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 June 2023

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.

# MARKING INSTRUCTIONS

## PREPARATION FOR MARKING

### TRADITIONAL

Before the Standardisation meeting you must mark at least 10 scripts from several centres. For this preliminary marking you should use **pencil** and follow the **mark scheme**. Bring these **marked scripts** to the meeting.

## 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 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 or by email.

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 questions 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 lined pages 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 an annotation 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 anyway 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. Assistant Examiners will email a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

9. **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 |

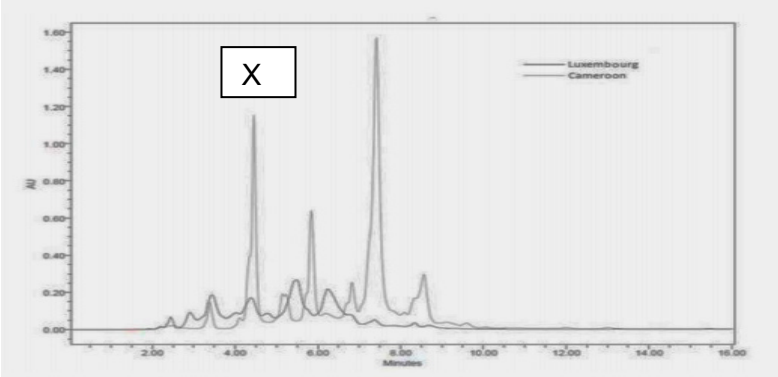
10. **Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).**

| 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 |

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>Ruler ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Wearing goggles / safety glasses/ visor ✓</td><td>1</td><td>ALLOW keep masses/equipment hanging over desk OWTTE<br>IGNORE risk assessment/generic lab safety</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Units of length in length and extension columns ✓</td><td>1</td><td>ALLOW named units of length<br>ALLOW Unit of Length<br>ALLOW units in table for both</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th>Mass / g</th><th>Length of spring</th><th>Extension</th></tr><tr><td>0</td><td>20</td><td>0</td></tr><tr><td>10</td><td>25</td><td>5</td></tr><tr><td>20</td><td>31</td><td>11</td></tr><tr><td>30</td><td>35</td><td>15</td></tr><tr><td>40</td><td>40</td><td>20</td></tr><tr><td>50</td><td>46</td><td>26</td></tr></table>✓</td><td>1</td><td>ALLOW only values measured minus the original length (20).</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Any three from<br>• Plot a graph<br>• Mass against extension<br>• (If Hooke’s Law applies,) the graph should be a straight line<br>• (line goes) through 0.0.<br>• calculate the ratio of extension / mass (and if it's constant the spring obeys Hooke's Law)<br>✓✓✓</td><td>3</td><td>ALLOW extension against mass<br>ALLOW compare extension and mass<br>ALLOW force/load for mass</td></tr>
</table>

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | | **(iv)** | Any 5 in correct order<br>• Title<br>• Aim / hypothesis<br>• Method / Procedure<br>• Results (including calculations and graphs)<br>• Discussion/Analysis<br>• Conclusions ✓✓✓ | 3 | **IGNORE** introduction<br><br>**ALLOW** prediction<br>**IGNORE** equipment<br><br>Ignore other subsections of an investigation<br>Ignore descriptions of sections<br><br>5 in correct order: 3 marks<br><br>3 or 4 in correct order: 2 marks<br><br>2 in correct order: 1 mark |
| **1** | **(c)** | **(i)** | Any two from<br>• Ensure balance reads zero (with no mass and before placing mass on balance)<br>• Use at least 2 calibration weights /weights whose masses are known (very accurately) ✓<br>• Place on the balance and adjust calibration knob/reading until the measured value matches the known value ✓ | 2 | **ALLOW** mass for weights throughout<br>**ALLOW** press tare (before placing mass on balance)<br><br>**ALLOW** standard weights/known weights |
| | | **(ii)** | B **AND** F ✓ | 1 | |
| | | **(iii)** | Keep away from naked flames<br>**OR** Keep container lid on when not in use✓ | 1 | **IGNORE** wear PPE/generic lab safety |
| | | | **Total** | **14** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 2 | (a) | (i) | <table><tr><td>More reproducible results obtained using TLC</td><td>✓</td></tr><tr><td>TLC is cheaper</td><td></td></tr><tr><td>TLC is easier to carry out</td><td></td></tr><tr><td>TLC uses less extract</td><td>✓</td></tr></table> ✓✓ | 2 | |
| | | (ii) | (Run the chromatogram against) known pigments ✓<br>Compare positions **OR** calculate Rf values ✓ | 2 | **ALLOW** compare Rf values with known pigments/database/reference values for 2 marks |
| | | (iii) | Origin to solvent front = 44 (mm) **AND**<br>Origin to carotene mark = 40 (mm) ✓<br><br>Rf value = 40 /44 = 0.9(1) ✓ | 2 | Both values required for mark 1<br>values can be in cm<br>**ALLOW** +/- 1mm for each measurement<br><br>**ALLOW** answers in range 0.87 = 0.95 with working for 2 marks<br><br>**ECF** for second mark |
| | | (iv) | Any 3 from ✓ ✓ ✓<br>• Carrots do not contain chlorophyll (and spinach does).<br>• Spinach has green pigment(s) and carrots do not.<br>• (Carrots look orange because) they have orange (and yellow)pigments/ β-carotene (but no green pigments).<br>• Spinach looks green because the green chlorophyll masks the yellow/orange pigments. | 3 | **ALLOW** only spinach has chlorophyll |

