GCSE
CHEMISTRY
8462/2F

Paper 2 Foundation Tier

Mark scheme

June 2023

Version: 1.0 Final

2 3 6 G 8 4 6 2 / 2 F / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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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 typical answer or answers which are expected
- extra information to help the examiner make their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name **two** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

3.4 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.

3.5 Errors carried forward

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	Mars		1	AO1 4.9.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	20%		1	AO1 4.9.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	algae and plants evolved photosynthesis took place		1 1	AO1 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(*y*-axis labelled) 5, 10, 15, (20) oxygen bar drawn to 16%	allow (*y*-axis labelled) 4, 8, 12, 16, (20) ignore correct intermediate values allow a tolerance of ± ½ a small square	1 1	AO2 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	test tube **A**		1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	a glowing splint		1	AO1 4.8.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	manganese dioxide is a catalyst in this reaction		1	AO2 4.6.1.4

Total Question 1	**9**

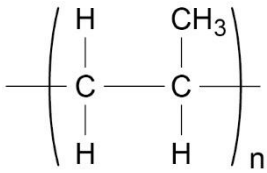
Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(the poly(propene) beaker will begin to) melt	allow poly(propene) has a low melting point	1	AO3 4.7.3.1
	(the poly(propene) beaker will) burn / ignite	allow poly(propene) is flammable	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(poly(propene) beakers are) less easily broken	allow (poly(propene) beakers are) less likely to shatter allow (poly(propene) beakers are) tougher allow (poly(propene) beakers have a) higher resistance to impact	1	AO3 4.7.3.1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	boron trioxide		1	AO1 4.10.3.3

Question	Answers	Mark	AO / Spec. Ref.
02.4	<table><tr><th>Symbol for element</th><th>Name of element</th><th>Number of atoms of element in one molecule of propene</th></tr><tr><td>C</td><td>carbon</td><td>3</td></tr><tr><td>H</td><td>hydrogen</td><td>6</td></tr></table> if no other mark awarded allow **1** mark for a correct column	1 1	AO1 AO2 4.1.1.1 4.7.2.1

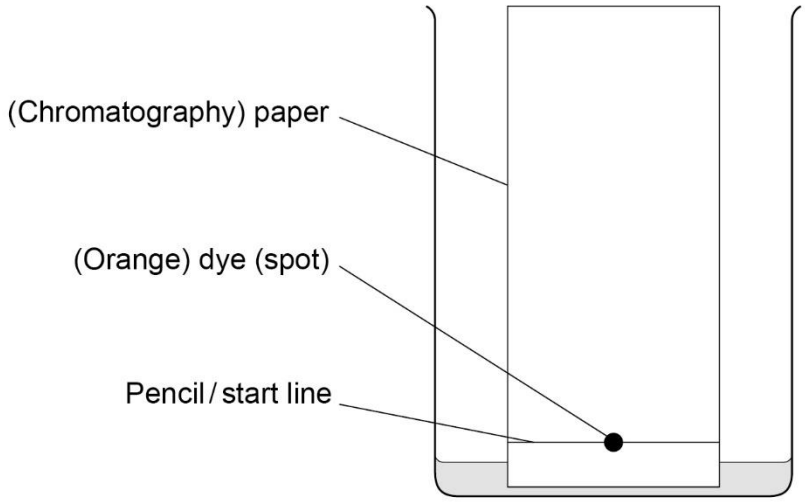
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5			1	AO2 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(**Stage 1** is) fractional distillation		1	AO1
	(**Stage 2** is) cracking		1	AO2
	(**Stage 3** is) polymerisation		1	AO2
				4.7.1.2 4.7.1.4 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	alkene		1	AO2 4.7.2.1
	monomer		1	4.7.3.1

Total Question 2	**12**

Question 3

Question	Answers	Mark	AO / Spec. Ref.
03.1		1 1 1	AO1 4.8.1.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	left the investigation for too long		1	AO3 4.8.1.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(there is) more than one spot **or** (there are) three spots		1	AO3 4.8.1.1 4.8.1.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(distance moved by red spot) = 1.8 (cm)	allow a value in the range 1.6 to 2.0 (cm)	1	AO2 4.8.1.3 RPA6
	(distance moved by solvent) = 7.2 (cm)	allow a value in the range 7.1 to 7.3 (cm)	1	
	$(R_f =) \frac{1.8}{7.2}$	allow correct use of incorrectly determined distance(s)	1	
	= 0.25		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	dark yellow spot		1	AO3 4.8.1.3 RPA6

