Oxford Cambridge and RSA

H

GCSE (9–1)

Chemisty B (Twenty First Century Science)

J258/03: Breadth in Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for November 2020

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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
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

1. 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

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2. 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.

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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.

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Question			Answer	Marks	AO element	Guidance
1	(a)		An acid is reacting with an alkali (to form a salt plus water) / AW ✓	1	1.2	**ALLOW** the reaction between acid and a base
	(b)	(i)	an indicator ✓ changes colour ✓	2	1.2	**ALLOW** named acid-base indicator **IGNORE** details of any quoted colour change
		(ii)	Take readings at eye level / take readings from (bottom of) meniscus / make sure no air in burette / add (the NaOH) drop by drop ✓	1	3.3b	**ALLOW** AW for any of the points **ALLOW** repeat and look for a similar value ;
	(c)	(i)	(25.80 – 0.90) = 24.9(0) ✓	1	2.2	
		(ii)	24.95 not used/is an outlier ✓ Mean = (24.55 + 24.65 =24.6)÷3 = 24.6(0) ✓	2	3.2a 1.2	 **ALLOW** Mean = (24.55 + 24.65)/2 = 24.6(0) **ALLOW 1 mark for** correct calculation of a mean using all 4 values (= 24.7 / 24.6875)
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.0037 or 3.7×10^{-3} (g) award 4 marks** Rearrange to mass of acid = 0.0908 ÷ volume of acid ✓ = 0.0908 ÷ 24.6 ✓ = 0.00369.... (g) ✓ = 0.0037 or 3.7 x 10^{-3} (g) (2sf) ✓	4	 1.2 2 × 2.2 1.2	 **ALLOW** rearrangement mark if it is clear that 0.0908 is being divided by a volume, even if volume is incorrect. **ALLOW ECF** if incorrect volume is calculated in (ii) and used in (iii) **ALLOW** sf mark on incorrect calculation

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Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	When the fizzing stops ✓	1	3.3a	
		(ii)	(broken-up tablet) greater surface area (of solid) (AW) ✓ more solid particles can react (in the same time) / more (successful / frequent) collisions ✓	2	1.1	
	(b)		Particles gain activation energy (AW) / frequency of collisions is greater / more successful collisions ✓	1	1.1	
	(c)	(i)	(the fizz means) a gas is being given off/made / carbon dioxide is being given off/made ✓	1	2.2	
		(ii)	Gradient/slope decreasing ✓	1	2.2	**ALLOW** idea that the curve is less steep (as time increases) **IGNORE** time increases and mass decreases
		(iii)	(Rate of reaction decreases as): number of (reactant) particles decreases / particles further apart ✓	1	2.2	**ALLOW** reactants/tablet/water used up **IGNORE** particles have less energy

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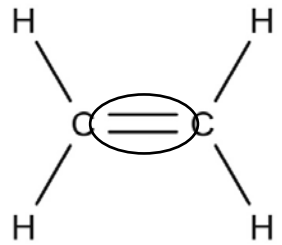
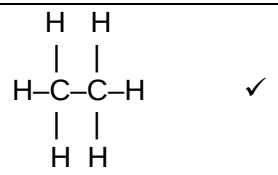
Question			Answer	Marks	AO element	Guidance
3	(a)		Ring around C=C ✓ 	1	2.1	**ALLOW** carbon atoms in the ring **DO NOT ALLOW** hydrogen atoms in the ring.
	(b)		2.4×10^{24} ✓	1	2.2	
	(c)	(i)	bromine ✓	1	1.2	**IGNORE** any state **DO NOT ALLOW** bromide
		(ii)	 ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	Temperature increases (quickly at first and more slowly later) ✓	1	3.1a	**ALLOW** temperature increases
		(ii)	1993 – 2017 / any two consecutive years between 2011 to 2017 ✓	1	3.2b	**ALLOW** +/- 1 year **ALLOW** from 2011 to 2017 +/- 1 year
	(b)	(i)	(Amaya is incorrect because) Any **two** from: CO_2 is in whole (lower) atmosphere / not a 'layer' (AW) ✓ CO_2/gases in the atmosphere absorb IR ✓ CO_2/gases in the atmosphere re-emits IR ✓	2	3.1b	**ALLOW** CO_2 doesn't reflect IR
		(ii)	Any **one** from: Drive fewer cars ✓ more efficient cars / plant trees ✓ don't cut trees down ✓ change from non-renewables to renewables ✓ burn less fossil fuels ✓	1	1.1	**ALLOW** use electric cars/hydrogen as a fuel
	(c)		Any **one** from: fewer places where crops can be grown ✓ extreme weather patterns ✓ named change to climate ✓ melting of polar ice ✓ rising sea levels ✓ flooding of low land ✓	1	1.1	

