

GCSE (9-1)

Combined Science B (Twenty First Century)

Unit **J260/06**: 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 Combined Science 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)			3	3 x 1.1	Mark links to states and links to colours separately. all correct links = 3 marks 4/5 correct links = 2 marks 2/3 correct links = 1 mark
	(b)	(i)	Less reactive down the group/OR A ✓	1	3.1a	ALLOW reactions take longer / react less / more energy needed down the group.
		(ii)	(Yes because) chlorine is less reactive than fluorine ✓ More reactive than bromine ✓	2	2 x 3.1b	ALLOW chlorine is between fluorine and bromine for 1 mark.
	(c)	(i)	2K AND 2KBr ✓	1	2.2	ALLOW correct multiples
		(ii)	(Magnesium) 2 electrons in outer shell, (Aluminium) 3 electrons in outer shell ✓ Mg ²⁺ , Al ³⁺ ✓ MgBr ₂ , AlBr ₃ ✓	3	3 x 2.1	1 mark per column ALLOW Mg ⁺² , Al ⁺³

Question			Answer	Marks	AO element	Guidance
2	(a)		Provide alternative route ✓ With lower activation energy ✓	2	2 x 1.1	
	(b)		Low volume - less catalyst needed / less expensive ✓ High surface area - more (chance of) collision / reaction ✓	2	2 x 1.1	ALLOW less metal ✓
	(c)	(i)	Smaller particle size has bigger surface area to volume ratio / 10 x particle size is 1/10 th surface area to volume ratio ORA ✓	1	3.1a	
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.6 (nm⁻¹) award 4 marks 10 x 10 / 100 (calculation of surface area of 1 face) ✓ (10 x 10) x 6 / 600 (calculation of total surface area) ✓ 10x10x10 / 1000 (calculation of volume) ✓ Surface area ÷ volume correctly evaluated ✓	4	4 x 2.2	ALLOW 0.6 : 1 / 6 : 10 for 4 marks

Question			Answer				Marks	AO element	Guidance
3	(a)	(i)		melting	photosynthesis	both	2	2 x 2.1	4 correct is 2 marks 3 or 2 correct is 1 mark 1 or 0 correct is 0 mark
			It is a physical change.	✓					
			It is a chemical change.		✓				
			New substances are formed.		✓				
			It involved an energy change			✓			
		(ii)	Particles in solid / ice cap are in fixed position / rigid structure ✓ Forces between liquid particles weaker ✓ Particles in liquid/sea can move around ✓				3	3 x 1.1	ALLOW molecules instead of particles throughout. IGNORE distance apart of particles ALLOW bonds between particles/ intermolecular bonds / particles held less tightly DO NOT ALLOW bonds between atoms

Question			Answer			Marks	AO element	Guidance															
	(b)	(i)	<table><thead><tr><th></th><th>True</th><th>False</th></tr></thead><tbody><tr><td>Water has the lowest melting point.</td><td></td><td>✓</td></tr><tr><td>Methane has the weakest forces between its molecules.</td><td>✓</td><td></td></tr><tr><td>The boiling point of methane is higher than the melting point of ammonia.</td><td></td><td>✓</td></tr><tr><td>Water has the highest relative formula mass.</td><td>✓</td><td></td></tr></tbody></table>				True	False	Water has the lowest melting point.		✓	Methane has the weakest forces between its molecules.	✓		The boiling point of methane is higher than the melting point of ammonia.		✓	Water has the highest relative formula mass.	✓		2	2 x 1.1	All correct =2 2/3 correct =1
	True	False																					
Water has the lowest melting point.		✓																					
Methane has the weakest forces between its molecules.	✓																						
The boiling point of methane is higher than the melting point of ammonia.		✓																					
Water has the highest relative formula mass.	✓																						
		(ii)	Gas on Earth AND liquid on Mars ✓ Temperature above boiling point (and melting point) on Earth✓ Temperature higher than melting point AND lower than boiling point on Mars✓			3	3.2a 2 x 2.1	ALLOW temperature is between melting and boiling point															

Question			Answer	Marks	AO element	Guidance
4	(a)		Kia – during the reaction, atoms are rearranged but the total mass does not change ✓	2	1.1	ALLOW reference to Law of Conservation of Mass/ atoms cannot be created or destroyed.
			Jane – the mass goes down as the carbon dioxide/gas leaves the reaction mixture ✓		2.2	
	(b)		Mass of tablet and mass of flask plus acid / total mass of tablet, acid and flask / mass after tablet added ✓ Final mass after reaction ✓ Uses a balance ✓ Plus any one from: Suitable container e.g. beaker/conical flask ✓ Measurement of acid e.g. measuring cylinder ✓	4	2 x 3.3a 1.2 1.2	DO NOT ALLOW mark if a gas syringe is used.
	(c)	(i)	0.07	1	2.2	ALLOW 0.17 to 0.24
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.20(g) award 3 marks (0.22+0.18+0.24+0.17)/4 ✓ = 0.2025/0.203/0.2 ✓ = 0.20 (g) (2 dp) ✓	3	3 x 2.2	
	(d)	(i)	40.1 + 12 + 48 OR 100.1 (g) ✓ 500(mg) = 0.5(g) ✓ (0.5 ÷ 100.1 = 0.005)	2	2 x 2.2	ALLOW 100 if Mr produced from Ca=40 /labelled as molecular mass
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.22(g) award 2 marks 44 ✓ 0.005 x 44 = 0.22 (g) ✓	2	2 x 2.2	

