Cambridge Technicals

Applied Science

Unit 2: Laboratory techniques

Level 3 Cambridge Technical in Applied Science

05847 – 05849, 05874 & 05879

Mark Scheme for January 2025

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.

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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.

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 40% 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. **Crossed-Out Responses**

Where a candidate has crossed out a response and provided a clear alternative then the crossed-out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed-out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM Assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple-Choice Question Responses

When a multiple-choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only one mark per response)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth two or more marks)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space).

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

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 is not 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.**

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:
To determine the level – start at the highest level and work down until you reach the level that matches the answer
To determine the mark within the level, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

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
/	alternative and acceptable answers for the same marking point
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

Question			Answer	Marks	Guidance
1	(a)	(i)	Any **three** from: • (Specify) volume/mass of water used • (Specify) pressures of gas used • Repeats • (Specify) the type of timer ✓✓✓	3	**ALLOW** angle of launcher **ALLOW** measurements of water/ how much water used **ALLOW** amount
		(ii)	• Being hit by the rocket / bottle ✓ • The rocket / bottle / gas /pump exploding✓	2	**ALLOW** response in either order **IGNORE** risks related to water
		(iii)	Any **two** from: • Wear safety glasses / goggles / face shield • Wear safety helmet • Do not point the rocket at anyone when it is fired • Use a (safety) screen when the rocket is pressurised • Keep a safe distance (around the firing / landing area) ✓✓	2	**IGNORE** glasses **IGNORE** gloves / PPE

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td></td><td>Any four from:
• Pressure AND Time columns ✓

• Units : pressure in kPa AND time/s ✓
• Columns for the repeats ✓
• Column for average / mean time value ✓
• Additional rows for data to be recorded ✓</td><td>4</td><td><table><tr><td>Pressure / kPa</td><td>Time / s Test 1</td><td>Time / s Test 2</td><td>Time / m Test 3</td><td>Average time/s</td></tr></table>IGNORE units not in column headings

ALLOW Kpa
ALLOW 2 repeats
IGNORE average of other measurements

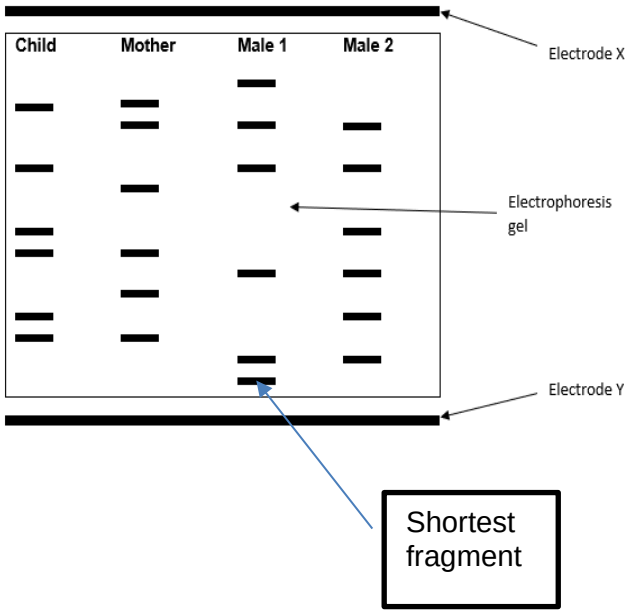
IGNORE column headed quantity of water
IGNORE units for average
If no table drawn award one mark for pressure kPa and time s</td></tr>
<tr><td></td><td>(c)</td><td></td><td>A scatter graph is more appropriate because the x axis values are /data is continuous.
OR
A bar chart is used when the x axis values are not continuous

✓</td><td>1</td><td>ALLOW allows for a line of best fit
ALLOW allows for estimation between points</td></tr>
<tr><td></td><td>(d)</td><td></td><td>• The higher the pressure ✓
• The longer the rocket stays in the air ✓
• The relationship is non- linear ✓

OR
• The lower the pressure ✓
• The less time the rocket stays in the air ✓
• The relationship is non- linear ✓</td><td>3</td><td>ALLOW responses in any order
ALLOW the more air in the bottle

