OCR
Oxford Cambridge and RSA

Cambridge Technicals
Applied Science

Unit 3: Scientific analysis and reporting

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

Mark Scheme for June 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.

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

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.

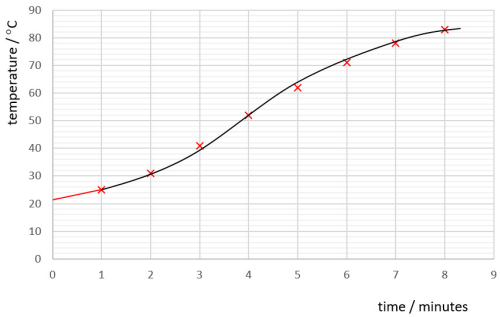
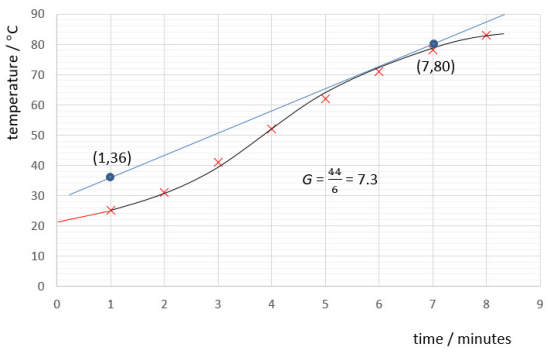
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New 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)	**FIRST CHECK ANSWER ON FINAL ANSWER LINE** **If answer = 74.9 / 75 award 2 marks** total mass = 749 ✓ mean mass (= total mass ÷ number samples = 749/10) = 74.9 / 75 ✓	2	
		(ii)	73 ✓	1	
		(iii)	1 ✓	1	
	(b)		**FIRST CHECK ANSWER ON FINAL ANSWER LINE** **If $s^2 = 860$, $s = 29.3$, AND working shown, award 6 marks** any $X-\bar{X}$ e.g. from row 1 $25 - 74.9$ **or** -49.9 ✓ then squared e.g. $(-49.9)^2 = 2490$ ✓ using all 10 values: $\Sigma (X-\bar{X})^2 = 7740.9$ ✓ variance, $s^2 = 7740.9 \div (9) = 860$ ✓ standard deviation, $s = \sqrt{860} = 29.3$ ✓ both values to 3 sf ✓	6	**ALLOW** if no working shown max 3 **ALLOW** ECF from first mark-point **ALLOW** any two calculated values to 3 sf
	(c)		**FIRST CHECK ANSWER ON FINAL ANSWER LINE** **If answer = 70 (%) award 2 marks** range = 74.9 – 29.3 to 74.9 + 29.3 **or** 45.6 to 104.2 ✓ (number of pellets in range = 7) % pellets in this range = 70 (%) ✓	2	**ALLOW** ECF using **(a)(i)** and **(b)** **ALLOW** 1 mark for identification of 7 pellets

Question			Answer	Marks	Guidance
	(d)	(i)	pellet 1 contains (remains of) 1 animal **and** pellet 6 contains (remains of) 3 animals **and** pellet 9 contains (remains of) 4 animals / **AW** ✓	1	**ALLOW** pellets are multiples (of ~25g)
		(ii)	Any **two** from ✓✓ • how many animals/prey are in each pellet • shape of skull / features of bones • features of teeth • type of fur • results of DNA analysis of animal parts	2	
	(e)		Any **two** from: ✓✓ • idea that owls have a preference for a particular species • idea that owls have a preference for particular size of prey • idea that not all species in a habitat are prey for owls • idea that some species are easier to catch • idea that owls may not hunt over entire habitat and species may not be evenly distributed over habitat • idea that owls hunt nocturnally when certain species may not be active	2	
			Total	**17**	

Question			Answer	Marks	Guidance
2	(a)	(i)	*P. pyralis* ✓ *P. consimilis* ✓	2	
		(ii)	 0.2 ± 0.1 s pulse duration ✓ 0.5 ± 0.1 s pulse interval ✓ 5.4 ± 0.1 s flash interval ✓	3	**ALLOW** max **2 marks** for description e.g. short pulses (two) pulses close together/with a short interval long delay (between flashes) / **AW**
		(iii)	*P. carolinus* ✓ *P. ignitus* **or** *P. consimilis* ✓	2	
	(b)	(i)	Any **two** from ✓✓ • universally/internationally recognised/understood • acceptable internationally / **AW** • dead language so not evolving/changing (means no confusion over time)	2	
		(ii)	form of scientific communication that is accepted/established by convention / enables scientists to communicate more precisely / enables close links to be made between different species of the same genus/**AW** / allows for easy classification ✓	1	**IGNORE** references to identification / universally accepted/understood
	(c)	(i)	photograph/video recording/sound recording/time recordings (that were used to produce the table)	1	**IGNORE** newspapers **ALLOW** drawings **ALLOW** interviews/surveys/experimental data/fieldwork collected by the researcher / **AW**
		(ii)	only count the male flashes ✓	1	
			Total	**12**	

