OCR
Oxford Cambridge and RSA

Cambridge Technicals
Applied Science

Unit 23: Scientific research techniques

Level 3 Cambridge Technical in Applied Science
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. 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 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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>Hypotheses</th><th>Tick</th></tr>
<tr><td>Myopia is more prevalent in people leaving FTE aged 21 than in the general population</td><td></td></tr>
<tr><td>There is a link between myopia and the number of years that students use computer screens during FTE</td><td></td></tr>
<tr><td>Myopia increases as the age of completing FTE increases</td><td>✓</td></tr>
<tr><td>To avoid visual disabilities the optimum age to leave FTE is 16</td><td></td></tr>
<tr><td>There is little change in the incidence of myopia between subjects who completed FTE when aged between 18 and 20</td><td>✓</td></tr>
</table>
</td><td>2</td><td></td></tr>
<tr><td>1</td><td>(a)</td><td>(ii)</td><td>Any three from:

• evidence that the same pattern, is reproducible/ occurs in, other countries/different populations ✓
• evidence that the changes (in refractive error) are not due to the effect of genes ✓
• evidence that the changes are not due to other lifestyle differences associated with full-time education / university / college / school ✓
• an explanation of how studying causes short-sightedness /what causes myopia✓
• evidence that the large change between 15 and 18 is due to the same type of study ✓
• evidence that the small change between 18 and 20 is due to different forms of study ✓</td><td>3</td><td>Allow correct sugestions made as questions

e.g never attended FTE

e.g. linked to computer/screen use</td></tr>
</table>

Question			Answer	Marks	Guidance
1	(b)		**Between 17 and 19 year olds** the error bars/ranges, do not overlap /large difference (between them) / the two sets of data are likely to be significantly different ✓ **Between 18 and 19 year olds** the error bars/ranges, overlap/no difference (between them) / the two sets of data are not likely to be significantly different ✓	2	**Allow** 1 mark max for correct calculation of differences between error bars for **both** comparisons without clear explanation OWTTE OWTTE
			Total	**7**	

Question			Answer	Marks	Guidance
2			**B** ✓ **D** ✓ **D** ✓ **F** ✓ **C, E or F**✓ **G** ✓ **A** ✓	7	
			Total	**7**	

Question			Answer	Marks	Guidance
3	(a)	(i)	**complexity** technique 1 (T1) – less complex / simple to use / just dipped in water ✓ **reliability** T1 – (more reliable because) only need to take readout / not judged by eye ✓ **OR** – T2 – (less reliable because) depends on, judgement /reading by eye / correct measuring of reagent/sample ✓ **repeatability** T1 – keep taking readings / repeat readings should be same in each location ✓ **OR** T2 – re-using/cleaning bottles / needs supply of chemicals ✓	3	ORA for T2
3	(a)	(ii)	T1 – risk of falling/slipping / disease/illness from water / skin irritation from buffer ✓ T2 – risk of, spillage/skin contact/irritation, from fumes/reagents / disease/illness from water/ risk of falling/slipping / cuts from (broken) glass ✓	2	**Allow** 'drowning' for either technique
3	(b)		Any **one** from: signature to declare that it has been read ✓ tick-boxes to show the safe procedure is followed ✓ completing a training package/meeting✓ (post-training) test/questionnaire ✓	1	**Allow** explaining to them
			Total	**6**	

Question			Answer	Marks	Guidance
4	(a)		Any **three** from: • support/haven/feeding ground, for other marine life / (bio)diversity ✓ • important for (commercial) fisheries ✓ • under threat from, trawling/harvesting/overfishing/human activity✓ • Multiple causes of kelp forest decline ✓ AVP e.g. kelp affects/affected by, climate change ✓	3	OWTTE **Ignore** under threat unqualified **Ignore** fishing
4	(b)		Any **two** from: (bylaw) to prevent trawling ✓ (method) to measure/monitor the changes to/amount/distribution, of kelp ✓ to show whether the law is working / if bylaw has encouraged growth ✓	2	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(c)</td><td></td><td>
<table>
<tr><td>backscatter information is a crucial component of the predictive model</td><td></td></tr>
<tr><td>harvesting of wild kelp is increasing</td><td>✓</td></tr>
<tr><td>it is difficult to access kelp in the shallow, rocky sublittoral fringe</td><td></td></tr>
<tr><td>kelp are critical to ecosystem functioning and commercial fisheries.</td><td>✓</td></tr>
<tr><td>monitoring is needed to ensure sustainability</td><td>✓</td></tr>
<tr><td>remote sensing technologies can now be used to monitor the kelp</td><td></td></tr>
<tr><td>the sublittoral fringe is shallow and rocky</td><td></td></tr>
</table>
</td><td>3</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
4	(d)		A – kelp, sequesters/removes/locks up, carbon to, fight/reduce climate change ✓ B – kelp is threatened by climate change ✓	2	
4	(e)		Any **three** from: • data to show agreement/comparison with other mapping methods ✓ • data to show the difference in acoustic data with/without presence of kelp ✓ • reference to other research that confirms the observation ✓ • evidence of peer review/evidence that other experts have confirmed the finding✓ • an explanation of how the method works ✓	3	(e.g. verification from ground-truthing)
4	(f)	(i)	line transect ✓	1	
4	(f)	(ii)	Any **two** from: low cost ✓ rapid / ease of covering large areas ✓ no difficulty accessing shallow/rocky areas ✓	2	**Ignore** easy unqualified
4	(g)		the data are **not reproducible** because different methods (used) produce different results ✓	1	**ALLOW** not reproducible because'the backscattering data from different vessels/echo sounders/instruments is not harmonised' / because backscatter data absent

