



Cambridge International AS & A Level

MARINE SCIENCE

9693/03

Paper 3 A Level Theory

For examination from 2022

MARK SCHEME

Maximum Mark: 75

Specimen

This document has **16** pages. Blank pages are indicated.

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	<p><u>'List rule' guidance</u> (see examples below)</p> <p>For questions that require n responses (e.g. State two reasons ...):</p> <ul style="list-style-type: none"> • The response should be read as continuous prose, even when numbered answer spaces are provided • Any response marked <i>ignore</i> 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	<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, unless 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. $a \times 10^n$) 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.</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>

Abbreviations used in the Mark Scheme

This mark scheme will use the following abbreviations:

;	separates marking points
/	separates alternatives within a marking point
OR	gives alternative marking point
R	reject
I	ignore mark as if this material was not present
A	accept (a less than ideal answer which should be marked correct)
COND	indicates mark is conditional on previous marking point
ECF	credit a correct statement that follows a previous wrong response
()	the word / phrase in brackets is not required, but sets the context
ORA	or reverse argument
AW	alternative wording (where responses vary more than usual)
AVP	alternative valid point (where a greater than usual variety of responses is expected)
<u>underline</u>	word underlined must be used by the candidate (grammatical variants accepted)
+	statements on both sides of the + are needed for that mark
max	indicates the maximum number of marks that can be awarded

Examples of how to apply the list rule

State three reasons ... [3]

A

1. Correct	✓	2
2. Correct	✓	
3. Wrong	✗	

B (4 responses)

1. Correct, Correct	✓, ✓	3
2. Correct	✓	
3. Wrong	ignore	

C (4 responses)

1. Correct	✓	2
2. Correct, Wrong	✓, ✗	
3. Correct	ignore	

D (4 responses)

1. Correct	✓	2
2. Correct, CON (of 2.)	✗, (discount 2)	
3. Correct	✓	

E (4 responses)

1. Correct	✓	3
2. Correct	✓	
3. Correct, Wrong	✓	

F (4 responses)

1. Correct	✓	2
2. Correct	✓	
3. Correct CON (of 3.)	✗ (discount 3)	

G (5 responses)

1. Correct	✓	3
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1. Correct	✓	2
2. Correct	✗	
3. CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1. Correct	✓	2
2. Correct	✗	
3. Correct CON (of 2.)	✓ (discount 2)	

Section A

Question	Answer	Marks	Guidance
1(a)(i)	<p>all four correct for 3 marks:</p> <p>A – granum ;</p> <p>B – thylakoid ;</p> <p>C – outer membrane ;</p> <p>D – stroma ;</p>	3	<p>3 correct for 2 marks, 2 correct for 1 mark, 1 correct, no marks A grana</p>
1(a)(ii)	in the thylakoid membrane ;	1	A in granum
1(a)(iii)	<p>any three from:</p> <p>trap light <u>energy</u> ;</p> <p>ref. photoactivation (of chlorophyll) ;</p> <p>emission of electron (from chlorophyll) ;</p> <p>photolysis of water ;</p> <p>producing ATP / reduced NADP ;</p>	3	<p>A splitting of water</p> <p>A producing NADPH</p>
1(a)(iv)	<p>any two from:</p> <p>ref. to lower light intensity / lower temperature (on shaded shore) ;</p> <p><u>limiting factors</u> ;</p> <p>so rate of photosynthesis is reduced ;</p>	2	A ORA

Question	Answer	Marks	Guidance
1(b)	<p>zone – lower shore / low tide mark / middle shore ;</p> <p><i>reasons – any three from:</i></p> <p>pigment X / chlorophyll a, highest at blue end of spectrum ;</p> <p>pigment X / chlorophyll a, absorb, blue light / light at 450 nm ;</p> <p>blue light penetrates deeper water ;</p> <p>so algae can photosynthesise in deeper water ;</p> <p>algae in middle shore can absorb green light and blue light ;</p> <p>chlorophyll a alone can only absorb blue light ;</p>	<p>1</p> <p>3</p>	<p>A no pigment X at red end of spectrum</p> <p>A short wavelength for 450 nm</p>
2(a)(i)	<p>it shows metamorphosis ;</p> <p>there are larval stages present ;</p>	2	A ORA
2(a)(ii)	<p><i>any two from:</i></p> <p>less competition for food ;</p> <p>can reach new habitats / dispersal ;</p> <p>AVP ;</p>	2	e.g. obtains different types of food / prevents cannibalism
2(b)(i)	<p><i>any one from:</i></p> <p>overharvesting (so none left to collect in the wild) ;</p> <p>wild population could, be diseased / have parasites ;</p>	1	

