

Cambridge Technicals Applied Science

Unit 3: Scientific analysis and reporting

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

Mark Scheme for January 2023

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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. **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 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

11. **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.

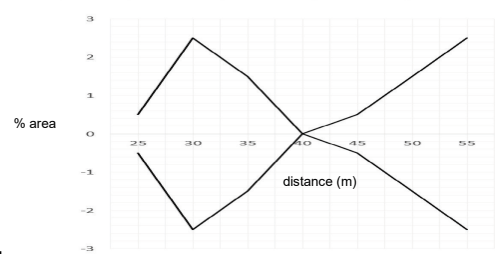
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

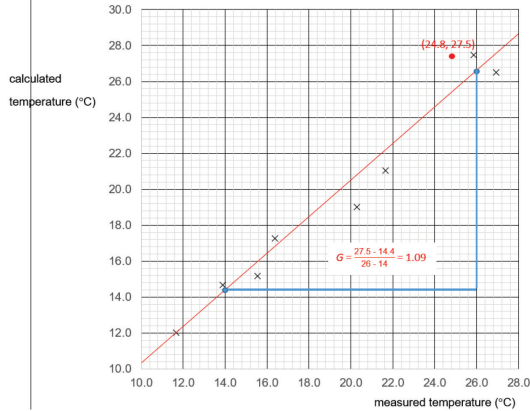
Question			Answer	Marks	Guidance
1	(a)	(i)	mode = 10.9 ✓ median = 11.15 ✓ range = 10.7 – 14.6 ✓	3	ALLOW 3.9 as calculated range
		(ii)	= 11.92 ✓	1	
	(b)	(i)	FIRST CHECK ANSWER ON FINAL ANSWER LINE If answer = 7854 (m²) award 2 marks A = 3.14 × 50 × 50 ✓ = 7854 (m ²) ✓	2	ALLOW 7853.98
		(ii)	FIRST CHECK ANSWER ON FINAL ANSWER LINE If answer = 68 000 kg / s award 4 marks M = 1.23 × 7854 × 7 ✓ = 67 622.94 ✓ = 68 000 ✓ Unit: kg s ⁻¹ ✓	4	ALLOW ecf using area A calculated in (b)(i) ALLOW 67 622.77 if 7853.98 substituted from (b)(i) ALLOW any calculated value from MP2 to 2sf
	(c)	(i)	smooth curve through all the points ✓	1	ALLOW ± one small square
		(ii)	vertical line at 8.4 intersects best fit line and horizontal line drawn across to intersect y-axis ✓ power = 1.2 × 10 ⁶ (W) ✓	2	ALLOW ± one small square for intercept on y-axis ALLOW correct answer for curve drawn in (c)(i)
		(iii)	power output increases with wind-speed ✓ (power output) increases non-linearly (with wind-speed) ✓	2	Also gains mark-point 1 if reference to power output and wind-speed
Total				15	

Question		Answer	Marks	Guidance
2	(a)	the diagram is an interpretation of an actual plant ✓	1	ALLOW reference to the source of the diagram e.g. textbook / other researchers
	(b)	(i) dichotomous key ✓	1	
		(ii) choose between two features (at each stage in the key) ✓ repeated until organism/group number is identified ✓	2	
		(iii) Any three from: ✓✓✓ difficult to match descriptions (of features) to observations (of features) / idea that minimal differences between species make objective decisions difficult specialist terms not always understood features may vary throughout the year / vary in old vs young / vary due to deformity / vary due to damage data are limited / idea that the plant one wants to identify is not included in the key	3	
	(c)	(i) it has 3 stigmas ✓ not known whether the perigynium is inflated or not ✓ the size of bract is not given / no scale shown on the diagram ✓	3	ALLOW idea of diagram not drawn to scale / reference to bract as <5mm or ≥6mm
	(c)	(ii) Any two from: ✓✓ hairless leaves 2 (or more) spikelets spikelets on same stem	2	

