
GCSE

Chemistry

CH3HP

Mark scheme

4402

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Version/Stage: 1.0 Final

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 Assessment Writer.

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.

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

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 his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.
- 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.

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**. Different terms in the mark scheme are shown by a / ; 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 error / 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 planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, 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

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

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

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **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 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

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

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

4. Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level.

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / SpecRef
1(a)(i)	fizz / effervescence / bubbles	allow calcium carbonate decreases in size or dissolves	1	AO2/AO3 3.4.1d, 3.6.2b
	because carbon dioxide produced / released	allow because gas produced / released	1	
	limewater turns cloudy / milky / white		1	
	because (a precipitate of or solid) calcium carbonate forms	allow because of carbon dioxide if not already credited	1	
1(a)(ii)	$ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{C} = \text{O} \\ \quad \\ \text{H} \quad \text{O} - \text{H} \end{array} $	allow –OH do not allow lower case 'h'	1	AO1 3.6.2a
1(a)(iii)	acid	must be in this order	1	AO1 3.6.2b
	ester(s)	ignore any name of an acid	1	
1(b)	white (precipitate) no change no change no change	all four correct 2 marks any two correct 1 mark	2	AO2 3.4.1e,f
1(c)(i)	lilac red	must be in this order	1	AO1 3.4.1a
		allow purple	1	
1(c)(ii)	colours are masked / changed by each flame colour		1	AO3 3.4.1a
Total			12	

Question	Answers	Extra information	Mark	AO / SpecRef
2			6	2AO1 / 3AO2 / 1AO3 3.4.1g
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.				
0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)	
No relevant content.	There is a simple description of using some of the apparatus.	There is a description of an experimental method including addition of acid to alkali which may include an indicator or colour change and may include a measurement of volume.	There is a description of titrations that would allow a comparison to be made between the two solutions of hydrochloric acid.	
<p>examples of chemistry points made in the response could include:</p> <ul style="list-style-type: none"> • acid in burette or flask • alkali/sodium hydroxide or acid in burette or flask • volume of acid or alkali measured using the pipette • indicator in flask • white tile under the flask • slow addition • swirling/mixing • colour change of indicator • burette volume measured 				
Total			6	

Question	Answers	Extra information	Mark	AO / SpecRef
3(a)(i)	atomic weights	allow atomic masses	1	AO1 3.1.1a
3(a)(ii)	proton	allow proton number	1	AO1 3.1.2a
3(b)(i)	F/fluorine	allow F ₂	1	AO3 3.1.3a,b,f
3(b)(ii)	<p>any one from:</p> <ul style="list-style-type: none"> • copper has a higher density • copper is stronger • copper is harder • copper is less reactive 	<p>allow converse for potassium</p> <p>allow named property</p> <p>ignore colour, conductivity, melting point and boiling point</p>	1	AO1 3.1.3c
3(b)(iii)	<p>relative distance from nucleus</p> <p>relative attraction to nucleus</p> <p>relative ease of gain or loss of electron</p> <p>opposite explanation of ease of gain or loss of electron for other group</p>	<p>max 3 marks if 'outer' not mentioned</p> <p>allow more / fewer energy levels / shells or larger / smaller atom</p> <p>allow more / less shielding</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	2AO1 / 1AO2 / 1AO3 3.1.3b,f,h
Total			8	

Question	Answers	Extra information	Mark	AO / SpecRef
4(a)	development / maintenance of teeth / bones	allow lowers risk of heart disease	1	AO1 3.2.1f
	because contains calcium ions / compounds	allow contains calcium	1	
4(b)	scum or calcium stearate		1	AO1 3.2.1a
4(c)	temporary hard water contains calcium hydrogencarbonate or hydrogencarbonate ions	allow hydrogencarbonate	1	1AO1 / 2AO2 / 1AO3 3.2.1c,d,e
	when heated / boiled these decompose	allow decompose (in the kettle)	1	
	to produce a precipitate / scale or to produce calcium carbonate		1	
	coats the heating element or coats the kettle	allow prevents heat / energy transfer to the water	1	
4(d)	ion exchange resins contain sodium / hydrogen ions	ions must be mentioned once to gain both of the first two marking points	1	2AO1 / 1AO2 3.2.1g, 3.2.2b
	which replace / remove the calcium / magnesium ions	allow displace, but do not allow references to reactivity series	1	
	so removing the hardness or producing soft water		1	
Total			10	

Question	Answers	Extra information	Mark	AO / SpecRef
5(a)	$\text{CH}_4 + 2\text{O}_2 \rightarrow$ $\text{CO}_2 + 2\text{H}_2\text{O}$	allow multiples	1	AO2 3.3.1a
5(b)	3444 J	if answer incorrect: one mark for temperature increase = 16.4 °C one mark for mass of water = 50 g ecf for one incorrect value gains two marks for correct calculation no ecf for two incorrect values	3	AO2 3.3.1a
5(c)(i)	1276 (kJ per mole)	ignore + or - if answer incorrect: $[(5 \times 413) + 347 + 358 + 467] + [(3 \times 495)] = 4722$ (1 mark) $[(4 \times 799) + (6 \times 467)] = 5998$ (1 mark) correct subtraction of calculated energy values (1 mark)	3	AO2 3.3.1f
5(c)(ii)	because energy released when bonds form is greater than energy used when bonds broken	allow converse if no mark awarded allow one mark for energy is used to break bonds or one mark for energy is released when bonds form	2	AO1 3.3.1e,f
5(c)(iii)	products line lower than reactants activation energy labelled overall energy change labelled		1 1 1	2AO2 / 1AO3 3.3.1d
Total			12	

Question	Answers	Extra information	Mark	AO / SpecRef
6(a)(i)	natural gas	allow fossil fuels / biogas generator	1	AO1 3.5.1a
6(a)(ii)	air contains oxygen this would react with / oxidise the hydrogen	allow this would react with / oxidise the iron ignore nitrogen	1 1	AO3 3.5.1b
6(a)(iii)	cooled ammonia condenses / liquefies (so can be separated) nitrogen and hydrogen (remain as gases and) are returned to the reactor	allow recycled	1 1 1	AO1 3.5.1b
6(b)(i)	200 °C and 1000 atmospheres		1	AO3 3.5.1b
6(b)(ii)	the reaction is reversible forward reaction is exothermic so increased temperature lowers the yield of ammonia a lower temperature would decrease rate of reaction a higher pressure would increase the yield of ammonia because the forward reaction produces the least number of (gaseous) molecules / moles higher pressures would involve high cost / energy	allow stated as equilibrium or forward / backward reaction anywhere in answer allow converse allow converse allow converse ignore risk / explosion	1 1 1 1	3AO1 / 2AO3 3.5.1d,e,f,g,h
Total			12	