



## Cambridge International AS & A Level

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**MARINE SCIENCE**

**9693/31**

Paper 3 A Level Theory

**May/June 2023**

MARK SCHEME

Maximum Mark: 75

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**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 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

**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	<p><u>'List rule' guidance</u></p> <p>For questions that require <i>n</i> responses (e.g. State <b>two</b> reasons ...):</p> <ul style="list-style-type: none"><li>• The response should be read as continuous prose, even when numbered answer spaces are provided.</li><li>• Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>.</li><li>• Incorrect responses should not be awarded credit but will still count towards <i>n</i>.</li><li>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should <b>not</b> 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.</li><li>• Non-contradictory responses after the first <i>n</i> responses may be ignored even if they include incorrect science.</li></ul>

**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)(i)	<p><i>any 3 of:</i>            (large amount of) sediment / silt, from rivers / in run-off from land ;  <u>sediment</u> / <u>silt</u>, deposited / settles / <u>sedimentation</u> occurs ;            due to, slowing down of water / water flow decreases ;            narrow entrance to sea (causes slowing down of water) ;            rate of sedimentation greater than erosion ;</p> <p>sheltered from waves, so little erosion ;</p> <p>ref. to tides and effect on water flow from river ;</p>	<b>3</b>
1(a)(ii)	<p><i>any 4 of:</i>            (idea of) leaves / plants, slow down current / absorb wave energy / act as a barrier (to waves) ;            (idea of) plants trap sediment / silt / substrate ;</p> <p>using <u>roots</u> / <u>rhizomes</u> ;            builds up height of land ;            (roots / leaves / plants), <u>absorb</u> / <u>uptake</u> nutrients ;            e.g. nitrates for, proteins / growth ;</p>	<b>4</b>
1(b)(i)	<p><i>any 2 of:</i>            (more) sewage from the city ;</p> <p>(more) waste / sewage from (intensive) farming / cattle / sheep / other animals ;            (more) fertiliser use (from intensive farming of crops) ;</p> <p><b>AVP</b> ;</p>	<b>2</b>
1(b)(ii)	<p><i>any 2 of:</i>            mats block, light / sunlight ;            so less / no photosynthesis (in, seagrass / saltmarsh plants) ;            (less photosynthesis) so less / no growth ;</p>	<b>2</b>

Question	Answer	Marks
1(c)(i)	<i>any 1 of:</i> less water exchange / currents ;  closer to source of (excess) nutrients ;	<b>1</b>
1(c)(ii)	ref. to <u>anaerobic respiration</u> ;  carry out <u>chemosynthesis</u> ; <b>AND any 1 of:</b> ATP produced ;  (chemosynthesis) fix carbon using chemical energy ;  from hydrogen sulfide / methane / hydrogen / iron / carbon dioxide ;	<b>3</b>

Question	Answer	Marks
2(a)(i)	<i>any 3 of:</i> small fins to reduce surface area ; so reducing heat loss ; small fins, as swimming speeds are slow ; correct ref. to named fin and advantage ; slow swimming speeds, use up less <u>energy</u> / conserves <u>energy</u> ; idea of body, more rounded / less streamlined, to retain more <u>heat</u> / to <u>insulate</u> body ; body camouflaged to, blend with <u>substrate</u> / prevent detection by prey ;	<b>3</b>
2(a)(ii)	<i>any 2 of:</i> dark / little / no light in these waters / at depth, (so do not use their eyes to find prey) ;  use smell / sense organs in lateral line, to detect prey ; (are apex predators so) do not need to look out for predators ;	<b>2</b>



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Question	Answer	Marks
2(b)	<p><i>any 4 of:</i>            water <u>enters</u> body (from sea water through the gills / skin) ;            by osmosis ;            as <u>higher water potential</u> in sea water than in shark / e.q. ;</p> <p>gills pump, less / no, sodium and chloride ions ;            so less ATP / energy used (in gills) ;            less energy needed to remove <u>urea</u> (in kidney as most retained in blood) ;            more energy available for other activities / catching prey / movement ;            always maintains (a stable amount of) water in body ;</p>	<b>4</b>
2(c)	<p><i>any 1 of:</i>            distribution will, be more restricted / decrease ;            migrate northwards (towards North Pole) / to deeper / colder, water ;</p>	<b>1</b>

Question	Answer	Marks
3(a)(i)	<p><i>any 2 of:</i>            captive breeding (and release) programme ;            legislation ;            creating UNESCO biosphere reserves ;            marine zoos and aquaria ;            ecotourism ;            control of invasive species ;  <b>AVP</b> ;</p>	<b>2</b>
3(a)(ii)	<p><i>any 2 of:</i>            areas of high <u>biodiversity</u> ;            (important) nursery / breeding, area (for marine organisms) ;            (important), habitat / feeding, areas for marine organisms / endangered species;            protect coast from erosion / storm damage / dissipate wave energy ;            areas of high oxygen production (from photosynthesis) ;            idea of coastal areas provide food / resources for humans <b>or</b> more likely to be disturbed by humans ;            they act as carbon sinks ;</p>	<b>2</b>

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Question	Answer	Marks
3(b)	<p><i>any 4 of:</i>  <u>too many</u> countries involved in fishing regulations / cannot agree on conservation / regulations / regulations, difficult / expensive, to enforce / monitor ;            fishing methods / bottom-trawling / dredging, <u>damage</u> seabed ;</p> <p>disturbing sediment / increases turbidity / releases toxins ;            destroying habitat / nursery areas / feeding areas, (for marine organisms ;            bottom-trawling increases by-catch ;</p> <p>idea of overfishing inside MPAs / more fishing inside MPAs than non-protected areas ;            (disturbance) causes marine organisms to migrate outside MPAs ;</p>	<b>4</b>