Question		Answer	Marks	Guidance
	(d)	<p>Any three from: ✓✓</p> <p>perigynium longer (than 3mm) – <i>C.bolanderi</i> OR shorter (than 3mm) – <i>C.arcta</i></p> <p>perigynium/surface view many/dark lined/veins – <i>C.arcta</i> OR few/no faint lined/veins – <i>C.bolanderi</i></p> <p>inflorescence branched/open – <i>C.bolanderi</i> OR compact/dense – <i>C.arcta</i></p> <p>inflorescence/cluster of florets shorter (approx. 5mm) – <i>C.arcta</i> OR longer (approx. 1cm) – <i>C.bolanderi</i></p>	2	<p>3 correct differences = 2 marks 1 or 2 correct differences = 1 mark</p> <p>OWTTE OWTTE</p>
	(e)	idea of responding (e.g. by change in in population) to a change in the environment (e.g. more/less pollution) ✓	1	ALLOW can be used to indicate the presence of a pollutant or other environmental/selection feature
Total			15	

Question			Answer	Marks	Guidance
3	(a)	(i)	40 m ✓	1	
		(ii)	(measure) temperature ✓ (measure) air quality / toxicity ✓	2	
		(iii)	use the same instrument / thermometer ✓ used in the same way / with the same method ✓	2	ALLOW example of method e.g. at the same height / for the same amount of time
	(b)		y – axis labelled %/percentage area AND regular scale ✓ x – axis labelled distance (m) AND suitable scale ✓ symmetrical about central axis ✓ all points plotted correctly ✓	4	e.g. 
	(c)	(i)	Any two from: ✓✓ <ul style="list-style-type: none"> irregular shapes gaps between shapes squares are partly filled area must be estimated 	2	ALLOW different shapes
		(ii)	4 (cm ²) ✓ ± 0.5 ✓	2	ALLOW from 3.5 to 4.5 ALLOW ± 0.4 - ± 0.6
		(iii)	systematic ✓	1	
Total				14	

Question	Answer	Marks	Guidance
4	<p>[Level 3] Candidate shows a high level of knowledge and understanding of the technique with most of the detailed method and most of the fine detail covered. (5 - 6 marks)</p> <p>[Level 2] Candidate shows knowledge and understanding of the technique with most of the outline method and most of the detailed method covered. (3 -4 marks)</p> <p>[Level 1] Candidate shows basic knowledge and understanding of the technique with most of the outline method covered. (1 – 2 marks)</p> <p>[Level 0] Candidate response includes fewer than two valid points. (0 marks)</p> <p style="text-align: right;">✓✓✓✓✓</p>	6	<p>Valid points</p> <p>Outline method</p> <ul style="list-style-type: none"> • Prepare solutions of known concentrations by diluting the stock solution. • Add an indicator to each solution. • Measure the absorbance of each solution. • Obtain a calibration curve. • Read off absorbance of waste water samples from the calibration graph. <p>Detailed method</p> <ul style="list-style-type: none"> • Prepare solutions of concentrations 1,2,3,4 and 5 mg dm⁻³ from the stock solution. • Mix each solution with an equal volume of an indicator to give a coloured solution. • Select the appropriate filter/wavelength. • Measure the absorbance of each solution. • Plot a graph of absorbance (y axis) against concentration. • Add the indicator to the sample to be tested. • Measure its absorbance and read off the concentration from the graph. <p>Fine detail</p> <ul style="list-style-type: none"> • Zero the spectrophotometer/colorimeter using water • Make a 5 mg dm⁻³ solution by taking 5 cm³ stock solution and making it up to 100 cm³ with distilled water. • Then diluting this by taking 4 cm³ and adding 1 cm³ water etc. • Name of indicator: 1,10–phenanthroline. • Colour of solution: orange-red.
	Total	6	

Question		Answer	Marks	Guidance
5	(a)	scatter ✓	1	
	(b)	(i) FIRST CHECK ANSWER ON FINAL ANSWER LINE If answer = 27.5 (°C) award 2 marks 9 + 37/2 or 9 + 18.5 ✓ 27.5 °C ✓	2	
		(ii) cross x plotted at (24.8, 27.5) ± ½ small square ✓	1	ALLOW ecf using the temperature calculated in (b)(i)
		(iii) straight line of best fit with even distribution of points above and below the line ✓ outlier at measured temperature of 27 °C ✓	2	ALLOW outlier for line drawn in (b)(iii) and/or cross plotted in (b)(ii)
	(c)	two points marked on the line of best fit that are apart by at least half of the length of the drawn line ✓ correct coordinates stated from the marked points ✓ substitution of coordinates/dy and dx in $G =$ ✓ $G \approx 1$ and no unit ✓	4	ALLOW either points or a triangle  MP3 ALLOW ecf for incorrectly read coordinates or incorrectly calculated dy and/or dx MP4 ALLOW ecf for correct gradient for graph drawn

