GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier Chemistry Paper 1

Mark scheme Practice Paper Series – Set 2 SGC/S2/C/1H

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This mark scheme is an original resource written for sciencegcse.co.uk to accompany the Set 2 practice paper SGC/S2/C/1H. It is not an AQA mark scheme and has not been produced or endorsed by AQA. It follows the structure and conventions of AQA GCSE science mark schemes so that students and teachers can mark the practice paper in the same way that a real paper is marked.

Marking should be carried out using the Information to Examiners on the following pages. The paper has not been standardised, so raw marks should not be converted into grades using any published grade boundaries.

Specification references are to the AQA GCSE Combined Science: Trilogy (8464) specification, Chemistry section 5.1–5.5. AO = assessment objective; WS = working scientifically; MS = mathematical skills; RP = required practical.

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the answer(s) expected, including alternative acceptable wording, in the **Answers** column
- guidance on which answers are and are not creditworthy in the **Extra information** column
- the assessment objective (AO) and specification reference for each marking point.

Award marks positively. Do not deduct marks for incorrect additional material unless it contradicts a correct answer (see 3.1). Marks are awarded for what the student has written, not for what they might have meant.

2. Emboldening and underlining

2.1 Where a list of acceptable answers is given and more than one mark is available, **any two from** (or similar) is used, followed by the acceptable answers.

2.2 A bold **and** indicates that both parts of the answer are needed to gain the mark.

2.3 Alternative answers acceptable for the same mark are separated by **or**. Different words that are acceptable within a marking point are separated by a forward slash (/).

2.4 Words in bold in the Answers column are the essential words that must be present, or their equivalent, for the mark to be awarded.

3. Marking points

3.1 Marking of lists
When a fixed number of responses is requested but extra responses are given, consider the whole list. Each incorrect response or contradiction cancels one otherwise available correct response, up to the mark limit; the score cannot fall below zero. Neutral material identified by **ignore** does not cancel a correct response. Do not apply this rule as a penalty for extra relevant detail in an extended answer.

3.2 Marking procedure for calculations
A correct final answer can receive the marks indicated in the question-specific scheme without every intermediate step being written. Do not award full marks if the working shown contradicts that answer. Where the question specifically requires a method, demonstration or working, apply that requirement. Credit correct stages when the final answer is wrong, including consequential steps where permitted. A printed unit may only be replaced by another unit when the numerical value is converted consistently.

3.3 Interpretation of 'it'
Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.4 Errors carried forward
Use an earlier incorrect value in a later part where ECF is allowed by the question-specific scheme. Within a calculation, credit later correct stages that use an earlier incorrect value consistently, subject to any stated limits. Do not repeatedly penalise the same error.

3.5 Phonetic spelling
Accept a misspelling when the intended scientific term is clear, including when a term is being recalled. Do not accept wording that could instead name a different scientific term.

3.6 Brackets
Words shown in brackets in the Answers column are not required to gain the mark but help to set the context.

3.7 Allow
Answers that are acceptable but which would not normally be expected are shown as **allow**.

3.8 Ignore
Statements shown as **ignore** are neither creditworthy nor penalised. Mark the rest of the answer normally.

3.9 Do not accept
Statements shown as **do not accept** are incorrect and, where they contradict or replace the expected answer, mean the mark is not awarded.

4. Level of response marking instructions

Extended-response questions (question 04.6 in this paper) are marked using a level of response mark scheme. The scheme has three levels, each covering two marks, plus a level descriptor and indicative content.

Step 1 – Determine a level. Read the whole answer and decide which level descriptor best fits it. Use a 'best-fit' approach: an answer does not need to meet every part of a descriptor to be placed in that level, and a weak part of the answer need not prevent it from reaching the higher level if the overall quality matches the descriptor.

Step 2 – Determine a mark within the level. Award the higher mark in the level if the answer meets the descriptor fully and the points made are well linked; award the lower mark if the answer only just meets the descriptor or contains minor errors or omissions.

