OCR
Oxford Cambridge and RSA

GCSE

Chemistry B (Twenty First Century)

Unit **J258/03**: Higher Tier – Breadth 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.

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.

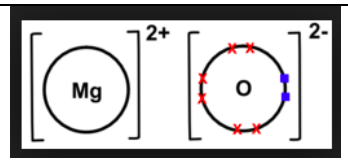
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New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

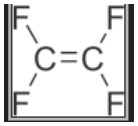
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

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)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 0.08 ± 1 (cm^3 / s) award 2 marks** Change in volume = 8 ± 1 (cm^3) ✓ rate = 8 / 100 = 0.08 (cm^3 / s) ✓	**2**	**2.2 × 2**	**ALLOW** use of any number 7- 9 anywhere in calculation (1) **ALLOW ECF for 2nd mark:** rate = change in volume / 100 **ALLOW** 0.07 – 0.09 (2)
	(b)		"Particle size" of carbonate / AW ✓ Temperature ✓	**2**	**3.3a × 2**	**ALLOW** take readings every 200s or less/ same time interval **IGNORE** 'the same time'
	(c)		Particles closer/have less space / more particles in same volume / more (densely) packed ✓ Collide more frequently / higher rate of collisions / more collisions per unit time/per second ✓	**2**	**2.1 × 2**	**ALLOW** molecules for particles **ALLOW** more chance of collisions **IGNORE** more particles / more collisions / faster collisions / energy arguments / more successful collisions /
	(d)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 17 (cm^3) award 3 marks** 0.07 / 0.10 or 0.10/0.07 ✓ (uses 24)= 16.8 ✓ = 17 (cm^3) ✓	**3**	**2.2 × 2** **1.2**	**IGNORE** 17.0 **ALLOW** MP3 for (incorrect) answer with working rounded to 2sf

Question			Answer	Marks	AO element	Guidance
2	(a)		No overall loss (in mass) idea / No elements/mass/atoms/chemicals/particles/compounds lost / law states that matter is neither (created nor) destroyed in a chemical reaction / AW ✓ Carbon dioxide is a gas / Carbon dioxide leaves the test tube / a gas is given off / idea that all products are not in the test tube / AW ✓	2	3.1b × 2	**ALLOW** It is an open system
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 52.2 /52.4 / 52.3 (%) award 4 marks** (formula mass of reactants or $MgCO_3$) = 84.3/84 ✓ (formula mass of product or CO_2) = 44 ✓ Correct substitution = 44/84.3 x 100 / 44/84 x 100 ✓ Ans+dec pl= 52.2 / 52.4 / 52.3 (%) (1 decimal place) ✓	4	2.2 × 3 1.2	If no marks awarded for MP3 and MP4 **ALLOW** correct working towards formula masses for max (2) 24(.3) + 12 + (3x16) / 12 + (2 x 16) **ALLOW** ecf **ALLOW** 52.1(%) (Rounding assessed in previous question)
	(c)	(i)	2.2 (g) ✓	1	2.2	**ALLOW** 2 or more sf
		(ii)	82(%) ✓	1	2.2	**ALLOW** 2 or more sf
	(d)		 Ions with correct electrons ✓ Charges ✓	2	1.2 × 2	**ALLOW (1)** for one correct ion **ALLOW** eight electrons in outer shell of Mg **ALLOW** all oxygen electrons with same symbol **IGNORE** correct inner shells **DO NOT ALLOW** incorrect inner shells

Question			Answer	Marks	AO element	Guidance
3	(a)		**A** high breaking strength <u>is good</u> / is strong(er) / won't break / cup would not hold its shape / can hold boiling water / softens <u>above 100</u>/at higher temperature than B or C ✓ **B** low breaking strength <u>is not good</u> / weak(er) / breaks / would not hold its shape / could not hold boiling water /softens <u>below 100</u>/at lower temperature than A or C ✓ **C** low breaking strength <u>is not good</u> / weak(er) / breaks / would hold its shape / could hold boiling water / softens <u>above 100</u>/above B/below A ✓ Breaking strength	3	3 × 3.1a	**IGNORE** list of properties repeated from the table e.g. 'A has high breaking strength, is fairly flexible but softens at 250' = 0 **Answer must show some processing of information e.g. links properties to 'good' and 'bad' or interprets properties** For (3) marks answer must discuss at least two properties
	(b)		**B** ✓ Lowest softening temperature ✓	2	2 × 3.2a	**IGNORE** references to flexibility/strength
	(c)			1	2.1	**ALLOW** f

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	No/very little/<1% oxygen until 2.5 billion years ago/for about (first) 1.5 billion years AW ✓ Fluctuations but overall increase / up and down but overall rise ✓	2	2 × 3.1a	**ALLOW** any number in range 2.8 – 2.5 for 'about 2.5 / 1.2-1.5 for 'about 1.5' **IGNORE** 'increases and decreases' or 'up and down' alone
		(ii)	1.7 – 2(.0)	1	3.1a	
		(iii)	Plants/bacteria evolved / photosynthesis✓ plants/bacteria established / number of plants or bacteria stayed the same / animals evolved / animals use up oxygen / respiration AW ✓	2	2 × 1.1	
	(b)		$2FeS_2 + 7O_2 \rightarrow Fe_2(SO_4)_3 + SO_2$	1	1.2	

