CAMBRIDGE
International Education

Cambridge International AS & A Level

MARINE SCIENCE **9693/42**

Paper 4 A Level Data-handling and Investigative Skills **May/June 2026**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

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General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

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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.

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6	<u>Calculation specific guidance</u> 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	<u>Guidance for chemical equations</u> 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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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
A	allow or accept
I	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
PAG	point already given

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Annotation	Meaning
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
1 , 1, a	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

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Question	Answer	Marks	Guidance
1(a)(i)	outline: clear, unbroken lines and no shading ; size: at least size of original ; proportion: width of cisternae in proportion to lengths and gaps ; detail: (minimum) six cisternae drawn ;	**4**	Max 3 if clearly pen Lengths in right order from left
1(a)(ii)	Golgi (body) ; modifies protein / polypeptide / packages proteins into vesicles / forms glycoproteins / forms lipoproteins / makes lysosomes / forms quaternary structures / **AW** ;	**2**	Packaging of protein / polypeptides **A** transport and sorting of proteins
1(a)(iii)	length measured between 109 mm and 112 mm / 10.9 cm and 11.2 cm ; correct division of image size by 11 000 ; correct conversion of units (allow cm or mm into μm) ; 9.9 μm up to 10.2 μm	**3**	 **A** ecf from wrong measurement for mp2 and mp3
1(b)(i)	*any **1** from:* 1 temperature ; 2 species / age of lettuce / algae ; 3 size of container ; 4 volume of solutions ; 5 other nutrients in soil ; 6 light intensity / light wavelength / light colour ; 7 **AVP** ;	**1**	 **I** (initial) size / mass of lettuce **I** volume of water

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Question	Answer	Marks	Guidance
1(b)(ii)	*any **3** from:* 1 water content reduces / water leaves the cells; 2 by osmosis ; 3 *(idea of)* greater concentration of sodium chloride has lower water potential / **ORA** ; 4 (water moves), down a water potential gradient / from high to low water potential ; 5 across the cell membranes ;	**3**	
1(b)(iii)	*any **2** from:* 1 with flavonoids the water loss is reduced / **AW** ; 2 estuary water changes salinity / when the tide is in the salinity is higher / **ORA** / **AW** ; 3 can control water loss / control water uptake / **AW** ; 4 **AVP** ;	**2**	e.g. preventing plasmolysis / loss of turgor / **AW**

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Question	Answer	Marks	Guidance
2(a)	*any **3** from:* 1 (microplastics) bind to toxins / release toxins when they break down ; 2 are consumed by plankton / filter feeders / **AW** ; 3 bioaccumulate / are not excreted / are not broken down / not released / **AW** ; 4 biomagnification along food chains / increase in mass along food chain / **AW** ; 5 kill higher trophic level animals / top predators / **AW** ;	**3**	**A** for plastic or toxins **A** can damage gills / can cross blood brain barrier / can cause suffocation / prevent feeding
2(b)(i)	(20 000 / 260 000) × 100 = 7.6923 % ;;	**2**	240 000 + 20 000 for 1 mark If working is shown and an error is carried forward into a correct percentage for that calculation, then award one mark
2(b)(ii)	*any **2** from:* 1 both increase **and** decrease with increased plastic ages ; 2 highest mass for macroplastic is 11–20 years ± highest mass for microplastic is 21–30 years ; 3 there is more macroplastic than microplastic **except** for > 30 / the only age that there is more microplastic is > 30 / **AW** ; 4 there is more total macroplastic than microplastic for all years / **ORA** ;	**2**	

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Question	Answer	Marks	Guidance
2(b)(iii)	*any **4** from:* 1 (macro)plastics breakdown ; 2 (microplastics breakdown) into microplastics ; 3 due to turbulence / wind / UV light exposure / wave action / **AW** ; 4 (plastic decreases) as eventually washes up on shores / **AW** ; 5 few(er) microplastics are released (recently) / **AW** ; 6 more recycling now / better disposal in last 10 years / more plastic was discarded in earlier years / less plastic now used /more awareness of plastic waste hazards / **AW** ;	**4**	**A** removed by organisms / by fishing
2(c)	*any **2** from:* 1 recycling banks ; 2 reducing packaging for food ; 3 encouraging reusable water bottles ; 4 poster campaigns / education / raise awareness ;	**2**	**A** ban single use plastics / use water fountains / use(named) sustainable materials e.g.: paper

