Marine Science marking guide and solution

External assessment 2021

Combination response (108 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 consists of a marking guide.

The marking guide:

- 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.

Marking guide

Multiple choice

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

Paper 1: Short response

Q	Sample response	The response:
21a)	Approximately 500 000 years ago	· states 500 000 **[1 mark]**
21b)	Rising sea levels flooded coastal plains and hills formed coastal islands. Corals began to grow on the edge of newly formed coastal islands and to overgrow submerged coastal plains. As sea levels continued to rise, corals overgrew submerged hills to form present cays and reefs.	· identifies how rising sea levels affected coastal areas **[1 mark]** · indicates how corals began growing on new coastal areas **[1 mark]** · identifies that rising sea levels allowed corals to overgrow submerged hills **[1 mark]**
22	Algae compete with corals for space. Herbivores feed on algae, which prevents overgrowth of algae. Reduced algal growth decreases competition for space and improves coral recruitment.	· identifies how algae competes with coral for space **[1 mark]** · explains that herbivores reduce algal growth **[1 mark]** · indicates that reduced competition improves coral recruitment **[1 mark]**
23a)	I: zygote II: planulae	· identifies I as zygote **[1 mark]** · identifies II as planulae **[1 mark]**
23b)	Coral larvae are the motile lifecycle stage, as polyps are sessile. Larvae are passively transported by currents. Corals are dependent on currents for long-distance dispersal. Dispersal is important for coral recruitment.	· identifies that larvae are the dispersive phase of the coral lifecycle **[1 mark]** · identifies that coral larvae are transported by currents **[1 mark]** · explains one reason for the importance of dispersal **[1mark]** · explains a second reason for the importance of dispersal **[1 mark]**
23c)	Coral planulae use receptors and chemical cues to select suitable sites. Chemical signals from competition, such as algae, prevent coral planulae from settling.	· explains that planulae use receptors and chemical cues for site selection **[1 mark]** · explains the role chemical cues play in determining unsuitable sites **[1 mark]**

Q	Sample response	The response:
	Therefore, planulae settle when they detect cues that indicate a suitable substrate and a lack of competition.	· explains the role chemical cues play in determining suitable sites **[1 mark]**
24a)	N = $\frac{25 \times 24}{8}$ N = 75	· states 75 as the answer **[1 mark]**
24b)	Coral trout use different habitats and locations during different stages of their life cycle. Therefore, captured and marked trout may have moved to another location and will not be re-captured, affecting the population estimate.	· identifies one limitation **[1 mark]** · explains how the limitation can affect the size of the population estimate **[1 mark]**

Q	Sample response	The response:
25a)	I: zooxanthellae II: nematocyst	· identifies I as zooxanthellae **[1 mark]** · identifies II as nematocyst **[1 mark]**
25b)	Coral tentacles emerge from their skeletons. They use their tentacles to capture prey and draw it into their mouth/s. They use the nematocysts in their tentacles to paralyse their captured prey.	· identifies that the tentacles are outside the skeleton during feeding **[1 mark]** · identifies the role of the tentacles in prey capture **[1 mark]** · identifies the role of nematocysts in prey paralysis **[1 mark]**
25c)	Symbiotic	· states that the relationship is symbiotic **[1 mark]**
26	Climate change affects ocean currents and weather patterns, resulting in increased intensity of cyclone activity. Cyclones have a direct effect on the physical destruction of coral reefs and increase discharge via surface runoff. Increased runoff increases the nutrient load, which increases algal growth. Destruction of reefs results in more space for algae. Increased algae result in a higher food supply for COTS larvae. This leads to an increase in the COTS population, which feeds on the coral and destroys it.	· identifies that climate change increases the intensity or frequency of cyclone activity **[1 mark]** · identifies that cyclones have a direct impact on the destruction of coral reefs and increase surface runoff **[1 mark]** · indicates how increased nutrient runoff increases algae growth **[1 mark]** · indicates that destruction of reefs increases space for algae **[1 mark]** · links increased algal growth to increased food supply for COTS larvae **[1 mark]** · identifies how COTS population preys on coral and destroys it **[1 mark]**

Q	Sample response	The response:
27a)	Zone 3	· identifies Zone 3 **[1 mark]**
27b)	Federal	· identifies federal level of government **[1 mark]**
27c)	Fixed quotas limit the total catch by setting the maximum number of fish, maximum fishing effort or maximum weight of fish that can be caught in a single year. Quotas are a fixed percentage of the total allowable commercial catch (TACC) that can be taken under permit by a fishery. Fixed quota limits are used in commercial fisheries to manage the sustainability of fish stock and improve catch rates and profitability by reducing competition.	· identifies how fixed quotas are used **[1 mark]** · identifies that quotas are a fixed percentage of the total allowable commercial catch (TACC) that can be taken under permit for a fishery **[1 mark]** · explains how fixed quotas are used by commercial fisheries **[1 mark]**
28	When thermal regimes change, the intensity and timing of currents increase. This alters the distribution of food sources and therefore the distribution of fish populations. Water temperature increases mean that thermal regimes are moving south. Therefore, distribution of fish populations is changing to stay within their tolerance limits.	· identifies currents change in intensity and timing **[1 mark]** · explains how change in distribution of food sources leads to changes in distribution of fish populations **[1 mark]** · indicates that thermal regimes are moving south **[1 mark]** · explains that distribution of fish populations is changing to stay within their tolerance limits **[1 mark]**

