

GCSE

CHEMISTRY

Paper 2 Higher Tier

Mark scheme Practice Paper Series – Set 1 SGC/S1/SC/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/SC/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 Chemistry (8462) specification, sections 4.6–4.10 (Paper 2 may also draw on sections 4.1–4.3). 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 (questions 05.4 and 07.4 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	any two from: - the percentage of carbon dioxide decreased (from 95% to 0.04%) - the percentage of oxygen increased (from 0 to 21%) - the percentage of nitrogen increased (from 3% to 78%)	figures from the table are not required allow the percentage of other gases decreased (from 2% to 1%)	2	AO3 4.9.1.4 MS 2c
01.2	carbon dioxide dissolved in the (water of the) oceans		1	AO1 4.9.1.2 4.9.1.4
	carbonates were precipitated / formed sediments , producing sedimentary rocks (such as limestone)	allow carbon dioxide was used to make the shells of sea creatures, which formed limestone	1	AO1 4.9.1.4
01.3	plants / trees took in carbon dioxide (from the atmosphere) for photosynthesis	allow plants used carbon dioxide to make glucose / their tissues	1	AO1 4.9.1.4
	the remains of the plants were buried and compressed (over millions of years), so the carbon was locked up in the coal	allow the plants did not decay so the carbon was not released	1	AO1 4.9.1.4
01.4	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	all three numbers are needed for the mark	1	AO2 4.9.1.3
01.5	(moles of CO_2 =) $66 \div 44 = 1.5$ (mol)	M_r of $\text{CO}_2 = 44$	1	AO2 4.9.1.3 4.3.2.2 MS 1a, 3c
	(moles of O_2 =) 1.5 (mol)	the ratio $\text{CO}_2 : \text{O}_2$ is $6 : 6 = 1 : 1$ allow ECF from 01.4	1	AO2 4.9.1.3 4.3.2.2 MS 1a, 3c
	(mass of $\text{O}_2 = 1.5 \times 32 =$) 48 (g)	an answer of 48 scores 3 marks allow a correct method using reacting masses: $66 \times (6 \times 32) \div (6 \times 44) = 48$ for 3 marks an answer of 24 (M_r of 16 used for oxygen gas) scores 2 marks	1	AO2 4.9.1.3 4.3.2.2 MS 1a, 3c
Total			10	
02.1	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 4.8.1.3 RP 6
02.2	the solvent (the mobile phase) moves up / through the paper (the stationary phase)	allow the solvent carries the dyes up the paper	1	AO1 4.8.1.3 RP 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	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 4.8.1.3 RP 6
02.3	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 4.8.1.3 RP 6
02.4	$(R_f =) 6.7 \div 8.0 = 0.8375$	an answer of 1.2 ($8.0 \div 6.7$) scores 0	1	AO2 4.8.1.3 MS 1c, 2a RP 6
	= 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 4.8.1.3 MS 1c, 2a RP 6
02.5	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 4.8.1.3 RP 6
02.6	dye P is a pure substance	allow P is a single compound / contains only one dye	1	AO3 4.8.1.1 4.8.1.3 RP 6
Total			8	
03.1	C ₃ H ₆	allow CH ₂ =CHCH ₃ do not accept propene (a formula is needed to complete the equation)	1	AO2 4.7.1.4
03.2	three carbon atoms joined by single bonds, with one Br atom on each of the two carbon atoms that were joined by the double bond	a C=C double bond in the product scores 0 for this mark	1	AO2 4.7.2.2
	six H atoms correctly placed, with all bonds shown	i.e. CH ₂ Br–CHBr–CH ₃ drawn as a displayed formula	1	AO2 4.7.2.2
03.3	C ₃ H ₈	allow propane allow CH ₃ CH ₂ CH ₃	1	AO2 4.7.2.2
03.4	propanoic acid is a weak acid, so it is only partially ionised (in water)	allow only some of the molecules release H ⁺ ions	1	AO2 4.7.2.4
	hydrochloric acid is a strong acid, so it is completely ionised (in water)	allow fully dissociated	1	AO2 4.7.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(so) the concentration of H⁺ ions is lower in the propanoic acid (so its pH is higher)	allow the converse for hydrochloric acid do not accept propanoic acid is more dilute	1	AO2 4.7.2.4