Question	Answer	Marks	Guidance
2(b)(ii)	<p>any two from: farmer will obtain the exact number of shrimp ordered / number less prone to human error ; healthier as shrimp will have been fed the correct amount of food ; shrimp will be uniform in size ; more cost-effective (as less food is wasted) ;</p>	2	
2(c)(i)	<p>any two from: phytoplankton use nitrogen compounds to make amino acids / proteins ; shrimp obtain amino acids / proteins, when they eat the phytoplankton ; proteins used for growth ;</p>	2	A to make chlorophyll
2(c)(ii)	<p>any three from: bacteria use the carbohydrate for, respiration / provide energy (for growth) ; bacteria reproduce, so numbers increase ; <u>respiration</u> in bacteria releases carbon dioxide ; which forms a weak acid / carbonic acid, in water ; carbonic acid dissociates releasing protons / H⁺, lowering pH ;</p>	3	

Question	Answer	Marks	Guidance
3(a)(i)	<p>any two from: invasive species are non-native species ; whose introduction is likely to cause harm ; to the environment / economy / human health ; unchecked population growth ;</p>	2	
3(a)(ii)	<p>advantage: idea that it does not kill other plants / animals ;</p> <p>disadvantage: needs to be completed annually / does not remove rhizomes which spread to other areas ;</p>	1	
3(a)(iii)	<p>(very) high risk of extinction in the wild (in the near future) ;</p>	1	
3(a)(iv)	<p>any four from: high tourist numbers / used for recreational activities all year ; so reduce feeding areas on beaches ; so disturb nesting sites in dunes / low vegetation ; marram grass covers dunes ; so less breeding sites available ;</p>	4	
3(b)(i)	<p>any invasive species surviving in tank water would be released out to sea and not inside the bay ;</p>	1	

Question	Answer	Marks	Guidance
3(b)(ii)	<p>any three from: sediment increases the height of salt marsh ; so can protect coastal communities from flooding ; salt marsh plants dissipate wave action ; so will protect low lying land from erosion ;</p>	3	
4(a)	<p>any two from: fishing restrictions increased lobster numbers as enough left to breed ; (more) lobsters eat more sea urchins, so sea urchin numbers decreased ; fewer sea urchins to eat giant kelp, so numbers increased ;</p>	2	
4(b)	<p>any one from: change in global water currents ; change in distribution of species ;</p>	1	A more warm water from EAC

Question	Answer	Marks	Guidance
4(c)	<p><i>any four from:</i></p> <p>warmer water is only reaching the east coast from EAC / west coast continues to receive cold current ;</p> <p>warmer water above optimum temperature for photosynthesis / enzymes (as giant kelp is adapted to cooler water) ;</p> <p>warm water contains less nutrients than cold water ;</p> <p>so fewer nutrients available for photosynthesis / growth ;</p> <p>greater numbers of sea urchins on east coast ;</p> <p>which eat kelp faster than it can reproduce ;</p>	4	<p>A OR A</p> <p>A any other sensible pathways, e.g. lobster population decreases due to high temperatures ; resulting in more sea urchins and fewer kelp ;</p>

Section B

Question	Answer	Marks	Guidance
5(a)	<p>any eight from:</p> <ol style="list-style-type: none"> 1 microplastics are pieces of plastic less than 5 mm across ; 2 long lasting / non-biodegradable so stays in environment many years ; 3 no current ways of removing successfully ; 4 found in all parts of the ecosystem ; 5 small enough to be eaten by primary consumers / zooplankton ; 6 same size as plankton ; 7 taken up by any organism that filter feeds ; 8 reduces food eaten so poor growth / reduced productivity ; 9 (plastic) not digested ; 10 some passed out with faeces, some remain in the intestines ; 11 eaten by other consumers (and also retained in intestines) ; 12 toxins in the plastics can be absorbed into the body / blood ; 13 higher concentrations (of toxins) passed on to next organisms in the chain / biomagnification ; 14 toxins may interfere with metabolism AW / affect behaviour / reproduction ; 15 reduction in biodiversity / extinction ; 	8	<p>A examples, e.g. shrimp, mussels, whales</p>

