OCR
Oxford Cambridge and RSA

Foundation

GCSE

Chemisty B Twenty First Century Science

J258/04: Depth in Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.
5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions
Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
   - there is nothing written in the answer space.

   Award Zero '0' if:
   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **X** and **X**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry B:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

Question			Answer	Marks	AO element	Guidance
1	(a)		**Any two from:** (in the modern model ……) (atoms) have a nucleus ORA ✓ (atoms) have electrons / have shells (of electrons) ORA ✓ (atoms) contain neutrons / protons ORA ✓ (atoms) include empty space ✓	2	1.1	**ALLOW** reverse argument for M1 M2 and M3 'IT' is the modern model **Allow (1) for** contains (sub-atomic) particles if no particles are named **IGNORE** Dalton's model shows a solid sphere alone (copied from label on diagram)
	(b)		Li/lithium ✓ Has three electrons / electron arrangement is 2.1 / first shell is full and one electron in the second shell ✓	2	2.2	Mark independently **IGNORE** atomic number/proton number of lithium is 3
	(c)	(i)	Contains one carbon (atom) and two oxygen (atoms) / contains three atoms / contains two different types of atom / contains two elements ✓	1	2.1	**DO NOT ALLOW** 'molecule' or 'ion' for 'atom' **IGNORE** has the formula CO_2 alone
		(ii)	Element idea: Dalton's formula is not an element / is a compound / contains (two) different types of atom / contains oxygen (atoms) / chlorine is an element / all atoms should be the same / chlorine contains one type of atom ✓ Number of <u>atoms</u> idea: Dalton's formula has five <u>atoms</u> / has too many <u>atoms</u> / more than 2 <u>atoms</u> / chlorine is <u>diatomic</u> / chlorine (molecules) contain two <u>atoms</u> ✓	2	2.1	NB 'It' is Dalton's formula NB 'Atoms' is needed for M2 **DO NOT ALLOW** 'molecule' or 'ion' or 'electrons' for 'atom' **DO NOT ALLOW** Dalton's formula contains 4/incorrect number of atoms **IGNORE** 'only bonds once'. **IGNORE** chlorine has the formula Cl_2 alone

Question			Answer	Marks	AO element	Guidance
	(d)		polymer molecule of oxygen atom proton electron ✓✓	2	2.1	All correct sequence= 2 marks One in wrong sequence = 1 mark **PO-MAPE**

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	Sample sweets from more than one large box / more than one packet / choose sweets randomly ✓	1	3.3a	**IGNORE** test more than one sweet / test different sweets
		(ii)	To avoid bias / to look for anomalous results/outliers / to check they are all the same / check for consistency / sample represents an overview / represents as many sweets as possible / represents a wide range ✓	1	1.2	**IGNORE** to check all sweets are safe (in the question) / some might be unsafe **IGNORE** represents ALL sweets **IGNORE** reliable / accurate / better quality data / fair test
	(b)	(i)	**First check the answer on answer line** **If answer = 0.7 award 2 marks** shows 3.5 and 5 in working ✓ = 0.7 ✓	2	2.2	**ALLOW 2 marks** for answer= 0.66-0.74 **For (1) mark….** **ALLOW M1** for solvent front distance 5.0-5.6 and spot distance 3.3 – 4.1 **ALLOW** 1 mark for final answer 6.6-7.4 **ALLOW M2** ECF on incorrect measurement of height of spot/solvent front
		(ii)	C and D ✓ Both only give one spot / contain only one colour ✓	2	3.2a	Mark independently **IGNORE** 'do not separate'
		(iii)	B ✓ D ✓	2	3.2b	
		(iv)	The highest spot/one spot/one colour does not match any known safe colours/cannot be identified/is unknown ✓	1	3.2b	**DO NOT ALLOW** more than one spot does not match / they don't match