03.5	sodium propanoate	allow C ₂ H ₅ COONa	1	AO2 4.7.2.4
03.6	ethanol and ethanoic acid	both needed for the mark, in either order	1	AO1 4.7.2.4
	an acid (catalyst)	allow (concentrated) sulfuric acid	1	AO1 4.7.2.4
Total			10	
04.1	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 4.6.1.2 WS 2.2 RP 5
04.2	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 4.6.1.1 MS 4e RP 5
	gradient calculated from the tangent, e.g. change in volume ÷ change in time	allow values read from a correctly drawn tangent	1	AO2 4.6.1.1 MS 4e RP 5
	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 4.6.1.1 MS 4e RP 5
04.3	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 ÷ 21 = 1.4 cm ³ /s and 30 ÷ 41 = 0.73 cm ³ /s	1	AO3 4.6.1.2 MS 4a RP 5
	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 4.6.1.2 MS 4a RP 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(moles of CaCO_3 $\Rightarrow$) $0.25 \div 100 = 0.0025$ (mol)	allow moles of $\text{CO}_2 = 0.0025$ (1 : 1 ratio)	1	AO2 4.6.1.1 MS 1a, 1b
	(mean rate $\Rightarrow$) $0.0025 \div 100$	allow ECF from an incorrect number of moles	1	AO2 4.6.1.1 MS 1a, 1b
	$= 2.5 \times 10^{-5}$ (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 4.6.1.1 MS 1a, 1b
04.5	(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 4.6.1.3
	(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 4.6.1.3
04.6	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 4.6.1.1
Total			12	
05.1	calcium	allow Ca^{2+} more than two metal ions given: deduct one mark for each extra ion	1	AO3 4.8.3.7
	lithium	allow Li^+ allow in either order	1	AO3 4.8.3.7
05.2	it can identify the ions in a mixture (the flame colours of calcium and lithium are similar / one masks the other)	allow more accurate / more sensitive / rapid / can measure the concentration of the ions ignore easier / cheaper	1	AO1 4.8.3.6
05.3	(colour) green	allow grey-green	1	AO1 4.8.3.2 RP 7
	$\text{FeSO}_4 + 2\text{NaOH} \rightarrow \text{Fe(OH)}_2 + \text{Na}_2\text{SO}_4$		1	AO2 4.8.3.2

Question	Answers		Extra information	Mark	AO / Spec. Ref.
05.4	Level 3 (5–6 marks)	A logical, complete plan with correct reagents and results that uniquely identifies all three named solids. Any valid sequence of discriminating tests is acceptable, including anion tests alone; tests for both ions are not required.		6	AO3 4.8.3.1–4.8.3.5 WS 2.2 RP 7
	Level 2 (3–4 marks)	A plan with mostly correct tests and results that would identify at least two solids, but has an omission or error preventing reliable identification of all three.			
	Level 1 (1–2 marks)	One or two relevant tests or reagents named, with few correct results.			
	0 marks	No relevant content.			
	Indicative content - dissolve a sample of each solid in (distilled) water; use a fresh sample for each test - add a few drops of sodium hydroxide solution: all three solutions form a white precipitate - add excess sodium hydroxide solution: the precipitate dissolves only for aluminium sulfate flame test with a clean wire loop in a blue Bunsen flame: calcium chloride gives an orange-red flame; magnesium bromide gives no colour - add dilute hydrochloric acid then barium chloride solution: a white precipitate shows sulfate ions (aluminium sulfate) - add dilute nitric acid then silver nitrate solution: a white precipitate shows chloride ions (calcium chloride); a cream precipitate shows bromide ions (magnesium bromide) - anion tests alone can distinguish all three named solids Credit other correct, relevant points. Do not credit hydrochloric acid used before silver nitrate (it adds chloride ions) or sulfuric acid used before barium chloride (it adds sulfate ions).				