IGNORE positive correlation
IGNORE data</td></tr>
</table>

Question			Answer	Marks	Guidance
2	(a)	(i)	Polymerase chain reaction ✓	1	**ALLOW** phonetic spellings of polymerase **DO NOT ALLOW** polymer /polymerised / polymerising
		(ii)	Any **two** from: A small/tiny sample of cells/tissue used ✓ Amplify (the number of copies of DNA/genes) ✓ (Amplify) DNA / genes ✓	2	OWTTE **ALLOW** make more copies **DO NOT ALLOW** RNA
	(b)	(i)	Negative – negative ✓	1	
		(ii)	Adenine – thymine ✓	1	

Question			Answer	Marks	Guidance
		(iii)	 Correct Label ✓ The shortest fragment travels the furthest ✓	2	**ALLOW** shortest fragment travels faster/fastest

Question			Answer	Marks	Guidance
		(iv)	**Most likely father:** Male 2 ✓ **Explanation:** the child has three fragments/bands which are the same as <u>three</u> of the mother's ✓ And <u>three</u> fragments/bands which are the same as male 2 ✓	3	**ALLOW** a diagram that shows 3 matches to mother **ALLOW** a diagram that shows 3 matches to male 2 **ALLOW** only 1 fragment matches with male 1 **IGNORE** child shares half DNA with male 2
	(c)		Any **one** from: ✓ • Forensic science / (collecting and analysing DNA from a) crime scene • Diagnosis of genetic diseases (OR a named disease eg Cystic fibrosis, Huntingdon's disease) • Identification of dead bodies • Organ transplants • GM crops • Tracking family history • Virus/pathogen (identification) • Identification of species or genomics	1	**ALLOW** Covid or coronavirus (test) **DO NOT ALLOW** finger fingerprint identification **IGNORE** crime investigation **IGNORE** paternity test
	(d)	(i)	Run a GC of pure pentan-1-ol or pure pentan-3-ol✓ Compare the retention time of the known pure alcohol with the retention times on the spectrum ✓	2	**ALLOW** run the two alcohols separately **IGNORE** peak
		(ii)	Measure the relative peak area ✓	1	**ALLOW** relative peak heights

Question			Answer	Marks	Guidance
3	(a)	(i)	Na = 23.0 O=16.0 H= 1.0 / 23.0 +16.0 +1.0 = (40.0 g mol^{-1})	1	**ALLOW** in any order
		(ii)	(0.025 / 4) = 0.00625 (mol) OR 6.25 x 10^{-3}✓	1	
		(iii)	Mass = 3(a)(ii) x 40.0 = ✓ = 0.250 (g) ✓	2	ALLOW mass = 0.25 g ECF from 3(a)(ii)
		(iv)	Volumetric flask ✓	1	**IGNORE** size of flask
	(b)	(i)	**A**: Burette✓ **B**: Conical flask✓	2	**DO NOT ALLOW** biuret **ALLOW** only correct responses at lines A and B, unless shown correctly on the diagram.
		(ii)	Colourless **TO** pink ✓	1	Both colourless and pink required for the mark. **IGNORE** clear **DO NOT ALLOW** other colours
		(iii)	The titration is between a weak acid and a strong alkali **OR** methyl orange is used to titrate a strong acid with a weak alkali. ✓	1	**ALLOW** initial pH of oil too high to show colour change **ALLOW** base for alkali **IGNORE** methyl orange's colour change at end point difficult to accurately spot against background colour of oil
		(iv)	Ring(s) around three values (20.15, 20.10 **AND** 20.15) but **NOT** 20.30	1	

Question			Answer	Marks	Guidance
		(v)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 20.13 award 2 marks** Correct calculation of mean using their values from **3(b)(iv**) ✓ Their answer given to 2dp ✓	2	**ALLOW** ecf **3(b)(iv)** **ALLOW** ecf mp1 **ALLOW** MP 1 calculation answer = 20.14 if working shown for first mp only
		(vi)	**If answer =** 5.0325 x10^{-4} **award 1 mark** 0.025 x **3(b)(v)** / 1000 = 5.0325 x10^{-4} ✓	1	**ALLOW** 5.03 x10^{-4} to 5.033 x10^{-4} **ALLOW** ecf **3(b)(v)** **ALLOW** answers not in standard form
	(c)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 40.3 g award 4 marks** Number.of moles NaOH required to neutralise 1dm^3 = 0.00050325 x 1000/10 = 0.050325 ✓ Number of moles NaOH required to neutralise 20 dm^3 = 0.050325 x 20 = 1.0065 ✓ Mass NaOH = 1.0065 x 40 = 40.26 g ✓ = 40.3g (3sf) ✓	4	**ALLOW** ecf for mean titre from **3(b)(vi)** **ALLOW** ecf throughout **ALLOW** up to maximum marks if multiplied at any stage by 6 to gain final answer.

