

GCSE

COMBINED SCIENCE: TRILOGY

Chemistry Paper 2 Higher Tier

Mark scheme Practice Paper Series – Set 1 SGC/S1/C/2H

Version 1.1

This mark scheme is an original resource written for sciencegcse.co.uk to accompany the Set 1 practice paper SGC/S1/C/2H. 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 5.6–5.10. 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

For a question asking for a fixed number of responses, consider the whole answer, including extra responses. Each incorrect or contradictory response cancels one correct response; ignore neutral additions. Numbered answer lines do not limit marking to the first responses. This rule does not apply to extended answers.

3.2 Marking procedure for calculations

Full marks can be awarded for a correct numerical answer without working, unless the question asks for working to be shown. If the answer is incorrect, marks may be awarded for the correct stages of working shown in the mark scheme. Anything shown in brackets in the Answers column (for example the unit) is not required for the mark.

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

Any error in the answer to a structured question causes the loss of the mark(s) for that part only. Later parts should be marked on the assumption that the incorrect answer was correct, where the mark scheme indicates that error carried forward (ECF) applies.

3.5 Phonetic spelling

Accept misspelled or phonetic scientific terms when the intended answer is clear, unless the spelling could be confused with a different technical term. This also applies when the question asks for the name of a process or structure.

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 01.2 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	an assessment of the environmental impact of a product over all the stages of its life / from the raw materials to disposal	allow a description of the stages: extracting and processing raw materials, manufacturing and packaging, use, and disposal allow 'cradle to grave' ignore environmentally friendly	1	AO1 5.10.2.1								
01.2	<table><tr><td>Level 3 (5–6 marks)</td><td>A coherent evaluation that compares both types of bag using data from Table 1, covers at least three stages of the life cycle (raw materials, manufacture, use, disposal), explains the environmental consequences of the differences, and reaches a judgement that is justified by the comparison.</td></tr><tr><td>Level 2 (3–4 marks)</td><td>A comparison that uses data from Table 1 for at least two stages of the life cycle, with some explanation of the environmental consequences (for example, more energy used means more fossil fuels burned and more carbon dioxide released). A judgement may be given but it is not fully justified.</td></tr><tr><td>Level 1 (1–2 marks)</td><td>Simple, isolated comparisons, for example paper bags use more energy or plastic bags take longer to break down, with little or no explanation.</td></tr><tr><td>0 marks</td><td>No relevant content.</td></tr></table>		Level 3 (5–6 marks)	A coherent evaluation that compares both types of bag using data from Table 1, covers at least three stages of the life cycle (raw materials, manufacture, use, disposal), explains the environmental consequences of the differences, and reaches a judgement that is justified by the comparison.	Level 2 (3–4 marks)	A comparison that uses data from Table 1 for at least two stages of the life cycle, with some explanation of the environmental consequences (for example, more energy used means more fossil fuels burned and more carbon dioxide released). A judgement may be given but it is not fully justified.	Level 1 (1–2 marks)	Simple, isolated comparisons, for example paper bags use more energy or plastic bags take longer to break down, with little or no explanation.	0 marks	No relevant content.	6	AO3 5.10.2.1 5.10.2.2
Level 3 (5–6 marks)	A coherent evaluation that compares both types of bag using data from Table 1, covers at least three stages of the life cycle (raw materials, manufacture, use, disposal), explains the environmental consequences of the differences, and reaches a judgement that is justified by the comparison.											
Level 2 (3–4 marks)	A comparison that uses data from Table 1 for at least two stages of the life cycle, with some explanation of the environmental consequences (for example, more energy used means more fossil fuels burned and more carbon dioxide released). A judgement may be given but it is not fully justified.											
Level 1 (1–2 marks)	Simple, isolated comparisons, for example paper bags use more energy or plastic bags take longer to break down, with little or no explanation.											
0 marks	No relevant content.											