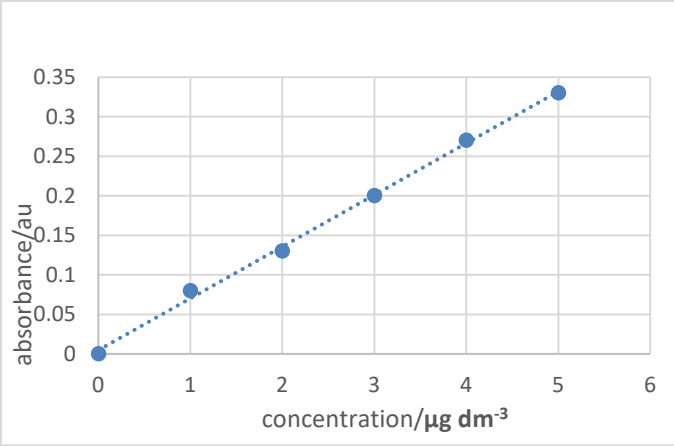
| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | **(b)** | | HPLC uses a **SOLID** stationary phase and a **LIQUID** mobile phase ✓<br><br>GC uses a **LIQUID** stationary phase and a **GASEOUS** mobile phase ✓ | 2 | **ALLOW** gas |
| | **(c)** | **(i)** | Correct peak labelled with a X ✓<br>  | 1 | **ALLOW** X drawn on variety A or B peak |
| | | **(ii)** | **Variety** \| A \| B ✓ | 1 | **ECF** from **(c)(i)** |
| | | **(iii)** | 7.67 (times) ✓ | 1 | **ALLOW** answers between 7.13 and 8.30<br>**ECF** from **(c)(i)** |
| | | **(iv)** | The mass spectrum tells us<br>• the molar mass (Mr) ✓<br>• and what groups of atoms are present ✓ | 2 | |
| | | | **Total** | **16** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | (a) | (i) | 40 (g $mol^{-1}$) ✓ | 1 | |
| | | (ii) | **FIRST CHECK ANSWER ON ANSWER LINE**<br>**If answer = 0.5(0) (g) award 2 marks**<br><br>n(NaOH) = 0.25 × 0.05 = 0.0125 ✓<br>mass NaOH = 0.0125 × 40 = 0.5(0) g ✓ | 2 | **ECF** from **(a)(i)** |
| | | (iii) | 2dp balance ✓<br>250 $cm^3$ volumetric flask ✓ | 2 | |
| | (b) | | Rinse with distilled water (and discard) ✓<br>Rinse with NaOH(aq) (and discard) ✓ | 2 | **ALLOW** deionised water<br>Must be in this order for both marks |
| | (c) | (i) | bromothymol blue: <br>litmus: <br>methyl orange: <br>phenolphthalein: ✓<br>universal indicator: | 1 | |
| | | (ii) | (More than one titre) within 0.1 ($cm^3$) (of each other) ✓ | 1 | **ALLOW** (More than one titre) within 0.05 ($cm^3$) (of each other)<br>**IGNORE** titre results are the same |
| | | (iii) | **FIRST CHECK ANSWER ON ANSWER LINE**<br>**If answer = 0.088 (mol $dm^{-3}$) award 3 marks**<br><br>Moles = concentration x volume = 0.05 x (17.5/1000)<br>= 8.75 ×$10^{-4}$ (mol) ✓<br>Concentration = (8.75 ×$10^{-4}$ / 10) x 1000 ✓<br>= 0.0875 (mol $dm^{-3}$ )✓ | 3 | **ALLOW** 0.0875 for 3 marks<br>**ECF** from first mark point |
| | | (iv) | 0.088 mol $dm^{-3}$ is 88.0 mmol $dm^{-3}$ (so fermentation is complete) ✓ | 1 | **ALLOW ECF** using the value calculated for **(c)(iii)**<br>**ALLOW** value is between 85 and 90 mmol $dm^{-3}$ |

