

Cambridge Technicals Applied Science

Unit 3: Scientific analysis and reporting

Level 3 Cambridge Technical in Applied Science
05848, 05849 & 05874

Mark Scheme for June 2022

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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.

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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. Work crossed out:
 - a. 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 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 questionNote: 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

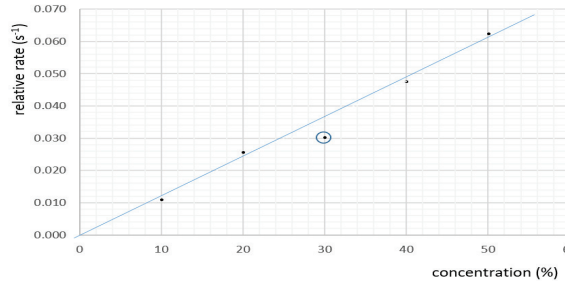
| Annotation | Meaning |
|---|--|
|  | Correct response |
|  | Incorrect response |
|  | Omission mark |
|  | Benefit of doubt given |
|  | Contradiction |
|  | Rounding error |
|  | Error in number of significant figures |
|  | Error carried forward |
|  | Level 1 |
|  | Level 2 |
|  | Level 3 |
|  | 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 |

| Question | | | Answer | Marks | Guidance | | | | | | | | | | | | | | | |
|----------|-----|--------------|---|-------|--|------|--------|---|------|------|---|-------|-------|---|------|--|---|--------------|---|--|
| 1 | (a) | (i) | <p>analysis</p> <table border="0"> <tr> <td>mean</td> <td>↘</td> <td>2.54</td> </tr> <tr> <td>median</td> <td>↗</td> <td>2.51</td> </tr> <tr> <td>mode</td> <td>↘</td> <td>0.235</td> </tr> <tr> <td>range</td> <td>↘</td> <td>2.45</td> </tr> <tr> <td></td> <td>↘</td> <td>2.22 to 2.69</td> </tr> </table> <p>✓✓✓✓</p> | mean | ↘ | 2.54 | median | ↗ | 2.51 | mode | ↘ | 0.235 | range | ↘ | 2.45 | | ↘ | 2.22 to 2.69 | 4 | |
| mean | ↘ | 2.54 | | | | | | | | | | | | | | | | | | |
| median | ↗ | 2.51 | | | | | | | | | | | | | | | | | | |
| mode | ↘ | 0.235 | | | | | | | | | | | | | | | | | | |
| range | ↘ | 2.45 | | | | | | | | | | | | | | | | | | |
| | ↘ | 2.22 to 2.69 | | | | | | | | | | | | | | | | | | |
| | (a) | (ii) | <p>(error due to precision is) instrument error ✓</p> <p>(error due to reaction time) is measurement error ✓</p> | 2 | | | | | | | | | | | | | | | | |
| | (a) | (iii) | <p>FIRST CHECK ANSWER ON FINAL ANSWER LINE If answer = 13.6 (%) award 2 marks</p> <p>total error = 0.3 (s) ✓</p> <p>$(0.3 \times 100 / 2.2 =) 13.6 (\%)$ ✓</p> | 2 | <p>ALLOW 0.3 seen or used in working</p> <p>ALLOW 0.136 (2 marks)</p> | | | | | | | | | | | | | | | |
| | (b) | (i) | <p>$(2.27/550 =) 0.00413$ or 0.0041 ✓</p> <p>$(2.15/350 =) 0.00614$ or 0.0061 ✓</p> | 2 | | | | | | | | | | | | | | | | |
| | | (ii) | <p>idea that number of s.f in calculated value depends on the number of s.f. in m and t ✓</p> | 1 | <p>ALLOW e.g. both are 2 s.f. because the mass is 2 s.f. or both are 3 s.f. because the time is 3 s.f.</p> | | | | | | | | | | | | | | | |