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	Indicative content • raw materials: plastic bags are made from crude oil, a finite / non-renewable resource; paper bags are made from trees, a renewable resource (if the trees are replanted), but cutting down trees can destroy habitats / reduce the carbon dioxide absorbed • manufacture: paper bags use much more energy (2600 MJ compared with 500 MJ, about five times as much) and much more water (1100 dm³ compared with 60 dm³); more energy means more fossil fuels burned and more carbon dioxide released • paper bags are much heavier (55 kg compared with 7 kg per 1000 bags), so more fuel is needed to transport them • use: plastic bags are stronger and are reused more times (2 to 4 times compared with 1 to 2), so fewer plastic bags are needed / the impact per use is lower • disposal: plastic bags are not biodegradable and take hundreds of years to break down in landfill, and they cause litter and harm to wildlife (e.g. in the sea); paper bags break down in a few months • plastic bags can be recycled, but many are not; paper bags can be recycled / composted • judgement, e.g. paper bags have the greater impact in the raw material and manufacturing stages while plastic bags have the greater impact at disposal, so neither is clearly better – reusing bags many times reduces the impact of both Credit other correct, relevant points. Credit a justified judgement either way. Data quoted from the table should be used as a comparison (e.g. more / less, or how many times), not simply copied.			
Total			7	
02.1	(a reaction in which) the products can react to form the reactants again or the reaction can go in both directions / forwards and backwards	ignore the reaction can be reversed (this repeats the question)	1	AO1 5.6.2.1
02.2	(the reverse reaction is) exothermic or energy is given out / transferred to the surroundings or the temperature rises	allow the forward reaction takes in energy but the reverse reaction gives out energy	1	AO2 5.6.2.2
	the same amount of energy is transferred (as in the forward reaction)	allow the energy given out equals the energy taken in when the crystals are heated	1	AO2 5.6.2.2
02.3	the forward and reverse reactions take place at the same rate	allow the rate of the forward reaction equals the rate of the reverse reaction do not accept the reaction has stopped	1	AO1 5.6.2.3
	(so) the amounts / concentrations of the reactants and products do not change (in the closed container)	allow the amounts of reactants and products stay constant do not accept there are equal amounts of reactants and products	1	AO1 5.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(a catalyst) provides a different pathway for the reaction	allow provides an alternative route	1	AO1 5.6.1.4
	(which has a) lower activation energy	allow (so) more particles have enough energy to react when they collide ignore 'speeds up the reaction' (given) do not accept the catalyst gives the particles more energy	1	AO1 5.6.1.4
Total			7	
03.1	pencil is insoluble in the solvent or pencil does not move / separate with the solvent	allow ink would dissolve / run / separate and mix with the dyes	1	AO1 5.8.1.3 RP 12
03.2	the solvent (the mobile phase) moves up / through the paper (the stationary phase)	allow the solvent carries the dyes up the paper	1	AO1 5.8.1.3 RP 12
	the dyes have different solubilities in the solvent / different attractions to the paper, so they move different distances	allow the dyes are distributed differently between the two phases do not accept the dyes have different masses / sizes	1	AO1 5.8.1.3 RP 12
03.3	Q and R	both needed for the mark, in either order if more than two dyes are given, apply the list rule (section 3.1)	1	AO3 5.8.1.3 RP 12
03.4	$(R_f =) 6.7 \div 8.0 = 0.8375$	an answer of 1.2 ($8.0 \div 6.7$) scores 0	1	AO2 5.8.1.3 MS 1c, 2a RP 12
	= 0.84 (to 2 significant figures)	an answer of 0.84 scores 2 marks an answer of 0.8375, 0.838, 0.83 or 0.8 scores 1 mark	1	AO2 5.8.1.3 MS 1c, 2a RP 12
03.5	the food colouring contains another dye / substance that is not P, Q, R or S	allow the food colouring contains an unknown dye allow the top spot is not one of the dyes tested	1	AO3 5.8.1.3 RP 12
03.6	dye P is a pure substance	allow P is a single compound / contains only one dye	1	AO3 5.8.1.1 5.8.1.3 RP 12
