CAMBRIDGE
International Education

Cambridge International AS & A Level

MARINE SCIENCE **9693/31**

Paper 3 A Level Theory **May/June 2026**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

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[Turn over

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions 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.
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.

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6	<u>Calculation specific guidance</u> 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	<u>Guidance for chemical equations</u> 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.

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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
✓	correct point or mark awarded
✗	incorrect point or mark not awarded
^	information missing or insufficient for credit
A	allow or accept
I	incorrect or insufficient point ignored while marking the rest of the response
CON	contradiction in response, mark not awarded
BOD	benefit of the doubt given
ECF	error carried forward applied
MR	maximum mark reached
PAG	point already given

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Annotation	Meaning
POT	power of ten error
R	incorrect point or mark not awarded
RE	rounding error
SEEN	point has been noted, but no credit has been given or blank page seen
TV	response is too vague or there is insufficient detail in response
1, 1, a	marking point 1 or marking point a is awarded. Used to mark against a particular marking point from an extended answer MS
	used to highlight parts of an answer / incorrect idea / irrelevant to question
	used to highlight parts of an extended response / incorrect idea / irrelevant to question
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
ruler	allows lengths to be measured
multi-line overlay	overlays graphs

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Question	Answer	Marks	Guidance
1(a)(i)	(shallow water) so more light **+** for photosynthesis ; *idea of* (muddy substrate) anchors plant **+** not uprooted by wave action ; **or** (muddy substrate contains) nutrients / minerals **+** for growth ;	**2**	**A MAX 1** for **first part** answer from two different mps.if there are no other marks **e.g.** more light + anchors plant OR more light + nutrients
1(a)(ii)	*any **3** of:* 1 photosynthesise, so provide a source of oxygen (for respiration) ; 2 use carbon dioxide (in photosynthesis) / acts as a carbon sink, so making the water less acidic ; 3 (leaves / roots) trap, sediment / sand / silt, so improving water clarity / reducing turbidity ; 4 *idea of* absorb, (excess) nutrients / toxins, so reducing pollution ; 5 (long / flexible, leaves) slow down current / reduces wave action, so reducing erosion ;	**3**	**Note** – **two** parts required for each mark point. **A MAX1** for part answers to two different marking points **only** if there are no other marks **A** substrate **A** fertilisers for nutrients **A** reducing algal blooms / eutrophication (as examples of pollution)
1(b)(i)	(number of hectares), fluctuates / keeps increasing and decreasing ;	**1**	
1(b)(ii)	(2012 =) 19 **and** (2017 =) 42 ; (difference = 42 – 19) = 23 ;	**2**	**A** any figure between 18 and 19 for 2012 and between 41 and 43 for 2017 **A ecf** if incorrect figures from graph **A** both marks for correct answer only – must be any number between 22 and 25 inclusive

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Question	Answer	Marks	Guidance
1(c)	*any **4** of:* 1 increased run-off (from land) ; 2 as less (plant) roots to absorb water ; 3 increased, water flow / current speed ; 4 (increased flow) could dislodge seagrass plants / roots **or** causes fluctuations in temperature ; 5 (increased rainfall / land clearance) causes water levels to rise / increases sediment / turbidity ; 6 (increased water levels / turbidity) reduces light for photosynthesis ; 7 more nutrients / toxins, (in run-off) ; 8 (more nutrients) cause algal blooms **or** / toxins poison seagrass ; 9 (increased rainfall) decreases salinity ; 10 *idea of*, (decreased salinity) affects water potential in seagrass ;	**4**	**Use numbered ticks for this question** **I** any ref.to CO_2 and global warming / acidification. **Note** paired answers must be linked, so second mark cannot be awarded without the first. **A** causes flooding **A** chemical for toxins **A** fertilisers **I** pollutants / minerals / salts more nutrient run-off Bod 2 marks more run-off with nutrients 1 mark **A** cause eutrophication **I** kill seagrass **A** idea of salinity levels fluctuating / too much freshwater

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Question	Answer	Marks	Guidance
1(d)	*any **2** of:* 1 replanting seagrass ; 2 planting more trees around the bay ; 3 introducing legislation / restrictions on recreational activities / deforestation ; 4 creating an MPA (to prevent further deforestation / land clearance) ; 5 raise awareness ;	**2**	 **A** prevent / limit **e.g**. education programmes for schools / public ; **I** increased monitoring of seagrass beds / proper disposal of waste products

Question	Answer	Marks	Guidance
2(a)	 oxygen release glucose / carbohydrate ATP carbon dioxide water ;;;;	**4**	6 correct for 4 marks, 5 correct for 3 marks, 4 correct for 2 marks, 3 or 2 correct for 1 mark Put ticks down RHS **A** chemical formula for oxygen, water and carbon dioxide (BOD O^2 or CO^2) **A** organic nutrients **I** glycogen **or** water followed by carbon dioxide

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Question	Answer	Marks	Guidance
2(b)	*aerobic respiration* – cytoplasm **and** matrix **+** inner membrane / cristae of mitochondrion ; *anaerobic respiration* – cytoplasm ;	**2**	**A** cytoplasm + mitochondrion