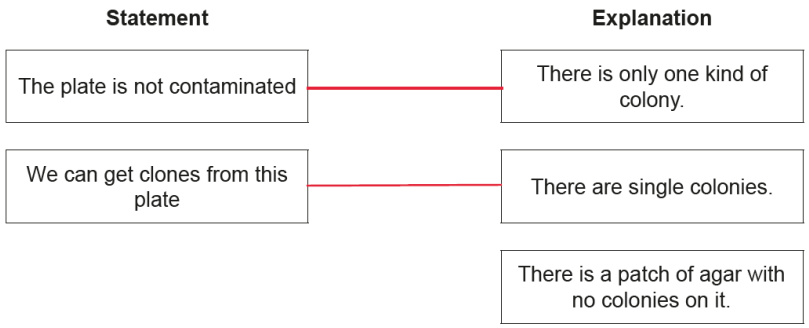
Question			Answer	Marks	Guidance
4	(a)		**[Level 3]** Candidate shows a high level of understanding by giving a good description of how they work **AND** differences between what they can be used to image **AND** potential hazards which pose a risk to the patient. ***(5 – 6 marks)*** **[Level 2]** Candidate shows understanding by giving a description of how they work **AND** differences between what they can be used to image **OR** potential hazards which pose a risk to the patient ***(3 – 4 marks)*** **[Level 1]** Candidate shows basic understanding by giving a limited description **EITHER** how they work, **OR** differences between what they can be used to image **OR** potential hazards which pose a risk to the patient ***(1 – 2 marks)*** **[Level 0]** Candidate response includes **no** valid points. ***(0 marks)*** ✓✓✓✓✓✓	6	Indicative valid points may include: **How they work** **Ultrasound:** • High frequency (sound) waves • Greater than 20 kHz • Reflect from boundaries with different hardness / acoustic impedance • Acoustic gel to prevent reflection from surface of skin • % reflected waves used to build a 3D image X rays **X-ray machine:** • High energy electromagnetic waves/high energy photons • Detected by photographic film / CCD • Absorbed by higher density tissues Leave shadow on detector **What they can be used to image** **Ultrasound:** • Soft tissues • Moving/real time • 3D • developing foetuses • blood flow/ heart valve function / PFO **X-ray machine:** • Hard/solid tissues/organs/structures • bones / teeth

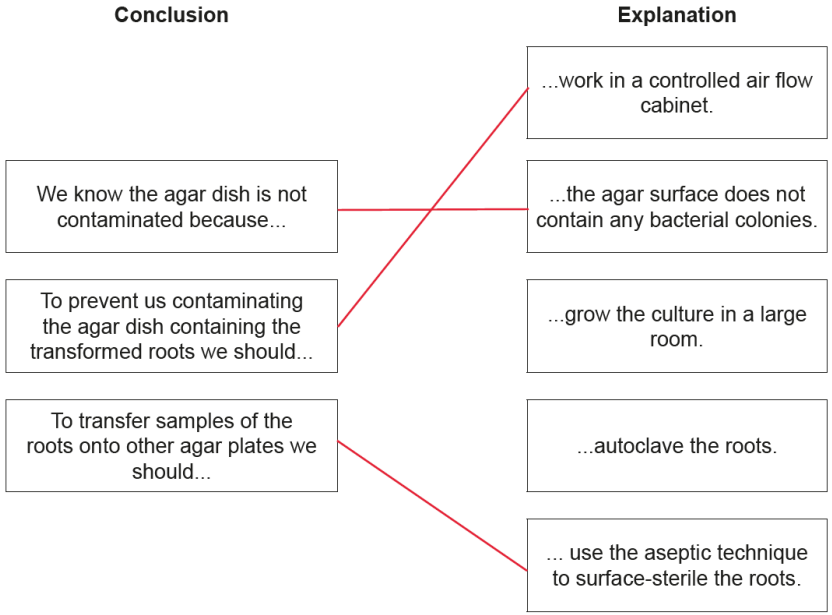
Question			Answer	Marks	Guidance
					• If contrast medium use -bowels / kidneys etc **Potential hazards which pose a risk to patient** **Ultrasound:** • No known risks **X-rays:** • Ionising radiation • Risk of mutation / cancer • Risk to foetus
	(b)	**(i)**	Any **two** from: ✓✓ • (More) expensive • Requires (specialist) training • Cannot be used to view live samples • Preparation takes more time • Images can only be seen in black and white (unless false colour is added) • EM is difficult to transport / use in the field	2	
		(ii)	47 (mm) **AND** 13 (mm)✓	1	+/- 0.5 (mm)
		(iii)	47/13 = 3.6 times ✓	1	Ecf from 4bii **ALLOW** 4 times **ALLOW** any number of decimal places correctly rounded
		(iv)	Actual distance = 3.4 x 50 μm ✓ = 1.7 x 10^{-4} m ✓	2	**ALLOW** answer between 1.5 x 10^{-4} m and 1.8 x 10^{-4} m for 2 marks