| Question | | Answer | Marks | Guidance |
|----------|-------|--|-----------|--|
| | (iii) | <p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 39.5 (%) award 2 marks</p> <p>$(k_{ave} =) 0.0051 \checkmark$</p> <p>% difference = 39.2 \checkmark</p> | 2 | <p>ALLOW ecf from b(i)</p> <p>ALLOW 0.00514, 0.005135</p> <p>ALLOW correct % difference for value of k_{ave} used</p> |
| | (c) | <p>Comparison: (large) difference between percentages / percentages should be same \checkmark</p> <p>Conclusion: relationship is not supported / Jamila is correct \checkmark</p> | 2 | ALLOW ecf from (b)(iii) and (a)(iii) in comparisons and conclusions |
| | (d) | <p>value in (a)(iii) may be anomalous \checkmark</p> <p>all other times give a smaller % uncertainty or the smallest time gives the largest % uncertainty or all other values increase the difference between the percentages \checkmark</p> | 2 | <p>ALLOW better to use the mean/median / other values less likely to be anomalous</p> <p>ALLOW for 2 marks - the largest value in the range has the smallest % uncertainty / the % uncertainty in 2.69 is 11.2% so it is less than 13.6%</p> |
| | | Total | 17 | |

| Question | | Answer | Marks | Guidance |
|----------|-----|---|-------|---|
| 2 | (a) | 0.063, 0.048, 0.030, 0.026, 0.011 ✓ all values to 2 SF ✓ | 2 | ALLOW 0.06, 0.05, 0.03, 0.03, 0.01 |
| | (b) | (i) axes labelled with units and sensible scale and all points correctly plotted ✓ straight line of best fit through origin and disregards the anomalous result and even spread of points above and below ✓ | 2 |  <p>ALLOW ecf from (a) for points plotted</p> |
| | | (ii) circle drawn around anomalous result ✓ | 1 | |
| | | (iii) FIRST CHECK ANSWER ON ANSWER LINE If answer = 1.25×10^{-3} award 2 marks read-offs substituted into $\Delta y \div \Delta x$ ✓ gradient = 1.25×10^{-3} ✓ | 2 | ALLOW plotted points if they are on the line |
| | (c) | (i) $\frac{1}{10}$ ✓ | 1 | |
| | | (ii) FIRST CHECK ANSWER ON ANSWER LINE If answer = $1.5 \times 10^{-5} \text{ g cm}^{-3}$ award 2 marks (dilution factor) 1×10^{-4} ($\times 0.15$) ✓ $1.5 \times 10^{-5} \text{ g cm}^{-3}$ ✓ | 2 | ALLOW ecf from c(i) ALLOW dilution factor = 1×10^4 |

| Question | | Answer | Marks | Guidance |
|----------|---------|---|-----------|------------------------------|
| | (d) (i) | FIRST CHECK ANSWER ON ANSWER LINE If answer = 0.6/0.64/0.643 (g) award 2 marks $(n \text{ Na}_2\text{S}_2\text{O}_3 = 3.17/158.2 = 0.02)$ $n \text{ S} = 0.02 \checkmark$ $\text{expected mass S} = 0.02 \times 32.1 = 0.6/0.64/0.643 \text{ (g)} \checkmark$ | 2 | |
| | (ii) | $\% \text{ yield} = \frac{0.463 \times 100}{0.643} = 72\% \checkmark$ | 1 | ALLOW ecf from (d)(i) |
| | | Total | 13 | |

| Question | | Answer | Marks | Guidance |
|----------|-----|---|-------|--|
| 3 | (a) | histogram ✓ continuous ✓ 5% ✓ 40% ✓ 30% and 45% ✓ | 5 | |
| | (b) | <p>[Level 3] Candidate shows a high level of understanding of the charts AND the further evidence needed to make the conclusion more secure <i>(5 - 6 marks)</i></p> <p>[Level 2] Candidate shows an understanding of the charts AND the further evidence needed to make the conclusion more secure <i>(3 – 4 marks)</i></p> <p>[Level 1] Candidate shows a basic understanding of the charts AND/OR the further evidence needed to make the conclusion more secure. <i>(1 – 2 marks)</i></p> <p>[Level 0] Candidate response includes fewer than two valid points. <i>(0 marks)</i></p> | 6 | <p>Understanding of the charts points:</p> <ul style="list-style-type: none"> the charts do not specify the actual journey time the areas of the charts are the same / add up to 100% of time bus route 1 had more idling/stationary time than route 2 ORA bus route 2 had more time at higher engine speeds than route 1 ORA route 1 could be shorter / take less time than route 2 ORA route 2 bus could idle/be stationary for more time outside schools/busy shopping areas than route bus ORA the charts do not give the locations where the buses were idling <p>Further evidence points:</p> <ul style="list-style-type: none"> the time taken by the buses for each route types of pollution emitted at different engine speeds how much fuel was used / burned how far the bus travelled locations such as schools and busy shopping areas where the engine is idling |

