

Surname	Centre Number	Candidate Number
Other Names		0



GCSE

4782/02



SCIENCE B

**UNIT 2: Science and Life in the Modern World
HIGHER TIER**

P.M. WEDNESDAY, 15 June 2016

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	16	
2.	11	
3.	5	
4.	9	
5.	6	
6.	13	
Total	60	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to question **2(c)** and **5**.

A periodic table is printed on page 16.

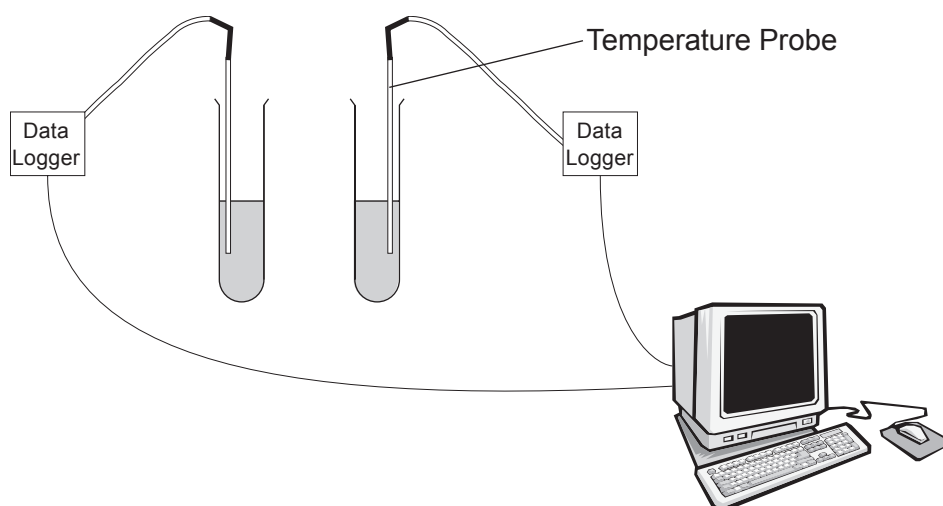
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Answer all questions.

1. A student investigated the reactions of hydrochloric acid with different alkalis.

The student followed the method below:

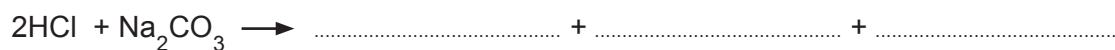
- 20 cm³ of sodium hydroxide solution was placed in tube 1
- 20 cm³ of sodium carbonate solution was placed in tube 2
- 20 cm³ of dilute hydrochloric acid was added in turn to each tube
- The temperature of each of the solutions was then recorded using a data logger



