

**GCE**

**Chemistry B (Salters)**

**H433/03: Practical skills in chemistry**

Advanced GCE

**Mark Scheme for June 2019**

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.

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.

© OCR 2019

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

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

<b>Annotation</b>	<b>Meaning</b>
<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

## Subject-specific Marking Instructions

### INTRODUCTION

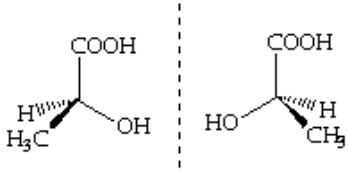
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

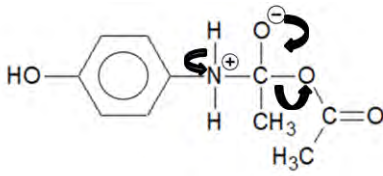
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

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	Mark	AO element	Guidance	
1	(a)	<p>(A molecule that has) non-superimposable mirror images ✓</p> <p>correct <b>3D</b> structural formula shown <math>\text{CH}_3\text{CH}(\text{OH})\text{COOH}</math> ✓</p> <p>correct use of wedges (dots) and dashes to show mirror images ✓</p>	3	1.1  2.1 x2	<p>Ignore references to C has four different groups.</p>  <p>would score MS2 and 3</p> <p><b>One mark scored for one of above structures</b>  <b>Don't worry about reflections of –OH, –COOH and etc.</b>  <b>DO NOT ALLOW</b> two 'lines' at 180</p>	
1	(b)	(i)	ester ✓	2	1.1	<b>DO NOT ALLOW</b> Polyetser
			hydrolysis ✓		2.5	<b>DO NOT ALLOW</b> Hydration
1	(b)	(ii)	<p>permanent dipole – permanent dipole ✓</p> <p>difference in electronegativity between C and O cause permanent dipole to be present AW ✓</p>	2	2.1 x2	<p><b>ALLOW</b> omission of one 'permanent' but not abbreviations</p> <p><b>ALLOW</b> 'O is more electronegative than C' / implied if C, O <math>\delta^+</math> <math>\delta^-</math> electronegative point is implied  <b>DO NOT ALLOW</b> general references to electronegativity e.g. Oxygen has a high electronegativity - must be compared to C</p>
1	(c)	<p>1. Adsorption of reactant(s) (molecules) on catalyst surface</p> <p>2. Bonds break (within reactants/ intramolecular bonds break)</p> <p>3. <u>New</u> bonds form</p> <p>4. Desorption/diffusion/release off surface of catalyst of product(s) (molecules)/leaves catalyst surface</p> <p><b>All correct</b> 2 marks ✓✓</p> <p><b>Three correct</b> 1 mark ✓</p>	2	1.1 x2	<p><b>ALLOW</b> reactants/molecules form bonds with <u>surface of catalyst</u> <b>DO NOT</b> allow catalyst adsorbed to reactant's surface</p> <p>Ignore bonds weaken</p> <p><b>DO NOT</b> allow bonds <b>between</b> reactants/intermolecular bonds</p> <p>Don't worry about where <u>new</u> bonds form</p> <p>Ignore references to activation energy</p> <p>If discussion in terms of enzymes – max 1 mark</p> <p>Remember not ticks for each step – colour dot</p>	

Question		Answer	Mark	AO element	Guidance
2	(a)	phenol ✓ (secondary) amide ✓	2	1.2 x2	<b>ALLOW</b> hydroxyl group <b>NOT</b> alcohol
2	(b)	electrophilic substitution ✓ reduction ✓	2	2.3 x2	<b>ALLOW</b> nitration
2	(c)	Keep away from flames ✓ <b>AW</b> Use in fume cupboard/well ventilated lab ✓ Wear (protective) gloves ✓	3	3.2 x3	<b>Allow</b> (lit) Bunsen burners/sparks <b>IGNORE goggles</b>
2	(d)	 ✓	1	2.5	Curly arrows must start at any point on the correct bond or negative charge and point to the correct atom or bond.
2	(e) (i)	vacuum filtration/filtration under reduced pressure/suction filtration ✓ <b>AND</b> <b>Any two from:</b> Moisten/damp(en) filter paper /wash paper with water ✓ wash solid/paracetamol with water ✓ suck dry / sucks to remove water/solvent ✓ crude paracetamol/solid left (on filter paper/in funnel) ✓	3	2.7 3.4 x2	Allow the word “pull” rather than “suck” In flask is a <b>CON</b>
2	(e) (ii)	much quicker/faster ✓	1	3.2	

