



Practice Paper 2

A Level Chemistry B

H433/02 Scientific literacy in chemistry

MARK SCHEME

Duration: 2 hours 15 minutes

MAXIMUM MARK 100

FINAL

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.
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:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - 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.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content 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 science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

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 science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **3(d)** and **5(i)**.

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).

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	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.

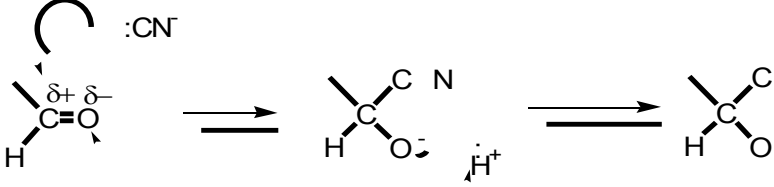
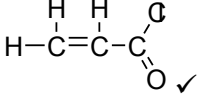
You should ensure that you have copies of these materials.

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**.

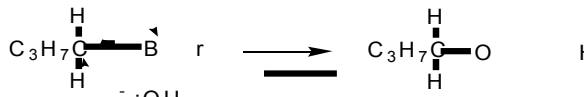
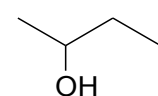
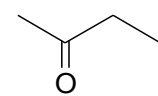
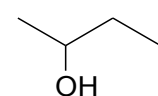
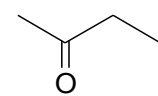
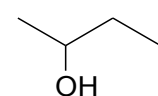
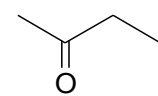
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

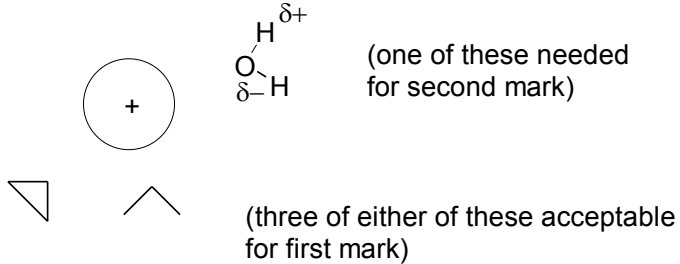
Question			Answer	Marks	Guidance
1	(a)		add until no more fizzing ✓ filter ✓ evaporate and allow to crystallise ✓ filter (or pick out crystals) and dry ✓	4	ALLOW until no more dissolves
	(b)	(i)	$\text{SrCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{SrCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2$ equation ✓ state symbols ✓	2	ALLOW state symbol mark if formulae or balancing wrong but no species is missing or extra.
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 7.4 (g) award 2 marks amount $\text{HCl} = 2 \times 50/1000$ OR $0.1(0)$ ✓ mass $\text{SrCO}_3 = (0.1 \times 147.6 \times 0.5) = 7.4$ (g) ✓	2	ALLOW ecf from first mark to second or from wrong formula for SrCO_3 in (b)(i) ALLOW 2 or more sf
	(c)	(i)	Heat, cool (in desiccator), weigh, ✓ Repeat until mass constant ✓	2	
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 6 award 4 marks amount $\text{AgCl} = 2.16/143.4$ OR 1.506×10^{-2} ✓ amount $\text{SrCl}_2 = 0.5 \times 2.16/143.4$ OR 7.531×10^{-3} ✓ $M_r \text{SrCl}_2 \cdot x\text{H}_2\text{O} = (2/7.531 \times 10^{-3}) = 266$ ✓ $x = ((266 - 158.6)/18) = 6$	4	ALLOW ecf Second mark subsumes first OR mass $\text{SrCl}_2 = 7.531 \times 10^{-3} \times 158.6$ (or 1.19g) and mass $\text{H}_2\text{O} = 2 - 1.19 = 0.81$ g ✓ $(0.81/18) = 0.045 / (1.19/158.6) = 0.0075 = 6$ ✓
		(iii)	Solubility of silver chloride = $\sqrt{K_{sp}} = 1.4 \times 10^{-5}$ (mol dm ⁻³) ✓ Moles in 200 cm ³ 3×10^{-6} which is negligible compared with 1.5×10^{-2} ✓	2	OR compare masses 4×10^{-4} g with 2.16g
		(iv)	$(36 \times 100/194.6) = 18.5$ or 18(%) ✓	1	ALLOW more sf
	(d)	(i)	electrons are promoted(AW) to higher energy levels by heat/energy ✓ drop down (energy levels) emitting light/radiation/photon ✓ energy dropped proportional to frequency/ $\Delta E = h\nu$ ✓	3	NOT promoted by light/radiation
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 293 (kJ mol ⁻¹) award 3 marks Use of $\Delta E = hc/\lambda$ ✓	3	ALLOW two or more sf ALLOW from a substituted expression

Question			Answer	Marks	Guidance
			$\Delta E = 6.63 \times 10^{-34} \times 6.02 \times 10^{23} \times 3 \times 10^8 / 4.08 \times 10^{-7} \times 1000$ $\checkmark$ $= 293 \text{ kJ mol}^{-1} \quad \checkmark$		ALLOW ecf for calculation of expression omitting or misplacing one of the terms
			Total	23	

