

Cambridge International AS & A Level

MARINE SCIENCE**9693/21**

Paper 2 AS Level Data Handling and Investigative Skills

May/June 2025**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 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **21** printed pages.

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 descriptions 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.

'List rule' guidance

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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

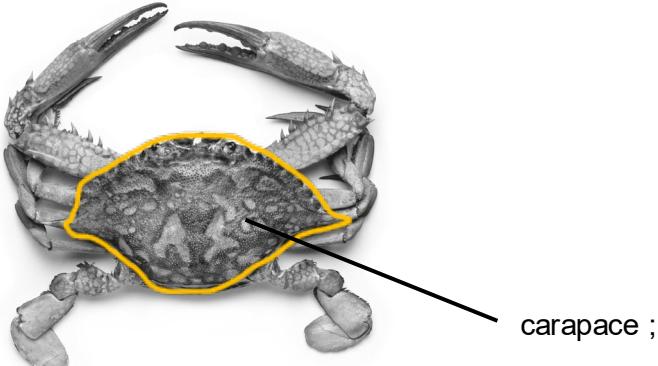
Annotations

Annotation	Meaning
✓	correct point or mark awarded
✗	incorrect point or mark not awarded
↖	information missing or insufficient for credit
Allow	allow or accept
Ignore	incorrect or insufficient point ignored while marking the rest of the response
CON	contradiction in response, mark not awarded
BOD	benefit of the doubt given
ECF	error carried forward applied
MR	maximum mark reached
NBOD	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied

Annotation	Meaning
PAG	Point already given
POT	power of ten error
R	incorrect point or mark not awarded
RE	rounding error
SEEN	point has been noted, but no credit has been given or blank page seen
TV	response is too vague or there is insufficient detail in response
  	marking point 1 or marking point a is awarded. Used to mark against a particular marking point from an extended answer MS
	used to highlight parts of an answer / incorrect idea / irrelevant to question
	used to highlight parts of an extended response / incorrect idea / irrelevant to question
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
ruler	allows lengths to be measured
multi-line overlay	overlays graphs

This mark scheme will use the following abbreviations:

;	separates marking points
/	alternative responses for the same marking point
R	reject the response
A	accept the response
I	ignore the response
ECF	error carried forward
AVP	any valid point / alternative valid point
ORA	or reverse argument
AW	alternative wording
<u>underline</u>	actual word given must be used by candidate (grammatical variants excepted)
()	the word / phrase in brackets is not required but sets the context
MAX	indicates the maximum number of marks that can be given
+ AND	statements on both sides of the + or AND are needed for that mark
OR	separates two different routes to a mark point and only one should be awarded

Question	Answer	Marks
1(a)(i)	 <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto; margin-right: 0;">BRAILLE PAPER mark inside the carapace</div>	1
1(a)(ii)	<p>any two from:</p> <p>segmented, abdomen / body ;</p> <p><u>jointed</u> legs ;</p> <p>two <u>pairs</u> of antennae ;</p> <p>AVP ;</p>	2

Question	Answer	Marks
1(a)(iii)	<p>outline: unbroken <u>pencil</u> lines and no shading ; size: most of the space provided and at least as big as original picture ; in proportion ; detail any number of nodules in the pincers AND 3 spines on top edge ;</p> <div data-bbox="343 489 906 727" style="border: 1px solid black; padding: 5px;"> <p>BRAILLE PAPER</p> <p>outline: unbroken lines ; no shading ; pencil ; in proportion ; size: big enough to see some detail ;</p> </div>	4
1(b)(i)	$(147 \times 139) / 45 ;$ $= 454.067 ;$ 454 ;	3
1(b)(ii)	<i>any two from:</i> <i>idea of reproduction or death of individuals ;</i> <i>idea of migration in to or out from area ;</i> marked individuals are not randomly distributed ; sample size may be too small ; AVP ;	2

