

INTERNATIONAL GCSE **COMBINED SCIENCE**

9204/CE

Paper 2 Chemistry Extension

Mark scheme

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2 4 B Y 9 2 0 4 / C E / 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 his or her judgement
- the Assessment Objectives, level of demand 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 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 planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, 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

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

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 is 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 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 **not** 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.

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 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 and not look to pick holes in 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 and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 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.

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the melting point is a range	allow the melting point is different to the melting point of the pure drug	1	AO3 3.10.1a 3.10.1b
	the melting point is below the melting point of the pure drug		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	to see if the drug contains other substances	allow to check the drug is safe (to consume)	1	AO3 3.10.1b

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	M contains colour A		1	AO3 3.10.1d
	M does not contain colour B		1	
	M contains an unknown colour		1	
		if no other mark awarded allow 1 mark for M contains two / three colours		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	to stop the escape of ethanol	allow because ethanol evaporates easily	1	AO4 3.10.1d

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	ink might dissolve (in the solvent / ethanol)	allow converse for pencil allow the ink might run (in the solvent / ethanol)	1	AO4 3.10.1d

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	Phase Mobile Stationary Description of phase Colour Ethanol Lid Paper Start line do not accept more than one line from a box on the left		1 1	AO2 3.10.1e
Total			10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(similarity) both react with acids		1	AO1 3.11.1a 3.11.1b
	(difference) alkalis are soluble in water	allow sodium hydroxide is soluble in water	1	
	or bases are insoluble in water	allow copper oxide is insoluble in water		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	copper does not react with (dilute) acids	allow copper is unreactive	1	AO3 3.9.1.1a 3.11.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	potassium reacts too violently	allow potassium is too reactive	1	AO3 3.9.1.1a 3.11.2a

Question	Answers	Mark	AO / Spec. Ref.
02.4	Level 3: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO4 3.11.2a 3.11.2b
	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 • use zinc oxide and sulfuric acid • warm the (sulfuric) acid • add zinc oxide to the (sulfuric) acid • in a beaker • stir • continue adding until the zinc oxide is in excess • shown by excess solid • filter (the reaction mixture) • to remove the excess zinc oxide • heat the solution • using a water bath or electric heater • to crystallisation point • leave the solution to crystallise • pat crystals dry with filter paper		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	$(\text{mass} =) \frac{14.5}{58} \times 100$ = 25 (g)		1	AO2 3.11.2b
			1	

Total		12
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	C=C bond 4 × C–H bonds	do not accept extra bonds an answer of $\begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{C} = \text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array}$ scores 2 marks	1 1	AO1 3.16.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	thermosetting (polymer)		1	AO1 3.16.2c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	broken down by microbes	allow bacteria / fungi for microbes	1	AO1 3.16.2e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(catalysts) provide a different pathway (for a chemical reaction) that has a lower activation energy		1 1	AO1 3.15.2e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	less poly(ethene) waste will end up in landfill		1	AO2 3.16.2e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	plants		1	AO1 3.9.1.1f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	any one from: • (energy used so) has large carbon footprint • damage to landscape • noise pollution • waste rock produced • loss of biodiversity	ignore references to cost allow global warming allow climate change	1	AO2 3.9.1.1f

Total		9
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any two from: (rubidium) • moves faster • (produces) more bubbles • sinks • explodes		2	AO3 3.13.1a 3.13.1b

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$2 \text{ Rb} + 2 \text{ H}_2\text{O} \rightarrow 2 \text{ RbOH} + \text{H}_2$	allow 1 mark for RbOH allow 1 mark for H ₂	3	AO2 3.12.1a 3.13.1a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(mass =) $3.40 \times 10^{-4} \times 85$		1	AO2 3.12.3a 3.14.1a
	= 0.0289 (g)		1	
	(rate =) $\frac{0.0289}{5}$	allow correct use of an incorrectly determined mass	1	
	= 5.78×10^{-3} (g/s)	allow 0.00578 (g/s)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	rubidium is more reactive (than potassium)	allow energy level for shell allow converse for potassium	1	AO1 3.13.1b 3.13.1f
	(rubidium's) outer shell / electron is further from the nucleus	allow the (rubidium) atom is larger allow (rubidium) has more shells	1	
	(so) there is less (electrostatic) attraction between the nucleus and the outer electron (in rubidium)	allow (so) there is more shielding between the outer electron and the nucleus (in rubidium)	1	
	(so) the (outer) electron (in rubidium) is more easily lost	allow (so) less energy is needed to remove the (outer) electron (in rubidium)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(krypton) has a full outer shell of electrons	allow energy level for shell	1	AO1 3.7.3c
	(which is) a stable arrangement		1	

Total		15
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	PVC is a (very) poor conductor of electricity	allow PVC does not conduct electricity allow PVC is an (electrical) insulator	1	AO3 3.9.1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	PVC has a lower density (so) pipes would be easier to transport / handle	allow (so) pipes would be lighter to transport / handle	1 1	AO3 3.9.1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(copper has) layers of atoms (which) are able to slide over each other		1 1	AO1 3.9.1a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(the use of) bacteria to produce leachate solutions (that contain copper compounds)		1 1	AO1 3.9.1.1f 3.9.1.1g 3.9.1.1h