Total				11	
06.1	two carbon atoms joined by a single bond, with four F atoms	do not accept a C=C double bond		1	AO2 4.7.3.1
	brackets with trailing bonds through them and <i>n</i> after the brackets			1	AO2 4.7.3.1
06.2	an ester link (–O–C(=O)– / –COO–) joining the two blocks	allow the link drawn as a displayed or a structural formula		1	AO2 4.7.3.2
	repeating unit containing one of each block , with brackets / trailing bonds and <i>n</i>	e.g. –[O–□–O–CO–■–CO] _{<i>n</i>} –		1	AO2 4.7.3.2
	(other product) water	allow either 2 <i>n</i> or (2 <i>n</i> - 1) as the water coefficient; a coefficient is not required		1	AO2 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any two from: - addition: the monomers have a C=C double bond or condensation: the monomers have two functional groups - condensation also produces a small molecule (such as water) or addition produces only the polymer - condensation usually uses two different monomers or addition can use one type of monomer - in addition polymers the repeating unit has the same atoms as the monomer	each difference must refer to both types of polymerisation, or the comparison must be clear	2	AO1 4.7.3.1 4.7.3.2
06.4	amine (–NH ₂) and carboxylic acid (–COOH)	both needed for the mark allow amino group	1	AO1 4.7.3.3
06.5	polypeptide	allow protein	1	AO1 4.7.3.3
06.6	nucleotides	ignore bases	1	AO1 4.7.3.4
Total			10	
07.1	57 (%)	allow 56 to 58	1	AO2 4.10.4.1 MS 4a
07.2	there are fewer molecules (moles) of gas on the right-hand side of the equation (2 compared with 4)	allow fewer moles of product than of reactants	1	AO1 4.6.2.7
	increasing the pressure shifts the (position of) equilibrium to the side with fewer molecules / to the right	allow the equilibrium shifts to reduce the pressure do not accept the rate increases (for this mark)	1	AO1 4.6.2.7
07.3	the forward reaction is exothermic, so the reverse reaction is endothermic		1	AO2 4.6.2.6
	increasing the temperature shifts the (position of) equilibrium in the endothermic direction / to the left	allow the equilibrium shifts to absorb the extra energy / to lower the temperature	1	AO2 4.6.2.6

Question	Answers		Extra information	Mark	AO / Spec. Ref.
07.4	Level 3 (5–6 marks)	A detailed and coherent explanation of the compromise for both temperature and pressure, linking each condition to both the rate and the yield (and to cost or safety), together with the role of the catalyst.		6	AO1 4.10.4.1 4.6.2.4
	Level 2 (3–4 marks)	An explanation of the effect of temperature or pressure on both the rate and the yield, or a description of the compromise for both conditions without full explanation.			
	Level 1 (1–2 marks)	Simple statements, for example a high pressure gives more ammonia or the catalyst speeds up the reaction, with little explanation.			
	0 marks	No relevant content.			
	Indicative content • temperature: a lower temperature would give a higher yield (the forward reaction is exothermic) but the rate would be too slow • a higher temperature gives a faster rate but a lower yield, so 450 °C is a compromise between rate and yield • pressure: a higher pressure gives a higher yield (fewer molecules of gas on the right) and a faster rate (particles closer together, more frequent collisions) • but very high pressures are expensive (energy for the compressors, stronger reaction vessels and pipes) and more dangerous • so 200 atmospheres is a compromise between the yield and rate and the cost / safety • the iron catalyst increases the rate (provides a pathway with a lower activation energy), so a reasonable rate is reached at a lower temperature • the catalyst does not change the yield / the position of equilibrium • the unreacted nitrogen and hydrogen are recycled, so a low yield on each pass through the reactor is acceptable • cooling removes the ammonia as a liquid, so it is not converted back into nitrogen and hydrogen Credit other correct, relevant points. Answers that only describe the conditions without explaining them should be placed in Level 1.				