The indicative content is not a checklist: students need not include every point to reach the top level, and other relevant, correct points should be credited. An answer that lists points without linking them into a coherent answer should be placed in a lower level than one that develops and connects them.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	polystyrene is a (thermal) insulator, so it reduces energy transfer from the surroundings	allow it reduces heat gain / heat loss allow glass is a better conductor ignore the beaker stops the cup falling over	1	AO2 5.5.1.1 RP
01.2	7.8 (°C)	(7.9 + 7.7) ÷ 2	1	AO2 5.5.1.1 MS 2b
01.3	point plotted correctly at (4.0, 7.8)	allow ± half a small square allow ECF from 01.2	1	AO2 5.5.1.1 RP MS 4a, 4c
	point plotted correctly at (5.0, 8.7)	allow ± half a small square	1	AO2 5.5.1.1 RP MS 4a, 4c
	a line of best fit: a straight line through the first points, then levelling off	allow a smooth curve that levels off do not accept points joined dot to dot	1	AO2 5.5.1.1 RP MS 4a, 4c
01.4	up to about 4 g, the temperature decrease increases as the mass increases	allow directly proportional / doubling the mass doubles the decrease	1	AO3 5.5.1.1 WS 3.5
	above about 5 g, the temperature decrease stays the same		1	AO3 5.5.1.1 WS 3.5
01.5	all the citric acid had reacted / was used up	allow the citric acid was the limiting reactant	1	AO3 5.5.1.1
	so no more reaction happened / no more energy was taken in		1	AO3 5.5.1.1
01.6	the reaction takes in energy from the surroundings / the solution	ignore endothermic on its own	1	AO1 5.5.1.1
	so the thermal energy store of the solution decreases / its temperature decreases		1	AO1 5.5.1.1
		Total	**11**	
02.1	(2 × 23) + 12 + (3 × 16)	an answer of 106 scores **2** marks	1	AO2 5.3.1.2 MS 1a
	= **106**		1	AO2 5.3.1.2 MS 1a
02.2	sodium nitrate		1	AO2 5.4.2.2
02.3	carbon dioxide	allow CO_2	1	AO1 5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	Na_2CO_3 + **2**HNO_3 → **2**$NaNO_3$ + H_2O + CO_2	both numbers needed	1	AO2 5.3.1.1
02.5	carbon dioxide (gas) escapes from the flask (into the air)	allow a gas is given off and lost	1	AO1 5.3.1.3
02.6	the volume should be in dm^3: 250 cm^3 = 0.250 dm^3	allow the student used the volume in cm^3	1	AO2 5.3.2.5 MS 1c
	5.30 ÷ 0.250	an answer of 21.2 (g/dm^3) scores the last **2** marks	1	AO2 5.3.2.5 MS 1c
	= **21.2** (g/dm^3)		1	AO2 5.3.2.5 MS 1c
		Total	**9**	
03.1	energy is taken in to break the bonds in the reactants	allow bond breaking is endothermic	1	AO1 5.5.1.3 (HT)
	energy is released when bonds form in the products	allow bond making is exothermic	1	AO1 5.5.1.3 (HT)
	more energy is released making bonds than is taken in breaking bonds	allow 864 kJ/mol released compared with 679 kJ/mol taken in do not accept energy is released when bonds break	1	AO1 5.5.1.3 (HT)
03.2	the minimum amount of energy that particles must have to react	allow the energy needed to start a reaction	1	AO1 5.5.1.2
03.3	products (2HCl) drawn at a lower energy than the reactants	allow a line that rises to a peak and then falls below the reactants	1	AO2 5.5.1.2
	activation energy shown as an arrow from the reactants to the peak		1	AO1 5.5.1.2
	overall energy change shown as an arrow from the reactants down to the products		1	AO1 5.5.1.2
		Total	**7**	
04.1	a single layer of carbon atoms / one atom thick	allow a single layer of graphite	1	AO1 5.2.3.3
	each carbon atom is covalently bonded to **three** other carbon atoms (in hexagonal rings)		1	AO1 5.2.3.3
04.2	each carbon atom has one **delocalised** electron	allow free electrons	1	AO1 5.2.3.3
	the delocalised electrons can **move** through the structure (and carry charge)	do not accept ions move	1	AO1 5.2.3.3

