Cambridge Assessment International Education

Cambridge International AS & A Level

MARINE SCIENCE **9693/04**

Paper 4 A Level Data-handling and Investigative Skills **For examination from 2022**

MARK SCHEME

Maximum Mark: 75

Specimen

This document has **14** pages. Blank pages are indicated.

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	‘List rule’ guidance (see examples below) 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.

Abbreviations used in the Mark Scheme

This mark scheme will use the following abbreviations:

;	separates marking points
/	separates alternatives within a marking point
OR	gives alternative marking point
R	reject
I	ignore mark as if this material was not present
A	accept (a less than ideal answer which should be marked correct)
COND	indicates mark is conditional on previous marking point
ECF	credit a correct statement that follows a previous wrong response
( )	the word / phrase in brackets is not required, but sets the context
ORA	or reverse argument
AW	alternative wording (where responses vary more than usual)
AVP	alternative valid point (where a greater than usual variety of responses is expected)
underline	word underlined must be used by the candidate (grammatical variants accepted)
+	statements on both sides of the **+** are needed for that mark
max	indicates the maximum number of marks that can be awarded

Examples of how to apply the list rule

State **three** reasons ... [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B (4 responses)

1. Correct, Correct	✓, ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C (4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓, ×	
3. Correct	ignore	

D (4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E (4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F (4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

Question	Answer	Marks	Guidance
1(a)(i)	1.30 ; ; kg trap^{-1} ;	**3**	marks for: 300 (000) ÷ 230 (000) ; 1.30 ; kg trap^{-1} or kg / trap ; 3 marks for 1.30 kg trap^{-1} with no working
1(a)(ii)	separate linear scales on both *y* axes that uses half the grid ; all axes labelled including units ; points correctly plotted (accept **ECF** for 2015) ; straight lines joining points ; key for lines / clear indication of lines / bars ;	**5**	**A** bar chart or line graph **Allow** two plotting errors **A** neat bars of equal width that do not touch
1(a)(iii)	CPUE decreases then increases ; identification of 1995 as 'turning point' ;	**2**	
1(a)(iv)	*any **four** from:* CPUE has increased as quotas have decreased ; suggesting that lobster numbers are higher ; CPUE has only changed a small amount ; CPUE decreased in 2015 despite quota increasing ; other factors may affect the population of lobsters ; CPUE was high in 1980 when there were no quotas ; there is a time lag between CPUE changes and quota changes ; traps may be more efficient / better at catching lobsters (when CPUE is high) / traps may be different ;	**4**	

Question	Answer	Marks	Guidance
1(b)	labelling of products / cans ; publicity campaigns ; price tariffs ;	**3**	**A** correct examples of each

Question	Answer	Marks	Guidance
2(a)	*any **three** from:* water is taken into mouth ; muscles in mouth contract when mouth closes ; volume decreases and pressure increases ; operculum opens ; water is forced from mouth over gills (via operculum) ;	**3**	

Question	Answer	Marks	Guidance
2(b)	*any **twelve** from:* *hypothesis:* as temperature increases, ventilation rate increases ; *plan:* temperature is the independent variable ; minimum of five different temperatures ; range of between minimum 5 °C and max. 30 °C ; ref. to use of water baths ; same age / species / mass trout ; count number of operculum openings in set time / time how long it takes to open operculum stated number of times ; calculate rate as number of openings divided by time taken ; replicates and calculate means ; two other named standardised variables, e.g. salinity, water volume, feeding, oxygen levels, carbon dioxide levels ; ref. to ethical treatment, e.g. allow fish to rest between experiments / do not test at very high temperatures / allow sufficient space to move ; ref. to one relevant safety feature ; calculate standard deviations / standard error ; determine if error bars overlap ;	**12**	 **A** null hypothesis **ORA** **A** other correct, relevant variables

Question	Answer	Marks	Guidance
2(c)(i)	clear outlines with no broken lines (line quality) ; correct magnification of ×2 (magnification and size) ; similar lengths of lamellae on upper and lower sides (proportion) ; correct number of lamellae (detail) ;	**4**	
2(c)(ii)	*any **two** from:* thicker lamellae / filaments so reduced surface area ; smaller gap between lamellae, reducing water flow ; reduced oxygen uptake / carbon dioxide removal ;	**2**	

