Marine Science marking guide

External assessment

Combination response (115 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. describe and explain the reef and beyond, changes on the reef, oceans of the future and managing fisheries
2. apply understanding of the reef and beyond, changes on the reef, oceans of the future and managing fisheries
3. analyse evidence about the reef and beyond, changes on the reef, oceans of the future and managing fisheries to identify trends, patterns, relationships, limitations or uncertainty
4. interpret evidence about the reef and beyond, changes on the reef, oceans of the future and managing fisheries to draw conclusions based on analysis.

Note: Objectives 5, 6 and 7 are not assessed in this instrument.

Purpose

This document is an External assessment marking guide (EAMG).

The EAMG:

- Provides a tool for calibrating external assessment markers to ensure reliability of results
- Indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- Informs schools and students about how marks are matched to qualities in student responses.

Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of ‘0’ will be recorded. Where no response to a question has been made, a mark of ‘N’ will be recorded.

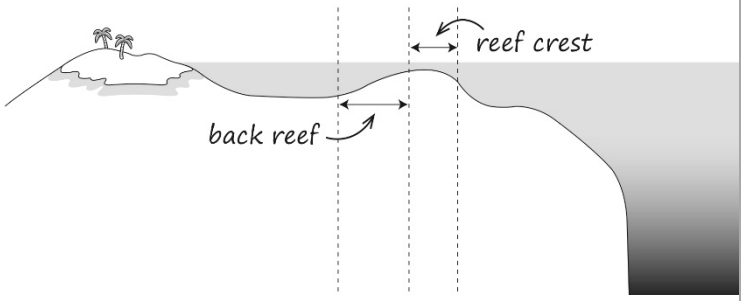
Allow FT mark(s) – refers to ‘follow through’, where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

External assessment marking guide

Multiple choice

Question	Response
1	C
2	A
3	D
4	B
5	D
6	D
7	A
8	B
9	B
10	B
11	D
12	D
13	A
14	C
15	D

Paper 1: Short response

Q	Sample response	The response:	
16	Zoning in MPAs can be used to protect connected ecosystems as a degraded ecosystem is highly connected. This will ensure recruitment to a degraded ecosystem can be maintained or improved. A management strategy to reduce degradation could be implementing permits that target the reduction of activities with a negative impact on the ecosystem. Reducing fishing by imposing closures within MPAs will allow the ecosystem to recover from damage caused by boating and allow fish stock time to replenish.	• identifies a management strategy to protect connected ecosystems **[1 mark]** • explains how connectivity will help to replenish the degraded ecosystem **[1 mark]** • identifies a management strategy to reduce degradation **[1 mark]** • explains how this management stategy will reduce degradation of the ecosytem **[1 mark]**	
17		• correctly identifies reef crest **[1 mark]** • correctly identifies back reef **[1 mark]**	
18	Mangrove ecosystems provide breeding grounds and critical nursery habitats in which many reef species develop. They also provide protection and food for larval and juvenile species. Mangroves improve connectivity by linking life cycle stages.	• identifies	
		- four ecosystem services	4 marks
		- three ecosystem services	3 marks
		- two ecosystem services	2 marks

Q		Sample response	The response:	
			- one ecosystem service	1 mark
19		Polyps share a protective skeletal structure. They form a sheath of living tissue (i.e. a coenosarc) that stretches across the whole colony. The body cavities of surrounding polyps are interconnected to share nutrients. Polyps do not compete with each other.	• identifies that polyps share a protective skeletal structure **[1 mark]** • indicates that polyps form a sheath of shared living tissue **[1 mark]** • indicates that body cavities and nutrients are shared **[1 mark]** • identifies that polyps do not compete **[1 mark]**	
20	a)	As the average pH of the ocean decreases from 8.18 to 7.49, the calcite saturation decreases from 5.3 to 1.3 (75%) and aragonite saturation decreases from 3.4 to 0.9 (74%). This would increase the dissolution (erosion) of existing reef structures, resulting in mortality of carbonate reef builders and the destruction of habitats. As pH decreases, aragonite organisms, such as corals and some macroalgae, would be more affected than calcite organisms. This would result in a higher proportion of calcite organisms surviving, such as crustaceans, until they reach their pH limit. Therefore, ocean acidification decreases the complexity and diversity of coral reef ecosystem.	• identifies that as pH decreases, both calcite and aragonite saturations decrease **[1 mark]** • links the decrease in pH to increased dissolution of carbonate reef builders **[1 mark]** • identifies that as pH decreases, aragonite organisms, such as corals and some macroalgae, will be affected more than calcite organisms **[1 mark]** • indicates that the reef ecosystem would have a higher proportion of calcite organisms **[1 mark]** • indicates that the consequence of ocean acidification is a reduction in complexity and diversity of the coral reef ecosystem **[1 mark]**	
	b)	Resilience varies between marine organisms and from one reef to another. A reef's resilience is a measure of how well it is able to resist ocean acidification and its impacts. Reef resilience is a short term phenomenon. It decreases over time as reefs are repeatedly impacted by acidification events.	• explains that resilience - varies between organisms and/or reefs **[1 mark]** - impacts the reef's ability to resist the impact of ocean acidification **[1 mark]** - decreases over time or is limited to the short term **[1 mark]**	

