Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2370225027

CO-ORDINATED SCIENCES **0654/43**

Paper 4 (Extended) **October/November 2017**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
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 32.

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 **28** printed pages and **4** blank pages.

CAMBRIDGE International Examinations

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1 Fig. 1.1 is a diagram of the alimentary canal and associated organs.

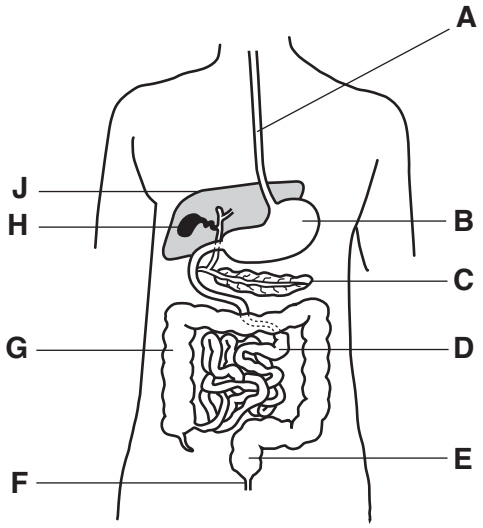


Fig. 1.1

(a) Use the letters in Fig. 1.1 to identify a

site of protease secretion, ...

site of bile production. .....

[2]

(b) Describe how bile aids digestion.

.....

.....

.....[2]

(c) The wall of the small intestine is covered in villi.

Explain the importance of the villi that line the small intestine.

.....

.....

.....[2]

(d) Crohn's disease is a long-term disease that causes inflammation and damage to the small intestine.

Suggest **one** long-term effect of Crohn's disease if it is left untreated.

.....

.....[1]

2 Table 2.1 shows the numbers of neutrons and the electronic structures in atoms of four elements **W**, **X**, **Y** and **Z**.

Table 2.1

element	number of neutrons	electronic structure
W	8	2,6
X	16	2,8,6
Y	18	2,8,7
Z	22	2,8,8

(a) (i) Using the information in Table 2.1, state which of these elements are in the same group of the Periodic Table.

Explain your answer.

elements .....

explanation .....

.....

[1]

(ii) Deduce the atomic number of element **Y**.

.....[1]

(iii) Deduce the relative atomic mass of element **X**.

Explain your answer.

relative atomic mass .....

explanation .....

.....

[2]

(iv) Predict **and** explain whether there are many compounds that contain element **Z**.

.....

.....

.....[2]

(b) Fig. 2.1 shows the structure of a molecule formed when atoms of **W** and **Y** in Table 2.1 combine.

Y—W—Y

Fig. 2.1

Complete Fig. 2.2 to show how **all** the **outer-shell** electrons are arranged in this molecule.

Use information about the electronic structures of elements **W** and **Y** in Table 2.1 to help you.

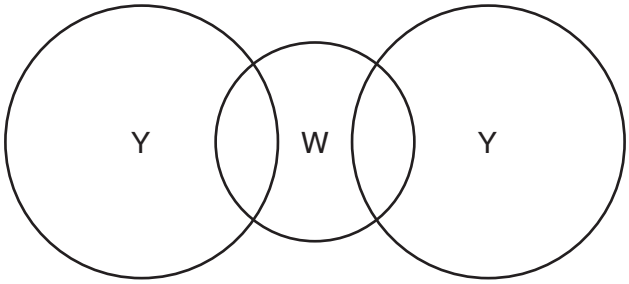


Fig. 2.2

[3]

3 **(a)** A radioactive isotope of iodine is used by a doctor to examine the thyroid gland of a patient.

The patient takes a tablet containing the iodine, which is absorbed by the thyroid gland.

The iodine emits γ-rays that are detected outside the body.

Iodine-123 has a half-life of 13 hours.

Suggest why the half-life of iodine-123 makes it suitable for use in the investigation of the thyroid gland.

.....

.....

.....[2]

(b) Endoscopes are used by doctors to observe inside a patient.

An endoscope uses optical fibres.

(i) Complete Fig. 3.1 to show how a ray of light travels down an optical fibre by total internal reflection.

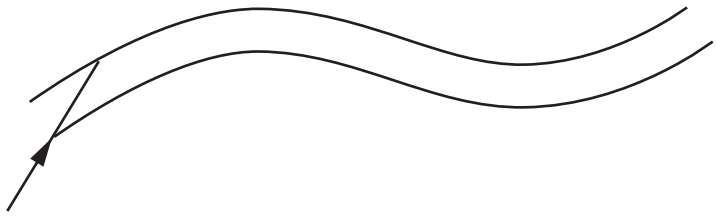


Fig. 3.1

[1]

(ii) Describe how light passes along optical fibres.

Use the terms *critical angle* and *total internal reflection* in your answer.

.....

.....

.....

.....

.....[2]

4 Sexual reproduction in large animal populations usually results in approximately equal numbers of male and female offspring.

(a) The ratio of male to female offspring in large animal populations is 1:1.

(i) State the genotypes of a male and of a female.

genotype of male: ..... genotype of female: ..... [1]

(ii) Using your answer in **(a)(i)**, complete Fig. 4.1 to show why the ratio is 1:1.

		male gametes	
		.....	.....
female gametes	.....	.....	.....
	.....	.....	.....