Paper 2: Short response

Q	Sample response	The response:
1	Shelford's law of tolerance indicates the impact of thermal stress on the abundance and distribution of corals. Corals live in a narrow thermal range close to the upper limit of their optimal range, therefore a small increase in thermal stress causes corals to shift into the zone of stress. When corals are exposed to temperatures at or beyond their bleaching threshold temperature, they enter the upper zone of stress. When corals become stressed for prolonged periods above their bleaching threshold, the zooxanthellae leave the coral and bleaching occurs.	· identifies that Shelford's law of tolerance indicates the impact of thermal stress on corals **[1 mark]** · identifies that corals live in a narrow optimal thermal range **[1 mark]** · indicates exposure to temperatures above their bleaching threshold causes coral to enter upper zone of stress **[1 mark]** · explains that prolonged periods in the upper zone of tolerance results in zooxanthellae being expelled, causing coral bleaching **[1 mark]**
2a)	Salmonids	· identifies salmonids **[1 mark]**
2b)	The combined production value of Australia's fisheries (wild caught fishery and aquaculture) increased from $2.8b to $3.0b from 2006 to 2016 (4%). The development of Australia's aquaculture sector in this period resulted in the sector increasing its share of total production value by 7% in relation to wild caught. Farmed salmonids drove most of this growth, rising by 106% in this period.	· determines that the combined value of wild caught and aquaculture production increased **[1 mark]** · determines that value of aquaculture production increased relative to wild caught production **[1 mark]** · determines that increases in aquaculture production value are due to increased production value of salmonids **[1 mark]**
2c)	A low-feed conversion rate makes prawns a desirable species to farm. Low-feed conversion rates result in low-feed costs compared to higher growth, which leads to increased production and profits.	· identifies a desirable attribute of an aquaculture species **[1 mark]** · explains how the attribute improves profit or production **[1 mark]**

Q	Sample response	The response:
3a)	The carbonate chemistry tipping point occurs at an atmospheric CO_2 concentration of approximately 480 ppm. Increasing atmospheric carbon dioxide concentration decreases the concentration of carbonate ions in seawater, which can lead to an undersaturation of aragonite. Undersaturated aragonite impacts on the ability of calcifying organisms (such as hard corals) to form their skeletons. This can manifest as lower skeletal density, lower extension rates, or both.	· identifies the ecological tipping point associated with the atmospheric CO_2 content **[1 mark]** · explains how changes in ocean chemistry result from changes in atmospheric carbon dioxide **[1 mark]** · explains the consequences of undersaturation of aragonite **[1 mark]**
3b)	The ice core data shows that historic carbon dioxide levels were between 180–300 ppm (with one outlier close to the modelled data), while the model is between 380–950 ppm. The ice core data also shows historic temperatures varied from 5.5 °C colder to 1.5 °C warmer than 2000 temperatures. The climate model, however, is predicting temperatures up to 3 °C warmer than 2000.	· contrasts carbon dioxide concentration **[1 mark]** · contrasts temperature **[1 mark]**
3c)	In approximately 2030, the model predicts that atmospheric carbon dioxide will exceed 480 ppm. Due to the threshold associated with carbonate chemistry at this atmospheric concentration, we would expect a significant decrease in calcifiers, e.g. hard corals, coralline algae. In approximately 2075, the model predicts that Caribbean coral reefs will cross a thermal threshold. This means that species that are susceptible to thermal stress, e.g. bleaching, will decline.	· identifies that there will be a change in community composition in approximately 2030 **[1 mark]** · explains that the change in community composition is a reduction in the number of calcifiers **[1 mark]** · identifies that there will be a change in community composition in approximately 2075 **[1 mark]** · explains that the change affects organisms susceptible to thermal stress **[1 mark]**

Q	Sample response	The response:
4a)	Labridae, as the number of species present was reduced from 13 to zero. This family has four trophic groups negatively impacted due to the reduction in coral cover.	· determines Labridae as the family most affected **[1 mark]** · provides one reason **[1 mark]**
4b)	The rugosity transect data shows that the complexity of the reef system decreased after the cyclone. A decrease in complexity reduces diversity of habitats, leading to less fish diversity. Three trophic groups (corallivores, carnivores and benthic invertivores) disappeared after the cyclone, indicating the variety of food sources decreased. This would also lead to less fish diversity. The number of trophic groups decreased from seven to four and the number of fish species decreased from 32 to 12. All families, except Scaridae, experienced a reduction in species number. Two families (Chaetodontidae and Labridae) disappeared from the survey. All this indicates that the diversity of fish reduced as the reef's habitat complexity decreased.	· identifies one inference from the data **[1 mark]** · identifies supporting evidence for an inference **[1 mark]** · identifies a second inference from the data **[1 mark]** · identifies supporting evidence for a second inference **[1 mark]** · identifies a third inference from the data **[1 mark]** · identifies supporting evidence for a third inference **[1 mark]**

