

Cambridge International AS & A Level

MARINE SCIENCE

9693/21

Paper 2 AS Level Data-Handling and Investigative Skills

October/November 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 October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **16** printed pages.

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.

PUBLISHED**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.

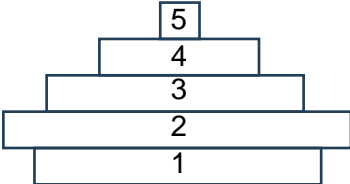
PUBLISHED

Question	Answer	Marks
1(a)	line at x axis (anywhere from 'i' at start of label to right), continuously getting closer to the y-axis as depth increases ; 0 near the top of the bathypelagic zone ;	2
1(b)(i)	carbon <u>dioxide</u> + water → glucose + oxygen ;	1
1(b)(ii)	<u>chemosynthesis</u>	1
1(c)(i)	(independent variable) (description of variation of) light <u>intensity</u> . AND (dependent variable) light transmitted / population or growth of phytoplankton / rate of photosynthesis / AW ;	1

Question	Answer		Marks
1(c)(ii)	key variable	how to standardise	3
	<i>any 2 in this column (for 1 mark)</i>	<i>1 mark for each correct answer matching a stated key variable (max 2)</i>	
	<u>temperature</u> (of water)	use of thermostat or water bath to maintain temp / screen or suitable method to prevent heating ;	
	salinity (of water)	<i>idea of</i> start with a stock solution of standard salinity to use for each trial ;	
	volume (of water)	use of (suitable) measuring equipment to measure volume ;	
	pH	<i>idea of</i> using stock solution / use a (pH) buffer ;	
	turbidity / clarity, (of water)	no sediment / particles / anything, that will block light ;	
	(dissolved) CO ₂	(sodium) hydrogencarbonate added to make this in excess / same amount added ;	
	(concentration of) nutrients	e.g. adding same, volume / mass, of nutrients to each experiment ;	
	(starting) volume / mass / number / population, of phytoplankton used / AW	description of mixed solution containing phytoplankton and equal volumes / mass / number etc. of phytoplankton added ;	
type / species of phytoplankton	use the same species / type ;		

PUBLISHED

Question	Answer		Marks														
1(c)(ii)	<table border="1"> <thead> <tr> <th data-bbox="322 217 741 282">key variable</th> <th data-bbox="741 217 1370 282">how to standardise</th> </tr> </thead> <tbody> <tr> <td data-bbox="322 282 741 384">background light</td> <td data-bbox="741 282 1370 384">any valid description to control e.g. turn off any other lights / dark room / close blinds etc ;</td> </tr> <tr> <td data-bbox="322 384 741 486">light sensor (calibration / initial value)</td> <td data-bbox="741 384 1370 486">make sure set to zero / same initial value each time ;</td> </tr> <tr> <td data-bbox="322 486 741 588">distance of light sensor from container</td> <td data-bbox="741 486 1370 588">using a ruler (or other valid measuring equipment) ;</td> </tr> <tr> <td data-bbox="322 588 741 691">time the phytoplankton is left for / intervals for readings</td> <td data-bbox="741 588 1370 691">stated duration of experiment / use of timer or stopwatch ;</td> </tr> <tr> <td data-bbox="322 691 741 793">wavelength / colour of light</td> <td data-bbox="741 691 1370 793">use the same lamp / bulb / filter ;</td> </tr> <tr> <td data-bbox="322 793 741 863"><i>idea of material the container is made from</i></td> <td data-bbox="741 793 1370 863">use container made from same material ;</td> </tr> </tbody> </table>	key variable	how to standardise	background light	any valid description to control e.g. turn off any other lights / dark room / close blinds etc ;	light sensor (calibration / initial value)	make sure set to zero / same initial value each time ;	distance of light sensor from container	using a ruler (or other valid measuring equipment) ;	time the phytoplankton is left for / intervals for readings	stated duration of experiment / use of timer or stopwatch ;	wavelength / colour of light	use the same lamp / bulb / filter ;	<i>idea of material the container is made from</i>	use container made from same material ;		
key variable	how to standardise																
background light	any valid description to control e.g. turn off any other lights / dark room / close blinds etc ;																
light sensor (calibration / initial value)	make sure set to zero / same initial value each time ;																
distance of light sensor from container	using a ruler (or other valid measuring equipment) ;																
time the phytoplankton is left for / intervals for readings	stated duration of experiment / use of timer or stopwatch ;																
wavelength / colour of light	use the same lamp / bulb / filter ;																
<i>idea of material the container is made from</i>	use container made from same material ;																
1(c)(iii)	<p>suitable safety precaution e.g. burn from lamp / electrical equipment and water ;</p> <p>plus any 3 from:</p> <p>suitable <u>method for</u> adjusting light intensity ;</p> <p>use of intervals resulting in at least three values ;</p> <p><i>idea of leaving</i> experiment for a period of time to get results ;</p> <p><i>idea of repeating</i> at least 3 (sets of) results ;</p> <p><i>idea of adding</i> nutrients to the vessel ;</p>		4														

