

# Higher

**GCSE**

**Combined Science B Twenty First Century Science**

**J260/06: Chemistry (Higher Tier)**

General Certificate of Secondary Education

**Mark Scheme for June 2022**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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**MARKING INSTRUCTIONS****PREPARATION FOR MARKING****RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

**MARKING**

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

**5. Crossed Out Responses**

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

**Rubric Error Responses – Optional Questions**

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

**Multiple Choice Question Responses**

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

*When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

**Contradictory Responses**

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions** (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

**Short Answer Questions** (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions** (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
  - there is nothing written in the answer space.

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

**The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

**The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.















**In summary:**

**The skills and science content determines the level.**

**The communication statement determines the mark within a level.**

Level of response questions on this paper are **X** and **X**

## 11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument



### 13. Subject-specific Marking Instructions

#### INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Combined Science B:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
<b>AO3.3</b>	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

Question			Answer	Marks	AO element	Guidance
1	(a)	(i)	Molecular formula: C <sub>5</sub> H <sub>12</sub> ✓ Empirical formula: C <sub>4</sub> H <sub>9</sub> ✓	2	2.2	
		(ii)	90-102 °C ✓	1	3.2a	If space left blank check table.
		(iii)	Liquid ✓ (Room temperature) above melting (point) and below boiling (point) / between the melting (point) and the boiling (point) ✓	2	3.2b	If answer incomplete check table Mark independently. <b>ALLOW</b> shown in a temperature scale showing room temperature between melting and boiling points <b>IGNORE</b> if just quotes the melting and boiling points
	(b)	(i)	<b>Any two from:</b> increase by CH <sub>2</sub> each time ✓ melting points increase ✓ boiling points increase ✓ state at room temperature goes from gas to liquid to solid ✓ same functional group ✓	2	3.1a	<b>IGNORE</b> similar chemical/physical properties  <b>ALLOW</b> increase in number of carbons each time/ <b>IGNORE</b> molecular formula increases / increase of 2 hydrogens each time
		(ii)	hydrocarbons ✓ alkanes ✓ C <sub>n</sub> H <sub>2n+2</sub> ✓	3	1.1 2.1 1.1	

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	250(s) ✓	1	1.2	
		(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> If answer = 2.2(g) award 2 marks  150.3 ✓ 152.5-150.3=2.2(g)✓	2	1.2	Look on graph if reading not given in working  <b>ALLOW</b> ECF from incorrect reading from graph <b>IGNORE</b> +/-
		(iii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> If answer = 0.0088 (g/s) award 2 marks  2.2/250 ✓ = 0.0088 (g/s)✓	2	2.2	<b>ALLOW</b> 0.009 (g/s) for 2 marks  <b>ALLOW</b> ECF from (a)(i) and (a)(ii) (a)(ii) ÷ (a)(i) correctly evaluated scores 2 marks  <b>ALLOW</b> correct evaluation of a mass ÷ (a)(i) for 2 <sup>nd</sup> marking point. E.g. 152.5 ÷ 250 = 0.61 even if mass is not same as in (a)(i) <b>ALLOW</b> (a)(i) ÷ (a)(ii) correctly evaluated scores 1 marks <b>IGNORE</b> +/-
	(b)		Steeper than original line with about the same initial mass ✓ Levelling off at about the same mass ✓	2	2.2	<b>DO NOT ALLOW</b> line above original line  <b>DO NOT ALLOW</b> starting mass higher than 152.5  Tolerance of +/- 2 small squares
	(c)		larger than ✓ the same as ✓	2	2.1	

