



Cambridge International AS & A Level

MARINE SCIENCE

9693/31

Paper 3 A Level Theory

May/June 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 May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **13** 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 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.

Key Points

- Refer to the *Instructions for Examiners (marking scripts on-screen) 2022* booklet for details of all procedures.
- As soon as you are able (usually about two days after the paper set date), please access the question paper and provisional mark scheme from the **RM support portal**. In conjunction with the provisional mark scheme, browse scripts in **RMA³** and feed any issues or comments to your **Team Leader**.
- The decisions of the **Principal Examiner** are final, and the final agreed mark scheme must be applied as intended by the Principal Examiner. If you are in any doubt about applying this mark scheme, consult your **Team Leader** by telephone or by email.
- Please report any serious problems during marking to your **Team Leader / Principal Examiner** (details in the confidential package).
- If you require technical support, please contact the **RM Helpdesk**. If you require administrative support relating to the examination process, please contact the **Cambridge International Examiner Helpdesk**. For all queries relating to payment, please contact **Cambridge Assessment Finance Division**. Up-to-date contact details for each of these can be found in the *Instructions for Examiners (marking scripts on-screen) 2022* booklet.
- The schedule of dates is very important. It is **essential** that you meet the **Batch 1** and **Batch 2** deadlines. If you experience problems, you must contact your Team Leader without delay.
- Mark strictly to the mark scheme. All marks awarded must relate directly to the mark scheme. However, always credit correct, relevant, science, even if it lies outside of the syllabus content. For answers not provided for in the mark scheme, give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
- Never transfer marks allocated for one question item to another.
- Where work has been crossed out, mark it when nothing else has been written.
- Do not penalise grammatical constructions/spelling of words that are not in the syllabus, so long as the meaning is clear.
- Credit should be given to all the candidate's correct responses, wherever they have been written (including blank pages, around diagrams, etc.).
- Additional materials may be attached and must be checked for candidates' responses. Show that you have checked blank pages for answers by placing an annotation on each blank page. Do not use crosses or ticks for this purpose, unless the points are credited as part of a response to a specific question. In this instance, please use the On Page Comment tool to clearly annotate which question part the marks relate to.
- If the candidate has left an answer blank, or has left a mark/comment that does not in any way relate to the question (for example 'my dog is black' or '----' or 'can't do' or '?') use the **NR** (No Response, #) option.
- Award 0 marks for any attempt which does not earn credit. This includes copying out all / part of the question or any working that does not earn any marks (whether crossed out or not).

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- 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)

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Question	Answer			Marks												
1(a)		<table border="1"> <thead> <tr> <th data-bbox="645 213 815 316">cell structure</th> <th data-bbox="819 213 1077 316">name</th> <th data-bbox="1081 213 1648 316">function</th> </tr> </thead> <tbody> <tr> <td data-bbox="645 316 815 379">A</td> <td data-bbox="819 316 1077 379">mitochondrion ;</td> <td data-bbox="1081 316 1648 379">(site of) aerobic respiration ;</td> </tr> <tr> <td data-bbox="645 379 815 443">B</td> <td data-bbox="819 379 1077 443"><u>rough</u> ER ;</td> <td data-bbox="1081 379 1648 443">transports proteins ;</td> </tr> <tr> <td data-bbox="645 443 815 512">C</td> <td data-bbox="819 443 1077 512">ribosome ;</td> <td data-bbox="1081 443 1648 512">protein synthesis ;</td> </tr> </tbody> </table>	cell structure	name	function	A	mitochondrion ;	(site of) aerobic respiration ;	B	<u>rough</u> ER ;	transports proteins ;	C	ribosome ;	protein synthesis ;		6
cell structure	name	function														
A	mitochondrion ;	(site of) aerobic respiration ;														
B	<u>rough</u> ER ;	transports proteins ;														
C	ribosome ;	protein synthesis ;														
1(a)(ii)	<p><i>any 2 from:</i> (respiration in mitochondria) provides energy ; in the form of ATP ; for movement / swimming / contraction of muscles ;</p>			2												
1(b)	<p><i>any 4 from:</i> they span the membrane / lipid bilayer / are intrinsic ; involved in both, facilitated diffusion and active transport / passive and active transport ; contain a hydrophilic channel ; for ions / polar molecules / charged substances (to pass through the membrane) ; (most can) open and close / act as gates ; so control the entry / exit of substances (into and out from the cell) / are specific ; can change shape ;</p>			4												