Total Question 3	**10**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	water (vapour) is colourless (calcium hydroxide and calcium oxide are) both white (powders / solids) **or** there is no change in the appearance of the powder / solids	allow water vapour cannot be seen	1 1	AO3 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the stopper would be pushed out	allow test tube may break	1	AO3 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	the mass of the empty test tube		1	AO2 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	5 minutes		1	AO2 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(mass =) 2.00 – 1.51 = 0.49 (g)		1 1	AO2 4.3.1.1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	5.90 kJ		1	AO2 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	endothermic		1	AO2 4.6.2.2

Total Question 4	**9**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	carbon dioxide methane		1 1	AO1 4.9.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(greenhouse gases) maintain temperatures on Earth (high enough to support life)		1	AO1 4.9.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(greenhouse gases absorb long wavelength) radiation	(greenhouse gases absorb long wavelength) infra-red (radiation)	1	AO1 4.9.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	higher sea levels melting polar ice		1 1	AO1 4.9.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(mass =) $\frac{0.25}{100} \times 350$		1	AO2 4.9.1.1 4.9.2.1
	= 0.875 (kg)		1	
	= 875 (g)	allow a correct conversion of an incorrectly determined mass	1	
	alternative approach: 350 kg = 350 000 g (1) (mass =) $\frac{0.25}{100} \times 350\,000$ (1) = 875 (g) (1)	allow correct use of incorrect / no conversion of mass		

Total Question 5	**9**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	coal is a solid	ignore references to cost	1	AO3 4.2.2.1
	(so solid) coal cannot flow through pipelines	allow (so) coal has to be made into a slurry to flow through pipelines	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2		MP2 is dependent upon MP1 being awarded		AO3 4.9.3.1
	(fuel) coal		1	
	(reason) (coal contains the) highest percentage of sulfur		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any **one** from: • acid rain • respiratory problems (in humans)	allow specified effects of acid rain allow specified respiratory problems	1	AO1 4.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		MP2 is dependent upon MP1 being awarded		AO3 4.9.3.1
	(fuel) (natural) gas		1	
	(reason) (natural gas produces) fewer / fewest solid particles		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **one** from: • global dimming • health problems for humans		1	AO1 4.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	combustion		1	AO1 4.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	any **three** from: • more oil is used than gas • use of oil has decreased overall • use of oil increased in some years • there was a large drop in use of oil between 2019 and 2020 • use of natural gas decreased overall • use of natural gas increased in some years • use of natural gas remained fairly constant from 2014 to 2020		3	AO2 4.9.2.4 4.9.3.1

Total Question 6	**12**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	carbon		1	AO1 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	chromium nickel		1 1	AO1 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	hard resistant to corrosion	in either order	1 1	AO1 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(percentage of titanium = 100 – 3.0 – 2.5) = 94.5 (%) (mass =) $\frac{94.5}{100} \times 5.0$ = 4.725 (kg) **alternative approach:** (mass of Al + V = $\frac{5.5}{100} \times 5.0$ =) 0.275 (kg) (1) (mass of titanium =) 5 – 0.275 (1) = 4.725 (kg) (1)	allow correct use of incorrectly determined percentage of titanium allow 4.7 / 4.73 (kg) allow correct use of incorrectly determined mass of Al and V allow 4.7 / 4.73 (kg)	1 1 1	AO2 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(both are) strong	allow (both contain) more aluminium	1	AO3 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	tin is toxic	allow tin reacts in the body	1	AO3 4.10.3.2

Total Question 7	**10**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	to reduce the escape of gas		1	AO3 4.6.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	(mean rate =) $\frac{0.78 + 0.81 + 0.81}{3}$	allow $\frac{0.78 + 0.81 + 0.68 + 0.81}{4}$	1	AO3
	0.80 (cm^3/s)	= 0.77 (cm^3/ s) for **1** mark	1	AO2
	$0.80 = \frac{20}{\text{mean time taken}}$	allow correct use of incorrectly determined mean rate	1	AO2
	(mean time taken =) $\frac{20}{0.80}$		1	AO2
	= 25 (s)		1	AO2 4.6.1.1 RPA5
	alternative approach: $0.78 = \frac{20}{\text{time}}$ **or** $0.81 = \frac{20}{\text{time}}$ (1)			
	(trial 1 time = $\frac{20}{0.78}$ =) 25.6 (1)			
	(trial 2 and 4 time = $\frac{20}{0.81}$ =) 24.7 (1)			