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(short wavelength) radiation from the Sun passes through the atmosphere and is absorbed by the Earth (warming the surface)		1	AO1 5.9.2.1
	the Earth emits long wavelength / infrared radiation		1	AO1 5.9.2.1
	greenhouse gases absorb the long wavelength radiation (and re-emit it in all directions), so less energy escapes into space	allow greenhouse gases trap the infrared radiation do not accept the greenhouse gases reflect the radiation do not accept the ozone layer traps the radiation	1	AO1 5.9.2.1
04.2	any one from: • (cattle / livestock) farming • rice growing (in paddy fields) • landfill sites / decay of waste • extracting / leaks of natural gas		1	AO1 5.9.2.2
04.3	$120 \times 12\,000 = 1\,440\,000$ (g)		1	AO2 5.9.2.4 MS 1a
	= 1.44 (tonnes)	allow 1.4 an answer of 1.44 scores 2 marks	1	AO2 5.9.2.4 MS 1a
04.4	any two from: • the cost / economic considerations (e.g. of new technology) • people may be unwilling to change their lifestyle • lack of international agreement / cooperation • lack of public information / education • alternatives (such as renewable energy) may not be available / reliable • scientific uncertainty about the effects		2	AO1 5.9.2.4
Total			8	
05.1	exothermic	this mark can only be awarded with a reason	1	AO3 5.6.2.6
	as the temperature increases , the percentage of N_2O_4 (the product) decreases	allow the converse allow the data quoted, e.g. 68% at 25 °C but 6% at 100 °C	1	AO3 5.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	increasing the temperature moves the equilibrium in the direction of the endothermic reaction, so the reverse reaction is endothermic (and the forward reaction is exothermic)	allow the equilibrium shifts to the left when the temperature rises, so the reverse reaction takes in energy	1	AO3 5.6.2.4 5.6.2.6
05.2	the colour becomes paler / lighter (brown)	allow less brown / nearly colourless allow ECF from an answer of endothermic in 05.1 (the colour becomes darker), with the correct reasoning	1	AO2 5.6.2.6
	lowering the temperature moves the equilibrium in the exothermic direction / to the right, so more (colourless) N_2O_4 and less (brown) NO_2 is present		1	AO2 5.6.2.6
05.3	the amount of NO_2 decreases	allow more N_2O_4 forms	1	AO2 5.6.2.7
	increasing the pressure moves the equilibrium to the side with fewer molecules (of gas): 1 molecule of N_2O_4 compared with 2 molecules of NO_2	allow fewer moles of gas the equilibrium shifts to the right to reduce the pressure, with no reference to fewer molecules, does not score this mark ignore references to the colour	1	AO2 5.6.2.4 5.6.2.7
Total			7	
06.1	any one from: - the size of the pieces / the surface area of the calcium carbonate - the temperature (of the acid)	allow the same form of calcium carbonate, e.g. all powder or all chips ignore the mass of calcium carbonate / the volume of acid (given in the question) do not accept the concentration of the acid (the independent variable)	1	AO2 5.6.1.2 WS 2.2 RP 11
06.2	tangent drawn to the 1.0 mol/dm^3 curve at 20 s	the tangent must touch the curve at 20 s without crossing it near that point	1	AO2 5.6.1.1 MS 4e RP 11
	gradient calculated from the tangent, e.g. change in volume $\div$ change in time	allow values read from a correctly drawn tangent	1	AO2 5.6.1.1 MS 4e RP 11
	1.2 (cm^3/s)	allow 1.0 to 1.3 an answer in this range with no tangent drawn on the graph scores 1 mark	1	AO2 5.6.1.1 MS 4e RP 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	time to produce 30 cm ³ : about 21 s with the 1.0 mol/dm ³ acid and about 41 s with the 0.5 mol/dm ³ acid	allow 20 to 22 s and 40 to 43 s allow mean rates calculated from these times, e.g. $30 \div 21 = 1.4 \text{ cm}^3/\text{s}$ and $30 \div 41 = 0.73 \text{ cm}^3/\text{s}$	1	AO3 5.6.1.2 MS 4a RP 11
	the time halves when the concentration doubles, so the rate doubles and the conclusion is supported	allow the time is about half / the rate is about double allow ECF from incorrect times allow the conclusion is supported but only two concentrations were tested, so more results are needed to be sure	1	AO3 5.6.1.2 MS 4a RP 11
06.4	(moles of CaCO ₃ =) $0.25 \div 100 = 0.0025$ (mol)	allow moles of CO ₂ = 0.0025 (1 : 1 ratio)	1	AO2 5.6.1.1 MS 1a, 1b
