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**MARINE SCIENCE**

**9693/02**

Paper 2 AS Data-Handling and Free-Response

**May/June 2017**

MARK SCHEME

Maximum Mark: 50

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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 will not enter into discussions about these mark schemes.

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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)

Question	Answer	Marks	Guidance
1(a)(i)	appropriate linear <b>scale</b> for both axes ;  both <b>axes</b> labelled including units ;  all points <b>plotted</b> correctly ( $\pm 1$ mm) ;  points joined with ruled <b>lines</b> ;	<b>4</b>	plots to cover at least 1 / 2 of the grid I axis orientation
1(a)(ii)	answer is consistent with graph, precise to $\pm 1$ mm ;  per $\text{m}^2 / \text{m}^{-2}$ ;	<b>2</b>	<b>ECF</b> from incorrect lines in 1(a)(i)
1(b)(i)	<i>any 2 of:</i>  uptake increases / simple statement of relationship ;  (then) levels off / rate of increase lessens ;  credit use of <u>manipulated</u> figures (if units stated, they must be correct) ;	<b>2</b>	e.g. the greater the concentration of nitrate, the higher the mean rate of uptake  e.g. an overall increase in uptake of 6.1 ( $\mu\text{mol dm}^{-3} \text{hr}^{-1}$ ) ;
1(b)(ii)	find the total uptake for all replicates ;  divide total by 7 / number of replicates ;	<b>2</b>	
1(b)(iii)	provide nitrogen for ;  synthesis of <i>any 2 of</i> , (named) amino acids / (named) protein / (named) enzyme / chlorophyll / DNA ; ;  to produce new cells ;	<b>2</b>	

Question	Answer	Marks	Guidance
2(a)	second (trophic level) ;	1	
2(b)(i)	2652 ; ;	2	If answer incorrect, check working (204 × 936) ÷ 72 = 1 mark
2(b)(ii)	6.63 (per m <sup>2</sup> ) ; ;	2	A 7, 6.6
2(b)(iii)	<p>any 3 of:</p> <p>idea of, moving into or out of area ;</p> <p>idea of, marked individuals may not be randomly mixed ;</p> <p>marking may <u>increase</u> likelihood of them being re-captured ;</p> <p>paint may wear off / fade / wash off ;</p> <p>reproduction / death of periwinkles ;</p> <p>marking may increase / change predation (rate) ;</p> <p>marking may <u>harm</u> periwinkles ;</p>	3	I ref. to human error, lack of replicates
3(a)	<p>idea of, change in community (structure) / change in numbers of different species ;</p> <p>over time ;</p> <p>e.g. (<i>Tevnia</i> replaced with <i>Riftia</i>) at hydrothermal vents ;</p>	3	<p>A other <u>marine</u> examples, e.g. succession on a whale carcass or on an artificial reef</p> <p>Individual species names are not required, but a relevant successional scenario is required</p>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>	<b>Guidance</b>
3(b)	<p><i>any six of:</i></p> <ol style="list-style-type: none"> <li>1 idea of, erosion explained as removal of particles / sediment / silt ;</li> <li>2 idea of, sedimentation as settling of particles / sediment / silt ;</li> <li>3 rocky shore develops where there is (a lot of) erosion ;</li> <li>4 rate of erosion exceeds sedimentation (at rocky shores) ;</li> <li>5 rocky shores associated with (fast) currents / (strong) wave action ;</li> <li>6 muddy shores develop where there is (a lot of) sedimentation ;</li> <li>7 rate of sedimentation exceeds erosion (at muddy shores) ;</li> <li>8 muddy shores associated with slow water flow / low, wave energy / action (which encourages sedimentation) ;</li> <li>9 credit reference to different sized particles ;</li> </ol>	<b>6</b>	(silt particle size 0.02 mm or smaller)

