Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/43**

Paper 4 (Extended) **May/June 2017**

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 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 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.

This document consists of **24** printed pages.

CAMBRIDGE International Examinations

[Turn over

1 **(a)** Use lines to connect the box on the left to different boxes on the right to make correct sentences.

One is done for you. The sentence reads 'Tobacco smoke contains nicotine'.

Draw **three** more lines to make three more correct sentences.

	keeps bacteria out of the airway.
	increases the concentration of carbon monoxide in the blood.
	damages the cilia in the airway.
Tobacco smoke	contains nicotine.
	can cure bronchitis.
	does not contain tar if a filter tip is present on the cigarette.
	causes more mucus to be produced in the lungs.

[3]

(b) Fig. 1.1 shows a diagram of an alveolus and a blood capillary.

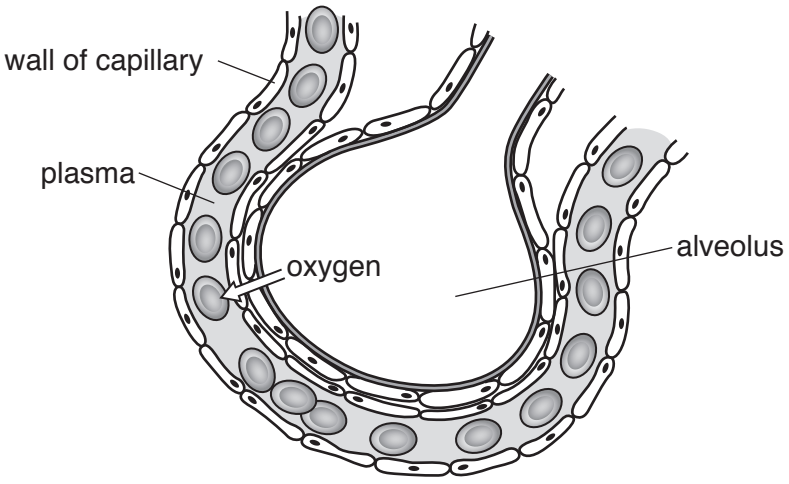


Fig. 1.1

(i) On Fig. 1.1 draw an arrow to show the net movement of carbon dioxide molecules at the alveolus. [1]

(ii) List **two** features of alveoli that make them a good gas exchange surface.

1. .....

2. .....
[2]

(c) Oxygen enters the blood as shown in Fig. 1.1.

Describe how oxygen is transported from the alveolus to the heart.

.....

.....

.....

.....

..... [3]

(d) Increased secretion of adrenaline causes the concentration of blood glucose and pulse rate to increase. This enables an increase in the respiration rate in cells to occur.

(i) Describe how an increase in blood glucose concentration enables an increase in the respiration rate in cells to occur.

.....

.....

..... [1]

(ii) Describe how an increase in pulse rate enables an increase in the respiration rate in cells to occur.

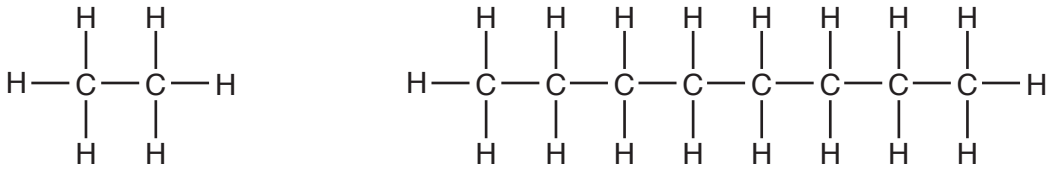
.....

.....

..... [1]

2 **(a)** Ethane and octane are obtained from petroleum by fractional distillation.

The structures of a molecule of ethane and a molecule of octane are shown in Fig. 2.1.



ethane octane

Fig. 2.1

(i) State the formula of octane.

..... [1]

(ii) Different fractions obtained from petroleum contain different amounts of ethane and octane.

Explain why a fraction formed higher up the fractional distillation column contains more ethane than octane.

Use ideas about molecular size, boiling points and intermolecular attractive forces in your answer.