| Question | | Answer | Marks | Guidance | | | | | | | | | | | | | | | | | | | |
|----------------------------|------------|--------------|--|-----------|---|--------------|---------------|---|--|------------------|--|---|---------------------------|---|--|----------------------------|---|--|-----------------|--|---|---|--------------------------------|
| | (c) | (i) | systematic error ✓ | 1 | ALLOW zero error / calibration error | | | | | | | | | | | | | | | | | | |
| | | (ii) | (when it is idling) the reading on the rev counter would be higher than 1200 RPM or the reading would be (1200+250 =) 1450 RPM ✓ or (when it is idling) the engine speed would be higher (than 15%) / it would be (1450/8000 =) 18% ✓ or (so when the data is presented in a graph) it will look as though bus 3 is never idling ✓ | 2 | | | | | | | | | | | | | | | | | | | |
| | (d) | | <table border="1"> <thead> <tr> <th></th> <th>repeatable</th> <th>reproducible</th> </tr> </thead> <tbody> <tr> <td>same observer</td> <td>✓</td> <td></td> </tr> <tr> <td>different routes</td> <td></td> <td>✓</td> </tr> <tr> <td>same measuring instrument</td> <td>✓</td> <td></td> </tr> <tr> <td>same measurement procedure</td> <td>✓</td> <td></td> </tr> <tr> <td>different buses</td> <td></td> <td>✓</td> </tr> </tbody> </table> <p style="text-align: center;">✓ ✓ ✓ ✓ ✓</p> | | repeatable | reproducible | same observer | ✓ | | different routes | | ✓ | same measuring instrument | ✓ | | same measurement procedure | ✓ | | different buses | | ✓ | 5 | One mark for each correct row. |
| | repeatable | reproducible | | | | | | | | | | | | | | | | | | | | | |
| same observer | ✓ | | | | | | | | | | | | | | | | | | | | | | |
| different routes | | ✓ | | | | | | | | | | | | | | | | | | | | | |
| same measuring instrument | ✓ | | | | | | | | | | | | | | | | | | | | | | |
| same measurement procedure | ✓ | | | | | | | | | | | | | | | | | | | | | | |
| different buses | | ✓ | | | | | | | | | | | | | | | | | | | | | |
| | | | Total | 19 | | | | | | | | | | | | | | | | | | | |

| Question | | Answer | Mark | Guidance |
|--------------|-----|--|-----------|---|
| 4 | (a) | fruticose – C ✓ foliose – B ✓ crustose – A ✓ | 3 | |
| | (b) | (i) Fig. 4.1 are secondary data and Fig. 4.2 is primary data ✓ | 1 | |
| | | (ii) Any three from: high resolution image (sharply) focused image contrasts with or stands out against the background angle chosen to show features clearly object is well illuminated the image allows the observer to match the plant closely to either the description or the drawing ✓✓✓ | 3 | IGNORE references to clarity/clear image unless qualified |
| | (c) | (i) Any six from: altitude where it grows type of habitat how it reacts to chemical tests (geographic) location where it grows colour when dry colour when wet shape of thallus ✓ ✓ ✓ ✓ ✓ ✓ | 6 | ALLOW e.g. upland or lowland ALLOW e.g. moorland or woodland ALLOW e.g. K positive or K negative ALLOW e.g. east or west ALLOW unqualified references to colour for 1 mark |
| | | (ii) Advantage: affected by atmospheric pollution / it is sensitive to SO ₂ ✓ Disadvantage: Ken's ecosystem may be in the west/upland /has too few old trees ✓ | 2 | ALLOW Ken's ecosystem may be unpolluted but species may be too rare to have spread there yet. |
| Total | | | 15 | |