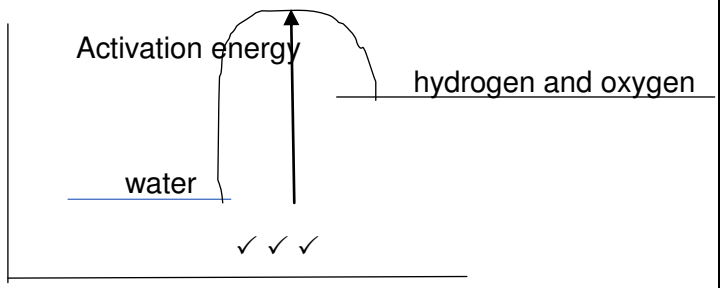
Question			Answer	Marks	AO element	Guidance
5	(a)		Bromine/Br_2 identified ✓ displaced (by the chlorine) / chlorine is more reactive than bromine ✓ $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ ✓	3	3 × 1.1	**ALLOW** from equation **IGNORE** 'replace' **DO NOT ALLOW** '<u>chloride</u> displaces bromide **ALLOW** 'chlorine displaces bromide' for MP2 **IGNORE** K^+ ions
	(b)		Astatine reacts with sodium to form NaAt ✓ Astatine is less reactive than iodine ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
6	(a)		large surface area to volume ratio / (very) small but have a large surface area ✓	1	1.1	
	(b)		**For:** (More complete combustion hence) less pollutants / less harmful gases / less incomplete combustion /less named pollutant: (carbon) particulates / carbon monoxide / CO, unburnt fuel/hydrocarbons AW ✓ Carbon monoxide is toxic//blocks haemoglobin / CO or particulates or unburnt HCs cause breathing or respiratory difficulties / particulates cause asthma/breathing difficulties / may cause cancer etc ✓ **Against:** CeO_2/nanoparticles (may be) harmful / toxic / risks not known ✓	3	3.1b 1.1 3.1b	**IGNORE** 'more complete combustion' alone (repeats Q) **IGNORE** 'less pollution' **ALLOW** idea of nanoparticles may harm humans, plants, animals or the environment **IGNORE** 'nanoparticles may be pollutants /cause pollution' (too vague)
	(c)		Charges balance/neutral/cancel / oxygen gives an overall charge of 4- / there are two O^{2-} ions AW ✓	1	1.2	**IGNORE** charges are equal
	(d)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 3 × 10^{-21} (mol) award 3 marks** Molecules in one nanoparticle = 8 × 10^{-27} / 4 × 10^{-30} / = 2000 ✓ Recall Avogadro constant = 6(.0) x 10^{23}✓ Moles = 2 × 10^3 / 6 × 10^{23} = 3.3 × 10^{-21} (mol) ✓	3	 2.2 1.2 2.2	**ALLOW** full credit (3) marks for any answer which starts by cubing volumes **ALLOW** correct working shown OR 2000 for (1**)** **ALLOW** ECF

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	Equilibrium sign / ⇌ / arrows point both ways ✓	1	1.1	**ALLOW** answers referring to the sign/arrow **IGNORE** it is reversible
		(ii)	forward and back(ward) reactions / both directions / reactants(N_2 and O_2) forming products (NO) and products forming reactants✓ rates are equal ✓	2	2 × 1.1	**ALLOW** equations for the correct reactions
	(b)	(i)	Fertilisers / explosives	1	1.1	**ALLOW** for growth of/nitrates for plants but **IGNORE** plants alone/ammonia/Haber process
		(ii)	No change ✓ Equal moles/molecules/particles on each side (of the equation) ✓	2	2 × 1.1	Mark separately
	(c)		**Any two FOR:** 100% atom economy / all reactants used up idea ✓ No by-products / no waste ✓ raw materials come from the air ✓ sustainable ✓ works at low pressure / AW ✓ **Any one AGAINST:** (very) high temperature (needed) / needs a lot of energy/fuel / doesn't give 100% yield / low yield ✓	3	3 × 2.1	**ALLOW** 'high atom economy' **IGNORE** 'readily available' **IGNORE** 'renewable'

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	$MnO_2(s) + 2C(s) \rightarrow 2CO(g) + Mn(s)$ correct formulae and balancing ✓ state symbols ✓	2	2 × 1.2	**ALLOW** state symbol mark for any version of manganese oxide + carbon → carbon oxide + manganese
		(ii)	Manganese is less reactive than carbon ORA ✓ carbon reduces / removes oxygen from / donates electrons to manganese (oxide) ✓	2	2 × 2.1	
	(b)		strong forces/bonds/attraction / electrostatic attractions between ✓ (free/delocalised/sea of) electrons ✓ and positive ions (from metal) ✓	3	3 × 1.1	**DO NOT ALLOW** intermolecular forces **IGNORE** metal atoms **DO NOT ALLOW** protons/nuclei