Q		Sample response	The response:
21		All organisms bioaccumulate mercury directly from the environment. For example, phytoplankton, which is a primary producer, has 2.8 ppm of mercury compared to seawater and sediment which have 1.6 ppm. Like other consumers, tuna also bioaccumulates through ingestion. From the evidence, the concentration of mercury increases with each trophic level. Tuna are accumulating mercury at a much higher level than phytoplankton indicating that most of the mercury is coming from their prey.	• identifies that all organisms bioaccumulate directly from the environment **[1 mark]** • identifies that phytoplankton has a higher concentration of mercury than environment **[1 mark]** • identifies tuna bioaccumulates mercury through ingestion **[1 mark]** • identifies that the concentration of mercury increases with each trophic level **[1 mark]** • concludes that most of the mercury in tuna comes from ingestion **[1 mark]**
22		Upwelling brings nutrient-rich water up to the surface. This nutrient-rich water results in higher levels of primary production. Fish gather in these areas to feed due to increased food supply, affecting the distribution of fish populations.	• identifies that upwelling brings nutrient-rich water to the surface **[1 mark]** • indicates that nutrient-rich water promotes algae and plankton growth **[1 mark]** • indicates that fish gather in upwelling due to increased food supply, affecting the distribution of fish populations **[1 mark]**
23	a)	Flooding increases freshwater plumes that result in decreased salinity. It also results in increased turbidity due to increased suspended sediments.	• identifies that flooding increases fresh water and decreases salinity **[1 mark]** • identifies that increased flooding increases turbidity due to increased suspended sediment **[1 mark]**
	b)	Increased turbidity would decrease light availability. Insufficient light decreases the rate of photosynthesis by zooxanthellae. Increased turbidity would also increase sedimentation, which would smother both the zooxanthellae and the coral. Decreased light and increased sediment cause the zooxanthellae to be expelled from the coral, resulting in bleaching.	• identifies that light availability decreases **[1 mark]** • indicates that rate of photosynthesis in zooxanthellae will decrease **[1 mark]** • identifies sediment increases and will smother coral and zooxathallae **[1 mark]** • indicates that zooxanthellae will be expelled and coral will bleach **[1 mark]**

Q	Sample response	The response:
24	The relative air temperature and air pressure between the ocean and the land creates land breezes and sea breezes. When the land heats faster than the ocean, the warmer air over the land becomes less dense and rises, creating an area of lower pressure. Cooler air from the ocean then moves towards the land to replace it, creating a sea breeze. At night, the ocean retains its temperature and the land cools, causing the air over the ocean to be warmer than the air over the land. When cooler air from the land moves towards the ocean to replace the warmer air that rises, a land breeze occurs.	• identifies that differences in air temperature and air pressure create land and sea breezes **[1 mark]** • identifies that land heats up faster than the surrounding ocean; therefore, warm air rises, creating an area of low pressure **[1 mark]** • explains that cooler air from the ocean moves towards the land to replace warmer air, creating a sea breeze **[1 mark]** • identifies that land cools quickly at night while ocean temperature remains the same **[1 mark]** • explains that land breezes occur when cooler air from the land moves towards the ocean **[1 mark]**
25	Increased surface ocean productivity results in greater organic matter sinking down at depth. This is then broken down, resulting in an increase in CO_2 being produced. An increase in the concentration of CO_2 decreases the ocean pH, causing the CCD to become shallower.	• identifies that increased productivity results in an increase in organic matter sinking **[1 mark]** • indicates that breakdown of organic matter increases CO_2 **[1 mark]** • indicates that increased [CO_2] decreases ocean pH **[1 mark]** • explains that a decrease in pH causes CCD to become shallower **[1 mark]**

