Cambridge International AS & A Level

MARINE SCIENCE **9693/21**

Paper 2 AS Data Handling and Investigative Skills **May/June 2022**

MARK SCHEME

Maximum Mark: 75

Published

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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	<u>'List rule' guidance</u> For questions that require *n* responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards *n*. • Incorrect responses should not be awarded credit but will still count towards *n*. • 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 *n* 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.

Final Mark scheme Key Points

- Refer to the *Instructions for Examiners (marking scripts on-screen) 2022* booklet for details of all procedures.
- As soon as you are able (usually about two days after the paper set date), please access the question paper and provisional mark scheme from the **RM support portal**. In conjunction with the provisional mark scheme, browse scripts in **RMA³** and feed any issues or comments to your **Team Leader**.
- The decisions of the **Principal Examiner** are final, and the final agreed mark scheme must be applied as intended by the Principal Examiner. If you are in any doubt about applying this mark scheme, consult your **Team Leader** by telephone or by email.
- Please report any serious problems during marking to your **Team Leader / Principal Examiner** (details in the confidential package).
- If you require technical support, please contact the **RM Helpdesk**. If you require administrative support relating to the examination process, please contact the **Cambridge International Examiner Helpdesk**. For all queries relating to payment, please contact **Cambridge Assessment Finance Division**. Up-to-date contact details for each of these can be found in the *Instructions for Examiners (marking scripts on-screen) 2022* booklet.
- The schedule of dates is very important. It is **essential** that you meet the **Batch 1** and **Batch 2** deadlines. If you experience problems, you must contact your Team Leader without delay.
- Mark strictly to the mark scheme. All marks awarded must relate directly to the mark scheme. However, always credit correct, relevant, science, even if it lies outside of the syllabus content. For answers not provided for in the mark scheme, give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
- Never transfer marks allocated for one question item to another.
- Where work has been crossed out, mark it when nothing else has been written.
- Do not penalise grammatical constructions/spelling of words that are not in the syllabus, so long as the meaning is clear.
- Credit should be given to all the candidate's correct responses, wherever they have been written (including blank pages, around diagrams, etc.).
- Additional materials may be attached and must be checked for candidates' responses. Show that you have checked blank pages for answers by placing an annotation on each blank page. Do not use crosses or ticks for this purpose, unless the points are credited as part of a response to a specific question. In this instance, please use the On Page Comment tool to clearly annotate which question part the marks relate to.
- If the candidate has left an answer blank, or has left a mark/comment that does not in any way relate to the question (for example 'my dog is black' or '----' or 'can't do' or '?') use the **NR** (No Response, #) option.
- Award 0 marks for any attempt which does not earn credit. This includes copying out all / part of the question or any working that does not earn any marks (whether crossed out or not).

- 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)	*any 2 from:* length of time (observed for) ; size of (coral) samples ; spacing of (coral) samples ; any water quality factor, e.g. pH / temperature / salinity / nutrients ;; (idea of) illumination / light intensity / sunlight ; size of tank ; same, size / age / species fish ; colour of coral ; (idea of avoiding bias towards a sample) distance fish introduced / released, to the coral ;	2
1(a)(ii)	*any 2 from*: samples A, B or C have higher (association) time than natural sample ; sample (B and) C have greatest (increase in association) time / spend largest amount of time with coral C (and B) ; sample D has same, effect / (association) time as natural sample ; **AND** correct use of data from graph to support answer ;	3
1(a)(iii)	*any 2 from:* food source / eat zooxanthellae ; shelter / protection (from, predators / water movement) ; (idea of) reproductive site / nursery ;	2

Question	Answer	Marks
1(b)	*any 3 from*: (from day 7) material D has the greatest percentage of larvae attaching… ; …but does not have the highest mean growth rate / relatively high growth rate ; sample(s) (B and) C have the highest growth rate(s) ; sample A has lowest percentage settling **and** lowest growth rate ; materials B and/or D (greatest percentage of larvae attaching) and are stable / C or D are the lowest percentage of larvae attaching and are decreasing ; insufficient length of time of investigation because percentage of C settling is decreasing ; correct use of manipulated data from table or graph to support answer ;	**3**
1(c)	*any 3 from:* (supports conclusion) as fish associate with artificial coral at least as much as natural ; (supports conclusion) as some samples allow larvae to, settle / grow ; 44 individual fish used is a high number of repeats ; (however) coral polyps may grow faster / attach better, on natural coral / no data on natural coral growth rate ; (however) larvae survival only monitored for 14 days ; (however) only one species / type of fish studied ; (however) no information on number / type of coral larvae used ; should conduct further research in natural habitat rather than tanks ; (idea of longer time period needed) research for longer than two weeks (idea of) research required on natural (bleached) coral to compare (settlement / growth rates) ; **AVP** ;	**3**