Question	Answer	Marks	Guidance
2 (a)	$\text{C}_3\text{H}_8\text{O}_3 \rightarrow \text{C}_3\text{H}_4\text{O} + 2\text{H}_2\text{O}$ one organic molecular formula correct ✓ completely correct ✓	2	
(b)	Aqueous bromine (AW) goes colourless ✓	1	
(c)	blue (solution) ✓ red/orange (ppt) ✓ Cu_2O ✓	3	ALLOW these colours or any combination but no others. ALLOW copper(I) oxide
(d) (i)	 attack on aldehyde showing curly arrows and partial charges ✓ intermediate (with negative charge) and attack by H^+ (including curly arrow) ✓ product ✓	3	Curly arrows must start (when projected) on a bond (or lone pair or minus sign) and end (when projected) on an atom ALLOW rest of acrolein structure or 'R' on 'spare' bond(
(ii)	HCN/CN^- is nucleophile ✓ will not attack negative charge of $\text{C}=\text{C}$ /no positive/ δ^+ for nucleophile to attack ✓	2	IGNORE reference to electrophiles.
(e) (i)		1	
(ii)	SOCl_2 ✓ NH_3 ✓	2	ALLOW 'thionyl chloride' or 'sulfur dichloride oxide' ALLOW 'ammonia' Mark separately
(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 14 (g) award 2 marks amount acrolein = $0.55 \times 100 / (3 \times 71)$ OR 0.258 mol ✓ mass acrolein = $0.258 \times 56 = 14$ (g) (2 sf) ✓	2	14.5 or 14.46... score 1 mark
	Total	16	

Question			Answer	Marks	Guidance
3	(a)		2-bromo-2-methylpropane ✓ 2-methylpropan-2-ol ✓	2	IGNORE dashes, commas and gaps
	(b)		withdraw (sample) using pipette at given times ✓ run into (conical) flask ✓ titrate (quickly) with <u>standard/know concentration of NaOH (in burette)</u> ✓	3	
	(c)	(i)	axes and labels: y: (CH ₃) ₃ CBr/ mol; x: time/ min ✓ scale: uses at least two-thirds of paper ✓ plotting ✓ curve of best fit going through all points except anomalous one (second) ✓	4	10 ⁻³ must be in units or included in scale
		(ii)	construction for two half-lives on graph ✓ half-lives constant ✓	2	
	(d)*		<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> Level 3 (5–6 marks) Detailed deductions about the mechanisms, orders of reaction and rate of both equations 3.2 and 3.3. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Outline comments about the mechanisms, orders of reaction and rate of both equations 3.2 and 3.3 but some detail excluded. OR Detailed deductions about the mechanism, order of reaction and rate of either equation 3.2 or 3.3. <i>There is a line of reasoning presented with some</i>	6	Indicative scientific points include: Mechanism Equation 3.2 • second step is (CH₃)₃C⁺ + OH⁻ → (CH₃)₃COH • this is fast (not rate-determining) Equation 3.3 • occurs in a step in which Br⁻ leaves as OH⁻ enters AW • since only one step Orders of reaction Equation 3.2 • first order with respect to [RBr] • RBr occurs in rds • zero order with respect to [OH⁻] • [OH⁻] occurs in fast step (only) Equation 3.3 • both RBr and OH⁻ are first order • RBr and OH⁻ both appear once in the single step

Question			Answer	Marks	Guidance									
			structure. The information presented is relevant and supported by some evidence. Level 1 (1–2 marks) Limited comments about the mechanisms, orders of reaction and rate of both equations 3.2 and 3.3, no detail. OR Outline comments about the mechanism, order of reaction and rate of either equation 3.2 or 3.3. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks No response or no response worthy of credit		Rate equations Equation 3.2 - Rate = k [RBr] Equation 3.3 - Rate = k [RBr][OH⁻] Mechanism 									
	(e)		tertiary AND OH group attached to C with no H/ 3 Cs	1	IGNORE 'it' for 'OH group'									
	(f)		<table><tr><td></td><td>Skeletal formula</td><td>Name</td></tr><tr><td>A</td><td></td><td>butan-2-ol ✓</td></tr><tr><td>B</td><td></td><td>butanone ✓</td></tr></table>		Skeletal formula	Name	A		butan-2-ol ✓	B		butanone ✓	4	Names must match structures ALLOW ecf for B as the oxidation product of A ALLOW butan-2-one
	Skeletal formula	Name												
A		butan-2-ol ✓												
B		butanone ✓												
				22										

