CAMBRIDGE
International Education

Cambridge International AS & A Level

MARINE SCIENCE **9693/43**

Paper 4 A Level Data-handling and Investigative skills **May/June 2024**

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 2024 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 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.
5	'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.

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
underline	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)	correct conversion to µm ; image length divided by 8500 ; given to three significant figures ;	**3**
1(a)(ii)	*any **2** of:* 1 chloroplast ; 2 cell wall ; 3 vacuole ; 4 starch granule ;	**2**
1(b)	clear thin lines with no shading and suitable size ; drawing at least size of micrograph mitochondrion ; width of mitochondrion in proportion to length and cristate thickness in proportion ; double membrane, minimum of 4 cristae and two circles ;	**4**

Question	Answer	Marks
2(a)(i)	(organisms) that can live in salt and fresh water / can live in a range of salinities / **AW** ;	**1**
2(a)(ii)	*any **2** of:* 1 (steep) increase ; 2 levels off after one day/fluctuates after one day / goes up and down after one day / decrease and increase after one day / **AW** ; 3 accept correct manipulated data ;	**2**
2(a)(iii)	*any **4** of:* 1 fish has lower water potential (than water) / (fresh) water has higher water potential than fish / **AW** ; 2 so water enter fish by osmosis / **AW** ; 3 (gill cells) move, salt / sodium / chloride / ions, **into**, body / blood ; 4 by active transport / active process (of salt) ; 5 so more energy (needs to be released) ; 6 as salt is lost from body via urine / diffusion / salt diffuses out of fish ; 7 maximum rate of, salt / sodium / chloride, pumping occurs after one day / **AW** ;	**4**

Question	Answer	Marks
2(a)(iv)	*any **1** of:* 1 as a control experiment ; 2 to compare the effects of different salinity on non-osmoregulatory cells / **AW** ;	**1**
2(b)(i)	0.85 ; 0.85/2.1 × 100 = 40.(476190) (%) ;	**2**
2(b)(ii)	*any **4** of:* 1 mussels are osmoconformers ; 2 correct ref to overlapping error bars ; 3 correct ref to movement of water by osmosis from high water potential to lower water potential / down a water potential gradient ; *Group **A** (max 2)* 4 water enters mussel cells by osmosis ; 5 as mussel (cells) had taken up salt / conformed to 35 ppt ; *Group **B** (max 2)* 6 water leaves mussel cells by osmosis ; 7 as mussel (cells) had lost salt / conformed to 15 ppt ;	**4**

Question	Answer	Marks
3(a)(i)	linear scales for all three axes and both lines must cover at least three large squares ; labels and unit on all axes ; plots correct ; points joined by straight lines ; lines have a key ; Table 3.1 year / number of haddock per square kilometre / mean length of female haddock / cm 1990 / 100 / 27 1995 / 120 / 28 2000 / 90 / 23 2005 / 120 / 19 2010 / 110 / 17 2015 / 140 / 16 2020 / 130 / 15	**5**
3(a)(ii)	*any **2** of:* 1 female fish size decreases ; 2 as larger fish are trapped in the mesh / smaller fish pass through the mesh / larger fish are caught / **AW** ; 3 so the number of larger fish in sea decreases / proportion of smaller fish in sea increases / **AW** ;	**2**
3(a)(iii)	the most frequent size of female fish / size of most fish / commonest length / **AW** ;	**1**
3(a)(iv)	*any **4** of:* 1 population of haddock increases / **AW** ; 2 (but mean) size of fish decreases / **AW** ; 3 percentage of female fish that are mature at 2 years increases / **AW** ; 4 younger fish are reproducing / younger fish become sexually mature younger / **AW** ; 5 age profile of haddock has changed / fewer older fish / more younger fish ; 6 higher fecundity / recruitment ;	**4**

Question	Answer	Marks
3(b)	*any **3** of:* ***max 2** of:* 1 satellite tracking / **AW** ; 2 patrol boats / checking at quayside / checking when ashore / observe with helicopters / **AW** ; 3 inspections of gear / catch ; ***max 2** of:* 4 fines ; 5 impounding gear / confiscating boats / confiscating equipment ; 6 imprisonment ;	**3**

