

## **Cambridge Technicals**

## **Applied Science**

### **Unit 23: Scientific research techniques**

Level 3 Cambridge Technical in Applied Science  
**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.

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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
  - b. 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
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument

Question			Answer	Marks	Guidance
1			A ✓ D ✓ B ✓	3	
			Total	3	

Question			Answer	Marks	Guidance
2	(a)	(i)	Any <b>three</b> from: <ul style="list-style-type: none"> <li>• number of AMY1 genes / levels of (salivary) amylase</li> <li>• amount of starch, consumed/in diet</li> <li>• selective pressure</li> <li>• availability of starch in the environment /habitat</li> <li>• water availability (in environment)</li> <li>• agricultural vs animal herders</li> </ul> <div style="text-align: right;">✓✓✓</div>	3	<b>ALLOW</b> high starch <b>IGNORE</b> diet unqualified  <b>IGNORE</b> behavioural differences unqualified / where they live
		(ii)	Any <b>two</b> from: <ul style="list-style-type: none"> <li>• there is/is not, a link between dietary starch levels and the number of AMY1 gene copies</li> <li>• there is/is not, a link between dietary starch levels and the amount of enzyme/amylase/protein, produced/present</li> <li>• there is/is not a link between the number of AMY1 genes and the amount of, enzyme/amylase, produced/present</li> <li>• the number of AMY1 genes is correlated with, selective pressure /type of, environment / habitat</li> </ul> <div style="text-align: right;">✓✓</div>	2	e.g. where there is more dietary starch, there are more AMY1 gene copies  <b>ALLOW</b> is there ...



Question			Answer	Marks	Guidance
	(b)		Any <b>two</b> from: <ul style="list-style-type: none"> <li>• <b>large</b> sample/wide range needed</li> <li>• a population is a large number of people / not possible to test a whole population</li> <li>• (large) sample can represent the population</li> <li>• (large sample) increases reliability/validity of data ✓✓</li> </ul>	2	<b>ALLOW</b> idea that small sample size detrimental  <b>IGNORE</b> accuracy <b>ALLOW</b> large sample increases reliability of data = 2 marks <b>ALLOW</b> ORA anomalous results have more impact/more difficult to detect in small sample size - 2 marks
			<b>Total</b>	<b>7</b>	

Question			Answer	Marks	Guidance
3	(a)		Any <b>three</b> from: <i>Tap water:</i>  contains (named) impurities/contaminants ✓  source of error ✓  does not have a unique density / will have a different density ✓  (so that the results) not reproducible / inaccurate / unreliable ✓	3	<b>ALLOW</b> ORA for distilled water throughout  <b>IGNORE</b> dirty / microbes / pathogens  <b>ALLOW</b> weight / mass for density <b>ALLOW</b> density of distilled water is known  <b>IGNORE</b> inconclusive
	(b)	(i)	precision / number of decimal places / readability ✓	1	<b>ALLOW</b> resolution, weight range
		(ii)	to give the correct / valid / accurate reading/ to remove systematic error ✓	1	<b>IGNORE</b> precise
	(c)	(i)	Any <b>two</b> from: <ul style="list-style-type: none"> <li>standard deviation</li> <li>variance</li> <li>percentage difference</li> <li>percentage error</li> </ul> ✓✓	2	
		(ii)	compare it to, the true (density) value /0.998203 ✓	1	<b>ALLOW</b> AW for true e.g. theoretical / given / known / actual
	(d)		Any <b>two</b> from: <ul style="list-style-type: none"> <li>reference to changes in the water temperature</li> <li>reference to change in (room) pressure</li> <li>reference to change in volume of water in beaker</li> <li>reference to evaporation</li> <li>reference to the angle of the pipette</li> <li>reference to pain / fatigue in the hand</li> </ul>	2	

Question			Answer	Marks	Guidance
			<ul style="list-style-type: none"><li>reference to small amounts of water lost from pipette (due to slow working)</li></ul> <p style="text-align: right;">✓✓</p>		
			<b>Total</b>	<b>10</b>	