Fig. 4.1

[2]

(b) Describe **one disadvantage** of sexual reproduction compared with asexual reproduction.

.....

.....[1]

(c) In some species, male and female organisms look very different from each other. In cardinal birds, the male bird is a bright red colour and the female bird is a dull brown-yellow colour.

The bright red colour was initially caused by a mutation.

(i) Define the term *mutation.*

.....[1]

(ii) Suggest **one** reason why this mutation was an advantage to male cardinal birds.

.....

.....[1]

(d) Over time, all the male cardinal birds in the population became bright red.

Describe how all the male cardinal birds became bright red.

.....

.....

.....[2]

5 **(a)** When lithium reacts with water, hydrogen and lithium hydroxide are produced.

(i) Describe the test for hydrogen and the positive result.

test .....

result .....
[2]

(ii) Lithium hydroxide, LiOH, contains the lithium ion, Li^+.

Deduce the formula and charge of the hydroxide ion.

formula **and** charge .....

explanation .....

.....
[2]

(iii) Fig. 5.1 shows the relative distances between the outer-shell electron and the nucleus in an atom of lithium and in an atom of potassium.

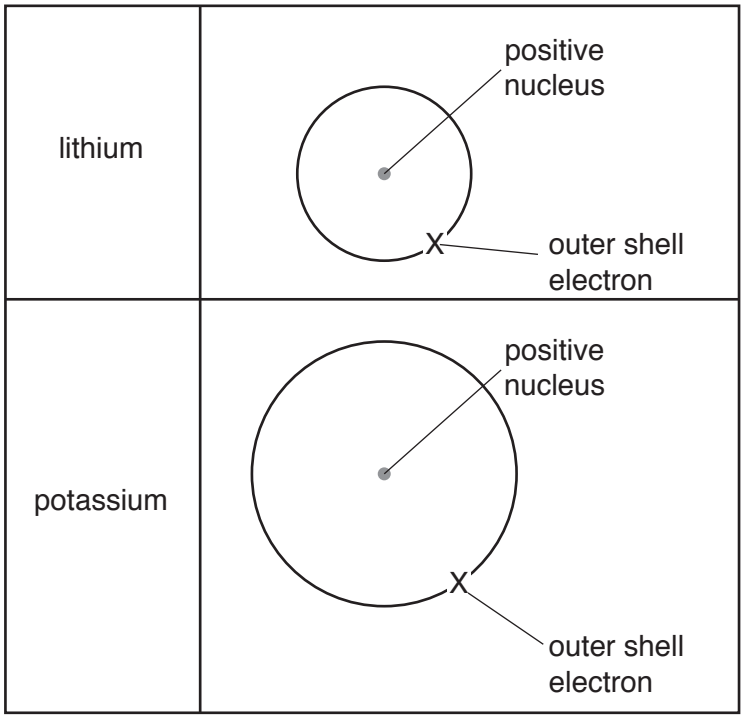


Fig. 5.1

Using the information in Fig. 5.1, suggest why atoms of potassium are more reactive than atoms of lithium.

.....

.....

.....[2]

(b) Fig. 5.2 shows apparatus used to produce lithium by electrolysis.

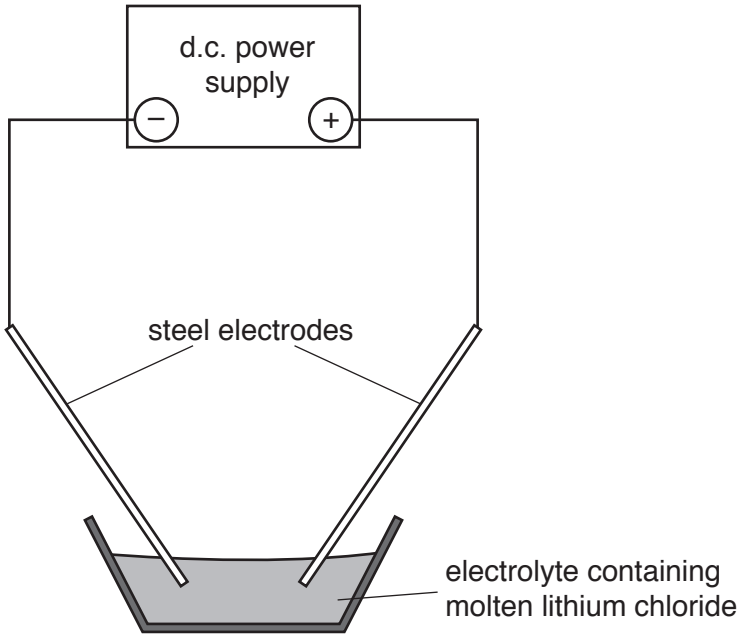


Fig. 5.2

(i) Name the element that forms at the anode.

.....[1]

(ii) Describe the change to a lithium ion, Li^+, during electrolysis.

.....

.....

.....[2]

(iii) State why the electrolyte in Fig. 5.2 must be molten, rather than an aqueous solution, to produce lithium.

.....