Question	Answer	Marks
4(a)(i)	<u>benthic</u> (trawling) <b>AND</b> as <u>sandeels swim</u> just above sea bed ;	<b>1</b>
4(a)(ii)	1998 = 520 000      2019 = 65 000 ;  (change is,) 455 000 (tonnes) <u>decrease</u> / – 455 000 ;	<b>2</b>
4(a)(iii)	(idea of) no, as numbers have fluctuated ;  correct reference to (sometimes) below maximum sustainable yield ;	<b>2</b>
4(b)	<p><i>any 3 of:</i>  <u>fewer</u> eggs are produced / released ;            phytoplankton bloom is over (before eggs hatch) ;            less, copepod larvae / food, present for <u>sandeel larvae</u> to feed on ;</p> <p>so less growth of sandeel larvae ;            fewer juveniles, survive / settle, to become adults / less recruitment ;</p>	<b>3</b>

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Question	Answer	Marks
4(c)	<p><i>any 4 of:</i>  less food for birds due to overfishing of sandeels, eq ;  less food for birds due to, mismatch of sandeels with their prey / decreased food availability (for sandeels) / fewer sandeels reaching maturity ;  seabirds could be, killed / injured, <u>flying / colliding</u> into wind farm ;  seabirds have to fly further (around windfarm) ;  so use up more energy (to find food) ;  less food for chicks / chicks starve / fewer chicks survive to adulthood ;  ref. to <u>construction / installation</u> + suitable effect on sandeels or birds ;  <b>AVP</b> ;</p>	<b>4</b>

Question	Answer	Marks
5	<p><i>any 10 of:</i>  1 gas exchange is by diffusion in <b>both</b> organisms ;  2 <b>both</b> have a large surface area (for gas exchange) / large surface area to volume ratio ;  3 gas passes across a thin layer (of cells) ;  4 short diffusion path ;  5 gases move from a high to a lower concentration ;  6 oxygen is taken into the body <b>and</b> carbon dioxide is removed ;  7 coral is, sedentary / sessile, so has a low oxygen demand / tuna swims (continually) so has a high oxygen demand ;  8 coral has no specialised structures for gaseous exchange / tuna has gills ;  9 coral has tentacles (which increase surface area for gaseous exchange) ;  10 tuna has (numerous), gill filaments / lamellae, (to increase surface area for gaseous exchange) ;  11 no transport system required in coral polyps / transport system in tuna to transport gases ;  12 tuna uses ram ventilation (to force water from the mouth, over the gills) ;  13 ref. to polyp tentacles moving to <u>create a current</u> ;  14 ref. to <u>counter-current</u> mechanism in tuna / blood flow and water moving in opposite directions ;  15 so concentration / diffusion gradient maintained ;</p>	<b>10</b>

Question	Answer	Marks
6(a)	<p><i>any 5 of:</i></p> <ol style="list-style-type: none"> <li>1 (surface) currents (mainly) formed by wind ;</li> <li>2 due to uneven heating of Earth's surface (by the Sun) ;</li> <li>3 correct reference to <u>Coriolis effect</u> ;</li> <li>4 currents formed by tides ;</li> <li>5 shape of sea bed / coastline ;</li> <li>6 movement of tectonic plates ;</li> <li>7 <u>differences in temperature</u> ;</li> <li>8 <u>differences in salinity</u> ;</li> <li>9 (deep-water currents caused by differences in) density ;</li> <li>10 <b>AVP</b> ;</li> </ol>	<b>5</b>
6(b)	<p><i>any 8 of:</i></p> <ol style="list-style-type: none"> <li>1 mix water / move water, around the Earth ;</li> <li>2 distributes nutrients ;</li> <li>3 correct ref. to <u>upwelling</u> ;</li> <li>4 (providing nutrients), for producers / for photosynthesis ;</li> <li>5 distribute plankton / eggs / gametes / larvae ;</li> <li>6 e.g. of broadcast spawners / suitable example ;</li> <li>7 form <u>migration</u> routes for marine organisms ;</li> <li>8 distribute heat / salinity;</li> <li>9 distribute (dissolved) gases ;</li> <li>10 influence weather / climate ;</li> <li>correct ref. to <u>El Niño / La Niña</u> ;</li> <li>11 used in extensive aquaculture to, supply food / supply oxygen / remove waste products ;</li> <li>12 potential change in global currents due to global warming ;</li> <li>13 deep-water / deep sea, currents are slow-moving ;</li> <li>14 so seabed acts as a carbon sink ;</li> <li>15 <b>AVP</b> ;</li> </ol>	<b>8</b>

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Question	Answer	Marks
7	<p><i>any 7 of:</i></p> <ol style="list-style-type: none"> <li>1 sodium ions are charged ;</li> <li>2 so cannot pass through the lipid bilayer ;</li> <li>3 pass through the membrane by <u>facilitated diffusion and active transport</u> ;</li> <li>4 using channel proteins <b>and</b> carrier proteins ;</li> <li>5 (proteins) are <u>specific</u> ;</li> <li>6 during (facilitated) diffusion ions pass through <u>channel proteins</u> ;</li> <li>7 from a high concentration to a low concentration / <u>down</u> a concentration gradient ;</li> <li>8 no ATP / no energy required / passive ;</li> <li>9 channel proteins have a fixed shape / can open and close / are gated ;</li> <li>10 <u>carrier proteins</u> are used for active transport ;</li> <li>11 (during active transport) ions pass from a low concentration to a high concentration / <u>against</u> concentration gradient ;</li> <li>12 requires ATP / energy / ions pumped across membrane ;</li> <li>13 carrier proteins can change their shape ;</li> </ol>	7