Question	Answer	Marks												
2(a)	<p>five horizontal rectangles drawn AND stacked centrally on top of each other AND no gaps ;</p> <p>all five bars in correct order (from bottom to top so smallest at top, largest second from bottom) ;</p> <p>all five bars drawn to scale AND all same, height for horizontal bars / width for vertical bars ;</p> <p>all bars labelled with correct trophic levels ;</p> <table border="1" data-bbox="338 486 871 948"> <thead> <tr> <th data-bbox="338 486 551 620">trophic level</th> <th data-bbox="551 486 871 620">total biomass / arbitrary units</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 620 551 686">5</td> <td data-bbox="551 620 871 686">0.5</td> </tr> <tr> <td data-bbox="338 686 551 751">4</td> <td data-bbox="551 686 871 751">2.1</td> </tr> <tr> <td data-bbox="338 751 551 817">3</td> <td data-bbox="551 751 871 817">3.4</td> </tr> <tr> <td data-bbox="338 817 551 882">2</td> <td data-bbox="551 817 871 882">4.6 (widest)</td> </tr> <tr> <td data-bbox="338 882 551 948">1</td> <td data-bbox="551 882 871 948">3.8</td> </tr> </tbody> </table> 	trophic level	total biomass / arbitrary units	5	0.5	4	2.1	3	3.4	2	4.6 (widest)	1	3.8	4
trophic level	total biomass / arbitrary units													
5	0.5													
4	2.1													
3	3.4													
2	4.6 (widest)													
1	3.8													
2(b)	<p><i>any 2 from:</i></p> <p><i>idea that</i> producers / trophic level 1 able to reproduce faster (than other trophic levels) ;</p> <p><i>idea that</i> data is a snapshot / point in time ;</p> <p><i>idea of</i> differences in percentage water content of different organisms affecting (dry) biomass readings ;</p>	2												
2(c)	24 (%) / 23.8 (%) ;	1												

PUBLISHED

Question	Answer	Marks
2(d)	<p><i>any 2 from:</i></p> <p><i>idea of comparison of <u>more energy used</u> in TL5 / less energy used in TL4 ;</i></p> <p><i>reason for <u>more</u> energy being used, e.g. hunting / catching prey / respiration / movement ;</i></p> <p><i>idea that (TL4) are carnivores and have <u>more</u> teeth / bones / indigestible parts / more waste (excreted) by TL5 (resulting in biomass that can not be transferred) ;</i></p> <p><i>idea of the higher the trophic level the smaller the prey population to support it ;</i></p> <p>AVP ;;</p>	2
2(e)	<p><i>any 1 from:</i></p> <p><i>harvesting ;</i></p> <p><i>idea of excretion / marine snow ;</i></p> <p><i>decomposers / bacteria ;</i></p> <p><i><u>break down</u>, waste / detritus OR decomposition ;</i></p> <p><i>named example of excreted chemical ;</i></p> <p>plus any 1 from:</p> <p><i>upwelling ;</i></p> <p><i>uptake of (inorganic) nutrients ;</i></p> <p><i>named example of uptaken chemical ;</i></p>	2

PUBLISHED

Question	Answer	Marks
3(a)	systematic / (line / belt), transect ; <i>plus any 2 from:</i> samples taken at regular intervals ; not affected by bias / ensures samples cover the full range of ocean sampled ; <i>idea of change in conditions / environmental factors ;</i>	3
3(b)	axes labels with units ; suitable linear scale ; plotted correctly $\pm \frac{1}{2}$ small square ; ruled lines linking points OR line of best fit drawn ;	4
3(c)	<i>any 3 from:</i> (depth of greatest proportion of) phytoplankton similar to / always (closely) above the depth of bottom of thermocline ; idea of water above thermocline is warmer which allows greater, growth / rate of photosynthesis ORA ; depth of (greatest proportion of) phytoplankton corresponds to depth of (greatest concentration of) nitrate ; nitrate needed for growth / named correct biological molecule requiring nitrate ; AVP ;	3

PUBLISHED

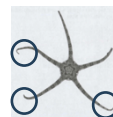
Question	Answer	Marks
4(a)(i)	use of pH meter / probe ;	1
4(a)(ii)	(ability to) compare vent sites with control ;	1
4(a)(iii)	<i>any 2 from:</i> salinity ; (water) temperature ; (water) pressure ; light <u>intensity</u> ; (dissolved) oxygen ; substrate ;	2
4(b)(i)	lipid(s) ; carbohydrate(s) ;	2