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Question	Answer	Marks	Guidance
3(a)(i)	$6CO_2$ and $C_6H_{12}O_6$;	1	
3(a)(ii)	*any **3** from:* 1 photoactivation of chlorophyll ; 2 occurs in grana / on thylakoids ; 3 photolysis of water ; 4 production of ATP ; 5 production of reduced NADP ; 6 **AVP** ;	3	**A** light excites electrons (in chlorophyll) / chlorophyll absorbs light **A** NADPH / $NADPH_2$ e.g. electron transport chain / chemiosmosis / photophosphoryation
3(b)(i)	1.17 ;; $mm^3 min^{-1}$; **OR** 0.0194 ;; $mm^3 s^{-1}$; **OR** 70.0 ;; $mm^3 hr^{-1}$;	3	**A** other correct answers using different units 35÷30 = 1.166666666…. for 1 mark 0.01944…… for 1 mark 70 for 1 mark

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Question	Answer	Marks	Guidance
3(b)(ii)	*any **5** from:* 1 green algae photosynthesise have fast(er) at higher light intensities / red / brown, algae photosynthesise fast(er) at lower light intensities / / **ORA** / **AW** 2 green algae have faster photosynthesis when closer to surface / **AW / ORA** ; 3 red / brown, algae have faster photosynthesis in deeper water / **AW** ; 4 red light / long wavelengths, do not penetrate far / **AW** / **ORA** ; **5** blue / green light, / short wavelengths, penetrate deeper water / **AW ;** 6 green algae cannot, absorb / use, green light / **AW** ; 7 brown algae / red algae, absorb / use, blue, red and green light / **AW** ; 8 <u>all</u> algae have chlorophyll *a* because it is the <u>primary pigment</u> ; 9 **AVP** ;	**5**	**A** green algae need higher light intensities / live at higher light intensities **A** red / brown algae live at lower light intensities **A** green algae cannot live at lower light intensities **A** green algae (are adapted to) live in shallow water / AW **A** green algae cannot live in deeper water **A** red / brown (are adapted to) live in deeper water / AW **A** green algae only, absorb / use, red and blue / e.g. there must be a cost associated with fucoxanthin / phycobilin for algae at surface / **AW ;** e.g. green algae may have higher concentration of chlorophyll / **AW** ;

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Question	Answer	Marks	Guidance
4(a)	*any **1** from:* 1 satellite tracking / AIS recognition devices ; 2 planes / drones ; 3 (boat) patrols ; 4 (random) inspection of catch ;	**1**	
4(b)(i)	1 linear *y*-axis for number of boats confiscated, labelled ; 2 linear *y*-axis for estimated fish population / million tonnes, labelled with units ; 3 both lines occupy at least half graph paper ; 4 points / bars, accurately plotted (± half square) ;; 5 straight lines drawn accurately / neat bars ;	**6**	**A** one mark for each set of data

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4(b)(ii)</td><td>any 3 from:
1 after monitoring / 2014, more boats confiscated / AW ;
2 as more boats are confiscated, fish populations increase / AW ;
3 fish are breeding more / higher recruitment / AW ;
4 data has no mention of types of fish (so may not be valid) / AW ;
5 fish populations were estimated / AW ;
6 AVP ;</td><td>3</td><td>A other factors may have affected the fish population

