Write your name here

Surname	Other names

Edexcel GCSE

Centre Number	Candidate Number

Chemistry/Additional Science

Unit C2: Discovering Chemistry

Higher Tier

Sample Assessment Material
Time: 1 hour

Paper Reference
5CH2H/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions

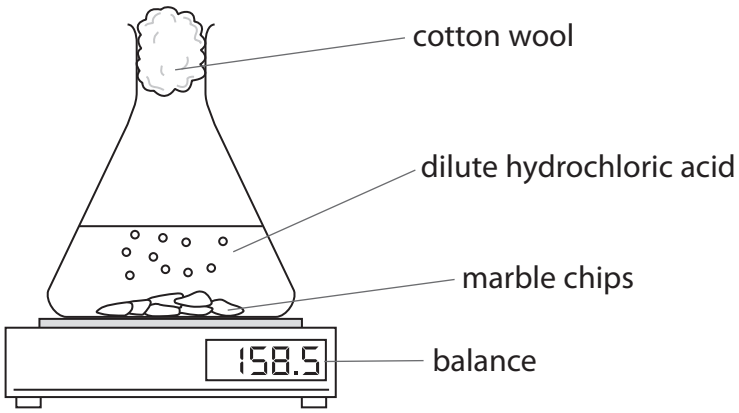
Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Changing the rate of a chemical reaction

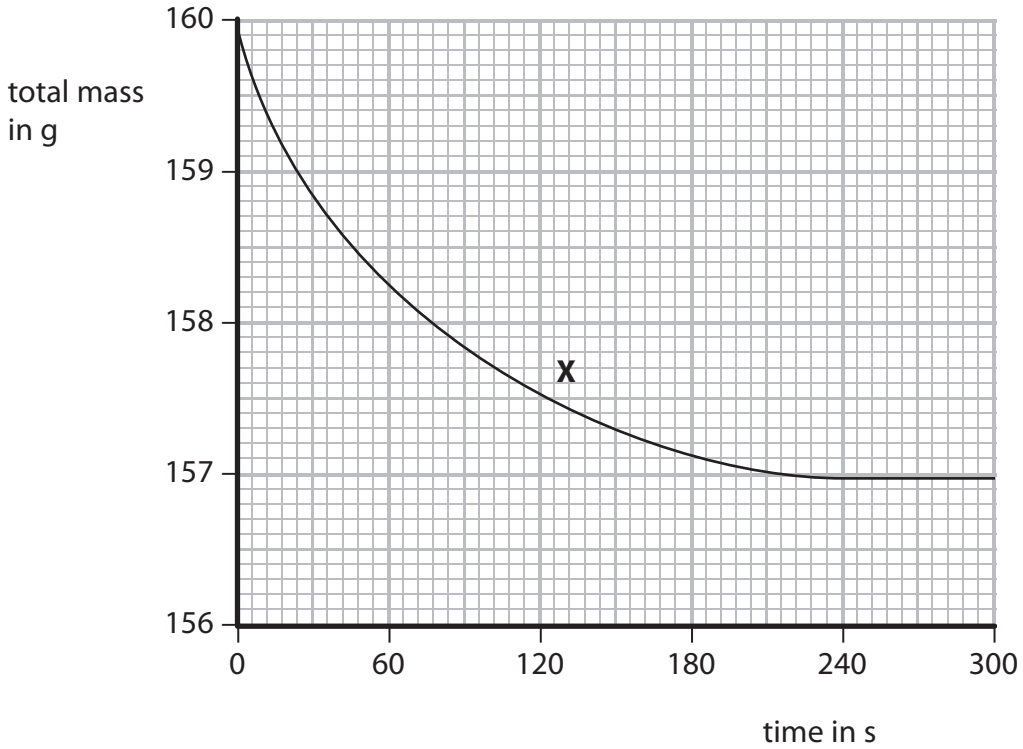
1 Chemical reactions can be slowed down or speeded up by changing the conditions.