.....[1]

[Turn over

6 **(a)** **(i)** State the name of the electromagnetic wave that is used in mobile (cell) phone communication.

.....[1]

(ii) State the speed at which all electromagnetic waves travel.

.....[1]

(b) Fig. 6.1 shows the information found on a mobile phone charger.

input: a.c. 240 V, 50 Hz, 80 mA

output: d.c. 5.3 V, 500 mA

Fig. 6.1

The charger contains a transformer to reduce the voltage.

The primary (input) coil has 2500 turns.

Calculate the number of turns on the secondary (output) coil.

State the formula you use and show your working.

formula

working

number of turns = ...[2]

(c) The ring tone on a mobile phone can be changed.

Fig. 6.2 shows the sound trace made by four sound waves on an oscilloscope screen.

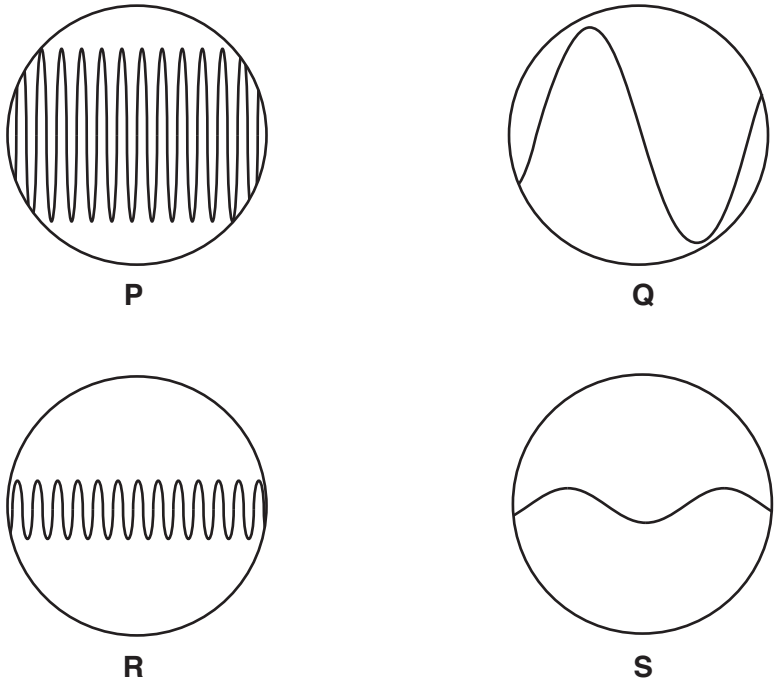


Fig. 6.2

State the letter that shows a sound trace from a ring tone which would be a

loud sound with a high pitch, ...

quiet sound with a low pitch. .....

[1]

(d) A student calculates the work done when she lifts her mobile phone through a vertical distance of 50 cm. The mobile phone weighs 0.9 N.

Each of the boxes contains a possible stage in her calculation.

Link the **three** boxes with lines that show how the student correctly calculated the work done.

formula:	W = F ÷ D	W = F × D	W = D ÷ F
calculation:	= 0.9 ÷ 50	= 0.9 × 50	= 0.9 × 0.5
answer:	= 0.018 J	= 45 J	= 0.45 J

[2]

7 **(a)** Table 7.1 lists different parts of a flower and their functions.

Complete Table 7.1. One row has been done for you.

Table 7.1

flower part	function
anther	.....
ovary	.....
sepal	.....
stigma	receives the pollen grains

[3]

(b) Fig. 7.1 is a photograph of a wind-pollinated plant *Sorghum halapense.*

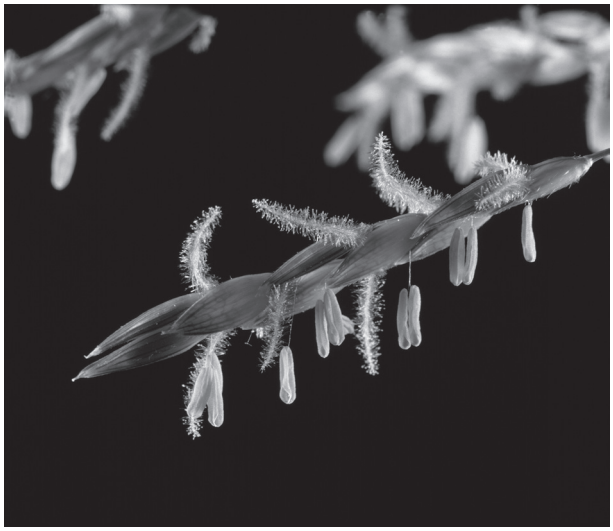


Fig. 7.1

State **two** visible adaptations of the flower in Fig. 7.1 for wind-pollination.

1 .....

2 .....

[2]

(c) Suggest why it is an advantage for wind-pollinated plants to produce more pollen than insect-pollinated plants.

.....

.....[1]

(d) Many plants have both male and female parts. This enables the plants to undergo self-pollination and fertilise themselves. Self-pollination is the transfer of pollen within the same plant.

Suggest **one** reason why self-pollination might be an advantage to a plant.

.....

.....[1]

(e) After fertilisation, seeds are formed. Seeds can be dispersed by wind.