Question		Answer	Marks	AO element	Guidance
3	(a)	<p><b>Any one from:</b>                      metals have higher melting points ✓                      metals have higher density ✓                      Metals conduct heat ✓                      reactive metals react with acids (to form hydrogen and salt) ✓                      metals usually solids at room temperature and non-metals usually liquids or gases ✓</p>	1	1.1	<p><b>ALLOW</b> metals are malleable/ductile/sonorous/shiny</p> <p><b>IGNORE</b> metals have higher boiling points/better electrical conductivity/hardness/small number of electrons in outer shells/type of ion formed/</p> <p><b>IGNORE</b> metals (unqualified) react with acids</p>
	(b)	(i)	2	2.1	<b>ALLOW</b> dot and cross diagrams
		(ii)	3	2.1	<p><b>ALLOW</b> metal for calcium and non-metal for chlorine</p> <p><b>ALLOW</b> (if no other mark allowed) reference to formation of full outer shell / stable electron configuration for 1 mark</p>
	(c)	(i)	2	2.1	

The diagram shows two boxes on the left labeled 'Calcium' and 'Chlorine'. To their right are four boxes stacked vertically: 'between atoms', 'between ions', 'between molecules', and 'between positive ions and delocalised electrons'. A line connects the 'Calcium' box to the 'between positive ions and delocalised electrons' box. Another line connects the 'Chlorine' box to the 'between positive ions and delocalised electrons' box. There are two checkmarks (✓✓) at the bottom right of the diagram area.

		(ii)	Calcium has stronger forces between particles than chlorine ✓ So needs more energy to separate particles ✓	2	2.1	<b>ALLOW</b> reference to bonds instead of forces unless refers to incorrect particles  <b>ALLOW</b> (if no other mark awarded) stronger forces in calcium and weaker forces in chlorine even if reference to incorrect particles ✓
	(d)		K <sup>+</sup> AND O <sup>2-</sup> ✓ Al <sub>2</sub> O <sub>3</sub> ✓	2	2.2	
	(e)	(i)	B AND C ✓	1	3.2a	
		(ii)	A ✓ Twice as many of one particle as the other ✓	2	3.2a	<b>ALLOW</b> 8 potassium and 4 oxygen ✓

Question			Answer	Marks	AO element	Guidance												
4	(a)	(i)	2 and 2 and 2 and 3 ✓	1	2.2													
		(ii)	(Reacts with the sodium hydroxide to) form hydrogen / H <sub>2</sub> ✓ Hydrogen is flammable/explosive ✓	2	2.2													
	(b)		<table border="1"> <thead> <tr> <th>Gas</th> <th>Method</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>hydrogen</td> <td>(Use a) lighted splint/flame</td> <td>(Squeaky) pop</td> </tr> <tr> <td>carbon dioxide</td> <td>(Bubbled through) limewater</td> <td>(Limewater) turns milky/cloudy white</td> </tr> <tr> <td>oxygen</td> <td>(Use a) glowing splint</td> <td>(Splint) relights</td> </tr> </tbody> </table> ✓✓✓	Gas	Method	Result	hydrogen	(Use a) lighted splint/flame	(Squeaky) pop	carbon dioxide	(Bubbled through) limewater	(Limewater) turns milky/cloudy white	oxygen	(Use a) glowing splint	(Splint) relights	3	1.2	1 mark for both method and result for each case.  <b>ALLOW</b> answer in either method or result box.
Gas	Method	Result																
hydrogen	(Use a) lighted splint/flame	(Squeaky) pop																
carbon dioxide	(Bubbled through) limewater	(Limewater) turns milky/cloudy white																
oxygen	(Use a) glowing splint	(Splint) relights																
	(c)	(i)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 0.15(g) AND (&lt;) 0.36(g) award 3 marks</b>  5x3 <b>AND</b> 12x3 ✓ ÷100 ✓ 0.15 <b>AND</b> 0.36 ✓	3	1.2													
		(ii)	(Indicator) changes colour ✓	1	2.2	<b>ALLOW</b> any specific colour change/sodium hydroxide changes colour <b>IGNORE</b> clear												