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>Benefit: MAX TWO from:
Prevent (skin) cancer/skin damage/sunburn ✓
Idea of providing better skin coverage ✓
Idea of not being able to see it on the skin ✓
Nanoparticles could modify existing properties of sun cream to make it more effective ✓

Risks: MAX TWO from:
Nanoparticles are (very) small ✓
Nanoparticles may enter the blood/brain/cells ✓
Unknown idea: (long term) effects of nanoparticles (on health) are unknown / not enough research idea ✓
Benefits outweigh risks ✓</td><td>3</td><td>1.1</td><td>IGNORE nanoparticles block harmful radiation (in the question)

IGNORE large surface to volume ratio
IGNORE absorbed by the body/skin
IGNORE you might / you could / potentially etc alone. Look for idea of <u>unknown / not enough research</u></td></tr>
<tr><td></td><td>(b)</td><td></td><td>.
<table><tr><th></th><th>True</th><th>False</th></tr><tr><td>Fullerenes and graphite are examples of nanoparticles.</td><td></td><td>✓</td></tr><tr><td>Nanoparticles are usually larger than atoms.</td><td>✓</td><td></td></tr><tr><td>Nanoparticles have a large volume compared to their surface area.</td><td></td><td>✓</td></tr><tr><td>The properties of nanoparticles are related to their sizes and shapes.</td><td>✓</td><td></td></tr></table>✓✓</td><td>2</td><td>1.1</td><td>Four correct = 2 marks
Two or three correct = 1 mark</td></tr>
</table>

	(c)		D A B C ✓✓	**2**	**1.2**	Largest is D and smallest is C = 1 mark A larger than B = 1 mark **ALLOW** numbers in correct order 8.9×10^{-9} 8.2×10^{-9} 2.1×10^{-9} 9.1×10^{-10}
	(d)	**(i)**	10 000 000 x ✓	**1**	**2.2**	
		(ii)	**First check the answer on answer line** **If answer = 9.3 (cm^3) award 2 marks** **Volume** 2.1 x 2.1 x 2.1 = 9.261 (cm^3)✓ = 9.3 (to 1dp) ✓	**2** **2.2** **1.2**		 **ALLOW** (1) for 9.3×10^x ($9.261 \times 10^x = 0$)
		(iii)	**First check the answer on answer line** **If answer = 26.46 (cm^2) award 2 marks** (2.1 x 2.1) x 6 ✓ = 26.46 / 26.5 ✓	**2**	**2.2**	 **IGNORE** any standard form added to working for M1 only

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	arrow upwards starts and ends in correct place ✓	1	1.2	**ALLOW** line with or without marks at either end. **ALLOW** double headed arrow **DO NOT ALLOW** arrow downwards. **DO NOT ALLOW** arrows with clear 'gap at the top or which do not align with reactants at the bottom by eye
		(ii)	(minimum) energy needed/taken in (to start a reaction) ✓ to break bonds (between atoms) ✓	2	1.1	**IGNORE** 'energy for a reaction/to cause a reaction' look for idea of needed/required/taken in **ALLOW** break bonds 'in molecules' but **IGNORE** to break bonds between molecules **DO NOT ALLOW** to make and break bonds
		(iii)	faster reaction / rate increases AW ✓ because it lowers the activation energy / less energy needed to start the reaction ✓	2	1.2	 **IGNORE** provides a different pathway / is not used up
	(b)		**First check the answer on final answer line** **If answer = 482 (kJ) award 3 marks** (436 x 2)+498 = 1370 (kJ) ✓ 463x4 = 1852 (kJ) ✓ (1370-1852) = (-) 482 (kJ) ✓	3	2.2	 **ALLOW ECF** for final mark Sign (-) not needed but if present must be correct.

