GCSE
CHEMISTRY
8462/1H

Paper 1 Higher Tier

Mark scheme

June 2024

Version: 1.0 Final

246G8462/1H/MS

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

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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 should be awarded for a correct numerical answer, without any working shown.
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	copper sulfate water	allow $CuSO_4$ allow H_2O	1 1	AO2 AO1 4.4.2.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	solid remains (in the mixture) **or** no more effervescence / bubbles / fizzing	ignore references to colours allow copper carbonate remains (in the mixture)	1	AO1 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	to remove copper carbonate	allow to remove excess (copper carbonate)	1	AO1 4.1.1.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	electric heater **or** water bath	ignore Bunsen burner	1	AO1 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$92.8 = \frac{\text{mass produced}}{12.5} \times 100$	allow mass produced = % yield × $\frac{\text{max theoretical mass}}{100}$	1	AO2 4.3.3.1
	(mass produced) = $\frac{92.8}{100} \times 12.5$		1	
	= 11.6 (g)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	(copper) does not react with (sulfuric) acid	allow is unreactive allow will not displace hydrogen allow is below hydrogen in the reactivity series ignore is not reactive enough	1	AO1 AO3 4.4.1.2 4.4.2.3
	(sodium) could explode **or** could get too hot	allow (the reaction is) dangerous	1	

Total Question 1	**10**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(similarity) both have one outer (shell) electron	allow energy level for shell allow same number of outer (shell) electrons	1	AO1 4.1.2.1
	(difference) sodium has 3 shells but potassium has 4 shells	allow potassium has more shells allow (different) number of shells	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	any **two** from: • effervescence / bubbles / fizzing • (potassium) floats • (potassium) moves around • (potassium) becomes smaller • (potassium) melts • flame • explosion	ignore gas produced allow (potassium) forms a ball ignore colour of flame	2	AO1 4.1.2.5 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	blue / violet / purple		1	AO2
	(the solution is) alkaline	allow (the solution) contains OH^- (ions) allow (the solution) contains hydroxide ions allow the solution is basic	1	AO1 4.1.2.5 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	all five points correctly plotted	allow a tolerance of ± ½ a small square allow **1** mark for three or four points correctly plotted	2	AO2 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	3.4 (mg/cm^3)	allow a value in the range 3.0 to 3.8 (mg/cm^3)	1	AO3 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	chlorine and potassium bromide		1	AO2 4.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	relative molecular mass increases and boiling point increases		1	AO1 4.1.2.6

Total Question 2	**11**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(model **A**) plum pudding (model **B**) Bohr	allow Thomson (model) allow nuclear (model) allow planetary (model) allow Rutherford-Bohr (model)	1 1	AO1 4.1.1.3

Question	Answers	Mark	AO / Spec. Ref.
03.2	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO1 4.1.1.3
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content	0	
	Indicative content **Similarities** • both contain electrons • both are neutral overall **Differences** • model **A** has no nucleus **or** the model used today has a nucleus • model **A** has no protons **or** the model used today has protons • model **A** has no neutrons **or** the model used today has neutrons • model **A** has positive charge spread throughout the atom **or** model **A** is a ball of positive charge • the model used today has the positive charge in the centre • model **A** the electrons are distributed randomly • the model used today has electrons in shells / energy levels • the mass was spread throughout model **A** • the mass is concentrated at the centre of the model used today • model **A** does not have empty space • model used today is mostly empty space		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	atoms with the same number of protons	allow atoms of the same element allow atoms with the same atomic number ignore references to electrons	1	AO1 4.1.1.5
	with different numbers of neutrons		1	