Question	Answer	Marks
1(c)	<p><i>any four from: MAX 3 marks for supports and 1 from the 'however'</i> <i>supports idea (MAX 3 marks)</i></p> <p>1 positive impact on the population / increased numbers (from 2008 / 2009) ; 2 the increase was sudden / significant / large / alot (for following 2 years) ; 3 increase n population, in most years / overall, compared to 2008 ; 4 higher mean 2008–2020 compared to 1990–2007 ; 5 (one or two) highest peak(s) (in 2010 and 2017) post 2008 higher than previous peaks ; <i>however</i> 6 some years post-2008 had <u>very</u> low population / accept a specific year ; 7 other factors may be having more impact on population size ; 8 manipulation of data ;</p>	4

Question	Answer	Marks
2(a)	particle that has gained or lost electron(s) /negative and positive charge ;	1
2(b)(i)	<p><i>any five from:</i></p> <p>(independent variable) – <i>idea of how to change nitrate concentration</i> ;</p> <p>(suitable range) – at least 3 concentrations used ;</p> <p>(dependent variable) – <i>idea of measuring change in height of seagrass</i> ;</p> <p><i>idea of replicates / repeat at least twice and calculate, means / medians / control experiment (using only sea water)</i> ;</p> <p><i>description of calculation of growth rate</i> ;</p> <p>standardised variables ;; (MAX two marks from this list)</p> <ul style="list-style-type: none"> • leave to grow for, suitable / fixed time • temperature of water • all other mineral ions in equal concentration • concentration of CO₂ • from lamp OR position / distance of the lamp / light intensity • pH • similar starting height of seagrass • same species of seagrass • volume of water • depth / type / mass, of sediment 	5
2(b)(ii)	<p>suitable column / row headings e.g. (nitrate) <u>concentration</u> AND growth (rate) / change in length of seagrass / change in height of seagrass ;</p> <p>appropriate units for dependent variable in heading only ;</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>BRAILLE PAPER Same MS as standard paper but as a description not a drawn table</p> </div>	2

Question	Answer	Marks
2(b)(iii)	<i>Idea of increase in nitrate concentration increases growth (rate) / ORA ;</i>	1
2(c)	<p><i>any two from:</i> proteins or amino acids ; chlorophyll ; DNA ; AVP ;</p>	2
2(d)(i)	<p><i>any two from:</i> species / sex, <u>of pipefish</u> used ; health <u>of pipefish</u> ; number <u>of pipefish</u> (in the tank) ; reference to the, number / age / size / density / population, <u>of prey</u> ; quantity / mass / species / age, <u>of seagrass</u> in each tank ;</p>	2

Question	Answer	Marks
2(d)(ii)	<p>150 / 100 × 62 OR $62 \times 150 / 100$ OR 150×0.62 OR $62 / 100 \times 150$</p> <p>93 ;;</p> <p>1 mark for incorrect values of 61 or 63 but correct calculation $150 / 100 \times 61 \text{ OR } 61 \times 150 / 100 = 92$</p> <p>$150 / 100 \times 63 \text{ OR } 63 \times 150 / 100 = 95$</p> <div data-bbox="343 732 848 901" style="border: 1px solid black; padding: 5px;"> <p>BRAILLE PAPER $150 / 100 \times 60 \text{ OR } 60 \times 150 / 100$</p> <p>90 ;;</p> </div>	2
2(d)(iii)	<p>any one from: highest survival rate seen with diet of both R and S together / pipefish survive the most when both prey species R and S are present / ORA ;</p> <p>prey species S cause the percentage to decrease most / species S has the lowest survival rate ;</p> <p>all survived for at least one day ;</p> <p>juvenile pipefish have greater survival rate with prey species R rather than prey species S ;</p> <p>idea of those with R in diet have higher survival ;</p>	1

Question	Answer	Marks
2(d)(iv)	<p><i>any two from:</i> only 1 species of pipefish investigated /only two prey species investigated ; only one tank (of pipefish) investigated for each diet / no repeats / only 1 trial ; differences in survival may be for other (unknown) reasons ; 7 days is too short a duration / not enough time for investigation / records only 7 days ; <i>idea of tank environment is not representative of conditions in the sea ;</i></p>	2