State **one other** method of seed dispersal.

.....[1]

8 (a) (i) Table 8.1 shows the pH values of four mixtures that are made by shaking four oxides with water.

Table 8.1

oxide	pH of mixture
calcium oxide	12
carbon dioxide	5
carbon monoxide	7
nickel oxide	7

Suggest which **two** oxides do **not** react with water.

Explain your answer.

oxides ..... and .....

explanation .....

.....

.....

[2]

(ii) Describe a **chemical** test for water.

test .....

result .....

[2]

(iii) Suggest a **physical** test to show that a colourless liquid is pure water.

.....

.....

.....[2]

(b) Fig. 8.1 shows apparatus a student uses to investigate the neutralisation reaction between dilute sulfuric acid and sodium hydroxide solution.

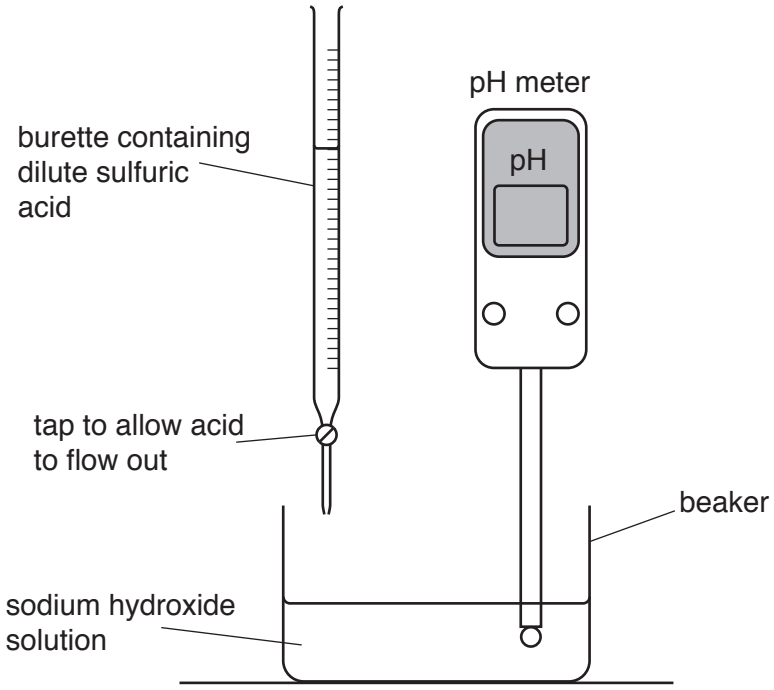


Fig. 8.1

Fig. 8.2 shows the change in pH of the mixture as dilute sulfuric acid is added to the sodium hydroxide solution.