(a) Marble chips react with dilute hydrochloric acid to produce carbon dioxide gas.

Kenny investigated the rate of this reaction at 20 °C using the apparatus shown in the diagram.



He measured the mass of the flask and its contents every 30 seconds.
The graph shows his results.



(i) Why did the total mass decrease?

(1)

(ii) How long did it take for the reaction to finish?

(1)

(iii) Why is the rate of reaction at point **X** different to the rate at the start of the reaction?

(1)

(iv) Kenny repeated the experiment at 40 °C keeping all other conditions the same.

Draw a line on the graph to show the results that Kenny would obtain at this temperature.

(2)

(v) Using a more concentrated acid increases the rate of the reaction.

Explain, in terms of particles, why the rate increases.

(2)

(b) The rate of some reactions can be increased by using a catalyst.

Put a cross (☒) in the box next to your answer.

Which of these is true for a catalyst?

(1)

☒ **A** It takes no part in a chemical reaction

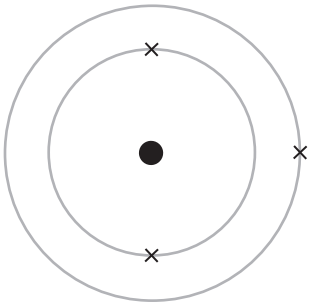
☒ **B** It causes the reaction to start

☒ **C** It is unchanged in mass at the end of the reaction

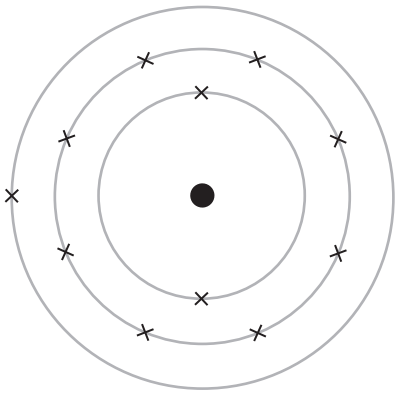
☒ **D** It causes the reaction to produce different products

(Total for Question 1 = 8 marks)

2 The diagrams show the electronic configurations of lithium and sodium.



lithium



sodium

(a) (i) Use the information in the diagrams to explain why lithium and sodium have similar reactions.

(1)

.....

.....

(ii) Use the information in the diagrams to explain in which group **and** period of the periodic table sodium is found.

(2)

.....

.....

.....

.....

(iii) Use the information in the diagrams to explain why sodium is more reactive than lithium.

(2)

.....

.....

.....

.....

(b) An atom of sodium contains 11 protons, 12 neutrons and 11 electrons.
What is the mass number of this atom?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** 11

☐ **B** 12

☐ **C** 23

☐ **D** 34

(c) The table gives information about the two stable isotopes of bromine.

isotope	mass number
bromine-79	79
bromine-81	81

Explain why bromine-79 and bromine-81 have different mass numbers but the same chemical reactions.

(2)

.....

.....

.....

.....

(Total for Question 2 = 8 marks)

Bottled water

3 Many people drink bottled water.

This is part of a label from a bottle of water.

typical analysis (mg dm^{-3})	
calcium	53
magnesium	17
potassium	1
sodium	6
chloride	6
sulfate	7
hydrogencarbonate	235

East Woods natural mineral water

The metals listed are present in the water as ions.

(a) What is an ion?

(1)

.....

.....

(b) Scientists test water samples to identify ions present in the water.
Which of these are they likely to use?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** X-rays

☒ **B** displacement reactions

☒ **C** spectroscopy

☒ **D** evaporation

(c) Describe the tests you could carry out on a sample of water to show that it contained dissolved sodium chloride.

(4)

(d) When barium chloride solution, $BaCl_2$, is added to sodium sulfate solution, Na_2SO_4, a white precipitate of barium sulfate, $BaSO_4$, is formed.

(i) Write the balanced equation for this reaction.

(2)

(ii) Describe the changes that take place when a barium atom forms a barium ion.

