basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MARINE SCIENCES P2

MAY/JUNE 2026

MARKS: 150

TIME: 2½ hours

This question paper consists of 17 pages.

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of THREE sections. Answer the questions as follows:

   SECTION A: COMPULSORY
   SECTION B: COMPULSORY
   Consists of QUESTIONS 2 and 3.
   Answer BOTH questions in this section.
   SECTION C: Consists of QUESTIONS 4 and 5.
   It is COMPULSORY to answer ONLY ONE of the two questions in this section.

2. Answer ALL the questions in the ANSWER BOOK.

3. Start the answers to EACH question at the top of a NEW page.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Present your answers according to the instructions of each question.

6. Do ALL drawings in pencil and label them in blue or black ink.

7. Draw diagrams, tables or flow charts only when asked to do so.

8. The diagrams in this question paper are NOT necessarily drawn to scale.

9. Do NOT use graph paper.

10. You must use a non-programmable calculator, protractor and a compass, where necessary.

11. Round off your FINAL numerical answers to TWO decimal places, where applicable.

12. Do NOT write outside the margins in the ANSWER BOOK.

13. Write neatly and legibly.

SECTION A

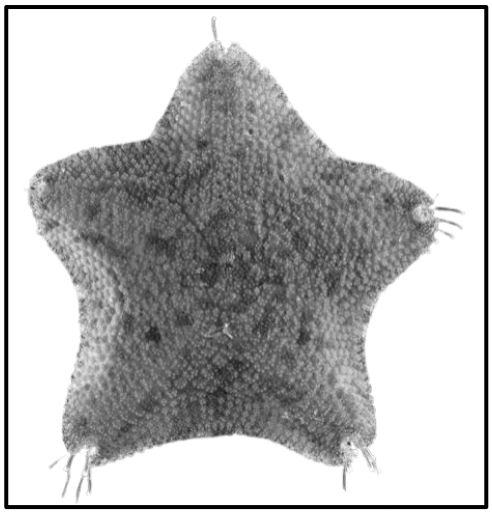
QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D.

1.1.1 In Marine Protected Area (MPA) management, the concept of spill-over refers to …

A water from streams in surrounding areas flowing into MPAs.
B excess tourists visiting MPAs moving to surrounding areas.
C fish and their gametes in MPAs moving to surrounding areas.
D marine debris from surrounding areas washing into MPAs.

1.1.2 The class to which the echinoderm in the image below belongs is …



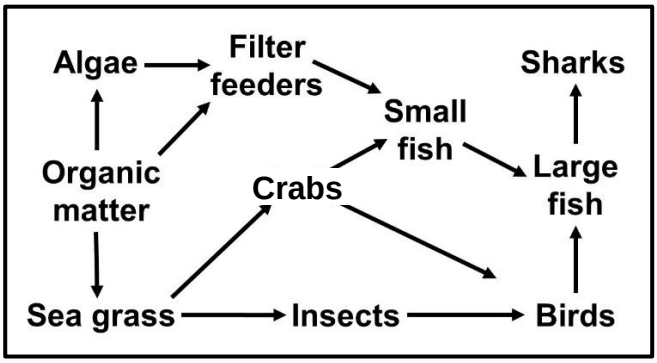
[Adapted from https://media.australian.museum/media/dd/images/]

A Crinoidea.
B Ophiuroidea.
C Echinoidea.
D Asteroidea.

1.1.3 Which ONE of the following options shows animals that are both found on the rocky shores of the East Coast of South Africa?

A Oysters and Pear-shaped Limpets
B Pill bugs and zoanthids
C Oysters and zoanthids
D Pill bugs and ghost crabs

1.1.4 The diagram below shows a food web of an estuary.



Which option ONLY contains primary consumers?

