



**GCE**

**Chemistry B**

**H033/01: Foundations of chemistry**

AS Level

**Mark Scheme for June 2023**

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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. Work crossed out:
  - a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
  - b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
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. There is a NR (No Response) option. Award NR (No Response)
  - if there is nothing written at all in the answer space
  - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
  - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

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.

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## 10. 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

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11. 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

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## 12. 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.

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## SECTION A

Q	KEY	AO
1	D	1.1
2	B	2.5
3	A	1.1
4	A	1.1
5	A	2.4
6	D	1.1
7	A	2.1
8	A	1.1
9	D	2.8
10	B	2.2
11	D	1.1
12	C	1.2
13	C	1.1
14	D	2.2
15	A	2.2
16	A	2.1
17	C	2.1
18	B	2.1
19	A	2.5
20	B	2.5

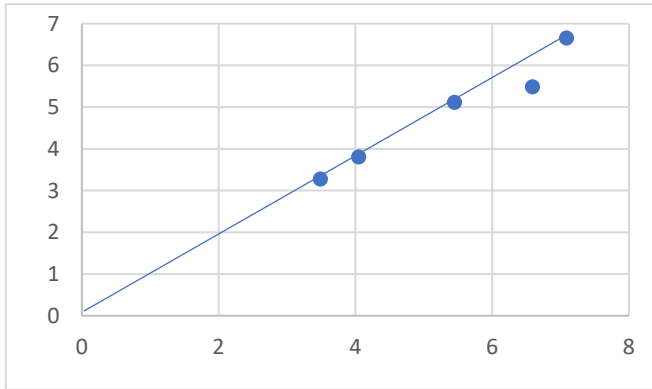


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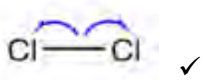
## SECTION B

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	Repeated heating and (re)weighing until no change (AW) ✓	1	1.1	<b>ALLOW</b> heating and reweighing.....
		(ii)	 <p>Mass left /g</p> <p>Mass heated /g</p> <p>Labelled axes (mass heated on x axis) ✓ Points plotted correctly, at least half the grid used in both axes ✓ Straight line of best fit through origin (ignoring anomalous point) ✓</p>	3	3 x 2.8	<b>IGNORE</b> numbers for first marking point, but must include either '/g' or '(g)' mp2 Check points by eye ( <b>ALLOW</b> +/- 1 square) mp3 All non-anomalous points (including zero) must be one within one square of straight line.
		(iii)	<p><b>FIRST CHECK ANSWER LINE</b> <b>If x = 0.5, award 3 marks</b> Amount anhydrous: Any mass (4 – 8g) divided by 136(.2) ✓ Amount water: <i>Corresponding</i> difference (read from line or from table for a non-anomalous point) divided by 18 ✓ (ecf from mp1) Ratio = 0.5 ✓ ecf on ratio</p>	3	3 x 2.6	<p><i>Example (using top point):</i> Amount anhydrous = <math>6.65/136 = 4.89 \times 10^{-2} \text{ mol}</math> ✓ Amount water = <math>(7.09 - 6.65)/18 = 2.44 \times 10^{-2} \text{ mol}</math> ✓ Ratio = <math>2.44/4.89 = 0.5</math> (to one sf) ✓ <i>must be water:anhydrous</i> <i>Example using average of four valid points</i> Amount anhydrous = <math>4.71/136 = 0.0346...</math> ✓ Amount water = <math>0.31/18 = 0.017....</math> ✓</p>
	(b)		(brick)red ✓	1	1.2	<b>ALLOW</b> brick red or orange-red <b>DO NOT ALLOW</b> any other colour <b>IGNORE</b> references to intensity e.g. bright

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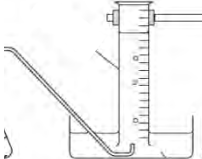
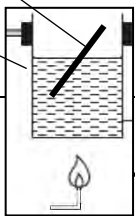
Question		Answer	Marks	AO element	Guidance
	(c)	(Mg and Ca) in same group/ Group 2 ✓ s <sup>2</sup> ✓	2	2 x 1.1	<b>ALLOW</b> Same number of outer shell electrons for mp2 but <b>NOT</b> same number of protons; <b>IGNORE</b> 2+ ions
	(d) (i)	42 ✓	1	1.1	
	(d) (ii)	<b>FIRST CHECK ANSWER LINE</b> <b>If answer = 40.12 award 2 marks</b> [(96.968 x 40) + 0.652 x 42) + (2.19 x 44) + 0.19 x 48)]/100 ✓ = 40.12 ✓	2	2 x 1.2	For mp1 <b>ALLOW</b> 40.115(84) (as must have used expression correctly to calculate this) <b>ALLOW</b> any answer calculated from any previous expression expressed to 2dp (correct rounding needed) for mp2
<b>Total</b>			<b>13</b>		
22	(a) (i)		1	1.1	Must be half arrows <b>IGNORE</b> any products
	(ii)	homolytic ✓	1	1.1	<b>ALLOW</b> homolysis
	(b) (i)	<b>Equation 22.3</b> <b>AND</b> (two radicals) forming a molecule/non-radical (AW) ✓	1	1.1	<b>ALLOW</b> 'Cl + Cl → Cl <sub>2</sub> ' for "equation 22.3" <b>IGNORE</b> 'chlorine formed'
	(ii)	Do cause breakdown of ozone (AW) ✓ (but) Equation is O <sub>3</sub> + O → 2O <sub>2</sub> ✓ chlorine atoms are catalytic/ Cl not used up (AW) ✓ so can break down many ozone molecules ✓ Equation 22.3 is slow/ not very fast - because chlorine atoms are so few/widely spaced (AW) ✓	5	3.1 2.3 3.1 2.7 3.2	mp2 or mp4 subsumes mp1 mp4 only scored if mp3 scored <b>ALLOW</b> Reference to regeneration of Cl radicals by UV radiation for mp5
	(c) (i)	<u>chloromethane</u> ✓	1	1.2	<b>NOT</b> 1-chloromethane
	(ii)	Cl is more electronegative than C ✓ molecule is asymmetric (and thus has a dipole) (AW) ✓	2	2 x 1.1	mp1 - Must be 'electronegative', not just 'negative' mp2 e.g. Molecule has one side slightly positive, the other slightly negative
	(d)	Ag <sup>+</sup> (aq) + Cl <sup>-</sup> (aq) → AgCl(s) Equation ✓ SS ✓	2	2 x 1.2	<b>ALLOW</b> mp2 for any balanced precipitation reaction between 2 ions