(2)

(Total for Question 3 = 10 marks)

Railway lines

4 The thermite reaction produces molten iron, which can be used to join railway lines.

Shutterstock

The reaction mixture is iron oxide and aluminium.

When ignited, it produces molten iron, and a large amount of heat is given off.

The equation for the reaction is

$$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$$

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.
This reaction gives out heat.

It can be described as

(1)

☒ **A** physical

☒ **B** endothermic

☒ **C** thermal decomposition

☒ **D** exothermic

(b) Explain, in terms of the bonds in reactants and products, why heat is given out during some reactions.

(3)

(c) Another oxide of iron does **not** have the empirical formula Fe_2O_3.
A 4.64 g sample of the oxide contained 3.36 g of iron.

Calculate the empirical formula of this oxide. You must show your working.
(Relative atomic masses: Fe = 56, O = 16)

(3)

formula = ...

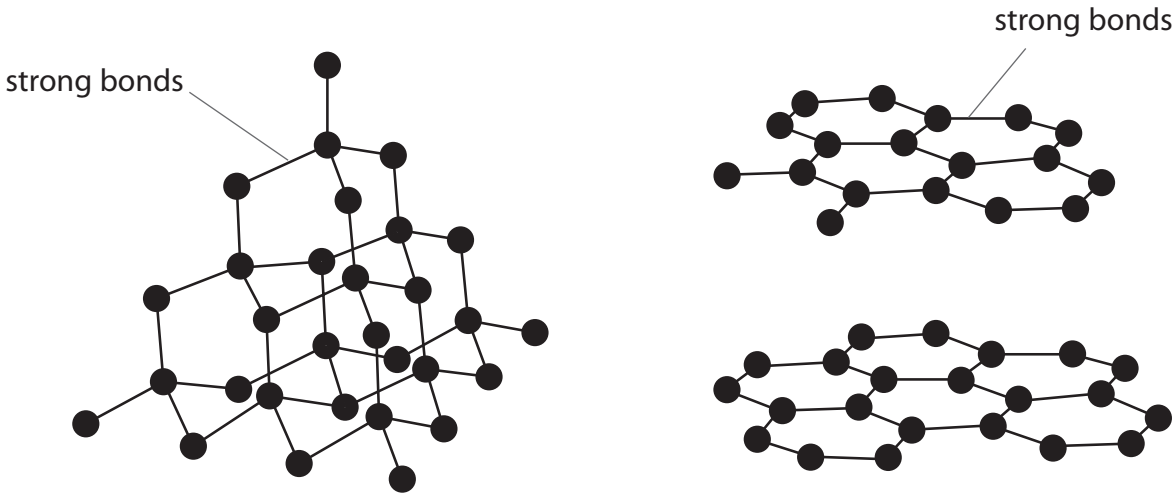
(d) When iron is extracted from iron oxide on a large scale, a waste product called slag is produced.
Explain why it is important that slag has commercial uses.

(3)

(Total for Question 4 = 10 marks)

5 The diagrams show the structures of two forms of carbon, diamond and graphite.

● = carbon atom



diamond graphite

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

Diamond and graphite have structures that are

(1)

☒ **A** ionic

☒ **B** simple molecular covalent

☒ **C** giant molecular covalent

☒ **D** metallic

(b) The 'lead' in pencils is a mixture of graphite and clay.

Why do pencils leave a mark on paper?

(1)

.....

.....

*(c) Use the diagrams of the structures of diamond and graphite to help you explain why graphite conducts electricity but diamond does not conduct electricity.

(6)

(d) Write the balanced equation for the reaction of carbon with oxygen to form carbon dioxide.

(2)

(e) Draw a dot and cross diagram to show the arrangement of the electrons in a molecule of carbon dioxide.

Show the outer electrons only.

(2)

(Total for Question 5 = 12 marks)

Sea water as a source of raw materials

6 Sea water contains dissolved salts.
Sodium, bromine and sodium chloride are some important materials that can be obtained from sea water.