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(moles of copper = $\frac{88.9}{63.5}$) = 1.40		1	AO2 3.12.3a 3.12.3b
	(number of atoms of copper =) $1.40 \times 6.02 \times 10^{23}$	allow correct use of an incorrectly determined number of moles of copper	1	
	= 8.428×10^{23}		1	
	= 8.43×10^{23}	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all the data in the question	1	
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(the conclusion is incorrect because) most group 1 carbonates do not decompose	allow (the conclusion is incorrect because) sodium carbonate, potassium carbonate and rubidium carbonate do not decompose	1	AO3 3.9.1.2a
	(but) lithium carbonate does decompose	allow (but) lithium carbonate is an anomaly	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	energy must be supplied to break bonds		1	AO1 3.15.2b 3.15.2e
	(and) energy is released when bonds are formed		1	
	(so) the energy needed to break existing bonds is greater than the energy released forming (new) bonds		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$\left(\text{moles MgCO}_3 = \frac{4.2}{84} =\right) 0.05$		1	AO2 3.12.1d
	(mass of CO ₂ =) 0.05×44	allow correct use of an incorrectly determined number of moles of MgCO ₃	1	
	= 2.2 g		1	

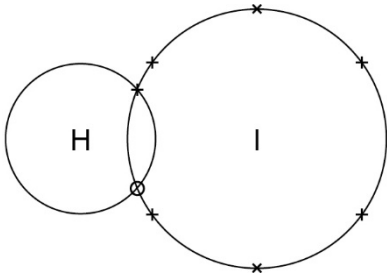
Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	0.25 (mol)		1	AO2 3.12.1b 3.12.1d

Total		9
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(+) 9 (kJ/mol)		1	AO2 3.15.1a 3.15.1d

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	any one from: - the reaction is reversible (some of the hydrogen iodide) may be lost (when separated from the reaction mixture)	allow gas for hydrogen iodide allow some of the reactants have reacted in a different way to expected	1	AO3 3.12.1e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(increasing pressure) increases the frequency of collisions (which) increases the rate of reaction		1 1	AO1 3.14.1d

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	1 shared pair of electrons in the overlap	allow any combination of x, o, e ⁽⁻⁾ , • for electrons	1	AO2 3.8.1g
	6 non-bonding electrons in outer shell of iodine	do not accept non-bonding electrons in the outer shell of hydrogen	1	
		an answer of  scores 2 marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(bonds broken = 436 + 243 =) 679		1	AO2 3.15.1a 3.15.2b
	(bonds made = 2 × 432 =) 864		1	
	(energy change = 679 – 864 =) (-) 185	allow correct use of incorrectly determined values in MP1 and/or MP2	1	

Total		9
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	E has a giant structure	allow E has a regular structure allow E is a lattice	1	AO3 × 1 AO1 × 3 3.8.2a
	(which) has (strong) electrostatic forces between oppositely charged ions		1	
	in all directions		1	
	(and) large amounts of energy needed to break the (many strong) bonds		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	(F is hard because F) has a giant structure		1	AO3 × 1 AO1 × 1 3.8.2f
	(where) each atom forms strong covalent bonds		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(G does not conduct electricity because G) consists of simple molecules		1	AO3 × 1 AO1 × 1 3.8.2e
	(which) do not have an overall electric charge	allow (which) do not have delocalised electrons allow (which) do not have ions	1	

Total		8
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(chlorine production of) bleach / plastics		1	AO1 3.9.2j
	(sodium hydroxide production of) soap		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	(chlorine has) more than one isotope		1	AO2 3.7.2k
	(and the relative atomic mass) is the average value for the isotopes		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	hydrogen is less reactive (than sodium)	allow sodium is more reactive (than hydrogen)	1	AO2 3.9.2g 3.9.2j

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	allow 1 mark for $\text{H}^+ + \text{e}^-$ irrespective of balancing numbers	2	AO2 3.9.2f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	chlorine gas dissolves in water (before 8 minutes so only some is collected)		1	AO3 3.9.2g 3.9.2j

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	hydroxide (ion)	allow OH ⁻ (ion)	1	AO2 3.9.2g
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	carboxylic acids have a higher pH (than nitric acid) because they are weak acids		1	AO3 × 1 AO1 × 1 3.11.1f 3.16.3.2b
	(and) weak acids do not ionise completely (when dissolved in water)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	$C_nH_{2n}O_2$		1	AO2 3.16.3.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	$ \begin{array}{ccccccc} & H & & H & & & \\ & & & & & & \\ H & -C & - & C & - & C & =O \\ & & & & & & \\ & H & & H & & O-H & \end{array} $		1	AO2 3.16.3.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	(moles NaOH =) $\left(\frac{25}{1000} \times 0.110\right) = 2.75 \times 10^{-3}$		1	AO2 3.12.4a 3.12.4c
	$\left(\text{moles H}_2\text{SO}_4 = \frac{2.75 \times 10^{-3}}{2} =\right)$ 1.375×10^{-3}	allow correct use of an incorrectly determined number of moles of NaOH	1	
	(concentration =) $1.375 \times 10^{-3} \times \frac{1000}{27.5}$	allow correct use of an incorrectly determined number of moles of H ₂ SO ₄	1	
	= 0.05 (mol/dm ³)		1	
Total			8	