

OXFORD

INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL GCSE COMBINED SCIENCE 9204/CE

Paper 2 Chemistry Extension

Mark scheme

June 2023

Version: 1.0 Final



2 3 6 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.

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

Copyright information

OxfordAQA retains the copyright on all its publications. However, registered schools/colleges for OxfordAQA are permitted to copy material from this booklet for their own internal use, with the following important exception: OxfordAQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Copyright © 2023 Oxford International AQA Examinations and its licensors. All rights reserved.

Level of response marking instructions

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 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 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.

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

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 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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	(from) liquid to solid		1	AO3 3.7.1a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.2	(lithium has) highest melting / boiling point		1	AO3 3.7.1a 3.8.2	A

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.3	lithium hydroxide	allow LiOH	1	AO1 AO2	E
	hydrogen	allow H ₂	1	3.12.1a 3.13.1a	

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.4	(moles =) $\frac{0.28}{7}$		1	AO2 3.12.3a	E
	= 0.04 (mol)		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.5	rubidium has a higher density than water		1	AO3 3.13.1a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.6	outer electron is further from the nucleus		1	AO1 3.13.1f	A

Total			8		
--------------	--	--	----------	--	--

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	150 – 23 = 127	allow 23 + 127 = 150	1	AO2 3.12.2a	E
	iodine		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.2	(there are) strong (electrostatic) forces of attraction	allow strong (ionic) bonds	1	AO1 3.8.2a	E
	between oppositely charged ions		1		
	(so) large amounts of energy needed to break the (many) forces / bonds		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.3	sodium atoms lose electrons	allow forming Na ⁺ and Cl ⁻ ions	1	AO1 3.8.1cde	E
	chlorine atoms gain electrons		1		
	transfer of 1 electron		1		
	forming sodium ions and chloride ions		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.4	dip a wire loop into the solution		1	AO1 3.10.2a	E
	hold the wire loop in the (blue / roaring) flame of a Bunsen burner		1		
	yellow flame produced		1		

Total			12		
--------------	--	--	-----------	--	--

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	(concentration =) $\frac{0.060}{0.075}$ = 0.8(0) (mol/dm ³)		1	AO2 3.12.4a	E
			1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.2	AgBr (s)	ignore attempts at balancing	1	AO2 3.12.1ab	E
			1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.3	sodium bromide sodium nitrate	ignore NaBr	1	AO4 3.10.1c	E
		ignore NaNO ₃	1		
		ignore silver nitrate ignore AgNO ₃			

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.4	Level 3: The plan would lead to the production of a valid outcome. The key steps are identified and logically sequenced.		5–6	AO4 3.10.1c 3.11.1ac 3.11.2a	E
	Level 2: The plan 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 plan 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 copper oxide and hydrochloric acid • add copper oxide to the (hydrochloric) acid • in a beaker • warm gently • stir • continue adding until the copper oxide is in excess • shown by excess solid • filter (the reaction mixture) • to remove the excess copper oxide • heat the solution • to crystallisation point • leave the solution to crystallise • filter to remove the crystals from the solution • dry the crystals with filter paper				
Total			12		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	atomic number	allow proton number	1	AO1 3.7.3a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.2	gallium is in the same group as aluminium or gallium has the same number of outer electrons as aluminium		1	AO2 3.7.3b	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.3	Ga ₂ O ₃		1	AO3 3.7.2b 3.7.3b	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.4	(similarity) same (relative) mass	allow both have a (relative) mass = 1 allow both particles are in the nucleus	1	AO1 3.7.2dj	E
	(difference) different (electrical) charge	allow proton = +1 and neutron = 0	1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.5	same number of protons and electrons	allow 31 protons and 31 electrons	1	AO1 3.7.2e	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.6	gallium has isotopes	allow gallium has atoms with different numbers of neutrons	1	AO2 3.7.2gk	E
	(so) different (isotopic) masses	allow (so) gallium has atoms with different mass (numbers)	1		
	(therefore) relative atomic mass is the average value for the isotopes	allow (therefore) relative atomic mass is the average value for the masses of different atoms	1		
Total			9		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	carbon	allow diamond	1	AO1 3.8.3b	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.2	all the atoms (in the structure) are linked to other atoms		1	AO1 3.8.1h 3.8.2f	E
	(by) covalent bonds	allow (when) atoms share electrons	1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.3	(one silicon atom =) 4 (bonds)		1	AO3 3.8.2f	E
	(one oxygen atom =) 2 (bonds)		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.4	(silicone polymer) is soft / flexible		1	AO2 3.16.2cd	E
	(because) there are weak forces between the (polymer) chains	allow (because) there are weak intermolecular forces allow (because) the (polymer) chains can move over each other	1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.5	polymers with cross-links do not melt	allow converse for polymer in Figure 5 allow polymers with cross-links are harder allow polymers with cross-links are more rigid ignore polymers with cross-links are stronger	1	AO1 3.16.2c	E
Total			8		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	(copper is a) substance made of only one sort of atom		1	AO1 3.7.2a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.2	layers (of atoms) (which can) slide over each other	allow layers (of ions)	1 1	AO1 3.9.1a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.3	copper is unreactive		1	AO1 3.9.1.1c	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.4	$(M_r = 63.5 + 56 + (32 \times 2))$ $= 183.5$ (percentage $= \frac{63.5}{183.5} \times 100$ $= 34.6049046$ $= 35$	allow correct use of an incorrectly determined M_r allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses the values in the question	1 1 1	AO2 3.12.2b	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.5	$0.38 \times \frac{63.3}{100}$	allow a correct conclusion based on an incorrect calculation	1	AO3 3.12.2b	E
	= 0.24054 (%)		1		
	0.24054 is less than 0.25 so is a low-grade ore		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.6	the plants are burned		1	AO1 3.9.1.1f	E
	(and) the ash contains copper compounds		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.7	$\text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2$		1	AO3 3.9.1.2a 3.12.1a	E
	$\text{Cu(OH)}_2 \rightarrow \text{CuO} + \text{H}_2\text{O}$		1		