Question			Answer	Marks	AO element	Guidance
9	(a)		(contains) potassium / K ✓	1	1.2	
	(b)	(i)	lines ✓ (lines are) coloured / (lines are) on a dark/black background ✓	2	2 × 1.1	**ALLOW** 'series/range of colours' **IGNORE** 'on a white background'
		(ii)	Compare/match the spectrum with the known spectrum (of potassium/(ECF answer to (a)) / AW✓	1	1.2	
	(c)	(i)	White precipitate	1	1.2	**IGNORE** cream
		(ii)	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$ correct formula for one product $BaSO_4$/NaCl ✓ fully correct equation with balancing ✓	2	2 × 1.2	

Question			Answer	Marks	AO element	Guidance
10	(a)		Hydrogen is produced at the cathode Water contains H^+ and OH^- ions	1	1.1	**Both needed**
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = (+)490 (kJ / mol) award 3 marks** (bonds broken): (= 4(O–H)) OR 1856 (kJ/mol) ✓ (bonds made): (= 2(H–H) + O=O) OR 1366 (kJ/mol) ✓ energy change (= 1856 – 1366) / (bonds broken – bonds made) = (+) 490 (kJ / mol) ✓	3	3 × 2.2	**For MP1 and MP2 ALLOW** either correct working or correct value **DO NOT ALLOW** -490 (if sign is shown, must be correct) **ALLOW** ECF for maximum (2) If answer should be negative (by ecf), then negative sign must be shown for third mark to be scored. Plus sign is not necessary.
	(c)		 ✓ ✓ ✓	3	2 × 2.2 1.1	Water on LHS lower than hydrogen and oxygen higher on RHS ✓ **ALLOW** ECF for exothermic diagram from a negative answer to (b) **DO NOT PENALISE** correct diagram if answer to (b) is incorrect Curve with hump ✓ Activation energy labelled with arrow starting at reactants and ending at peak of hump ✓ **ALLOW** double arrow / line with end stops **DO NOT ALLOW** downwards arrow

Question			Answer	Marks	AO element	Guidance
11	(a)		$Al^{3+} + 3e \rightarrow Al$ ✓ $2O^{2-} \rightarrow O_2 + 4e$ ✓	2	2 × 1.2	**ALLOW** equations with electrons on the right (eg $Al^{3+} \rightarrow Al - 3e$) **ALLOW** $O^{2-} \rightarrow {}^{1}/_{2}O_2 + 2e$ **ALLOW** (1) mark if number of electrons are correct for both equations but on incorrect sides of both equations (even if oxygen is shown as O)
	(b)		ions / charged particles✓ can't move in solid / held in lattice / do not move / in fixed positions ✓ can move in liquid/when molten ✓	3	3 × 1.1	**DO NOT ALLOW** electrons/'particles' alone
	(c)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 667etc (dm^3) award 4 marks** 4 × 27(g) (=108) ✓ =1000 ÷ 108 ECF (= 9.259) ✓ 3 × 24 (dm^3) (=72) ✓ = (x 72 ECF =) 667 (dm^3) ✓ **OR** No moles Al = 1000/27 (=37.04) ✓ Uses ratio 4:3 in calculation ✓ No moles O_2 = ANS x ¾ (=27.77…..) ✓ (x 24=) 667 (dm^3) ✓	4	4 × 2.2	**9.259 = (2) for MP1 and MP2** **0.667 = (3) for MP1 MP3 and MP4** **222 = (3) for MP1 MP2 and MP4** **0.222 = (2) for MP1 and MP4** **ALLOW** 666 (Rounding already assessed in earlier Q) **ALLOW** any number of sig figs **27.7 = (3) for MP1, MP2 and MP3**

			Answer	Marks	AO element	Guidance
12	(a)		(The arrow shows that) the acid is fully dissociated/ionised / the reaction goes to completion AW / there is no equilibrium sign ✓	1	1.1	
	(b)	(i)	Volumetric pipette ✓	1	1.2	
		(ii)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 0.0025 (mol) award 3 marks** Unit conversion cm^3 to dm^3 = 25 × 10^{-3} = 0.025 dm^3 / divides 25 by 1000 / shows 25 x 0.001 in working ✓ Shows × 0.1 in working ✓ Correct answer = 0.0025 (mol) ✓	3	1.2 2 × 2.2	**ALLOW** ECF
		(iii)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 0.051 (mol / dm^3) award 3 marks** moles H_2SO_4 = ANS (ii)/2 / 0.0025 / 2 (= 0.00125) ✓ conc H_2SO_4 = 0.00125 (ECF) / 0.0245 ✓ conc H_2SO_4 =0.051 (mol / dm^3) ✓	3	3 × 2.2	**ALLOW** ECF (including from part (ii)) **0.102 = (1) for MP2** **ALLOW** answer with working to 2 sig figures

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