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 January 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. 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 any way 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
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

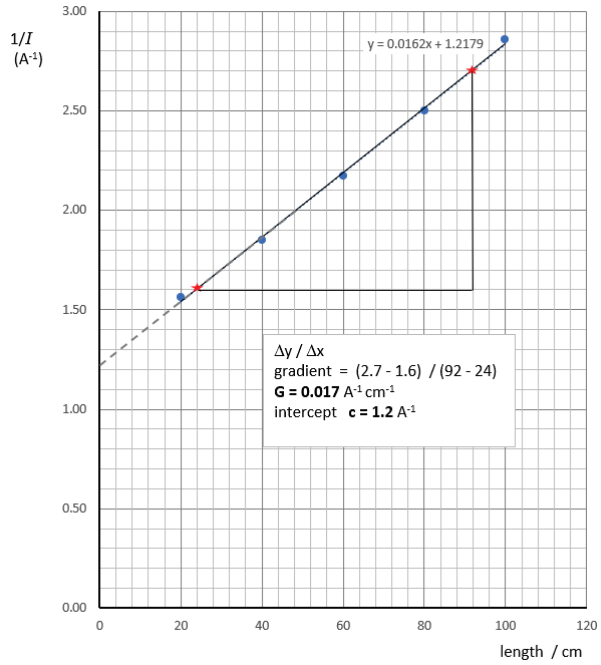
10. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

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)	even-pinnate has two pinnae at tip / an even number of pinnae ✓	1	**ORA** for odd-pinnate
		(ii)	pinnate has pinnae on the main stem / **ORA** ✓ pinnate has no side stems **/** bipinnate/tripinnate (main) stems divide into separate stems ✓ bipinnate stems divide once and then have pinnae ✓ tripinnate stems divide twice and then have pinnae ✓ bipinnate/tripinnate pinna size decreases **/** pinnate pinna size is constant ✓	5	
	(b)	(i)	long **AND** wide/blunt/rounded nearer the tip **AND** tapering/narrow/thin at the base ✓	1	
		(ii)	both are wide/blunt/rounded at the tip **AND** tapering/narrow/thin at the base ✓	1	**ALLOW** have similar shape **DO NOT ALLOW** have same shape
		(iii)	Lanceolate are longer and thinner / **ORA** ✓	1	

Question			Answer	Marks	Guidance
	(c)	(i)	Any **two** from: ✓✓ *Dryopteris* is the genus *filix-mas* is the species binomial nomenclature	2	 **ALLOW** first name is the genus **ALLOW** second name is the species

Question			Answer	Marks	Guidance
		(ii)	Any **four** from: ✓✓✓✓ Idea of number of pinnae on each frond shape of pinnae shape of the blade length of the stipe length of the fronds colour (of the fronds) fern's habitat	4	
			Total	**15**	

Question			Answer	Marks	Guidance
2	(a)		(I =) 0.64 ✓ (1/ I =) 1.6 ✓ both values to 2 sf✓	3	 **ALLOW** any two values to 2 sf
	(b)		axes in correct orientation and labelled with units ✓ suitable scale ✓ all points plotted to ± 1/2 a small square tolerance ✓ straight line of best fit with an even distribution of points above and below the line ✓ best fit line extended to intercept y-axis ✓	5	1/I (A^{-1}) on y-axis, L (cm) on x-axis **DO NOT ALLOW** awkward scales e.g. 3, 7, 15 **DO NOT ALLOW** kinks, curves, discontinuities, feathering 

Question			Answer	Marks	Guidance
	(c)	(i)	points from a large triangle at least half the length of the drawn line apart ✓ x,y coordinates of both points ✓ coordinates substituted into Δy/Δx ✓ G = 0.016 A^{-1} cm^{-1} ✓	4	 **ALLOW** x,y coordinates stated in Δy/Δx **ALLOW** calculated Δy and Δx **ALLOW** G = 0.015 - 0.017 A^{-1} cm^{-1}
		(ii)	1.3 (value) **AND** A^{-1} (units) ✓	1	**ALLOW** correct intercept for straight line drawn
	(d)	(i)	substitution e.g. Rw = (500 x 0.016) ÷ 1.3 ✓ = 6.2 (Ω) ✓	2	**ECF** for G and c from **(c)(i)** and **(c)(ii)**
		(ii)	% error = ((Rw – 8) x 100 /8) = 22.5 (%) (based on Rw = 6.2) ✓ a comment on the accuracy based on the calculation **AND** a suitable criterion. ✓	2	**ECF** for Rw from **(d)(i)** **ALLOW** e.g. the % difference is less/more than 5% so is/is not accurate **ALLOW** any criterion up to 20%
	(e)		Any **two** from: ✓✓ as *L* is decreased, *V* increases / **ORA** the increase in *V* gets larger (for every 10 cm step) negative correlation	2	