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Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	Wire ✓ (place) sample in (Bunsen) flame ✓ Blue/colourless flame must be used ✓	3	1.2	**ALLOW** splint
		(ii)	purple/violet/mauve/lilac ✓	1	1.2	**ALLOW** blue-purple etc but not 'blue' alone
	(b)		$BaCl_2(aq) + K_2SO_4(aq) \rightarrow BaSO_4(s) + 2KCl(aq)$ Species of products ✓ balancing ✓ state symbols ✓	3	2.2	If no marks **ALLOW (1)** for 1 correct product or one (s) product shown
	(c)	(i)	(Fertiliser E) contains potassium / potassium and other metal(s) ✓	1	3.2b	**ALLOW** Fertiliser E contains potassium sulfate
		(ii)	Sensitivity / accuracy / speed / AW / don't have to judge colours ✓	1	1.1	**ALLOW** can give quantitative information

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Question			Answer	Marks	AO element	Guidance
6	(a)		(Jane wrong) (nail X will rust because) air/oxygen is present (dissolved in the water) ✓ (Ben correct) (nail Y will not rust because) zinc is more reactive than iron ✓	2	3.1b	**ALLOW** idea that zinc is a sacrificial metal **IGNORE** idea that zinc stops rusting because it is wrapped around the iron alone
	(b)	(i)	Fe ✓	1	3.2b	
		(ii)	It (iron) loses electrons ✓	1	1.1	**ALLOW** oxygen is gained
	(c)		Iron(III) hydroxide ✓	1	1.1	

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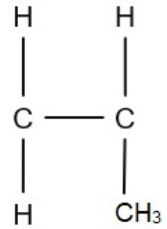
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)</td><td>CH_2 ✓</td><td>1</td><td>2.2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td> 
No double bond seen in structure ✓

(No double bond and) rest of structure correct ✓</td><td>2</td><td>2.2</td><td>ALLOW CH_3 drawn as a displayed formula
ALLOW CH_3 in any position</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Any one from:
hot liquids are at a lower temperature than the melting point of poly(propene)/aluminium ✓
idea that the melting point of aluminium/poly(propene) is above the boiling point of water ✓</td><td>1</td><td>3.1b</td><td>IGNORE yes/no
ALLOW polymers soften below their melting point
IGNORE aluminium has a higher melting point than polypropene</td></tr>
<tr><td></td><td>(c)</td><td></td><td>
<table>
<tr><th></th><th>True</th><th>False</th></tr>
<tr><td>When monomers form condensation polymers, a small molecule is also formed.</td><td>✓</td><td></td></tr>
<tr><td>DNA is a polymer formed from nucleotides.</td><td>✓</td><td></td></tr>
<tr><td>To make a condensation polymer, each monomer needs only one functional group.</td><td></td><td>✓</td></tr>
</table>
</td><td>3</td><td>1.1x2

2.1</td><td></td></tr>
</table>

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>8</td><td>(a)</td><td></td><td>(In graphite) bonds/links/attractions between the layers are weak ✓

(In graphite) so layers can separate/slide over each other AW ✓

all diamond atoms held by strong bonds ✓</td><td>3</td><td>2.1</td><td>ALLOW intermolecular forces between layers in graphite

DO NOT ALLOW intermolecular forces in diamond</td></tr>
<tr><td></td><td>(b)</td><td></td><td>(giant) ionic (structure) ✓</td><td>1</td><td>1.1</td><td>ALLOW ‘ionic lattice’ or ‘ionic’ or ‘regular ionic’
IGNORE ‘bonding’</td></tr>
<tr><td></td><td>(c)</td><td></td><td><table><tr><td></td><td>Graphite</td><td>Sodium Chloride</td></tr><tr><td>(Conducts when)</td><td>(Solid)</td><td>(either molten or) in aqueous/solution ✓</td></tr><tr><td>(Particles that conduct are)</td><td>electrons ✓</td><td>ions ✓</td></tr></table></td><td>3</td><td>1.1</td><td>IGNORE (Sodium chloride conducts when) liquid</td></tr>
</table>