	(mean time =) $\frac{25.6 + (2 \times 24.7)}{3}$ (1) = 25 (s) (1)	allow correct use of incorrectly determined value(s) for time allow $\frac{25.6 + 29.4 + (2 \times 24.7)}{4}$ = 26.1 (s) for **1** mark		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	use a lower temperature use sulfuric acid of a lower concentration		1 1	AO1 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	(test) burning / lit splint (result) burns with a (squeaky) pop sound	MP2 is dependent upon MP1 being awarded allow flame do **not** accept glowing splint allow pops	 1 1	AO1 4.8.2.1

Total Question 8	**10**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(mass =) $\frac{39.8}{29.6}$ $(\times 1)$ = 1.34 (g)	 allow 1.34459459 (g) correctly rounded to at least 2 significant figures	1 1	AO2 4.7.2.3

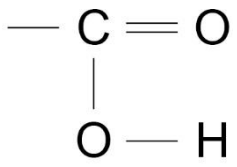
Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	all six points plotted correctly	allow a tolerance of ± ½ a small square allow **1** mark for four or five points plotted correctly	2	AO2 4.7.2.3

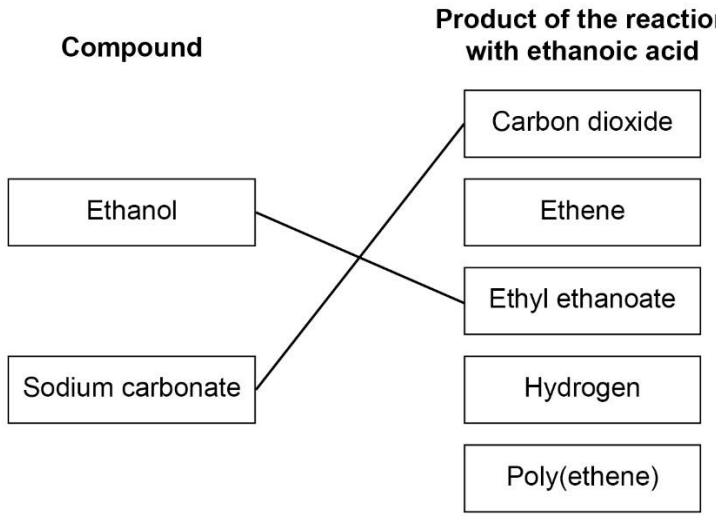
Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	40.6 (kJ)	allow a value in the range 40.4 – 40.8 (kJ) allow a value consistent with the plotted points	1	AO2 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	calcium hydroxide		1	AO1 4.8.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	(limewater turns) milky / cloudy	allow white precipitate (formed) allow calcium carbonate is produced	1	AO1 4.8.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	an oxidising agent		1	AO1 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7			1	AO1 4.7.2.4

Question	Answers	Mark	AO / Spec. Ref.
09.8	 do **not** accept more than **one** line from a box on the left	1 1	AO1 4.7.2.4

Total Question 9	11

Question 10

Question	Answers	Mark	AO/ Spec. Ref
10.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.8.3.1 4.8.3.4 RPA7
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content (potassium ions) • **place sample on (clean metal) wire** • **introduce into (blue / non-luminous) flame** • using (Bunsen) burner • **observe lilac flame colour** • which shows presence of potassium (ions) (bromide ions) • **dissolve sample** • in (distilled) water • in test tube • add (dilute) nitric acid • **add silver nitrate (solution)** • using (dropping) pipette • **observe cream precipitate (formed after addition of silver nitrate solution)** • which shows presence of bromide (ions)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	flame emission spectroscopy		1	AO1 4.8.3.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	any **one** from: • (more) accurate • (more) sensitive • fast(er) • determine the concentration of ions present	allow requires a small(er) sample	1	AO1 4.8.3.6

Total Question 10	**8**