Question			Answer	Marks	Guidance
	(f)	(i)	measure the voltage across the battery ✓	1	
		(ii)	(the total voltage stays the same because) as voltage increases across the resistor ✓ the voltage across the wire decreases ✓	2	
			Total	**22**	

Question			Answer	Marks	Guidance
3	(a)	(i)	(56.40 – 50.32) = 6.08 g ✓	1	**ALLOW** correct rounding
		(ii)	idea that 2 moles $FeSO_4$ gives 1 mole Fe_2O_3 and so 2 × 152 g $FeSO_4$ gives 160 g Fe_2O_3 ✓	1	
		(iii)	304 g $FeSO_4$ gives 160g Fe_2O_3 6.08 g $FeSO_4$ gives $\frac{160 \times 6.08}{304}$ g Fe_2O_3 = 3.2(0) (g) Fe_2O_3 ✓	1	
		(iv)	(52.54 – 50.32) = 2.22 g ✓	1	**ALLOW** correct rounding
		(v)	$\frac{100 \times 2.22}{3.20}$ = 69.375 (%) ✓	1	**ECF** for mass of product obtained and mass of product expected from **a(iv)** and **(a)(iii)** **ALLOW** correct rounding
		(vi)	heat (again) to constant mass ✓	1	
		(vii)	accuracy – D ✓ measurement error – E ✓ precision – C ✓ random error – B ✓ systematic error – A ✓	5	

Question			Answer	Marks	Guidance
	(b)	(i)	20 s ✓ 0 - 200 s ✓	2	**ALLOW max 1 mark if both answers correct but without units**
		(ii)	the reaction was still producing gas ✓	1	**ALLOW** the reaction had not finished
		(iii)	Any **three** from: ✓✓✓ mass of magnesium carbonate concentration of (hydrochloric) acid volume of (hydrochloric) acid temperature (of hydrochloric acid) how the CO_2 is collected **AND** how its volume is measured	3	
		(iv)	(Jamila) will get the same/similar results ✓	1	
		(v)	rate decreases (with time) ✓ 0 – 20 s = ((24 – 0) ÷ 20) = 1.2 (cm^3 s^{-1}) ✓ 0 – 200 s = ((95 – 93) ÷ 20) = 0.1 (cm^3 s^{-1}) ✓	3	
			Total	**21**	

Question			Answer	Marks	Guidance
4	(a)	(i)	histogram ✓ it shows the distribution of numerical/continuous data / each bar represents a range of values/masses ✓	2	**DO NOT ALLOW MP2 if MP1 incorrect** **DO NOT ALLOW** references to discontinuous/categorical data
		(ii)	the filling machine does not deliver exactly the correct/ amount of cocoa each time (because it is inaccurate/imprecise) / **AW** ✓	1	**ALLOW** unqualified references to the precision/accuracy of the machine
		(iii)	number of samples is the sum of all the bar heights (1+2+3+6+8+ 10+11+13+10+9+7+4+3+2+1+1) ✓ = 91 ✓	2	
	(b)	(i)	250 (g) ± 0.631 (g) ✓	1	**ALLOW** correct rounding
		(ii)	249.4 (g) ✓ 250.6 (g) ✓	2	**ECF** for 95% confidence limits from **(b)(i)**
		(iii)	if too low - buyers will complain / loss of customers / legal consequences ✓ if too high - profits decrease / risk of overspill ✓	2	
		(iv)	the mean (mass) range/95% confidence interval is greater than ± 0.5 ✓	1	
		(v)	s = ((0.5 ×√91) ÷ 1.96) = 2.43 ✓	1	**ALLOW** correct rounding
		(vi)	filling machine needs to be more consistent / use a more accurate/dispenser / **AW** ✓	1	**IGNORE** unqualified references to use of a different/better filling machine
			Total	**13**	

