Cambridge Assessment International Education

Cambridge International AS & A Level

MARINE SCIENCE **9693/43**

Paper 4 A Level Data-handling & Investigative Skills **October/November 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 October/November 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **12** 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	<u>'List rule' guidance</u> 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)	*any **3** from:* chlorophyll / photosystem (I/II) absorbs light (energy) ; photolysis of water (occurs) / **AW** ; producing oxygen ; ATP produced ; NADPH / **AW**, produced ; ref. to movement of electrons / oxidation of chlorophyll / photoactivation / movement along electron transport chain / **AW** ;	**3**
1(b)(i)	*any **3** from:* all colours penetrate further in open ocean / **ORA** ; blue penetrates furthest in open ocean but green penetrates furthest in coastal water ; violet penetrates least in coastal water but red penetrates the least in open ocean ; red and violet penetrate least for both ; credit correct manipulated comparison ;	**3**
1(b)(ii)	*any **2** from:* less sediment / mud / sand ; from outflow of river / less runoff (from land) ; less movement of tide / less wave action, on seabed stirring up sediment ; more algae / phytoplankton in surface water / eutrophication / **AW** ; deeper water in open ocean so less easy for sediment to be brought to surface / **AW** ;	**2**
1(c)(i)	correct measurement of distance from origin to xanthophyll ; correct calculation of R_f value ; correct number of significant figures ;	**3**
1(c)(ii)	*any **3** from:* species from 2 m has no xanthophyll / species from 20 m has xanthophyll ; no red / violet, light at 20 m depth ; (xanthophyll) absorbs additional light wavelengths / absorbs, more yellow / green / blue / more colours ; to enable photosynthesis ; credit ref. to idea of competitive advantage of having xanthophyll at depth or disadvantage closer to surface ;	**3**

Question	Answer	Marks
1(d)	photosynthesis will be faster in red / blue / orange light / **ORA** ; *any **10** from:* ***independent variable*** independent variable identified as light wavelength / colour ; place different colours of cellophane in front of lamp / light source ; ***dependent variable*** *max **2** from:* dependent variable identified as rate of photosynthesis / rate of oxygen production / bubble rate / e.g. ; measurement of dependent variable e.g. counting bubbles / collecting volumes of oxygen ; in set time measured with timer ; ref. to minimum 3 replicates and means ; ***standardised variables*** *max **3** from:* constant temperature ; carbon dioxide (concentration) ; volume of water ; mass / species / type, of seaweed ; same distance from lamp / ensure light intensity is constant / same power of bulb ; pH ; ***method points*** *max **3** from:* place seaweed in test tube / beaker / **AW**, and cover with water ; leave seaweed to adjust to each light colour ; use of water bath / use of heat shield ; addition of sodium hydrogencarbonate (as a source of carbon dioxide) ; (same volume of water) measured with syringe / pipette / measuring cylinder ; switch off all other lights ; ***risk*** care with bulb and water / care not to get burnt / low risk experiment statement / care with cutting / do not get wires wet / **AW** ;	**11**

Question	Answer	Marks
1(d)	***ethics*** don't take seaweed from areas where it is needed / care with disposal of sodium hydrogen carbonate ; ***analysis*** *max **2** from:* calculation of rate as number of bubbles / volume of oxygen divided by time ; bar chart / (line) graph, of light wavelength / colour plotted on x-axis and rate on y-axis ; appropriate statistical test ;	

Question	Answer	Marks
2(a)	all four cells drawn with clear membrane, nuclei and touching ; clear thin lines with no shading and suitable size ; correct proportions of width and length ; one nucleus and one membrane labelled ;	**4**
2(b)(i)	X: phospholipid ; Y: protein ;	**2**
2(b)(ii)	*any **2** from:* proteins diffuse / move through phospholipids / phospholipids can move ; proteins are embedded in / surrounded by the phospholipids / **AW** ; ref. to hydrophilic heads of phospholipids on the outside / hydrophobic tails on inside ;	**2**
2(c)(i)	increase in rate ; level off / **AW**, at 55 / 60 ;	**2**
2(c)(ii)	*any **4** of:* diffusion / facilitated diffusion ; sodium ions are charged / polar / positive ; so do not pass through the bilayer / **AW** ; pass through (protein) channels / carriers / **AW** ; diffusion gradient increases as external concentration increases ; as graph levels off, (number of) (protein) channels / carriers becomes limiting ;	**4**