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>04.3</td><td>any one from:
• fullerenes have hollow shapes / are closed cages or tubes
• fullerenes can contain rings of five or seven carbon atoms
• fullerenes are (separate) molecules</td><td>ignore fullerenes are not flat unless qualified</td><td>1</td><td>AO1
5.2.3.3</td></tr>
<tr><td>04.4</td><td>any one from:
• nanotechnology
• electronics
• reinforcing materials, e.g. in tennis rackets</td><td>allow other sensible uses based on strength or conductivity</td><td>1</td><td>AO1
5.2.3.3</td></tr>
<tr><td>04.5</td><td>1500 (: 1)</td><td>1.5 × 1000 ÷ 1.0</td><td>1</td><td>AO2
5.2.3.3
MS 1c</td></tr>
<tr><td>04.6</td><td>
<table>
<tr><td>Level 3
(5–6 marks)</td><td>A detailed evaluation of all three materials using several pieces of data from the table and knowledge of the structure of graphene, leading to a justified choice.</td></tr>
<tr><td>Level 2
(3–4 marks)</td><td>Some comparison of at least two materials, using some data from the table. A choice may be given but it is not fully justified.</td></tr>
<tr><td>Level 1
(1–2 marks)</td><td>Simple statements about one or more materials, for example graphene lets the most light through.</td></tr>
<tr><td>0 marks</td><td>No relevant content.</td></tr>
</table>
</td><td></td><td>6</td><td>AO3 (4)
AO1 (2)
5.2.3.3
WS 1.4</td></tr>
<tr><td></td><td>Indicative content
• a folding screen needs a layer that can bend many times: indium tin oxide cracks easily, so it is not suitable
• graphene lets the most light through (97%): it is only one atom thick
• graphene has high conductivity: it has delocalised electrons
• graphene can be bent many times: its strong covalent bonds make it strong, and because it is one atom thick it can bend without cracking
• graphene is the most expensive (£2.00) and large sheets are difficult to make
• the conducting polymer is the cheapest (30p) and can be bent many times
• but the polymer lets the least light through (85%), has only medium conductivity and breaks down in sunlight, so the screen may not last
• indium is rare, so indium tin oxide may become more expensive
• conclusion, e.g. graphene is the best choice for a folding screen if the cost can be justified / reduced
To reach Level 3 the answer must compare the materials using data and give a justified conclusion. Any reasoned conclusion can be credited.</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Total</td><td>13</td><td></td></tr>
<tr><td>05.1</td><td>2,8,4</td><td></td><td>1</td><td>AO1
5.1.1.7</td></tr>
<tr><td>05.2</td><td>atoms of the same element with the same number of protons</td><td>allow same atomic number</td><td>1</td><td>AO1
5.1.1.6</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	but different numbers of neutrons	allow different mass numbers do not accept different numbers of electrons	1	AO1 5.1.1.6
05.3	16	30 − 14	1	AO1 5.1.1.5
05.4	covalent		1	AO1 5.2.1.4
05.5	carbon dioxide is made of small molecules		1	AO1 5.2.2.4
	with weak intermolecular forces (between molecules), which need little energy to overcome	do not accept weak covalent bonds	1	AO1 5.2.2.4
	silicon dioxide has a giant (covalent) structure	allow lattice / macromolecule	1	AO2 5.2.2.6
	many strong covalent bonds must be broken, which needs a lot of energy		1	AO2 5.2.2.6
		Total	**9**	
06.1	X, Y, Z (most reactive first)		1	AO3 5.4.1.2 WS 3.5
	X displaces both Y and Z / Y displaces Z only / Z does not displace either metal	a reason is needed for this mark	1	AO3 5.4.1.2 WS 3.5
06.2	**2** and **2** for X and X^{3+}		1	AO2 5.4.1.4 (HT)
	3 and **3** for Y^{2+} and Y	allow multiples	1	AO2 5.4.1.4 (HT)
06.3	X (atoms) are oxidised		1	AO1 5.4.1.4 (HT)
	because they **lose** electrons	allow $X \rightarrow X^{3+} + 3e^-$	1	AO1 5.4.1.4 (HT)
06.4	6	allow ECF from 06.2	1	AO2 5.4.1.4 (HT)
06.5	$3e^-$ on the left		1	AO2 5.4.3.5 (HT)
	X on the right	$X^{3+} + 3e^- \rightarrow X$ scores **2** marks	1	AO2 5.4.3.5 (HT)
		Total	**9**	
07.1	41		1	AO2 5.3.1.2
07.2	Al: 5.40 ÷ 27 = 0.200 (mol)	an answer of $2Al + N_2 \rightarrow 2AlN$ with correct working scores **4** marks	1	AO2 5.3.2.3 (HT) MS 1a, 1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	N_2: 2.80 ÷ 28 = 0.100 (mol)		1	AO2 5.3.2.3 (HT) MS 1a, 1c
	AlN: 8.20 ÷ 41 = 0.200 (mol)	allow ECF from 07.1	1	AO2 5.3.2.3 (HT) MS 1a, 1c
	ratio 2 : 1 : 2 so **2**Al + N_2 → **2**AlN	allow 1 mark for a correctly balanced equation without working	1	AO2 5.3.2.3 (HT) MS 1a, 1c
07.3	atoms are not created or destroyed (in a chemical reaction), they are only rearranged	allow mass is conserved because no atoms are lost	1	AO1 5.3.1.1
07.4	the mass increase is the mass of nitrogen that reacted: moles of N = 1.26 ÷ 14 = 0.0900	an answer of 90 (%) scores **4** marks allow moles of N_2 = 1.26 ÷ 28 = 0.0450	1	AO2 5.3.2.2 (HT) MS 1a, 1c
	moles of Al = 0.0900	allow ECF from the ratio in 07.2	1	AO2 5.3.2.2 (HT) MS 1a, 1c
	mass of Al = 0.0900 × 27 = 2.43 (g)	allow the mass-ratio method: 27 g Al reacts with 14 g N, so 1.26 × 27 ÷ 14 = 2.43 (g)	1	AO2 5.3.2.2 (HT) MS 1a, 1c
	2.43 ÷ 2.70 × 100 = **90.0** (%)	allow 90 (%)	1	AO2 5.3.2.2 (HT) MS 1a, 1c
07.5	the increase in mass would appear smaller, so the calculated mass of aluminium would be too low		1	AO3 5.3.2.2 WS 3.7
	so the calculated percentage of aluminium would be **lower** than the true value		1	AO3 5.3.2.2 WS 3.7
		Total	**12**	
		TOTAL FOR PAPER	**70**	