| Question | | | Answer | Marks | Guidance |
|----------|-----|------|--|-------|--|
| 5 | (a) | (i) | range bar at 30 minutes from 210 to 270 ✓ | 1 | |
| | | (ii) | diabetic graph extends to the left and downwards to intercept y-axis ✓ correct read-off for graph drawn at the intercept and unit ✓ | 2 | ALLOW $\pm \frac{1}{2}$ small square |
| | (b) | | Any four from: (all) levels rise after eating / named level rises after eating diabetic rate of increase is fastest / normal rate of increase is slowest idea that all/named level(s) peak between 60 and 100 minutes diabetic increase is greatest / normal increase is smallest pre-diabetic rate of decrease is faster / diabetic rate of decrease is slowest diabetic remains (much) higher for (much) longer ✓✓✓✓ | 4 | ALLOW also gains MP1 ALLOW also gains MP1 |
| | (c) | (i) | State: bar chart ✓ Explanation: data is discontinuous ✓ | 2 | ALLOW data is categoric |

| Question | | Answer | Marks | Guidance |
|--------------|------|--|-----------|----------|
| | (ii) | biscuit sales have fallen <input type="checkbox"/> people are eating less sugar <input type="checkbox"/> puddings contain large amounts of sugar <input checked="" type="checkbox"/> some products are more easily reformulated to contain less sugar <input type="checkbox"/> some product ranges are not included in the report <input checked="" type="checkbox"/> yoghurt is sold as a health food <input type="checkbox"/> | 2 | |
| Total | | | 11 | |

| Question | | | Answer | Marks | Guidance |
|----------|-----|------|---|-------|---|
| 6 | (a) | (i) | <p>Step</p> <p>Killing</p> <p>Fixing and hardening</p> <p>Staining</p> <p>Dehydration</p> <p>Function</p> <p>Removes all traces of water to allow further processing</p> <p>Colours parts of the specimen for clear differentiation of structures</p> <p>Makes the tissue ready for subsequent processing and able to take up stains</p> <p>Instantaneous stoppage of processes to stop post-mortem changes</p> <p style="text-align: right;">✓✓✓</p> | 3 | 4 correct = 3 marks 2 or 3 correct = 2 marks 1 correct = 1 mark |
| | | (ii) | <p>Any one from:</p> <p>obtaining specimen/tissue (from organism)</p> <p>placing specimen/tissue on microscope slide</p> <p>mounting</p> <p>adding the cover slip ✓</p> | 1 | |
| | (b) | | <p>1. fluorescence ✓</p> <p>2. viability ✓</p> <p>3. dead ✓</p> | 3 | |
| | (c) | | <p>Any three from:</p> <p>time-consuming</p> <p>idea that need specialist/highly trained technicians</p> <p>expensive</p> <p>need differential stains</p> <p>cannot see living processes ✓✓✓</p> | 3 | IGNORE reference to specimen being dead/not living |

| Question | | Answer | Marks | Guidance |
|----------|-----|----------------------|--|-----------|
| | (d) | (i) | 1 | |
| | | Selective media | | |
| | | Nutrient agar | | |
| | | ✓ Differential media | | |
| | | Minimal media | | |
| | | (ii) | 4 | 1 |
| | (e) | (i) | 3 | 1 |
| | | (ii) | (fungal colonies) are seen from above / not from the side. | 1 |
| | | (iii) | (bacterial colonies) are too small. | 1 |
| | | | Total | 15 |

| Question | | Answer | Marks | Guidance |
|----------|-----|--|-----------|---|
| 7 | (a) | Area = $(8 \times 20) \times (2.5 \times 20) = 8000 \text{ (km}^2\text{)}$ | 1 | ALLOW range from 6400 -9600 (km ²) |
| | (b) | Any two from: date time location/coordinates camera settings ✓✓ | 2 | |
| | (c) | large field of view / large area can be photographed ✓ inhospitable / remote areas can be photographed ✓ | 2 | OWTTE OWTTE |
| | (d) | Any two from: satellites may not be in correct position to take photographs cost of the satellites availability of satellite / satellite time effect of cloud cover ✓✓ | 2 | |
| | (e) | iceberg has moved away from Larsen ice shelf ✓ iceberg has got smaller ✓ | 2 | |
| | (f) | Graphical Information Survey <input type="checkbox"/> Geological Implementation Security <input type="checkbox"/> General Instrumentation System <input type="checkbox"/> Geographical Information System <input checked="" type="checkbox"/> | 1 | |
| | | Total | 10 | |

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