

GCSE (9-1)

Chemistry B (Twenty First Century)

Unit **J258H/04**: Higher Tier – Depth in chemistry

General Certificate of Secondary Education

Mark Scheme for June 2018

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


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.

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Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

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

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)	(to identify alkene) add bromine (water) ✓ (to identify acid) add indicator/ any named indicator / a carbonate ✓ result for alkene: bromine goes (from orange to) colourless <u>and</u> result for acid: turns indicator paper red / gives pH less than 7 with UI or pH probe / fizzes with carbonate (and remaining compound is neither) ✓	3	1.2 2x 2.1	IGNORE additional reagents ALLOW yellow/orange colour / low pH ALLOW phenolphthalein goes (purple or pink to) colourless	
	(b)	(i)	quotes both 1.7 and 4.0 (mol/dm ³) in answer ✓ uses 'greater than or equal to' (1.7) and 'less than' (4.0) ✓	2	2x 2.2	ALLOW 1.7 and 3.9 ALLOW 3.9 for 'less than 4.0' IGNORE use of symbols
	(b)	(ii)	5(.0) or higher / quotes value ✓	1	2.2	IGNORE units
	(b)	(iii)	Any three from: gloves / goggles / safety screen ✓ identifies mixture hazard as flammable ✓ identifies mixture hazard as corrosive ✓ additional detail: mix chemicals <u>before</u> lighting any flame / use a water bath or electric heater / do not heat with a naked flame / avoid contact with skin or eyes / wash any splashes (immediately) ✓	3	3x 3.3a	ALLOW it will catch fire ALLOW it will burn <u>you</u> or burn <u>skin/eyes</u> ALLOW 'protect skin/eyes'

Question		Answer	Marks	AO element	Guidance
2	(a)	4 ✓	1	2.1	
	(b)	they were not yet discovered / he didn't know about them ✓	1	2.1	
	(c)	In any order: Cu Zn Cr ✓✓	2	2x 2.1	ALLOW names IGNORE Fe Co Ni DO NOT ALLOW any other additional elements (apply list principle) All three correct = 2 marks Two or one correct = 1 mark
	(d)	They act as catalysts in reactions ✓	1	1.1	
	(e) (i)	(adds UI to the acid/drops acid on paper AND) looks at (red/yellow/orange) colour ✓ compares colour to chart ✓	2	2x 1.2	
	(e) (ii)	some salts have similar pH / all have pH of 3 or 4 / copper sulfate and iron sulfate have the same pH / zinc sulfate and nickel sulfate have the same pH / pH values are only to whole numbers ✓ use a pH probe / use full range indicator paper ✓	2	2x 3.3.b	

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	Stage 2 / distillation ✓ water evaporates / becomes a vapour/gas (and then condenses) ✓ salt is left behind ✓	3	3x 1.2	ALLOW boils ALLOW for 'distillation separates soluble substances and water/a solvent' ✓
		(ii)	(distillation uses) high temperatures/heat/100°C ✓ bacteria are killed/die ✓	2	2x 1.2	ALLOW 'boiling' IGNORE 'remove' bacteria ALLOW bacteria left behind with salt / do not evaporate
		(iii)	to kill bacteria / idea that bacteria may enter water later / keep water free of bacteria ✓	1	1.1	ALLOW microbes / micro-organisms / pathogens for bacteria

Question		Answer	Marks	AO element	Guidance
4	(a)	fluorine protons: 9 neutrons : 10 group: 7 / 17	3	3 x 2.1	All 4 correct = ✓ ✓ ✓ ✓ 3 correct = ✓ ✓ 1 or 2 correct = ✓
	(b)	(i)	2	2.1 1.1	ALLOW '-' IGNORE 'negative' ALLOW M2 for idea of gaining electrons, even if M1 is not awarded. ALLOW 'has (one) more electron than protons'
		(ii)	1	1.1	
		the atoms both have 7 electrons in the <u>outer shell</u> / both atoms have the same number of electrons in the <u>outer shell</u> / both need one electron to give a full <u>outer shell</u> ✓			

Question		Answer	Marks	AO element	Guidance
5	(a)	<p>Similarities: both contain covalent bonds ✓</p> <p>(which form from) shared electrons / both have 4 bonds around the carbon atom ✓</p>	2	2x 1.1	<p>DO NOT ALLOW MP1 for <u>both</u> have single covalent bonds/<u>both</u> have double covalent bonds NOT intermolecular forces</p> <p>IGNORE structure</p>
	(b)	<p>diamond has a giant structure/every atom is bonded to 4 others / carbon dioxide contains simple molecules/small molecules/simple covalent structure ✓</p> <p>(all) bonds in diamond are strong / need a lot of energy/high temperatures to break bonds ✓</p> <p>(intermolecular) forces/<u>intermolecular</u> bonds between carbon dioxide molecules are weak/do not need a lot of energy to break ✓</p>	3	3x 1.1	<p>DO NOT ALLOW ionic (this statement contradicts MP1)</p> <p>DO NOT ALLOW intermolecular forces linked to diamond (this statement contradicts MP2)</p> <p>DO NOT ALLOW bonds in carbon dioxide are weak (this statement contradicts MP3)</p>
	(c)	<p>diamond and graphite are both elements / both contain <u>only</u> carbon / are pure carbon / contain all the same atoms ✓</p> <p>carbon dioxide is a compound / contains (carbon and) oxygen / contains different atoms ✓</p>	2	2x 1.1	