Q	Sample response	The response:
5a)	As atmospheric CO_2 increases, there is a corresponding increase in surface air temperature. As surface air temperature increases, sea surface temperature increases. Increasing water temperature results in a corresponding decrease in ocean pH.	· identifies that increases in atmospheric CO_2 correspond to increases in surface air temperature **[1 mark]** · determines sea surface temperature increases at the same rate as surface air temperature **[1 mark]** · identifies that ocean pH decreases as water temperature, air temperature and atmospheric CO_2 increases **[1 mark]**
5b)	The graphs indicate that as atmospheric CO_2 increased from 1900, the concentration of $H^+(aq)$ also increases, as shown by the decrease in pH. An increase in atmospheric CO_2 increases the concentration of CO_2 dissolved in seawater, which increases the concentration of $H_2CO_3(l)$. The H_2CO_3 dissociates, increasing the concentration of $H^+(aq)$ and resulting in a decrease in ocean pH. $H^+(aq)$ ions react with $CO_3^{2-}(aq)$ ions to form $HCO_3^-(aq)$ ions, which reduces the availability of concentrated $CO_3^{2-}(aq)$ ions and therefore reduces that rate of calcification.	· indicates increases in atmospheric CO_2 from 1900 correlate with increase in the concentration of H^+ ions, as shown by the decrease in pH **[1 mark]** · links increase in atmospheric CO_2 to increase in dissolved CO_2 and increase in concentration of H_2CO_3 **[1 mark]** · identifies H_2CO_3 dissociates, increasing the concentration of H^+ and decreasing ocean pH **[1 mark]** · identifies H^+ ions react with CO_3^{2-} ions to form HCO_3^- ions, which reduces the availability of CO_3^{2-} ions and rate of calcification **[1 mark]**
6a)	Permits	· identifies a management strategy **[1 mark]**
6b)	When multiuse zoning was introduced, coral trout (*Plectropomus spp*.) biomass increased from 3 to 5 kg/1000 m^2 from 1996 to 2004. With the introduction of NTMR in 2004, biomass increased rapidly and reached peak levels, similar to or greater than the 1980s levels. On reefs open to fishing, biomass increased but at a slower rate than NTMRs, which resulted in an average of ~2.5 times greater coral trout biomass on NTMR reefs than on open fishing reefs. Therefore, the size of the coral trout biomass increased in all areas but faster in NTMRs.	· identifies small increase in coral trout biomass from 1996–2004 when multiuse zoning was introduced **[1 mark]** · identifies rapid increase in coral trout biomass from 2004 back to levels equal to or greater than prezoning when NTMR zones was introduced **[1 mark]** · identifies biomass of coral trout increased in fished areas and NTMRs but rate of increase was slower in fished areas **[1 mark]**

Q	Sample response	The response:
	The density of coral trout increased in both fished areas and NTMRs, but the data suggests this was greater in NTMRs. However, NTMRs have had little to no effect on the percentage cover of algae, or hard or soft corals. Overall, NTMRs have had positive effects on fishery-targeted coral trout populations but had no real effect on the health of the reef overall.	· identifies density of coral trout increased in fished areas and NTMRs but increase was greater in NTMRs **[1 mark]** · identifies that there has been little effect on cover of algae, or hard or soft corals **[1 mark]** · concludes NTMRs have been effective for improving coral trout numbers, but not overall marine health **[1 mark]**
6c)	Both aim to protect marine environments. Non-government organisations play an important part in social education, public awareness and lobbying governments to protect areas. Government organisations provide financial support and pass and enforce laws to protect marine areas.	· identifies a similarity **[1 mark]** · identifies a difference **[1 mark]** · identifies the significance of either the similarity or the difference **[1 mark]**

Q	Sample response	The response:
7	If average MMM increased to 29.2 ºC, both regions would experience an increase in temperature stress. Thermal stress in the Southern region would increase beyond the bleaching threshold temperature, increasing the risk of bleaching and reducing coral cover. The Far Northern region would remain close to its optimum range and below its bleaching threshold so coral cover would be maintained. Corals that survive bleaching in the Southern region would be more resilient to future bleaching events.	· identifies a similarity **[1 mark]** · identifies a difference **[1 mark]** · identifies the significance for coral cover **[1 mark]** · identifies the significance for coral resilience **[1 mark]**