![Cambridge Assessment International Education]

Cambridge International AS & A Level

MARINE SCIENCE **9693/23**

Paper 2 AS Data-Handling and Investigative Skills **October/November 2022**

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 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **12** printed pages.

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 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
<u>underline</u>	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)	pH meter / probe ; universal indicator ;	**2**
1(b)(i)	*any 1 from:* they were measured to different degrees of accuracy ; means should only be calculated when results are measured using the same method / apparatus ;	**1**
1(b)(ii)	**K ;**	**1**
1(b)(iii)	*any 2 from:* water coming from hydrothermal vents has (a high concentration of) dissolved nutrient(s) / minerals / named correct chemical / ions ; which makes the water (very) acidic / pH goes below 7 ;	**2**
1(c)	*any 4 from:* light present (in surface water) ; presence of photosynthetic organisms (in surface water) ; (photosynthesis / producers) releasing oxygen (in surface water) ; atmospheric dissolution (in surface water) ; wave action increases oxygen dissolving (in surface water) ; low mixing with higher layers containing oxygen (at hydrothermal vent) ; correct ref. solubility of oxygen at different temps / **OWTTE** ; organisms respiring oxygen (at hydrothermal vent) ; higher pressure so solubility lower (at hydrothermal vent) ; correct ref. to solubility of oxygen at different salinities / **OWTTE** ;	**4**

Question	Answer	Marks
2(a)	outline is an oval shape (single unbroken line, no sketchy lines) ; size (larger than the diagram) ; detail (central groove running lengthwise, with break in the middle, 2 rows white spots, two outer rows of white structures evenly distributed with clear gap to outer edge of diatom) ; proportions of their included details (relative sizes of groove, spots and / two outer rows of white structures) ;	**4**
2(b)(i)	carbon dioxide + water ; $\rightarrow$ glucose + oxygen ;	**2**
2(b)(ii)	*any 2 from:* all contain carbon / C **+** oxygen / O **+** hydrogen / H ; (many are formed from) fatty acids **and** glycerol ; **AVP** ;;	**2**
2(b)(iii)	*any 2 from:* decomposition / decay ; upwelling ; run-off ;	**2**
2(b)(iv)	*any 2 from:* both types of organisms have silica parts (of cell), so may be justified in statement ; no scientific data / investigations to support this ; land and sea organisms may be from different kingdoms / phyla / domains ; different habitats / temperature differences ; (link to MP3 or 4) so energy requirements may differ ;	**2**

Question	Answer	Marks
2(b)(v)	*any 2 from:* absorb carbon dioxide ; climate control ; release oxygen ; maintain stable, ecosystems / food web ; provide food source ;	**2**
2(c)(i)	tuna **OR** shark ;	**1**
2(c)(ii)	5 rectangular closed bars ; correct relative proportions from base to top **+** approx. the same height ; correctly labelled with named organisms from food chain ;	**3**
2(c)(iii)	$\dfrac{19900}{136000} \times 100$; 14.6 **OR** 14.63 ;;	**3**
2(c)(iv)	*any 3 from:* diatoms to fish larvae more efficient / **ORA** ; sharks are, more active / faster / longer distance, swimmers than fish larvae / **ORA** ; (which) increases energy use ; (lost) through heat / movement / respiration ; (lost) through egestion / parts uneaten or undigested ;	**3**
2(c)(v)	*any 1 from:* all boxes would (eventually) reduce in size ; size of diatom box would reduce first ;	**1**

Question	Answer	Marks
3(a)	microscopic ; drift in currents / limited motility ;	**2**
3(b)(i)	*any 3 from:* stopwatch ; ruler ; light (source) ; water container / measuring cylinder (containing water) ; **AVP** ;	**3**
3(b)(ii)	*any 3 from:* (same) temperature ; (same) pH ; (same) salinity ; (same) oxygen concentration ; (same) time to settle ; (same) species ; (same) volume / height of measuring cylinder / water column ; (same) intensity of light source ; (same) exposure time **OR** (same) distance travelled ; ref. to background light ;	**3**
3(b)(iii)	*any 5 from:* place a zooplankton in measuring cylinder containing sea water and leave in dark (to settle to the bottom) ; (place glass sheet between light source and cylinder) to ensure temperature doesn't change ; switch on light ; record time to swim (set) distance e.g. 5 cm / analyse a video to find time **OR** record distance swam in a set time ; repeat 3 times **+** find mean ; repeat with at least 3 different sized zooplankton / 3 stated sizes ; photograph / measure, size of each zooplankton on ruler / mm scale ; accept reasonable safety precaution ; **AVP** ;	**5**

Question	Answer	Marks
3(c)	a column / row, headed zooplankton size / mm ; ***PLUS** any **1** from:* a column / row, headed distance, cm / mm **OR** a column / row headed time / s **OR** a column / row headed speed mm / s or mm s^{-1} ;	**2**

Question	Answer	Marks
4(a)(i)	*any **2** from:* cartilaginous / non-ossified <u>skeleton</u> ; gill slits / no operculum ; denticles ; no swim bladder ; lateral line is not visible ;	**2**
4(a)(ii)	(just above) ocean floor / **AW** ;	**1**
4(b)	*Amblyraja radiata ;*	**1**
4(c)	*any **2** from:* camouflaged (with the benthic zone) / **OWTTE** ; (dorso-ventrally) flattened ; protruding eyes / eyes on top of the head / eyes found dorsally ; ability to bury in sand ; mouth on underside – for (benthic) feeding ; **AVP** ;	**2**

Question	Answer	Marks
5(a)(i)	**axes** labelled with units ; appropriate linear **scales** (plotted data to cover at least half the grid) ; **all plots** correct (± half small square) ; smooth **line** (curve) drawn (no sketchiness) ;	**4**
5(a)(ii)	greater change of salinity between 4 and 6 m ; little change / fairly constant, above 4 m / below 6 m ;	**2**
5(a)(iii)	halocline ;	**1**
5(a)(iv)	(read off graph) approx. 17 (ppt) ;	**1**
5(a)(v)	large change occurs **+** insufficient data within that region ;	**1**
5(b)	*any 1 from:* reduced mixing ; fresh water floats on sea water / **ORA** ;	**1**

Question	Answer	Marks
6(a)	120 ;	1
6(b)	<table><tr><td></td><td>**mangrove area Y** n/N</td><td>**mangrove area Y** $(n/N)^2$</td></tr><tr><td>*Nypa fruticans*</td><td>0.49</td><td>0.2401 ; / (**A** range of 0.2334–0.2364)</td></tr><tr><td>*Rhizophora harrisonii*</td><td>0</td><td>0 ;</td></tr><tr><td>*Rhizophora racemosa*</td><td>0.32</td><td>0.1024 ; (**A** 0.1031)</td></tr><tr><td>Σ</td><td></td><td>0.3619 ; (**A** range 0.3555–0.3589)</td></tr></table> $1 - 0.3619 = 0.6381$; (0.6411 – 0.6445)	5
6(c)	*any 3 from:* inconclusive ; diversity <u>index</u> lower for mangrove area **Y** by 0.079 (**A ECF** from **6(b)**) / **ORA** ; (but) not by a large amount / need to do (named) significance test ; but species richness is unchanged ; (looking at raw data) 2 species (*Acrosichum aureum and Drepanocarpus lanatus)* reduced by a large amount (in area **Y**) ; one species (*Rhizophora harrisonii*) disappeared but numbers low in mangrove area **X** ; dominant species in mangrove area **X** (*Rhizophora racemosa*) is no longer the dominant species ; need to test in more areas / more data needs to be collected ; **AVP** ;	3