	(mean rate =) $0.0025 \div 100$	allow ECF from an incorrect number of moles	1	AO2 5.6.1.1 MS 1a, 1b
	= 2.5×10^{-5} (mol/s)	an answer of 2.5×10^{-5} scores 3 marks an answer of 0.000025 (not in standard form) scores 2 marks an answer of 2.5×10^{-3} (moles not divided by the time) scores 1 mark	1	AO2 5.6.1.1 MS 1a, 1b
06.5	(in the 1.0 mol/dm ³ acid) there are more acid particles in the same volume	allow the acid particles are closer together / more crowded	1	AO1 5.6.1.3
	(so) there are more frequent collisions (between the acid particles and the calcium carbonate)	allow more collisions per second do not accept more collisions alone ignore more energy / faster particles	1	AO1 5.6.1.3
06.6	the same mass / amount of calcium carbonate was used (and the acid was in excess), so the same amount of carbon dioxide was produced	allow the calcium carbonate was the limiting reactant in both experiments	1	AO2 5.6.1.1
Total			12	
07.1	sedimentation (in settlement tanks) to produce sewage sludge and effluent		1	AO1 5.10.1.3
	anaerobic digestion of the (sewage) sludge	allow the sludge is broken down by bacteria without oxygen (producing methane / biogas)	1	AO1 5.10.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	aerobic (biological) treatment of the effluent	allow air is bubbled through the effluent so that bacteria break down the organic matter	1	AO1 5.10.1.3
07.2	(test) damp (blue) litmus paper	allow damp universal indicator paper do not accept dry litmus paper	1	AO1 5.8.2.4
	(result) the paper is bleached / turns white	allow blue litmus turns red then white this mark can be awarded if litmus / indicator paper is used but damp is not given	1	AO1 5.8.2.4
07.3	plants are grown on (soil containing) a low-grade ore and absorb copper compounds (through their roots)		1	AO1 5.10.1.4
	the plants are harvested and burned (the ash contains copper compounds)		1	AO1 5.10.1.4
07.4	bacteria are used to produce a solution (leachate) that contains copper compounds (from the ore)	allow bacteria dissolve / leach copper compounds / ions out of the ore ignore references to acid do not accept bacteria produce copper (metal)	1	AO1 5.10.1.4
07.5	iron is more reactive than copper (so it displaces copper from its compounds)	allow iron is higher in the reactivity series than copper do not accept iron reacts with copper	1	AO2 5.10.1.4
07.6	(mass of ore =) $1.0 \div 0.0025$ or $1.0 \times 100 \div 0.25$	an answer of 400 scores 2 marks	1	AO2 5.10.1.4 MS 1c
	(mass of ore =) 400 (tonnes)	an answer of 0.0025 or 0.25 scores 0 marks	1	AO2 5.10.1.4 MS 1c
Total			11	
08.1	(it is / it acts as a) catalyst	allow it speeds up the cracking (reaction) ignore it heats the paraffin do not accept it absorbs the paraffin	1	AO1 5.7.1.4
08.2	(otherwise) cold water would be sucked back (into the boiling tube)	allow the gas in the tube would cool / contract or the pressure would fall, so water would be drawn back ignore to stop the gas escaping	1	AO2 5.7.1.4 WS 2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	the hot boiling tube would crack / shatter	allow the tube would break	1	AO2 5.7.1.4 WS 2.4
08.3	3 (C ₂ H ₄)		1	AO2 5.7.1.4
08.4	the supply of fuel oil and bitumen is greater than the demand : 54% compared with 34%	max 1 mark if no data from Table 3 are quoted	1	AO3 5.7.1.4 MS 1c
	the demand for a fraction with smaller molecules is greater than the supply , e.g. petrol: 34% compared with 20%, so cracking converts the excess large molecules into smaller, more useful molecules	allow refinery gases (8% compared with 5%) or diesel oil (24% compared with 21%) allow cracking produces alkenes (for making polymers / other chemicals) in place of smaller, more useful molecules	1	AO3 5.7.1.4 MS 1c
08.5	16 (CO ₂) and 18 (H ₂ O)	2C ₈ H ₁₈ + 25O ₂ → 16CO ₂ + 18H ₂ O	1	AO2 5.7.1.3
	25 (O ₂)	allow ECF for oxygen from incorrect numbers of CO ₂ and H ₂ O if the oxygen atoms balance	1	AO2 5.7.1.3
08.6	carbon monoxide is toxic / poisonous	allow it reduces the amount of oxygen the blood can carry / it combines with haemoglobin (in red blood cells)	1	AO1 5.9.3.2
	it is colourless and odourless, so it is not easily detected	allow it cannot be seen or smelled allow colourless or odourless if linked to it not being detected / noticed ignore it cannot be detected unless linked to colour / smell	1	AO1 5.9.3.2
Total			10	
TOTAL FOR PAPER			70	