Question	Answer	Marks
1(d)(i)	clear outline ; suitable size ; in proportion ; detail – must include all visible fins and outline of three black vertical areas in approximately correct positions and the eye ;	**4**
1(d)(ii)	both fins labelled correctly either on the drawing or photograph ;	**1**

Question	Answer	Marks
2(a)	*any 3 from:* different masses of salt (weighed) ; using balance / weighing scales ; volume of water measured / stated ; using measuring cylinder ; salt (fully) <u>dissolved </u>in water ; **OR** determine salinity of (sea) water sample / use sample of saturated solution of saline ; measure volume of, sea water / saline ; using measuring cylinder ; diluting with known volume of fresh water ;	**3**

Question	Answer	Marks
2(b)(i)	*any 2 from*: freezer initially set at higher temperature / suggested temp, e.g. –1°C ; water samples given time to freeze / suitable suggested time, e.g. two hours ; (if freezing all samples at the same temperature) record time taken to freeze (different) samples / record temperature at which each sample freezes ; temperature gradually reduced ; reference to control variables, e.g. same volume ; use of data loggers ; repeating two more times (for reliability) ;	**2**
2(b)(ii)	*any 2 from*: ref. to lack units for salinity ; ref. to 'temperature' being unspecific, e.g. should be 'freezing point of sample' / freezing temperature ; ref. to lack of repeated results / add more trials / add more samples ;	**2**
2(b)(iii)	the greater the salinity the lower the freezing point / lower the salinity the higher the freezing point ;	**1**
2(b)(iv)	*any 3 from*: <u>precipitation</u> will decrease (salinity) ; <u>melting</u> of sea ice will decrease (salinity) / freezing of sea ice will increase (salinity); <u>run-off</u> will decrease (salinity) / glaciers melting ; <u>evaporation</u> will increase (salinity) ; water from hydrothermal vents will increase (salinity) ; <u>upwelling</u> will increase salinity ;	**3**
2(c)(i)	<u>measure</u> the mass **and** volume OR use the mass **and** volume <u>of the water sample</u> ; divide mass by volume ; units are, $kg / m^3 / kg\,m^{-3}$	**3**
2(c)(ii)	both axes labelled ; any line from bottom left towards top right / bar chart with three or more increasing height bars from left to right;	**2**

Question	Answer	Marks
2(c)(iii)	more saline water is more dense so will sink (below less saline water) **ORA** ; *PLUS* any *1* from: (contributes to) formation of ocean layers ; (contributes to) formation of ocean currents ; ref. to salt water wedges in estuaries ; allows halocline to form ;	**2**

Question	Answer	Marks
3(a)	positive correlation / correct description of correlation ; use of data demonstrating positive correlation / use of data to show that larger rock pools contain more species / **ORA** ;	**2**
3(b)(i)	0.2189 ; 0.7811 ; 0.78 ;	**3**
3(b)(ii)	a higher value for *D* means greater diversity / the closer the number is to 1 the greater the diversity ; *D* for largest rockpool greater than *D* for smaller rockpool ; hypothesis should be accepted **and** justification ;	**3**
3(c)	*any 4 from*: data for only two rockpools / need to sample more rockpools / sample too small ; small sample size less reliable ; (other student) chose different rockpools / different sized rock pools may have the same number of species ; numbers of individuals quite small ; needs more sampling over several days / weeks ; miscounted number of individuals / misidentified species ; number of species quite small ; idea of correlation not causation / **AW** ; suggested other factor involved, e.g exact position on shore / depth of rockpool ; ref. to significant difference ;	**4**