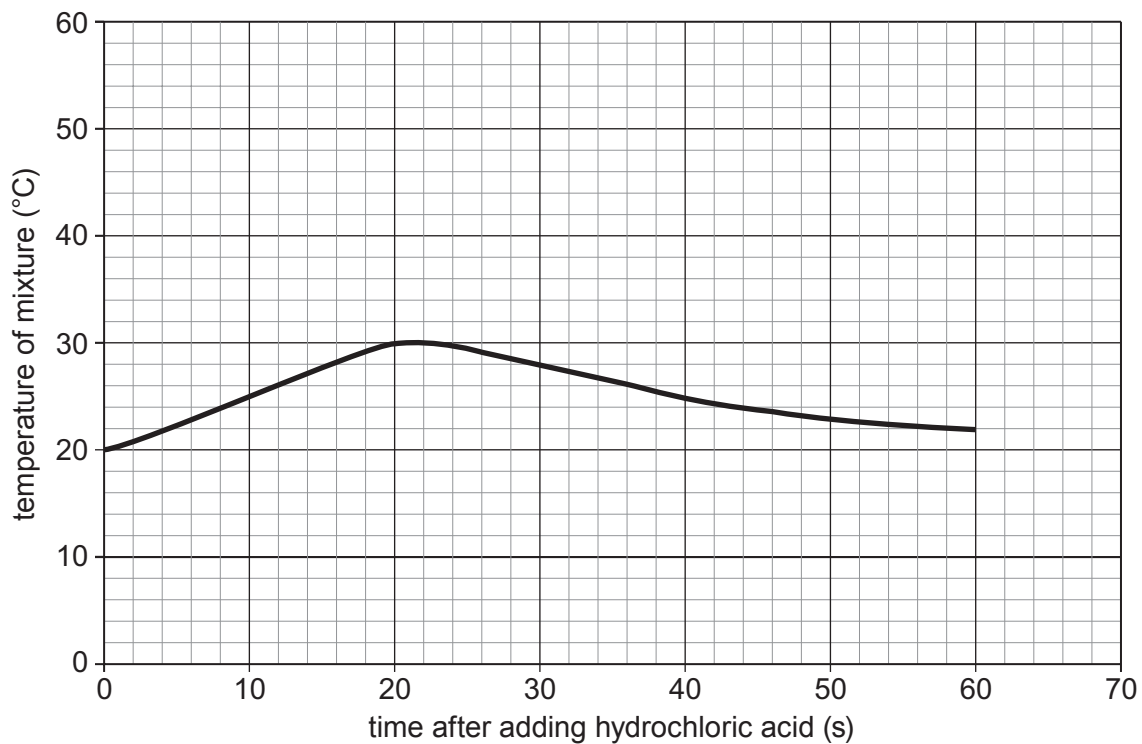
The equation for **Reaction 1** is given by:



(a) Complete the balanced symbol equation for **Reaction 2**. [3]



- (b) The temperature changes recorded for the reaction between sodium hydroxide and hydrochloric acid (**Reaction 1**) have been plotted for you.



- (i) Plot the following results for **Reaction 2** on the graph above.

[3]

Time after adding the hydrochloric acid (s)	Temperature of solution (°C)
0	20
10	30
20	55
30	48
40	45
50	42
60	40

(ii) Complete the table to show the increase in temperature for the reactions.

[2]

Examiner
only

Reaction	Initial temperature (°C)	Maximum temperature (°C)	Maximum rise in temperature (°C)
1
2

(c) Describe the changes that occur in **Reaction 1** and **Reaction 2**.

[4]

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(d) The student calculated the concentration of the hydrochloric acid used in this investigation.

- (i) To do this the student performed a titration. He measured 35.0 cm^3 of the hydrochloric acid into a flask and added a few drops of indicator. He then titrated 0.50 mol/dm^3 potassium hydroxide from a burette. The results of the titrations are shown below.

Calculate the mean titre.

[1]

Trial	Volume of potassium hydroxide (cm^3)
1	65.40
2	65.30
3	64.30
Mean titre

- (ii) Calculate the concentration of the hydrochloric acid using the formula below. Give your answer to two decimal places. [3]

concentration of alkali \times volume of alkali used = concentration of acid \times volume of acid used.

Answer = mol/dm^3

2. Plastic technology is advancing rapidly with new plastics being made all the time.

(a) Plastic production relies on the formation of a polymer.

Describe the main **structural** differences between ethene and polyethene. [2]

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(b) Explain how the properties of thermoplastics (e.g. polyethene) and thermosets (e.g. melamine) are related to the structures shown. [3]



THERMOPLASTIC



THERMOSETTING

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- (c) The table below compares the production of 1 kg of a bioplastic called polylactic acid (PLA) with two traditional plastics.

	Polylactic (PLA) plastic	Polyethene	Polystyrene
energy consumption (kWh)	10.74	20.56	22.56
water consumption (dm ³)	74.61	67.05	184.86
CO ₂ emissions (units)	2.60	5.62	5.02
solid waste (g)	0.84	1.74	2.22
source of raw materials	corn plants	crude oil	crude oil
biodegradable	yes	no	no

Use your knowledge and the information in the table to discuss the **advantages and disadvantages** of the production of bioplastics such as polylactic (PLA) compared to traditional plastics. [6 QWC]

Your answer should include:

- The data in the table
- Advantages of using bioplastics
- Disadvantages of using bioplastics