.....

.....

.....

.....

.....

..... [3]

(b) Ethene molecules are made from large hydrocarbon molecules.

Name this process.

..... [1]

(c) Ethane, ethene and octane are hydrocarbons.

Identify the type of each of these hydrocarbons.

ethane .....

ethene .....

octane .....

[2]

(d) Complete the diagram below to show the bonding electrons in a molecule of ethene, C_2H_4.

Use dots and crosses to represent the electrons.

C **C**

[2]

3 Fig. 3.1 shows a cyclist riding her bicycle at a constant speed along a road. The arrows labelled **A**, **B**, **C** and **D** show the forces acting on the bicycle.

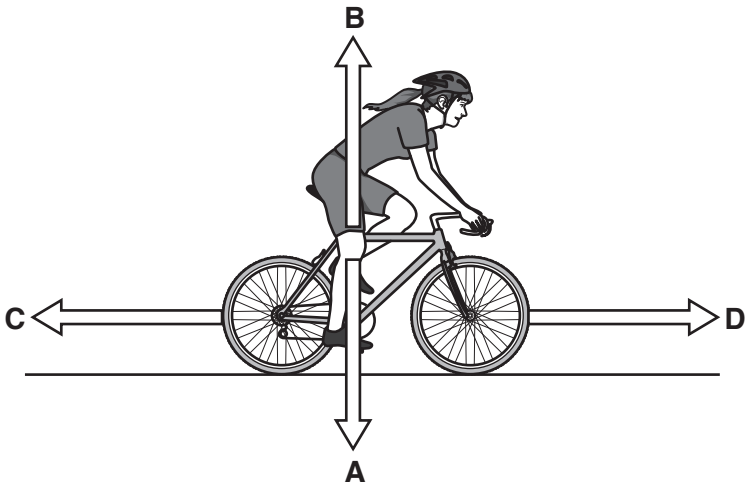


Fig. 3.1

(a) (i) State which letter, **A**, **B**, **C** or **D**, corresponds to

1. frictional force .....

2. weight .....

[1]

(ii) Force **A** is measured and found to be 1000 N.

State whether force **B** is 1000 N or has a different value.

Give a reason for your answer.

.....

..... [1]

(b) The cyclist goes downhill at a constant speed of 15 km / h. The road down the hill is 1 km long.

Calculate the time in seconds for the cyclist to reach the bottom of the hill.

Show your working.

time = ... s [2]

(c) The cyclist and her bicycle have a total mass of 100 kg. She is moving at 4 m / s.

Calculate the kinetic energy of the cyclist and her bicycle.

State the formula you use and show your working.

formula

working

kinetic energy = ... J [2]

(d) The cyclist works at a rate of 120 W as she cycles. She produces a driving force of 25 N to move the bicycle.

The cyclist and bicycle travel 1000 m in 250 s.

(i) Calculate the energy input by the cyclist for this journey.

Show your working.

energy input = ... J [1]

(ii) Calculate the work done in moving the cyclist and bicycle for this journey.

State the formula you use and show your working.

formula

working

work done = ... J [2]

(iii) Calculate the percentage efficiency of the bicycle.

State the formula you use and show your working.

formula

working

efficiency = ...% [2]

Please turn over for Question 4

4 Fig. 4.1 shows what happens to a seed after it is planted. The responses shown by the shoot and root are controlled by plant hormones called auxins.

