



GCSE

Additional Science / Chemistry

CH2HP

Mark scheme

4408 / 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(d) 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)	5.75 or 5.8	correct answer with or without working gains 2 marks correct working showing addition of any four results and division by 4 gains 1 mark OR 6(.04) for 1 mark	2	AO2/AO3 2.5.1a,c
1(a)(ii)	use a polystyrene cup or lid to prevent energy/heat gain OR use a digital thermometer easier to read (to 0.1°C)	accept insulate the beaker accept to prevent energy/heat transfer do not accept energy/heat loss allow use a data logger	1 1	AO3 2.5.1a,c
1(b)	(as mass increases) the final temperature increases then stays constant correct reference to a value above 8 g up to and including 10 g as mass when the trend changes		1 1 1	2AO2 / 1AO3 2.5.1b
Total			7	

Question	Answers	Extra information	Mark	AO / SpecRef
2(a)	endothermic		1	AO1 2.5.1d
2(b)	82 (%)	<p>correct answer with working gains 3 marks</p> <p>if 17 or 34 not shown in working max 2 marks</p> <p>accept 82.4</p> <p>accept 82.35 to full calculator display (82.35294...) correctly rounded to at least 2 sf</p> <p>if no answer or incorrect answer, then</p> <p>($M_r =$) 17 gains 1 mark or</p> <p>14/17 gains 2 marks</p> <p>OR</p> <p>($2M_r =$) 34 gains 1 mark or</p> <p>28/34 gains 2 marks</p> <p>OR</p> <p>14/their M_r shown gains 1 mark or</p> <p>correct calculation of 14/their M_r gains 2 marks</p>	3	AO2 2.3.3a, 2.3.1f
2(c)(i)	7 / seven		1	AO1 2.6.2d
2(c)(ii)	$\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$		1	AO1 2.6.2e
2(c)(iii)	ammonium chloride	<p>allow NH_4Cl</p> <p>ignore an incorrect formula</p>	1	AO1 2.6.2b

Question 2 continues on the next page

Question 2 continued

Question	Answers	Extra information	Mark	AO / SpecRef
2(d)			6	2AO2 / 4AO3 2.6.2c
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.	Suggestion with a reference to a graph.	Suggestion with reasons referring to more than one graph.	Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise.	
<p>Examples of chemistry points made in response: A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha). Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).</p> <p>Yield:</p> <ul style="list-style-type: none"> Using fertiliser improves yield. Yield improved most up to about 200 kg (per ha) of fertiliser. Yield only increased slightly above about 200 kg (per ha). <p>Profit:</p> <ul style="list-style-type: none"> About 200 kg of fertiliser gives the most profit. Above about 200 kg (per ha) of fertiliser profit declines. <p>Run off:</p> <ul style="list-style-type: none"> Run off is at low levels until about 300 kg (per ha) of fertiliser. Above about 300 kg (per ha) of fertiliser, run off increases. <p>Examples of linking of ideas:</p> <ul style="list-style-type: none"> Overall 200 kg gives high crop yield and most profit. In conclusion 200 kg gives high crop yield and low run off. 200 kg gives most profit and low run off. <p>Examples of compromise:</p> <ul style="list-style-type: none"> Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield. 200 kg gives the highest profit although it is not the highest yield. 500 kg gives the best yield but has the most runoff. 				
Total			13	

Question	Answers	Extra information	Mark	AO / SpecRef
3(a)(i)	(mass number = 16) because there are 8 protons and 8 neutrons (in the nucleus)	accept mass number is total number of protons and neutrons for 1 mark	2	AO1/AO2 2.3.1a,b,c
3(a)(ii)	<p>same number of protons or both have 6 protons</p> <p>^{12}C has 6 neutrons</p> <p>^{14}C has 8 neutrons</p>	<p>numbers, if given, must be correct</p> <p>accept same atomic number</p> <p>accept different number of neutrons for 1 mark</p> <p>incorrect reference to electrons = max 2 marks</p>	<p>1</p> <p>1</p> <p>1</p>	2AO1 / 1AO2 2.3.1d
3(b)(i)	<p>2 bonding pairs</p> <p>4 unbonded electrons around oxygen</p>	<p>accept dot, cross or e or – or any combination</p> <p>additional unbonded electrons negates this mark</p>	<p>1</p> <p>1</p>	AO1 2.1
3(b)(ii)	covalent		1	AO1 2.1.1g

Question 3 continues on the next page

Question 3 continued

3(b)(iii)	<p>any one from:</p> <ul style="list-style-type: none"> • no delocalised / free electrons • no overall electric charge • no ions 	<p>do not accept any implications of the presence of ions</p> <p>ignore mobile electrons</p> <p>accept no charge (carriers)</p>	1	AO1 2.2.1c
3(c)(i)	larger	<p>accept the size of a few hundred atoms</p> <p>accept atoms are smaller (than nanoparticles)</p> <p>allow up to 1000 atoms</p>	1	AO1 2.2.6a
3(c)(ii)	(nanoparticles have) large(r) surface area		1	AO2 2.2.6a
Total			11	

