



## Cambridge International AS & A Level

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**MARINE SCIENCE**

**9693/03**

Paper 3 A2 Structured Questions

**May/June 2021**

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.

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This document consists of **15** 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.

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**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.

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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	<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 (<i>a</i>) 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>

This mark scheme will use the following abbreviations:

<b>;</b>	separates marking points
<b>/</b>	separates alternatives within a marking point
<b>()</b>	contents of brackets are not required but should be implied / the contents set the context of the answer
<b>R</b>	reject
<b>A</b>	accept (answers that are correctly cued by the question or guidance you have received)
<b>I</b>	ignore (mark as if this material was not present)
<b>AW</b>	alternative wording (where responses vary more than usual, accept other ways of expressing the same idea)
<b>AVP</b>	alternative valid point (where a greater than usual variety of responses is expected)
<b>ORA</b>	or reverse argument
<b><u>underline</u></b>	actual word underlined must be used by the candidate (grammatical variants excepted)
<b>MAX</b>	indicates the maximum number of marks that can be awarded
<b>+</b>	statements on both sides of the + are needed for that mark
<b>OR</b>	separates two different routes to a mark point and only one should be awarded
<b>ECF</b>	error carried forward (credit an operation from a previous incorrect response)

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)(i)	<p><i>any 2 of:</i>            fix carbon to form glucose / organic molecules ;            used as a food source / energy source ;            provide shelter / habitat for zooplankton / organisms ;            used to provide oxygen, for respiration ;</p>	<b>2</b>
1(a)(ii)	<p>manure contains nitrogen / nitrates / magnesium / phosphates ;            nitrogen / nitrates used to make proteins (for growth) / magnesium used to make chlorophyll, (so increased photosynthesis more energy for reproduction) / phosphates used to make DNA (so that cells can divide) ;</p>	<b>2</b>
1(b)(i)	<p><i>any 4 of:</i>  <u>upwelling</u> ;  <u>run-off</u> of, fertilisers / detergents / sewage / agriculture (waste) ;            aquaculture concentrated in coastal areas ;            adds, nitrogen / nitrates / phosphates, to water ;            shallow water, so warmer ;            shallow water, so more light penetration / higher light intensity ;            so increasing rate of photosynthesis / increased growth / increased productivity ;</p>	<b>4</b>
1(b)(ii)	<p><i>any 3 of:</i>            algae / producers die (due to, overgrowth / lack of light) ;            are decomposed by bacteria / decomposers ;            decomposition uses the oxygen in the water ;            too little oxygen, for consumer respiration / consumers suffocate ;            release toxins (which kill consumers) ;            algae clog fish gills ;</p>	<b>3</b>

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Question	Answer	Marks
1(c)	<p><i>any 3 of:</i>  no need to, visit cages / to check sensors ;  saves time / fuel costs / might not be possible in adverse weather ;  sensors and mussels only monitor the water quality next to the cage / satellites provide a view of whole area / larger area ;  mussels could open and close due to other factors / predation / salinity change ;  mussels / satellites provide continuous / real-time monitoring ;  sensors and mussels can only show that an algal bloom is already at the site / satellite can predict earlier where they are most likely to occur ;  no time to move fish with sensor or mussels / time to, harvest fish / move fish / time to prepare for algal bloom, with satellite image ;  maps of risk can be used to decide where to locate fish cages in future ;</p>	<b>3</b>

Question	Answer	Marks
2(a)(i)	glucose ; carbon dioxide <b>and</b> water ;	<b>2</b>
2(a)(ii)	<i>process: (simple) <u>diffusion</u> ;</i> <i>plus any 3 reasons:</i> thin (body) <u>wall</u> / body <u>wall</u> of two layers ; large surface area to volume ratio ; short distance for diffusion / all cells close to surface ; no organs / gills / lungs / blood, for gaseous exchange ;	<b>4</b>
2(a)(iii)	maintains a diffusion / concentration gradient ;	<b>1</b>
2(b)(i)	<i>any 3 of:</i> gills in <u>constant</u> contact with water ; (feathery) so provide a large(r) surface area (to volume ratio) ; so that <u>more / sufficient / enough</u> oxygen / oxygen uptake is faster ; shorter diffusion distance (into blood) ;	<b>3</b>