(a) Bromine is obtained from sea water by passing chlorine gas into the sea water.

$$Cl_2 + 2NaBr \rightarrow Br_2 + 2NaCl$$

(i) Why does a reaction take place?

(1)

.....

.....

(ii) What type of reaction is this?

(1)

.....

.....

(b) Sodium reacts with water to produce hydrogen.

(i) Describe what would be **seen** when sodium is added to water.

(3)

.....

.....

.....

.....

.....

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The balanced equation for the reaction of sodium with water is

(1)

☒ **A** $Na + H_2O \rightarrow NaOH + H$

☒ **B** $Na + 2H_2O \rightarrow NaOH + H_2$

☒ **C** $2Na + 2H_2O \rightarrow 2NaOH + H_2$

☒ **D** $Na + H_2O \rightarrow Na(OH)_2 + H_2$

*(c) Hydrogen chloride and sodium chloride are both compounds of chlorine.

Hydrogen chloride has a boiling point of –85 °C.
Sodium chloride has a boiling point of 1413 °C.

Explain this difference in the boiling points in terms of the structures and bonding between the particles in the two compounds.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Sample Mark Scheme

Unit C2: Discovering Chemistry (Higher Tier)

Question Number	Answer	Mark
1(a)(i)	carbon dioxide/gas given off/lost	**(1)**

Question Number	Answer	Mark
1(a)(ii)	any value between 220 and 240 (s)	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	acid less concentrated/ surface area of marble chips decreases	some reactants used up	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iv)	curved line below original line starting at 160, and levelling off at 157	do not penalise if curve not smooth	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(v)	an explanation linking the following: particles are closer together (1) (so) more (frequent/successful) collisions (1)	more particles in same volume	**(2)**

Question Number	Answer	Mark
1(b)	**C**	**(1)**

TOTAL: 8 MARKS

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	same number of outer electrons/both have one electron in outer shell	same group	**(1)**

Question Number	Answer	Mark
2(a)(ii)	an explanation that links the following: group 1 because 1 outer electron (1) period 3 because 3 electron shells (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	an explanation that links the following: outer electron more easily lost (1) (because) electron is further from nucleus/sodium has more shells/sodium has more shielding/outer shell further from nucleus (1)	ignore sodium has more electrons	**(2)**

Question Number	Answer	Mark
2(b)	**C**	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)	an explanation that links the following: different mass number due to different number of neutrons (1) (but) same chemical reactions since same number of electrons (1)	same element	**(2)**

TOTAL: 8 MARKS

Question Number	Answer	Acceptable answers	Mark
3(a)	an atom or group of atoms with a charge	an atom or group of atoms with different numbers of protons and electrons ignore names from the table	**(1)**

Question Number	Answer	Mark
3(b)	**C**	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)	a description to include the following: sodium (ions) cause a yellow flame (1) for chloride ions: add dilute nitric acid (1) add silver nitrate (solution) (1) white precipitate/solid forms (1)	do not accept turns white	**(4)**

Question Number	Answer	Acceptable answers	Mark
3(d)(i)	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$ all 4 formulae correct (1) balancing correct formulae (1)	$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ gains 2 marks if fully correct	**(2)**

Question Number	Answer	Mark
3(d)(ii)	a description including the following: barium atom loses (two) electrons (1) to form an ion with a full outer shell (1)	**(2)**

TOTAL: 10 MARKS

Question Number	Answer	Mark
4(a)	**D**	**(1)**

Question Number	Answer	Mark
4(b)	an explanation linking the following: energy released/given out when new bonds are formed (1) is greater than (1) energy used/taken in to break bonds (1)	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(c)	mass of oxygen 1.28 (g) (1) $\frac{3.36}{56}$ $\frac{1.28}{16}$ (1) (0.06) (0.08) Fe_3O_4 (1)	1.28 seen anywhere scores this mark evidence of dividing by correct RAM final answer with no working only scores 1	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(d)	an explanation including the following: if it has uses, it can be sold (1) this increases profit of the (iron making) industry (1) and prevents slag having to be thrown away/disposed of (1)	producing slag uses up raw materials/energy (1) disposal would cost money/cause environmental problems (1) (so) using slag means higher profit/less waste (1)	**(3)**