A Small fish, large fish and birds
B Algae, sea grass and filter feeders
C Insects, small fish and sharks
D Crab, filter feeders and insects

1.1.5 During a flooding event, water from a river flowed into rock pools. Sea stars in a rock pool would experience the following effect:

	Water moves …	Size of cells	Cells
A	in through osmosis	Decreases	Burst
B	in through osmosis	Increases	Burst
C	out through osmosis	Decreases	Shrink
D	out through osmosis	Increases	Shrink

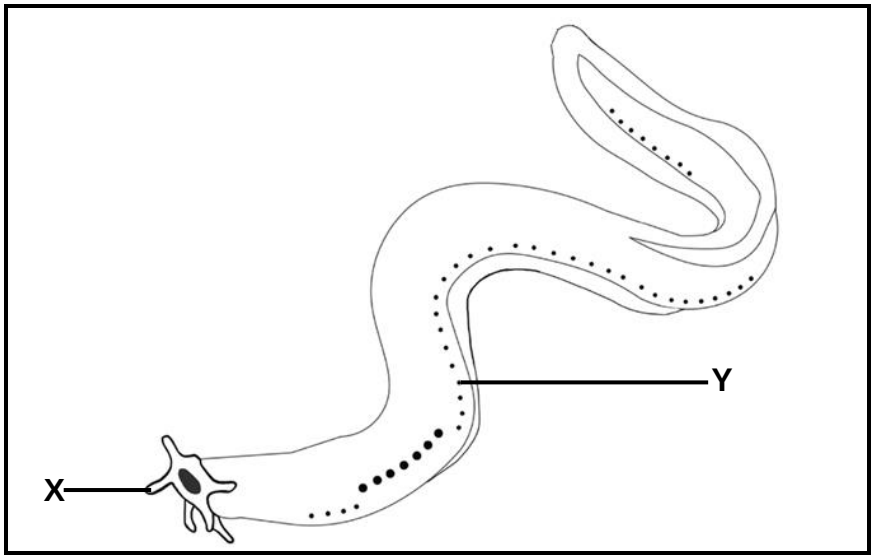
1.1.6 The following phrases refer to different reproductive characteristics:

(i) Mate in the ocean
(ii) Internal fertilisation
(iii) Pups are precocial at birth
(iv) Generally live in large colonies
(v) Mothers recognise pup calls

Which option below has ONLY CORRECT definitive features of reproduction in fur seals?

A (ii), (iv) and (v)
B (i), (iii) and (iv)
C (i), (ii) and (iii)
D (iii), (i) and (v)

1.1.7 The diagram below shows a hagfish.



[Adapted from https://www.researchgate.net/]

Which option in the table below gives the CORRECT combination for the hagfish? **X** and **Y** refer to the labels in the diagram above.

	X is sensitive to …	**If Y is absent, …**
A	pressure	decreased mobility
B	light	lower gaseous exchange rate
C	chemicals	decline in slime production
D	touch	slows down circulation

1.1.8 The terms below refer to the characteristics of fish.

(i) Bony skeleton
(ii) Foldable fins
(iii) Cartilaginous skeleton
(iv) Dermal scales
(v) Fleshy fins

Which option below has ONLY CORRECT definitive features of Osteichthyes?

A (iv), (v) and (i)
B (ii), (iii) and (v)
C (iii), (v) and (ii)
D (i), (ii) and (iv)

1.1.9 Which ONE of the following states an effective way to prevent overtourism at sensitive zones of marine tourist destinations?

A Make money for conservation by allowing mass tourism
B Entry into zones only allowed if pre-booked on system
C Allow people to explore the entire area freely
D Decrease the cost of entry tickets at peak times

1.1.10 Sea anemones congregate in gullies of rock pools because …

A the temperature of the water is stable.
B water flow brings concentrated food sources.
C competition is reduced in the gullies.
D they actively move to search for prey. (10 x 2) **(20)**

1.2 Give the correct **scientific term/phrase** for each of the following descriptions. Write only the term/phrase next to the question numbers (1.2.1 to 1.2.10) in the ANSWER BOOK.