Question	Answer	Marks
4(a)(i)	3.9 (m) ;	**1**
4(a)(ii)	*any 3 from*: ref. to gravitational pull of Moon AND Sun ; ref. to alignment of Moon AND Sun ; correct description of spring OR neap tide ; correct use of example days from data ;	**3**
4(b)	**MAX 2** *from*: high tide is the same time for both ; (idea of) low tide is later for lagoon / low tide has a lag time for lagoon / lagoon takes longer to adjust between high and low tides ; high tide is the same depth / height, for both ; low tide is lower for offshore / tidal range is greater offshore **ORA** ; **PLUS** *at least 1 from:* idea that water is trapped inside lagoon / takes time to drain away ; idea that not all water leaves lagoon before tide turns ; rate of water flow into the lagoon (after low tide) is greater than offshore ; rate of change of tide height is greater for the lagoon than offshore ; offshore tide needs to be high enough to re-enter the lagoon ;	**3**

Question	Answer	Marks
4(c)	*any 5 from*: *abiotic factors:* 1 higher tides will allow greater mixing of ocean and lagoon water / **ORA** ; 2 (may affect) mixing of nutrients ; 3 (may affect) temperature of <u>lagoon</u> water ; 4 (may affect) salinity of lagoon due, to evaporation (at low tide) / influx of sea water at high tide ; 5 (reef) erosion ; 6 change in atoll shape / movement of sand / sediments / morphology of lagoon ; 7 correct ref. to light intensity ; 8 change in oxygen / carbon dioxide, levels / concentration; *biotic factors:* 9 lower tides will result in reef acting as barrier to organisms ; 10 ability of predators to enter or exit lagoon / prey will need to avoid predators ; 11 (at low tide) food availability changes e.g. may affect ability of zooplankton / phytoplankton to enter lagoon ; 12 (may affect) ability of larvae to enter / leave lagoon ; 13 (idea of) desiccation of corals / organisms ; 14 damage to vegetation ; 15 competition increases as more species enter lagoon at high tide ;	5

Question	Answer	Marks
5(a)(i)	idea of, easier to, manipulate / control the variable / no predation of dinoflagellates / ethical / **AW** ;	1
5(a)(ii)	*any 1 from*: temperature / pH / salinity / nutrient content / illumination of water / light intensity / dissolved CO_2 / dissolved O_2 / volume of water / tank size ; number / concentration / species of dinoflagellates ;	1
5(b)(i)	correct plots within 1 mm ; correct scale on *y*-axis ; correct label on both *x* and *y*-axis ; suitable line of best fit ;	4

Question	Answer	Marks
5(b)(ii)	*any 3 from*: higher concentration of copepodamide results in increased light production ; increase is greatest at lower concentrations / **ORA** ; greatest effect seen after 48 hours / effects are shown more clearly over a longer period of time / the longer the dinoflagellates are exposed the more light they produce / **AW** ; little effect after 1 hour / **ORA** ; at 48 hours it is still increasing ; at 0 concentration zero light is emitted ; increases at the start before levelling out ; use of data / manipulation of data e.g. after 1 hour the percentage increase is only 40% ;	3
5(b)(iii)	*any 3 from:* data supports idea **+** because there is greater bioluminescence in presence of, copepodamide / predator ; (idea of) long time taken for full effect may not help avoid <u>predation</u> ; bioluminescence may be coincidence / for other biochemical reasons; (idea of) not knowing how much copepodamide equates to one copepod ; not tested with actual predators to see if bioluminescence works ;	3
5(c)	*any 3 from:* (supported because…) 1 (in sample A) non-bioluminescent dinoflagellates make up majority (76%) of predator diet ; 2 in sample B or C when bioluminescent dinoflagellates present, majority of diet changes to alternative prey (75%) or (96%) / **ORA** ; 3 idea that presence of copepodamide increases further the extent to which alternative prey are consumed / copepodamide decreases the extent to which dinoflagellates are being consumed ; 4 manipulation of data e.g. difference of 51% dinoflagellate consumption between samples A and B ; (not supported because…) 5 may be other differences between types of dinoflagellates that affect predation (e.g. chemical cues) ; 6 not clear how many dinoflagellates / alternative prey were available to eat ; 7 (idea that) other predators may not be deterred by bioluminescence ; 8 reference to lack of, repeats / means in the investigation ; 9 repeat investigation with non-bioluminescent dinoflagellates ; 10 **AVP**, e.g. comment on methodology	3