



# Cambridge International AS & A Level

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**MARINE SCIENCE**

**9693/02**

Paper 2 AS Level Data-handling and Investigative Skills

**For examination from 2022**

MARK SCHEME

Maximum Mark: 75

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**Specimen**

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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	<p><u>Calculation specific guidance</u></p> <p>Correct answers to calculations should be given full credit even if there is no working or incorrect working, <b>unless</b> the question states 'show your working'.</p> <p>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.</p> <p>For answers given in standard form, (e.g. <math>a \times 10^n</math>) in which the convention of restricting the value of the coefficient (<math>a</math>) 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.</p> <p>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.</p>
7	<p><u>Guidance for chemical equations</u></p> <p>Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.</p> <p>State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.</p>

### Abbreviations used in the Mark Scheme

This mark scheme will use the following abbreviations:

;	separates marking points
/	separates alternatives within a marking point
<b>OR</b>	gives alternative marking point
<b>R</b>	reject
<b>I</b>	ignore mark as if this material was not present
<b>A</b>	accept (a less than ideal answer which should be marked correct)
<b>COND</b>	indicates mark is conditional on previous marking point
<b>ECF</b>	credit a correct statement that follows a previous wrong response
( )	the word / phrase in brackets is not required, but sets the context
<b>ORA</b>	or reverse argument
<b>AW</b>	alternative wording (where responses vary more than usual)
<b>AVP</b>	alternative valid point (where a greater than usual variety of responses is expected)
<b><u>underline</u></b>	word underlined must be used by the candidate (grammatical variants accepted)
<b>+</b>	statements on both sides of the + are needed for that mark
<b>max</b>	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	✓	<b>2</b>
2. Correct	✓	
3. Wrong	✗	

**B (4 responses)**

1. Correct, Correct	✓, ✓	<b>3</b>
2. Correct	✓	
3. Wrong	ignore	

**C (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct, Wrong	✓, ✗	
3. Correct	ignore	

**D (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct, CON (of 2.)	✗, (discount 2)	
3. Correct	✓	

**E (4 responses)**

1. Correct	✓	<b>3</b>
2. Correct	✓	
3. Correct, Wrong	✓	

**F (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct	✓	
3. Correct CON (of 3.)	✗ (discount 3)	

**G (5 responses)**

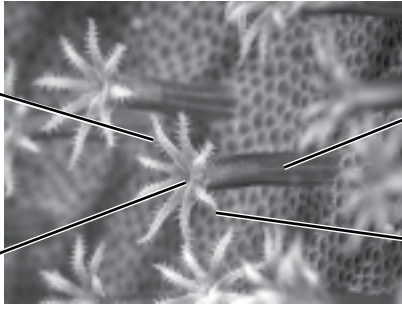
1. Correct	✓	<b>3</b>
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

**H (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct	✗	
3. CON (of 2.) Correct	(discount 2) ✓	

**I (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct	✗	
3. Correct CON (of 2.)	✓ (discount 2)	

Question	Answer	Marks	Guidance
1(a)	<p>correct placement of labels as follows:</p> <p>mouth labelled in centre of tentacles ;</p> <p>stomach labelled on body of polyp ;</p> <p>nematocysts labelled on tentacle(s) ;</p> <p>one or any number of tentacles labelled ;</p>	4	<p>mouth</p> <p>nematocysts</p>  <p>tentacle</p> <p>stomach</p>
1(b)(i)	<p>pentaradial symmetry ;</p> <p>tube feet ;</p>	2	
1(b)(ii)	<p>quality of outline (thin and continuous) ;</p> <p>suitable size (at least 70 mm × 70 mm) ;</p> <p>in proportion (arms longer than they are wide) ;</p> <p>detail (at least white area on ends of arms demarked) ;</p>	4	<b>AVP</b>
1(c)	<p><i>C. / Chaetodon, trifascialis</i> ;</p>	1	

Question	Answer	Marks	Guidance
1(d)	<p>any <b>three</b> from: use of transect ; use of quadrat ; idea of sampling in systematic way, e.g. placing quadrat every 2 m ; idea of recording organisms found ; idea of repeating multiple transects ; avoidance of reef damage ;</p>	3	<p><b>A</b> belt or line <b>A</b> taking photographs</p>
Question	Answer	Marks	Guidance
2(a)(i)	<p>suitable scale for x and y axes ; correct labels for each axis including units ; correct plots <math>\pm 1</math> mm ; plots joined with straight lines ;</p>	4	<p>plots must cover at least half of grid <b>R</b> extrapolation beyond plots</p>
2(a)(ii)	<p>any <b>three</b> from: as temperature of water increases density decreases ; decrease is greater at higher temperatures ; manipulation of figures ;</p>	3	
2(b)	<p>values for density would decrease ; due to change in bonding as state changes ;</p>	2	
2(c)	<p>values at each temperature would be higher ; dissolved salts add to mass per unit volume ;</p>	2	

Question	Answer	Marks	Guidance
2(d)	warming of water at surface (by Sun) causes it to float (above) ; colder water with higher density will sink ;	2	
3(a)(i)	$52 \times 41 / 12 = 177.67 / 177.7$ ; 178 ;	2	answer of 178 gains both marks
3(a)(ii)	any <b>three</b> from: same catch effort for each sample ; take each sample at the same place on the reef ; take each sample at the same time of day ; take each sample at the same point in the tidal cycle ; ref. to appropriate length of time between samples ; ensure tags are all attached in same way ;	3	<b>A</b> ref. to high / low not neap / spring