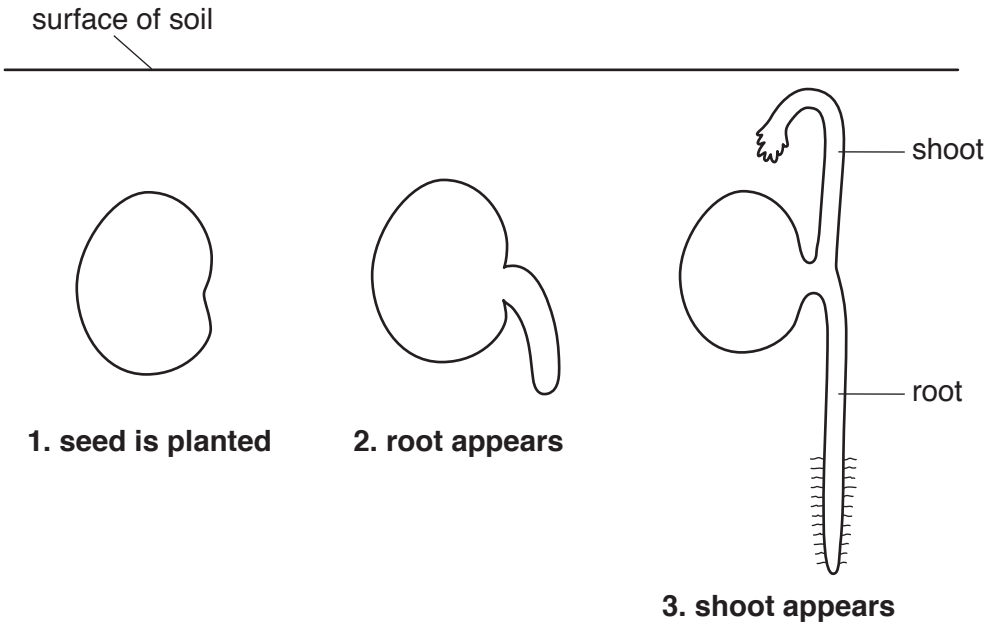


Fig. 4.1

(a) Name the response shown by both the root and the shoot in Fig. 4.1.

..... [1]

(b) A second similar seed is germinated and pinned on a vertical board as shown in Fig. 4.2. The apparatus is kept in the dark. The distribution of auxin hormones becomes uneven in the seedling.

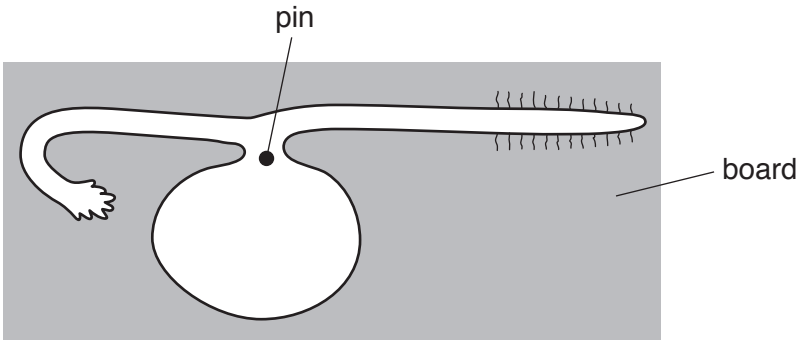


Fig. 4.2

(i) Complete Fig. 4.3 to show how the growth of the shoot and root will change over the next few days.

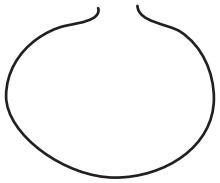


Fig. 4.3

[2]

(ii) In terms of the action of auxins, explain your answer to **(i)** for the **shoot** only.

.....

.....

.....

..... [2]

(c) Acid rain is produced as the result of burning fossil fuels. Acid rain can reduce the rate of germination of seeds.

(i) Describe how acid rain is produced.

.....

.....

.....

..... [2]

(ii) Suggest how acid rain reduces germination of seeds.

.....

.....

..... [1]

[Turn over

5 **(a)** The atomic number of magnesium is 12.

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

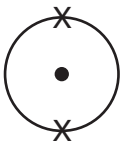


Fig. 5.1

[2]

(b) A student investigates the reaction between magnesium and dilute hydrochloric acid.

The student uses the apparatus shown in Fig. 5.2 for the investigation.

