



Practice paper 2

A Level Chemistry B (Salters)

H433/01 Fundamentals of Chemistry

MARK SCHEME

Duration: 2 hour 15 minutes

MAXIMUM MARK 110

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 **34(d)** and **35(a)**.

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.

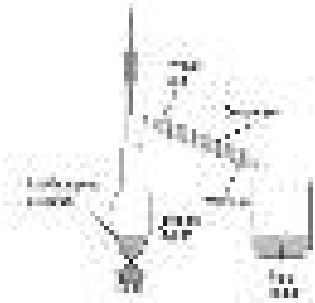
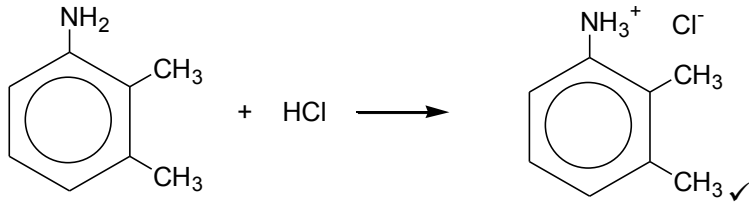
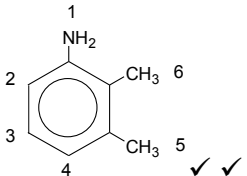
			Mark	
1	B		1	
2	C		1	
3	C		1	
4	D		1	
5	A		1	
6	A		1	
7	A		1	
8	B		1	
9	C		1	
10	D		1	
11	D		1	
12	B		1	
13	A		1	
14	C		1	
15	B		1	
16	C		1	
17	B		1	
18	C		1	
19	B		1	
20	B		1	
21	D		1	
22	A		1	
23	C		1	
24	B		1	
25	C		1	
26	C		1	
27	B		1	
28	D		1	
29	C		1	
30	A		1	
		Total	30	

Question			Answer	Marks	Guidance
31	(a)	(i)	Nitrogen and oxygen <u>from the air/atmosphere</u> combine due to high temperature. ✓	1	ALLOW formulae for gases
31	(a)	(ii)	 Unpaired electron (on oxygen) ✓	2	IGNORE 'lone', 'single'
31	(b)	(i)	A radical reacts to produce a new radical (to continue the reaction) (AW) ✓	1	
31	(b)	(ii)	$\text{CO} + 2\text{O}_2 \rightarrow \text{CO}_2 + \text{O}_3$ ✓	1	
31	(c)		reactants in the same phase/ physical state ✓ Speeds up a reaction but is not used up OR provides a different reaction pathway with lower E_A ✓	2	DO NOT ALLOW lowers activation enthalpy
31	(d)		Absorbs <u>high energy/high frequency</u> UV radiation ✓ Which would cause skin cancer ✓	2	ALLOW which would cause a mutation in DNA
31	(e)	(i)	 Homolytic ✓	2	Must be half-arrows. IGNORE dots on radicals
31	(e)	(ii)	Energy of radiation = $8.5 \times 10^{14} \times 6.63 \times 10^{-34}$ OR $5.64 \times 10^{-19} \text{ J}$ ✓ Energy supplied in kJ mol^{-1} = $\text{ans} \times 6.02 \times 10^{23} / 1000 = 339 \text{ kJ mol}^{-1}$ ✓ UV radiation in the troposphere insufficient to break the bond. ✓	3	Alternative method: Energy required to break 1 bond: $346000 / 6.02 \times 10^{23}$ OR 5.75×10^{-19} ✓ Frequency required to break the bond $5.75 \times 10^{-19} / 6.63 \times 10^{-34}$ OR 8.67×10^{14} . ✓ Higher than that available. ✓
			Total	14	