Question	Answer	Marks																
3(a)	divergent (plate boundary) ;	1																
3(b)(i)	<p>both axes labelled with units ;</p> <p>suitable linear scale ;</p> <p>points, plotted correctly $\pm \frac{1}{2}$ small square ;</p> <p>suitable line ;</p> <table border="1"> <thead> <tr> <th>rate of ocean floor spreading / mm per year</th> <th>mean number of hydrothermal vents per 100 km</th> </tr> </thead> <tbody> <tr> <td>39</td> <td>1.8</td> </tr> <tr> <td>55</td> <td>2.5</td> </tr> <tr> <td>67</td> <td>3.1</td> </tr> <tr> <td>88</td> <td>3.6</td> </tr> <tr> <td>100</td> <td>4.0</td> </tr> <tr> <td>115</td> <td>4.8</td> </tr> <tr> <td>140</td> <td>6.2</td> </tr> </tbody> </table> <p>BRAILLE PAPER 7 points, plotted correctly (leeway needed) ;; suitable line drawn ;</p>	rate of ocean floor spreading / mm per year	mean number of hydrothermal vents per 100 km	39	1.8	55	2.5	67	3.1	88	3.6	100	4.0	115	4.8	140	6.2	4
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88	3.6																	
100	4.0																	
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140	6.2																	

Question	Answer	Marks
3(b)(ii)	Spearman's (rank);	1
3(c)(i)	<p><i>any three from:</i> both factors start low;</p> <div style="border: 1px solid black; padding: 5px; margin-top: 5px;"> <p>BRAILLE PAPER Hydrogen sulfide starts and ends on 0.25 nmol dm⁻³.</p> </div> <p>both factors show increase AND decrease (thereafter) ; both factors increase more rapidly than they decrease ; decrease in hydrogen sulfide concentration more rapid than turbidity / ORA ; both peak at (around) the same distance / both reach their highest point at the same distance / both peak at 2 km ; concentration of hydrogen sulfide has a larger range than the turbidity ;</p>	3
3(c)(ii)	<p>2.2 / 2.20 (a.u) ;</p> <div style="border: 1px solid black; padding: 5px; margin-top: 5px;"> <p>BRAILLE PAPER (2.25 – 0.25)</p> <p>2.0 (a.u) ;</p> </div>	1

Question	Answer	Marks
3(c)(iii)	<p><i>any two from:</i></p> <p>temperature ;</p> <p>pH ;</p> <p>(dissolved) oxygen <u>concentration</u> ;</p> <p>salinity ;</p> <p>density ;</p>	2
3(c)(iv)	<p><i>any three from:</i></p> <p>organisms cannot tolerate extreme conditions in the plume / temperature of water is beyond that suitable for organisms to survive / ORA ;</p> <p><u>dissolved</u>, minerals / ions AND affect / lower pH / more acidic, (of) water which organisms cannot tolerate ;</p> <p>temperature change AND affects <u>solubility</u> of gases so there is less O₂ available (for organisms) ;</p> <p>temperature change AND could affect growth rates (of organisms) ;</p> <p>increased turbidity AND affects bioluminescent organisms ;</p> <p>increases biodiversity / productivity ;</p> <p>(availability of) hydrogen sulfide for, chemosynthetic organisms / <i>Endoriftia</i>* producers / chemosynthesis ;</p> <p>AVP ;</p>	3