Question			Answer	Marks	Guidance
3	(a)		scale – points occupy at least 8 large squares horizontally and at least 1 large square for each 10°C vertically ✓ plotting – all points plotted correctly to nearest small square ✓ smooth, continuous, thin, curved, line-of-best-fit with increasing gradient to approx. 4 minutes and then decreasing gradient ✓	3	 **IGNORE** line extended beyond 8, 83
	(b)		line extends to intercept temperature axis ✓ correct read-off for line drawn ✓	2	**ALLOW** ± one small square
	(c)	**(i)**	value between ± 2°C - ± 4°C ✓	1	
		(ii)	[answer **(c)(i)** ÷ answer **(b)**] x 100 % ✓	1	**ALLOW** ECF from **(c)(i)** and/or **(b)**
	(d)	**(i)**	tangent touching curve at 6 minutes and at least 4 large squares in length ✓ read-offs substituted into $\frac{\text{change in temperature}}{\text{change in time}}$ ✓ answer in range from 7.0 - 7.5 ✓	3	

Question			Answer	Marks	Guidance
		(ii)	**SI units:** K s^{-1} ✓ **Explanation:** divide (gradient) by 60 ✓ change in temperature is the same in K as in °C **and** change in time is mins × 60 ✓	3	

Question			Answer	Marks	Guidance
	(e)		**[Level 3]** Candidate shows a high level of understanding of repeatability **and** reproducibilty **and** suggests further information needed for repeatability **and** reproducibility ***(5 – 6 marks)*** **[Level 2]** Candidate shows an understanding of repeatability **and** reproducibilty **and** suggests further information needed for repeatability **or** reproducibility ***(3 – 4 marks)*** **[Level 1]** Candidate shows a basic understanding of repeatability **or** reproducibilty **or** suggests further information needed for repeatability **or** reproducibility. ***(1 – 2 marks)*** **[Level 0]** Candidate response includes **fewer than two** valid points. ***(0 marks)***	6	**Repeatability** • same person • using the same apparatus • following the same methods/techniques • under the same conditions **Reproducibility** • other people • using different apparatus • following different methods/techniques • in different conditions **Information needed for repeatability** • type of oil used • volume of oil used • type of heat source used • distance from heat source to boiling tube • time and temperature data (for comparison) • gradient calculation (for comparison) **Information needed for reproducibility** • a volume of liquid is heated by a heat source • method: to record temperature at intervals of time • list of variables to control • the expected shape of the graph
			Total	**19**	

Question			Answer	Marks	Guidance
4	(a)		Any **one** from ✓ • the reaction has stopped • no more gas is given off • no further decrease in mass	1	**DO NOT ALLOW** any reference to end point
	(b)	(i)	to reduce the effect of random error✓	1	
		(ii)	repeated measurements are close together / **AW** ✓	1	
	(c)		outlier/anomalous value for experiment 2 is not included when calculating the mean ✓	1	
	(d)		±0.005 g✓	1	
	(e)		**If answer = 3.077 / 3.08 / 3.1 / 3 award 2 marks** $\%\ \text{difference} = \frac{(\text{calculated value} - \text{experimental value}) \times 100}{\text{calculated value}}$ $= \frac{(0.650-0.630) \times 100}{0.65}$ ✓ = 3.077 / 3.08 / 3.1 / 3 ✓	2	
	(f)	(i)	no more bubbles given off / no more fizzing ✓ magnesium carbonate has dissolved / magnesium carbonate no longer visible ✓	2	**IGNORE** no more CO_2/gas produced

<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>
<table>
<tr><th>Concentration of acid (mol dm^{-3})</th><th>Time taken for reaction to stop (s)</th><th>$\frac{1}{\text{time}}$ (s^{-1})</th></tr>
<tr><td>0.5 mol dm^{-3}</td><td>135</td><td>0.007</td></tr>
<tr><td>1.00 mol dm^{-3}</td><td>70</td><td>0.014</td></tr>
<tr><td>2.00 mol dm^{-3}</td><td>36</td><td>0.028</td></tr>
</table>
3rd column correct✓