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Question			Answer	Marks	AO element	Guidance
9	(a)		Rate of forward reaction = rate of back reaction (AW) ✓	1	1.2	**ALLOW** 'they are the same'
	(b)	(i)	Temperature = 350 °C and Pressure = 1.5 (MPa) ✓	1	2.2	**ALLOW** pressure between 1.3 and 1.6MPa
		(ii)	Reaction is slow / rate of reaction low ✓	1	2.2	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 68 (tonnes) award 3 marks** RFM of NH_3 = 14 + 3 = 17 ✓ Shows mole ratio is 3:2 OR correctly converts g to tonnes ✓ Mass of NH_3 = 17 x 2/3 x ($6x10^6$) = $68x10^6$g = 68 tonnes ✓	3	2.2	**ALLOW ECF** from incorrect RFM for max 2
	(c)		filter ✓ wash (with water) (and dry) ✓	2	1.2	
	(d)		(Compound fertilisers) contain other elements / K / P (that act as fertilisers) ✓	1	2.1	

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Question			Answer	Marks	AO element	Guidance
10	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5.1 (g) award 3 marks** Shows in working (1 ÷ 6.9) **OR** 71 and 13.8 **OR** 35.5 and 6.9 ; ✓ (71/13.8 OR 35.5/6.9 =) 5.14492754 ✓ = 5.1 (g) (1dp) ✓	**3**	**2.2 x 2** **1.2**	**ALLOW** A_r Li = 7 **ALLOW (2 marks):** 71/6.9 = 10.3 **ALLOW (1)** for incorrect answer to 1 dp
	(b)		$2Li + 2H_2O \rightarrow 2LiOH + H_2$ correct species ✓ 1 mark for balanced equation ✓	**2**	**1.2**	
	(c)		cathode: lithium (metal) ✓ anode: chlorine (gas) ✓	**2**	**1.2**	**ALLOW** (1) for correct products in reverse order. **DO NOT ALLOW** 'chloride' **IGNORE** formulae
	(d)	**(i)**	Add chlorine to a (solution of a metal) bromide / AW ✓ Brown colour seen ✓	**2**	**2.2** **1.2**	**ALLOW** any named metal bromide
		(ii)	Avoid inhalation / ventilation / work in fume cupboard ✓ Chlorine is toxic / poisonous / harmful / irritant (gas) ✓	**2**	**2.2**	

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Question			Answer	Marks	AO element	Guidance
11	(a)		(positive/metal) ions and electrons ✓ have strong electrostatic forces / opposite charges idea / positive and negative attract ✓	2	1.1	
	(b)		They both conduct electricity ✓ They both form cations ✓	2	1.1	
	(c)	(i)	amount of reactant (atoms) used to make (useful) product / amount of wasted reactant (atoms) (AW) ✓	1	1.1	**DO NOT ALLOW** references to yield
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 60 (%) award 3 marks** 47.9 OR 79.9✓ (47.9 ÷ 79.9) × 100 = 59.99..... ✓ = 60 (%) (2 sf) ✓	3	**2 × 2.2** **1.2**	**Allow ECF** for incorrect RFMs **Allow** sf mark on incorrect calculation
		(iii)	Method 2 **AND any one from:** since method 1 has more reactants / ✓ method 1 has Mg on LHS / method 2 has only one reactant / ✓ denominator in fraction is bigger for method 1 / ✓ larger mass or percentage of waste products / ✓ fewer wasted atoms ✓	1	2.2	**ALLOW** atom economy of method 1 is 37%

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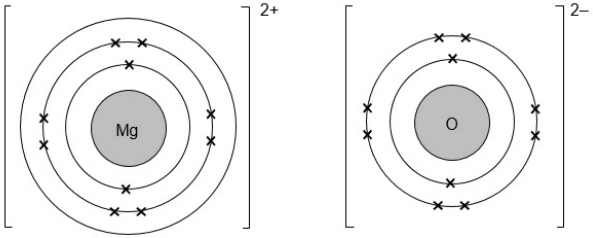
		(iv)	(Either Jamal or Mia are correct) Any **three** from: Higher AE wastes fewer atoms / less chemicals / less waste✓ yield may be low / reaction may reach equilibrium ✓ rate may be low ✓ some by-products may be toxic/harmful / by-products may not harm the environment ✓ may requires high energy input / use fossil fuels / produces greenhouse gases / other named pollutant ✓ by-products may be useful / oxygen is a useful by product AW ✓	**3**	**3.1b**	**IGNORE** 'pollution' or 'pollutants' alone
	(d)		 ✓✓	**2**	**1.2**	**ALLOW** electrons as all dots, all crosses, or a mixture of both which represent electrons moving from Mg to O.

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