

GCSE (9–1)

Combined Science B (Twenty First Century Science)

J260/06: 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

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)	(i)	Gas particles leave the flask ✓	1	1.2	
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.012 award 3 marks $0.7 \div (1 \times 60)$ ✓ $= 0.01166666\dots$ ✓ $= 0.012$ (g/s) (2sf) ✓	3	2.2x2 1.2	ALLOW any number of significant figures e.g. 0.01 ALLOW ecf from incorrect calculation
	(b)		Use more concentrated acid ✓ Use powdered calcium carbonate instead of pieces ✓	2	3.3b	
	(c)	(i)	gas syringe ✓ graduated ✓ OR collection over water with measuring cylinder ✓ graduations ✓	2	1.2	ALLOW labels to identify apparatus and graduations.
		(ii)	(Yes because) Any one from: Rate/volume of gas increases when temperature increases ✓ Volume of gas given off equivalent to rate ✓ Volume of gas doubles every 10°C ✓ AND Uses data to justify proportionality/rate doubles every 10°C ✓	2	3.2b	DO NOT ALLOW if 'no' is selected. NOTE (yes because) rate of gas doubles every 10°C = 2 marks NOTE (no because) rate of gas doubles every 10°C = 1 mark

Question		Answer			Marks	AO element	Guidance	
2	(a)	Symbol	Na atom	F ⁻ ion	3	2.1	One mark for two correct Two marks for three/four correct Three marks for five correct	
		Atomic number	11	(9)				
		Number of protons	(11)	(9)				
		Number of electrons	11	10				
		Number of neutrons	12	10				
		✓✓✓						
	(b)	(i)	(Same period) because both have 3 shells ✓ (Different group) because different number of electrons in outer shell ✓			2	2.1	ALLOW have same number of shells
		(ii)	(Argon is) unreactive (because it has a full outer shell of electrons) ✓			1	1.1	IGNORE stable/not very reactive
	(c)	(i)	<u>positive</u> (metal) ions / cations (delocalised) electrons ✓			1	1.1	BOTH needed for one mark
		(ii)	Malleable – ions slide past each other Solid conducts electricity – outer shell electrons move freely High melting point – strong attraction between ions and electrons ✓✓			2	1.1	three correct = 2 marks two correct = 1 mark

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	<p>bromine (liquid to gas) particles go from moving around each other to moving in all directions ✓ particles move further apart (but are still randomly arranged) ✓</p> <p>water (solid to liquid) particles move from regular arrangement to more randomly arranged ✓ particles vibrate about a fixed position and then start to move past each other ✓</p>	4	1.1	<p>Must be comparisons.</p> <p>ALLOW idea of increased movement DO NOT ALLOW move freely</p>
		(ii)	<p>Any two from:</p> <p>Particles are not spheres ✓ Particles are diatomic in Bromine gas / not single atoms ✓ Gaps between gas particles much bigger than shown ✓</p>	2	1.1	
	(b)	(i)	<p>Any one from:</p> <p>The solid melts over a range of temperatures ✓ The solid melts at a different temperature than the value in data book. ✓</p> <p>AND (explanation) Mixtures contain two or more chemical substances which aren't chemically bonded together, (and can be separated by physical methods) ✓</p>	2	2.2	
		(ii)	Use paper chromatography ✓	1	2.2	

Question			Answer			Marks	AO element	Guidance
4	(a)	(i)	Particle	Relative Mass	Relative Charge	2	1.1	One mark for all relative masses correct One mark for all relative charges correct ALLOW +1 for mass of protons/neutrons
			Proton	1	+1/+			
			Neutron	1	0/neutral			
			Electron	Almost 0/ negligible/0.0005/1/1840	-1/-			
			✓✓					
		(ii)	protons AND neutrons are in nucleus ✓ electrons are orbiting/in shells (around the nucleus) ✓			2	1.1	ALLOW more developed models if they are scientifically correct ALLOW surrounding the nucleus
	(b)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4300 (m) award 2 marks 43 x 1 x 10 ⁵ (mm) ✓ ÷ 1000 = 4300 (m) ✓			2	2.1 1.2		

