OCR
Oxford Cambridge and RSA

Cambridge Technicals
Applied Science

Unit 2: Laboratory Techniques

Level 3 Cambridge Technical in Applied Science
05847 – 05849/05874/05879

Mark Scheme for January 2021

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.

Annotations

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

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
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

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.

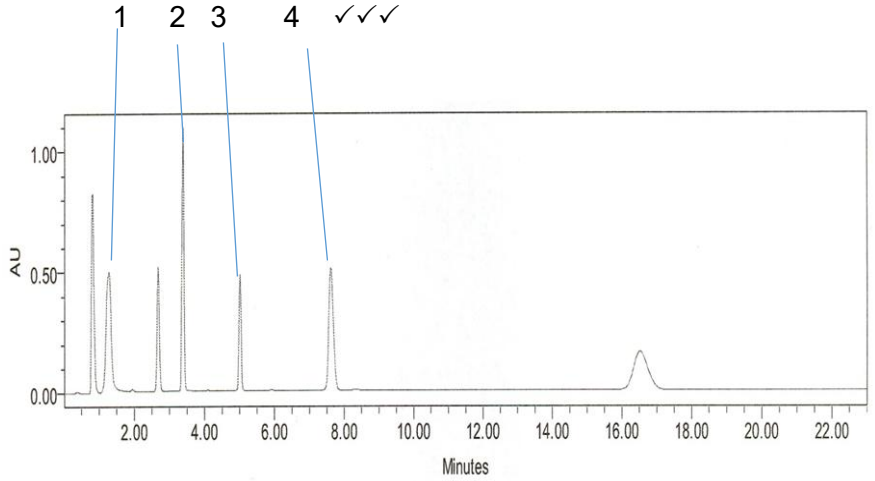
You should ensure that you have copies of these materials.

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)		To ensure traceability / audit trail/ so they know who did the work **and** when ✓	1	**ALLOW** ideas about different people **and** times leading to different results
	(b)		Units of /mm (for extension) ✓	1	
	(c)	(i)	Repeats ✓ A wider range of/ more loads (weights) added/tested ✓	2	 **ALLOW** smaller increments
		(ii)	**Any four from**: Labels in **all** column headers ✓ Units in **all** column headers (appropriate for labels) ✓ Columns for repeats ✓ Rows for at least 5 independent variable values ✓ Independent variable in first column ✓	4	**IGNORE** average column
	(d)	(i)	sharp wire /falling weights✓	1	**IGNORE** wire could snap
		(ii)	A preventative measure that must match answer to (d)(i) ✓	1	**IGNORE** PPE unless matches hazard in di
	(e)		To reduce the chance of employees being injured at work/prevent accidents ✓	1	**ALLOW** know what to do in an emergency **IGNORE** so employees are safe

Question			Answer	Marks	Guidance
	(f)		Use a buffer solution of known pH **OR** pH 7✓ Adjust the pH meter to match that of the pH of the buffer ✓ Rinse pH probe with distilled water (and wipe dry between each buffer change) ✓ Use a different buffer solution of known pH/ pH 4 and **adjust** the pH meter to match that of the buffer ✓	**4**	**ALLOW** press the calibrate button for the adjust mark **ALLOW** in any order Rinsing the probe should be mentioned after every buffer change but credit this once only

Question			Answer	Marks	Guidance
2	**(a)**			**3**	4 correct = 3 marks 3 correct = 2 marks 1 or 2 correct = 1 mark

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Advantage</th><th>Tick</th></tr>
<tr><td>Positive identification of unknown chemicals</td><td>✓</td></tr>
<tr><td>Technicians need less training</td><td></td></tr>
<tr><td>Reduced cost</td><td></td></tr>
<tr><td>Quantification of known compounds</td><td>✓</td></tr>
<tr><td>Reduces the time taken to separate the molecules</td><td></td></tr>
<tr><td>Provide information on structure of compounds</td><td>✓</td></tr>
</table>
</td><td>3</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(ii)</td><td>gas ✓
electrons ✓
magnetic ✓</td><td>3</td><td>Answers must be in the correct order</td></tr>
<tr><td></td><td>(c)</td><td></td><td>[Level 3] Candidate shows a high level of understanding and gives a good description of how TLC is set up, the principle of separation for TLC and identifying compounds and calculating Rf values. (5 - 6 marks)

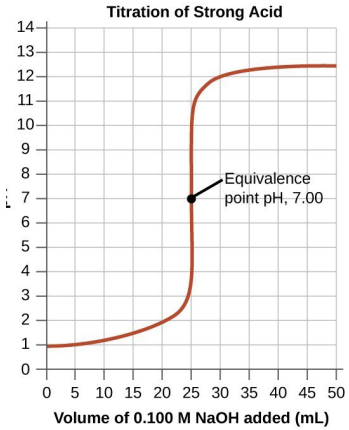
[Level 2] Candidate shows an understanding of how TLC is set up, the principle of separation for TLC and identifying compounds and calculating Rf values. (3 – 4 marks)