Total Question 3	**8**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	line of best fit using the first five points	max **1** mark if the lines do not intersect	1	AO3 4.5.1.1 RPA4
	line of best fit using the last four points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the temperature rises because the reaction is exothermic **or** the temperature rises because energy is transferred to the surroundings	allow heat for energy	1	AO2
	until 0.8 g (zinc) is added	allow a tolerance of ± ½ a small square allow until the temperature reaches 47 °C allow a correctly determined value for mass of zinc or temperature from the intersection of drawn lines of best fit	1	AO2
	(so) there is no additional reaction	allow (when) the reaction has finished	1	AO3
	(because) zinc is in excess **or** (because) copper sulfate is used up		1	AO3 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3		allow converse statements for glass		AO1 4.5.1.1 RPA4
	polystyrene is a better (thermal) insulator		1	
	(so) there is less energy transfer to the surroundings	allow (so) less energy is lost (to the surroundings) allow heat for energy	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ allow **1** mark for $Zn^{2+} + Cu$		2	AO2 4.1.1.1 4.2.2.2 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(mean highest temperature =) $\frac{37.6 + 37.2 + 37.8 + 37.4}{4}$	allow (mean highest temperature =) $\frac{150}{4}$	1	AO2 4.3.1.4
	= 37.5 (ºC)		1	
	37.5 (ºC) ± 0.3 (ºC)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	any **one** from: • starting temperature may be different • inconsistent stirring	ignore room temperature allow inconsistent use of a lid	1	AO3 4.5.1.1 RPA4

Total Question 4	**14**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	each calcium atom loses two electrons	allow **1** mark for calcium atoms lose electrons **and** chlorine atoms gain electrons	1	AO2 4.2.1.2
	(and) each chlorine atom gains one electron		1	
	(so) one calcium atom reacts with two chlorine atoms		1	
	(to form) Ca^{2+} ions **and** Cl^- ions **or** (to form) calcium ion(s) **and** chloride ion(s)	allow (to form) ions with full outer shells allow energy level for shell	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the ions cannot move	allow the ions are in fixed positions	1	AO1 4.2.2.3 4.4.3.1 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	hydrogen	allow H_2	1	AO2 4.4.3.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$2Cl^- \rightarrow Cl_2 + 2e^-$		1	AO2 4.1.1.1 4.4.3.4 4.4.3.5 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5		allow cathode for negative electrode allow anode for positive electrode allow attraction for movement		AO3 4.4.3.1
	Cu^{2+} / copper ions are blue **and** CrO_4^{2-} / chromate ions are yellow		1	
	(because) Cu^{2+} / copper ions move to the negative electrode		1	
	(and also) CrO_4^{2-} / chromate ions move to the positive electrode		1	

Total Question 5	**10**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(most reactive) Mg Zn Ni Cu Ag (least reactive)	allow name of metal for symbol allow **1** mark for (most reactive) Mg Zn Ni **or** Ni Cu Ag (least reactive)	2	AO3 4.4.1.2 4.5.2.1
	(justification) the higher the (positive) voltage the more reactive the metal	allow the most reactive (metal) has the highest (positive) voltage allow the least reactive (metal) has the most negative voltage allow the greater the difference in reactivity the greater the (magnitude of the) voltage	1	

Question	Answers	Mark	AO / Spec. Ref.
06.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3 4.3.4 4.5.2.1
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method 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 • **set up cell with sodium chloride solution as the electrolyte** • **use two different metals as electrodes** • **measure voltage** • **repeat at different concentrations of electrolyte solution** • **by diluting the sodium chloride solution with water** • using measured volumes of sodium chloride solution and water • measure volumes with a measuring cylinder (allow pipette / burette) • use the same two metals each time • use the same volume of electrolyte solution		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		ignore references to electrodes		AO1 4.5.2.2
	hydrogen is oxidised (electrochemically)	allow hydrogen loses electrons	1	
	to produce water		1	

