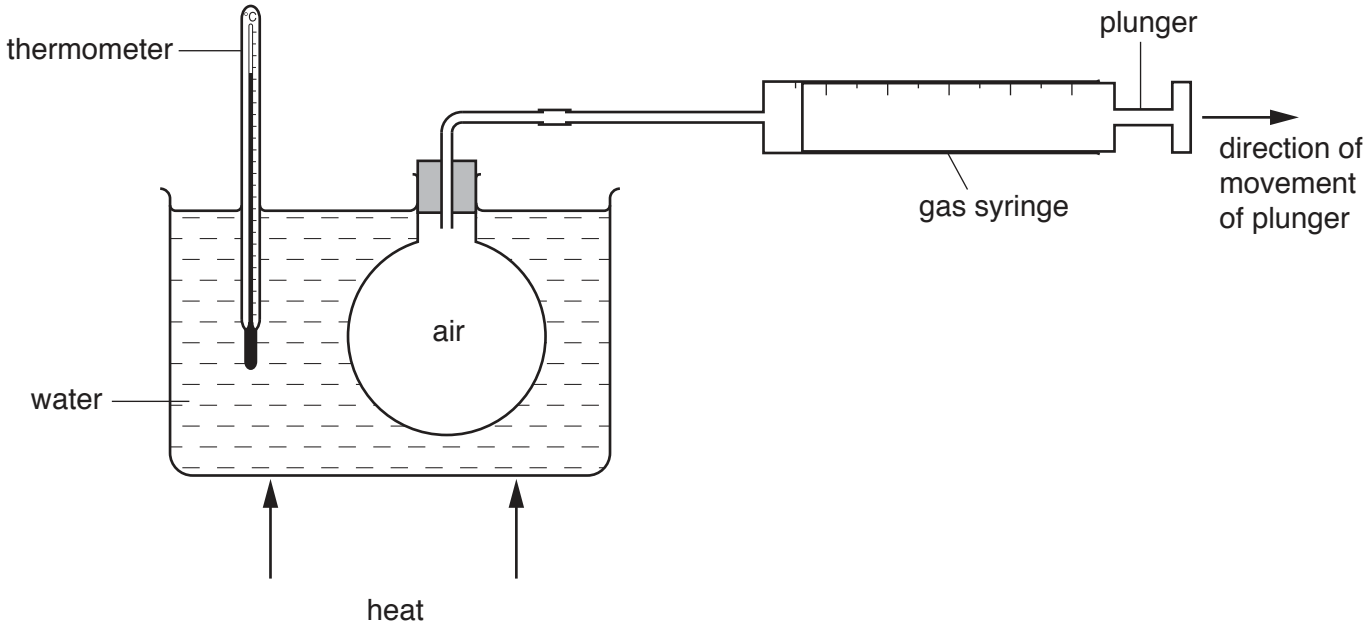


Fig. 15.1

(a) State the physical property of air that is measured in this experiment.

.....[1]

(b) At the start of the experiment, the reading on the gas syringe is zero.

On Fig. 15.2, sketch a graph to show the relationship between temperature and the gas syringe reading for the experiment shown in Fig. 15.1.

Label the x-axis of the graph.

.....

Fig. 15.2

[3]

(c) There is a small amount of friction between the plunger and the syringe.

Explain, in terms of forces, why the plunger moves to the right.

.....

.....

.....[2]

16 Gonorrhoea and syphilis are both sexually transmitted diseases.

(a) (i) Complete Table 16.1 to describe a sign or symptom of each disease.

Table 16.1

disease	sign or symptom
gonorrhoea	
syphilis	

[2]

(ii) State the treatment used to cure these diseases.

.....[1]

(b) Human immuno-deficiency virus (HIV) is also sexually transmitted.

State one method of contraception used to prevent the spread of this virus.

.....[1]

17 The following is a list of substances.

ammonium chloride	**carbon dioxide**	**carbon monoxide**
ethane	**ethene**	**nitrogen dioxide**
		potassium carbonate

Use the list to complete the following sentences.

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

(a) The substance that changes bromine water from brown to colourless is

..... . [1]

(b) The substance that reacts with sodium hydroxide to produce an alkaline gas is

..... . [1]

(c) The substance that is produced by the incomplete combustion of hydrocarbon fuels is

..... . [1]

(d) The substance that dissolves in water to produce a solution with a pH value of 2 is

..... . [1]

(e) The substance that burns in oxygen to produce only **one** product is

..... . [1]

[Turn over

18 An electric field exerts a force of 2.4×10^{-14} N on an alpha-particle with a mass of 6.64×10^{-27} kg.

(a) Calculate the acceleration a of the alpha-particle.

a = ... m/s^2 [2]

(b) **(i)** State the number of protons in an alpha-particle.

..... [1]

(ii) A proton has a positive charge of 1.6×10^{-19} C.

Calculate the charge on the alpha-particle.

charge = ... C [1]

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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.).