e.g. the number of boats confiscated in 2018 was the same as in 2016 but fish population increased from 2016</td></tr>
<tr><td>4(c)(i)</td><td><table>
<tr><td>2012</td><td>23</td><td>2</td><td>450</td><td>2.5</td><td>–0.5</td><td>0.25</td></tr>
<tr><td>2013</td><td>18</td><td>1</td><td>350</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>2014</td><td>46</td><td>3</td><td>450</td><td>2.5</td><td>0.5</td><td>0.25</td></tr>
<tr><td>2015</td><td>75</td><td>4</td><td>480</td><td>4</td><td>0</td><td>0</td></tr>
<tr><td>2016</td><td>95</td><td>5.5</td><td>650</td><td>5</td><td>0.5</td><td>0.25</td></tr>
<tr><td>2017</td><td>125</td><td>7</td><td>750</td><td>7</td><td>0</td><td>0</td></tr>
<tr><td>2018</td><td>95</td><td>5.5</td><td>740</td><td>6</td><td>–0.5</td><td>0.25 ;</td></tr>
<tr><td colspan="6"></td><td>ΣD^2 = 1(.00) ;</td></tr>
</table></td><td>2</td><td>ECF total from incorrect data at 2016 and 2018</td></tr>
<tr><td>4(c)(ii)</td><td>0.98 (21429) ;</td><td>1</td><td>A ECF from (c)(i)</td></tr>
</table>

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Question	Answer	Marks	Guidance
4(c)(iii)	*any **3** from:* there is a significant positive correlation; the null hypothesis is rejected ; the critical value is 0.786 ; the calculated value is greater than the critical value ;	**3**	**A ECF** from **(c)(ii)** **A** there is a probability of less than, 0.05 / 5%, that the correlation is due to chance ;
4(c)(iv)	*any **2** from:* 1 more employment (for legal fishers) / higher income / **AW** ; 2 higher standard of living / **AW** ; 3 more secondary / service industry ; 4 better social cohesion / less crime / better relationship with authorities / **AW** ; 5 loss of livelihood / money / way of making a living for illegal fishers ; 6 risk of prison for illegal fishers so loss of money for families ;	**2**	
4(c)(v)	*any **2** from:* 1 (mean monthly) income has increased / **AW** ; 2 there is high variability / bigger range in income, (in 2018) / **ORA / AW**; 3 standard deviations overlap so may be no, (significant) difference ; 4 some people in 2018 earn less than some people in 2012 ;	**2**	

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Question	Answer	Marks	Guidance
5(a)	*any **4** from:* 1 carbon dioxide dissolves in water ; 2 carbonic acid formation / pH falls / increased acidity occurs ; 3 forms hydrogen ions / forms hydrogen carbonate ions ; 4 loss of carbonate ions in water / fewer carbonate ions for shell production / calcium carbonate in shells reacts with acid / shells dissolve shells / shells are weaker / **AW** ; 5 more susceptible to predation / damaged by wave action / **AW** ;	**4**	 **A** correct formulae **A** correct formulae

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Question	Answer	Marks	Guidance
5(b)	*hypothesis (h)* increasing concentration of copper will reduce growth of cowries / **AW** ; ***PLUS** any **10** from*: *independent variable (i)* 1 changing concentration of copper sulfate ; 2 use of at least five concentrations ; *dependent variable (d)* 3 (rate of) growth of cowries / size of cowries / **AW** ; *standardised variables (**MAX 3**)(c)* 4 same substrate / volume of tank / volume of water ; 5 same oxygen; 6 same species / age of cowrie / **AW** ; 7 same concentration of carbon dioxide / bicarbonate ; 8 temperature ; 9 same food ; 10 same salinity ; 11 pH ;	**11**	**A** null hypothesis **A** different volumes of copper sulfate Needs units or % at least once

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Question	Answer	Marks	Guidance
5(b)	*methods (**MAX 3**)(m)* 12 method of making dilutions ; 13 measure, (change in) length / mass, in stated time ; 14 use of water baths; 15 use of buffer ; *safety and ethics (e)* 16 suitable safety method linked to relevant risk ; 17 suitable ethical consideration linked to relevant risk ; *analysis (a) (**MAX 3**)* 18 example of results table (with headers) ; 19 replications **+** calculation of means / standard deviations ; 20 use of appropriate statistical test (e.g. Spearman's rank / 95% confidence limits) ; 21 description of appropriate graph (must have axes) ;		e.g. use of eye protection as copper sulfate is toxic / **AW** ; e.g.do not use excessive concentrations / do not damage cowries / return animals to shore / do not wash waste chemicals into water system / do not take too many from wild ;

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