[Level 1] Candidate shows a basic understanding of how TLC is set up, the principle of separation for TLC and identifying compounds and calculating Rf values. (1 – 2 marks)</td><td>6</td><td>Indicative points:

Set up:
• Solid phase/silica on an inert support
• Base line in pencil
• Sample spotted onto plate
• Plate placed in solvent
• Solvent below pencil line
• Lid on chamber to stop evaporation

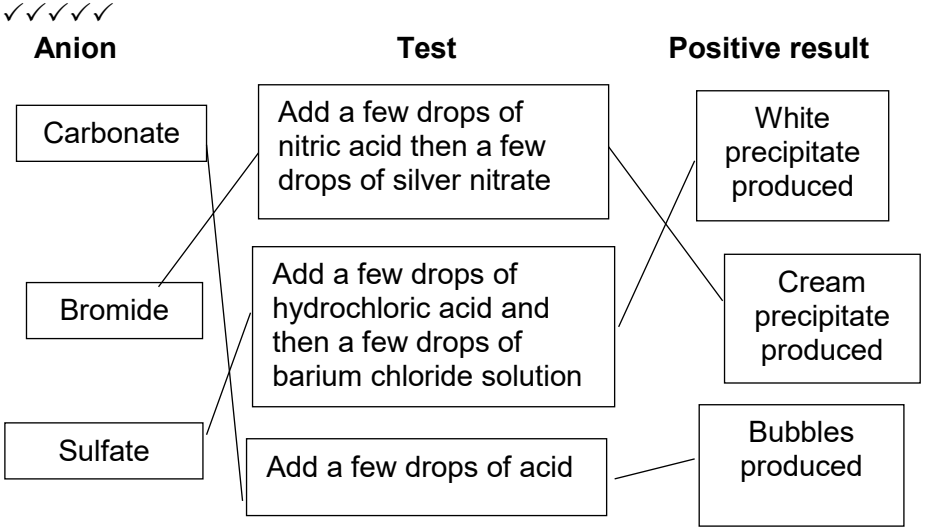
Separation:
• Mobile phase moves up solid phase</td></tr>
</table>

Question			Answer	Marks	Guidance
			[Level 0] Candidate response includes **fewer than two** valid points. ***(0 marks)***		• Different compounds (sometimes) have differing solubilities in the mobile phase • Higher solubility compounds migrate the furthest • 2D TLC with a different solvent can increase the separation of compounds Rf values • Identify visible spots • Developing agent for invisible spots • Calculating Rf values Rf values can be compared with literature values for identification

Question			Answer	Marks	Guidance
3	(a)		 shallow gradient at extremes ✓ vertical section at 25 cm^3 ✓ equivalence point at pH7 **and** midway between shallow gradients ✓	3	
	(b)	(i)	Perpendicular viewing/eye level ✓ Read from the bottom of the meniscus ✓	2	**IGNORE** check there are no air bubbles **ALLOW** use of a contrast background
		(ii)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 20.20 award 2 marks** (41.15 - 20.95) = 20.20 (cm^3) ✓ Answer to 4 SF ✓	2	**ALLOW** 3 SF for max 1 mark **ALLOW** ecf = 1 mark max. **ALLOW** 1 mark for 20.2 cm^3
		(iii)	20.20 + 20.10 + 20.15 /3 = 20.15 (cm^3) ✓	1	**ALLOW** ecf from bii **ALLOW** 3 or 4 sf

Question			Answer	Marks	Guidance
	(c)	(i)	Moles of $HCl = \frac{0.02 \times 19.5}{1000} = 0.00039$ **OR** 3.9×10^{-4} (mol) ✓	1	
		(ii)	Moles of $Ca(OH)_2 = \frac{0.00039}{2}$ $= 0.000195$ **OR** 1.95×10^{-4}(mol) ✓	1	**ALLOW** ecf from (i) (the mark is for dividing (i) by 2)
		(iii)	Concentration = $\frac{0.000195 \times 1000}{25}$ $= 0.0078$ (mol dm^{-3}) ✓	1	**ALLOW** ecf from (i) or (ii)
	(d)		electrode ✓ endpoint ✓ small ✓ endpoint ✓ volume ✓	4	5 correct = 4 marks 4 correct = 3 marks 3 correct = 2 marks 2/1 correct = 1 mark Answers must be in the correct order