	(c)		**Advantages** reaction produces only water / no harmful emissions / no named harmful emission e.g. carbon dioxide/carbon monoxide/hydrocarbons/greenhouse gases ✓ produces a lot of energy ✓ **Disadvantages** hydrogen (and oxygen) is difficult to store / takes a lot of space / needs to be stored under pressure ✓ high flammability causes a risk (to the shuttle) / risk of explosion AW ✓	**3**	**3.1b**	**IGNORE** no pollution **IGNORE** use water for drinking **ALLOW** (for additional mark) fuel cell is lighter/more reliable/no moving parts (compared to combustion engine) **IGNORE** renewable/non renewable arguments **IGNORE** arguments about making of hydrogen e.g. needs electricity **IGNORE** 'it is flammable' alone (all fuels are) **IGNORE** it is dangerous/hazardous alone

Question			Answer	Marks	AO element	Guidance
5*			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Describes a method, including apparatus, a control variable/measurement and a predicted result. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes a basic method with some fine details of apparatus, controls, measurements and/or expected results *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Makes a statement to describe at least one aspect of the method or expected results *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **0 marks** *No response or no response worthy of credit.*	6	2.2	**Applies knowledge and understanding of how to investigate a chemical reaction to determine whether it is endothermic or exothermic** **METHOD** **basic method** • add solids to water and measure temperature **measuring equipment:** • thermometer/device to measure temperature • measuring cylinder to measure volume / balance to measure mass **measurements and control variables** • control/use the same volume of water / quotes a volume • control/use the same mass of solid/ quotes a mass • record temperature of water before and after adding solids/after fixed time **EXPECTED RESULTS** • temperature (of solution) increases for calcium chloride and decreases for ammonium chloride • quotes predicted values of temperature at the end of the experiment for calcium chloride and ammonium chloride Methods including external heating limits to Level 1 (no basic workable method) **ALLOW** 'amounts' for mass/volume in description for L1 1 mark Errors e.g. measurement of solids by volume compromise the relevance of the information at Levels 2 and 3

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td>(i)</td><td>Ring around <u>both</u> COOH groups in monomer 1✓

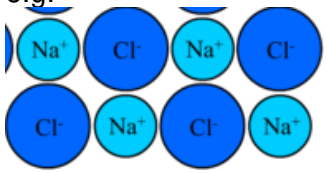
Ring around <u>both</u> NH_2 groups in monomer 2 ✓</td><td>2</td><td>2.2</td><td>DO NOT ALLOW if any C atom on main chain is within circle for either marking point.
DO NOT ALLOW two rings used to circle C=O and O-H