1.2.1 The offshore region just below the spring low-tide mark

1.2.2 Specific forms of behaviour exhibited by animals in order to increase their chances of survival

1.2.3 Grooves on the arms of echinoderms from which tube feet extend

1.2.4 Can engulf small particles and foreign cells into itself

1.2.5 Subclass of Chondrichthyes that includes sharks, skates and rays

1.2.6 External ear serving to focus sound into the auditory canal

1.2.7 Unregulated experiences offered to tourists centred on outdoor environments

1.2.8 In data collection, referring to a group of items or people that closely matches the characteristics of its population as a whole

1.2.9 The region where plants and animals have shared or similar characteristics due to climatic and environmental conditions

1.2.10 Ability of an ecosystem to support and maintain its processes as well as a diverse community of organisms (10 x 1) **(10)**

1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.5) in the ANSWER BOOK.

COLUMN I		COLUMN II	
1.3.1	Bursa of brittlestars	A: B:	gaseous exchange development of offspring
1.3.2	Broad foot of limpets	A: B:	adapted for wave action adapted for light intensity
1.3.3	Greenwashing	A: B:	cleaning beaches before tourists arrive giving false or misleading information on environmental benefits
1.3.4	Adaptation in cetaceans to store oxygen	A: B:	high levels of myoglobin diving bradycardia
1.3.5	The importance of protecting BOFFFs in an MPA	A: B:	easier to count for research large fish are economically more valuable

(5 x 2) **(10)**

TOTAL SECTION A: 40

SECTION B

QUESTION 2

2.1 Study the investigation below and answer the questions that follow.

The KwaZulu-Natal bather protection programme has been implemented at 37 beaches along the KwaZulu-Natal coastline. With the goal to ensure safe swimming conditions, shark nets or a combination of shark nets and drumlines are used to catch sharks before they can reach shallow water and potentially endanger bathers.

A study was done from 1983 to 2014 to determine if different size classes of Tiger Sharks (*Galeocerdo cuvier*) eat different species of prey.

The following was done in this study:

- Recently dead, but not yet decaying, Tiger Sharks were retrieved from the shark nets and drumlines, and then frozen until dissection.
- The Tiger Shark sizes were categorised as small (<150 cm), medium (150–220 cm) and large (>220 cm).
- The complete stomach with contents was removed from 628 Tiger Sharks. The stomach contents were separated, counted and weighed.
- Prey items found with shark net twine were excluded from the counts, due to potentially being scavenged from shark nets.
- From the stomach contents, prey was identified and categorised.
- The abundance of each prey category was used as an indication of its importance in the sharks' diet.

The table below shows the data for the stomach contents collected from the sharks in this study.

	ABUNDANCE OF PREY CATEGORY		
PREY CATEGORY	**SMALL SHARKS**	**MEDIUM SHARKS**	**LARGE SHARKS**
Birds	113	314	611
Bony fish	3 923	1 042	1 250
Cephalopods	206	644	287
Mammals	921	1 682	1 644
Sharks and rays	3 145	4 361	2 920

[Adapted from Dicken, ML et al. 2017. PLoS ONE 12 (6): e0177897]

2.1.1 Draw a pie chart to present the abundance of the different categories of prey eaten and consumed by the large sharks. Show ALL calculations. (7)

2.1.2 Calculate the percentage abundance of invertebrates in the diet of the medium sharks. (2)

2.1.3 State TWO ways in which the reliability of this study was increased. (2)

2.1.4 Give ONE reason why the scientists did not want to use decaying Tiger Sharks. (1)

2.1.5 Explain why there is a shift in importance in the diet from bony fish in small Tiger Sharks to mammals in large Tiger Sharks. (4)
(16)