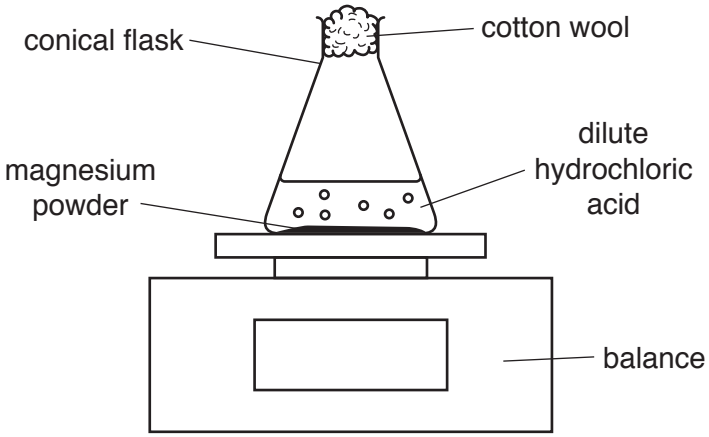


Fig. 5.2

Fig. 5.3 shows the mass of the conical flask and its contents during the reaction.

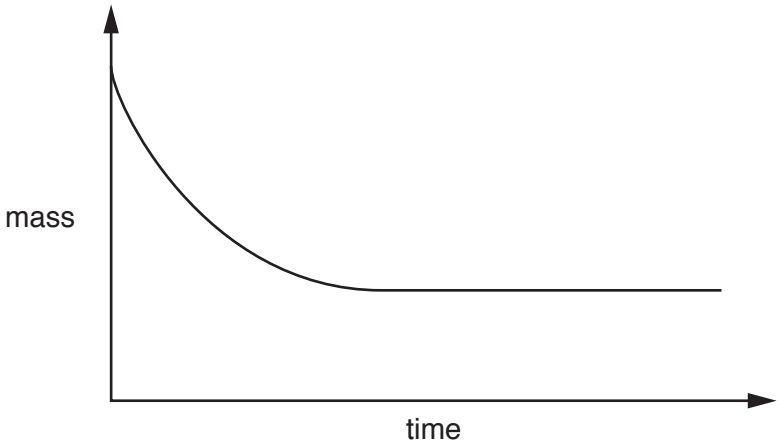


Fig. 5.3

(i) Explain why

at first the mass decreases,

.....

.....

later on the mass does not change.

.....

.....

[2]

(ii) Complete and balance the symbolic equation for this reaction.

Mg + ... → ..... + $MgCl_2$ [2]

(c) (i) State the effect, if any, of using a higher temperature on the rate of a reaction.

Explain your answer in terms of particle collisions.

effect .....

explanation .....

.....

.....

[2]

(ii) State the effect of using a catalyst on the rate of a reaction.

Describe the change, if any, to the catalyst at the end of the reaction.

effect .....

change to catalyst .....

[2]

6 Fig. 6.1 shows a man riding a snowmobile across snow and ice at a research station in Antarctica.

Fig. 6.1

(a) The temperature of the air is –40 °C, but the man must keep his body temperature at 37 °C.

(i) State the main method of thermal energy transfer from the man through his clothing to the outside.

..... [1]

(ii) The man wears several layers of thin clothing which trap air between them, instead of one layer of thick clothing.

Suggest **one** reason for this.

.....

..... [1]

(b) The snowmobile is driven by a gasoline (petrol) engine. Inside the engine, temperatures reach 800 °C as the fuel burns. The combustion of the fuel forms carbon dioxide and water molecules.

(i) State which of the diagrams in Fig. 6.2, **X**, **Y** or **Z**, shows the arrangement of molecules as they are formed in the engine.

Give a reason for your answer.

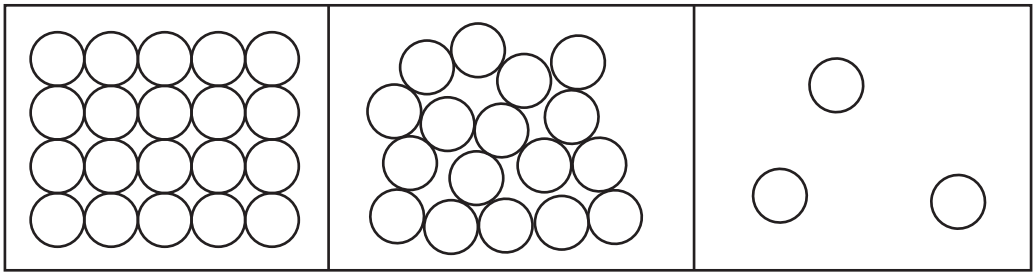


Fig. 6.2

diagram .....

reason .....