Question			Answer	Marks	Guidance
5	(a)		complexometric ✓	1	
	(b)		<table><tr><td>Blue to red</td><td></td></tr><tr><td>Colourless to red</td><td></td></tr><tr><td>Red to blue</td><td>✓</td></tr><tr><td>Red to colourless</td><td></td></tr></table>	1	
	(c)		two titres within 0.1 (cm^3) ✓	1	
	(d)		Any **two** from: ✓✓ add EDTA drop-wise (near the end point) (ensure complete mixing by) swirling the flask / using a magnetic stirrer use a small amount of deionised water to wash the titrant into the mixture	2	
	(e)	(i)	n(EDTA) = ((0.05 / 1000) x 27.05) = 1.3525×10^{-3} (mol) ✓	1	**ALLOW** correct rounding
		(ii)	n(Ca^{2+}) = 1.3525×10^{-3} (mol) ✓	1	**ECF** for n(EDTA) calculated in **e(i)**

Question			Answer	Marks	Guidance
		(iii)	$n(CaCO_3) = (1.35(25) \times 10^{-3} \times (250/10))$ $= 0.0338125$ (mol) ✓	1	**ECF** for $n(Ca^{2+})$ calculated in **e(ii)** **ALLOW** correct rounding
		(iv)	$mass(CaCO_3) = (0.0338125 \times 100.1)$ $= 3.38\ldots..$ (g) ✓	1	**ECF** for $n(CaCO_3)$ calculated in **e(iii)** **ALLOW** correct rounding
		(v)	$\%\ CaCO_3 = \frac{(3.38....) \times 100}{5.18}$ ✓ $= 65.3$ (%) ✓	2	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 65.3 (%) award 2 marks** **ECF** for $mass(CaCO_3)$ calculated in **e(iv)**
	(f)		data does show that the soft-shelled egg had less calcium than the hard-shelled egg ✓ only one soft-shelled egg was tested ✓ to have more confidence in the result it must be reproducible with other soft-shelled eggs ✓	3	**ORA** based on answer for **(e)(v)**
			Total	**14**	

Question			Answer	Marks	Guidance
6	(a)	(i)	data collected by somebody else ✓	1	
		(ii)	the reference/source is cited ✓	1	
		(iii)	data is produced by a research group working in an academic institution ✓	1	
	(b)	(i)	Any **two** from: ✓✓ journalists politicians / policy makers /governments scientific community / researchers / academics milk producers / (agriculture) industry / farmers environmentalists / pressure groups	2	**IGNORE** references to general public, students/schools **ALLOW** relevant named pressure groups
		(ii)	to understand the environmental impact of milk production ✓ to decide which milk to drink / **AW** ✓ to reduce their environmental footprint / **AW** ✓	2	

Question			Answer	Marks	Guidance
	(c)		Any **two** from: ✓✓ data makes dairy milk look a lot more environmentally friendly than Fig. 6.1 produced by an organisation that has a vested interest in dairy farming / **AW** internet/online references listed are not necessarily peer-assessed	2	**IGNORE** unqualified references to bias **IGNORE** unqualified references to dairy industry

Question	Answer	Marks	Guidance
(d)*	**[Level 3]** Candidate shows a high level of understanding by giving a good explanation **AND** comparison considering the quality of the reporting in terms of clarity **AND** conciseness **AND** appropriateness. ***(5 – 6 marks)*** **[Level 2]** Candidate shows a reasonable level understanding by giving a workable explanation **AND** comparison considering the quality of the reporting in terms of clarity **AND** conciseness, **OR** clarity **AND** appropriateness, **OR** conciseness **AND** appropriateness. ***(3 – 4 marks)*** **[Level 1]** Candidate shows a basic understanding by giving a brief explanation **AND** comparison considering the quality of the reporting in terms of clarity **OR** conciseness **OR** appropriateness. ***(1 – 2 marks)*** **[Level 0]** Candidate response includes **fewer than two** valid points. ***(0 marks)*** ✓✓✓✓✓✓	6	**Indicative points may include:** **Clarity** ***Fig. 6.1*** presented very clearly Values at the ends of the bars enable the actual values to be determined Clear to which year the data is referring ***Fig. 6.2*** presented not so clearly The horizontal axis has no units and it is unclear what the numbers refer to Difficult to determine the exact values of each bar Not clear to which year(s) the data is referring **Conciseness** ***Fig. 6.1*** a wide range of data displayed in one page ***Fig. 6.2*** smaller amount of data displayed in the same space **Appropriateness** ***Fig. 6.1*** appropriate for scientific and wider audience. Includes eutrophication which is an important environmental issue of interest to scientists Quotes values per litre of milk which is a standard volume used by scientists ***Fig. 6.2*** appropriate to encourage consumers that dairy farming has less of an environmental impact Does not include eutrophication Quotes emissions rather than greenhouse gas emissions which is less scientific Quotes values per 200 ml (one glass) which is appropriate for consumers because it is easier to visualise
	Total	**15**	

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