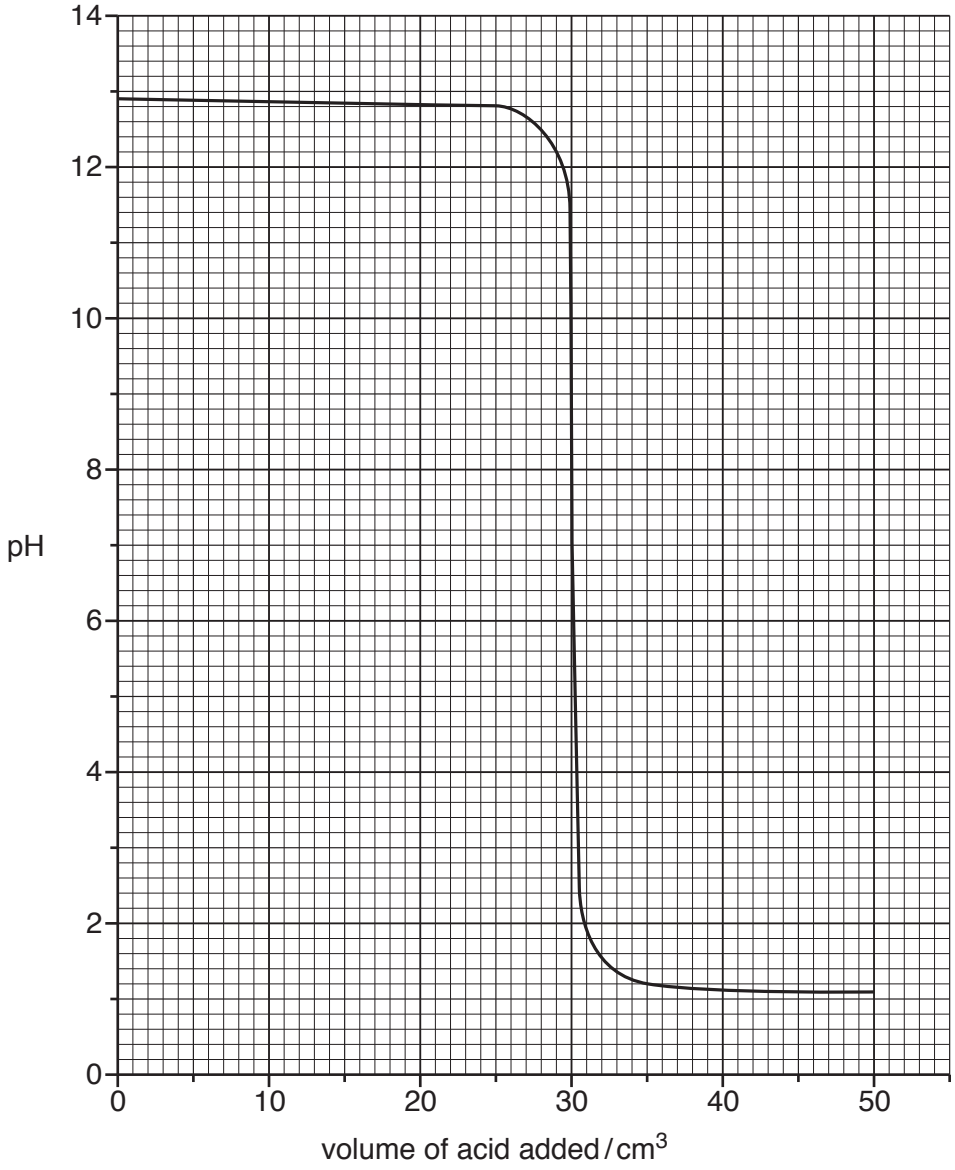


Fig. 8.2

(i) Describe the pH change as 50 cm^3 of dilute sulfuric acid is added.

.....

.....

.....

.....

.....[3]

(ii) State the volume of dilute sulfuric acid needed to neutralise the sodium hydroxide solution.

..... cm^3 [1]

(iii) Calculate the mass of 0.2 moles of sodium hydroxide, NaOH.
[A_r: Na = 23, O = 16, H = 1]

Show your working.

mass = ...g [2]

(iv) Calculate the number of moles of sodium hydroxide in 0.25 dm^3 of a 0.2 mol / dm^3 solution.

Show your working.

number of moles = ...[1]

9 Green plants are living organisms that carry out photosynthesis and respiration.

(a) (i) State the **balanced symbol** equation for photosynthesis.

.....[2]

(ii) State the substances needed for respiration.

.....[1]

(b) The graph in Fig. 9.1 shows the volume of oxygen produced per hour by a plant over a period of 24 hours.

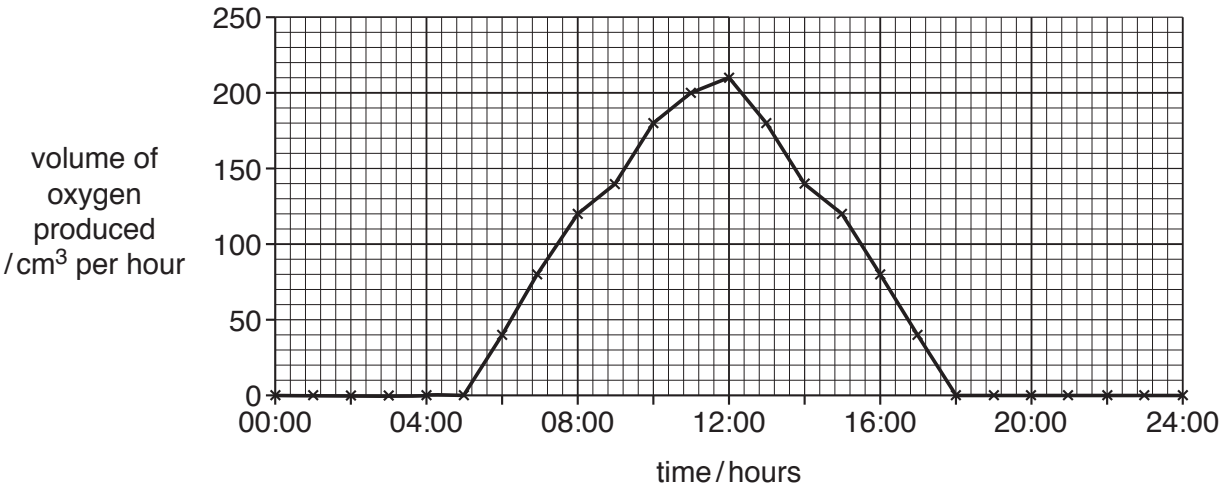


Fig. 9.1

(i) State the time when the fastest rate of photosynthesis occurs.

..... [1]

(ii) A plant also produces carbon dioxide.

Explain why carbon dioxide is produced constantly but oxygen is only produced at certain times of the day.

.....

.....

.....[2]

(iii) Suggest **and** explain why the rate of oxygen production increases rapidly between 05:00 and 12:00 hours.

.....

.....

.....[2]

10 (a) Fig. 10.1 shows the speed-time graph for the journey of a bus along a road for 80 seconds.