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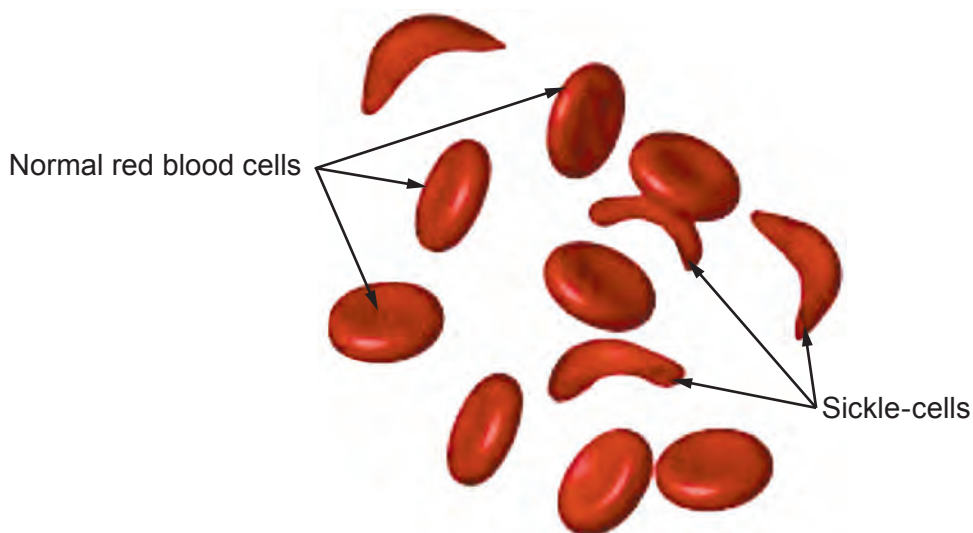
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3. Sickle-cell anaemia is an inherited disease caused by a **recessive allele**. In a patient with this disease the haemoglobin in red blood cells develops abnormally. The cells form sickle shapes.



- (a) James and Chinaza, a couple with a family history of sickle-cell anaemia, are both heterozygous for sickle-cell anaemia, often referred to as a 'sickle-cell trait'.

Use an appropriate diagram to calculate the chance of James and Chinaza producing a baby with sickle-cell anaemia. [3]

chance of sickle-cell anaemia =

- (b) Suggest what advice a genetic counsellor may offer this couple. [2]

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4. The table contains some physical properties of four elements, **W**, **X**, **Y** and **Z**.

Element	Melting point (°C)	Boiling point (°C)	Conducts electricity?	Density (g/cm ³)
W	-101	-35	No	0.0029
X	98	890	Yes	0.97
Y	-7	59	No	3.1
Z	113	184	No	4.9

(a) Identify which of the above elements **W**, **X**, **Y** or **Z** are sodium and chlorine. Give **one** reason for each choice. [4]

(i) sodium

Reason

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(ii) chlorine

Reason

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(b) When a piece of sodium is exposed to air, the freshly cut surface immediately reacts with a gas in the air.

(i) Write a balanced symbol equation for this reaction. [3]

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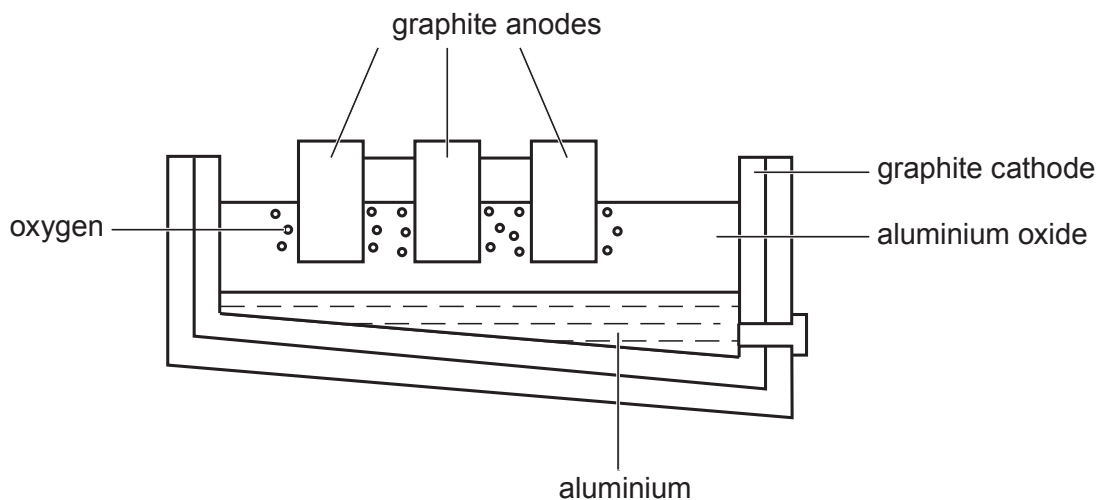
(ii) Explain how the storage of sodium prevents this reaction. [2]