Question	Answer	Marks	Guidance
5(b)	<p>any seven from:</p> <ol style="list-style-type: none"> 1 ref. to re-using plastic ; 2 ref. to suitable example ; 3 avoid / reduce, use of single use plastic ; 4 legislation to reduce use of plastic / microplastic ; 5 using alternatives to plastic, e.g. paper / glass / cloth ; 6 could increase costs / convenience for businesses ; 7 <u>recycle</u> more plastic ; 8 education / awareness ; 9 avoid products / cosmetics containing microbeads ; 10 reduce use of plastic in fishing gear ; 11 take part in a river / beach clean-up ; 12 support plastic bans / organisations addressing plastic pollution ; 13 shop where you can use your own containers ; 14 send a letter to manufacturers using plastic ; 15 deposit scheme on return of plastic items for re-use ; 16 switching to plastics that are easier to recycle ; 	7	<p>e.g. shredded and used in roads building / clothing / furniture e.g. food packaging / drinks cups / straws A bring a re-useable coffee mug or cup for coffee to go ;</p> <p>A use re-fillable lighters or matches ;</p> <p>e.g. alternatives to plastic heavier to transport ;</p> <p>use alternatives to microbeads, e.g. salt, oatmeal</p>

Question	Answer	Marks	Guidance
6	<p>any six from:</p> <ol style="list-style-type: none"> 1 idea that cell surface membrane is made of phospholipids ; 2 ref. to a bilayer of phospholipid ; 3 ref. to hydrophilic / phosphate, 'heads' of molecules face outwards ; 4 ref. to hydrophobic / fatty acid 'tails' face inwards ; 5 also contains proteins ; 6 ref. to proteins scattered in the phospholipids ; 7 ref. to proteins moving in the phospholipid bilayer ; 8 ref. to fluid-mosaic model ; 9 ref. to some proteins forming channels through the membrane ; 10 ref. to other proteins being on the outer surface of the membrane ; 	6	<p>1 cholesterol and glycoproteins / glycolipids (not specified by syllabus)</p> <p>1 any ref. to functions</p>

Question	Answer	Marks	Guidance
7	<p>any nine from:</p> <p>importance – maximum of 5</p> <ol style="list-style-type: none"> 1 ref. to a suitable reason for mangrove decline ; 2 partly submerged roots form perches for barnacles / oysters / crabs ; 3 these are a food source for small fish / birds / invertebrates ; 4 trees form roosting / nesting sites for birds ; 5 mangrove roots are important nursery areas for fish / invertebrates ; 6 roots trap sediment, so stabilising / protecting the coastline ; 7 reduces sediment build-up on coral reefs / seagrass beds ; 8 mangrove forests are biodiverse areas ; 9 which increases tourism to view wildlife ; 10 provides food / timber / fuel for the local community ; 11 ref. to mangroves as important carbon sinks (so helping to combat climate change) ; 	9	<p>e.g. trees cut for timber / silt added to reduce mosquitoes / land used for building / area used for aquaculture</p> <p>A any suitable named example</p> <p>mangrove forests can sequester up to 1.5 MT of carbon per hectare</p>

Question	Answer	Marks	Guidance
	<p><i>replanting strategies – maximum of 5</i></p> <p>12 government funding / legislation to promote replanting ;</p> <p>13 ref. to growing seedlings in a greenhouse and then planting in mudflats along the shore ;</p> <p>14 this has a poor / often less than 20%, survival rate ;</p> <p>15 hand planting is labour intensive / restoration can be costly ;</p> <p>16 single species are usually planted ;</p> <p>17 so mangrove forest is less diverse ;</p> <p>18 water flow is critical to mangrove restoration ;</p> <p>19 sediment build-up should be removed to create a gentle slope to the sea, so allowing tidal flow ;</p> <p>20 seedlings need to be planted where their roots will be wet for 30% of the time / dry 70% of the time ;</p> <p>21 floating seeds / propagules will then naturally re-plant the area ;</p> <p>22 better success rates if local communities are involved ;</p> <p>23 restricted access while mangroves establish ;</p> <p>24 could cause resentment by local communities involved in planting ;</p>		<p>ref. to ecological – hydrological mangrove restoration (EMR)</p>