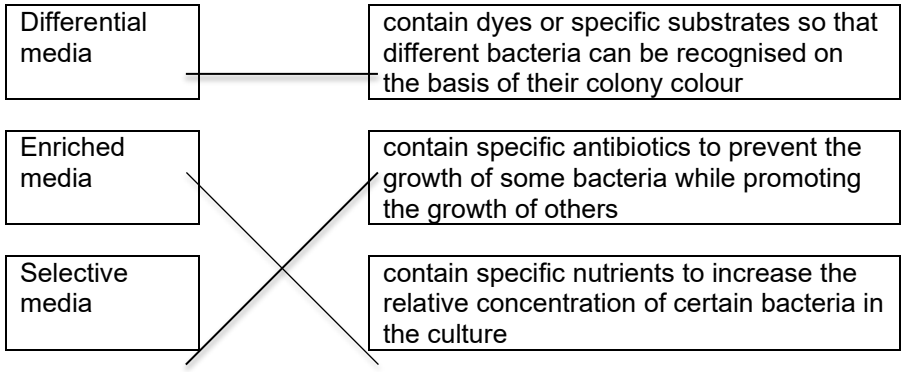
all values to 3 dp with at least one correctly calculated value✓</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>• rate of reaction increases / time for reaction to end decreases as concentration increases ✓

• as concentration doubles, rate of reaction doubles ✓</td><td>2</td><td>Also gains MP1</td></tr>
<tr><td></td><td>(g)</td><td>(i)</td><td>Idea that 360º/10 = 36º✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>radii drawn at 90° and approx.. 198° ✓

all 3 labels correct for proportion ✓</td><td>2</td><td>alginic acid < calcium carbonate < glucose</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>16</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
5	(a)	(i)	**Type of chart** • histogram ✓ **Reasons** Any **two** from ✓✓ • bars touch • data is continuous • sort order cannot be changed	3	
		(ii)	54 ± 3 ✓	1	
	(b)		normal distribution between 12-26mm ✓	1	
	(c)		Any **three** from ✓✓✓ • females are longer (than males) / **ORA** • females wider range of body lengths (than males) / **ORA** • body length has normal distribution (in both male and female) • more males have a body length from 8.0 to 9.9 mm • more females have a body length from 18.0 to 19.9 mm • no overlap in length between males and females	3	
	(d)	(i)	5.1 is secondary **and** 5.2 is secondary✓	1	

Question			Answer	Marks	Guidance
		(ii)	it is too small ✓ females are 12 mm (or longer) / **AW** ✓	2	**IGNORE** references to lengths of males **Also gains MP1**
		(iii)	a diagram/description of the identifying features of females (compared to males) ✓	1	
			Total	**12**	

Question			Answer	Marks	Guidance
6	(a)	(i)	<table><tr><td>Crystal violet</td><td>✓</td></tr><tr><td>Leishman's stain</td><td></td></tr><tr><td>Methylene blue</td><td></td></tr><tr><td>Safranin</td><td>✓</td></tr><tr><td>Sudan III</td><td></td></tr><tr><td>Toluidene blue</td><td></td></tr></table>	2	
		(ii)	cell wall ✓	1	
		(iii)	greater concentration of/number of/more bacteria needed ✓	1	**ALLOW** idea of growing bacteria
	(b)		 ✓✓✓	3	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Name of bacteria
• Neisseria lactamica / N. lactamica ✓

Identification
• it is lactose fermenting / the colonies are pink✓
• cell shape is coccus/round ✓</td><td>3</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>idea of contamination of culture plate ✓</td><td>1</td><td></td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td><table><tr><td>Circular</td><td>✓</td></tr><tr><td>Filamentous</td><td></td></tr><tr><td>Rhizoid</td><td></td></tr><tr><td>Spindle</td><td></td></tr></table></td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><td>clearing</td><td>2</td></tr><tr><td>dehydration</td><td>1</td></tr><tr><td>mounting</td><td>3</td></tr></table>✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Any two from ✓✓

• Sample/bacteria, name/species
• Source / patient name
• Gram/stain used
• Date</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>14</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
7	(a)		Any **two** from ✓✓ • easy to understand/interpret • allows easy comparison • website users do not need to be specialists • quick to use / seen at a glance	2	
	(b)	(i)	Any **two** from ✓✓ • quicker to collect data • less expensive to collect data • data for values that are difficult to collect practically can be obtained.	2	**IGNORE** easier to collect data
		(ii)	Any **two** from ✓✓ • the maximum accelerations have very similar values • the maximum accelerations occur at very similar times (after the impact). • correct reference to comparative value(s)	2	
		(iii)	**A**ny **two** from ✓✓ • the same crash can be watched many times • the crash can be watched a frame at a time / replayed / fast-forwarded / paused • a permanent record can be kept • recording can be shared • recording may be watched at different times / in different places	2	**ALLOW** idea of analysing recording

Question			Answer	Marks	Guidance
	(c)		**Fig. 7.1** general public / car buyers / journalists ✓ **Fig 7.2** engineers / car manufacturers / mechanics / academics / legislators / H&S experts ✓	2	**IGNORE** shareholders
			Total	**10**	

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