Question	Answer	Marks	Guidance
3(a)	quadrat ;	**1**	**R** quadra**n**t
3(b)	samples were taken, along a line / at regular intervals / every metre ;	**1**	**A** samples not selected at random
3(c)	percentage cover / ACFOR / Braun-Blanquet ;	**1**	**A** take a photo and use, computer or AI analysis of the image / surface area covered **I** percentage frequency
3(d)	*any **3** of:* 1 found, in shallow water ; 2 contain chlorophyll *a ;* 3 which traps red light / light around 670 nm ; 4 red light, cannot penetrate deep water / can only penetrate a short distance (through water) ; 5 green algae (are small and) cannot compete (for light) against brown and red macroalgae (lower down the shore) ; 6 (green macroalgae) may be able to tolerate longer, exposure to air / direct sunlight / higher temperatures ;	**3**	**A** long wavelength for red light **A** blue and red light **A** green algae lack accessory pigments (to live lower down the shore) **A** can tolerate desiccation **I** most / more light

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Question	Answer	Marks	Guidance
3(e)	*any **4** of:* 1 (brown and red algae) contain <u>accessory pigments</u> ; 2 **two** examples of accessory pigments ; 3 (their pigments) trap <u>short wavelengths</u> of light **or** trap, wavelengths / light, which can penetrate deeper water ; 4 allows, red / brown, algae to live, lower down shore / in deeper water ; 5 brown algae trap, blue / green, wavelengths / light ; 6 red algae trap, yellow / orange, wavelengths / light ;	**4**	**e.g.** carotenoids / xanthophyll / fucoxanthin / phycobilins / phycocyanin / phycoerythrin **R** red light / long wavelength of light **R** any mention of 'brown' light **A** trap, OYGBIV, which penetrates deeper water (i.e. any one of these colours is OK) **A** correct depth from graph **R** if red light included **R** if red light included
3(f)	found in a rock pool / misidentification ;	**1**	**A** mutation / dip in landscape

Question	Answer	Marks	Guidance
4(a)(i)	*any **2** of:* carbon dioxide / methane / water vapour / chlorofluorocarbons (CFCs) / <u>nitrous</u> oxide ;	**1**	Note **2** answers required for 1 mark **A** correct formulae **A** ozone
4(a)(ii)	*any **2** of:* 1 (greenhouse gases) trap / reflect ; 2 <u>Infrared</u> radiation (from the ground) ; 3 (infrared radiation / heat) remains within the atmosphere ;	**2**	**R** if gases trapped **A** absorb for trap **R** if infrared coming from Sun **I** insulates Earth

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Question	Answer	Marks	Guidance
4(a)(iii)	*any **2** of:* 1 burning / combustion, of fossil fuels ; 2 (farming), livestock / cattle / rice cultivation ; 3 deforestation ; **4 AVP** ;	**2**	**I** respiration **A** example of fossil fuel / driving gas powered cars **e.g.** landfill / draining wetlands / processing petroleum / cement, steel and chemical production / drilling for oil / aerosol spays
4(b)	1 (air) temperature has increased in <u>2023</u> (compared with previous years) ; 2 correct data, quote / comparison, between 2023 with range from 1940 to 2022 ;	**2**	**I** reference to summer / autumn / seasons **e.g.** highest temperature in 2022 was 16.6 °C, in 2023 it was 17 °C / temp in 2023 around 0.15 to 0.5 °C higher **e.g**. air temperature in 2023 always above the range from May / June onwards ;

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Question	Answer	Marks	Guidance
4(c)(i)	*any **3** of:* 1 enzymes used in, (respiration / egg production), could (begin to) denature ; 2 respiration rate will increase / reproduction rate will decrease (with increasing temperature) ; 3 sea water will hold less oxygen (for respiration) / increased demand for oxygen ; 4 so less energy available for, growth / reproduction ; 5 suitable effect on breeding season ; 6 idea of, reduced, production / survival, of eggs / larvae ; 7 **AVP** ;	**3**	Answers must include a reference to respiration **and** reproduction for 3 marks **I** any ref.to salinity / pH **I** ref. to phytoplankton / algal blooms **R** no oxygen **e.g.** affects timing / affected by temperature **e.g.** may cause sex reversal in fish **e.g.** cannot migrate to breeding grounds

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Question	Answer	Marks	Guidance
4(c)(ii)	*any **4** of:* 1 air temperature in 2023 is the highest on record ; 2 oceans absorb heat from the atmosphere ; 3 during El Niño upwelling is reduced / stops ; 4 less / no, cold water is brought to the surface ; 5 sea temperature (in the Pacific Ocean) would increase (further) ; 6 so could increase global temperatures by more than 1.5 °C ; 7 which could change ocean currents ; 8 as temperature affects water density ; 9 idea of change in weather patterns ; 10 **AVP** ;	**4**	Assume that 'water' means 'sea water'. sea temperature will be high**er** **A** global conveyor belt **e.g**. increased, storms / hurricanes / drought / rainfall / change in wind patterns **e.g.** thermocline becomes deeper / causes salinity changes / warmer water holds less carbon dioxide so less greenhouse gases stored in ocean

