

INTERNATIONAL GCSE **COMBINED SCIENCE**

9204/CE

Paper 2 Chemistry Extension

Mark scheme

June 2024

Version: 1.0 Final



2 4 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.

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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.

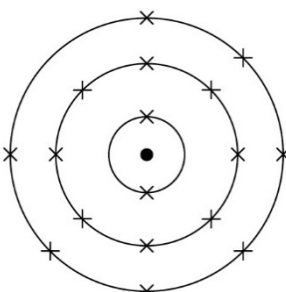
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any two from: - improve appearance - improve durability - prevention of corrosion	ignore references to cost allow prevention of rusting	2	AO1 3.9.2h

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	ions cannot move (in a solid)	allow the ions are in a fixed position	1	AO2 3.8.2b 3.9.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(time =) $\frac{0.33}{1.1}$ = 0.3 (hours) (0.3 × 60) = 18 (minutes) alternative approach (rate = $\frac{1.1}{60}$ =) 0.01833 (g/min) (1) (time =) $\frac{0.33}{0.01833}$ (1) = 18 minutes (1)	allow a correct conversion of an incorrectly determined time in hours allow correct use of an incorrectly determined rate in g/min	1 1 1	AO2 3.9.2h

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$2 \text{ Br}^- \rightarrow \text{Br}_2 + 2 \text{ e}^-$		1	AO2 3.9.2f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	zinc is more reactive (than hydrogen)	allow converse	1	AO3 3.9.2g
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	2, 8, 7	allow 	1	AO2 3.7.2i

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	same number of electrons in the highest energy level	allow outer shell for highest energy level allow 7 electrons in their highest energy level allow needs 1 electron to complete the outer shell	1	AO1 3.7.3b

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	argon / Ar		1	AO2 3.8.1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(giant ionic) lattice	allow giant / regular (ionic) structure	1	AO1 3.8.2a
	(strong) electrostatic forces of attraction	do not accept intermolecular forces	1	
	between oppositely charged ions		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(percentage =) $\frac{2 \times 35.5}{95} \times 100$ $= 74.7368$ $= 74.7(\%)$	$\left. \begin{array}{l} \text{allow 1 mark for} \\ \frac{35.5}{95} \times 100 = 37.368 \end{array} \right\}$ allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all of the values in the question	1 1 1	AO2 3.12.2b
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(mass =) 0.003×24 = 0.072 (g)		1 1	AO2 3.12.3a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(volume of hydrogen gas = 70 – 36) = 34 (cm ³) (time taken = 50 – 10) = 40 (s) (rate of reaction =) $\frac{34}{40}$ = 0.85 (cm ³ /s)	allow correct use of incorrectly determined volume and/or time	1 1 1 1	AO2 3.14.1a

Question	Answers	Mark	AO / Spec. Ref.
03.3	Level 3: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO4 3.14.1a 3.14.1e
	Level 2: The method 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 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 • measure mass of magnesium • using a balance • measure volume of hydrochloric acid • using a measuring cylinder • add magnesium to hydrochloric acid • in a suitable container • start a timer • collect the gas in a gas syringe - or - collect the gas in a measuring cylinder over water - or - suitable apparatus to follow rate of reaction • measure the volume of gas given off every 10 seconds - or - measure the time taken for a certain volume of gas to be given off - or - suitable measurements to be used to determine rate • repeat with different concentrations of hydrochloric acid • same mass of magnesium piece • same volume of hydrochloric acid		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	increasing the concentration of hydrochloric acid increases the rate of reaction		1	AO1 3.12.4a 3.14.1e
	(because of the) increase in the frequency of collisions		1	
Total			14	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(the centre / nucleus of the atom) contains protons and neutrons		1	AO1 AO2 AO3 × 2 3.7.2c 3.7.2j
	(and) protons and neutrons have a (relatively) large mass		1	
	(but) electrons are in shells (around the centre / nucleus)	allow (but) electrons are in energy levels (around the centre / nucleus)	1	
	(and) electrons have a very small mass	allow (but) electrons are outside the centre / nucleus of the atom	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	OH ⁻		1	AO1 3.11.1f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(NH ₄) ₂ SO ₄		1	AO2 3.8.1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	A	MP3 and MP4 are dependent upon MP1 being awarded	1	AO2 × 2 AO3 × 2 3.7.1b
	molecules move by diffusion		1	
	ammonia (molecules) have a lower relative formula mass	allow hydrogen chloride molecules have a higher relative formula mass allow ammonia is a lighter molecule allow hydrogen chloride is a heavier molecule	1	
	(so) ammonia molecules travel faster / further	allow (so) hydrogen chloride molecules travel slower allow (so) hydrogen chloride molecules travel a shorter distance	1	
Total			10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	add bromine water (bromine water) changes from orange to colourless	allow (bromine water) is decolourised MP2 is dependent upon MP1 being awarded	1 1	AO2 3.16.1.3d