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Question	Answer	Marks
2(a)(i)	<i>name</i> – light-dependent stage ; <i>occurs</i> – in thylakoid membrane ;	2
2(a)(ii)	A – photolysis ; B – oxygen ; C – ATP (or reduced NADP / NADPH if not stated for D) ; D – reduced NADP / NADPH (or ATP if not stated for C) ;	4
2(b)(i)	<i>any 3 from:</i> <u>rate of</u> photosynthesis increases with increasing light intensity ; as light is a limiting factor ; (increasing light provides) more energy for photoactivation of chlorophyll ; after a certain point it remains constant / plateaus ; as another factor is limiting / light is no longer limiting ;	3
2(b)(ii)	line same shape but below existing line on graph	1
2(b)(iii)	higher temperature begins to denature <u>enzymes</u> (used for photosynthesis) ;	1

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Question	Answer	Marks
3(a)(i)	<p><i>any 2 from:</i> too many fishing boats / overfishing ; fish numbers reduced ; fish do not have enough <u>time</u> to (grow and) breed / fish caught before they reproduce / reach maturity ; less, mature / adult, fish available / higher numbers of juveniles caught ; stocks are unsustainable ;</p>	2
3(a)(ii)	<p><i>any 3 from:</i> less fish can be caught by locals as fishing area is smaller / closer to coast / simple fishing methods / gear used ; foreign owned companies provide their own fishing fleets and factories, so do not need to buy fish from locals ; loss of employment for, local fishermen / women processors, due to lack of fish ; less food supply for locals as less fish caught ; less fish to sell locally, so loss of income ; local population have their main protein source reduced (and could suffer from malnutrition) ; AVP ;</p>	3
3(a)(iii)	<p><i>acoustic surveys:</i> size of <u>shoal</u> / numbers of fish in <u>shoal</u> / direction or location of shoal or fish / depth of shoal or fish ; <i>records of catch:</i> numbers / species / size / mass, of fish / idea of used to assess fish stocks over time ;</p>	2
3(a)(iv)	<p><i>any 3 from:</i> labelling of fish ; so the fish could be marketed as caught, in an environmentally friendly way / using traditional methods ; shows traceability / shows where fish was caught ; fish could be marketed as sustainably harvested ; advertising / education campaign ; can promote health benefits of eating fish ; certification used ; price tariffs reduced (to decrease price) ;</p>	3

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Question	Answer	Marks
3(b)	<p><i>any 3 from:</i> warmer waters contain less oxygen ; for (aerobic) respiration ; so less energy for growth / movement ; warmer waters can kill fish eggs / change reproductive patterns ; food species migrate northwards / number of food species reduces ; AVP ;</p>	3

Question	Answer	Marks
4(a)(i)	<p><i>any 2 from:</i> carbon dioxide / methane / nitrous oxide / water vapour / NOx gases / sulfur dioxide / carbon monoxide / particulates ;</p>	1
4(a)(ii)	<p><i>any 2 from:</i> brought (to sea) by rainfall / precipitation ; <u>dissolves</u> / <u>dissolution</u> (in sea water) ; <u>absorbed</u> by producers / algae / phytoplankton ;</p>	2
4(a)(iii)	<p><i>any 3 from:</i> mercury cannot be excreted from the body ; <u>bioaccumulates</u> in body ; consumers eat <u>many</u> producers ; so <u>concentration</u> increases up the food chain ; <u>biomagnification</u> occurs (up through food chain) ;</p>	3
4(b)(i)	<p>mercury (concentrations) in the air and sea water have decreased ; manipulation of figures ;</p>	2
4(b)(ii)	<p><i>any 1 from:</i> countries could increase their fossil fuel emissions ; mercury might be coming from other sources, e.g. mining / dredging / volcanic eruptions / increased use of cars (which use fuel) ;</p>	1

