CAMBRIDGE
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Cambridge International AS & A Level

MARINE SCIENCE **9693/21**

Paper 2 AS Data Handling and Investigative Skills **May/June 2024**

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 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre–U components, and some Cambridge O Level components.

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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 descriptions 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
underline	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)	clear outline with thin lines with no shading, no gaps ; suitable size ; in proportion ; detail ;	**4**
1(b)	(primary / secondary) consumers / eat phytoplankton / eat plants ; provide food / make energy available / source of energy **OR** increase biomass, for higher trophic levels **OR** zooplankton are prey for / fed on by, other animals / other (marine) organisms **OR** source of food for other organisms ;	**2**
1(c)(i)	3 ;	**1**
1(c)(ii)	*any **3** from:* **1** both species / A **and** H, have the similar (percentage) composition between 0–200 m ; **2** (percentage composition of) both species increase with depth **ORA** ; **3** *idea of* greater increase (in percentage composition) for species H **ORA** ; **4** ref. to greatest increase for both species between 0–200 m and 201–500 m / **ORA** ; **5** correct manipulation of data to support answers ;	**3**

Question	Answer	Marks
1(c)(iii)	**1** *idea of* (presence or absence of) adaptations to different conditions e.g. different species adapted to different (environmental) conditions / some species lack adaptations to survive (and need sunlight) / composition of species H increases with depth, so H is suited to deeper areas of the ocean ; ***plus** any **2** from:* **2** (differing / changing amounts of) predation ; **3** (differing / changing) abundance of food ; **4** (differing / changing) salinity / pH ; **5** (differing / changing) oxygen (concentration) ; **6** (differing / changing) density / pressure ; **7** (differing / changing) competition ; **8** (differing / changing)(water) temperature ; **9** (differing / changing) light intensity / brightness / light penetration ;	**3**
1(d)(i)	0.24(0) **AND** 0.058 / 0.0576 ;	**1**
1(d)(ii)	$\Sigma (n / N)^2 = 0.256$ or 0.2556 ; 1 – 0.256 = 0.744 or 1 – 0.2556 = 0.744(4) ; calculated answer given to 3 sig figs ;	**3**
1(d)(iii)	links change in biodiversity to change in depth e.g. biodiversity is decreasing **OR** the deeper, the lower biodiversity of copepod zooplankton there is **OR** biodiversity declines with depth **ORA** ; value closer to 1 indicates higher biodiversity ;	**2**

Question	Answer	Marks
2(a)	intertidal region of the, shore / shoreline ; *idea of* highest high tides and lowest low tides e.g. the highest and lowest, spring tides / spring tide marks ;	**2**
2(b)(i)	*any **1** from*: ref. to repeats / multiple trials / more trials ; record mean (time) / calculation of mean (time) ; use correct units for light intensity (or correct stated example e.g. lumen / lux) ;	**1**
2(b)(ii)	*any **2** from*: depth / level / volume of the water ; diameter / thickness / mass, (of the discs); concentration of CO_2 (in water) ; ensuring discs start at the bottom ; temperature (of the water) ; **AVP**; e.g. turbidity	**2**
2(b)(iii)	oxygen (bubbles) produced (by photosynthesis) / discs contain oxygen ; (oxygen) reduces density of discs / oxygen (gas) has a lower density than water ;	**2**

Question	Answer	Marks
2(c)(i)	(species R because)… species R is quickest / takes least time, to rise at lower light intensities ; so must be, producing oxygen / photosynthesising, faster / the most (at lower light intensities) ; light intensity will be, lower / lowest / little, when tide is in / when in deeper water / ;	**3**
2(c)(ii)	(mean time for discs to rise between) 111 (s) ;	**1**

Question	Answer	Marks
3(a)	correct labels for both axes and units for x-axis ; correct scale added to both axes ; all plots correct ±1 mm / ± ½ small square ; appropriate line of best fit ;	**4**
3(b)	*any **3** from ;* *idea that* both have positive relationship ; *idea that* rate of increase, levels off / plateaus, for both ; *idea that* predation by damselfish is (always) greater **OR** rate of increase in damselfish is greater ; correct use of manipulated data to support comparison ;	**3**

Question	Answer	Marks
3(c)(i)	*any **2** from ;* (fewer predatory fish will lead to) decreased predation of (CoTS) larvae OR increased abundance / overpopulation, of (CoTS) larvae ; *Idea of* more larvae will become, adults / starfish ; ref. to increased population of CoTS feeding on coral ; *idea of* less predation of other coral consuming organisms if predators removed / predatory fish eat the fish that feed on the corals / prey of these predators that use coral overpopulate, could damage corals / removal of predatory fish damages the coral because there is no hunting of invasive species which eat coral ; **AVP** ;	**2**