Question			Answer	Marks	Guidance
	(c)		Any **two** from ✓✓ SEM uses/detects reflected or knocked-off electrons to create an image and TEM uses transmitted electrons to create an image. SEM images reveal the surface view of structures and TEM images reveal detailed, internal structures SEM equipment produce three-dimensional (3D) images and TEM equipment only produce 2D / flat images.	2	**ALLOW** only SEM can produce 3D images **IGNORE** cost

Question			Answer	Marks	Guidance
5	(a)		**Ba^{2+}** - (apple/pale) Green ✓ **Ca^{2+}** - Orange red ✓ **Li^{+}** - Red ✓	3	**ALLOW** responses **only** in the correct order **ALLOW** orange **ALLOW** crimson/carmine
	(b)		(Clean) Nichrome wire loop dipped into sample **OR** spill soaked (overnight) in solution✓ Place into blue flame and note the colour of the flame.✓	2	**ALLOW** add to splint **IGNORE** clean loop **ALLOW** roaring flame **IGNORE** incorrect name of colour from ion
	(c)	(i)	Atomic emission spectroscopy ✓	1	
		(ii)	Mg or Mg^{2+}✓ Al *or* Al^{3+}✓	2	**ALLOW** magnesium **ALLOW** aluminium **ALLOW** answers in either order **IGNORE** incorrect charges
		(iii)	**All** (of the spectral lines /colours) ✓ spectral lines /colours from magnesium **and** aluminium are present /match competitor spectra ✓	2	**ALLOW** one mark for lines/spectra for Al and Mg match the competitor if no other mark awarded
	(d)		Fe^{2+} ✓ Pb^{2+} ✓	2	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(e)</td><td>(i)</td><td>One mark for each correct column
✓ ✓
<table><tr><th>Concentration of Li+ (mol dm^{-3})</th><th>Volume of solution S (cm^3)</th><th>Volume of water (cm^3)</th></tr><tr><td>0.01</td><td>10</td><td>0</td></tr><tr><td>0.008</td><td>8</td><td>2</td></tr><tr><td>0.006</td><td>6</td><td>4</td></tr><tr><td>0.004</td><td>4</td><td>6</td></tr><tr><td>0.002</td><td>2</td><td>8</td></tr></table></td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Working shown on graph ✓
Concentration = 0.0046 to 0.0048 mol dm^{-3} ✓</td><td>2</td><td>Ecf from working</td></tr>
</table>

Question			Answer	Marks	Guidance
6	(a)	(i)	 ✓✓	2	
		(ii)	**Any four from:** Heat / flame a wire/(inoculating) loop ✓ Check that the wire/loop is red-hot (to sterilise it) ✓ Allow loop to cool ✓ flame neck of bottle/broth/culture ✓ Collect/pick the incoculum/bacteria (from another plate / agar slope) ✓ Streak the inoculum onto a region/edge of the plate ✓ Reheat the wire/loop ✓ Streak the wire/loop through the first set of streaks / rotate plate as you streak ✓	4	

Question			Answer	Marks	Guidance
		(iii)	autoclaved✓ autoclaved✓	2	
	(b)	(i)	Wiping ✓ Flaming ✓ Flaming ✓	3	**ALLOW** responses only in correct order.
		(ii)	 ✓✓✓	3	

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