2.2 Read the extract below and answer the questions that follow.

> Traditional methods of producing anti-fouling paints for the shipping industry are energy intensive and release toxic chemicals into the ocean.
>
> Tunicates produce non-toxic chemicals to prevent organisms attaching or even settling close to them (anti-fouling). The adhesion of marine organisms (biofouling) to ships is a global maritime problem. Researchers looked into the possibility of creating an anti-fouling paint based on the chemicals produced by tunicates to replace traditional methods of preventing biofouling.
>
> [Adapted from Chambers, LD et al. 2006. Surf. Coat. Technol. 201 3 642–3 652]

2.2.1 Explain why it is beneficial to prevent organisms from sticking to the tunicates. (3)

2.2.2 You were tasked to design and produce such an anti-fouling paint by using the biomimicry design process. You are allowed to work with a team.

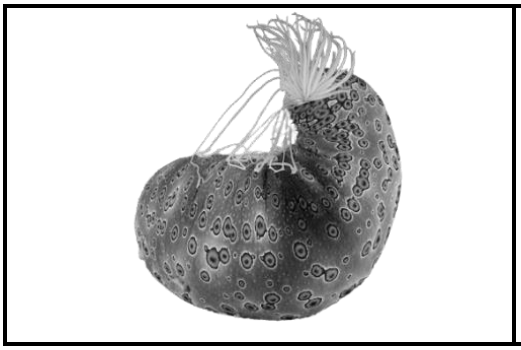
(a) Name TWO types of experts that you will include in your team. Motivate why you would include EACH of these experts.
(2 x 2) (4)

(b) Discuss ONE biomimicry principle that you can implement during the making and use of anti-fouling paints to make it more responsible and sustainable. (2)

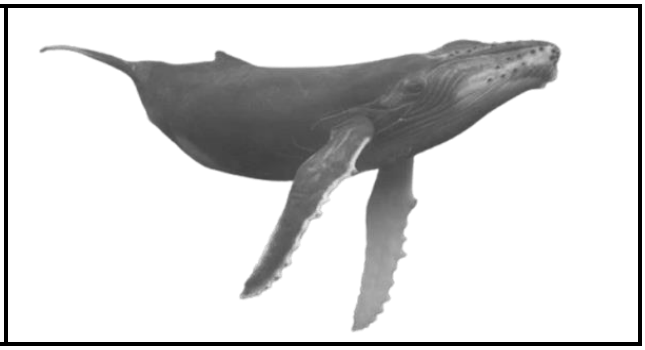
2.2.3 Explain ONE possible limitation of using anti-fouling paints inspired by the chemicals of the tunicates in real-world maritime settings.
(1 x 2) (2)

2.2.4 By referring to the tunicates, give your opinion on whether it would be a good idea to emulate the chemicals produced by these animals in shipping. Substantiate your answer. (2)
(13)

2.3 Study the images of a Leopard Sea Cucumber (*Bohadschia argus*) and a Humpback Whale (*Megaptera novaeangliae*) below to answer the questions that follow.



[Source: https://www.livescience.com/]



[Source: https://uk.whales.org/]

2.3.1 Leopard Sea Cucumbers and Humpback Whales use different structures to filter feed. By referring to these structures, explain how food is ingested by:

(a) Leopard Sea Cucumbers (2)