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Question	Answer	Marks
2(b)(ii)	<i>any 2 of:</i> sea slugs are active / move around <b>ORA</b> ; sea slugs require <u>more</u> oxygen / energy than sea anemones <b>ORA</b> ; sea slugs are multi-layered / body with organs ; diffusion distance is too great to supply all cells with oxygen ;	<b>2</b>

Question	Answer	Marks
3(a)(i)	size of shoal / (mackerel) numbers / migration route / location of shoal / direction of movement ;	<b>1</b>
3(a)(ii)	<i>any 3 of:</i> size range of fish / number of juveniles, shows if recruitment has been successful ; low numbers of juveniles show fishing is unsustainable ; CPUE can determine if stocks are increasing or declining ; number of adult fish caught indicated fecundity / potential for reproduction ; size of catch shows fishing mortality ; location of fish caught, shows dependency on a particular habitat ;	<b>3</b>
3(a)(iii)	<i>any 1 of:</i> mackerel migrate in shoals throughout the, North Atlantic / North Sea ; size of mesh can easily control size of fish caught ; restricting mesh size ensures that, juveniles / immature fish, are able to <u>breed</u> / juveniles survive to increase recruitment ;	<b>1</b>
3(b)(i)	(increase of) 0.14 ; ; mt per year / mt year <sup>-1</sup> / mt / year ;	<b>3</b>
3(b)(ii)	<i>any 3 of:</i> (large) increase in biomass of spawning adults / biomass of spawning adults has doubled / increased by (approx.) 2 mt ; feeding areas have expanded (northwards and westwards) / additional feeding areas ; so fish (use more energy to) migrate further from spawning grounds / travel further (to find food) / prey moved further away ; not enough food / increased competition for food ; warmer water reduces available oxygen ; lower respiration rate / less <u>energy</u> , for growth ;	<b>3</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	<p><i>any 2 of:</i>            no silt to clog gills ;            no silt to reduce light penetration, so phytoplankton productivity high ;            no freshwater / river water, to dilute seawater / keeps salinity high enough ;            temperature remains stable / river water brings cooler water ;            no water flow to remove phytoplankton / grouper eggs / grouper fry ;</p>	<b>2</b>
4(b)(i)	<p><i>any 3 of:</i>            to <u>remove</u> waste products / faeces / carbon dioxide / toxins / pathogens ;            which could be, toxic / decrease chance of, disease / algal blooms ;            to renew oxygen ;            for respiration / prevents suffocation ;            to bring in food (for grouper) / nutrients <u>for phytoplankton</u> ;            maintains, salinity / temperature / pH ;            as grouper can only tolerate a small range of salinity / temperature / pH ;</p>	<b>3</b>
4(b)(ii)	<p>oxygenates / aerates the water ;             ensures an even distribution of food / phytoplankton (for grouper) ;             ensures an even distribution of nutrients (for phytoplankton) ;</p>	<b>1</b>
4(b)(iii)	<p><i>any 2 of:</i>            photosynthesis occurs during the day / not at night ;            oxygen levels fall at night ;            so paddles maintain sufficient oxygen (for grouper respiration) ;</p>	<b>2</b>
4(c)(i)	<p>to remove / kill any parasites / disease-causing organisms / pathogens ;            so that they do not infect <u>new stock / fingerlings</u> ;</p>	<b>2</b>

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Question	Answer	Marks
4(c)(ii)	<p><i>any 4 of:</i></p> <ol style="list-style-type: none"> <li>1 <u>high demand</u> for grouper fingerlings ;</li> <li>2 too many wild-caught fingerlings are used ;</li> <li>3 too few left to grow into adult grouper in the wild ;</li> <li>4 less reproduction / less fingerlings / population decreases / unsustainable in future / less recruitment ;</li> <li>5 less (adult) grouper for fishermen to catch ;</li> <li>6 importing fingerlings from overseas is more costly <b>ORA</b> ;</li> <li>7 local production provides more jobs / economic benefit ;</li> <li>8 more control on fingerling quality ;</li> <li>9 supply of wild-caught fingerlings not guaranteed / fingerling supply from hatchery more guaranteed / can meet demand ;</li> </ol>	<b>4</b>
5(a)	<p><i>any 1 of:</i></p> <p><u>increase</u> in agriculture / irrigation / aquaculture / industry / factories ;  <u>increased</u> pollution of fresh water / rivers ;  <u>increase</u> in personal use of water ;  <u>increase</u> in hotels / tourism ;            idea of: climate becoming drier / drought ;</p>	<b>1</b>
5(b)(i)	<p><i>any 1 pair of:</i></p> <p>position inflow pipe in deeper water / not close to surface ;            as plankton and eggs are usually close to surface / float ;  <b>or</b>            position inflow pipe under sea bed ;            so water filtered before entry ;</p>	<b>2</b>