Paper 2: Short response

Q		Sample response	The response:	
1	a)	From pH 8.2 to 7.8, no change is present. From pH 7.8, the percentage of fertilised eggs decreases significantly.	• identifies that percentage of eggs fertilised decreased as pH decreased **[1 mark]**	
	b)	As CO_2 increases, pH decreases, which has a negative impact on both the fertilisation of eggs and the development of larval morphology. The decrease in pH due to CO_2 has more impact than a decrease in pH due to hydrogen ions from HCl. This indicates that a decrease in pH affects the $[CO_3^{2-}]$ available for marine calcifiers as the first deposition of $CaCO_3$ occurs in the larval stage rather than dissolution due to low pH. Increased atmospheric CO_2 leads to acidification of the seawater by decreasing pH. Therefore, future changes in ocean acidity will potentially affect the population size and structure of carbonate organisms by interfering with reproduction and larval stages of their life cycle.	• identifies that decrease in pH has a negative impact on fertilisation **[1 mark]** • identifies that decrease in pH has a negative impact on the development and morphology of larvae **[1 mark]** • identifies that decrease in pH due to CO_2 has more impact than a decrease in pH due to hydrogen ions from HCl **[1 mark]** • concludes that the negative impact on morphology is due to a decrease in $[CO_3^{2-}]$ available rather than dissolution **[1 mark]** • concludes that the increased atmospheric CO_2 leads to acidification of the seawater by decreasing pH **[1 mark]** • concludes that increased atmospheric CO_2 decreases population size by interfering with reproduction and larval stages of the life cycle **[1 mark]**	
	c)	Laboratory-scale experiments allow the variables to be controlled to isolate cause and effect. They also allow investigation of higher CO_2 concentrations than those found in the field.	• identifies 2 advantages	**2 marks**
			• identifies 1 advantage	**1 mark**
			• does not satisfy any of the descriptors above.	**0 marks**

Q		Sample response	The response:	
2	a)	Wild caught contributed 85% of prawn production in 2002–3. This steadily declined to 75% in 2011–12 before steadily increasing back to 80% in 2016–17. During the 10-year period, the contribution of aquaculture, in monetary terms, remained fairly constant at $60–$80m. Overall production has reduced by almost $150m between 2002–3 and 2016–17.	• identifies that wild-caught prawn production decreased from 2002–3 before increasing in 2016–17 **[1 mark]** • identifies that aquaculture prawn production remained roughly constant **[1 mark]** • identifies decrease in overall production **[1 mark]**	
	b)	Australian prawns are exported because they have high value due to high quality and production costs. Australia imports prawns with lower production costs and therefore lower retail cost to help meet domestic demand.	• identifies that Australian prawns are exported for their high quality **[1 mark]** • identifies that Australia imports cheaper prawns to meet domestic demand **[1 mark]**	
	c)	Aquaculture production dropped significantly because stocks were reduced to try to eradicate the disease and to reduce the risk of white spot escaping into the wild population.	• identifies that aquaculture production dropped significantly because stocks were reduced to - try to eradicate the disease **[1 mark]** - reduce the risk of white spot escaping into the wild population **[1 mark]**	
3	a)	Resilience to disease Fast growth rate	• identifies 2 attributes	**2 marks**
			• identifies 1 attribute	**1 mark**
			• does not satisfy any of the descriptors above.	**0 marks**
	b)	Open systems involve the accumulation of waste or the removal of waste via natural processes. Closed systems involve significant water treatment before release into the environment.	• identifies that waste is accumulated or removed via natural processes in open systems **[1 mark]** • identifies that waste is removed via water-treatment processes in closed systems before being released into the environment **[1 mark]**	

Q		Sample response	The response:
	c)	If the water in a system is not treated, controlled or removed, water quality will reduce carrying capacity.	• describes how decrease in water quality would lead to a decrease in carrying capacity **[1 mark]**
	d)	Closed systems support higher stocking density than open systems. Closed systems have greater control over water quality and feed inputs.	• predicts that closed systems can support a higher stocking density than open systems **[1 mark]** • indicates that higher stocking density is possible because water quality can be controlled **[1 mark]**
4		The carbonate system allows the ocean to buffer against pH changes when CO_2 is absorbed from the atmosphere. Increased dissolved CO_2 produces carbonic acid, which dissociates to shift the equilibrium of the carbonate system in seawater to decrease pH by increasing $[H^+]$. This results in a corresponding decrease in $[CO_3^{2-}]$ ions available to calciferous organisms to form calcite or aragonite skeletons. In the past, changes in $[CO_2]_{atm}$ have occurred over geological time, allowing the carbonate system to maintain its buffering capacity by replacing carbonates that also cycle over geological time. When the rate of CO_2 being absorbed by the oceans outstrips the supply of $[CO_3^{2-}]$ ions available, the buffering capacity of the oceans is lost and pH decreases.	• identifies that the carbonate system allows the ocean to buffer against pH changes when CO_2 is absorbed from the atmosphere **[1 mark]** • indicates that dissolved CO_2 produces carbonic acid, which dissociates to shift the equilibrium of the carbonate system to decrease pH by increasing $[H^+]$ **[1 mark]** • links decrease in pH to decrease in availability of CO_3^{2-} ions for organism to form calcite or aragonite skeletons **[1 mark]** • explains that past changes in $[CO_2]_{atm}$ have occurred over geological time and that inorganic carbonates cycle over geological time, allowing the carbonate system to maintain its buffering capacity **[1 mark]** • indicates that when the rate of CO_2 being absorbed by the oceans outstrips the supply of available CO_3^{2-} ions, the buffering capacity of the oceans is lost and pH decreases **[1 mark]**