Question	Answer	Marks	Guidance
3(a)(i)	photosynthesis ;	**1**	
3(a)(ii)	0.5 (3) ; ; ;	**3**	calculation of net increase (218 – 214) = 4 ($\times 10^{12}$) kg ; **A** other valid method calculation of (4 ($\times 10^{12}$)) ÷ (750 ($\times 10^{12}$)) ; calculation of percentage change (0.5(3)%) ; **I** additional significant figure
3(a)(iii)	(pH will) decrease ; (because there is a) net increase of atmospheric carbon dioxide / more carbon dioxide dissolves in ocean water ;	**2**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3(b)(i)</td><td>correct completed table ; ;</td><td>2</td><td>(one mark for correct rows, one mark for correct calculation of the sum of D^2)
<table>
<tr><th>pH of solution</th><th>rank pH</th><th>decrease in mass of shell / g</th><th>rank decrease mass of shell</th><th>D</th><th>D^2</th></tr>
<tr><td>1</td><td>1</td><td>3.35</td><td>7</td><td>–6</td><td>36</td></tr>
<tr><td>2</td><td>2</td><td>3.37</td><td>6</td><td>–4</td><td>16</td></tr>
<tr><td>3</td><td>3</td><td>3.10</td><td>5</td><td>–2</td><td>4</td></tr>
<tr><td>4</td><td>4</td><td>2.71</td><td>3.5</td><td>0.5</td><td>0.25</td></tr>
<tr><td>5</td><td>5</td><td>2.71</td><td>3.5</td><td>1.5</td><td>2.25;</td></tr>
<tr><td>6</td><td>6</td><td>0.42</td><td>2</td><td>4</td><td>16</td></tr>
<tr><td>7</td><td>7</td><td>0.10</td><td>1</td><td>6</td><td>36</td></tr>
<tr><td colspan="5"></td><td>ΣD^2 = 110.5 ;</td></tr>
</table></td></tr>
<tr><td>3(b)(ii)</td><td>there is no association / correlation, between pH and decrease in mass of shell ;</td><td>1</td><td></td></tr>
<tr><td>3(b)(iii)</td><td>–0.973 ;</td><td>1</td><td>A ECF</td></tr>
<tr><td>3(b)(iv)</td><td>any three from:
the calculated value is greater than the critical value of 0.786 ;

there is a significant negative correlation ;

the null hypothesis is rejected ;

there is a less than, 0.05 / 5% , probability that the association is due to chance ;</td><td>3</td><td>A ECF using incorrect value from 3(b)(iii)</td></tr>
</table>

Question	Answer	Marks	Guidance
3(b)(v)	*any **two** from:* carry out more replicates ; to remove the effect of outliers / anomalies ; control other named variables ; intermediate pH values (e.g. 1.5, 2.5) ;	**2**	 **I** reduce anomalies

Question	Answer	Marks	Guidance
4(a)(i)	*any **two** from:* (bacteria) are the producers ; fixing energy for higher trophic levels ; as there is no light for photosynthesis ;	**2**	

Question	Answer	Marks	Guidance
4(a)(ii)	*any **four** from:* *similarities:* both use carbon dioxide ; both produce glucose ; *differences:* water is produced by chemosynthesis / is used by photosynthesis ; sulfur is produced by chemosynthesis ; hydrogen sulfide is used in chemosynthesis ; light is the energy source for photosynthesis ; chlorophyll versus no chlorophyll ;	**4**	
4(b)(i)	*any **one** from:* algae / phytoplankton could be present ; (lack of light) prevents photosynthesis ; which would fix carbon / so that all carbon fixed is due to chemosynthesis ;	**1**	
4(b)(ii)	*any **three** from:* increases up to 60 °C and then decreases ; highest rate (measured) at 60 °C ; correct example of data manipulation ; large increase at 60 °C ;	**3**	

Question	Answer	Marks	Guidance
4(b)(iii)	*any **three** from:* rate increases at 50 °C, 60 °C and 80 °C / rate does not increase at 15 °C ; only significant increase at 60 °C ; as error bars do not overlap ; credit correct example of data manipulation ; credit correct statement about temperature or hydrogen sulfide acting as limiting factors ;	**3**	

Question	Answer	Marks	Guidance
5(a)	*euryhaline*: lives in salt water and freshwater ; *osmoregulator*: organism that maintains its water content / **AW** ;	**2**	
5(b)(i)	*name:* Golgi, body / apparatus ; *function:* modification of proteins / **AW** ;	**2**	
5(b)(ii)	*any **three** from:* many mitochondria present ; providing energy ; for active transport ; ref. to pumping of salt / chloride ions ; against concentration gradient ;	**3**	

Question	Answer	Marks	Guidance
5(c)	*any **two** from:* more cells at 50 ppt and 15 ppt ; more chloride / salt needs pumping at high and low salinities ; 35 ppt is isotonic to fish body fluids ;	**2**	