Question	Answer	Marks
3(a)(i)	125 × 1000 × 40 = 5 000 000 ; mg ;	**2**
3(a)(ii)	one linear *y*-axis labelled ; second linear *y*-axis labelled ; bars correctly plotted ; neat bars with gaps and labels ; key for bars ;	**5**
3(b)(i)	$6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_20$;;	**2**
3(b)(ii)	*any **4** from:* heavier fish / fish with more muscle mass, have a greater concentration of myoglobin / **ORA** ; fish that swim further / sustained swimming have a greater concentration myoglobin / fish that swim for short periods have a lower concentration of myoglobin ; (high myoglobin) stores lots of oxygen for <u>respiration</u> (to release energy) ; for (continuous) muscle contraction / activity / movement ; (short periods of swimming) can be anaerobic respiration (so need less myoglobin) ;	**4**

Question	Answer	Marks
4(a)	*any **3** from:* toxic chemicals are absorbed onto the microplastics ; (toxins / microplastics) pass along food chain / are biomagnified along food chain / fish at top of food chain have high concentrations ; humans eat fish, that are high up food chain / have high toxin concentrations / that eat plankton / **AW** ; microplastics / toxins, are not excreted / broken down / removed from bodies / bioaccumulate ;	**3**
4(b)(i)	719 + 174 = 893 ;	**1**
4(b)(ii)	174 / 893 × 100 = 19.48(%) / 19.5 ;	**1**

Question	Answer	Marks
4(b)(iii)	*any **4** from:* nets are most damaging / pose most risk ; 32% of reefs with nets were damaged ; nets are the most common type of gear found on the reefs / nets most discarded ; ropes are the least common type of discarded gear ; nets made up 78% of the discarded gear when found on or near reefs ; nets / ropes, which are on top of reefs are more damaging than when adjacent ; nylon lines are least damaging ; nylon lines caused 16% damage to reefs where they were found ;	**4**
4(b)(iv)	*any **2** from:* compare damage to reefs with no fishing gear on them ; standardise ages of reef ; measure distance on reef from adjacent gear ; standardise sizes / percentage cover, of fishing gear / quantify amount of fishing gear ; standardise types / area, of coral / state which coral species are damaged ; record weather patterns / standardise temperatures / investigate different seasons / etc. ; quantify the damage ; examine other areas of reef (away from Thailand) ; state if reefs have more than one type of gear ;	**2**
4(b)(v)	*any **1** from:* fish / turtles / dolphins / birds / **AW**, become trapped / damaged ; ingested / eaten by fish / turtles / **AW** ; block light reaching reef ; release toxins ;	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)(i)</td><td>falls until 2005 then increases ;
detail e.g. decrease in 2010 / highest catch 2012 / increase to a higher level than at the start / overall increase from 2000 to 2012 ;</td><td>2</td></tr>
<tr><td>5(a)(ii)</td><td>any 1 from:
restriction by season ;
restriction by quotas ;
restriction by licensing ;
boat size ;
restriction of location / refuge zones / no-take zones / marine protected areas (MPAs) ;
restrictions on the size of organism ;
restriction of intensity ;
monitoring / logging boats ;</td><td>1</td></tr>
<tr><td>5(b)(i)</td><td>there is no difference between the ratios of the fish in each lengths category in the sample compared to the expected ratios / AW ;</td><td>1</td></tr>
<tr><td>5(b)(ii)</td><td>
<table>
<tr><th>length category / cm</th><th>Expected ratio</th><th>number of bone fish in sample (O)</th><th>expected number of fish (E)</th><th>$(O-E)$</th><th>$(O-E)^2$</th><th>$\frac{(O-E)^2}{E}$</th></tr>
<tr><td>< 15</td><td>5</td><td>605</td><td>625</td><td>-20</td><td>400</td><td>0.64</td></tr>
<tr><td>15 – 35</td><td>4</td><td>485</td><td>500</td><td>-15</td><td>225</td><td>0.45</td></tr>
<tr><td>36 – 75</td><td>2</td><td>265</td><td>250</td><td>15</td><td>225</td><td>0.9</td></tr>
<tr><td>> 75</td><td>1</td><td>145</td><td>125</td><td>20</td><td>400</td><td>3.2 ;</td></tr>
</table>
</td><td>1</td></tr>
<tr><td>5(b)(iii)</td><td>5.19 ;</td><td>1</td></tr>
</table>

Question	Answer	Marks
5(b)(iv)	*any **3** from:* there is no significant difference (in the observed numbers and the expected numbers) ; the null hypothesis is accepted / the population is sustainable ; the calculated value is less than the critical value / less than 7.815 ; there is a probability of greater than 0.05 / 5% that the difference is due to chance ;	**3**
5(c)	*any **2** from:* increase population of bonefish / more larger fish / **AW** ; fish live longer / reach maturity ; more fish able to breed (so population increases) ;	**2**