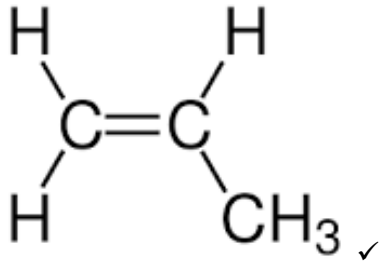
ALLOW (1) for <u>one</u> functional group correctly circled in both monomers</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>The functional groups join the monomers together (at both ends) ✓</td><td>1</td><td>1.1</td><td>IGNORE the functional groups ‘react’ alone / react to form polymers
IGNORE so that they can react to form water</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>2 ✓</td><td>1</td><td>3.1a</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>water and H_2O ✓</td><td>1</td><td>1.2</td><td>IGNORE numbers in front of formula e.g. $2H_2O$</td></tr>
<tr><td></td><td>(c)</td><td></td><td><table><tr><th></th><th>True</th><th>False</th></tr><tr><td>DNA forms a polymer from four different monomers.</td><td>✓</td><td></td></tr><tr><td>Sugars and amino acids are monomers of naturally occurring polymers.</td><td>✓</td><td></td></tr></table>✓</td><td>1</td><td>1.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	C_2H_5 ✓	1	1.2	
		(ii)	States that formula contains 4 C atoms / states that n=4 ✓ Shows (2n+2) or (2x4+2) or (8+2) = 10 ✓	2	1.2	**ALLOW** M1 for the molecular formula C_4H_{10}
		(iii)	Alkanes ✓	1	1.1	
	(b)	(i)	C_5H_{12} / C_6H_{14} / C_7H_{16} / C_8H_{18} / C_9H_{20} ✓	1	2.2	**ALLOW** alkenes between C_5 and C_9
		(ii)	$C_{20}H_{42}$ ✓	1	2.2	**ALLOW** $C_{20}H_{40}$
	(c)		Boiling point increases as molecules get larger/longer chains/number of carbon atoms increases /as mass of molecules increases ✓ Intermolecular forces increase/become stronger/need more energy to break (as size of molecules increase) / more intermolecular forces ✓	2	2.2	NB 'They' = boiling points **IGNORE** down the table **IGNORE** melting points **ALLOW** wording 'boiling point increases *with* size of molecules etc. **DO NOT ALLOW** 'proportional' **IGNORE** 'correlation' **IGNORE** intermolecular forces need a <u>higher temperature</u> to break **IGNORE** 'bonds get stronger' but **DO NOT ALLOW** 'bonds between carbon atoms / bonds between carbon and hydrogen atoms get stronger **DO NOT ALLOW** intermolecular forces between carbons/between <u>atoms/ions</u> **DO NOT ALLOW** references to incorrect structures e.g. ionic/giant covalent
	(d)		Hydrocarbons are feedstocks for the petrochemical industry ✓ There is not a large enough supply of renewable energy sources to meet the needs of modern life ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
8	(a)		100(%) ✓ only one product / no additional product / no byproduct / mass of the (useful) product is the same as the (total) mass of the reactants / RFM of the product is the same as the RFM of the reactants ✓	2	2.1	**IGNORE** same 'amount' of products as reactants **IGNORE** conservation of mass e.g. no atoms are lost / both sides have same mass / same (total) RFM **IGNORE** equilibrium **ALLOW** 34 ÷34 x 100 = 100 %
	(b)		the reaction is reversible / is an equilibrium reaction / ammonia reacts to reform nitrogen and hydrogen ✓	1	1.1	**IGNORE** incomplete reaction / reaction has not finished / needs more time / impure reactants
	(c)		Less feedstock is used ✓ The overall yield increases ✓	2	2.1	

	(d)*		Refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Discusses the effect of a change in at least <u>two</u> conditions on <u>both</u> yield and rate **AND** makes a judgement about a disadvantage. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Discusses the correct effect of a <u>change</u> in condition on yield <u>and</u> on rate. **OR** discusses the effect of <u>two</u> conditions on yield or rate *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Makes a statement linking a condition to either yield or rate. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **0 marks** *No response or no response worthy of credit.*	**6**	**2 x 2.2** **2 x 3.1a** **2 x 3.2b**	**3.1a Interprets information to discuss yield** • A <u>higher</u> pressure increases yield/more ammonia/moves equilibrium to the right/favours forward reaction • A <u>higher</u> temperature decreases yield • catalyst does not affect yield • Yield at 450°C and 200 atm is (approx.) 35 % **IGNORE** yield values given for other conditions **2.2 Applies knowledge to discuss rates** • (finely powdered) catalyst/iron increases rate • <u>higher</u> temperature increases rate • <u>higher</u> pressure increases rate **3.2a Makes judgements about disadvantages of higher pressure/temperature** • expresses idea of compromise between higher yield <u>and</u> a higher rate • high pressures are dangerous/difficult to maintain/require specialised equipment/need large amounts of energy to maintain • high temperatures use a lot of energy/fuel • reaction (too) slow at low temperature • yield is (too) low at low pressure **IGNORE** explanations e.g. activation energy, particle collision theory, number of moles of gas, energy change of reaction etc Incorrect statements about yield or rate compromise the relevance of the information at catalyst affects yield **IGNORE** high pressures are expensive alone