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Question	Answer	Marks
5	<p><i>benefits</i> MAX 6 from:</p> <ol style="list-style-type: none"> 1 easier to <u>monitor</u> fish ; 2 less chance of predation / parasites (such as sea-lice) ; 3 easier to harvest ; 4 no boat required / no need to travel to sea cages ; 5 does not <u>cause</u> pollution of the marine environment / habitat destruction (under cage) ; 6 can <u>control</u> / <u>regulate</u> / <u>manage</u> water quality / is a controlled environment ; 7 no / little chance of fish escape ; 8 not affected by pollution at sea / algal blooms / increased temperature due to climate change / adverse weather ; 9 can provide optimum conditions for growth / increased yield / increased growth / increased productivity ; 10 easier to spot / treat diseases / no environmental effect of chemical control ; <p><i>challenges</i> MAX 6 from:</p> <ol style="list-style-type: none"> 1 increased expense of building ; 2 increased expense of pump / aeration / filter / heating / lighting ; 3 increased running costs / electricity costs ; 4 need to <u>monitor</u> water quality / temperature / pH / oxygen / ammonia / nitrates / abiotic factors ; 5 need filtration system ; 6 to remove ammonia / nitrites / nitrates ; 7 needs (a continuous) supply of air / oxygen ; 8 for (aerobic) respiration ; 9 no natural food, so increased, food required / feeding costs ; 10 more labour intensive ; 	10

Question	Answer	Marks
6(a)	<p><i>any 8 from:</i></p> <ol style="list-style-type: none"> 1 release large amounts of / more, <u>fresh</u> water (into the sea) ; 2 increasing (sea) water levels ; 3 causing increased flooding (in low-lying land) ; 4 causing coastal erosion ; 5 increased turbidity / more sediment released into sea water ; 6 less light reaching benthic habitat / deeper water ; 7 suitable effect (of sediment or less light) on marine species ; 8 (less ice sheet / increased depth of shallow water) causes <u>habitat loss</u> for marine species + suitable example; 9 displacement of people / marine communities ; 10 decreases biodiversity / causes changes to, food chains / webs ; 11 reduction in salinity ; 12 affects, <u>osmoconformers</u> / <u>stenohaline</u>, organisms ; 13 reduces survival of eggs / larvae ; 14 causes ocean currents to change direction ; 15 loss of ice as a thermal insulator ; 16 ref. to change in water temperature and effect on, solubility of salts / density of water / oxygen concentration ; 17 releases nutrients which can increase primary productivity / cause algal blooms ; 	8
6(b)	<p><i>any 6 from:</i></p> <ol style="list-style-type: none"> 1 carbon dioxide <u>dissolves</u> / <u>dissolution</u> of carbon dioxide, in sea water ; 2 enhanced by, wave action / storms ; 3 to form, a weak acid / carbonic acid / H_2CO_3 ; 4 carbonic acid <u>dissociates</u> ; 5 to form, hydrogencarbonate <u>ions</u> / HCO_3^- ; 6 and protons / hydrogen <u>ions</u> / H^+ ; 7 (protons / H^+) lower pH / increases acidity ; 8 which, erodes / thins, the, shells / skeletons, of molluscs ; 9 excess H^+ combine with, carbonate / CO_3^{2-} ; 10 so availability of carbonate decreases ; 11 calcium (carbonate) required to make shell ; 12 molluscs are unable to make shells / shells are deformed ; 13 mollusc more prone to predation without shell ; 	6

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Question	Answer	Marks
7	<p><i>any 6 from:</i></p> <ol style="list-style-type: none"> 1 allows general public, to see / study, marine life ; 2 so generating funding for, zoo / aquarium / conservation projects ; 3 provides, protection / home, for, (endangered / vulnerable) species / rehabilitate injured animals ; 4 act as research facilities ; 5 allows captive breeding to increase numbers ; 6 for (possible) reintroduction into the wild ; 7 suitable example e.g. corals (after bleaching event) / turtles ; 8 can result in inbreeding if population is small ; 9 so reducing genetic diversity ; 10 assisted reproduction possible using AI / IVF ; 11 increases awareness / education about marine conservation ; 12 possible adverse effect on food chains / food webs / ecosystem of conservation of just one species ; 	6