Question			Answer	Marks	Guidance
4	(h)		Any **three** from: use the data in, graphical/mathematical, techniques ✓ evaluate it for, uncertainty/error/precision/repeatability ✓ compare it with any new measurements / measure changes (over time) ✓ assess/explain any conflicting evidence ✓	3	
			Total	**20**	

Question		Answer	Marks	Guidance
5	Report	**Levels of Response** **Level 3** • Provides a detailed justification of the focus of the research • Detailed information and evidence generated which is clearly relevant and applicable to the area of focus • Information is interpreted and used effectively, justifying the findings reported • Detailed evaluation of methods and sources used and evidence generated • Detailed conclusions based on the sources used and evidence generated • Clear consideration of the validity, reliability and • generalizability of the research undertaken • Implications of the findings are well thought through and clearly presented. • Provides clear proposals of possible areas for further research which are relevant to the focus/theme and are feasible. • Well-structured and clear reporting with correct terminology used • Many points are developed **[16 – 20 marks]** **Level 2** • Provides a sound justification of the focus of the research. • Detailed information and evidence generated which is of some relevance to the area of focus • Information is interpreted and used effectively at times	20	**Valid points** • **Explanation** of area of focus o is clear and concise o may be expressed as question(s) to explore o related to the pre-released material o may be oppositional o may be a different slant • **Justification** o in relation to the pre-release o in relation to own personal interest in the theme o in relation to another specific source o in relation to current/contemporary issues linked to the pre-release • **Reporting** of findings taking into consideration: o appropriate use of information/data o comparing and contrasting methods, results or findings o relevance and appropriateness of findings from information gathered o clear link and relevance to area of focus being researched o acknowledgement of sources o avoidance of plagiarism o consideration of any relevant ethical issues • **Evaluation** of research should aim to assess validity, reliability and generalizability related to the following: Method(s) chosen o quantitative and/or qualitative o primary and/or secondary o details of methods (e.g. survey, questionnaire, interview, literature review, etc…)

Question		Answer	Marks	Guidance
		• Some evaluation of research conducted but may only focus on some of methods used, sources used and evidence generated • Reasonable conclusions based on the sources used and evidence generated • 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. • Implications of the findings are provided but may be quite general in nature. • Provides a reasonable proposal for possible areas for further research which has some relevance to the focus/theme and are feasible. • Reasonably clear reporting of findings, using correct terminology • Some points are developed **[9 – 15 marks]** **Level 1** • Provides a basic description of the focus of the research • Basic information and evidence generated which is not always relevant to the area of focus • Findings are basic; information gathered is used with limited effectiveness • Some description of methods used, sources used and evidence generated • Limited consideration of the impact on the validity and reliability but may be more general than in relation to specific aspects such as methodology • Some more developed points made • Some basic conclusions drawn but may not always clearly relate to the evidence generated		○ participants (where applicable) ○ ethical considerations Evidence generated ○ notes and records ○ types of data ○ selecting/collecting/interpreting relevant data, graphs and tables ○ analysis of results (e.g. compilation of data, results and findings, use of methods of analysis valid for data collected, including triangulation, use of percentages, use of statistical averages) ○ appropriate referencing and acknowledgement of sources ○ advanced search tools and refining search data Source material(s) used ○ Identifying secondary sources: ▪ Library search carried out ▪ Lists the key terms used ○ Selecting secondary sources ▪ Appropriate ▪ Relevant ▪ Complimentary ▪ Trustworthy ▪ identifies possible bias ▪ strengths or limitations of research methods used ▪ ethics of the research ▪ representativeness of samples

Question		Answer	Marks	Guidance
		• Limited consideration of the validity, reliability and generalizability of the research undertaken • Some implications of the findings may be suggested • Proposes some possible areas for further research which show some relevance to the focus/theme but may be unrealistic • Reporting is limited in terms of style, structure and use of terminology (list-like answers should be placed in this level) • Very few, if any, developed points **[1 - 8 marks]** **Level 0** Candidate includes fewer than two valid points. **[0 marks]**		• **Conclusions** will bring together your key findings, your evaluation and relate them back to your focus and should: o be in relation to the area of focus/research question/hypothesis o make judgements on evidence/findings o use the information gathered o consider the validity, reliability and generalizability of the research conducted • Answer may assess implications of findings for: o Individuals o groups o practitioners/professionals o practice o private, public, voluntary sectors o areas of policy o those who carry out research o particular areas of sport science and sport studies • Proposals for relevant areas for further research may include: o questions that have not been answered o areas where further evidence is needed o alternative research methods that could be used • Proposals should: o be plausible and realistic o build on current knowledge o relate to the focus and/or theme o be linked to limitations identified

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