Question	Answers	Extra information	Mark	AO / SpecRef
4(a)	because sulfur / S (forms) (which) is solid / insoluble / a precipitate/ a suspension		1 1	AO2 2.6.1a
4(b)	any two from: <ul style="list-style-type: none"> • volume of sodium thiosulfate • volume of (hydrochloric) acid • concentration of sodium thiosulfate • concentration of (hydrochloric) acid 	ignore amount of sodium thiosulfate ignore amount of (hydrochloric) acid if no other mark, allow 1 mark for same cross or same flask or unspecified volume or unspecified concentration ignore same person do not accept references to temperature	2	AO3 2.4.1
4(c)	rate increases because particles move faster so frequency of collisions increases more particles/ collisions have energy greater than (or equal to) the activation energy	accept particles have more energy accept particles are more likely to collide or more chance of collisions ignore more collisions	1 1 1 1	AO1 2.4.1b,c
4(d)	cool or decrease the temperature (of the solutions)	accept refrigerate or method to decrease temperature	1	AO3 2.4.1c
Total			9	

Question	Answers	Extra information	Mark	AO / SpecRef
5(a)	<p>magnesium loses two electrons and chlorine gains one electron</p> <p>one magnesium and two chlorines</p> <p>noble gas structure or eight electrons in the outer shell or (electrostatic) attraction between ions or forms ionic bonds</p>	<p>reference to incorrect particles or incorrect bonding or incorrect structure = max 3</p> <p>accept magnesium loses electrons and chlorine gains electrons for 1 mark</p> <p>ignore oxidation and reduction</p> <p>accept MgCl₂</p> <p>accept full outer shell (of electrons)</p> <p>do not accept covalent bonds</p>	<p>2</p> <p>1</p> <p>1</p>	<p>AO1/AO2 2.1.1a,b,c,e,f</p>
5(b)(i)	<p>because ions can move</p> <p>(and ions move) to the electrodes or (and ions) carry charge</p>	<p>accept converse for solid</p> <p>ignore ions attracted</p> <p>do not accept molecules/atoms moving</p> <p>do not accept incorrect reference to electrons moving</p>	<p>1</p> <p>1</p>	<p>AO1 2.2.2b,2.7.1a</p>

5(b)(ii)	magnesium (ions) attracted (to the electrode)		1	2AO1 / 1AO2 2.7.1b,c,d,e
	so magnesium ions gain electrons	accept magnesium ions are reduced ignore oxidised	1	
	2 electrons	accept a correct half equation for 2 nd and 3 rd marking points	1	
5(b)(iii)	hydrogen	allow H ₂	1	AO2 2.7.1f
5(b)(iv)	magnesium is more reactive than hydrogen	accept converse allow magnesium is high in the reactivity series or magnesium is very/too reactive. do not accept magnesium ions are more reactive than hydrogen ions	1	AO2 2.7.1f
5(b)(v)	$2 \text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	must be completely correct	1	AO1 2.7.1g
5(c)		any mention of intermolecular/ weak bonds/forces = max 1		AO2 2.2.4b
	layers (of particles/atoms/ions) (particles/atoms/ions/layers) can slide		1 1	
Total			14	

Question	Answers	Extra information	Mark	AO / SpecRef
6(a)	has delocalised electrons	reference to incorrect particles or incorrect bonding or incorrect structure = max 1	1	AO1/AO2 2.2.4a; 2.1.1h
	(so electrons) can move through the structure/metal	accept free (moving) electrons accept (so electrons) can carry charge through the structure/metal accept (so electrons) can form a current	1	
6(b)	giant structure	reference to intermolecular forces/bonds or incorrect particles = max 1	1	AO1 2.2.3a,b
	strong bonds	accept lattice accept each atom forms four bonds (with other carbon atoms) ignore macromolecular accept covalent do not accept ionic	1	

Question 6 continues on the next page

Question 6 continued

6(c)	<p>thermosetting polymers do not melt (when heated)</p> <p>due to cross-links (between chains)</p>	<p>reference to smart polymers = max 1</p> <p>accept converse argument</p> <p>accept thermosetting polymers do not change shape (when heated)</p> <p>accept thermosetting polymers have high(er) melting points</p> <p>ignore thermosetting polymers do not soften (when heated)</p> <p>accept due to bonds between chains</p>	<p>1</p> <p>1</p>	<p>AO1/AO2 2.2.5b</p>
Total			6	