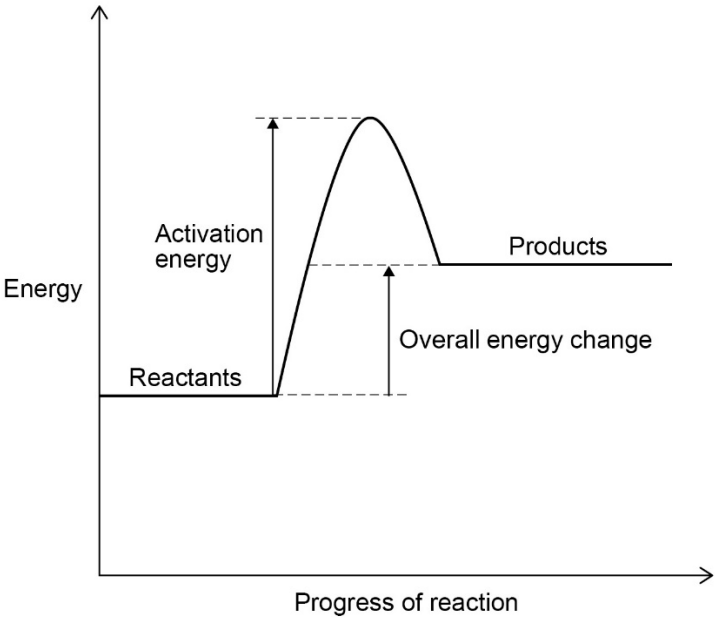
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$n \begin{array}{c} \text{H} & \text{H} \\ & \\ \text{C} = & \text{C} \\ & \\ \text{H} & \text{H} \end{array} \longrightarrow \left(\begin{array}{c} \text{H} & \text{H} \\ & \\ -\text{C} - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n$	if equation incorrect allow 1 mark for 5 single bonds or allow 1 mark for n	2	AO1 3.16.2a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(using) different catalysts or (using) different reaction conditions	allow (using) different temperatures / pressures	1	AO1 3.16.2b

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	chains in LDPE are further apart	allow converse allow LDPE has branched chains allow LDPE has a random structure allow there are weaker intermolecular forces	1	AO3 3.16.2c

Question	Answers	Mark	AO / Spec. Ref.
05.5	Level 2: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3 3.16.1.2f 3.16.2e 3.16.2f
	Level 1: Some logically linked reasons are given. There may also be a simple judgement.	1–2	
	No relevant content.	0	
	Indicative content • PLA from a renewable resource • poly(ethene) is not from renewable resource so may run out • using plants for PLA can cause problems with land use • clearing forests destroys habitats • destroyed trees increases carbon dioxide • less land available for food production • PLA is biodegradable and poly(ethene) is not • poly(ethene) has problems with waste disposal in landfill • poly(ethene) more likely to cause litter problems • PLA needs an industrial composter to decompose • PLA would need sorting from rubbish to be decomposed • PLA can still cause problems in landfill • judgement		
Total		10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	as mass added increases the temperature decreases		1	AO3 × 2 AO2 × 2
	(because) reaction is endothermic	allow energy is taken in from the surroundings	1	3.15.1c 3.15.1e
	from 6 g the temperature remains constant	allow when the temperature reaches 18.5 °C the temperature remains constant	1	
	(because) there is no further reaction		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	product level above reactants		1	AO1 × 2 AO2 × 1 AO3 × 1 3.15.2a
	correct shape of energy profile		1	
	activation energy drawn and labelled		1	
	overall energy change drawn and labelled	allow ΔH for overall energy change	1	
	an answer of  scores 4 marks			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	calcium carbonate is produced		1	AO1 3.10.2d 3.11.1e
	(which) is a precipitate	allow (which is) an insoluble solid	1	