..... [1]

(ii) Fig. 6.3 shows white trails coming out of the engines of an aircraft landing at the research station when the air temperature was –45 °C.

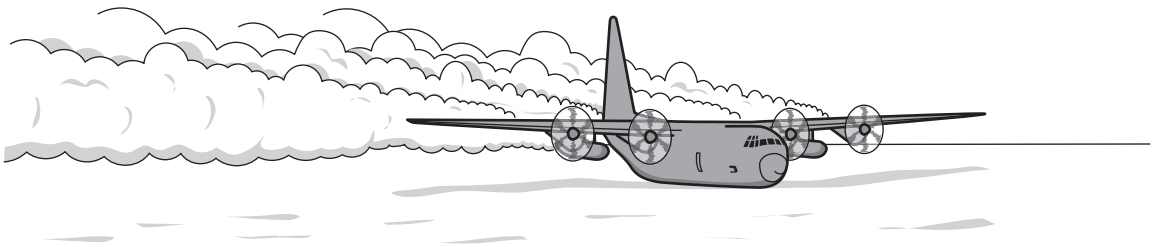


Fig. 6.3

Suggest what these white trails are made of. Give a reason for your answer.

The white trails are made of .....

reason .....

.....

[2]

(c) Antarctic research stations use satellites to relay communications to their home bases.

(i) Name the part of the electromagnetic spectrum used for satellite communications.

..... [1]

(ii) On Fig. 6.4, put the part of the electromagnetic spectrum you have named in **(i)** in its correct place in the incomplete electromagnetic spectrum.

	X-rays		visible light			

Fig. 6.4

[1]

(d) The man on the snowmobile uses a radio to talk to the aircraft pilot as he watches the aircraft landing. He can hear the sound of the engines of the aircraft in Fig. 6.3 several kilometres away.

(i) The man hears the sound of the engines for several seconds after the pilot says over the radio that the engines have been switched off.

Explain why this happens.

.....

..... [1]

(ii) Describe how the engines produce sound and how this is transmitted to the man.

.....

.....

..... [2]

Please turn over for Question 7

7 Fig. 7.1 shows a diagram of the cells in a cross section of a leaf.

(a) Most photosynthesis takes place in the palisade cells of the leaf.

Complete the balanced symbol equation for photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} \text{.....} + \text{.....}$$ [1]

