



Cambridge International AS & A Level

MARINE SCIENCE

9693/21

Paper 2 AS Data Handling and Investigative Skills

May/June 2023

MARK SCHEME

Maximum Mark: 75

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.

This document consists of **16** printed pages.

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.

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 two reasons ...):</p> <ul style="list-style-type: none">• The response should be read as continuous prose, even when numbered answer spaces are provided.• Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>.• Incorrect responses should not be awarded credit but will still count towards <i>n</i>.• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should not 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.• Non-contradictory responses after the first <i>n</i> responses may be ignored even if they include incorrect science.

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:

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

Question	Answer	Marks
1(a)(i)	distance of tube from lamp / distance of the lamp / distance of lamp from the plant ; <u>volume</u> of, gas / oxygen, produced / collected / measured / released ;	2
1(a)(ii)	<i>any 2 of:</i> concentration of carbon dioxide / hydrogencarbonate (in water) ; mass / surface area of, aquatic plant / chlorophyll OR number / size of leaves ; pH (of water) ; salinity (of water) ; wavelength of light / colour of light / background light intensity ; time spent / exposed to light / time volume of gas collected for ; volume of water ;	2
1(b)(i)	timer / stop clock / stopwatch / watch / clock ;	1
1(b)(ii)	both axes labelled with units ; suitable linear scale ; points, plotted correctly $\pm \frac{1}{2}$ small square ; suitable line ;	4

Question	Answer	Marks
1(b)(iii)	<p><i>any 3 of:</i> (volume of) oxygen / gas, produced decreases, as, lamp moves further away / there is less light, OR the closer the lamp to the plant is the more oxygen it releases OR negative correlation AW / ORA ;</p> <p>as, light intensity decreases ORA ;</p> <p>rate of photosynthesis decreases (with lower light intensity) ORA ;</p> <p>data manipulation / any data used must be correct ;</p>	3
1(c)(i)	<p>1 both treatments have an, optimum / peak / highest, temperature ;</p> <p>2 nitrate enriched is, always higher rate / photosynthesis (rate), when photosynthesising than deficient water ;</p> <p>3 (optimum rate) at 17 °C nitrate-deficient AND 20 °C nitrate-enriched ;</p> <p>4 (optimum rate) at 13 arbitrary units (a.u.) nitrate-deficient AND 19 arbitrary units (a.u.) nitrate-enriched ;</p> <p>5 both zero at 2 °C / both zero at 26–27 °C ;</p> <p>6 correct data <u>manipulation</u> to show a <u>comparison</u> ;</p>	3
1(c)(ii)	<p><i>any 2 of:</i> increased rate of photosynthesis ;</p> <p>(nitrates) allow for <u>increased</u> synthesis of, proteins / DNA / amino acids ;</p> <p>allowing for increased, growth / rate of cell division / population / biomass ;</p>	2

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Question	Answer	Marks				
2(a)(i)	hydrogen (ion) ;	1				
2(a)(ii)	universal <u>indicator</u> / pH probe ;	1				
2(b)	<p>table with columns / rows headed 'pH' AND 'increase in mass (of coral) OR 3 or 4 columns 'pH', 'initial mass' and final mass (and increase in mass) ;</p> <table border="1" data-bbox="342 448 1126 579"> <thead> <tr> <th data-bbox="342 448 600 512">pH</th> <th data-bbox="600 448 1126 512">increase in mass / g / kg / %</th> </tr> </thead> <tbody> <tr> <td data-bbox="342 512 600 579"></td> <td data-bbox="600 512 1126 579"></td> </tr> </tbody> </table> <p>g / kg / mg / % increase in mass ;</p>	pH	increase in mass / g / kg / %			2
pH	increase in mass / g / kg / %					
2(c)(i)	<p>(greater impact on) species B + (line on graph) shows a steeper line / gradient / the level of decrease is faster / higher rate of change / greater difference ;</p> <p>B, has a difference of / falls by, 5 % + A, has a difference of / falls by, 2 % ;</p>	2				
2(c)(ii)	<p>species B will show, some / slow, growth OR B grows, more / faster, than A ;</p> <p>species A will show, no growth / reef erosion ;</p>	2				

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Question	Answer	Marks
2(d)	<p><i>any 2 of:</i></p> <p>1 temperature (change) / global warming / climate change / coral bleaching ;</p> <p>2 (idea of natural physical damage) (tropical) storm / hurricane damage / high wave energy / tsunami ;</p> <p>3 (idea of human physical damage) description of damage by boats / anchors / trawling / dredging / drag net fishing / damage by divers / dynamite fishing / human harvesting ;</p> <p>4 (increased) feeding damage by parrot fish / bioerosion / predation (by named organisms) ;</p> <p>5 algal bloom or over / excessive, algal growth / eutrophication ;</p> <p>6 disease ;</p> <p>7 presence of sediment / abrasive action of sediment ;</p> <p>8 named pollution / sun cream washing into the (sea)water ;</p> <p>9 removal of, <u>nearby</u> / <u>associated</u>, seagrass / mangrove, systems ;</p>	2