Q		Sample response	The response:
5	a)	$N = 36$ $\Sigma n(n-1)$ $= 33 \times 32 + 3 \times 2$ $= 1056 + 6 = 1062$ $SDI = 1 - \left(\frac{\Sigma n(n-1)}{N(N-1)}\right) = 1 - \left(\frac{1062}{36 \times 35}\right) = 1 - \frac{1062}{1260} = 1 - 0.84$ $= 0.16$	• determines that N = 36 **[1 mark]** • determines that $\Sigma n(n-1)$ = 1062 **[1 mark]** • calculates a consequentially correct value for SDI **[1 mark]**
	b)	Reef A has higher overall species diversity. Reef A has higher species richness, as four species are present compared with only two at Reef B. Reef A has higher species evenness, as there are more species present.	• identifies that Reef A has higher species diversity **[1 mark]** • identifies that Reef A has higher species richness **[1 mark]** • identifies that Reef A has higher species evenness **[1 mark]**
	c)	Rugosity profile 1 aligns with Reef A. Rugosity profile 1 shows a higher degree of structural complexity compared to rugosity profile 2. Higher rugosity/habitat complexity is associated with increased species diversity.	• identifies rugosity profile 1 **[1 mark]** • indicates that rugosity profile 1 shows a higher degree of structural complexity **[1 mark]** • explains that higher rugosity is associated with increased species diversity **[1 mark]**
6	a)	Acropora: Regardless of size, all Acropora species have a high level of bleaching response. Montipora: Severity of bleaching is moderate. Montipora that are in the size class 10–50 cm have the highest level of bleaching. Pocillopora: As size increases, bleaching severity increases. Porites: As size increases, bleaching severity decreases. Bleaching severity is low for all sizes of porites.	• identifies, for Acropora, that all sizes experience similar bleaching **[1 mark]** • identifies, for Montipora, that size class 10–50 cm has the highest level of bleaching **[1 mark]** • identifies, for Pocillopora, that bleaching severity increases as size increases **[1 mark]** • identifies, for Porites, that bleaching severity decreases as size increases **[1 mark]**

Q		Sample response	The response:
	b)	There will be a change in species composition. Acropora: will see a significant decline in abundance. Montipora: will increase in abundance. Pocillopora: small corals will increase in relative abundance. Porites: will increase in relative abundance.	• explains likely change in relative abundance of each genus **[1 mark]** • identifies that Acropora will decline significantly in relative abundance **[1 mark]** • identifies that Montipora will increase in abundance **[1 mark]** • identifies that Pocillopora will increase in relative abundance **[1 mark]** • identifies that Porites will increase in relative abundance **[1 mark]**
7		Photosynthesis by marine organisms decreases [CO_2(aq)] in oceans. H_2CO_3 breaks down to produce water and replace CO_2 used up by photosynthesis. [H^+](aq) decreases as it reacts with CO_3^{2-}(aq) and HCO_3^-(aq) to form more H_2CO_3. Therefore, pH increases due to photosynthetic activity.	• identifies that [CO_2(aq)] in oceans decreases due to photosynthesis **[1 mark]** • explains that CO_2 used up by photosynthesis is replaced by the breakdown of H_2CO_3(l) **[1 mark]** • indicates that [H^+] (aq) decreases as it reacts with CO_3^{2-} (aq) and HCO_3^-(aq) to replace H_2CO_3 **[1 mark]** • explains that pH increases due to a decrease in [H^+](aq) **[1 mark]**
8		2008 posed the greatest threat of a COTS outbreak. Increased discharge in 2008 resulted in the largest increase in nutrients (phosphorus and nitrogen). Increased nutrients led to phytoplankton blooms. Increased phytoplankton increases food supply for COTS larvae. Therefore, COTS numbers would increase, increasing the probability of a COTS outbreak.	• states 2008 as the answer **[1 mark]** • links increase discharge to increase in P and N nutrient levels **[1 mark]** • explains that increased nutrient levels led to phytoplankton blooms **[1 mark]** • links increased blooms to increased survival of COTS larvae **[1 mark]** • concludes that COTS numbers would increase, leading to a higher probability of an outbreak **[1 mark]**