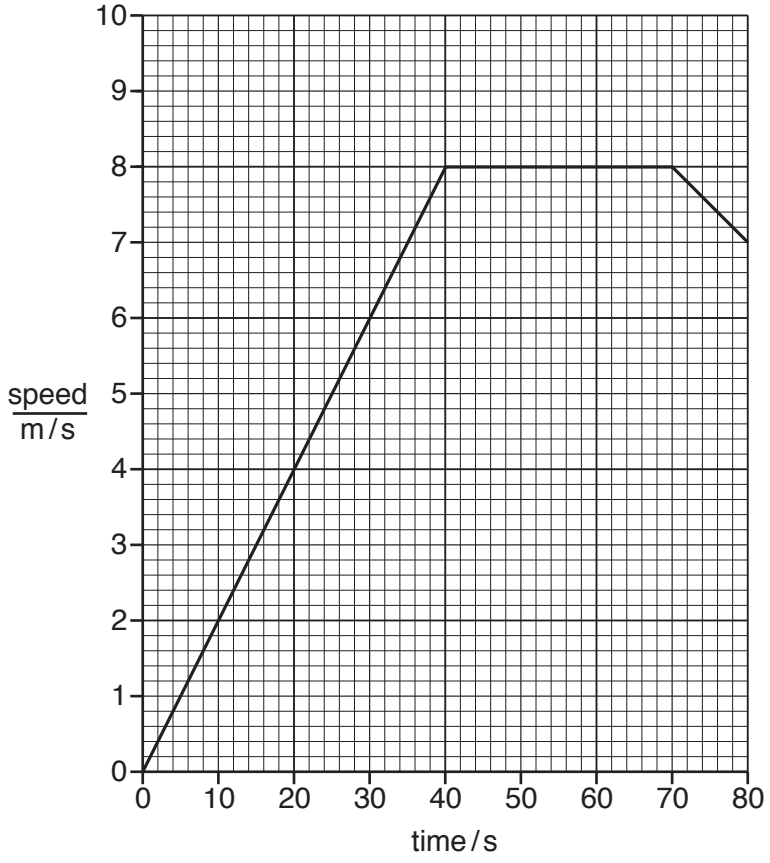


Fig. 10.1

(i) Calculate the distance travelled by the bus in 80 seconds.

Show your working.

distance = ...m [3]

(ii) The mass of the bus is 8000 kg. Calculate the maximum kinetic energy of the bus during the journey.

State the formula you use and show your working.

formula

working

kinetic energy = ...J [3]

(b) The bus has four wheels. Each wheel has a tyre inflated with air.

After a long journey, the tyres are hot and the air pressure in the tyres has increased.

(i) Describe how the air molecules in a tyre exert a pressure on the wall of the tyre.

.....

.....

.....[2]

(ii) Explain, in terms of molecules, why the pressure of the air in the tyres increases when the temperature increases.

.....

.....

.....[2]

(c) The bus has two headlights, $\mathbf{L_1}$ and $\mathbf{L_2}$.

The lamp inside headlight $\mathbf{L_1}$ is connected in parallel with the lamp inside headlight $\mathbf{L_2}$ across a 12 V battery.

Fig. 10.2 shows the circuit diagram for this arrangement.

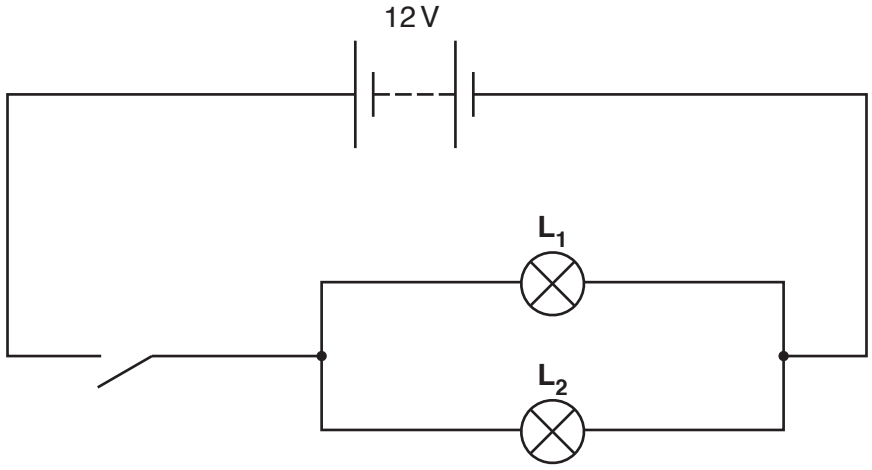


Fig. 10.2

(i) A current of 3.0 A flows through **each** lamp for 80 seconds.

Calculate the total charge that flows through the **two** lamps.

State the formula you use, show your working and state the unit of your answer.

formula

working

charge = ... unit ..... [3]

(ii) The resistance of each lamp is 4.0 Ω.

Calculate the combined resistance of the two lamps connected in parallel.

Show your working.

resistance = ...Ω [2]

(d) Some of the bodywork on the bus is made from iron. Other parts are made from steel.

Both iron and steel are magnetic.

Describe **one** difference between the magnetic properties of iron and the magnetic properties of steel.

.....

.....[1]

11 Alkanes and alkenes are homologous series of hydrocarbons.

(a) (i) Complete Table 11.1 by stating the four missing hydrocarbon names.

Table 11.1

number of carbon atoms in one molecule	name of alkane	name of alkene
2	.....	.....
3	propane	propene
4	.....	.....

[2]

(ii) Explain why **no** alkene molecules contain only one carbon atom.