		(iii) <b>Any one from:</b> use a burette to measure the acid ✓ add acid slowly/drop by drop ✓ white tile to see colour change ✓ swirl flask ✓ Check no air bubbles in burette ✓	1	1.2	<b>IGNORE</b> repeats/measuring cylinder/pipette  <b>ALLOW</b> shake flask
	(d)	(i) <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 0.0062 award 3 marks</b>  24.8 ÷ 1000 (=0.0248) ✓ (0.0248) × 0.25 ✓ = 0.0062 ✓	3	1.2 2.2 × 2	<b>If answer = 6.2 award 2 marks</b>
		(ii) 0.0062 ✓	1	2.2	<b>ALLOW ECF</b> from (d)(i)
		(iii) <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 0.248(g) award 3 marks</b>  40 / 23+16+1 ✓ 0.0062 × 40 ✓ = 0.248 (g) ✓	3	2.2	<b>ALLOW ECF</b> from (d)(ii)



Question		Answer	Marks	AO element	Guidance
5	(a)	0 ✓ 1 ✓ 1 ✓	3	2.2	
	(b)	<p><b>Any one from:</b> Reasons why she is correct:</p> <p>values do go up and down (between 2015 and 2019/2020) ✓ in each year from 2015 – 2019 some go up and some go down ✓ changes in particulates are same order of magnitude (each year) ✓</p> <p><b>AND</b> <b>Any one from:</b> Reasons why she is incorrect:</p> <p>change in NO/NO<sub>2</sub> for 2020 is bigger order of magnitude than other years ✓ In 2020 all pollutants go down ✓</p>	2	3.1b	<p><b>ALLOW</b> changes in particulates are not significant/close together/smaller</p> <p><b>ALLOW</b> changes in NO/NO<sub>2</sub> are significant /bigger</p>
	(c) (i)	<p><b>Particulates:</b> Incomplete combustion ✓ of hydrocarbons/petrol/diesel/fossil fuels ✓</p> <p><b>Nitrogen oxides:</b> Nitrogen and oxygen (from the air) ✓ at high temperature ✓</p>	4	1.1	<p><b>IGNORE</b> fuel unqualified</p> <p><b>DO NOT ALLOW</b> nitrogen and oxygen from anything other than air</p>

		(ii)	<p>The diagram consists of three boxes on the left containing the chemical formulas CO, CO<sub>2</sub>, and SO<sub>2</sub> from top to bottom. On the right, there are three boxes containing the statements: 'It causes acid rain', 'It causes global warming', and 'It is toxic' from top to bottom. Lines connect CO to 'It causes acid rain', CO<sub>2</sub> to 'It causes global warming', and SO<sub>2</sub> to 'It is toxic'. Additionally, a diagonal line connects CO to 'It is toxic'.</p>	2	1.1	<p>Three correct = 2 marks                  One or two correct = 1 marks</p> <p><b>ALLOW</b> 'it is toxic' for sulfur dioxide.</p>
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✓✓

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	Reaction is reversible.✓	1	1.1	<b>ALLOW</b> description of reversible reaction <b>IGNORE</b> equilibrium
		(ii)	(They are) equal/ the same.✓	1	1.1	<b>IGNORE</b> constant/stay the same
		(iii)	<b>Any two from:</b> Ammonia reacts ✓ Goes back to reactants ✓ Concentration stays the same/does not increase ✓	2	2.1	

