Cambridge Technicals

Applied Science

Unit 3: Scientific analysis and reporting

Level 3 Cambridge Technical in Applied Science

05848, 05849 & 05874

Mark Scheme for June 2024

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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. Award No Response (NR) if:
    - there is nothing written in the answer space

    Award Zero '0' if:
    - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

    Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

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.

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

9. 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

10. **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 =) 35 ✓ (median =) 35 ✓ (range =) 13 to 100 **or** 87 ✓	3	**BP** or **SEEN** as appropriate on additional page
		(ii)	42 ✓	1	
	(b)	(i)	Thebe ✓	1	
		(ii)	larger moons discovered before 1951/1974 **AW or** smaller moons discovered after 1951/1974 **AW or** diameter of moons decreases with time **AW** / **ORA** ✓	1	
		(iii)	idea that improvements in telescopes (with time) allowed discovery of smaller moons / smaller moons discovered by space probes (e.g. Voyager) ✓	1	**ALLOW** later moons
	(c)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer for g = 4.1 x 10^{-2} N kg^{-1} award 4 marks** g = 6.67 ×10^{-11} x 8.7 ×10^{17} ÷ (3.75 ×10^{4})^2 ✓ = 0.0413 ✓ = 0.041 (2 sf) ✓ **Units:** N kg^{-1} ✓	4	 **DO NOT ALLOW ECF** from MP1 **ALLOW** any value to 2 sf
	(d)	(i)	use ruler and scale (bar/line) ✓ measure (at least) 3 different diameters ✓	2	

Question			Answer	Marks	Guidance
	(d)	**(ii)**	diameter is not uniform / Thebe is not a sphere **or** image is unclear / hard to measure accurately	1	
			Total	**14**	

Question			Answer	Marks	Guidance
2	**(a)**		Any **two** from: ✓✓ consistency accepted naming convention / universally recognised shows evolutionary relationship / order/categorise living things	2	**Apply list rule**
	(b)	**(i)**	wider at the tips/ends ✓ upward curving (at the tips) **/ AW**	2	**Apply list rule** **ALLOW** vertical
		(ii)	scale / indication of length ✓ labels (to explain the details shown) ✓ (Illustration in) colour ✓	2	**Apply list rule**
	(c)	**(i)**	binomial nomenclature/name ✓ identifies/includes genus and species ✓	2	**ALLOW** reference to correct genus **and** species
		(ii)	what it feeds on ✓ time of year seen ✓	2	**Apply list rule**

		(iii)	Any **three** from: ✓✓✓ length (to which it grows) if it moults colour changes (with age) time of year seen length of hairs colour of hairs at tip	3	**Apply list rule** **ALLOW** size
	(d)		decrease/change in population, due to change in environment ✓ e.g. climate change/light pollution/loss of habitat / **AVP** ✓	2	
			Total	**15**	

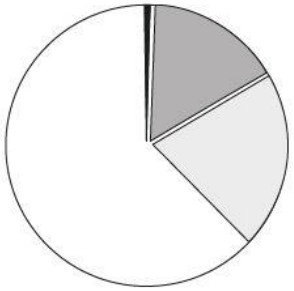
Question			Answer	Marks	Guidance
3	(a)	(i)	time decreases up to 35 °C ✓ time increases above 35 °C ✓ reference to breakdown (of starch) ✓	3	
		(ii)	the reaction/experiment is fastest at 35°C / enzyme most active at 35°C ✓ up to 35°C the rate of reaction increases due to more frequent collisions ✓ above 35°C, the enzyme is denatured so cannot break down starch ✓	3	**Apply list rule** **ALLOW** starch present for shortest time at 35°C
	(b)	(i)	idea that the results only suggest a range for the optimum temperature / results are not exact/accurate ✓ optimum temperature could be anywhere between 31and 39^{o}C ✓	2	
		(ii)	between 30 - 40^{o}C ✓ take samples more often (eg every 30s) ✓ repeat with smaller temperature differences (eg 32,34,36 and 38^{o}C) / more samples/temperatures near 35^{o}C ✓	3	
	(c)	(i)	axis labels ✓	1	**ALLOW** temperature and time **ALLOW** axes correctly labelled temperature and time labelled on Fig **IGNORE** “titles”

Question			Answer	Marks	Guidance
		(ii)	data is continuous / bar graph for discontinuous data	1	**IGNORE** numerical
		(iii)	error/range bars / indication of uncertainty ✓ line of best fit ✓ indication of outliers ✓	3	**Apply list rule**
			Total	**16**	

<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>Volume of sodium thiosulfate / cm^3</th><th>Volume of water / cm^3</th><th>% concentration of sodium thiosulfate</th><th>Time taken for the cross to disappear / s</th><th>1/time / s^{-1}</th></tr>
<tr><td>10</td><td>40</td><td>20</td><td>164</td><td>0.0061</td></tr>
<tr><td>20</td><td>30</td><td>40</td><td>85</td><td>0.012</td></tr>
<tr><td>30</td><td>20</td><td>60</td><td>56</td><td>0.018</td></tr>
<tr><td>40</td><td>10</td><td>80</td><td>42</td><td>0.024</td></tr>
</table>
✓
all correct % concentration✓
all correct 1/time ✓
all 1/time values to 2 sf ✓</td><td>3</td><td>ALLOW any number of sf correctly rounded
ALLOW any incorrect values to 2 sf</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>line starts at origin and is a straight line ✓
even distribution of points above and below line ✓</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>vertical line from 70% intercepts drawn line ✓
1/t = 0.027 ✓
t = 37 s ✓</td><td>3</td><td>ECF from (b)(i)
ECF from MP2 for line not drawn from 70%
ALLOW correct value for drawn line
ALLOW correct value for drawn line</td></tr>
</table>