Question		Answer	Mark	AO element	Guidance
2	(f)	<p><b>FIRST CHECK THE ANSWER ON THE ANSWER LINE</b> If answer = 52 (%) award 3 marks</p> <p>2.1g of 4-aminophenol produces maximum  <math>2.1 \times \frac{151}{109} = 2.9 \text{ (g)} \checkmark</math></p> <p>% yield = <math>\frac{1.5}{2.9} \times 100 = 51.72 \checkmark</math>            = 52(%) (2 sig figs.) <math>\checkmark</math></p>	3	2.8 x3	<p><b>ALLOW</b> ecf  <b>ALLOW</b> 3 or more sf for second mark  <b>OR</b>            2.1 g of aminophenol = 0.0193 mols (from 2.1 g/109)</p> <p>1.5 g of paracetamol = 0.010 mols (from 1.5 g/151)</p> <p>% = <math>\frac{0.010}{0.0193} \times 100 = 51.81 = 52(\%)</math></p> <p>An answer of 51% can be achieved by not rounding - lookout</p>
2	(g) *	<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><b>Level 3 (5-6 marks)</b> Majority of indicative scientific points used as evidence from each spectrum to identify the compound as paracetamol.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured.</i></p> <p><b>Level 2 (3-4 marks)</b> Some evidence from each spectrum used to identify the compound as paracetamol.  <b>OR</b> Detailed evidence from two of the spectra used to identify the compound as paracetamol.</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><b>Level 1 (1-2 marks)</b></p>	6	3.1 x 4 3.2 x 2	<p><b>Indicative scientific points include:</b></p> <p><b>Information from IR</b></p> <ul style="list-style-type: none"> <li>absorption at ~ 1650 suggests C=O present (cannot be 4-aminophenol)</li> <li>big absorption around ~3300+ suggests presence of phenolic OH and/or NH (cannot be ethanoic anhydride or ethanoic acid)</li> </ul> <p><b>Information from <sup>1</sup>Hnmr</b></p> <ul style="list-style-type: none"> <li>5 unique proton environments (so cannot be other structures which have 4, 2 and 1 proton environments)</li> <li>number of protons in ratio 3;2;2;1;1</li> <li>representing CH<sub>3</sub> two sets of 2 H's on ring and a single OH and NH on paracetamol (can be shown on annotated structure)</li> </ul> <p><b>Information from <sup>13</sup>Cnmr</b></p> <ul style="list-style-type: none"> <li>6 unique carbon environments</li> <li>cannot therefore be reactants or ethanoic acid (too many carbon) OR a paracetamol</li> <li>C=O; 4 groups of aromatic Cs</li> </ul>



Question		Answer	Mark	AO element	Guidance
		<p>Detailed evidence from one of spectra to identify the compound as paracetamol.</p> <p><b>OR</b></p> <p>Some evidence used from two of spectra to identify the compound as paracetamol.</p> <p><b>OR</b></p> <p>Evidence from all spectra but compound not identified as paracetamol.</p> <p><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> No response or no response worthy of credit.</p>			<p>Look for any evidence on the spectra i.e. annotations</p> <p>At Level 3 it would be expected that explanations of why it cannot be a specific substance would be included</p> <p>If paracetamol not identified (name or structure) can only score L1</p>
	(h)	(i)	2	2.2 x2	<p><b>Ignore presence or not of + charge</b></p> <p><b>DO NOT ALLOW simple molecular formula e.g. C<sub>2</sub>H<sub>3</sub>O</b></p>
	(h)	(ii)	1	2.2	<p><b>ALLOW</b> one carbon in structural formula identified as <u><sup>13</sup>C / C<sup>13</sup></u></p> <p>If <sup>2</sup>H is mentioned it isn't wrong i.e. 1 mark</p>





Question	Answer	Marks	AO element	Guidance
	<p><b>Level 3 (5 – 6 marks)</b> Detailed explanation of the structure of complex ions. <b>AND</b> Detailed explanation of the origin of colour and why there are different colours. <b>AND</b> Gives at least one example from the titration in the Insert.</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><b>Level 2 (3 – 4 marks)</b> An explanation of the structure of complex ions. <b>AND</b> An explanation of the origin of colour and why there are different colours. <b>AND</b> Gives at least one example from the titration in the Insert.</p> <p><b>OR</b> Detailed explanation of the structure of complex ions. <b>AND</b> Detailed explanation of the origin of colour and why there are different colours.</p> <p><b>OR</b> Detailed explanation of the structure of complex ions. <b>AND</b> Gives at least one example from the titration in the Insert.</p> <p><b>OR</b> Detailed explanation of the origin of colour and why there are different colours. <b>AND</b></p>			<ul style="list-style-type: none"> <li>• Ligands</li> <li>• Co-ordinate(dative) bonds to central metal</li> </ul> <p><b>Colour:</b></p> <ul style="list-style-type: none"> <li>• d-orbitals</li> <li>• splitting of d orbitals</li> <li>• gap of magnitude/right size to allow..</li> <li>• absorption of energy in visible/light energy....</li> <li>• causes electrons move to higher/excited level/shell</li> <li>• frequency absorbed <math>\Delta E = hv</math></li> <li>• colour seen is complementary colour/due to missing wavelength/frequency</li> </ul> <p><b>Different colours:</b></p> <ul style="list-style-type: none"> <li>• Different gaps in d split orbitals</li> <li>• Different wavelengths/frequency absorbed</li> <li>• Gives different complementary colours</li> </ul> <p><i>Fine detail</i></p> <ul style="list-style-type: none"> <li>• Gap size affected by different ligands</li> <li>• Gap size affected by central metal ion</li> <li>• Gap size affected by oxidation state</li> </ul> <p><b>Examples</b> <math>MnO_4^- / [Mn(H_2O)_6]^{2+} / [Fe(H_2O)_6]^{2/3+}</math></p> <p>References to emission make it difficult to be Level 3</p>

Question	Answer	Marks	AO element	Guidance
	<p>Gives at least one example from the titration in the Insert.</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><b>Level 1 (1 – 2 marks)</b>            An explanation of the structure of complex ions.  <b>OR</b>            An explanation of the origin of colour.  <b>OR</b>            An explanation as to why there are different colours.  <b>OR</b>            Gives at least one example from the titration in the Insert.</p> <p><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>Level 0 (0 marks)</b>  <i>No response or response has no merit.</i></p>			

**OCR (Oxford Cambridge and RSA Examinations)**  
**The Triangle Building**  
**Shaftesbury Road**  
**Cambridge**  
**CB2 8EA**

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

**Oxford Cambridge and RSA Examinations**  
is a Company Limited by Guarantee  
Registered in England  
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA  
Registered Company Number: 3484466  
OCR is an exempt Charity

**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

© OCR 2019