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Question	Answer	Marks
5(b)(ii)	<p><i>any 3 of:</i>            are <u>osmoconformers</u> / have the same, ion / salt / body fluid, concentration as sea water / cannot regulate their, ion / salt / body fluid, concentration ;            are stenohaline / can only tolerate a narrow range of salinities ;            higher water potential inside, mussels / molluscs, than sea water ;            so will <u>lose water</u> ;            by osmosis (and die) ;            mussels cannot move away / reduced food supply ;</p>	<b>3</b>
5(b)(iii)	<p><i>any 4 of:</i>            (high pressure) will <u>remove</u> benthic / sessile / bottom-dwelling organisms / corals ;            larvae cannot settle close to outfall / larvae / eggs washed away from outfall ;            (high pressure) will disturb sediment / erodes / damage sea bed / reduces habitat ;            sediment could block / damage gills, (of fish or invertebrates) / causes coral bleaching / consumers unable to locate food / prey (due to poor visibility) ;            reducing area of gills for gaseous exchange ;            sediment / increased turbidity, blocks light (from plants / producers) ;            so less / no photosynthesis ;            less, food / oxygen for consumers ;            disrupt food chains / <u>reduces</u> biodiversity ;            disruption of sediment can release toxins / mercury / heavy metals / TBT ;</p>	<b>4</b>

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Question	Answer	Marks
5(c)(i)	bulge to the right of the line, bulge starting at 250 m ; 	1
5(c)(ii)	brine / <u>outflow</u> (water) is more, salty / dense (than sea water) ;	1
5(d)	<p><i>any 2 of:</i></p> <p>can denature enzymes <b>and</b> alters rate of chemical reactions / reduces productivity / rate of photosynthesis ;</p> <p>causes coral bleaching <b>and</b> zooxanthellae killed / expelled due to increase in temperature ;</p> <p>water holds less oxygen <b>and</b> reduces respiration rate / animals suffocate ;</p> <p>organisms die <b>and</b> food chains / webs altered / reduced biodiversity ;</p> <p>disrupts breeding patterns / reduces breeding <b>and</b> valid reason ;</p>	2

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Question	Answer	Marks
6(a)	alevin ; parr ;	<b>2</b>
6(b)	wild salmon numbers will decline ; <i>plus any 2 of:</i> excavation of river bed destroys, salmon nests / redd / habitat / eggs / alevin <b>OR</b> removes, gravel required for nest / redd / hiding places for alevin / fry ; excavation release sediment so blocking gills ; water deeper, so oxygen concentration at river bed decreased (as greater distance between river bed and surface) / temperature too cold ; dam prevents migration / salmon reaching spawning area / juveniles / smolt reaching estuary / ocean ; collecting (wild) salmon reduces numbers <u>breeding</u> ; <b>AW</b>	<b>3</b>
6(c)	<i>any 2 of:</i> more offspring / eggs survive <b>and</b> there are no predators / salmon are constantly monitored ; increased chance of fertilization <b>and</b> eggs can be artificially fertilized ; optimum (named) conditions provided <b>and</b> faster growth / larger fish / more reliable supply of fish / more able to meet market demand ; easier to spot disease / fish can be vaccinated / given antibiotic <b>and</b> prevent disease / treat disease / less mortality ; selective breeding (over several generations) <b>and</b> faster growth / larger fish / more eggs / fry ; increased chance of breeding <b>and</b> mature salmon kept together ;	<b>2</b>
6(d)(i)	<i>any 1 of:</i> hatchery produced salmon could be inbred / have (harmful) mutations ; have a different, genotype / gene pool ; idea of: wild salmon genotype / gene pool / genetic diversity, is not altered ;	<b>1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(d)(ii)	<i>any 2 of:</i> idea of increased competition for food / breeding sites / mate ;  easier for diseases / parasites, to spread ;  poor swimmers ; less able to adapt to any change in <u>named</u> conditions ;  more easily predated (as they are not used to predators) ; can alter food chains / webs ;	<b>2</b>