.....

.....[1]

(b) Fig. 11.1 shows apparatus a teacher uses to demonstrate the redox reaction between methane, CH_4, and the black solid, copper oxide, CuO.

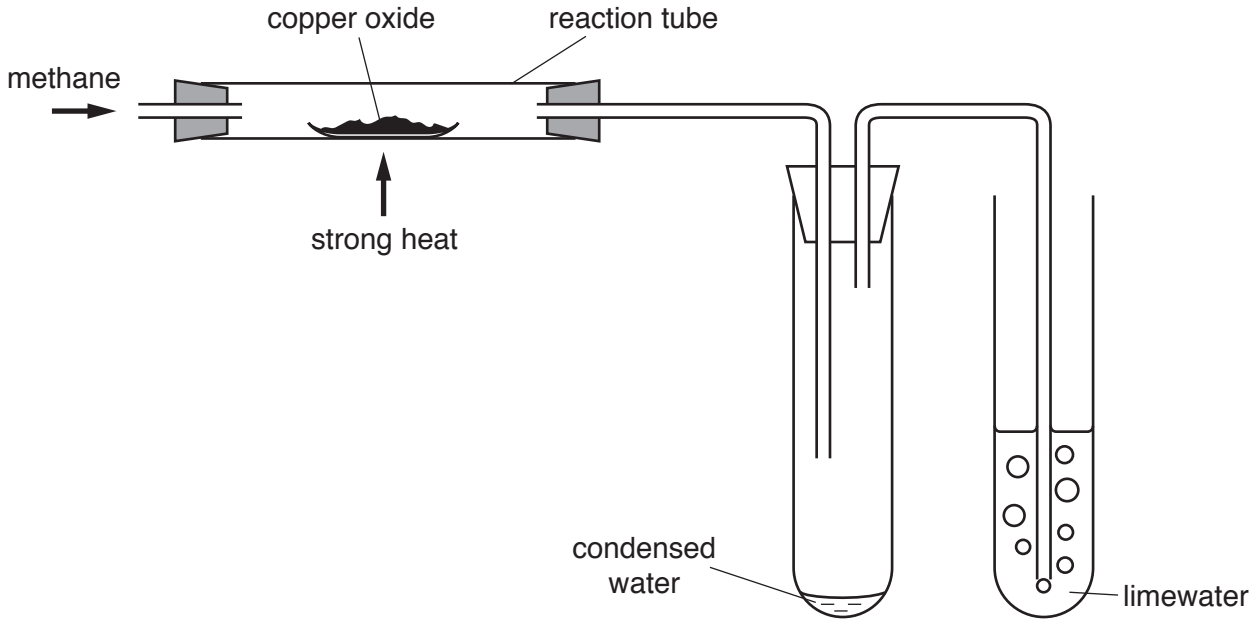


Fig. 11.1

As methane flows over the hot copper oxide, the black solid turns to pink copper.

(i) Describe the observation that shows the presence of carbon dioxide in the gases leaving the reaction tube.

.....[1]

(ii) Construct the **balanced symbolic** equation for the reaction between methane and copper oxide.

.....[2]

(iii) In the reaction, copper ions, Cu^{2+}, are reduced.

Define, in terms of electrons, the term *reduced.*

.....

.....[1]

(iv) Methane is the main constituent of natural gas.

Suggest why natural gas is described as a *fossil* fuel.

.....

.....[1]

12 (a) An electric cooker connected to a mains supply of 240 V has a power input of 6000 W.

(i) Show that the current that flows is 25 A.

State the formula you use and show your working.

formula

working

[2]

(ii) The cooker has its own circuit breaker.

Explain why a circuit breaker rated at 20 A must **not** be used in the cooker circuit.

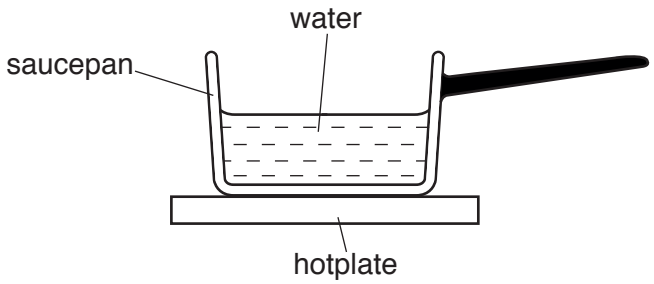
.....

.....

.....

.....[2]

(b) Fig. 12.1 shows some water being heated in a saucepan on the hotplate of the cooker.



not to scale

Fig. 12.1

The weight of the saucepan and water is 25 N. The area of the saucepan in contact with the cooker hotplate is 300 cm^2.

(i) Calculate the area of the saucepan in contact with the hotplate in m^2.

area = ... m^2 [1]

(ii) Calculate the pressure exerted by the saucepan on the surface of the hotplate in Pa.

State the formula you use and show your working.

formula

working

pressure = ... Pa [2]

(c) Fig. 12.2 shows a graph of the temperature of the water as it is heated for 1000 s.

