OCR
Oxford Cambridge and RSA

H

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

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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

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

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 ÷ (1x60) ✓ = 0.01166666…. ✓ = 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

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

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	**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) ✓ **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 ✓	**4**	**1.1**	Must be comparisons. **ALLOW** idea of increased movement **DO NOT ALLOW** move freely
		(ii)	Any **two** from: Particles are not spheres ✓ Particles are diatomic in Bromine gas / not single atoms ✓ Gaps between gas particles much bigger than shown ✓	**2**	**1.1**	
	(b)	**(i)**	Any **one** from: The solid melts over a range of temperatures ✓ The solid melts at a different temperature than the value in data book. ✓ **AND** (explanation) Mixtures contain two or more chemical substances which aren't chemically bonded together, (and can be separated by physical methods) ✓	**2**	**2.2**	
		(ii)	Use paper chromatography ✓	**1**	**2.2**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><td>Particle</td><td>Relative Mass</td><td>Relative Charge</td></tr>
<tr><td>Proton</td><td>1</td><td>+1/+</td></tr>
<tr><td>Neutron</td><td>1</td><td>0/neutral</td></tr>
<tr><td>Electron</td><td>Almost 0/ negligible/0.0005/1/1840</td><td>-1/-</td></tr>
</table>
✓✓</td><td>2</td><td>1.1</td><td>One mark for all relative masses correct
One mark for all relative charges correct
ALLOW +1 for mass of protons/neutrons</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>protons AND neutrons are in nucleus ✓

electrons are orbiting/in shells (around the nucleus) ✓</td><td>2</td><td>1.1</td><td>ALLOW more developed models if they are scientifically correct
ALLOW surrounding the nucleus</td></tr>
<tr><td></td><td>(b)</td><td></td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 4300 (m) award 2 marks

43 x 1 x 10^5 (mm) ✓
÷ 1000 = 4300 (m) ✓</td><td>2</td><td>2.1
1.2</td><td></td></tr>
</table>

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_6H_{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*			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **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.** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **Describes nature of the chemical bonds in the compounds** **AND** **compares the melting points of the compounds.** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **Describes nature of the chemical bonds in the compounds** **OR** **compares the melting points of the compounds.** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	**1.1 x 2** **3.1a x 2** **3.2a x 2**	**AO1.1 Description of nature of bonding** • 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 **AO3.1a Compares the melting points** • PCl_3 low(est) melting point • $NaCl$ high(est) melting point • PVC melts over a range **AO3.2a Explains difference in melting points** • 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 and 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 x 2.1 = 2520 ✓ 90 ÷1000 = 0.09 ✓ (mass produced by new car =)15000 x 0.09 = 1350 ✓ (difference = 2520 - 1350) ✓	**4**	 **2.2** **1.2** **2.2** **1.2**	

<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>(i)</td><td>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. ✓</td><td>2</td><td>1.1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>✓✓✓
<table>
<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>
<tr><td>O_2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>H_2</td><td></td><td>4</td><td></td><td>1.2×10^{24}</td></tr>
<tr><td>H_2O</td><td>18</td><td></td><td></td><td>3.0×10^{23}</td></tr>
</table></td><td>3</td><td>2.2</td><td>four correct = 3 marks
three correct = 2 marks
two correct = 1 mark</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>✓✓
<table>
<tr><th></th><th>true</th><th>false</th></tr>
<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>
</table></td><td>2</td><td>2.1</td><td>three correct = 2 marks
two correct = 1 mark</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>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 ✓</td><td>3</td><td>2.2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Mass of product unchanged ✓
phosphorus is limiting factor/ no phosphorus left to react with extra chlorine ✓</td><td>2</td><td>2.1</td><td></td></tr>
</table>

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} ($moldm^{-3}$) ✓	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 $0.1mol/dm^3$/the same
	(c)	(i)	$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$ ✓✓	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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