



## Cambridge International AS & A Level

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**MARINE SCIENCE**

**9693/23**

Paper 2 AS Data Handling and Investigative Skills

**May/June 2023**

MARK SCHEME

Maximum Mark: 75

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

**PUBLISHED****Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**PUBLISHED****GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<p><u>'List rule' guidance</u></p> <p>For questions that require <i>n</i> responses (e.g. State <b>two</b> reasons ...):</p> <ul style="list-style-type: none"><li>• The response should be read as continuous prose, even when numbered answer spaces are provided.</li><li>• Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>.</li><li>• Incorrect responses should not be awarded credit but will still count towards <i>n</i>.</li><li>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should <b>not</b> be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.</li><li>• Non-contradictory responses after the first <i>n</i> responses may be ignored even if they include incorrect science.</li></ul>

**6** Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7** Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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This mark scheme will use the following abbreviations:

<b>;</b>	separates marking points
<b>/</b>	separates alternatives within a marking point
<b>()</b>	contents of brackets are not required but should be implied / the contents set the context of the answer
<b>R</b>	reject
<b>A</b>	accept (answers that are correctly cued by the question or guidance you have received)
<b>I</b>	ignore (mark as if this material was not present)
<b>AW</b>	alternative wording (where responses vary more than usual, accept other ways of expressing the same idea)
<b>AVP</b>	alternative valid point (where a greater than usual variety of responses is expected)
<b>ORA</b>	or reverse argument
<b><u>underline</u></b>	actual word underlined must be used by the candidate (grammatical variants excepted)
<b>MAX</b>	indicates the maximum number of marks that can be awarded
<b>+</b>	statements on both sides of the <b>+</b> are needed for that mark
<b>OR</b>	separates two different routes to a mark point and only one should be awarded
<b>ECF</b>	error carried forward (credit an operation from a previous incorrect response)

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	calcium ;	<b>1</b>
1(b)	clear outline ; suitable size ; in proportion ; detail ;	<b>4</b>
1(c)(i)	add together all shell lengths (for one / each shore) <b>AND</b> divide by 100 ;	<b>1</b>
1(c)(ii)	2.19 : 1 ;	<b>1</b>
1(c)(iii)	<i>any 4 of:</i> length : aperture ratio lower on exposed shore / <b>ORA</b> ; shell aperture is larger (relative to length) on exposed shore / <b>ORA</b> ; larger foot ; stronger attachment to rock ; increases, survival chance / ability to stay attached, with stronger wave action ; (mean) shell length greater on sheltered shore / <b>ORA</b> ; because dogwhelks have higher life expectancy so grow bigger ; feeding efficiency greater on sheltered shore ;	<b>4</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(d)	<p><i>any 3 of:</i></p> <p><i>(yes because...)</i></p> <p>more light-shelled dogwhelks with a higher paint fading score / <b>ORA</b> ;</p> <p>suggesting they spent more time exposed to the Sun / <b>ORA</b> ;</p> <p><i>(no because)</i></p> <p>peak numbers are very close together ;</p> <p>sample size of dark-shelled dogwhelks much smaller / less than half ;</p> <p>ref. to limited scope of investigation e.g. one area / small numbers / only ; 3 days ;</p> <p>other factor may affect fading of paint e.g. saltwater ;</p> <p>idea of, correlation not causation / a different factor may be involved ;</p>	<b>3</b>
1(e)	<p><i>any 1 of:</i></p> <p>taking care not to damage dogwhelks / other shore organisms ;</p> <p>taking care to, replace dogwhelks in same place / allow dogwhelks to reattach properly ;</p> <p>using a paint that does not harm the dogwhelks / environment ;</p>	<b>1</b>