Total Question 6	**11**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(thermal) energy is transferred	allow heat is transferred	1	AO1 4.2.1.5
	by delocalised electrons		1	4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2		allow (positive / metal) ions for atoms throughout		AO1 4.2.2.7
	(the alloy / mixture has) different sized atoms		1	
	(so the) layers are distorted		1	
	(so the) layers cannot easily slide	allow (so the) atoms cannot slide over each other	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$		1	AO2 4.3.1.1 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	$1\,Fe^{2+} : 2\,Fe^{3+} : 4\,O^{2-}$		1	AO2 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(M_r Fe_3O_4 =) 232		1	AO2 4.3.1.2
	(% Fe =) $\frac{3 \times 56}{232} \times 100$	allow $\frac{168}{232} \times 100$ allow correct use of an incorrectly determined M_r using the values of A_r given in the question	1	
	= 72.4 (%)	allow 72.41379 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6		a maximum of **4** marks can be awarded for a method which determines and uses the volume of iron oxide as a gas		AO2 4.3.2.1 4.3.2.2
	(40.0 kg =) 40 000 (g)		1	
	(moles Fe_2O_3 = $\frac{40\,000}{160}$ =) 250	allow correct use of an incorrectly converted or unconverted mass	1	
	(moles CO_2 = 250 × $\frac{3}{2}$ =) 375	allow correct use of an incorrectly determined number of moles of Fe_2O_3	1	
	(volume of CO_2 =) 375 × 24	allow correct use of an incorrectly determined number of moles of CO_2	1	
	= 9000 (dm^3)		1	

Total Question 7	**15**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	propane is a small molecule	allow propane is a simple molecule	1	AO1 4.2.1.4 4.2.2.1 4.2.2.4
	(so) the forces between molecules are weak **or** (so) the intermolecular forces are weak	do **not** accept covalent bonds are weak	1	
	(which) require little energy to overcome	do **not** accept answers in terms of breaking covalent bonds	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	**B**		1	AO1 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(bonds broken = 2(347) + 8**X** + 5(498) =) 3184 + 8**X**		1	AO2 4.5.1.3
	(bonds made = 6(805) + 8(464) =) 8542		1	
	(energy released = bonds made – bonds broken =) 2219 = 8542 – (3184 + 8**X**)	allow correct use of incorrectly determined values of bonds broken and/or bonds made	1	
	(8**X** =) 3139 (kJ/mol)	allow correct evaluation of the expression energy released = bonds broken – bonds made	1	
	(**X** =) 392 (kJ/mol)	allow 392.375 correctly rounded to at least 3 significant figures allow correct use of an incorrectly determined value for 8**X**	1	

Total Question 8	**9**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(an acid which) is partially ionised	allow (an acid which) is partially dissociated	1	AO1 4.4.2.4 4.4.2.6
	in aqueous solution	allow (when dissolved) in water MP2 is dependent on the award of MP1	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	pH increases		1	AO2 4.4.2.6
	(because) the concentration of hydrogen ions decreases		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	use a (volumetric) pipette to add the alkali		1	AO1 4.4.2.5 RPA2
	any **two** from: • into a conical flask • add an indicator (to the alkali) • take the initial burette reading • use a white tile (under a conical flask)	ignore beaker allow named indicator do **not** accept add universal indicator	2	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	(volume of HCl = $\frac{0.0045}{0.15}$) = 0.030 (dm^3)		1	AO2 4.3.4 4.4.2.5 RPA2
	(conversion 0.030 dm^3 =) 30 (cm^3)	allow correct conversion of an incorrectly determined volume in dm^3	1	
	alternative approach $\left(\text{concentration} = \frac{0.15}{1000} =\right)$ 0.00015 (mol/cm^3) (1)			
	$\left(\text{volume} = \frac{0.0045}{0.00015} =\right)$ 30 (cm^3) (1)	allow correct use of an incorrectly determined concentration in mol/cm^3		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5		allow converse arguments in terms of magnesium allow energy level for shell		AO2 4.1.2.3 4.2.1.2 4.4.1.2
	(calcium's) outer shell / electrons are further from the nucleus	allow calcium has more shells ignore calcium atoms are larger	1	
	(so) the outer electrons are less strongly attracted to the nucleus	allow (so) the outer electrons are more shielded from the nucleus	1	
	(so) positive ions are formed more easily	allow (so) electrons are more easily lost	1	

Total Question 9	**12**