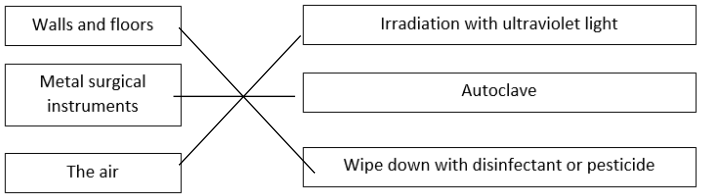
| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | | (v) | Fruit yoghurts contain other acids (Jack's method only tells you the **total** acid concentration) ✓<br>Fruit yoghurts are coloured so the colour change of the indicator would be difficult to see ✓ | 2 | |
| | | | **Total** | **15** | |

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>
<table>
<tr><th>Feature</th><th>Electron microscope</th><th>Light microscope</th><th>Hand lens</th></tr>
<tr><td>Easiest to use outside the laboratory</td><td></td><td></td><td>✓</td></tr>
<tr><td>Has the highest magnification</td><td>✓</td><td></td><td></td></tr>
<tr><td>Has the lowest cost</td><td></td><td></td><td>✓</td></tr>
<tr><td>Can be used to view living blood cells</td><td></td><td>✓</td><td></td></tr>
</table>
✓ ✓ ✓ ✓
</td><td>4</td><td>1 mark for each correct tick</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Eye-piece lens</th><th>Objective lens</th><th></th></tr>
<tr><td>x 40</td><td>x 10</td><td></td></tr>
<tr><td>x 100</td><td>x 4</td><td></td></tr>
<tr><td>x 10</td><td>x 40</td><td>✓</td></tr>
</table>
✓
</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Any one from ✓<br>• Living processes (of cells can be seen)<br>• (Natural) colour/pigmentation (of cells can be seen)</td><td>1</td><td>ALLOW Named living process<br>IGNORE living cells</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Sickle cells are pointed/elongated/not round/ lose the flexibility to change their shape ✓</td><td>1</td><td>ALLOW oval/abnormal/irregular shape<br>IGNORE size/ different shapes</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Measured diameter = 60 (mm)<br>AND<br>Actual diameter = 9 (µm) ✓</td><td>1</td><td></td></tr>
</table>