Question			Answer	Marks	AO element	Guidance
9	(a)		at least 4 sodium ions and 4 chloride ions shown in 1:1 ratio ✓ ions alternate both horizontally and vertically ✓	2	2.2	e.g.  **ALLOW** 1:1 ratio of ions shown in larger structure Na^+ and Cl^- must be labelled **ALLOW** gaps between ions
	(b)		**Any two from:** Charges: Calcium (ion) has a +2 charge (and sodium (ion) has a +1 charge) ✓ Ratio on the diagram: sodium chloride has a 1:1 ratio of sodium to chloride ions / same number of sodium and chloride ions ✓ Difference: calcium chloride has two chloride ions (to every calcium ion) / ratio of chlorine to calcium is 2:1 ✓	2	2.2	**Maximum 1 mark** for reference to molecules/implication of covalent/molecular e.g. 'diatomic' **IGNORE** calcium is in Group 2 / loses 2 electrons **ALLOW** 'chlorine atoms' or 'chlorines' **IGNORE** 'the diagram only has one chloride ion' **IGNORE** 'calcium forms two bonds with chlorine'

	(c)	**(i)**	four electrons shared in double bond / double bond carbon atoms share two electrons from each ✓ two electrons shared in a single bond / one electron shared from each carbon ✓	**2**	**1.1**	For 2 marks answer must include the word 'shared' e.g. '4 electrons in double bond' is 1 mark '4 electrons in double bond, 2 electrons in a single bond' =1
		(ii)	 ✓	**1**	**1.2**	Methyl group does not need to be fully displayed. All other bonds must be shown.

Question			Answer	Marks	AO element	Guidance
10	(a)		**Any two pairs from:** Rinse the burette with acid before filling ✓ to ensure there is no water/other contaminants in burette ✓ Use a (volumetric) pipette/measuring cylinder to measure the NaOH ✓ so that the volume/the measurement is more accurate/precise ✓ Add the acid slowly/dropwise ✓ see the exact point of colour change / exact endpoint / see point when reaction has finished / to avoid adding too much / to add minimum acid needed / exactly how much acid needed (for neutralisation) ✓ Stop adding when indicator has just changed ✓ see the exact point of colour change / exact endpoint / see point when reaction has finished / to avoid adding too much / to add minimum acid needed exactly how much acid needed (for neutralisation) ✓ Use a white tile ✓ To see the colour change ✓ Use an acid-base indicator e.g. methyl orange/litmus/phenolphthalein✓ to see a sharp colour change✓ Use a conical flask ✓ so solution can be swirled without spilling / prevent solution splashing out ✓ Swirl/shake/stir mixture ✓ to ensure acid and hydroxide <u>fully</u> mix/react/to check if colour change is permanent / to make sure reaction has finished ✓	4	3.3b	**IGNORE** repeats **IGNORE** lower the burette **IGNORE** references to 'faster' throughout **IGNORE** 'IT is more accurate' alone **ALLOW** more accurate reading/result/volume/value/amount etc. **IGNORE** 'to mix the acid and sodium hydroxide' alone **ALLOW** (fully) evenly distributed

Question			Answer		Marks	AO element	Guidance
	(b)		**(2 marks)** when the concentration of acid doubles the volume needed is halved / volume needed is inversely proportional to the concentration ✓✓ **(1 mark)** when the concentration of acid increases the volume needed decreases ✓	**2**	**3.1a**		**IGNORE** references to correlation **IGNORE** data quoted alone
	(c)	**(i)**	0.05 ✓	**1**	**3.2b**		
		(ii)	The equation shows a 1:1 ratio of HCl:NaOH / one (mole of) HCl reacts with one (mole of) NaOH ✓ The sodium hydroxide has the <u>same concentration</u> as the acid ✓	**2**	**2.2**		**IGNORE** 25.0cm^3 is almost the same as 25.1 cm^3 alone **ALLOW 2 marks for** no. mol HCl (=no mols NaOH) (added from burette) = 0.00125 ✓ conc NaOH = n/V =0.00125/0.025 = 0.05 ✓ **OR** mol HCl (=no mols NaOH) (added from burette) = 0.00125 ✓ mol NaOH= cV =0.025 x 0.05=0.00125 ✓

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