Question			Answer	Marks	Guidance
4	(a)		light ✓ resolution ✓ graticule ✓	3	Answers must be in the correct order
	(b)		**Any four from:** Place slide on stage under the lowest magnification eyepiece lens/start with lowest magnification ✓ Stage at highest point relative to eyepiece lens ✓ Focus slide using focussing knob ✓ Rotate lens to next highest magnification ✓ Focus slide using fine focus ✓ Rotate lens to next highest magnification ✓ Focus slide using fine focussing knob and oil immersion ✓	4	**ALLOW** any realistic order of steps. **ALLOW** idea of moving slide/stage away from lens **IGNORE** steps to make slide **IGNORE** references to light
	(c)	(i)	Single cell is drawn the shape of which roughly similar to that in the picture and the outline of the cells is clear, pencil line not feathery ✓ Nucleus has 3 lobes ✓ Drawing is bigger than original image ✓	3	**REJECT** if white blood cell shaded **IGNORE** red blood cells/background drawn
		(ii)	15 (mm) plus or minus 1mm ✓	1	
		(iii)	$(15 / 1.5 \times 10^{-2}) = \times 1000$ ✓	1	**ALLOW ecf** from (ii)
		(iv)	1000 / 10 = 100X ✓	1	**ALLOW ecf** from (iii)

Question			Answer	Marks	Guidance
		(v)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 6(mm) award 2 marks** If answer uses information from ciii 400 x $1.5x10^{-2}$ ✓ = 6 (mm) ✓ OR If answer uses information from cii 4 x 15 ✓ =60 (mm) ✓	**2**	**ALLOW ecf** from (ii) with working shown
5	**(a)**	**(i)**	✓✓✓✓✓  	**5**	5 marks for 5 or 6 correct lines 4 marks for 4 correct lines 3 marks for 3 correct lines 2 marks for 2 correct lines 1 marks for 1 correct line

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>(ii)</td><td>(Bubble through) limewater ✓

White precipitate (produced) / turns milky/turns cloudy ✓</td><td>2</td><td>Responses must be in the correct order for 2 marks.
2nd mark is dependent on the 1st</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Chloride and iodide ✓</td><td>1</td><td>DO NOT ALLOW bromide / fluoride / chlorine/ bromine
ALLOW Cl^- and I^-</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>To remove carbonate ✓

which can also form a white precipitate ✓</td><td>2</td><td>Answers are independent marks</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Atomic Emission Spectroscopy</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>Feature</th><th>Flame test</th><th>ICP-AES</th></tr>
<tr><td>Quantitative analysis</td><td></td><td>✓</td></tr>
<tr><td>Cheap and easy to do</td><td>✓</td><td></td></tr>
<tr><td>High levels of sensitivity</td><td></td><td>✓</td></tr>
<tr><td>Requires high level of training</td><td></td><td>✓</td></tr>
<tr><td>Can be done outside of the laboratory</td><td>✓</td><td></td></tr>
<tr><td>Can detect multiple metals in the same sample</td><td></td><td>✓</td></tr>
</table>
</td><td>4</td><td>5 or 6 rows correct = 4 marks
4 rows correct = 3 marks
2 or 3 rows correct = 2 marks
1 row correct = 1 mark</td></tr>
</table>

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<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>
<table>
<tr><th>Item</th><th>Autoclave</th><th>Spray with ethanol solution</th><th>Filter</th><th>Open flame</th><th>Dry heat</th></tr>
<tr><td>Bacterial growth medium</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Inoculating loop</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>Antibiotic solutions</td><td></td><td></td><td>✓</td><td></td><td></td></tr>
<tr><td>Empty glassware</td><td></td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>Open bottle of sterile diluting water</td><td></td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td>Inside of controlled air flow cabinets</td><td></td><td>✓</td><td></td><td></td><td></td></tr>
</table>
</td><td>6</td><td>5th row accept either answer or both</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Only one kind of colony OWTTE✓</td><td>1</td><td>ALLOW all colonies are same shape</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>39 ✓</td><td>1</td><td>ALLOW +/- 2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>FIRST CHECK ANSWER ON ANSWER LINE
If answer = 390000 OR 39 x 10^4 award 2 marks
39 x (10 x 1000) ✓
= 390000 OR 3.9 x 10^5 ✓</td><td>2</td><td>ALLOW ecf from (c)(i)</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>too many colonies to count / confluent growth / colonies not separated ✓</td><td>1</td><td>OWTTE</td></tr>
</table>

Question			Answer	Marks	Guidance
	(d)	(i)	4 ✓ 4 different colony morphologies ✓	2	**ALLOW** 5 **ALLOW** different shapes/idea of looking different **IGNORE** different sizes Answers are independent marks
		(ii)	To prevent the microorganisms becoming contaminated ✓ To prevent the scientist/technician from being contaminated/infected ✓	2	**ALLOW** correct responses in either order. **ALLOW** unqualified avoid contamination for a mark if no other marks awarded.

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