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Question	Answer	Marks
3(a)	<p><i>any 1 of:</i> <u>prop</u> roots ; salt exclusion by roots / roots help filter salt water ; viviparous reproduction / propagules ;</p>	1
3(b)(i)	<p>either: known <u>mass</u> of, sodium chloride / salt ; dissolved in, known / stated, volume / mass, of water ;</p> <p>or: use, (stock) solution / sea water, of known concentration / 34 ppt ; and dilute known volume with known volume of water ;</p> <p>or: add salt to, distilled / fresh, water OR (dilute) seawater with distilled / fresh, water + using a, salinometer / refractometer ; until it reaches the correct salinity ;</p>	2
3(b)(ii)	<p><i>any 2 of:</i> (investigate for) longer than 30 weeks ; (investigate) more (than 3) species ; (investigate) a greater range of salinities ; more seedlings ;</p>	2
3(c)(i)	<p>surviving number / 50, $\times 100$;</p>	1

Question	Answer	Marks
3(c)(ii)	$48 \div 100 \times 50$ OR 48 % is 48 in 100 so 24 in 50 OR $24 / 50 \times 0.48$ OR $48 \div 2$; 24 ;	2
3(d)	species X + highest survival rate in most saline water ; Site A highest salinity (closest to sea / shoreline) ; Site A will experience, least mixing with fresh water / fresh water spread out over a wider area / more time mixed with incoming sea water AW ;	3
3(e)	(idea of) high tide increasing salinity / water becomes more saline at high tide / as tide comes in more salty water will be at B / as tide goes out more fresh water will be at B / ORA ; (idea of) increased (proportion of) sea water to freshwater / ORA ; (idea of) spring tides cause greater increase in salinity (at high water) / ORA for neap tides ;	3
3(f)	<i>any 2 of:</i> tourism ; food sources / nursery grounds for fish / fisheries / provide nutrients ; (source of) timber ; coastal protection / flooding / reduce wave energy / prevent erosion ; (source of) fuel ; (source of) (antifungal) drug / medicines / medical use ;	2

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Question	Answer	Marks
4(a)	abiotic factors are non-living (factors) ;	1
4(b)	<p><i>any 5 of:</i></p> <p>1 correctly linking a described method as systematic or random ;</p> <p>2 transect or grid ;</p> <p>3 (use of 1 m²) <u>quadrats</u> ;</p> <p>4 place quadrat at, stated / even, intervals along the transect OR random distance apart along the transect OR random placement within a grid ;</p> <p>5 ref. method of generating random locations / coordinates ;</p> <p>6 remove and examine sediment / sieve sediment to obtain samples / take a core sample to examine for species ;</p> <p>7 suitable reference to depth of sediment taken ;</p> <p>8 counting the species / record the number of species, found in each quadrat ;</p> <p>9 correct description of calculating the mean number of species per m² ;</p> <p>10 repeat same method on each, shore / coastline ;</p> <p>11 reference to ethical treatment of organisms ;</p> <p>12 ref. to a relevant and sensible health and safety ;</p>	5
4(c)(i)	<p>substitution of numbers into equation ;</p> <p>correct answer only to any number of sig. figs. from –0.8863636363636363 to –0.89 (any rounding must be correct) ;</p> <p>reasonable answer expressed to 2 significant figures ;</p>	3

Question	Answer	Marks
4(c)(ii)	it is an, inverse / negative, (correlation) ; as the value is negative ; OR it is a strong correlation ; as value is close to (-)1 ;	2
4(c)(iii)	<i>any 3 of:</i> the greater the slope gradient the lower the biodiversity ORA ; the greater the particle size the lower the biodiversity ORA ; awareness of correlation not meaning causation ; ref. to data only showing species number not abundance ;	3
4(d)	<i>particle size may affect:</i> 1 ability to burrow / move ; 2 ability to, ingest food / pass food through body ; 3 moisture content of substrate OR risk of (organisms) drying out ; <i>slope may affect:</i> 4 drainage of water / slope affects risk of (sediment / organism) drying out ; 5 how easily, detritus / food sources, deposited ; 6 area of shore in tidal range ; 7 size / impact of wave action ;	4
4(e)	takes into account number of <u>individuals / population size</u> (as well as number of species) / takes into account abundance (as well as number of species) ;	1

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Question	Answer	Marks
5(a)	clear outline ; suitable size ; in proportion ; detail ;	4
5(b)	(upper) part of (open) ocean where light is available (for producers) ;	1
5(c)	(all) carnivores eat, meat / do not eat plants / other animals / named animals / consumers ; (predators) hunt animals / prey on animals / catch animals / kill animals ;	2
5(d)(i)	<i>any 2 of;</i> both catch effort and catch (generally) increase OR more effort was put into catching blue sharks, global catch (usually) increased ; catch effort and catch rapidly increasing from (1994–1998) onwards / idea that before (1994–1998) there was minimal change / stable ; (global annual) catch, reduces / decreases, in 2015 despite catch effort continuing to increase ; catch effort begins to increase in 1994 OR global annual catch begins to increase more in 1998 ;	2
5(d)(ii)	(idea of) most of data of little use as population size unknown ; <i>idea that</i> decreasing catch, from 2015 / despite increased effort, suggests a, decrease in / low population ;	2

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Question	Answer	Marks
5(d)(iii)	<i>any 2 of;</i> chance of recapturing marked individuals very low ; due to (large) size of area that individuals exist in ; idea that it is difficult to account for births and deaths ; idea that population is not evenly distributed <i>e.g. move in groups or schools ;</i>	2