Total			11		
08.1	to increase crop yields / agricultural productivity or to replace the elements / mineral ions used by plants	allow to help plants grow (better)	1	AO1 4.10.4.2	
08.2	$(M_r =) (2 \times 14) + (8 \times 1) + 32 + (4 \times 16) = 132$		1	AO2 4.10.4.2 4.3.1.2 MS 1c	
	$(28 \div 132) \times 100$	allow ECF from an incorrect M_r $14 \div 132 \times 100 = 10.6$ scores 1 mark (the M_r mark)	1	AO2 4.10.4.2 4.3.1.2 MS 1c	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	= 21.2 (%)	allow 21 / 21.21 an answer of 21.2 scores 3 marks	1	AO2 4.10.4.2 4.3.1.2 MS 1c
08.3	phosphate rock is insoluble (so plants cannot absorb the phosphorus)		1	AO1 4.10.4.2
	the acid converts it into soluble salts (which plants can absorb)	allow produces a soluble fertiliser	1	AO1 4.10.4.2
08.4	triple superphosphate	allow calcium phosphate	1	AO1 4.10.4.2
08.5	(mined) potassium chloride or potassium sulfate	allow mining	1	AO1 4.10.4.2
08.6	any two from: - industry needs very large amounts, so a continuous process in large reactors is used - making the starting materials from cheap raw materials costs less than buying them - using the energy released by the reactions reduces energy costs - titration and crystallisation are too slow / only make small amounts	answers must give a reason, not just a difference copied from the table	2	AO3 4.10.4.2
Total			10	
09.1	2 (tonnes)	$500 \times 0.4 \div 100$	1	AO2 4.10.1.4 MS 1c
09.2	plants are grown on the low-grade ore / on land containing copper compounds		1	AO1 4.10.1.4
	the plants absorb copper compounds (through their roots)	allow absorb copper ions do not accept absorb copper (metal)	1	AO1 4.10.1.4
	the plants are harvested and burned , and the ash contains copper compounds		1	AO1 4.10.1.4
09.3	iron is more reactive than copper	allow iron is higher in the reactivity series	1	AO2 4.10.1.4
	(so) iron displaces copper from the solution (of the copper compound)	allow iron takes the place of the copper in the compound	1	AO2 4.10.1.4
09.4	bronze or cupronickel	brass scores 0 for both marks	1	AO3 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	a reason using the data, e.g. - bronze: harder than brass and has good resistance to corrosion in sea water, at a lower cost than cupronickel - cupronickel: hard and has the best resistance to corrosion in sea water (the extra cost is worth it)	the reason must compare at least two properties from Table 3	1	AO3 4.10.3.2
09.5	zinc is more reactive than iron		1	AO2 4.10.3.1
	(so) the zinc reacts / corrodes (is oxidised) instead of the iron – sacrificial protection	allow the zinc loses electrons more easily than iron do not accept the zinc forms a barrier (the coating is scratched)	1	AO2 4.10.3.1
Total			10	
10.1	(short wavelength) radiation from the Sun passes through the atmosphere and is absorbed by the Earth (warming the surface)		1	AO1 4.9.2.1
	the Earth emits long wavelength / infrared radiation		1	AO1 4.9.2.1
	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 4.9.2.1
10.2	any one from: (cattle / livestock) farming - rice growing (in paddy fields) - landfill sites / decay of waste - extracting / leaks of natural gas		1	AO1 4.9.2.2
10.3	$120 \times 12\,000 = 1\,440\,000$ (g)		1	AO2 4.9.2.4 MS 1a
	= 1.44 (tonnes)	allow 1.4 an answer of 1.44 scores 2 marks	1	AO2 4.9.2.4 MS 1a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	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 4.9.2.4
Total			8	
TOTAL FOR PAPER			100	