Total		10
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Question	Answers	Mark	AO / Spec. Ref.
07.1	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 × 2 AO3 × 2 3.8.1h 3.8.2d 3.8.2f 3.8.3c
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content.	0	
	Indicative content Similarities in bonding • both have covalent bonding • both form by sharing electrons • both have 3 covalent bonds per atom Differences in structure • graphite is a giant structure • phosphorus is a simple molecule • graphite has layers of atoms • graphite has hexagonal rings of carbon atoms • graphite has one delocalised electron per atom • phosphorus molecule is a pyramidal shape • graphite has no covalent bonds between layers • phosphorus has intermolecular forces between molecules to access Level 2 there must be a comparison of the structure and bonding of both graphite and phosphorus, in addition a reference to magnitude must also be made		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(graphite has) delocalised electrons		1	AO1 3.8.2g 3.8.3d
	(which) move through the structure		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(moles =)			AO2 3.12.2c
	$\frac{3.1}{31}$	$\frac{4.0}{16}$	1	
	= 0.1	= 0.25	1	
	(ratio=)			
	$(\frac{0.1}{0.1} =) 1$	$(\frac{0.25}{0.1} =) 2.5$	1	
	P ₂ O ₅	allow correct use of an incorrectly determined mole ratio	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(most reactive) D		1	AO3 3.9.1.1a 3.9.1.1b
	A			
	C			
	(least reactive) B			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	potassium is more reactive than lithium	allow energy level for shell allow converse argument in terms of lithium	1	AO1 3.13.1b 3.13.1f
	(because potassium's) outer electron / shell is further from the nucleus	allow (because potassium) has more shells allow the (potassium) atom is larger	1	
	(so) there is less attraction between the nucleus and the outer electron / shell	allow (so) there is more shielding from the nucleus (in potassium)	1	
	(so) potassium atom loses an electron more easily	allow (so) less energy is needed to remove the (outer) electron (in potassium)	1	
Total			15	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	crude oil is heated to vaporise (the hydrocarbons)	allow the (fractionating) column is cooler at the top	1	AO1 3.16.1.1c
	there is a temperature gradient in the (fractionating) column		1	
	(so) the fractions condense at different levels		1	
	(because the fractions have) different boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$	allow 1 mark for $C_7H_{16} + O_2 \rightarrow CO_2 + H_2O$ irrespective of balancing numbers	2	AO2 3.12.1a 3.16.1.2d

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	gain of oxygen (by a substance)	allow loss of electrons	1	AO1 3.9.1.1d 3.16.1.2e

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	1 mol X produces 176 g CO ₂		1	AO2
	($M_r \text{ CO}_2 =$) 44		1	3.12.2a 3.12.3a 3.16.1.2d
	$\left(\text{moles CO}_2 = \frac{176}{44} \right) = 4$	allow correct use of incorrectly determined M_r	1	
	(moles of C = 4 so formula =) C ₄ H ₁₀	allow correct use of incorrectly determined moles of carbon atoms	1	
	alternative approach			
	($M_r \text{ CO}_2 =$) 44 (1)			
	$\left(\text{moles CO}_2 = \frac{17.6}{44} \right) = 0.4$ (1)	allow correct use of incorrectly determined M_r		
	$\left(\text{moles of C} = \frac{0.4}{0.1} \right) = 4$ (1)			
	C ₄ H ₁₀ (1)	allow correct use of incorrectly determined moles of carbon atoms		
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(A) calcium bromide	allow 1 mark for a compound containing calcium allow 1 mark for a compound containing bromide	2	AO3 3.10.2a 3.10.2b 2.10.2c 3.10.2e
	(B) iron(III) iodide	allow 1 mark for a compound containing iron(III) allow 1 mark for a compound containing iodide	2	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	filter the mixture		1	AO4 3.10.1c 3.11.2c
	wash the residue / precipitate		1	
	dry the residue / precipitate		1	
	weigh the residue / precipitate		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	(conversion $15 \text{ cm}^3 =$ $0.015 \text{ (dm}^3 \text{)}$)		1	AO2 3.12.1d 3.12.4a
	(moles of sodium chloride =) 0.015×0.40 $= 0.006 \text{ (mol)}$	allow correct use of incorrect / no conversion	1	
			1	
	(moles of silver chloride = moles of sodium chloride) (mass of silver chloride =) 0.006×143.5		1	
	$= 0.861 \text{ (g)}$	allow correct use of incorrectly determined moles of silver chloride	1	

Total		13
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