PUBLISHED

Question	Answer	Marks
4(b)(ii)	<p><i>any 1 from:</i></p> <p><i>Supports the idea:</i></p> <p>(at sites with) lower pH water, (algae have) higher, dry mass / protein content ORA; this result is consistent for both sites tested ;</p> <p>plus any 1 from:</p> <p><i>Does not support the idea:</i></p> <p>only two sites tested / small sample / lack of repeats / only one type of algae tested ; may not be true for, all vents / water with lower pH ; could be another factor causing higher protein content / correlation does not mean causation ; ‘nutritional content’ is not only determined by protein content / other nutritional content might be lower ; <i>idea that</i> pH is same at different sites but results in different protein content ; need a statistical analysis to see if correlation is significant ;</p>	2

PUBLISHED

Question	Answer	Marks
4(b)(iii)	<p><i>any 2 from:</i></p> <p><i>supports the idea:</i></p> <p>(near vent) at both test sites the mean protein content of algae and mean thickness of shell is greater (than away from vent) ;</p> <p><i>does not support the idea:</i></p> <p>only two sites tested / small sample / lack of repeats OR may not be true for, all vents / water with lower pH ;</p> <p>another factor causing thicker shells ;</p> <p>site B has a higher protein content even though the mean thickness of the snail shell is lower than site A ;</p>	2
5(a)	<p>quality of outline (thin and continuous) <u>in pencil</u> ;</p> <p>suitable size (at least as large as the photo) ;</p> <p>proportion (angles, length of arms, centre diameter) ;</p> <p>detail (minimum 2 out of the 3 curls on end of 3 arms circled) ;</p>	4
5(b)	<p>Species A: <i>Acanthaster planci</i> ;</p> <p>Species B: <i>Diadema setosum</i> ;</p>	2



PUBLISHED

Question	Answer	Marks
5(c)	<p>either:</p> <p>for all six organisms correctly linked with 6 arrows in right direction ;;</p> <p>OR:</p> <p>food web of six organisms correct organisms with 6 lines / incorrect direction of arrows ;</p> <p>OR:</p> <p>food web of five correct organisms with correct direction of arrows ;</p> <p>OR:</p> <p>food web of six organisms correct organisms with correct direction of five arrows ;</p>	2
5(d)	<p><i>idea of camouflage from / less likely to be seen ;</i></p> <p><i>(so less likely to be seen / eaten) by predators / octopus / puffer fish ;</i></p>	2

PUBLISHED

Question	Answer	Marks
6(a)	correct label on one of two dorsal fins shown	1
6(b)	<i>any 2 from:</i> cartilaginous skeleton ; gill slits ; no swim bladder ; denticles ;	2
6(c)	$N = (152 \times 185) / 44 ;$ $N = 639.090909 ;$ $N = 640 ;$	3
6(d)	<i>idea of consistent name used in all countries / languages ;</i> plus any 1 from: useful for comparing / sharing, scientific research ; <i>idea it avoids confusion / problems / misunderstandings caused by using different names ;</i> <i>idea of useful for showing, classification / evolutionary relationships, with other organisms ;</i>	2
6(e)	working showing (100 cm +) appropriate gains in length ; answer in range 205–230 (cm) / 2.050–2.30 (m) ; correct units for answer given ;	3

PUBLISHED

Question	Answer	Marks
7(a)(i)	<p><i>any 3 from:</i></p> <p>idea of (convergent) plates <u>stuck</u> / <u>movement not occurring</u> (towards each other) ;</p> <p>causing build up of, pressure / tension (in the plates) ;</p> <p><u>sudden slippage</u> of the plates ;</p> <p>releasing <u>large amount of energy</u> (during earthquake) ;</p>	3
7(a)(ii)	<p><i>any 2 from:</i></p> <p>large volume / body of water AND displaced / moves ;</p> <p>idea of pushed upwards / drops down / vertical displacement (of water) ;</p> <p><i>idea of</i> (water / tsunami wave) moves away from the source of the earthquake event / tsunami (wave) (redistributing the water level) ;</p>	2
7(b)(i)	<p><i>any 2 from:</i></p> <p><i>idea that</i> funnel shaped bays would result in water being pushed higher as the channel gets narrower ;</p> <p>(differences in relative) steepness of the shore / coast / depth of water ;</p> <p>relative orientation of the (fishing) port to incoming tsunami ;</p>	2
7(b)(ii)	<p>(weathering) <i>idea of</i> (water) breaking rock / sediment (into smaller pieces) ;</p> <p>(erosion) <i>idea of</i> sediments (re)moved <u>by the water</u> ;</p>	2
7(b)(iii)	<p>removal / deposit of organisms on shoreline ;</p> <p>deposition of waste / debris from inland (after waves recede) ;</p>	2