Question	Answer	Marks
4(a)(i)	*any **2** of:* **accurate because (max 1):** 1 if fish populations are high, catch will be high / **ORA** / **AW** ; 2 number of fish caught represents the populations / **AW** ; 3 idea that data is standardised (so easy to compare) ; **not accurate because (max 1):** 4 other factors affect effort /effort is not just number of days and number of fishers / **AW** ; 5 ignores bycatch / dumped fish / **AW** ; 6 boats sizes may vary / fishing gear / methods vary / time actually spent fishing may vary **AW** ; 7 illegal fishing may occur / some catches are not recorded / **AW** ; 8 not all fish in the population are not caught / **AW** ; 9 other factors influence fish populations / fish may migrate / fish populations are seasonal / **AW** ;	**2**
4(a)(ii)	*any **2** of:* 1 in Area A / no take zone, CPUE increases / fish population is more sustainable / **AW** ; 2 steep / **AW**, increase, between 4 and 5 years / after 4 years ; 3 compared with in Area B / fished area, where CPUE / population falls / population is less sustainable / **AW** ;	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)(iii)</td><td>any 3 of:
1 no-take zone is a breeding area / nursery area / AW ;
2 more food in zone / more prey in zone / AW ;
3 allows fish to reach maturity / reproductive age / AW ;
4 fish travel out of zone into fishing areas (so catches rise) / AW ;
5 less damage to habitats from fishing / AW ;</td><td>3</td></tr>
<tr><td>4(b)(i)</td><td>there is no correlation / association, between CPUE and income ;</td><td>1</td></tr>
<tr><td>4(b)(ii)</td><td>
<table>
<tr><th>year</th><th>CPUE / kg per fisher per day</th><th>rank CPUE</th><th>income / US$ per fisher per month</th><th>rank income</th><th>D</th><th>D^2</th></tr>
<tr><td>0</td><td>2.5</td><td>9</td><td>240</td><td>8</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>2.7</td><td>8</td><td>225</td><td>9</td><td>-1</td><td>1</td></tr>
<tr><td>2</td><td>3.0</td><td>7</td><td>250</td><td>7</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>3.1</td><td>5.5</td><td>400</td><td>6</td><td>-0.5</td><td>0.25</td></tr>
<tr><td>4</td><td>3.1</td><td>5.5</td><td>425</td><td>4</td><td>1.5</td><td>2.25</td></tr>
<tr><td>5</td><td>3.8</td><td>2.5</td><td>410</td><td>5</td><td>-2.5</td><td>6.25</td></tr>
<tr><td>6</td><td>3.7</td><td>4</td><td>465</td><td>3</td><td>1</td><td>1</td></tr>
<tr><td>7</td><td>3.8</td><td>2.5</td><td>525</td><td>1</td><td>1.5</td><td>2.25 ;</td></tr>
<tr><td>8</td><td>3.9</td><td>1</td><td>520</td><td>2</td><td>-1</td><td>1</td></tr>
</table>
</td><td>1</td></tr>
<tr><td>4(b)(iii)</td><td>$\sum D^2 = 15$;
0.875 ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
4(b)(iv)	*any **3** of:* 1 there is a significant positive correlation / association ; 2 the calculated value of the coefficient is greater than the critical value ; 3 0.7 is the critical value ; 4 there is a probability of less than, 0.5 / 5%, that the association is due to chance ; 5 the null hypothesis is rejected ;	**3**
4(b)(v)	*any **4** of:* ***max 3** of (long term):* 1 unemployment for short term / loss of income / fewer fishers / **AW** ; 2 loss of living standards lack of purchasing power / poverty / **AW** ; 3 unable to buy food / malnutrition due to lack of money / **AW** ; 4 loss of traditional ways of life / **AW** ; 5 migration of people away from area / **AW** ; 6 loss of services / schools / secondary industries / loss of businesses / loss of boat builders / harbour services / **AW** ; 7 increase in illegal activities / illegal fishing / **AW** ; 8 conflict / tension, against authorities / **AW** ; ***max 3** of (short term):* 9 fishing is sustainable ; 10 secures food for future / **AW** ; 11 long term employment secured / job security / future generations will be able to fish / **AW** ; 12 new job opportunities / people retrain into new careers / **AW** ;	**4**

Question	Answer	Marks
5 (a)(i)	41 250 000 000 ; kg ;	**2**

Question	Answer	Marks
5(a)(ii)	*any **2** of:* 1 flooding of coastal areas / sea level rise / **AW** ; 2 habitat loss ; 3 coral bleaching / **AW** ; 4 changes in distribution of species / migration of species / **AW** ; 5 changes in circulation of sea currents ; 6 loss of biodiversity / extinction of species / loss of biodiversity / **AW** ; 7 spread of disease / pathogens / pests / **AW** ;	**2**
5(a)(iii)	*any **3** of:* 1 carbon dioxide dissolves ; 2 forms H_2CO_3 / carbonic acid ; 3 dissociates into H^+ and HCO_3^- (hydrogen carbonate) ; 4 H^+ ions react with CO_3^{2-} ions ;	**3**

Question	Answer	Marks
5(b)	lower pH will reduce rate of growth of mussels ; *and any **11** of:* *independent variable* 1 independent variable: pH ; 2 at least five stated pHs used ; 3 mussels placed into beakers ; *dependent variable* 4 dependent variable: length / mass of mussels / growth of mussel / **AW** ; 5 length measured with ruler / mass with balance ; *standardised variables* ***(max 3)*** 6 volume of water / volume of tanks ; 7 volume of pH buffer added ; 8 temperature ; 9 salinity / mineral ions / **AW** ; 10 quantity of food / nutrients / feeding regime / **AW** ; 11 oxygen / carbon dioxide concentration ; 12 same mussel, species / age / size / **AW** ; *method marks* ***(max 3)*** 13 air bubbled through ; 14 pH buffers used ; 15 salt weighed out and added to water (to maintain salinity) ; 16 method for measuring mussels ; *ethics and safety* 17 identification of any risk with method to minimise / statement that experiment is low risk / **AW**; 18 ensure no extreme temperature / pH used so mussels are not harmed / ensure mussels are replaced / ensure that 19 mussels are fed / do not release waste chemicals into the drains / **AW** ;	**12**

Question	Answer	Marks
5(b)	*analysis* ***(max 3)*** 20 rate of growth calculated as, length / mass, divided by time ; 21 plot graph of mussel length / mass / growth rate against pH ; 22 calculation of correlation coefficient / Spearman's rank ; 23 example of correct results table ; 24 repeats and calculate mean / median / standard deviation / standard error ;	