Question		Answer	Marks	AO element	Guidance
6	(a)	alkenes have a (C=C) double bond / needs a double bond ✓ (methene would have) one carbon atom / would be CH ₂ / meth indicates one carbon atom / does not have enough carbon atoms / needs two carbon atoms ✓	2	2 x 2.1	
	(b)	(i) increase by CH ₂ each time / all have same <u>general</u> formula / all have formula C _n H _{2n} / all have twice as many hydrogen (atoms) as carbon (atoms) ✓	1	2.1	IGNORE all have similar formulae / same empirical formula
		(ii) For two marks: (numbers) for alkenes hydrogen atoms are <u>twice</u> number of carbon atoms but for alkanes it is not / alkanes have two extra hydrogens for each carbon ORA / general formula for alkenes is C _n H _{2n} <u>and</u> general formula for alkanes is C _n H _{2n+2} ✓ ✓ For one mark: (general comment) have a different number of hydrogen (atoms) per carbon (atom) / same number of carbon (atoms) but different numbers of hydrogen (atoms) / ratio of carbon atoms to hydrogen atoms is different / different general formula ✓	2	2 x 2.1	ALLOW 'amount' for 'number' Need <u>both</u> general formulae for (2) marks IGNORE one general formula IGNORE empirical formula IGNORE 'have a different number of hydrogen atoms' alone ALLOW 'alkanes have (C-C) single bonds <u>and</u> alkenes have (C=C) double bonds for 1 mark only. IGNORE saturated/unsaturated
	(c)	C ₅₀ H ₁₀₂ ✓	1	2.1	

Question		Answer	Marks	AO element	Guidance
	(d) (i)	$\text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O} \checkmark$ <p>Reasoning: n is 4 / n gives 4CO_2 and $4\text{H}_2\text{O} \checkmark$ $(1.5n =) 1.5 \times 4 = 6 (\text{O}_2) \checkmark$</p>	3	3 x 2.1	
	(ii)	Alkanes have (two) more hydrogen atoms / alkanes produce more water / alkanes need more oxygen to burn ✓	1	2.1	ALLOW 'different number of hydrogens'

Question		Answer	Marks	AO element	Guidance
7	(a)*	<p><i>Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.</i></p> <p>Level 3 (5–6 marks) Identifies element(s) present and not present, explains reasons and describes further experiments</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Identifies element(s) present <u>and</u> not present, and explains reasons</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Identifies element(s) present <u>and</u> not present.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	4x 3.2b 2x 3.3a	<p>AO3.2b Analyses information and ideas to draw conclusions and identify elements in salt</p> <ul style="list-style-type: none"> • Present: sodium, potassium and unknown(s) • Not present: lithium, rubidium <p>IGNORE elements incorrectly identified as present or not present at L1 and L2 only</p> <p>AO3.2b Analyses information and ideas to draw conclusions and explains how they identified elements in salt</p> <ul style="list-style-type: none"> • For elements present lines are in same pattern / position / spectra ‘match’ or ‘fit’. • Absent elements there is no match/(only) partial match. • Unknown elements: some lines do not match elements given <p>AO3.3a Analyses information and ideas to make judgements to describe what further experiments are needed</p> <ul style="list-style-type: none"> • Need to find spectra for other elements • Need to match new spectra to spectrum of salt idea • Add sodium hydroxide to test for metal cations / add silver nitrate to test for chlorides / add barium salt to test for sulfate / add acid to test for carbonate / <u>ion</u> chromatography <p>IGNORE elements incorrectly identified as present or not present at L1 and L2 only</p>

Question		Answer	Marks	AO element	Guidance
	(b)	Qualitative techniques / spectroscopy used to identify which elements/'what' are present / shows sodium is present ✓ Qualitative techniques/spectroscopy do not say how much of each element is present ✓	2	2x 2.2	

Question		Answer	Marks	AO element	Guidance	
8	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 8.1 (g) award 3 marks</p> <p>calculates mass of magnesium oxide = 40.3 g ✓</p> <p>40.3 (or ECF) x 0.2 = 8.06 (g) ✓</p> <p>= 8.1 (g) (answer correctly rounded to 1 decimal place) ✓</p>	3	2.2 2.2 1.2	If other mass is used in place 40.3 allow ECF if working is otherwise correct. DO NOT ALLOW ECF from an incorrect method.	
	(b)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 6.77 / 6.73 (g) award 4 marks</p> <p>Works out number of moles of copper oxide = 0.05 / shows 4.0 / 79.5 in working ✓</p> <p>M1 x 134.5 ✓</p> <p>= 6.767295597484277 (g) ✓</p> <p>= 6.77 (g) (2 decimal places) ✓</p>	4	2.2 2.2 2.2 1.2	If other mass is used in place of 79.5 or 134.5 allow ECF if working is otherwise correct. DO NOT ALLOW ECF from an incorrect method. M3 ALLOW 6.725 g (calculated by using 0.05) M4 ALLOW 6.73 g rounded from 6.725	
	(c)	(i)	actual yield low(er) ✓	1	2.2	IGNORE less than 100%/less than theoretical yield
		(ii)	use more acid / higher volume of acid / more concentrated acid ✓	1	3.3b	ALLOW use less copper oxide IGNORE 'dilute'