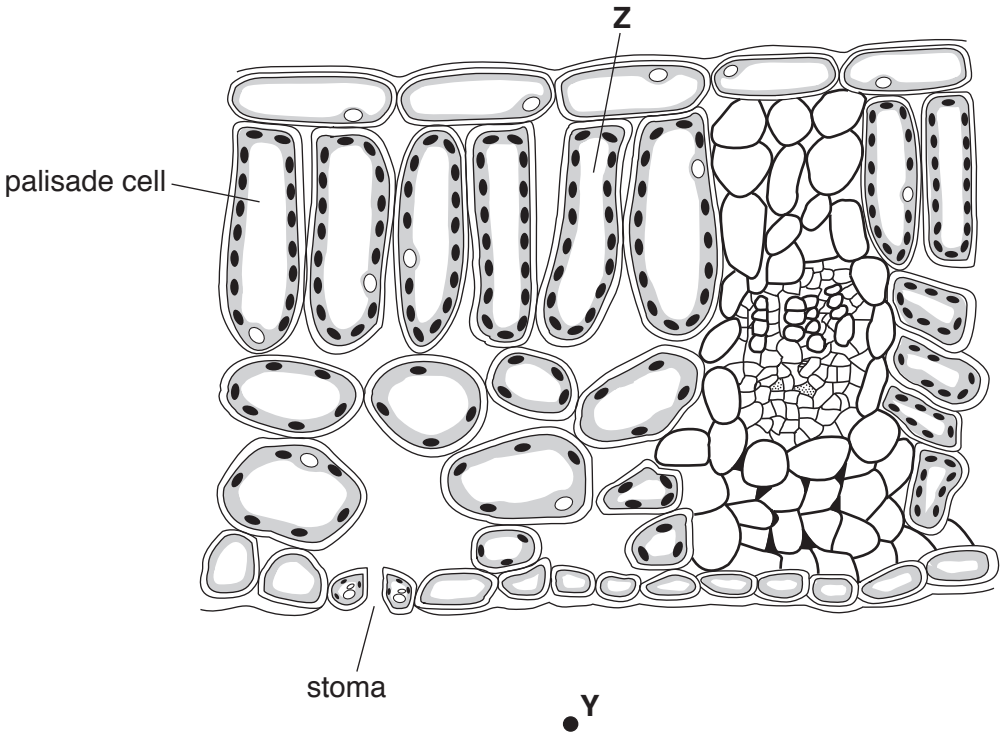


Fig. 7.1

(b) On Fig. 7.1

(i) draw a line to show a possible path taken by carbon dioxide from point **Y** to palisade cell **Z**, [1]

(ii) label the tissue that provides water for the leaf. [1]

(c) When the stomata are open there is a net movement of water molecules by diffusion out of the leaf. This is called transpiration.

Fig. 7.2 shows the area around the stoma of the leaf shown in Fig. 7.1.

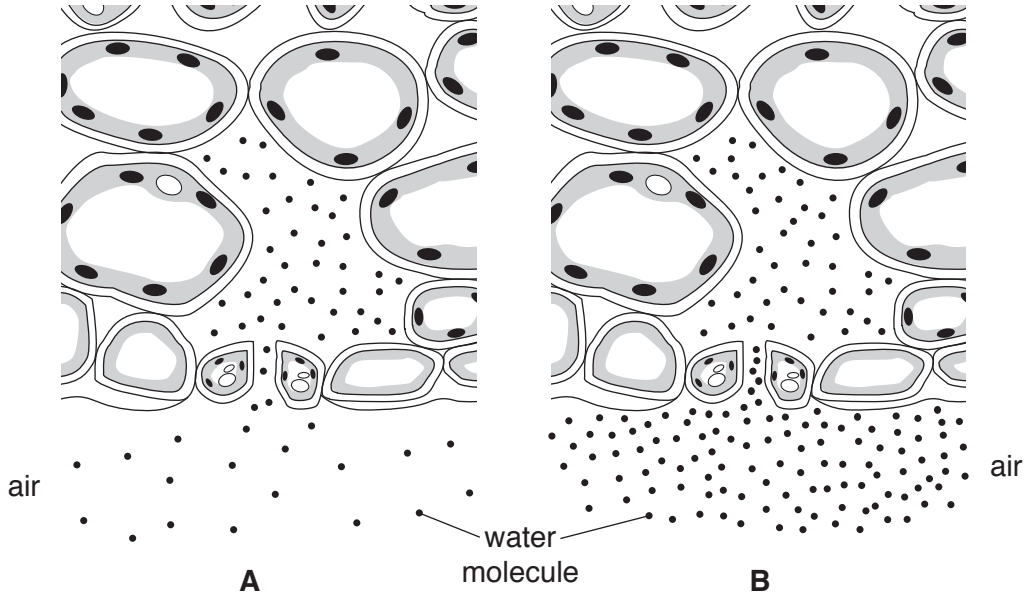


Fig. 7.2

(i) Describe how the water molecules get into the space inside the leaf above the stoma, as shown in Fig. 7.2.

.....

.....

..... [2]

(ii) Fig. 7.2 shows a difference in the environment around the leaf in diagram **A** compared with diagram **B**.

Predict whether the rate of transpiration will be greater in **A** or **B**.

Explain your answer.

.....

.....

..... [2]

8 **(a)** The melting points of the first four Group I metals are shown in Table 8.1.