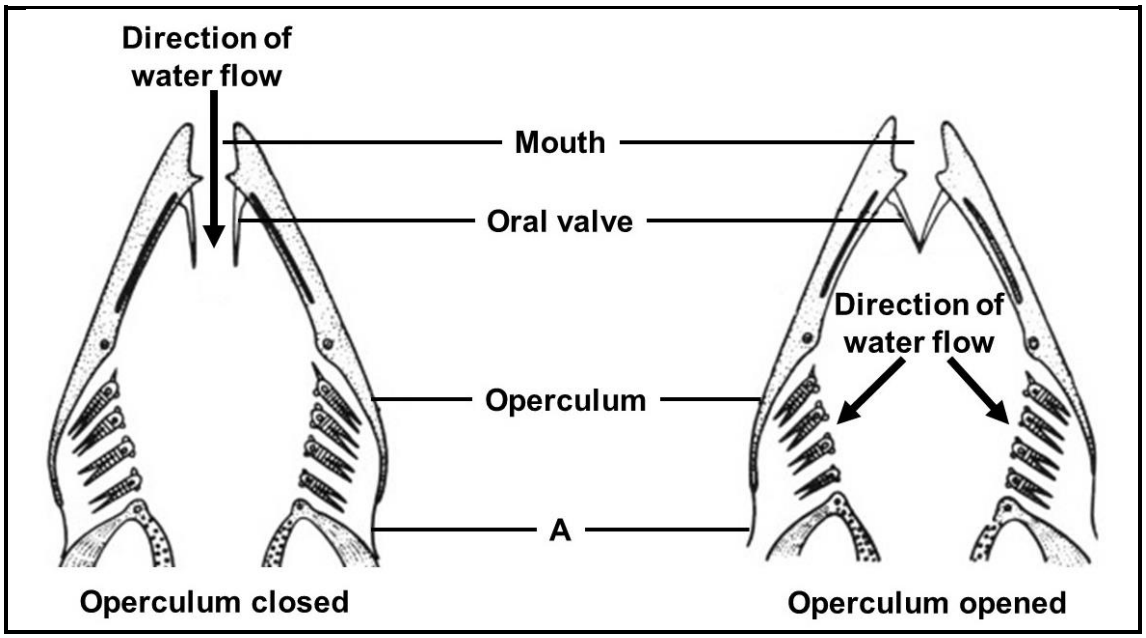
(b) Humpback Whales (2)

2.3.2 Discuss how Humpback Whales can breathe and filter feed at the same time. (2)

2.3.3 Explain why it is important to conserve both smaller animals, such as the Leopard Sea Cucumber, and large animals, such as the Humpback Whale. (2)
(8)
[37]

QUESTION 3

3.1 Study the diagram showing the ventilation mechanism of a fish species below to answer the questions that follow.



[Illustration adapted from https://ars.els-cdn.com/content/image/]

3.1.1 Label structure **A**. (1)

3.1.2 Explain why the oral valve is closed when the operculum is opened. (2)

3.1.3 If the structure in QUESTION 3.1.1 above is permeable, explain the effect this would have on the ability of the fish to ventilate their gills. (2)

3.1.4 Draw a labelled diagram of the structure that increases surface area for gaseous exchange. (4)
(9)

3.2 Read the article below to answer the questions that follow.

COULD FAKE KELP FORESTS PREVENT SHARK ATTACKS?

Réunion Island in the Indian Ocean is situated between Mauritius and Madagascar. Between 2010 and 2019, there were 24 shark attacks, 10 of which were fatal. The Réunion government is testing a potential solution that would not only protect people from shark attacks, but also protect sharks from people.

The SharkSafe barrier (indicated in the image below) is a series of vertical pipes that look like a kelp forest. The pipes contain magnets which are designed to overstimulate the ampullae of Lorenzini of sharks. The barrier has been developed by a team of scientists and shark specialists that is based in South Africa. The team has been working on this project since 2011.

One potential obstacle to using this barrier is cost. One 8 m section of the SharkSafe barrier costs about R4 000, which is much more expensive than shark nets, and the number of pipes required can be in the dozens.

