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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

MARINE SCIENCES: PAPER II

EXAMINATION NUMBER

Time: 2½ hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 28 pages. Please check that your question paper is complete.
2. Read the questions carefully.
3. This question paper consists of THREE sections. Answer the questions as follows:
   SECTION A: (40 marks): COMPULSORY
   SECTION B: (75 marks): COMPULSORY
   SECTION C: (35 marks): Consists of QUESTIONS 6 and 7. Answer only ONE of the two questions in this section.
4. **Answer ALL the questions on the question paper and hand it in at the end of the examination. Remember to write your examination number in the blocks above.**
5. Non-programmable calculators may be used.
6. Please **do not write in pencil** as work in pencil will not be marked. However, any sketches or diagrams may be done in pencil.
7. It is in your own interest to write legibly and to present your work neatly.
8. Four blank pages (pages 25–28) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the question number of your answer should you use this extra space.

Allocation of marks

Q1	Q2	Q3	Q4	Q5	Q6	OR	Q7	TOTAL
40	25	20	10	20	35		35	150

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SECTION A

QUESTION 1 MULTIPLE-CHOICE

1.1 Ten multiple-choice questions are given below. Choose the correct option for each question and write the letter of your choice in the space provided in the table at the bottom of the page.

1.1.1 In what way do echinoderms exhibit both radial and bilateral symmetry during their life cycle?

A Bilateral symmetry as larvae, radial symmetry as adults.
B Radial symmetry as larvae, bilateral symmetry as adults.
C Radial symmetry in feeding structures, bilateral symmetry in movement.
D Bilateral symmetry in digestive system, radial symmetry in body plan.

(2)

1.1.2 How does larval feeding in echinoderms affect their ecological interactions?

A It reduces their predation risk by keeping them in deeper waters.
B It allows them to occupy a unique niche and reduces competition.
C It prevents them from becoming prey to larger marine animals.
D It accelerates their growth, minimizing the larval phase duration.

(2)

1.1.3 A deep-sea fish has large, fan-shaped pectoral fins and a relatively small caudal fin. How does this fin morphology likely affect its locomotion and behaviour in its environment?

A It allows for rapid, sustained swimming in open water.
B It enables quick bursts of speed to escape predators.
C It increases the fish's overall swimming energy expenditure.
D It enables hovering and manoeuvring in complex environments.

(2)

1.1.4 Which reproductive strategy is common among many marine Osteichthyes, and how does it enhance reproductive success?

A Oviparity with external fertilization, increasing the number of offspring.
B Viviparity with internal fertilization, reducing the risk of predation.
C Asexual reproduction, ensuring greater genetic diversity.
D Sequential hermaphroditism, allowing self-fertilization. (2)

1.1.1	1.1.2	1.1.3	1.1.4

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1.1.5 Which of the following best explains why echinoderms are considered to have a deuterostome development pattern?

A Their blastopore develops into a mouth.
B They exhibit radial symmetry in adulthood.
C Their blastopore develops into an anus.
D They possess a notochord at some life stage. (2)

1.1.6 Which statement best describes the differences in the feeding strategies of pelagic and benthic marine Osteichthyes?

A Pelagic species are filter feeders, while benthic species are scavengers.
B Pelagic species are herbivores, while benthic species are detritivores.
C Pelagic species are active predators, while benthic species are often ambush predators.
D Pelagic species primarily consume algae, while benthic species hunt other fish. (2)

1.1.7 Which of the following do Chondrichthyes use to increase their body temperature in cold oceanic conditions?

i By using a counter-current system.
ii By migrating to warmer surface waters.
iii By using a heat generated in the muscles and liver.
iv By retaining heat using body fat.

A i, ii and iv
B i, ii and iii
C i, iii and iv
D ii, iii and iv (2)

1.1.8 How do Chondrichthyes excrete excess salt in a marine environment?

A By the kidneys excreting dilute urine.
B By excreting excess salt through gills.
C By actively excreting salt through their skin.
D By excreting salts directly into the digestive tract. (2)

1.1.9 What is a unique respiratory feature of rays compared to sharks?

A Lungs for breathing air.
B Gills covered by an operculum.
C Spiracles for water intake.
D Nostrils on the dorsal side. (2)

1.1.5	1.1.6	1.1.7	1.1.8	1.1.9

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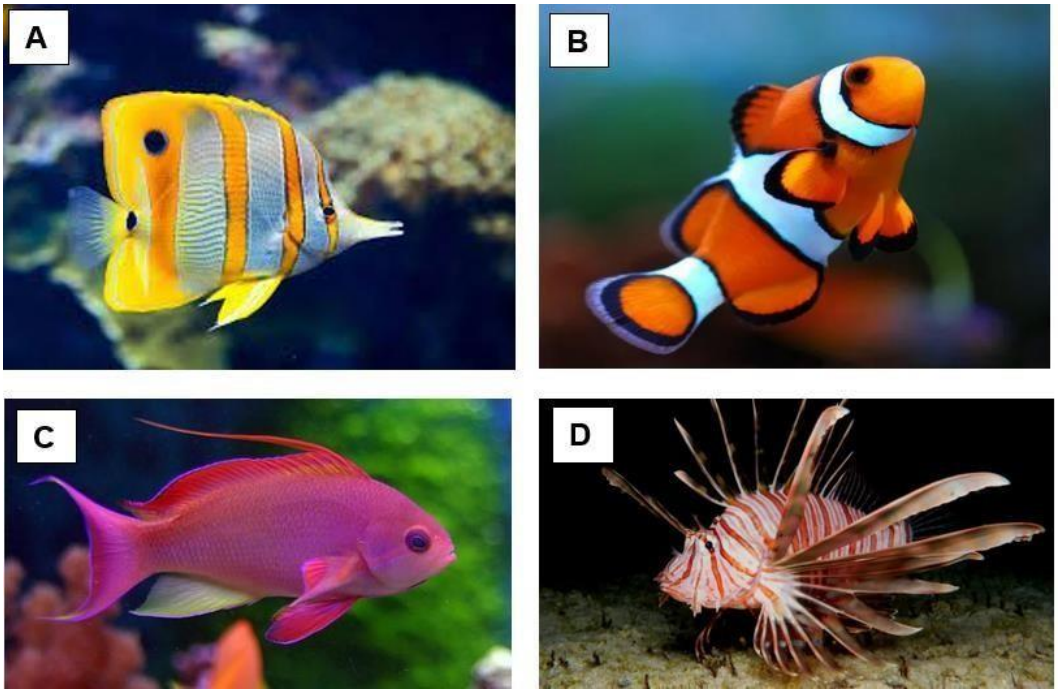
1.1.10 Which fish shown below is most likely to consume other fish and invertebrates and has become an invasive species in many parts of the world?