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	4 ✓	1	1.1	
		(ii)	Any two from: forms (lots of) bonds with other carbons ✓ forms rings ✓ forms chains (of different lengths) ✓	2	1.1	
	(b)	(i)	C ₆ H ₁₄ ✓	1	2.1	
	(b)		Similar chemical properties ✓ Trend in physical properties/ correct example of trend in physical properties ✓	2	1.1	

Question	Answer	Marks	AO element	Guidance
6*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) Fully describes nature of the chemical bonds in the compounds AND compares the melting points of the compounds AND explains why the melting points are different. <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) Describes nature of the chemical bonds in the compounds AND compares the melting points of the compounds. <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) Describes nature of the chemical bonds in the compounds OR compares the melting points of the compounds. <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	1.1 x 2 3.1a x 2 3.2a x 2	<p>AO1.1 Description of nature of bonding</p> <ul style="list-style-type: none"> • ionic electron transfer • ionic has charged particles • ionic giant lattice • (strong) attraction between ions/attraction in all directions • covalent has shared electrons • covalent bonds strong • intermolecular bonds weak • simple covalent has small molecules • polymers have large molecules <p>AO3.1a Compares the melting points</p> <ul style="list-style-type: none"> • PCl_3 low(est) melting point • $NaCl$ high(est) melting point • PVC melts over a range <p>AO3.2a Explains difference in melting points</p> <ul style="list-style-type: none"> • intermolecular bonds weak in PCl_3 • little energy needed to separate PCl_3 molecules • PVC higher than PCl_3 because molecules are longer • PVC has range because molecules with different lengths • $NaCl$ high because strong attraction between ions • $NaCl$ high because all ions are attracted to ions around

Question		Answer	Marks	AO element	Guidance
7	(a)	Any one from: both increase over time <u>and</u> similar pattern idea / both increasing more and more ✓ as carbon emissions increase the amount of carbon dioxide in the atmosphere increases ✓	1	3.1a	
	(b)	Any two from: plant trees ✓ carbon capture ✓ examples of energy saving ✓	2	1.1	DO NOT ALLOW alternative sources of energy
	(c) (i)	Any three from: electric cars do not use fossil fuels/produce CO ₂ ✓ mains electricity for recharging electric cars could be made from fossil fuels ✓ mains electricity for recharging electric cars could be made without using fossil fuels ✓ CO ₂ reduced if less fossil fuel used ✓	3	2.1	
	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1170 (kg) award 4 marks (mass produced by old car =) $1200 \times 2.1 = 2520$ ✓ $90 \div 1000 = 0.09$ ✓ (mass produced by new car =) $15000 \times 0.09 = 1350$ ✓ (difference = $2520 - 1350$) ✓	4	2.2 1.2 2.2 1.2	