[Adapted from https://www.theguardian.com/environment/]



[Source: https://www.sun.ac.za/researchforimpact/]

3.2.1 Describe how this kelp forest design in the image is able to prevent shark attacks. (2)

3.2.2 State ONE significant effect of this barrier as an artificial kelp forest. (1)

3.2.3 Explain how overtourism could have resulted in the increased number of shark attacks. (2)

3.2.4 There is great potential in promoting ecotourism around the coasts of Réunion Island.

(a) Suggest ONE type of ecotourism activity that would benefit from increased shark numbers. (1)

(b) Discuss ONE way in which the environmental protection pillar of an ecotourism business plan can contribute to shark conservation at Réunion Island. (2)

(c) In your opinion, is this method a sustainable approach in dealing with shark attacks experienced in the waters of Réunion Island? Substantiate your answer. (2)
(10)

3.3 Read the text below to answer the questions that follow.

NAHOON MANGROVES

The Nahoon Estuary near East London in the Eastern Cape has the southernmost mangrove forest in South Africa.

Like many estuaries, Nahoon is under threat from urban development, with sewage run-off being of particular concern.

[Referenced from Geldenhuys, C et al. 2016. *South African Journal of Botany* 107 and Cotiyane, P et al. 2017. *African Journal of Aquatic Science* 42(3)]

3.3.1 Explain ONE ecological role of mangrove forests. (2)

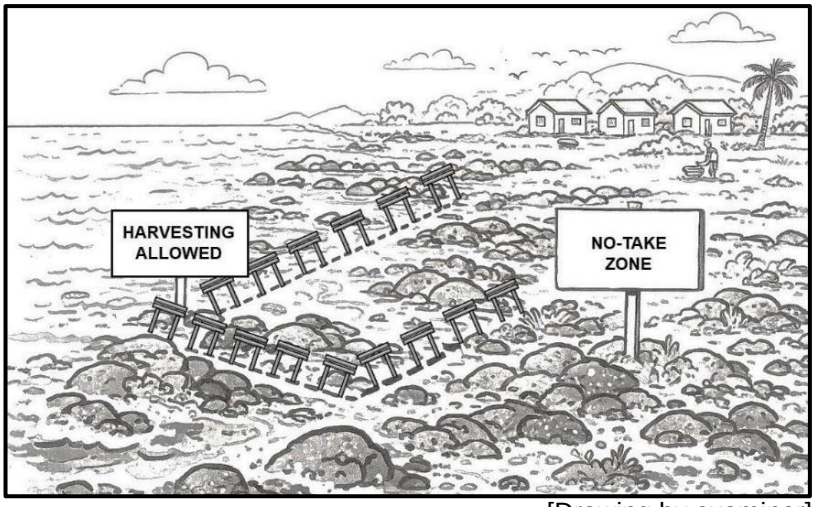
3.3.2 Discuss how sewage run-off from urban developments might influence the ecological role of the mangrove forest in the Nahoon Estuary. (3)
(5)

3.4 Refer to the text and diagrams below of a hypothetical Marine Protected Area scenario to answer the questions that follow.

Rocky shores are among the most accessible marine ecosystems. Species found on rocky shores are often harvested by local coastal communities. Limpets are especially targeted, because they are easy to get to and have high nutritional value.

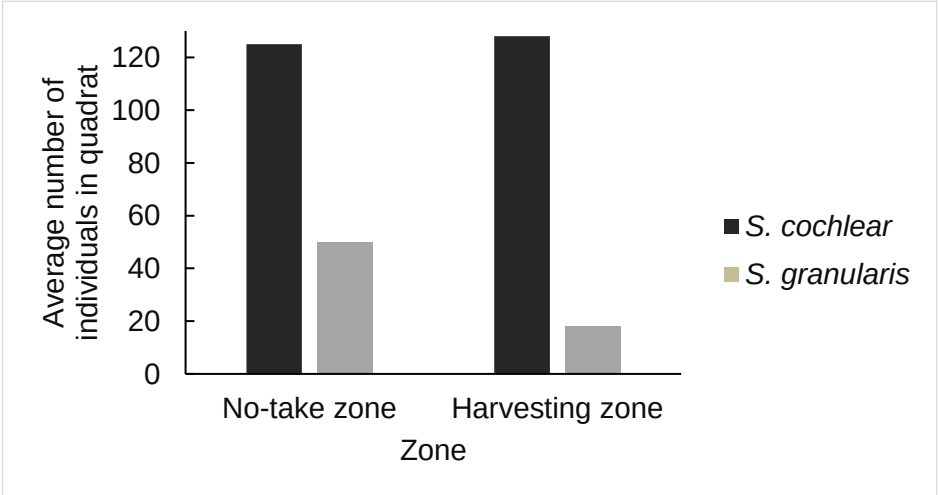
A Marine Protected Area (MPA) with a no-take zone and a harvesting zone was used in a study. The harvesting zone was established so that the local community was not excluded from their traditional food source. The scientists focused on the Pear-shaped Limpet (*Scutellastra cochlear*) found in the cochlear zone and the Granular Limpet (*S. granularis*) found in the balanoid zone. The Pear-shaped Limpet is smaller than the Granular Limpet. The number of limpets in 0,25 m^2 quadrats was counted in the harvesting zone and the average density was determined.