Question			Answer	Marks	Guidance
4	(a)	(i)	Any <b>two</b> from: targeted/precision gene editing ✓ (using) CRISPR/Cas9 ✓ at lemon white gene/lw1 ✓	2	<b>IGNORE</b> gene editing unqualified
		(ii)	(miscanthus) leaves, were not green/changed to, pale green/yellow striped or white ✓  prior studies using maize gave the same result ✓	2	
	(b)	(i)	Any <b>three</b> from:  since 2018 - area of miscanthus increased 1000 ha /from 7000 - 8000 ha  since 2018 - area of short coppice decreased 1000 ha/from 3000 to 2000 ha  Since, 2018/ 2019 total area for all bioenergy crops increased 25 000 ha/from 96000 to 121000 ha  since 2019 – area of wheat increased 18 000 ha/from 11000 to 29000 ha  between 2016 and 2019 - area of wheat decreased 66000 to 11000ha/ 55000ha  ✓ ✓ ✓	3	<b>IGNORE</b> no change  <b>ALLOW</b> any other correctly described trend with year(s) and size, from Table or text  <b>ALLOW</b> correct areas given without units/magnitude, e.g. 1 instead of 1000ha  1 correct trend with no size = no mark 2 correct trends with no size = 1 mark 3 correct trends with no size = 2 marks

Question			Answer	Marks	Guidance
		(ii)	any correct reference to percentages ✓	1	
		(iii)	(2015) 7/93 <b>or</b> (2016)7/132 <b>or</b> 7.5% <b>or</b> 5.3% ✓ 7.5% <b>and</b> 5.3% ✓	2	
		(iv)	allows comparison / actual areas, same/7ha, but percentages, different/7.5% and 5.3% ✓ <b>OR</b> idead of ratios of areas e.g. comparison with total arable area: e.g. bioenergy crops area is a small percentage/only 2.1% of <b>total arable</b> area ✓	1	
	(c)	(i)	Any <b>four</b> from: reference to miscanthus OR different (named) crop plant (for new research) ✓ (and) CRISPR/Cas9/same gene editing method ✓ identify a new / different gene to be introduced ✓ insert new gene ✓ reference named improvement e.g.novel bioproducts / carbon sequestration ✓	4	<b>IGNORE</b> gene editing unqualified

Question			Answer	Marks	Guidance
		(ii)	Any <b>two</b> from:  time to identify and insert (useful) genes time to produce large quantities of seeds / plants time to grow crop / plants still living (from sowing to harvest) time to analyse the properties of the crops time to compare with other GM modified miscanthus time for peer review  ✓ ✓	2	
		(iii)	COSHH / Control of substances hazardous to health ✓	1	<b>ALLOW</b> Genetic Technology (Precision breeding) Act 2023
		(iv)	Any <b>two</b> from: • risk of toxicity (to insects / grazing animals) • risk of gene transfer to other grass species • risk of creating, 'superweeds' /invasive, plants that outcompete native species AW • risk to soil  ✓ ✓	2	<b>IGNORE</b> safety of environment unqualified
			<b>Total</b>	<b>20</b>	

Question		Answer	Marks	Guidance
5	Report	<p><b>Levels of Response</b></p> <p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>Provides a detailed justification of the focus of the research</li> <li>Detailed information and evidence generated which is clearly relevant and applicable to the area of focus</li> <li>Information is interpreted and used effectively, justifying the findings reported</li> <li>Detailed evaluation of methods and sources used and evidence generated</li> <li>Detailed conclusions based on the sources used and evidence generated</li> <li>Clear consideration of the validity, reliability and generalizability of the research undertaken</li> <li>Implications of the findings are well thought through and clearly presented.</li> <li>Provides clear proposals of possible areas for further research which are relevant to the focus/theme and are feasible.</li> <li>Well-structured and clear reporting with correct terminology used</li> <li>Many points are developed</li> </ul> <p style="text-align: right;"><b>[16 – 20 marks]</b></p>	20	<p><b>Valid points</b></p> <ul style="list-style-type: none"> <li><b>Explanation</b> of area of focus <ul style="list-style-type: none"> <li>is clear and concise</li> <li>may be expressed as question(s) to explore</li> <li>related to the pre-released material</li> <li>may be oppositional</li> <li>may be a different slant</li> </ul> </li> <li><b>Justification</b> <ul style="list-style-type: none"> <li>in relation to the pre-release</li> <li>in relation to own personal interest in the theme</li> <li>in relation to another specific source</li> <li>in relation to current/contemporary issues linked to the pre-release</li> </ul> </li> <li><b>Reporting</b> of findings taking into consideration: <ul style="list-style-type: none"> <li>appropriate use of information/data</li> <li>comparing and contrasting methods, results or findings</li> <li>relevance and appropriateness of findings from information gathered</li> </ul> </li> </ul>