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Question			Answer	Marks	AO element	Guidance
				13		

Question			Answer	Marks	AO element	Guidance
23	(a)		based on several/many compounds/molecules (AW) ✓	1	1.1	<b>IGNORE</b> several/many tests/samples
	(b)		<b>FIRST CHECK ANSWER LINE</b> If bond enthalpy = (+)863 (kJ mol <sup>-1</sup> ), award 3 marks  1. $2(\text{C}\equiv\text{N}) + 347 + 498 - 945 - 2(1077) = -529$ ✓ 2. $2(\text{C}\equiv\text{N}) = 945 + 2(1077) - 498 - 529 - 347$ ✓ 3. $\text{C}\equiv\text{N} = 1725/2 = 862.5/863$ (kJ mol <sup>-1</sup> ) ✓	3	3 x 2.2	<b>ALLOW</b> 862.5 <b>ALLOW</b> ecf mp 2 subsumes mp1 mp2 – <b>ALLOW</b> $2(\text{C}\equiv\text{N})$ calculated correctly (with ecf) mp3 – Dividing evaluated expression by 2 (ecf) If no other marks scored award 1 mark for (-)3099 anywhere
	(c)	(i)	(The table shows the) energy needed/taken in ✓ to break bonds ✓	2	2 x 1.2	Reference to balance between breaking and making bonds is a <b>CON</b> of mp2
		(ii)	$\text{C}\equiv\text{O}$ shorter (than $\text{C}=\text{O}$ ) (ora) ✓	1	1.1	No need to specify both species (in the stem) <b>IGNORE</b> any reference to material not mentioned in table 23.1 unless <b>CON</b>
	(d)	(i)	<b>Experiment 1</b> tube extended to dip under water in suitable vessel with measuring cylinder above ✓    thermometer beaker (AW)  <b>Experiment 2</b> 	3	3 x 3.3	<b>IGNORE</b> clamps Expt 1 Measuring cylinder to be labelled or indicated by calibration marks.  Expt 2 Tube may not be extended but flame must be shown

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Question		Answer	Marks	AO element	Guidance
		Tube with flame playing on a suitable vessel containing liquid ✓ vessel and a thermometer labelled ✓			Second mark for Expt 2 scores on its own
	(ii)	Vessel lagged/Draught excluder/Lid on beaker/stir water ✓	1	3.4	<b>IGNORE</b> bomb calorimeter Credit any modifications shown in diagram 2 in part d(i) <b>IGNORE</b> any modifications which affect precision rather than accuracy, eg thermometer with more graduations/repeat and average
	(iii)	<b>FIRST CHECK ANSWER LINE</b> <b>If rise = 12 (°C), award 4 marks</b>  Amount cyanogen = 240/24000 = 0.01(0) mol ✓ E(or Q etc) = mcΔT ✓ ΔT = 529000 x 0.01/110 x 4.18 = 11.5.... ✓ ΔT = 12 (°C) to 2 sf ✓	4	4 x 2.8	mp1 – moles of cyanogen mp2 – expression written or use implied T interpreted as time is <b>CON</b> mp3 - Calculated value of ΔT scores (ecf) mp4 - Award sf mark for any <b>calculated</b> number to 2sf
	(e)	carbon monoxide	1	1.1	<b>IGNORE</b> CO
			<b>16</b>		

Question		Answer	Marks	AO element	Guidance
24	(a)	<pre> H H     -C-C-     H O   C=O   H-C-H   H </pre> ✓	1	1.2	<b>IGNORE</b> brackets or 'n'.  Must be full structural but <b>ALLOW</b> CH <sub>3</sub>

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Question		Answer	Marks	AO element	Guidance
	(b)	permanent dipole-permanent dipole ✓	1	2.1	<b>ALLOW</b> pd-pd <b>ALLOW</b> ecf from wrong structure in 24a, eg accept hydrogen bonding if O-H bonds shown in 24a
	(c)	Bromine (water) decolorised/ turned orange to colourless ✓	1	1.2	<b>ALLOW</b> brown, orange or yellow (or combinations) for description of aqueous bromine <b>IGNORE</b> colours if 'decolorised' is stated.
	(d)	Aldehyde/carbonyl ✓	1	1.1	
	(e)	vinyl acetate ✓ C=C peak identified at (around) 1600 ✓ 2 marks for any two peaks identified from ✓✓ C=O at 1750, C-O at 1000 to 1300 and no OH at (around) 3000	4	3.2 3.1 3.1 3.1	
			8		

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