Diagram of Marine Protected Area indicating the two different zones

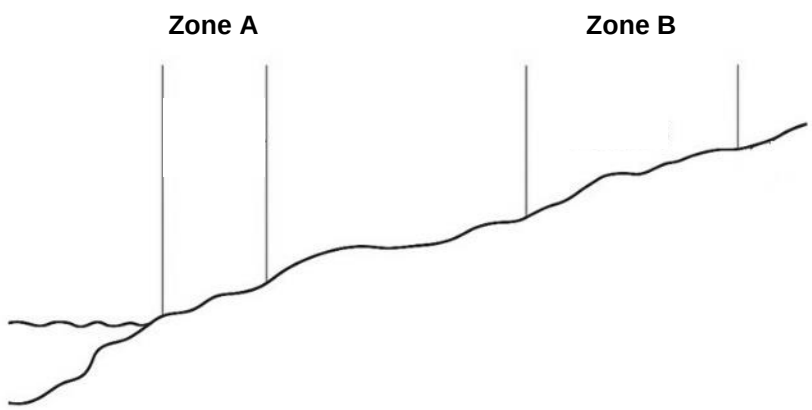


[Drawing by examiner]

Average number of Pear-shaped Limpets and Granular Limpets in the no-take zone and the harvesting zone



Rocky shore zonation



[Inspired by Baliwe, NW et al. 2022. 10.3389/fmars.2022.893260]

3.4.1 (a) Use the bar graph on the previous page to name the limpet species that was most harvested by the local community. (1)

(b) Use the text on the previous page to explain why the local community preferred to harvest the species named in QUESTION 3.4.1(a) above. (2)

3.4.2 Give the IUCN category for this MPA. (1)

3.4.3 If this entire MPA is not declared a no-take zone, discuss ways in which the harvesting of limpets could be made sustainable for this community. (4)

3.4.4 Refer to the diagram on rocky shore zonation above to name the zone (**A** or **B**) where the harvested limpet species is found. (1)

3.4.5 Describe how the overharvesting of the limpet would affect the zone named in QUESTION 3.4.4 above. (3)

3.4.6 In your opinion, is this MPA effective in conserving both limpet species? Motivate your answer. (2)
(14)
[38]

TOTAL SECTION B: 75

SECTION C

Answer any ONE question in this section.

Clearly indicate the QUESTION NUMBER of the chosen question.

NOTE: Your answer must be in the form of an essay. NO marks will be awarded for answers in the form of tables, flow charts or diagrams.

QUESTION 4

Read the text on amphibians and reptiles below.

During the Late Carboniferous Period, approximately 307 million years ago, Earth experienced a dramatic climate shift known as the Carboniferous Rainforest Collapse. This event led to the development of a drier and warmer climate during which large parts of rainforests were wiped out. Areas vital for reproduction in amphibians were thereby reduced. The egg survival rate of amphibians was also drastically influenced.