Question	Answer	Marks
3(c)(ii)	*any **4** from:* **1** ref. to no data on damage to corals OR investigation did not look at corals **OR** no evidence of CoTS impact on corals shown ; **2** idea that coral reefs provide hiding places for larvae / more difficult to predate larvae ; **3** graph suggests not all predatory species will have significant impact on CoTS larvae **AW** ; **4** idea that investigation is lab based and might not replicate on coral reefs ; **5** fish may not consume as many larvae if other food sources are available ; **6** fish numbers on reef may not be high enough to have an impact / investigation did not look at effect of (predatory) fish population ; **7** CoTS larvae density on reef may be too high for damselfish to have impact ; **8** other, fish / predator, species, may have an impact / need to be investigated ; **9** idea of need for peer review / other Scientists obtaining similar results / reference to lack of repeats / use of statistical methods ; **10** coral damage may be due to, other factors / pH / temperature ;	**4**

Question	Answer	Marks
4(a)(i)	*note that ref. to low tide must be linked to safety for MP1 or MP9.* **1** appropriate safety measure e.g. checking tide times ; *plus any **3** from:* **2** use of either line transect / belt transect **OR** grid ; **3** use of quadrat **OR** take photographs over a measured area ; **4** place quadrat at, stated / even, intervals along the transect OR random distance apart along the transect **OR** random placement within a grid ; **5** ref. method of generating random locations / coordinates ; **6** count how many (lugworm) casts (accept from a photo) / count the number of holes and divide by 2 ; **7** describes or calculates counts of casts to number per m^2 ; **8** idea of repeat(s) / series of trials + mean calculation ; **9** idea of timing, to count at low tide / leaving sufficient time for casts to appear ;	**4**
4(a)(ii)	*any **2** from:* not every lugworm may have produced a cast (at time of counting) / some casts may not be as visible as others and missed / could be other species that make casts / idea that 2 casts could appear to be one ; casts may be disturbed / removed ; standing water may prevent cast formation ; adjacent casts may overlap ;	**2**

Question	Answer	Marks
4(b)(i)	*either* increased (percentage) of organic matter in sediment increases the population density of lugworms / more organic matter leads to an increase in population density of lugworm / does the organic matter in sediment affect lugworm population density / if there is a high % organic matter the population density will be larger ; **OR** lugworm population density will be highest in medium sediment diameters ; **OR** valid null hypothesis e.g. the percentage of organic matter in sediment does not affect the population density of lugworms ;	**1**
4(b)(ii)	*any **2** from:* increase number of shores studied / do this with other shores apart from A, B and C. / more areas on the same shore ; increase variety of mean sediment sizes / change the % organic matter content / measuring organic matter within each quadrat ; idea of use of statistical analysis to, accept hypothesis / reject hypothesis / shows significance of data / determine correlation or relationship ;	**2**
4(c)(i)	description of (rapid) increase, followed by (rapid) decrease ; *plus any **2** from:* description of the decrease changing rate over its duration (more than it does on the increase) ; idea of same / identical pattern **OR** idea that each cycle is exactly same duration ; correct use of 2 values of flow rate data to support answer ;	**3**

Question	Answer	Marks
4(c)(ii)	*any **3** from:* replenishing oxygen (in the burrow) ; preventing accumulation of / expelling waste (from burrow) ; replenishing, food (sources) / organic matter (in the burrow) ; expelling / remove, sediment (from the burrow) ; **AVP** ;	**3**

Question	Answer	Marks
5(a)(i)	a substance / chemical, that dissolves in a solvent ;	**1**
5(a)(ii)	$MgSO_4$ AND $NaCl$;	**1**
5(b)(i)	use a known volume of water ; determine mass of salt that dissolves ;	**2**

Question	Answer	Marks
5(b)(ii)	*any **3** from:* **1** The Atlantic Ocean is colder than the Indian Ocean **ORA** ; **2** Magnesium sulphate is more soluble (than sodium chloride), in the Indian Ocean / at 27 °C **ORA** ; **3** both sodium chloride and magnesium sulphate are more soluble in the Indian ocean / at 27 °C **ORA** ; **4** Sodium chloride is more soluble than magnesium sulphate, in the Atlantic Ocean / 8 °C **ORA** ; **5** There is a greater difference in the solubility between magnesium sulphate and sodium chloride in the Atlantic Ocean (compared to the Indian Ocean) **ORA** ; **6** comparing manipulated data ; ;	**3**
5(c)(i)	divergent / constructive ;	**1**
5(c)(ii)	solubility of, salts / minerals, higher at high temperature / minerals dissolve in the water as it's heated ; sudden cooling reduces solubility ; idea of cold (water) causing, salts / minerals, deposited / precipitate / build up / settle around the (vent)(to form chimney) ;	**3**
5(d)(i)	117–55 ; 62 (cm per year) ;	**2**
5(d)(ii)	ppt ;	**1**
5(d)(iii)	1.8 (ppt) ;	**1**
5(d)(iv)	salinity at 50 °N is lower than 30 °S **ORA** ; at 50 °N precipitation is (much) greater (than evaporation) **ORA** for 30 °S **OR** at 30 °S precipitation is (much) lower (than evaporation) **ORA** for 50 °N ;	**2**