Question	Answer	Marks	Guidance
3(c)	<p><i>any 6 of:</i></p> <ol style="list-style-type: none"> <li>1 damage due to, storms / cyclones / physical effects ;</li> <li>2 drying / exposure to air ;</li> <li>3 temperature change / global warming ;</li> <li>4 causes bleaching / loss of zooxanthellae ;</li> <li>5 presence of predators / crown of thorns starfish (COTS) / parrot fish / corals are eaten ;</li> <li>6 increased carbon dioxide / acid rain ;</li> <li>7 decreased pH / increased acidity ;</li> <li>8 dissolves coral skeleton / can't form (CaCO<sub>3</sub>) exoskeleton ;</li> <li>9 sedimentation / sediment / silt, blocks mouth of polyp / physical damage ;</li> <li>10 damage due to <u>named</u> human disturbance ;</li> <li>11 idea of, nutrient enrichment / chemicals in run off ;</li> <li>12 leading to, eutrophication / algal growth / toxicity to coral ;</li> <li>13 blocking / reduction, of light (by sediment / turbidity / algae) ;</li> <li>14 (coral) disease ;</li> </ol>	<b>6</b>	<p><b>A</b> H<sup>+</sup> increase as a decrease in pH</p> <p>e.g. tourist trampling, blast fishing, dredging, anchorage of boats</p>

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Question	Answer	Marks	Guidance
4(a)	<p><i>any five of:</i></p> <ol style="list-style-type: none"> <li>1 idea of, (named) salt / (named) mineral input from volcanoes (increases) salinity ;</li> <li>2 volcanic gases contain, carbon dioxide / sulfur dioxide / hydrogen sulfide / hydrogen chloride ;</li> <li>3 gases dissolve / (atmospheric) dissolution ;</li> <li>4 carried into sea water <u>in rain</u> water / reference to <u>hydrological cycle</u> ;</li> <li>5 (ions) enter water directly through underwater volcano / hydrothermal vent ;</li> <li>6 idea of, (sea) water becomes more acidic / decreased pH ;</li> <li>7 gases are less soluble in hot water ;</li> <li>8 idea of, a lot of volcanic ash would raise pH ;</li> </ol>	<b>5</b>	<p><b>A</b> CO<sub>2</sub> / SO<sub>2</sub> / H<sub>2</sub>S / <u>sulfides</u> / S<sup>2-</sup> / HCl hydrochloric acid / <u>chloride</u> (ions) / Cl<sup>-</sup></p> <p><b>I</b> mixing</p> <p><b>A</b> ref. to hydrosphere</p>

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Question	Answer	Marks	Guidance
4(b)	<p><i>any five of:</i></p> <ol style="list-style-type: none"> <li>1 warming of surface layers ;</li> <li>2 warm water less dense than cold water ;</li> <li>3 (therefore) floats on colder water ;</li> <li>4 temperature decreases as depth increases ;</li> <li>5 ref. to thermocline / description of ;</li> <li>6 (mixing by) wind / storms / cyclones / hurricanes / typhoons ;</li> <li>7 (mixing by) currents / upwelling ;</li> <li>8 (leads to) cooling of surface water ;</li> <li>9 results in <u>convection</u> (mixing) ;</li> </ol>	<b>5</b>	description of thermocline must imply <u>sudden</u> change in temp. with depth



Question	Answer	Marks	Guidance
4(c)	<p><i>(the concentration of DO is lower in a tropical lagoon because:)</i> <i>any five of:</i></p> <ol style="list-style-type: none"> <li>1 higher temperature (than open ocean) ;</li> <li>2 solubility of oxygen decreases (as temperature increases) ;</li> <li>3 less, wave action / mixing / turbulence ;</li> <li>4 waves help atmospheric oxygen to dissolve ;</li> <li>5 higher salinity in a lagoon (due to evaporation) ;</li> <li>6 oxygen less soluble in more saline water ;</li> <li>7 fewer producers in lagoon ;</li> <li>8 less (production of oxygen by) photosynthesis ;</li> <li>9 higher nutrient concentration (in lagoon) / idea of, eutrophication ;</li> <li>10 lagoon is an enclosed body of water (vs open ocean with lots of mixing) ;</li> </ol>	<b>5</b>	<p>Implication of a comparison is needed in the answer.</p> <p><b>A</b> reference to a lagoon being, a closed system / isolated, or surrounded by a reef / atolls</p>