During this time, reptiles underwent a major evolutionary radiation in response to the drier and warmer climate. One of the greatest evolutionary developments was the amniotic egg, as well as other structural advances. These adaptations allowed reptiles to spread into different habitats. Some marine reptiles like the Yellow-bellied Sea Snake (*Hydrophis platurus*) underwent a unique evolutionary adaptation in the reproductive strategy. This allowed these animals to move back into the ocean.

[Adapted from https://www.britannica.com/ and https://theconversation.com/]

Western Leopard Toad (*Sclerophrys pantherina*)	**Yellow-bellied Sea Snake (*Hydrophis platurus*)**
 [Source: https://thebdi.org/]	 [Source: https://www.waikikiaquarium.org/]

Write an essay to address the following aspects:

- Explain the impact that the habitat reduction had on the amphibian egg survival rate during the Carboniferous Rainforest Collapse.
- Describe how the eggs of marine reptiles are adapted to drier climates AND discuss the unique adaptation of the Yellow-bellied Sea Snake to reproduce in its natural environment.
- Explain why the Yellow-bellied Sea Snake needs to osmoregulate in its natural environment AND describe how these sea snakes are adapted for osmoregulation.
- Describe the gaseous exchange structures of toads, such as the Western Leopard Toad, and the Yellow-bellied Sea Snake.
- In your opinion, which gaseous exchange structure (Western Leopard Toad OR Yellow-bellied Sea Snake) would be more adapted to its environment? Motivate your answer.

Content: (25)
Synthesis: (10)
(35)

QUESTION 5

Read the text below to answer the question that follows.

Recent climate data have indicated that the average temperature of beach sand during the summer months, compared to 20 years ago, has increased by 2–3 °C. Climate change poses a huge threat to coastal breeding and nesting grounds. The effects of severe weather conditions due to climate change can cause storm surges with heavy rainfall which threatens the suitability of nesting sites. This is concerning as it might negatively impact the nesting sites of marine birds and turtles.

Tern (*Sterna spp*) nests are shallow scrapes in the bare sand on the beach and are often exposed. These nests are generally found on flat open ground, occasionally on gently sloping ground. Clutches consist of one or two eggs and are incubated for around four weeks by both parents. Both parents remain at the nest during incubation, but once the eggs hatch, parents take turns to feed in the ocean, with one parent remaining at the nest to guard the chicks.

Leatherback Turtles (*Dermochelys coriacea*) rely on beach sand as a medium for covering their eggs. Female turtles return to the same beach on which they hatched and typically lay between 80 to 120 eggs for the duration of the nesting period. The female turtles make their way to the high tide mark of the beach and dig deep nests with their flippers. After laying the clutches of eggs, the females cover the nests with sand before returning to the ocean.

[Adapted from Gammon, M et al. 2023. Coastal and Marine Ecology, https://dewetswild.com/tag/sterna-bergii/ and https://www.sodwanabaylodge.com/]

Tern (*Sterna spp.*)	**Leatherback Turtle (*Dermochelys coriacea*)**
 [Source: https://besgroup.org/2006/12/22/]	 [Source: https://i.guim.co.uk/img/media/]

Write an essay to address the following aspects:

- Discuss at least TWO ways in which the reproductive strategy of marine birds, such as the tern, enables them to breed despite the effects of climate change.
- Describe the nesting process of Leatherback Turtles AND discuss the possible effect that an increase in the temperature of the beach sand might have on the turtle population.
- Describe how marine birds, such as the tern, ensure waterproofing of their feathers during a storm.
- Explain the impact that a storm surge might have on the nesting grounds AND the egg survival of the terns and Leatherback Turtles.
- In your opinion, which parental care strategy (tern OR Leatherback Turtle) would have a higher chance of offspring survival when having to overcome the environmental effects of climate change? Motivate your answer.

Content: (25)
Synthesis: (10)
(35)

TOTAL SECTION C: 35
GRAND TOTAL: 150

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