Question			Answer	Marks	Guidance
32	(a)	(i)	$\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$ ✓ Chlorine is the oxidising agent: it gains electrons OR oxidation state lowered ✓	2	ALLOW reference to oxidation state of Br increasing or Cl decreasing
32	(a)	(ii)	FIRST CHECK THE ANSWER ON THE ANSWER LINE If the answer = 93.6 award 3 marks Moles of Cl^- ions/dm ³ : $208/35.5 = 5.86$ ✓ Moles of Br^- ions/dm ³ : $5/79.9 = 0.0626$ ✓ Ratio $5.86/0.0626 = 93.6$ ✓	3	ALLOW 2 or more significant figures ALLOW in moles per 100 cm ³
32	(a)	(iii)	Bromine is toxic OR volatile ✓	1	ALLOW poisonous DO NOT ALLOW harmful
32	(b)	(i)	$\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HClO}$ 0 -1 +1 ✓	1	
32	(b)	(ii)	chloric(I) acid ✓	1	ALLOW chloric (I) acid IGNORE hypochlorous acid
32	(c)		Beakers: ClO^- and Cl^- and H^+ and Pt electrode ✓ I_2 and I^- and Pt electrode ✓ Salt bridge ends in both solutions AND 1 mol dm ⁻³ for all solutions ✓ Electron flow in wire from I_2/I^- to ClO^-/Cl^- ✓ $\text{ClO}^- + 2\text{H}^+ + 2\text{I}^- \rightarrow \text{Cl}^- + \text{H}_2\text{O} + \text{I}_2$ ✓	5	
32	(d)		$2\text{HBr} + \text{H}_2\text{SO}_4 \rightarrow \text{Br}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$ ✓ $8\text{HI} + \text{H}_2\text{SO}_4 \rightarrow 4\text{I}_2 + \text{H}_2\text{S} + 4\text{H}_2\text{O}$ ✓	2	ALLOW '1' instead of no number in front of H_2SO_4 etc.
32	(e)		MnO_4^- as its E^\ominus value is more positive than Cl_2/Cl^- ✓ and thus electrons will flow there from the other half cell AW ✓ $2\text{MnO}_4^-(\text{aq}) + 16\text{H}^+(\text{aq}) + 10\text{Cl}^-(\text{aq}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + 8\text{H}_2\text{O}(\text{l}) + 5\text{Cl}_2(\text{aq})$ ✓	3	
Total				18	

Question			Answer	Marks	Guidance																				
33	(a)		Titrate the equilibrium mixture with alkali/NaOH of known concentration (to find total moles of acid) ✓ Subtract moles of (H ₂ SO ₄) catalyst ✓	2																					
33	(b)		FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer =3.61 award 4 marks <table><tr><th>Substance</th><th>Mass at start</th><th>Amount present at the start</th><th>Amount present at equilibrium</th></tr><tr><td>ethanol</td><td>15.8</td><td>15.8/46 (= 0.343)</td><td>(0.343 – [0.35-0.123]) = 0.116</td></tr><tr><td>ethanoic acid</td><td>21.0</td><td>21.0/60 (= 0.35(0))</td><td>0.123</td></tr><tr><td>ethyl ethanoate</td><td>0</td><td>0</td><td>[0.35-0.123 =] 0.227</td></tr><tr><td>water</td><td>0</td><td>0</td><td>0.227</td></tr></table> One mark for both amounts at start ✓ One mark for amount of ethanol at equilibrium ✓ One mark for amounts of ester and water at equilibrium ✓ $K_c = 0.227^2 / (0.123 \times 0.116) = 3.61$ ✓	Substance	Mass at start	Amount present at the start	Amount present at equilibrium	ethanol	15.8	15.8/46 (= 0.343)	(0.343 – [0.35-0.123]) = 0.116	ethanoic acid	21.0	21.0/60 (= 0.35(0))	0.123	ethyl ethanoate	0	0	[0.35-0.123 =] 0.227	water	0	0	0.227	4	ALLOW ecf throughout ALLOW other answers (to 2 or more sf) by using various rounding during calculation.
Substance	Mass at start	Amount present at the start	Amount present at equilibrium																						
ethanol	15.8	15.8/46 (= 0.343)	(0.343 – [0.35-0.123]) = 0.116																						
ethanoic acid	21.0	21.0/60 (= 0.35(0))	0.123																						
ethyl ethanoate	0	0	[0.35-0.123 =] 0.227																						
water	0	0	0.227																						
33	(c)		<div><div><div>HCH₃</div><div>—C—C—</div><div>HCO</div><div>OCH₃ ✓</div></div></div>	1	ALLOW any unambiguous structure IGNORE brackets or ‘n’																				
33	(d)		Methyl propanoate AND methanal ✓	1																					