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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)(i)	<p><i>any 5 of:</i></p> <p>(independent variable) description of changing distance of light source from beaker ;</p> <p>sensible suggested intervals for lamp e.g. every 10 cm ;</p> <p>(dependent variable) description of measuring <u>volume</u> of gas (in capillary tube) over a set time ;</p> <p>description of any two control variables (pH, temperature, quantity of aquatic plant, CO<sub>2</sub> availability) ; ;</p> <p>description of repeats for each light intensity ;</p> <p>calculation of mean ;</p> <p>credit reference to trying to remove heating effect e.g. using Perspex screen ;</p> <p>time spent / exposed to light / time volume of gas collected for ;</p> <p>credit reference to ensuring sufficient CO<sub>2</sub> ;</p> <p>credit safety consideration e.g. burn from lamp / electrical kit and water ;</p>	<b>5</b>
2(a)(ii)	<p>table with columns headed ‘lamp distance from aquatic plant’ <b>AND</b> ‘volume of gas collected’ ;</p> <p>suitable units for both variables – cm / mm <b>AND</b> cm<sup>3</sup> / mm<sup>3</sup> / ml respectively ;</p>	<b>2</b>
2(a)(iii)	<p>volume of oxygen / gas, divided by time taken ;</p>	<b>1</b>
2(a)(iv)	<p>line showing rate increasing with increasing light intensity ;</p> <p>rate increasing and levelling off ;</p>	<b>2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(b)(i)	<p><i>any 3 of:</i></p> <p>species X has greatest abundance at / towards MLWM <b>AND</b> species Z has greatest abundance at / towards MHWM ;</p> <p>appropriate use of data from diagram e.g. species X only occurs from 80 m onwards / species Z only occurs down to 70 m ;</p> <p>species Y shows greatest distribution along the shore / only absent for first 10 m below MHWM ;</p> <p>no point on shore where all three species occur together ;</p> <p>comparison of relative abundance in same region of shore e.g. Z more abundant than Y between 10 and 40 m / Y more abundant than Z between 40 and 70 m ;</p> <p><b>AVP ;</b></p>	<b>3</b>
2(b)(ii)	<p>species X as occurs further down shore ;</p> <p>(so) will spend longer submerged (in reduced light intensity) ;</p>	<b>2</b>
2(b)(iii)	<p>spends greater amount of <u>time</u> exposed / uncovered by tide ;</p> <p>so must (be adapted to) prevent desiccation / dehydration ;</p>	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)	used (by producers as nitrogen source) for building amino acids / proteins / DNA ;	<b>1</b>
3(b)(i)	<p>x-axis labelled (with units) <b>AND</b> suitable linear scale ;</p> <p>all points plotted correctly <math>\pm \frac{1}{2}</math> small square ;</p> <p>suitable <u>curved</u> line ;</p>	<b>3</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(b)(ii)	within the range of 60–140 m ;  (idea of) greatest change in temperature with change in depth / <b>AW</b> ;	<b>2</b>
3(b)(iii)	<i>any 1 of:</i>  seasonal change in air temperature / radiation input from Sun ;  changes in currents / upwelling / mixing ;  extreme weather event such as typhoon / hurricane ;	<b>1</b>
3(c)(i)	28.3(°C) ;	<b>1</b>
3(c)(ii)	<i>any 3 of:</i>  rate of uptake lower in surface water due to lower concentration ;  increase in uptake with depth due to increased concentration / increased number of producers ;  decrease in uptake with increasing depth due to lack of producers / phytoplankton ;  decrease in uptake with increasing depth due to decreasing water temperature ;	<b>3</b>
3(d)	peak nitrate uptake will be greater ;  peak abundance now three times higher... ;  at a shallower depth than previous peak ;  so trend may show peak at shallower depth than before algal bloom ;  algal bloom near surface will reduce light intensity / block light, for algae at greater depth <b>AW</b> ;	<b>3</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	both organisms benefit ; crab gets protection <b>AND</b> anemone gets food ;	<b>2</b>
4(b)	carapace / segmented abdomen / jointed legs / two pairs of antennae ;	<b>1</b>
4(c)	Cnidaria ;	<b>1</b>
4(d)(i)	<i>any 2 of:</i> scattergram appears to show a (positive) correlation ; allows them to determine if there is a significant / strong correlation ; idea of using data that can be ranked ;	<b>2</b>
4(d)(ii)	substitution of numbers into equation ; correct answer only to any number of sig. figs. From 0.8867630701 ; reasonable answer expressed to 2 significant figures ;	<b>3</b>
4(d)(iii)	(strong) <u>positive</u> correlation ; as answer is close to 1 ;	<b>2</b>
4(e)(i)	to keep anemones a manageable size ;	<b>1</b>

Question	Answer	Marks
4(e)(ii)	<p><i>any 3 of:</i></p> <p>supports idea as anemones removed grow at similar rate as anemones never attached ;</p> <p>(whereas) attached anemones change little in size ;</p> <p>however doesn't prove crabs control this ;</p> <p>correlation is not causation / could be due to another factor (such as area available for attachment) ;</p> <p>idea of larger sample size would give firmer conclusion ;</p>	<b>3</b>

Question	Answer	Marks
5(a)	<u>concentration</u> of the hydrogen / H <sup>+</sup> (ions) ;	<b>1</b>
5(b)	<p>UI mixed (thoroughly) with water sample <b>AND</b> record colour change (indicates pH) ;</p> <p>comparison with, standard / reference, colour charts / key ;</p>	<b>2</b>
5(c)(i)	idea of UI not sensitive enough to detect such small changes in pH ;	<b>1</b>
5(c)(ii)	$8.135 - 8.07 = 0.065$ ;	<b>1</b>
5(d)(i)	<p>for a comparison to be made / to compare to ;</p> <p>normal / natural pH of sea water ;</p>	<b>2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(d)(ii)	<p><i>any 3 of:</i></p> <p><i>supports because:</i> all organisms grew better in control tanks <b>OR</b> reduction in abundance / mass of 4 out of 5 organisms in acidified tank ;</p> <p>alga B has a reduced growth rate ;</p> <p><i>evidence is weak because...</i></p> <p>only one ecosystem studied ;</p> <p>only 5 organisms studied ;</p> <p>only one tank studied for each condition ;</p>	<b>3</b>
5(d)(iii)	<p><i>any 4 of:</i></p> <p>maintains stability of ecosystems ;</p> <p>provides source of medicines ;</p> <p>ref. to keyhole limpet hemocyanin ;</p> <p>providing / sustaining food sources ;</p> <p>ref. contribution to climate control ;</p> <p>ref. phytoplankton absorbing CO<sub>2</sub>/ carbon sink ;</p> <p>ref. protection of physical environment ;</p> <p>ref. to coral reefs protecting coastline ;</p>	<b>4</b>