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Question	Answer	Marks	Guidance
5	*any **10** of:* 1 both the kelp and salmon benefit (from growing close together) ; 2 salmon respire releasing carbon dioxide ; 3 carbon dioxide is, used / fixed, during photosynthesis (in kelp) ; 4 kelp releases oxygen (as a waste product) in photosynthesis ; 5 oxygen is used for (aerobic) respiration in salmon ; 6 salmon releases (nitrogenous) waste products ; 7 suitable example of how kelp uses the minerals in waste ; 8 idea that waste promotes growth / acts as a fertiliser for kelp ; 9 idea that kelp provides a habitat for salmon food sources ; 10 use of waste products by kelp, reduces impacts of pollution / improves water quality ; 11 suitable example of commercial use of kelp ; 12 so both salmon and kelp can be harvested (without impacting each other) ; 13 increasing income / profit ;	**10**	**Use numbered ticks on LHS for all Section B questions** **I** any reference to kelp providing a nursery area for salmon larvae / young **I** ref to extensive / intensive aquaculture **A MAX 1** for salmon produces carbon dioxide for kelp and kelp produces oxygen for salmon if no mark points 2 to 5 awarded. **A** faeces / urine / phosphates **e.g.** nitrogen is used by kelp to make amino acids / proteins phosphates used to make DNA / ATP **A** phosphorus / magnesium makes chlorophyll **I** salmon eats kelp **e.g.** reduces the chance of algal blooms / eutrophication **e.g.** use in medicine / used in miso soup / as a fertiliser / can be added to fishmeal **I** costs

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Question	Answer	Marks	Guidance
5	14 are easier to monitor (as they are next to each other) ; 15 suitable example, e.g. growth / disease / damage to cage ; 16 **AVP** ;		 **e.g.** salmon create currents while swimming to help distribute, nutrients / gases **e.g.** kelp attracts wrasse that clean lice from salmon **e.g.** kelp reduce wave action, so protecting salmon / salmon cages from damage **e.g.** ensures that only one habitat is disturbed for aquaculture

Question	Answer	Marks	Guidance
6(a)	*any **5** of:* 1 Visking tubing is a membrane ; 2 is selectively permeable / it only allows, small molecules / water, to pass through / **ORA** ; 3 the (sucrose) solution in the Visking tubing has a lower water potential (than the sucrose solution in the beaker) **ORA** ; 4 water will move ; 5 from a high water potential to a lower water potential / down a water potential gradient ; 6 (from the beaker) into the Visking tubing ; 7 by osmosis ; 8 Visking tubing will, swell / increase in volume ;	**5**	**I** any ref. to hypotonic / hypertonic **A** semi-permeable / partially permeable **R** if sucrose or solution moving **I** water concentration **A** (from the 0.2 mol dm^{-3} solution) into the 0.5 mol dm^{-3} solution

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Question	Answer	Marks	Guidance
6(b)	1 diffusion is the movement of substances from a high concentration to a low concentration / down a concentration gradient ; 2 no ATP / energy, is required / passive ; ***Max 4** of:* 3 applies to, (large) polar molecules / ions / charged particles ; 4 carrier proteins **and** channel proteins used ; 5 large polar molecules pass through carrier proteins **or** charged / polar substances, pass through channel proteins ; 6 suitable example of, e.g. glucose / amino acids **or** e.g. water **or** e.g. sodium ions / chloride ions ; 7 *idea of* proteins are specific (for one substance) ; 8 ref. to channel proteins having a fixed shape / carrier proteins change shape ; 9 ref. to a factor affecting the rate of facilitated diffusion ;	**6**	**A** using the kinetic energy of the substance (for movement) **R** if any incorrect examples quoted **e.g.** only allow one type of molecule or ion to pass through it ; **A** protein is selective **I** open and close **e.g.** number of proteins in membrane / temperature / concentration gradient / surface area

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Question	Answer	Marks	Guidance
7	*any **9** of:*	**9**	
	similarities		
	1 (usually) have an oval shape ;		**A** round / same shape
	2 are membrane bound organelles / contain a, double / inner and outer, membrane;		**R** cell membrane
	3 (inner) membrane, is folded / forms a large surface area ;		
	4 liquid centre ;		
	5 contain enzymes / ATPase ;		
	6 **AVP** ;		**e.g.** contain, ribosomes / RNA / DNA / ETCs / genetic material
	differences		
	7 chloroplasts are larger ;		
	8 grana are (only) present in chloroplasts ;		
	9 stroma in chloroplasts **+** matrix in mitochondria ;		
	10 starch grains present in chloroplasts ;		
	11 thylakoids, in chloroplast **+** cristae in mitochondria ;		**R** cisternae
	12 chloroplast / thylakoids, contain light-absorbing pigments ;		**A** example e.g. chlorophyll

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