Question			Answer	Marks	Guidance								
33	(e)		FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = (+)666(K) award 3 marks $\Delta S_{\text{sys}} = (+) 154.7 \text{ (J K}^{-1} \text{ mol}^{-1}) \checkmark$ $T = \Delta H/\Delta S_{\text{sys}}$ OR $T = 103000/154.7 \checkmark$ $T = (+)666 \text{ (K)} \checkmark$	3									
33	(f)		<table><tr><td>Change</td><td>Increased temperature</td><td>Increased pressure</td><td>Use of a catalyst</td></tr><tr><td>Effect on K_c</td><td>Increase</td><td>No change</td><td>No change</td></tr></table> $\checkmark \checkmark$	Change	Increased temperature	Increased pressure	Use of a catalyst	Effect on K_c	Increase	No change	No change	2	All 3 correct 2 2 correct 1
Change	Increased temperature	Increased pressure	Use of a catalyst										
Effect on K_c	Increase	No change	No change										
33	(g)		FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 4390(dm3) award 3 marks Unit conversion, $n= 25000/142$, $p=150000$, \checkmark Use of $pV=nRT$ and 50% yield, $V = 0.5 \times 25000 \times 8.314 \times 900/142 \times 150000 \checkmark$ Evaluation and conversion to dm3 4390 \checkmark	3	ALLOW 2 or more sf								
33	(h)		Allows reaction to occur at lower temp AND less energy used \checkmark	1									
			Total	17									

Question	Answer	Marks	Guidance
34 (a) (i)	 <p>Correct arrangement of flask and thermometer ✓ Correct arrangement of condenser, water in at bottom, condenser not 'sealed' ✓ More volatile liquid can be collected at its boiling point ✓</p>	3	labels not essential apart from water connection anti-bumping granules not essential
34 (a) (ii)		1	ALLOW 'NH ₃ Cl' ALLOW any correct equation
34 (a) (iii)	Add alkali/ NaOH ✓ Put in separating funnel and collect organic layer ✓	2	
34 (b)		2	ALLOW 3,4,5,6 in any order. ALLOW 1 mark if both methyl groups have the same number OR if all both remaining arene protons are labelled '2'.

Question		Answer	Marks	Guidance
34	(c)	<p>FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 18.7(kg) award 3 marks</p> <p>Moles Mefenamic acid required = $15000/241$ (= 62.24) ✓ Moles 2-clorobenzoic acid needed = ans to 1st point x $100/52$ (= 119.69) ✓ Mass 2-clorobenzoic acid needed = ans to 2nd point x $156.5/1000$ = 18.7 (kg) ✓</p>	3	<p>ALLOW ecf throughout ALLOW 2 or more sf</p>
34	(d)*	<p><i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i></p> <p>Level 3 (5–6 marks) Describes the appearance of the infrared and mass spectra in detail. AND Clearly explains how mol mass, fragmentation and fingerprint region confirm identity.</p> <p><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>Level 2 (3–4 marks) Describes the appearance of the infrared. OR Describes the appearance of the mass spectra in detail. AND Clearly explains how mol mass, fragmentation and fingerprint region confirm identity.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p>	6	<p>Indicative scientific points may include:</p> <p>Absorbances on Infrared:</p> <ul style="list-style-type: none"> • About 3300-3500 N-H amines • 2500-3300 O-H carboxylic acid • 1700-1725 C=O carboxylic acid • 1450-1650 several peaks Arenes • 3000-3100 C-H arenes • About 2850-2950 C-H alkyl groups <p>Mass spectrum peaks</p> <ul style="list-style-type: none"> • Molecular ion peak at 241 (allow ecf from (c)) • suggestion of a fragment (eg 196 – COOH missing) <p>Identification of structure:</p> <ul style="list-style-type: none"> • Fingerprint region unique to compound • Compare with database to confirm identity • Molecular ion gives relative molecular mass which matches that of mefenamic acid. • Fragments consistent with functional groups present