Table 8.1

Group I metal	melting point / °C
lithium, Li	180
sodium, Na	98
potassium, K	64
rubidium, Rb	.....

Complete Table 8.1 by suggesting the melting point of rubidium, Rb. [1]

(b) A student investigates the reaction between four metals, **A**, **B**, **C** and **D**, and the oxides of these metals.

The results of this investigation are shown in Table 8.2.

Table 8.2

metal	metal oxide			
	A oxide	**B** oxide	**C** oxide	**D** oxide
A		✓	X	✓
B	X		X	✓
C	✓	✓		✓
D	X	X	X	

key
✓ reaction
X no reaction

(i) Deduce the order of reactivity of the four metals, from most reactive to least reactive.

..... most reactive

.....

.....

..... least reactive

[2]

(ii) The reaction between metal **A** and metal **B** oxide is exothermic.

Describe the energy transformation which occurs during an exothermic reaction.

.....

.....

..... [2]

(c) Sodium, Na, is extracted from sodium chloride, NaC*l*, by electrolysis, as shown in Fig. 8.1.

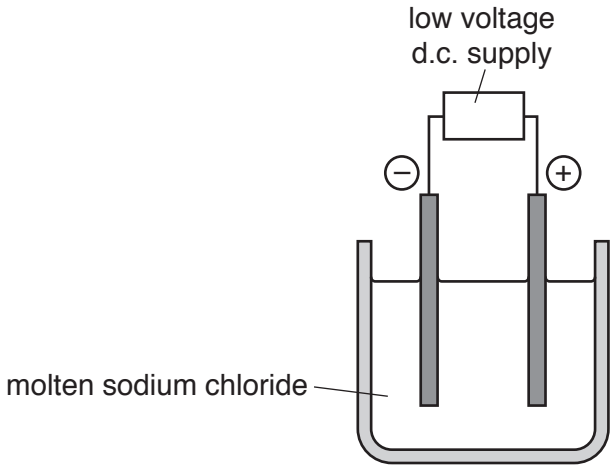


Fig. 8.1

(i) Name the electrode at which sodium forms.

..... [1]

(ii) State the gas that is formed during this electrolysis.

..... [1]

(iii) Explain, in terms of ions, why the sodium chloride must be molten rather than solid during this electrolysis.

.....

.....

..... [1]

9 Fig. 9.1 shows a circuit set up to measure the current in different parts of a circuit.

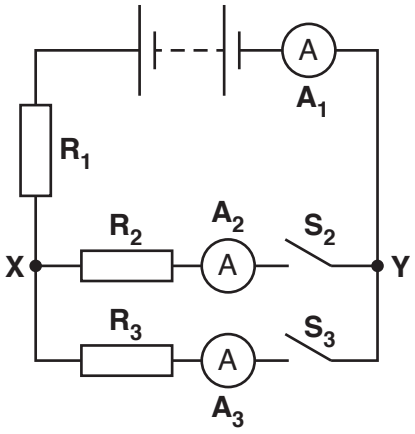


Fig. 9.1

(a) When both switches are closed, ammeter $\mathbf{A_1}$ reads 6A and ammeter $\mathbf{A_2}$ reads 1.5A.

(i) Predict the reading on ammeter $\mathbf{A_3}$.

Give a reason for your answer.

Reading on $\mathbf{A_3}$ = ... A

reason .....

.....

.....

[1]

(ii) Deduce why different currents are recorded on ammeters $\mathbf{A_2}$ and $\mathbf{A_3}$.

Give reasons for your answer.

.....

.....

.....

..... [2]

(b) A voltmeter is connected across the battery. The reading is 12 V.

Switch $\mathbf{S_2}$ is closed, but switch $\mathbf{S_3}$ is left open. Ammeter $\mathbf{A_1}$ reads 3 A.

The voltmeter is now connected between points **X** and **Y**. The reading is 3 V.

(i) State the reading on ammeter $\mathbf{A_2}$.

reading = ... A [1]

(ii) Deduce the value of resistance $\mathbf{R_1}$.

Show your working.

value of $\mathbf{R_1}$ = ... Ω [2]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –		

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.)