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6. The process of electrolysis can be used to extract reactive metals from their ores.



(a) (i) Give the state (*solid, liquid or gas*) of the aluminium oxide used in this process. [1]

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(ii) Explain why the aluminium oxide must be in this state. [2]

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(b) Explain what happens at the graphite cathode. [3]

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(c) Explain why aluminium ore is extracted using electrolysis rather than by chemical reduction. [2]

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- (d) The cost of electricity for producing one tonne of aluminium from its ore is £2500. Recycling aluminium uses only 5% of the electricity needed to extract it from its ore. Calculate the cost of the electricity needed to recycle 1 tonne of aluminium. [1]

Cost = £

- (e) Give **one** environmental reason why aluminium should be recycled apart from saving energy. [1]

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- (f) State **three** factors that need to be considered when deciding upon the location of a new aluminium production plant. [3]

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END OF PAPER

Periodic Table of the Elements

element name
atomic number
symbol

1	2	3	4	5	6	7	0	
lithium 3 Li	beryllium 4 Be	hydrogen 1 H	boron 5 B	carbon 6 C	nitrogen 7 N	oxygen 8 O	fluorine 9 F	helium 2 He
sodium 11 Na	magnesium 12 Mg	aluminium 13 Al	silicon 14 Si	phosphorus 15 P	sulfur 16 S	chlorine 17 Cl	argon 18 Ar	
potassium 19 K	calcium 20 Ca	gallium 31 Ga	zinc 30 Zn	germanium 32 Ge	arsenic 33 As	selenium 34 Se	bromine 35 Br	krypton 36 Kr
rubidium 37 Rb	strontium 38 Sr	iron 26 Fe	copper 29 Cu	indium 49 In	nickel 28 Ni	tin 50 Sn	iodine 53 I	xenon 54 Xe
caesium 55 Cs	barium 56 Ba	cobalt 27 Co	silver 47 Ag	antimony 51 Sb	cadmium 48 Cd	antimony 51 Sb	astatine 85 At	radon 86 Rn
francium 87 Fr	radium 88 Ra	rhodium 45 Rh	gold 79 Au	thallium 81 Tl	platinum 78 Pt	polonium 84 Po		
		osmium 76 Os	iridium 77 Ir	bismuth 83 Bi	lead 82 Pb			
		rhenium 75 Re	platinum 78 Pt	lead 82 Pb				
		tungsten 74 W	gold 79 Au					
		vanadium 23 V	mercury 80 Hg					
		niobium 41 Nb						
		titanium 22 Ti						
		zirconium 40 Zr						
		hafnium 72 Hf						
		yttrium 39 Y						
		lutetium 71 Lu						
		scandium 21 Sc						
		chromium 24 Cr						
		manganese 25 Mn						
		technetium 43 Tc						
		rhodium 45 Rh						
		iridium 77 Ir						
		osmium 76 Os						
		platinum 78 Pt						
		gold 79 Au						
		mercury 80 Hg						
		thallium 81 Tl						
		lead 82 Pb						
		bismuth 83 Bi						
		polonium 84 Po						
		astatine 85 At						
		radon 86 Rn						