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | | (ii) | **FIRST CHECK ANSWER ON ANSWER LINE**<br>**If answer = 6666.7 x award 2 marks**<br><br>Magnification = $\frac{\text{measured size}}{\text{actual size}}$<br><br>Mag. = $\frac{60 \times 1000}{9}$ ✓<br><br>Mag. = 6666.7 (x) ✓ | 2 | **ALLOW ECF** from **(c)(i)**<br><br>**ALLOW** alternate method<br><br>Mag. = $\frac{60}{9 \times 10^{-6}}$<br><br>Mag. = 6666.7 (x) |
| | | (iii) | The cell shape is regular / uniform / ball-like ✓<br>The nucleus is curved / not straight / could be viewed at different angles ✓ | 2 | **OWTTE**<br>**ALLOW** idea that nucleus is irregular shape<br>**IGNORE** size |
| | | (iv) | Scanning (EM)/SEM ✓<br><br>**Any one from** ✓<br>Surface of the cell is visible<br>3D shape<br>Other than the nucleus, cell organelles are not visible | 2 | |
| | | | **Total** | **14** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 5 | (a) | (i) | Atomic emission spectroscopy ✓ | 1 | |
| | | (ii) | Iridium **AND** platinum ✓ | 1 | |
| | | (iii) | Axes correctly labelled with units. Concentration on the x axis✓<br>Appropriate scale covering more than half the grid ✓<br>Min 5 of the 6 points plotted correctly to within +/- half square ✓<br>Appropriate single line of best fit to go through 0 0 ✓<br>  <br> | 4 | If numbers for absorbance are copied directly from table onto grid lines then only axes and line of best fit mark can be awarded |
| | | (iv) | Line(s) on the graph clearly indicating how the value for the concentration was obtained ✓<br>3.5 (µg $dm^{-3}$) ✓ | 2 | **ALLOW ECF** for the calibration graph in **(a)(iii)** |
| | | (v) | Mass arsenic in 100 $cm^3$ solution or in 2.0 g rice = 0.35 µg<br>Mass in 1.0 g rice = 0.175 µg ✓<br>**AND** Yes ( the rice is safe to eat) ✓ | 2 | **ECF** from **(a)(iv)**<br><br>Second mark is dependent on first mark being awarded |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 5 | (b) | | **[Level 3]** Candidate shows a high level of understanding by giving a good description of the method including some fine detail **AND** results for all four ions to confirm the identity of X and Y. ***(5 – 6 marks)***<br><br>**[Level 2]** Candidate shows an understanding by giving a basic description of the method for all of the tests **AND** gives results for positive tests. **OR** fine detail for 2 of the ions **AND** positive tests for them. ***(3 – 4 marks)***<br><br>**[Level 1]** Candidate shows some understanding by giving a basic description of at least 2 of the tests<br><br>**OR** some of the fine detail**.** ***(1 – 2 marks)***<br><br>**[Level 0]** Candidate response includes **fewer than two** valid points. ***(0 marks)*** | 6 | Indicative points might include:<br>**Simple method**<br>• $Al^{3+}$ : Add sodium hydroxide to X<br>• $SO_4^{2-}$ : Add barium chloride to X<br>• $Li^+$ : Flame test on Y and note flame colour<br>• $Br^-$ : Add silver nitrate to Y<br><br>**Positive tests**<br>• $Al^{3+}$ : white precipitate soluble in excess NaOH<br>• $SO_4^{2-}$ : white precipitate<br>• $Li^+$ : red flame<br>• $Br^-$ : cream precipitate<br><br>**Detail**<br>**X**<br>**$Al^{3+}$**<br>• Add aqueous sodium hydroxide dropwise to an aqueous solution of X<br>• Add excess aqueous sodium hydroxide<br>**$SO_4^{2-}$**<br>• Add HCl(aq)/$HNO_3$(aq)<br>• followed by aqueous barium chloride to an aqueous solution of X<br><br>**Y**<br>**Li+**<br>• Clean a platinum / nichrome / testing loop in acid **OR** in (blue) flame<br>• Dip into the solid Y and place in a (blue) flame<br>**$Br^-$**<br>• Add $HNO_3$(aq)<br>• followed by aqueous silver nitrate to an aqueous solution of Y |
| | | | **Total** | **16** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 6 | (a) | (i) |  <br>✓✓ | 2 | 3 lines = 2 marks<br><br>1 or 2 lines = 1 mark |
| | | (ii) | **Any two from**<br><br>**Difference**<br>fewer colonies in **Fig 6.1** ✓<br>**Explanation**<br>fewer microorganisms landed on the plate(in the same time period)/less bacteria/fungi/microorganisms in the air ✓<br><br>**Difference**<br>fewer colony types in **Fig 6.1** ✓<br>**Explanation**<br>fewer types/species of bacteria/fungi/microorganisms landed on the plate/ in the air ✓ | 4 | **ALLOW** response in either order but explanation must match difference<br>**ALLOW reverse argument for Fig 6.2**<br><br>**IGNORE** air quality alone<br><br>**IGNORE** different |
| | | (iii) | **Before** - to prevent contamination/infection of the patient.✓<br><br>**After** - to prevent contamination/infection of the surgeon/employees/following patients. ✓ | 2 | **IGNORE** cross contamination unqualified<br><br>**ALLOW** to remove contamination/infection of the from first patient |
| | (b) | (i) | All <u>genetically</u> identical. ✓ | 1 | **ALLOW** identical DNA/genotype |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | | (ii) | **Any two from** ✓✓<br>• All the bananas would look/be exactly the same.<br>• New plants can be produced more quickly.<br>• Only one parent plant needed / male and female not needed.<br>• Phenotype/genotype assured (if grown under similar conditions).<br>• All need same growing conditions<br>• genetically modified against pests<br>• ensure desired traits.<br>• grown all year round | 2 | **IGNORE** cost/profit<br><br>**ALLOW** specific named trait once only<br><br>**ALLOW** use less land |
| | | (iii) | **Any two from** ✓✓<br>• All banana plants will be susceptible to the same diseases.<br>• Requires specialist equipment/technical knowledge to grow them.<br>• Dependent on supplies (of cloned plants) available. | 2 | **IGNORE** lack of variety<br>**IGNORE** cost/jobs<br><br>OWTTE |
| | | (iv) | Much cheaper / easier / carried out without the need for a laboratory. ✓ | 1 | **IGNORE** quicker |
| | (c) | | **Any one from** ✓<br>• If microorganisms are found on the surface of a planet/in space they can be sure that they are not from Earth<br>• Earth-based microorganisms may contaminate life on the planet / in space | 1 | OWTTE<br><br>**IGNORE** cross contamination unqualified |
| | | | **Total** | **15** | |

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