Question	Answer	Marks	AO element	Guidance
5*	<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> Level 3 (5–6 marks) Describes patterns in the data in detail AND explains the patterns in terms of the effect of bonding and structure on melting point. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Describes patterns in the data AND discusses effect of bonding on melting point. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Describes patterns in the data OR discusses effect of bonding on melting point. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>	6	2.1 x 3 3.1a x 3	AO3.1a Describes the patterns in the data • ionic compounds have higher melting points than covalent • melting points of ionic oxides get higher across the period • ionic compounds do not follow a pattern in MP/ oxides increase but chlorides decrease • melting points of covalent lower across the period • melting points of oxides higher than melting points of chlorides AO2.1 Discusses effect of bonding on melting point. • ionic compounds held together by strong forces between the ions • simple covalent compound held together by weak forces between the molecules • smaller simple covalent molecules have weaker forces • stronger forces between particles means higher melting points • stronger forces mean more energy needed to separate the particles • high melting point means more energy needed to separate • oxide ions greater charge than chloride ions • higher charge on ions means stronger attraction • charge on metal ion gets bigger as move across the period • melting point of silicon dioxide high because giant covalent

Question			Answer	Marks	AO element	Guidance												
6	(a)		Formulation is a mixture (of pure substances) ✓ Pure substance is a single substance ✓	2	2 x 1.1	DO NOT ALLOW bonded together IGNORE reference to compounds / elements ALLOW is a single compound or element IGNORE is a single element / compound alone												
	(b)	(i)	Water does not look coloured ✓	1	2.2													
		(ii)	Use a different solvent / liquid / named solvent ✓	1	3.3b													
	(c)	(i)	9 / 9.0 for solvent moved for BOTH dyes ✓ Yellow dye 6.2 and Red dye 3.8 ✓	2	2 x 2.2	ALLOW tolerance of +/- 0.1												
		(ii)	<table border="1"><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td>Compare the R_f values with a reference table of known dyes.</td><td></td><td>✓</td></tr><tr><td>Do an experiment to find the R_f value for pure samples of the listed dyes ✓</td><td></td><td>✓</td></tr></table>							Compare the R _f values with a reference table of known dyes.		✓	Do an experiment to find the R _f value for pure samples of the listed dyes ✓		✓	2	2 x 2.2	
Compare the R _f values with a reference table of known dyes.		✓																
Do an experiment to find the R _f value for pure samples of the listed dyes ✓		✓																
		(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4.16 (cm) award 2 marks 0.52 = distance ÷ 8 / distance = 0.52 x 8 ✓ 4.16 (cm) ✓	2	2 x 2.2	ALLOW 4 / 4.2												
	(d)		Dyes are coloured / can see the dyes✓	1	1.1													

Question			Answer	Marks	AO element	Guidance
7	(a)		ions ✓ can't move in solid/can in liquid ✓ moving ions / charged particles carry the current ✓	3	3 x 1.1	DO NOT ALLOW mark if reference to electrons moving.
	(b)	(i)	Oxygen ✓ $\text{O}^{2-} \rightarrow \text{O}_2 + \text{e}^-$ ✓ Correctly balanced ✓	3	3 x 2.1	
		(ii)	reduction and gained ✓	1	1.2	
	(c)		Al_2O_3 , 3 ✓ (aq), (l) ✓	2	2 x 2.2	DO NOT ALLOW $\text{Al}^{2+}\text{O}^{3-}$ / Al_2O_3
	(d)	(i)	Aluminium more reactive (than hydrogen) / Al^{3+} less tendency to gain electrons/be reduced (than H^+) ✓	1	2.2	
		(ii)	Hydrogen ✓ H^+ ions (from water) ✓ Gain electrons ✓	3	3 x 1.2	

Question			Answer	Marks	AO element	Guidance
8	(a)		Reaction is reversible ✓ (Comes to) equilibrium ✓ Product reacts as fast as it is formed ✓	3	3 x 1.1	
	(b)	(i)	Higher temperature produces lower yield ✓ Higher pressure produces higher yield ✓	2	2 x 3.1a	
		(ii)	100(°C) AND 400 (atm) ✓	1	3.2b	
		(iii)	Temperature – low temperature is too slow ✓ Pressure – high pressure is too expensive/unsafe ✓	2	2 x 1.1	ALLOW rate is slower at low temperature / reaction is faster (at 400-450)
9	(a)		Similarities: Covalent bonds (between carbons) ✓ Giant (structure) ✓ Differences: Diamond atoms have 4 bonds (to carbon) and graphite 3 ✓ Diamond 3D structure and graphite in layers ✓	4	4 x 1.1	DO NOT ALLOW covalent bonds between molecules
	(b)		Hardness: Diamond – all bonds are strong ✓ Graphite – weak(er) bonds between the layers ✓ Electrical conductivity: Diamond has no mobile electrons / graphite does ✓ Diamond all electrons in bonding, graphite 3 outer electrons in bonding (so has a free electron) ✓	4	4 x 1.1	DO NOT ALLOW reference to intermolecular bonds.

Question			Answer	Marks	AO element	Guidance															
10	(a)		Universal indicator/pH paper ✓ Check colour with scale ✓	2	2 x 1.2																
	(b)		Strong acids ionise completely / weak acids partially ionise ✓ Hydrogen ion concentration higher in strong acids ✓	2	2 x 1.1																
	(c)		<table border="1"><tr><td>1</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td><td>Strong ✓</td></tr><tr><td>3</td><td></td><td></td><td>1×10^{-5} ✓</td><td></td></tr></table>	1					2				Strong ✓	3			1×10^{-5} ✓		2	2 x 2.1	
1																					
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