Question			Answer	Marks	AO element	Guidance																				
8	(a)	(i)	The mole – the amount of substance containing the same number of particles as there are atoms in 12g of carbon-12. ✓ Avogadro constant – number of atoms in 12g of carbon-12. ✓	2	1.1																					
		(ii)	✓✓✓ <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Substance</th> <th>Relative formula mass</th> <th>Mass of substance (g)</th> <th>Number of moles of substance</th> <th>Number of molecules</th> </tr> </thead> <tbody> <tr> <td>O₂</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>H₂</td> <td></td> <td>4</td> <td></td> <td>1.2 x 10²⁴</td> </tr> <tr> <td>H₂O</td> <td>18</td> <td></td> <td></td> <td>3.0 x 10²³</td> </tr> </tbody> </table>	Substance	Relative formula mass	Mass of substance (g)	Number of moles of substance	Number of molecules	O ₂					H ₂		4		1.2 x 10 ²⁴	H ₂ O	18			3.0 x 10 ²³	3	2.2	four correct = 3 marks three correct = 2 marks two correct = 1 mark
Substance	Relative formula mass	Mass of substance (g)	Number of moles of substance	Number of molecules																						
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		(iii)	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th></th> <th>true</th> <th>false</th> </tr> </thead> <tbody> <tr> <td>The total number of reactant molecules is the same as the total number of product molecules</td> <td></td> <td>✓</td> </tr> <tr> <td>The total number of reactant atoms is the same as the total number of product atoms</td> <td>✓</td> <td></td> </tr> <tr> <td>The number of each type of atom in the reactants is equal to the number of each type of atom in the products</td> <td>✓</td> <td></td> </tr> </tbody> </table>		true	false	The total number of reactant molecules is the same as the total number of product molecules		✓	The total number of reactant atoms is the same as the total number of product atoms	✓		The number of each type of atom in the reactants is equal to the number of each type of atom in the products	✓		2	2.1	three correct = 2 marks two correct = 1 mark								
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	(b)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3 award 3 marks 6.2 ÷ 31 = 0.2 ✓ 21.3 ÷ 71 = 0.3 ✓ 0.2:0.3 = 2:3 ratio, so 2 moles react with <u>3</u> moles ✓	3	2.2																					
		(ii)	Mass of product unchanged ✓ phosphorus is limiting factor/ no phosphorus left to react with extra chlorine ✓	2	2.1																					

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	All contain H ⁺ ions ✓ All have pH less than 7 ✓	2	2.1	ALLOW any reference to hydrogen ions IGNORE low pH
		(ii)	pH = 3 ✓ H ⁺ concentration = 1 x 10 ⁻³ (mol dm ⁻³) ✓	2	2.2	
	(b)	(i)	Strong acid is fully dissociated into H ⁺ ions ✓ Weak acid is partially dissociated into H ⁺ ions ✓	2	1.1	ALLOW 1 mark if difference in dissociation given but no reference to H ⁺ ions
		(ii)	Hydrochloric acid – concentration same as hydrogen ion concentration ✓ Ethanoic acid - concentration bigger than hydrogen ion concentration ✓	2	3.1a	ALLOW 1 mark for ethanoic acid has lower concentration of H ⁺ ions than hydrochloric acid when concentration of the 2 acids is 0.1 mol/dm ³ /the same
	(c)	(i)	Mg + 2H ⁺ → Mg ²⁺ + H ₂ ✓✓	2	2.1	ALLOW 1 mark if formulae correct but not balanced.
		(ii)	A is faster than B and C ✓ B and C are the same / not very different ✓ (support -) Shorter time means faster rate/data to support their conclusions/comparisons ✓	3	3.2b x2 3.1a	
		(iii)	Rate depends on concentration of hydrogen ions ✓ (support) - Hydrogen ion concentration much lower for D ✓	2	2.1	

Question		Answer	Marks	AO element	Guidance
10	(a)	Sodium ions gain electrons AND chloride ions lose electrons ✓ Loss of electrons is oxidation AND gain of electrons is reduction ✓ Sodium ions are reduced AND chloride ions are oxidised ✓	3	1.2	
	(b) (i)	solution in beaker with label 'sodium chloride solution' with electrodes in solution AND power source or battery ✓ AND Power source or battery connected to electrodes with no gaps in the circuit ✓ OR inverted test tubes to collect gases ✓	2	1.2	
	(ii)	Hydrogen ions H ⁺ ✓ Hydroxide ions OH ⁻ ✓	2	2.2	ALLOW both correct names or both correct formulae for 1 mark.
	(iii)	sodium is more reactive than hydrogen ✓ (in solution) hydrogen ions from water form hydrogen ✓ when molten sodium ions are the only (positive) ion / no hydrogen ions ✓	3	2.2	
	(iv)	(Holding a piece of) damp blue litmus paper just inside the open mouth of the test tube/in a test tube of the gas ✓ The test should show that the blue litmus paper turns red, then bleaches white. ✓	2	1.2	ALLOW damp starch-iodide paper turning from white to blue-black

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