Total			15		
--------------	--	--	-----------	--	--

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.1	$2 \text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	allow $2 \text{Cl}^- - 2\text{e}^- \rightarrow \text{Cl}_2$	1	AO1 3.9.2f	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.2	hydrogen hydrogen ions (in seawater) are attracted to the cathode (and) hydrogen is less reactive than sodium / calcium / magnesium / potassium so is produced		1 1 1	AO2 3.9.2gj	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.3	$(\text{moles of Br}^- \text{ in } 1 \text{ dm}^3 = \frac{0.0672}{80})$ $= 0.00084 \text{ (mol/dm}^3\text{)}$ $(\text{volume} =) \frac{1}{0.00084}$ $= 1190 \text{ (dm}^3\text{)}$	allow correct use of incorrect determination of mol/dm^3 allow an answer correctly rounded to at least 2 significant figures	1 1 1	AO2 3.12.3a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.4	(bromide ions) lose electrons		1	AO1 3.8.1e 3.9.2d	E

Total			8		
--------------	--	--	----------	--	--

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.1	M_r increases by 14 (down the homologous series) (because of the addition of) CH_2		1 1	AO3 3.12.2a 3.16.3.2a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.2	given a value by measurement	allow can take any value	1	AO4 3.16.3.2a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.3	(combustion is an) exothermic reaction	allow energy is transferred to the surroundings	1	AO1 3.15.1a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.4	$\text{CH}_3\text{COOH} + 2 \text{O}_2 \rightarrow 2 \text{CO}_2 + 2 \text{H}_2\text{O}$	allow multiples	1	AO2 3.12.1a	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.5	$\left(\text{moles} = \frac{3.00}{60}\right) = 0.050$ (energy change =) $(-) 874 \times 0.050$ $= (-) 43.7 \text{ (kJ)}$	allow correct use of incorrectly determined moles	1 1 1	AO2 x2 AO3 3.12.3a 3.15.1b	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.6	orange spots green background	allow yellow / red spots if no other mark awarded allow 1 mark for correct colours not linked to spots or background	1 1	AO2 3.11.1f	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.7	(stationary phase) paper (mobile phase) solvent		1 1	AO2 3.10.1e	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.8	A is more soluble (in the solvent) (so) A is carried further along the (chromatography) paper (by the solvent) alternative approach B has a greater attraction to the (chromatography) paper (1) (so) B does not move as far along the (chromatography) paper (1)		1 1	AO2 3.10.1e	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.9	measure distance moved by spot and distance moved by solvent		1	AO1 3.10.1d	E
	$R_f = \frac{\text{distance moved by spot}}{\text{distance moved by solvent}}$		1		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.10	(carboxylic acid) ethanoic acid	ignore CH ₃ COOH	1	AO2 3.16.3.1a 3.16.3.2ab	E
	(alcohol) propanol	ignore CH ₃ CH ₂ CH ₂ OH	1		

Total			18		
--------------	--	--	-----------	--	--

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
09.1	$ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{Cl} \\ \\ \text{H} \end{array} $		1	AO2 3.16.1.2b	E

Question	Answers				Extra information	Mark	AO / Spec. Ref.	ID																
09.2	<table><tr><td></td><td>C</td><td>H</td><td>Br</td></tr><tr><td>moles</td><td>$\frac{22.2}{12}$</td><td>$\frac{3.7}{1}$</td><td>$\frac{74.1}{80}$</td></tr><tr><td>=</td><td>1.85</td><td>3.7</td><td>0.926</td></tr><tr><td>ratio</td><td>2</td><td>4</td><td>1</td></tr></table>					C	H	Br	moles	$\frac{22.2}{12}$	$\frac{3.7}{1}$	$\frac{74.1}{80}$	=	1.85	3.7	0.926	ratio	2	4	1				
		C	H	Br																				
	moles	$\frac{22.2}{12}$	$\frac{3.7}{1}$	$\frac{74.1}{80}$																				
	=	1.85	3.7	0.926																				
	ratio	2	4	1																				
empirical formula = C ₂ H ₄ Br				allow correct use of incorrectly determined values of mole(s)	1	AO2 x4 AO3 3.12.2c	E																	
molecular formula = C ₄ H ₈ Br ₂				allow correct use of incorrectly determined ratio	1																			
				allow correct use of incorrectly determined empirical formula	1																			

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
09.3	rate doubles when concentration of chloroethane doubles rate doubles when concentration of sodium hydroxide doubles	if no other mark awarded allow 1 mark for rate increases when concentration of halogenoalkane increases and rate increases when concentration of sodium hydroxide increases	1 1	AO3 3.14.1e	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
09.4	2.4×10^{-9} (mol/dm ³ per second)		1	AO3 3.14.1e	E

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
09.5	CH ₃ CH ₂ OH or C ₂ H ₅ OH		1	AO3 3.16.3.1a	E

Total			10		
-------	--	--	----	--	--