Question			Answer	Marks	Guidance
4	(a)	(i)	$\text{Na}^+(\text{g}) + \text{Cl}^-(\text{g})$ ✓ $\text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})/\text{NaCl}(\text{aq})$ ✓ $\text{NaCl}(\text{s})$ ✓ –370 ✓	4	IGNORE ΔH labels ALLOW two steps to this level Level must be above NaCl(s) line to score. Minus sign required for last marking point
		(ii)	 (one of these needed for second mark) (three of either of these acceptable for first mark) Na⁺ surrounded by at least three water molecules (minimum as shown) ✓ at least one water molecule shown with atoms and dipole ✓	2	
		(iii)	(yes) ionic bonds in lattice ✓ (no) bonds (between water and ions) are ion-dipole ✓ (yes) bonds broken and made are very similar OR because sum of enthalpies of hydration of ions similar to LE ✓ OR ion dipole bonds have similar strength to ionic bonding OR enthalpy change of solution is small	3	must clearly state or imply error to score second mark.
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = –0.7789 (°C), to any sf, award 2 marks $\Delta T = 4000 \times 10 / (210 \times 4.18 \times 58.5) = -0.8 \text{ (°C)}$ ✓✓	2	ALLOW any sf (1 is most correct) Answers scoring 1 mark: • acceptable number with plus (or no) sign • –4.56 (no moles) • –0.000779 (no unit conversion) correct expression with wrong evaluation.
	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = –3.72 (°C), to 2 or more sf, award 2 marks	2	ALLOW ecf

Question			Answer	Marks	Guidance
			particles per dm ³ = 2.00 ✓ fpt = 2 x 0.1 x 18.6 = -3.72 (°C) ✓		
		(ii)	mass of CaCl ₂ = 56 g ✓ Uncertainties in mass and volume are: 56±1 AND 1% OR 2sf AND 1000±10 AND 1% OR 2sf OR 3 sf✓ Uncertainty in temp 0.5 x 100 /3 AND 17% OR 1sf, so least precise/biggest uncertainty ✓	3	ALLOW 56±01 AND 2% ALLOW ecf from first marking point ALLOW 56 ± 0.5 to score last mark, comparisons must all be in %s or all in sf ALLOW ecf in statement of which is least precise/uncertain
				16	

Question			Answer	Marks	Guidance
5	(a)	(i)	froth/detergent flotation AND matte ✓	1	
		(ii)	NiS + H ₂ SO ₄ → NiSO ₄ + H ₂ S OR CuS + H ₂ SO ₄ → CuSO ₄ + H ₂ S	1	IGNORE state symbols
		(iii)	electrolysis	1	
	(b)	(i)	high melting AND unreactive	1	
		(ii)	2CO + 2NO → N ₂ + 2CO ₂	1	ALLOW halves or multiples IGNORE state symbols
	(c)		4d ⁶	1	
	(d)	(i)	 6 ✓	2	ALLOW bridging oxygen bonding in axial or equatorial positions IGNORE brackets and charges.
		(ii)	square planar OR tetrahedral	1	
	(e)		R ₂ NH ₂ ⁺ ✓ 3 + balances 3– (AW) ✓	2	
	(f)		10 ⁷ – 10 ¹⁰ or any value in that range ✓	1	
	(g)		[Cu(H ₂ O) ₆] ²⁺ + 4NH ₃ → [Cu(NH ₃) ₄ (H ₂ O) ₂] ²⁺ + 4H ₂ O ✓ (light)blue dark blue/violet/purple/mauve ✓	2	ALLOW [Cu(H ₂ O) ₆] ²⁺ + 6NH ₃ → [Cu(NH ₃) ₆] ²⁺ + 6H ₂ O IGNORE state symbols
	(h)		Wrong: d subshells still split ✓ Ag ⁺ is d ¹⁰ OR Ag has full d subshell ✓ so no movement possible (AW) ✓	3	
	(i)*		<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> Level 3 (5–6 marks) Describes in detail the methods of extraction and gives chemical details from the article of all three compounds. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i>	6	Indicative Scientific points include: Description of extraction of Pd: - extracted by ligand exchange - followed by dissolving in organic solvent Chemical details from article concerning Pd: - equation, eg [equation, eg [Pd(H₂O)₆]²⁺(aq) + 4Cl[–](aq) → [PdCl₄]^{2–}(aq) + 6H₂O(l)] - this reaction is much slower for other PGMs Description of extraction of Pt:

Question	Answer	Marks	Guidance
	Level 2 (3–4 marks) Describes in detail the methods of extraction of all three compounds AND Gives the chemical details from the article for either Pd, Pt or Os <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Outlines the methods of extractions for of all three compounds AND Gives the chemicals details from the article for either Pd, Pt or Os. OR Describes in detail the method of extraction for one of the compounds and gives chemical details from the article concerning this compound. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks No response or no response worthy of credit		- anion exchange - reacted with $R_2NH_2^+ Cl^-$. Chemical details from article concerning Pt: $2[R_2NH_2^+ Cl^-] + [PtCl_6]^{2-} (aq) \rightleftharpoons (R_2NH_2^+)_2 [PtCl_6]^{2-} + 2Cl^-$ $(R_2NH_2^+)_2 [PtCl_6]^{2-}$ is soluble in organic solvents whereas the equivalent salts of other PGMs have lower solubility. Description of extraction of Os: - oxidation - oxide volatile and can be removed by heating Chemical details from article concerning Os: - oxidised to OsO_4 - may be mixed with RuO_4
		23	