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.3 (cm³/s) award 3 marks</p> <p>Uses 20 (s) in working ✓</p> <p>Uses 26 (cm³) in working ✓</p> <p>26 ÷ 20 = 1.3 (cm³/s) ✓</p>	3	3x 2.2	<p>Allow values correctly read not at 20s e.g. at 10s giving 13 cm³</p> <p>M3 Allow ECF for volume ÷ time</p> <p>ALLOW $\Delta y/\Delta x$ for (1)</p>
		(ii)	Ruler drawn straight tangent, both sides of line above curve, centre touches curve at 60s ✓	1	2.2	
		(iii)	<p>Rate of reaction has slowed down ✓</p> <p>Tangent at 0 is steeper / tangent at 60s is less steep / gradient is less ✓</p>	2	3.1a 2.2	IGNORE it levels out
	(b)	(i)	<p>yes because) Any 2 from: rate is proportional to concentration ✓</p> <p>straight line <u>with a positive gradient</u> / straight line <u>through the origin</u> ✓</p> <p>as concentration doubles, rate doubles ORA ✓</p>	2	1.1 2.2	<p>ALLOW MP1 rate = k x concentration (1)</p> <p>IGNORE 'correlation'</p> <p>ALLOW answers which use values from the graph to show that the ratio of rate:concentration is constant</p>

Question		Answer	Marks	AO element	Guidance
	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3.6 (cm³/s) award 2 marks Quotes rate and concentration values from graph e.g. 1.2 at 1.0 or 1.8 at 1.5 or 2.4 at 2.0 ✓ = 3.6 (cm ³ /s) ✓	2	2x 2.2	ALLOW +/-0.05 ALLOW 3.4-3.8

Question		Answer	Marks	AO element	Guidance
10	(a)*	<p><i>Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.</i></p> <p>Level 3 (5–6 marks) States and explains differences in the information and fully discusses how the information supports PET bottles in terms of energy, emissions and waste.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) States and explains a difference in the information and how the information supports PET bottles in terms of energy, emissions and waste.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) States that the information supports the use of PET bottles. OR Uses the information to state a similarity or difference between the companies.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	3 x 3.1b 3 x 3.2a	<p>AO3.2a Analyses information and ideas to make judgements about information from both companies</p> <ul style="list-style-type: none"> • both show that PET bottles use least energy • both show that PET bottles produce lowest mass/amount of waste • both show that PET bottles produce less (CO₂) emissions <p>AO3.1b Analyses information and ideas to evaluate the differences from each company Company 2 information is about materials, not actual objects</p> <ul style="list-style-type: none"> • Company 2 charts do not give volume of waste • measurements for company one are per 1000 litres of drinks and for company 2 it is over a year • company 2 includes paper • company 2 shows other materials all together / company one data is for individual materials • cannot be sure that values from company 1 give same percentages as company 2 / cannot check percentages • units used for mass are different

Question		Answer	Marks	AO element	Guidance
	(b)	Less litter / less waste / less transport of bottles / more are recycled ✓	1	1.1	IGNORE less harm to the environment alone IGNORE reused
	(c)	non-biodegradable materials do not rot/break down/decompose / non-biodegradable materials cause a <u>long term</u> problem / take up space in landfill ✓	1	1.1	

Question		Answer			Marks	AO element	Guidance	
11	(a)		True	False	2	2x 1.1	All correct = 2 3/2 correct = 1 1 correct = 0	
		Nitrogen oxides form in an oxidation reaction.	✓					
		Nitrogen oxides come from impurities in the coal.		✓				
		Nitrogen oxides are acidic oxides.	✓					
		Ammonia is an example of a nitrogen oxide.		✓				
	(b)	(i)	<p>Any two from: The highest daily concentration has fallen by more than 50 % / supports the statement ✓ The mean concentration has fallen by approx 50% ✓ The lowest daily concentration has not fallen by 50%/by a small amount / does not support the statements / there is a large variation in the data over time ✓ MP3: Quotes one 1980 value and one 2012 value to support their statements ✓</p>			3	3 x 3.1b	<p>ALLOW</p> <p>ALLOW the mean concentration has fallen by (about) 50%</p> <p>e.g. 190 to 60 / 120 to 50 / 60 to 40 All values +/-5 IGNORE data linked to incorrect statements</p>
		(ii)	6.0 x 10 ⁻⁵ mg/cm ³ ✓			1	2.2	
	(c)		<p>Any two from: Spread monitoring stations evenly / randomly ✓ In towns ✓ In countryside / away from towns / away from roads ✓ Near roads ✓ Near industry ✓</p>			2	2 x 1.2	IGNORE power stations

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