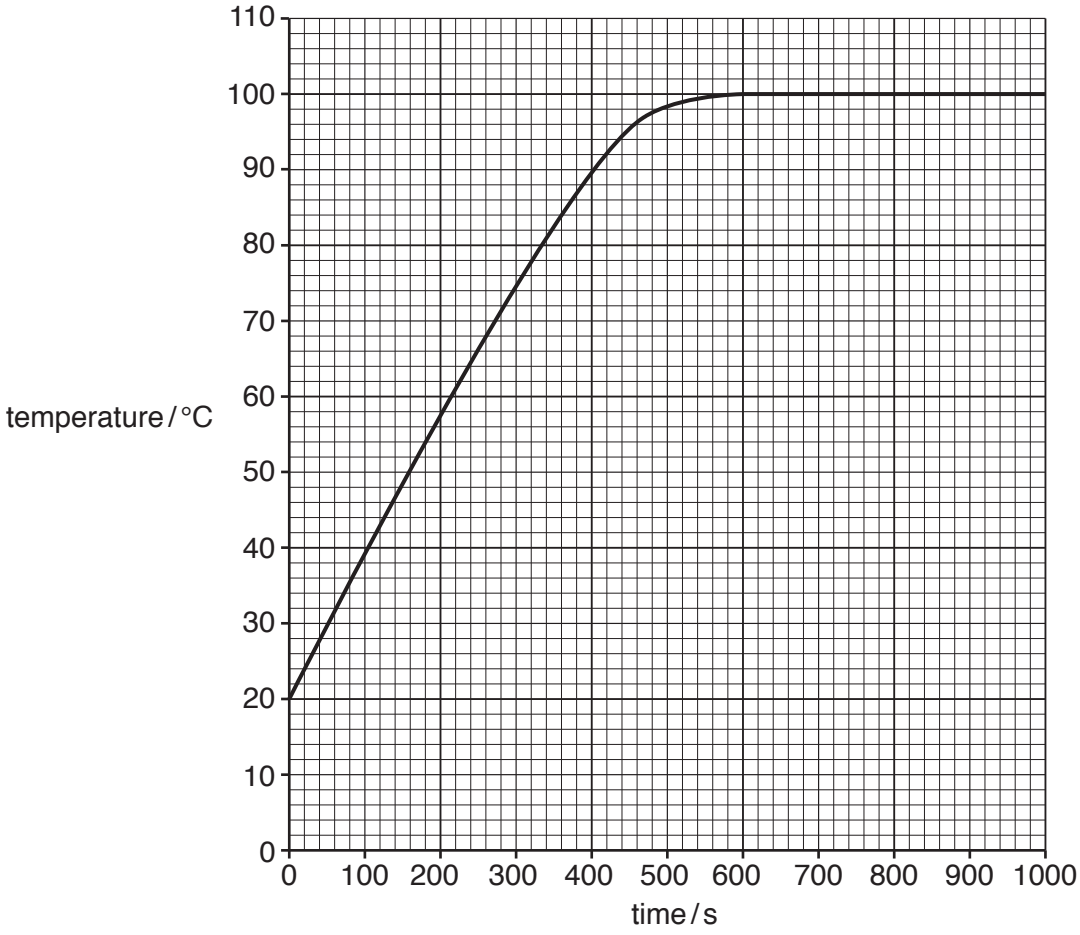


Fig. 12.2

(i) The mass of the heated water is 1.5 kg. The specific heat capacity of water is 4200 J / (kg °C).

Calculate the energy required to heat the water to 100 °C.

State the formula you use and show your working.

formula

working

energy = ... J [3]

(ii) Before the water boils, some of the water evaporates.

State **two** ways in which boiling differs from evaporation.

1 .....

.....

2 .....

.....

[2]

13 Fig. 13.1 is a diagram of a root hair cell.

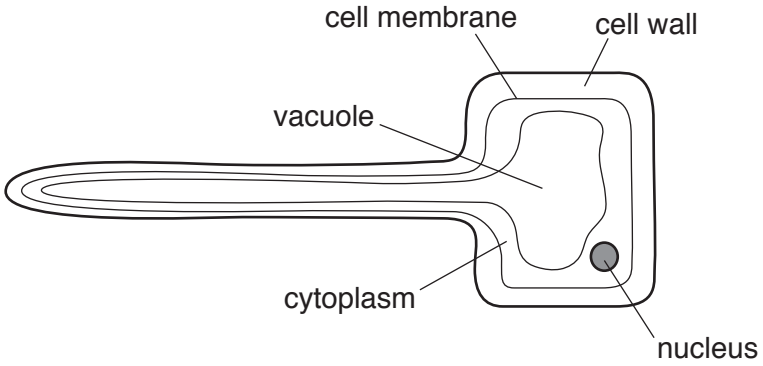


Fig. 13.1

The function of a root hair cell is to absorb water and mineral ions into the plant.

(a) Describe how root hair cells are adapted for their function.

.....

.....

.....[2]

(b) Describe, in detail, how water enters the root hair cells.

.....

.....

.....[2]

(c) Describe how water is moved from the roots to the leaves in a plant.

.....

.....

.....

.....

.....[3]

(d) Suggest **and** describe how an increase in humidity would affect the movement of water through a plant.

.....

.....

.....[2]

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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.).