Question	Answer	Marks
4(a)(i)	<p><i>any two from:</i> location C would have <u>lowest</u> (permeability) ; B will have slightly <u>higher</u> (permeability) than A / location A and B has <u>more</u> (permeability) than C / A and B are the <u>highest</u> ; samples from location A and B would have <u>similar</u> (permeability) / A is almost as permeable as B ;</p>	2
4(a)(ii)	<p>larger particles have larger spaces in between / ORA ; <i>idea of permeability as, space for / flow of, water through material e.g. allowing greater permeability for water / increased movement of water / ORA ;</i></p>	2
4(b)(i)	<p><i>any four from:</i></p> <ol style="list-style-type: none"> <li data-bbox="332 679 1964 716">1 flounder have <u>greatest</u> density on substrates with large particles ORA ; <li data-bbox="332 752 1964 805">2 (mean) population / density, of flounder is <u>higher</u> when (percentage of) sand in sediment is <u>higher</u> / ORA ; <li data-bbox="332 841 1964 894">3 (mean) population / density, of flounder is <u>lower</u> when (percentage of) clay in sediment is <u>higher</u> / ORA ; <li data-bbox="332 930 1964 982">4 (mean) population / density, of flounder is <u>lower</u> when (percentage of) silt in sediment is <u>higher</u> / ORA ; <li data-bbox="332 1019 1964 1071">5 comparison of correct data e.g. location A and B both have population density of 0.05 AND have percentage of sand close to 80% ; <li data-bbox="332 1092 1964 1129">6 (idea that) similar percentage of stones at all three locations has no / little / unknown effect on the (mean) density of flounder ; 	4

Question	Answer	Marks
4(b)(ii)	<p>any three from:</p> <p>(may affect) ability of flounder to, avoid / hide from / camouflaged from, predators ;</p> <p>(may affect) ability of flounder to, hide from / camouflaged from, prey ;</p> <p>(may affect) species / abundance, of, prey / predators, present ;</p> <p>(may affect) ability of flounder to reproduce / better nursery conditions ;</p> <p>(may affect) presence of competitor species ;</p> <p>AVP :</p>	3
4(c)	<p>any three from:</p> <p>idea of same, mass / volume, of sediment from each sample (placed in tube) ;</p> <p>water poured in at constant rate / equal, mass / volume, of water passed through each sample ;</p> <p>measure, volume / mass / depth, of water passing through in set time</p> <p>OR</p> <p>time taken for set, volume / mass / depth, of water to be collected ;</p> <p>relevant measuring equipment suggested ;</p> <p>e.g. <i>stop clock/timer/measuring cylinder/balance/graduated cylinder.</i></p> <p><i>idea of repeats for each sample and mean calculate ;</i></p>	3

Question	Answer	Marks
5(a)	<p>one organism <u>lives, in / on, another organism</u> ;</p> <p>(parasite) gains benefit AND (host) organism is, harmed / disadvantaged ;</p>	2

Question	Answer	Marks
5(b)(i)	<p><i>any two from:</i></p> <p><i>idea that gobies with parasites travelled further ORA ;</i></p> <p><i>idea that as (mean no of) gobies competing for each hiding space increases the distance travelled increases (both with and without parasites) ORA ;</i></p> <p><i>idea that difference in maximum distance travelled by gobies (with parasite) increases with increasing mean number competing per hiding place ORA ;</i></p>	2
5(b)(ii)	<p><i>any two from:</i></p> <ol style="list-style-type: none"> 1 reduces energy available, for growth / reproduction / disrupts physiological processes ; 2 (behaviour changes) to travel further to find, an (alternative) hiding space / food / need to eat more / to reach more favourable conditions for the copepod ; 3 resulting in smaller gobies ; 4 increases chance of (goby) predation ; 	2
5(c)(i)	3 ;	1
5(c)(ii)	$(612 / 3.6) = 170 ;$ <div data-bbox="343 981 886 1103" style="border: 1px solid black; padding: 5px;"> <p>BRAILLE PAPER No table, might get just the written answer</p> </div>	1

Question	Answer	Marks
5(c)(iii)	<p>correct manipulation of data ;;</p> <p><i>plus MAX three from:</i></p> <p><i>Echeneis naucrates</i> (EN) associated more with <i>Mobula alfredi</i> (MA) OR <i>Mobula alfredi</i> (MA) associated more with <i>Echeneis naucrates</i> (EN) ;</p> <p><i>Remora remora</i> (RR) associated more with <i>Mobula birostris</i> (MB) OR <i>Mobula birostris</i> (MB) associated more with <i>Remora remora</i> (RR) ;</p> <p><i>Mobula birostris</i> (MB) has more remora (in total) compared to <i>Mobula alfredi</i> (MA) ;</p> <p>sample sizes vary considerably ;</p>	4