Question		Answer	Marks	Guidance
		<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>Provides a sound justification of the focus of the research.</li> <li>Detailed information and evidence generated which is of some relevance to the area of focus</li> <li>Information is interpreted and used effectively at times</li> <li>Some evaluation of research conducted but may only focus on some of methods used, sources used and evidence generated</li> <li>Reasonable conclusions based on the sources used and evidence generated</li> <li>Some consideration of the validity, reliability and generalizability of the research undertaken but may be more general than in relation to specific aspects such as methodology.</li> <li>Implications of the findings are provided but may be quite general in nature.</li> <li>Provides a reasonable proposal for possible areas for further research which has some</li> </ul>		<ul style="list-style-type: none"> <li>clear link and relevance to area of focus being researched o acknowledgement of sources</li> <li>avoidance of plagiarism</li> <li>consideration of any relevant ethical issues</li> </ul> <p>• <b>Evaluation</b> of research should aim to assess validity, reliability and generalizability related to the following:</p> <p>Method(s) chosen</p> <ul style="list-style-type: none"> <li>quantitative and/or qualitative</li> <li>primary and/or secondary</li> <li>details of methods (e.g. survey, questionnaire, interview, literature review, etc...)</li> <li>participants (where applicable)</li> <li>ethical considerations</li> </ul> <p>Evidence generated</p> <ul style="list-style-type: none"> <li>notes and records</li> <li>types of data</li> <li>selecting/collecting/interpreting relevant data, graphs and tables</li> <li>analysis of results (e.g. compilation of data, results and findings, use of methods of analysis valid for data collected,</li> </ul>



Question	Answer	Marks	Guidance
	<p>relevance to the focus/theme and are feasible.</p> <ul style="list-style-type: none"> <li>Reasonably clear reporting of findings, using correct terminology</li> <li>Some points are developed</li> </ul> <p style="text-align: right;"><b>[9 – 15 marks]</b></p> <p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>Provides a basic description of the focus of the research</li> <li>Basic information and evidence generated which is not always relevant to the area of focus</li> <li>Findings are basic; information gathered is used with limited effectiveness</li> <li>Some description of methods used, sources used and evidence generated</li> <li>Limited consideration of the impact on the validity and reliability but may be more general than in relation to specific aspects such as methodology</li> <li>Some more developed points made</li> <li>Some basic conclusions drawn but may not always clearly relate to the evidence generated</li> <li>Limited consideration of the validity, reliability and generalizability of the research undertaken</li> </ul>		<p>including triangulation, use of percentages, use of statistical averages)</p> <ul style="list-style-type: none"> <li>appropriate referencing and acknowledgement of sources</li> <li>advanced search tools and refining search data</li> </ul> <p>Source material(s) used</p> <ul style="list-style-type: none"> <li>Identifying secondary sources: <ul style="list-style-type: none"> <li>Library search carried out</li> <li>Lists the key terms used</li> </ul> </li> <li>Selecting secondary sources <ul style="list-style-type: none"> <li>Appropriate</li> <li>Relevant</li> <li>Complimentary</li> <li>Trustworthy</li> <li>identifies possible bias</li> <li>strengths or limitations of research methods used</li> <li>ethics of the research</li> <li>representativeness of samples</li> </ul> </li> </ul> <p>• <b>Conclusions</b> will bring together your key findings, your evaluation and relate them back to your focus and should:</p>

Question	Answer	Marks	Guidance
	<ul style="list-style-type: none"> <li>Some implications of the findings may be suggested</li> <li>Proposes some possible areas for further research which show some relevance to the focus/theme but may be unrealistic</li> <li>Reporting is limited in terms of style, structure and use of terminology (list-like answers should be placed in this level)</li> <li>Very few, if any, developed points</li> </ul> <p style="text-align: right;"><b>[1 - 8 marks]</b></p> <p><b>Level 0</b></p> <p>Candidate includes fewer than two valid points.</p> <p style="text-align: right;"><b>[0 marks]</b></p>		<ul style="list-style-type: none"> <li>be in relation to the area of focus/research question/hypothesis</li> <li>make judgements on evidence/findings</li> <li>use the information gathered</li> <li>consider the validity, reliability and generalizability of the research conducted</li> <li>Answer may assess implications of findings for: <ul style="list-style-type: none"> <li>Individuals</li> <li>groups</li> <li>practitioners/professionals</li> <li>practice</li> <li>private, public, voluntary sectors</li> <li>areas of policy</li> <li>those who carry out research</li> <li>particular areas of sport science and sport studies</li> </ul> </li> <li>Proposals for relevant areas for further research may include: <ul style="list-style-type: none"> <li>questions that have not been answered</li> <li>areas where further evidence is needed</li> <li>alternative research methods that could be used</li> </ul> </li> </ul>

Question		Answer	Marks	Guidance
				<ul style="list-style-type: none"> <li>Proposals should:               <ul style="list-style-type: none"> <li>be plausible and realistic</li> <li>build on current knowledge</li> <li>relate to the focus and/or theme</li> <li>be linked to limitations identified</li> </ul> </li> </ul>
		<b>Total</b>	<b>20</b>	

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