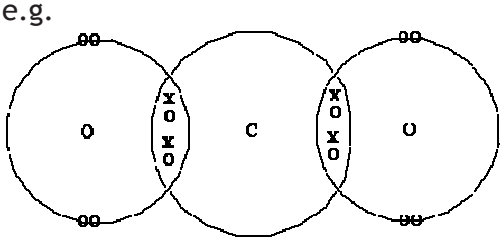
TOTAL: 10 MARKS

Question Number	Answer	Mark
5(a)	**C**	**(1)**

Question Number	Answer	Mark
5(b)	layers rub off (onto paper)	**(1)**

Question Number		Indicative content	Mark
***5(c) QWC**		an explanation including some of the following: • every carbon forms 4 bonds in diamond • no unused electrons in diamond • no way for conduction to occur • every carbon forms 3 bonds in graphite • leaves delocalised electrons • these can move • parallel to the layers of carbon atoms • to conduct electricity	**(6)**
Level	**0**	No rewardable material	
1	**1–2**	• a basic explanation of the idea of 'spare' electrons in graphite; no reference to number of bonds or movement of electrons. • no 'spare' electrons in diamond; no reference to number of bonds • communicates ideas using simple language and some scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3–4**	• a reasonable explanation but lacking in full detail; terms such as delocalised or non-bonding electrons are used • there may be limited reference to numbers of bonds or movement of electrons • communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5–6**	• a clear explanation is given including all the detail given above • the description clearly links to the numbers of bonds and movement of electrons • communicates ideas clearly and uses a range of scientific terminology appropriately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
5(d)	$C + O_2 \rightarrow CO_2$ correct formulae for both reactants(1) correct formula for product (1)	any incorrect attempt to balance max 1	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(e)	correct shared pairs non-bonding electrons e.g. 	do not penalise inner electrons if correct but max 1 if incorrect non-bonding electrons do not have to be 'paired'	**(2)**

TOTAL: 12 MARKS

Question Number	Answer	Acceptable answers	Mark
6(a)(i)	chlorine more reactive than bromine	chloride ions displace bromide ions	**(1)**

Question Number	Answer	Mark
6(a)(ii)	displacement/redox	**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b)(i)	a description including three of the following in a logical order: sodium floats/moves on water (1) sodium melts/forms into ball (1) sodium disappears/gets smaller (1) fizzing/bubbles formed (1)	accept references to catching fire do not accept references to hydrogen production	**(3)**

Question Number	Answer	Mark
6(b)(ii)	**C**	**(1)**

Question Number		Indicative content	Mark
*6(c) QWC		an explanation including some of the following: **hydrogen chloride** • simple molecules • covalent bonds • weak forces between molecules • molecules easily separated **sodium chloride** • giant lattice • ionic bonds • strong forces between ions • ions not easily separated • more energy is needed to separate the ions than the molecules, therefore the boiling point is higher for ionic compounds	(6)
Level	**0**	No rewardable material	
1	**1-2**	• a basic explanation of the bonding in each compound; reference to covalent and ionic bonds may be missing • a basic explanation of the structure of each compound • a basic reference to the forces within each compound, with no explanation of how these affect boiling points • communicates ideas using simple language and some scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3-4**	• an explanation of the bonding in each compound, with at least one of the compounds correctly identified as covalent or ionic. • an explanation of the structure of each of the compounds is given, with some comparison • reference to the difference in forces within each compound and some reference to the effect this has on the boiling point • communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5-6**	• a clear explanation of bonding in each compound, identifying both correctly as ionic and covalent • a clear explanation of the structure of each compound • an explanation of the forces between the compounds and why these differences affect the boiling points. • communicates ideas clearly and uses a range of scientific terminology appropriately • spelling, punctuation and grammar are used with few errors	

TOTAL: 12 MARKS