Question	Answer	Marks	AO element	Guidance
(b)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b> Describes the effect of temperature and pressure on yield. <b>AND</b> Explains the choice of conditions. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Describes the effect of temperature and pressure on yield. <b>AND</b> Describes the effect the conditions on other factors <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Describes the effect of temperature and pressure on yield. <b>OR</b> Describes the effects one or more conditions on other factors.  <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b> <i>No response or no response worthy of credit.</i></p>	6	2 x 3.1a 2 x 2.2 2 x 1.2	<p><b>AO3.1a Analysing information about effect of temperature and pressure on yield</b></p> <ul style="list-style-type: none"> <li>• increase in temperature gives decrease in yield</li> <li>• increase in pressure gives increase in yield</li> </ul> <p><b>AO1.2 Demonstrating knowledge of effect of temperature and pressure and catalysts on other factors</b></p> <ul style="list-style-type: none"> <li>• higher temperature gives faster rate</li> <li>• higher pressure gives faster rate</li> <li>• higher temperature needs more energy</li> <li>• higher pressure needs more energy</li> <li>• higher pressure needs stronger equipment</li> <li>• catalyst increases rate</li> <li>• catalyst do not affect yield</li> </ul> <p><b>AO2.2 Applying knowledge and understanding to explain choice of conditions</b></p> <ul style="list-style-type: none"> <li>• idea of compromise</li> <li>• high temperature gives low yield/higher energy use but faster rate</li> <li>• high pressure for high yield/rate but low pressure for cost of equipment/safety/energy use</li> <li>• use of catalyst increases rate allowing lower temperature and pressure</li> </ul>

Question		Answer	Marks	AO element	Guidance
7	(a)	sodium nitrate ✓ HNO <sub>3</sub> ✓ NaOH ✓	3	1.2	<b>DO NOT ALLOW</b> NAOH <b>ALLOW</b> for 1 mark, both formulae with correct atoms in wrong order
	(b)	H <sup>+</sup> / hydrogen (ion) from acid ✓ OH <sup>-</sup> / hydroxide (ion) from alkali ✓	2	1.1	<b>ALLOW</b> specific acid or alkali (named or formulae) <b>ALLOW</b> (if no other mark awarded) 1 mark for both ions / positive ion from acid and negative ion from alkali.
	(c)	(i) H <sup>+</sup> concentration - higher pH number has lower H <sup>+</sup> concentration ✓ Acidity and alkalinity of the solution - higher pH number is less acidic AND more alkaline ✓ ORA	2	1.1	
		(ii) 1x10 <sup>-7</sup> (mol/dm <sup>3</sup> ) ✓	1	2.2	
	(d)	Measuring cylinder ✓ pH meter ✓	2	3.3a	

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	<p>These electrons can move (and carry charge) ✓</p> <p>All (outer) electrons in diamond used in bonding ✓ Only 3 (outer) electrons in graphite and graphene used in bonding/not all (outer) electrons used in bonding ✓</p>	3	1.1	<p><b>IGNORE</b> free electrons/layers moving</p> <p><b>ALLOW</b> as alternative to marking points 2 and 3</p> <p>Diamond has 4 bonds per carbon AND graphite and graphene has 3 bonds per carbon ✓ Only graphite and graphene have delocalised electrons ✓</p>
		(ii)	<p>Diamond and graphene Difficult to pull particles/atoms apart / high energy needed to separate particles/atoms/bonds ✓ (In diamond and graphene) all atoms held by strong covalent bonds ✓</p> <p>Graphite Layers/sheets can slide over each other ✓ (Graphite) has weak bonds between the layers ✓</p>	4	1.1	<p><b>DO NOT ALLOW</b> separation of ions or molecules</p> <p><b>DO NOT ALLOW</b> reference to ions/intermolecular bonds</p> <p><b>ALLOW</b> intermolecular bonds/forces <b>DO NOT ALLOW</b> covalent/ionic bonds</p>
		(iii)	1 x 10 <sup>-10</sup> m ✓	1	1.1	
	(b)	(i)	<p>They are hollow ✓ They are very small ✓</p>	2	1.2	
		(ii)	<p>Risk – may cause damage to body/long term effects not studied ✓</p> <p>Benefit – targets the affected area / delivers efficiently / absorbed more easily ✓</p>	2	1.1	<p><b>ALLOW</b> may cause specified damage e.g. may get into brain</p> <p><b>ALLOW</b> any reasonable benefit <b>IGNORE</b> quicker/effective</p>

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