Question		Answer	Marks	Guidance
	(d)	<p>the gradient of the line is close to 1 ✓</p> <p>(gradient shows) the two temperatures are similar/close ✓</p>	2	<p>ALLOW reverse arguments for first and second mark-points; second mark-point must be consistent with the first.</p> <p>ALLOW e.g. an individual observation is / is not accurate enough to be the same as the measured temperature OR below 20°C the calculated temp is within 0.5°C of the measured temp</p>
	(e)	(i)		
		<p>similar/same results are obtained ✓</p> <p>carried out by different investigators ✓</p>	2	
		(ii)		
		<p>details about the location of measurements e.g. field or laboratory ✓</p> <p>Any two from: ✓✓</p> <ul style="list-style-type: none"> • weather/laboratory conditions during measurements • time of day of the measurements • time of year of the measurements • light intensity • species/development stage/sex of cricket • method of temperature measurement 	3	IGNORE unqualified references to location
			Total	17

Question		Answer	Marks	Guidance
6	(a)	<p>unpredictable ✓</p> <p>cannot ✓</p> <p>expected ✓</p>	3	
	(b)	<p>measured values are in close agreement ✓</p> <p>measured values agree to within approx. 0.015 hPa / values range from approx. 998.620 to 998.635 hPa ✓</p>	2	
	(c)	<p>(i) FIRST CHECK ANSWER ON FINAL ANSWER LINE If answer = 1.76 (%) award 2 marks</p> <p>% error = $1786 / 1016$ ✓</p> <p>= 1.76 (%) ✓</p>	2	
		<p>(ii) Explanation yes AND the <u>% error</u> is small OR no AND <u>% error</u> is large ✓</p> <p>Further information Any one from: ✓</p> <ul style="list-style-type: none"> • Distance from the weather station to her location • Weather conditions at the two locations • Altitude of the two locations 	2	
			Total	9

Question		Answer	Marks	Guidance											
7	(a)	(i)	to see which alkaloids are actually present in the sample ✓	1	OWTTE										
		(ii)	6 ✓	1											
		(iii)	spot three clearly identified with T ✓	1											
		(iv)	run again with the plate turned through 90 degrees / 2-D TLC ✓ run with a different solvent. ✓	2											
	(b)	(i)	some of the spots may fade over time ✓	1											
		(ii)	D only contains codeine and one other alkaloid (whereas all the others contain several alkaloids) ✓	1	OWTTE										
		(iii)	plate ✓ solvent ✓ spectrophotometer ✓	3											
		(iv)	<table border="1"> <tr> <td>calorimetry</td> <td></td> </tr> <tr> <td>colorimetry</td> <td></td> </tr> <tr> <td>densitometry</td> <td>✓</td> </tr> <tr> <td>micrometry</td> <td></td> </tr> <tr> <td>titration</td> <td></td> </tr> </table>	calorimetry		colorimetry		densitometry	✓	micrometry		titration		1	
calorimetry															
colorimetry															
densitometry	✓														
micrometry															
titration															
			Total	11											

Question		Answer	Marks	Guidance
8	(a)	bar chart / bar graph ✓ (line) graph ✓ (density) map ✓	3	
	(b)	data can be updated on a more regular basis ✓ data can be accessed by many more people / across the world ✓	2	OWTTE OWTTE
	(c)	CDC is a reputable organisation / part of US government / data may be peer-assessed ✓	1	OWTTE
	(d) (i)	Overall trends: heart disease decreasing AND accidents decreasing ✓ Detail: heart disease levelling off from about 2011 ✓ accidents increasing more rapidly from about 2015 ✓	3	
	(ii)	Heart disease Any two from: ✓✓ <ul style="list-style-type: none"> • (Different) health initiatives need to be put in place • Named health initiative e.g. balanced diet / exercise etc • Greater communication/awareness for (wider) population Accidents/unintentional injuries Any two from: ✓✓ <ul style="list-style-type: none"> • Identify the cause of the (significant) increase from 2015 onwards • (More) safety initiatives need to be put in place • Named safety initiative e.g improve road safety / improve health and safety at work etc 	4	OWTTE OWTTE OWTTE OWTTE
Total			13	

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