	(c)	**(i)**	**Table 4.1:** when concentration increases eg from 20% to 40% rate increases from 0.006 to 0.012 ✓ **Fig 4.1:** graph is a straight line through 0,0 ✓	2	
		(ii)	**Table 4.1:** state a value of 1/t at any concentration of thiosulfate eg 1/time at 40% is 0.012 ✓ **Fig 4.1:** state the value of 1/time at the same concentration of thiosulfate eg rate at 40% is 0.014 ✓ Comparison of the two values eg 0.014 > 0.012 ✓	3	
	(d)		Any **four** from: ✓✓✓✓ name of acid (actual) concentration of thiosulfate concentration of acid volume of conical flask temperature (of solutions) colour/size of cross	4	**Apply list rule** **ALLOW** size
			Total	**17**	

Question			Answer	Marks	Guidance
5	(a)		**[Level 3]** Candidate shows a high level of understanding of the data by giving a detailed descriptions about the cooling of iron. ***(5 – 6 marks)*** **[Level 2]** Candidate shows an understanding of the data by giving simple descriptions about the cooling of iron with some detailed descriptions. ***(3 – 4 marks)*** **[Level 1]** Candidate shows a basic understanding of the data by giving simple descriptions about the cooling of iron. ***(1 – 2 marks)*** **[Level 0]** Candidate includes **fewer than two** valid points. ***(0 marks)***	6	**Indicative valid points including:** **Simple description** • above 1540 °C iron is liquid/molten • below 1540 °C iron is solid • BCC between 1540 - 1400 °C • FCC/non-magnetic between 1400 - 910 °C • BCC/non-magnetic between 910 - 760 °C • BCC/magnetic below 760 °C **Detailed description** • melting point of pure iron is 1540 °C • temperature is constant at 1400 °C and 910 °C as atomic arrangement changes. • temperature is constant at 760 °C as iron changes from non-magnetic to magnetic. • magnetic property does not depend on atomic arrangement

	(b)	**(i)**	**carbon:** 133(.2)^{o} **and** **silicon:** 90^{o} ✓	1	
		(ii)	 radius drawn at 90^{o} to third segment ✓ correct labels for all five segments ✓	2	S < P < Mn < Si < C
			Total	**9**	

Question			Answer	Marks	Guidance
6	(a)	(i)	$MnO_4^-(aq) + \mathbf{8}H^+(aq) + \mathbf{5}e^- \rightarrow Mn^{2+}(aq) + \mathbf{4}H_2O(l)$ ✓	1	
		(ii)	reduced ✓ MnO_4^- has gained electrons ✓	2	I**GNORE** number of electrons if stated
		(iii)	colourless to pink/purple ✓	1	
	(b)	(i)	moles $KMnO_4$ = (12.2 x 0.02/1000) = 2.44×10^{-4} ✓	1	
		(ii)	moles H_2O_2 in 10 cm^3 = ($2.5 \times 2.44 \times 10^{-4}$) = 6.1×10^{-4} ✓	1	**ECF** from (b)(i)
		(iii)	concentration = ($6.1 \times 10^{-4} \times 100$) = 0.061 mol dm^{-3} ✓	1	**ECF** from (b)(ii)
		(iv)	dilution factor = (100/5) = 20 ✓ concentration in mouthwash = (0.061 x 20) = 1.22 mol dm^{-3} ✓	2	**ECF** from (b)(iii)
	(c)		Mr H_2O_2 = 34 ✓ moles in 100 cm^3 = (3/34) = 0.0882 ✓ concentration in mol dm^{-3} = (0.0882 x 100) = 0.882 ✓	3	**ECF** from MP1 **ALLOW** any number of sf correctly rounded **ECF** from MP2 **ALLOW** any number of sf correctly rounded

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>Precipitation ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>appearance of (permanent) red colour ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td><table><tr><td>Trial</td><td>1</td><td>2</td><td>3</td></tr><tr><td>17.95</td><td>17.80</td><td>17.60</td><td>17.80</td></tr></table>
all values correct to 2 dp ✓

mean titre = 17.8(0) ✓</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td>FIRST CHECK ANSWER ON ANSWER LINE
If answer for % error = 0.56 award 2 marks

% error = $\frac{0.05 \times 2 \times 100}{17.8}$ ✓

= 0.56 (%) ✓</td><td>2</td><td>ALLOW 1 mark if x 2 is omitted (0.28%)

ALLOW any number of sf correctly rounded</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>18</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
7	(a)	(i)	**Fig 7.1** **Audience:** public✓ **Justification:** published in a newspaper/website which is readily available to read / idea of use of simple language/visuals to get the readers' attention. ✓ **Fig 7.2**: **Audience:** peers / scientific community ✓ **Justification:** published in a specialist journal / covers detailed methods and explanations. ✓	4	**DO NOT ALLOW** peers, scientific community **DO NOT ALLOW** public
		(ii)	idea of promoting wider understanding of science within the population ✓	1	
	(b)	(i)	idea of having more confidence in the findings because it has been checked independently ✓	1	
		(ii)	draft publication sent to an independent expert / **AW** ✓ independent expert makes a judgment on the work / **AW** ✓ independent expert reports back so the editor can decide if the work is to be published / **AW** ✓	3	
	(c)	(i)	9 (months) ✓	1	**ALLOW** 10 (months)
		(ii)	6 ✓	1	
			Total	**11**	

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