Question	Answer	Marks	Guidance
3(a)(iii)	<p>paired points, <b>one</b> mark for limitation and <b>one</b> for explanation:</p> <p>any <b>two</b> from:</p> <ol style="list-style-type: none"> <li>1 tags may come off ... ; ... so <math>m_2</math> smaller than should be ;</li> <li>2 fish may enter / leave ecosystem between samples ... ; ... so <math>m_2</math> smaller / <math>n_2</math> smaller or larger than should be ;</li> <li>3 fish may die between samples ... ; ... so <math>m_2 / n_2</math> smaller than should be ;</li> <li>4 fish often occur in shoals / lack of mixing of population ... ; ... so estimate could end up much larger or smaller than actual population ;</li> <li>5 small sample size (especially <math>m_2</math>) ... ; ... so greater room for error ;</li> </ol>	2	<p><b>R</b> idea of more fish being born</p>
3(b)	<p>any <b>three</b> from:</p> <p>idea of correlation not causation ; higher parasite numbers in same years as high health index / poor health ; true for both parasites overall ; in 2006 health index low but parasite <b>B</b> numbers high ; in 2007 health index high but parasite <b>A</b> numbers not so high ;</p>	3	

Question	Answer	Marks	Guidance				
4(a)(i)	carbon dioxide + water ; glucose + oxygen ;	2	<p><b>A</b> correct, balanced symbol formulae</p> <p><b>I</b> chlorophyll + light</p>				
4(a)(ii)	<p><b>any five from:</b> seagrass carefully removed / contained in suitable vessel ; (independent variable) description of variation of light intensity ; suggested suitable range ; (dependent variable) measurement of evolution of oxygen ; suitable method described for recording oxygen evolution ; description of rate calculation ; any <b>two</b>, standardised / control, variables, e.g. temperature of water / amount of seagrass used ; idea of repeating results ; calculation of mean from repeats ; credit reference to trying to remove heating effect, e.g. using Perspex screen ; credit reference to ensuring CO<sub>2</sub> is not a limiting factor ; credit safety consideration, e.g. burn from lamp / electrical kit and water ;</p>	5	<p><b>A</b> changing distance / voltage of lamp</p> <p><b>A</b> use of meters or measuring volume</p>				
4(a)(iii)	<p>labelled 1st column for independent variable + appropriate units ; labelled 2nd column for dependent variable + appropriate units ;</p>	2	<p>e.g.</p> <table border="1" data-bbox="1241 190 1380 779"> <tr> <td data-bbox="1241 488 1326 779">distance of lamp from seagrass / cm</td> <td data-bbox="1241 190 1326 488">volume of oxygen produced / cm<sup>3</sup></td> </tr> <tr> <td data-bbox="1326 488 1380 779"></td> <td data-bbox="1326 190 1380 488"></td> </tr> </table> <p><b>I</b> inclusion of repeats or mean</p>	distance of lamp from seagrass / cm	volume of oxygen produced / cm <sup>3</sup>		
distance of lamp from seagrass / cm	volume of oxygen produced / cm <sup>3</sup>						

Question	Answer	Marks	Guidance
4(a)(iv)	axes labelled and line showing rate increasing with increasing light intensity / rate increasing and levelling off ; axes correct way round (independent variable on x axis) ;	2	
4(a)(v)	<i>any two from:</i> increase in light intensity increases rate of photosynthesis ; because more energy is available ;	2	A rate levels off due to limiting factor (e.g. chlorophyll content)
4(b)	<i>any two from:</i> easier to obtain samples of organism ; easier to maintain organism in the lab ; idea of easier to, standardise / control, amount of photosynthetic material ; easier to, standardise / control, other factors / named example of factor ;	2	
Question	Answer	Marks	Guidance
5(a)(i)	29 ; cm ;	2	
5(a)(ii)	as temperature increases oxygen concentration decreases <b>ORA</b> ; oxygen less soluble in warmer water ;	2	

Question	Answer	Marks	Guidance
5(b)	<p>any <b>three</b> from:</p> <p>sulfide released from (fissure in) Earth's crust ;</p> <p>exposure of seawater to magma ;</p> <p>due to seawater entering Earth's crust ;</p> <p>sulfide dissolves ;</p> <p>high, pressure / temperature helps nutrients sulfide dissolve ;</p>	3	
5(c)	<p>any <b>two</b> from:</p> <p>water cools as it re-enters ocean ;</p> <p>salts precipitate (out of solution) ;</p> <p>salts accumulate forming a chimney ;</p>	2	
Question	Answer	Marks	Guidance
6(a)	<p>any <b>three</b> from:</p> <p>nitrate concentration increases as depth increases ;</p> <p>little increase in nitrate levels between 0–40 m ;</p> <p>greatest increase from 40–56 m ;</p> <p>lower increase (again) below 104 m ;</p>	3	
6(b)(i)	<p>correct extraction of data (2.0 and 0.2) ;</p> <p>correct sum (<math>2.0 - 0.2 / 0.2 \times 100</math>) ;</p> <p>900 ;</p>	3	award all 3 marks for 900

Question	Answer	Marks	Guidance
6(b)(ii)	<p>any <b>three</b> from:            low light penetration below 40 m ;            lower productivity ;            fewer photosynthetic organisms / phytoplankton uptaking nitrates ;            idea of detritus from above ;</p>	<b>3</b>	
6(c)	<p>high winds cause, movement of water / ocean currents ;            leading to upwelling of nitrates from depth ;            increase in nitrate concentration in surface water ;</p>	<b>3</b>	
6(d)	<p>EITHER            increases due to increased photosynthesis ;            due to increased productivity of producers ;            OR            decreases due to increased respiration ;            due to increased consumer population ;            OR            no change ;            because photosynthesis and respiration both increase ;</p>	<b>2</b>	

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