Question			Answer	Marks	Guidance
			<p>Level 1 (1–2 marks) Describes the appearance of the infrared. OR Describes the appearance of the mass spectra. OR Clearly explains how mol mass, fragmentation and fingerprint region confirm identity.</p> <p><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></p> <p>0 marks No response or no response worthy of credit</p>		
			Total	17	

Question	Answer	Marks	Guidance
35 (a)*	<p><i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i></p> <p>Level 3 (5–6 marks) Describes the set-up of the experiment in detail. AND States and explains some of the expected observations in detail.</p> <p><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>Level 2 (3–4 marks) Describes the set-up of the experiment in detail. AND States a number of observations. OR States and explains a few of the expected observations in detail.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Describes the set-up of the experiment in outline. AND States a couple of observations. OR States and explains an expected observation.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited</i></p>	6	<p>Indicative scientific points may include: Set-up of experiment in detail:</p> <ul style="list-style-type: none"> • Suitable means of collecting hydrogen produced, can exemplified via a diagram • Collection method has volume measurements • Idea of measuring vol of hydrogen per unit time. • Fair testing, same no of moles of metal, same surface area, same temperature etc. <p>Observations:</p> <ul style="list-style-type: none"> • Gas bubbles produced • Metal decreases in size/disappears • Faster rate of reaction for Ba • Ca cloudier than Ba (AW) <p>Explanations:</p> <ul style="list-style-type: none"> • Both metals react to produce hydroxides and hydrogen gas • Equation eg $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ • Hydroxides more soluble down the group • Rate of reaction increases down the group as electrons lost more easily down the group • Weaker attraction between outer electron and nucleus as atomic radius increases.

Question			Answer	Marks	Guidance
			<i>evidence and the relationship to the evidence may not be clear.</i> 0 marks No response or no response worthy of credit.		
35	(b)	(i)	FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = $5.50 \times 10^{-6} \text{ mol}^3 \text{ dm}^{-9}$ award 4 marks Mean titre = 13.90 (exclude trial and anomaly) ✓ Concentration of OH^- = $13.90 \times 0.04/25 = 0.02224 \text{ mol dm}^{-3}$ ✓ Concentration of Ca^{2+} is therefore $0.02224/2 = 0.01112 \text{ mol dm}^{-3}$ ✓ $K_{\text{sp}} = 0.0111 \times 0.0222^2 = 5.50 \times 10^{-6}$ AND units $\text{mol}^3 \text{ dm}^{-9}$ ✓	4	ALLOW answers that round to 5.5×10^{-5}
35	(b)	(ii)	Titre would be (much) lower as magnesium hydroxide is less soluble ✓	1	
	(c)		FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = (+)38.8 (°C) award 3 marks $\Delta_{\text{sol}} H \text{ CaCl}_2 = 2258 - 1650 - (2 \times -364) = -120 \text{ kJ mol}^{-1}$ ✓ Energy given out by 15.00 g = $15 \times 120000/111.1 = 16202 \text{ J}$ ✓ Temp rise $16202/(100 \times 4.18) = (+)38.8(^\circ\text{C})$ ✓	3	ALLOW 2 or more sf
			Total	14	