[Source: <https://za.pinterest.com/>]

A Animal A
B Animal B
C Animal C
D Animal D (2)

1.1.10

[20]

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1.2 Definitions are provided in COLUMN A below. Write the correct term for each of the definitions in the space provided in COLUMN B.

	COLUMN A	**COLUMN B**
1.2.1	Teeth, such as those found in sharks, that are all of the same type and shape and typically serve similar functions.	
1.2.2	Chemosensitive cells able to detect tiny amounts of substances like blood or rotting flesh.	
1.2.3	A mass of adipose tissue found in the foreheads of all toothed whales that acts as a sound lens.	
1.2.4	A reflective layer behind the retina that enhances night vision by reflecting light back through the retina.	
1.2.5	The ability of certain organisms to emit light from their bodies.	
1.2.6	A thin membrane on the posterior edge of the operculum of a fish, which assists in sealing the gill slit while the fish inhales water through its mouth.	
1.2.7	A suborder of cetaceans that includes toothed whales, dolphins, and porpoises, known for using echolocation.	
1.2.8	The small bones in the inner ear of a fish, which assist with hearing.	
1.2.9	Microscopic tooth-like structures growing from the skin of elasmobranchs.	
1.2.10	A structure that increases the length and surface area of the intestine in some sharks, enabling efficient digestion and absorption.	

(10)

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1.3 Use the following codes (A–D) to determine which of the items in COLUMN II relate to the description in COLUMN I. Write the selected letter in the Answer column.

A Only item 1 relates to the term.
B Only item 2 relates to the term.
C Both items 1 and 2 relate to the term.
D Neither item 1 nor 2 relates to the term.

	COLUMN I	**COLUMN II**	**Answer**
1.3.1	Amphibians	1. A three-chambered heart 2. Double circulation	
1.3.2	The type of scales found in the Osteichthyes	1. Placoid 2. Ctenoid	
1.3.3	Sensory organ in Chondrichthyes that detect weak electric fields produced by prey	1. Lateral line system 2. Ampullae of Lorenzini	
1.3.4	Adaptation allowing marine Osteichthyes to maintain buoyancy in the ocean	1. High fat content in muscles 2. Swim bladder	
1.3.5	Excrete salt out of their nasal passages	1. Marine birds 2. Marine reptiles	

(10)

40 marks

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SECTION B

QUESTION 2

Study the sources below and answer the questions that follow.

Source 1

Orcas Targeting White Shark Livers Pose Threat to South African Ecosystem

Orcas are known to occasionally hunt the broadnose sevengill shark, bronze whalers, and white sharks, leading to their displacement from coastal sites.

Only three studies have formally described this behaviour and the associated flight responses in white sharks. Direct observation of predation has been lacking, giving rise to speculation about the hunting strategies used by orcas to capture and kill white sharks and the subsequent behavioural impact on surviving white sharks in the area where the predation took place, including the cues and timing of shark responses to these events. With greater numbers of people being aware of this trend and having cell phones accessible, both researchers and tourists have captured more photography and video footage documenting the behaviours and predation techniques employed by orcas.

In a recent display of predatory behaviour, a pair of orcas named 'Port' and 'Starboard' have targeted and consumed the livers of 19 broad-nose seven-gill sharks off the west coast of South Africa. This is not their first occurrence, as they previously preyed on at least eight great white sharks in 2017, consuming only their livers.

The orcas demonstrate near-surgical precision in extracting shark livers, a highly nutritious organ rich in fats and vitamins. The buoyant nature of shark livers also makes them easily accessible to orcas, compared to other organs that may sink or be harder to locate. Marine biologists suggest that orcas learn through experience and retain the knowledge of the liver's location, making them more efficient hunters. Their tactics involve cooperation and intelligence, like tag-team wrestling, where they incapacitate sharks by inducing tonic immobility.

The recent attacks have raised ecological concerns, as the removal of top predators like sharks can lead to cascading effects, disrupting the local ecosystem. The real impact extends beyond the number of sharks killed, affecting the behaviour of prey species and the overall balance of the ecosystem. With no great white sharks restricting Cape fur seal behaviour, the seals can prey on endangered African penguins or compete for the small pelagic fish they eat.

Researchers are intrigued by the possibility of cultural behaviour, where these techniques may be passed on to others in their group. Preliminary genetic evidence suggests that Port and Starboard, an unusual pair of male orcas, might be related, possibly brothers.

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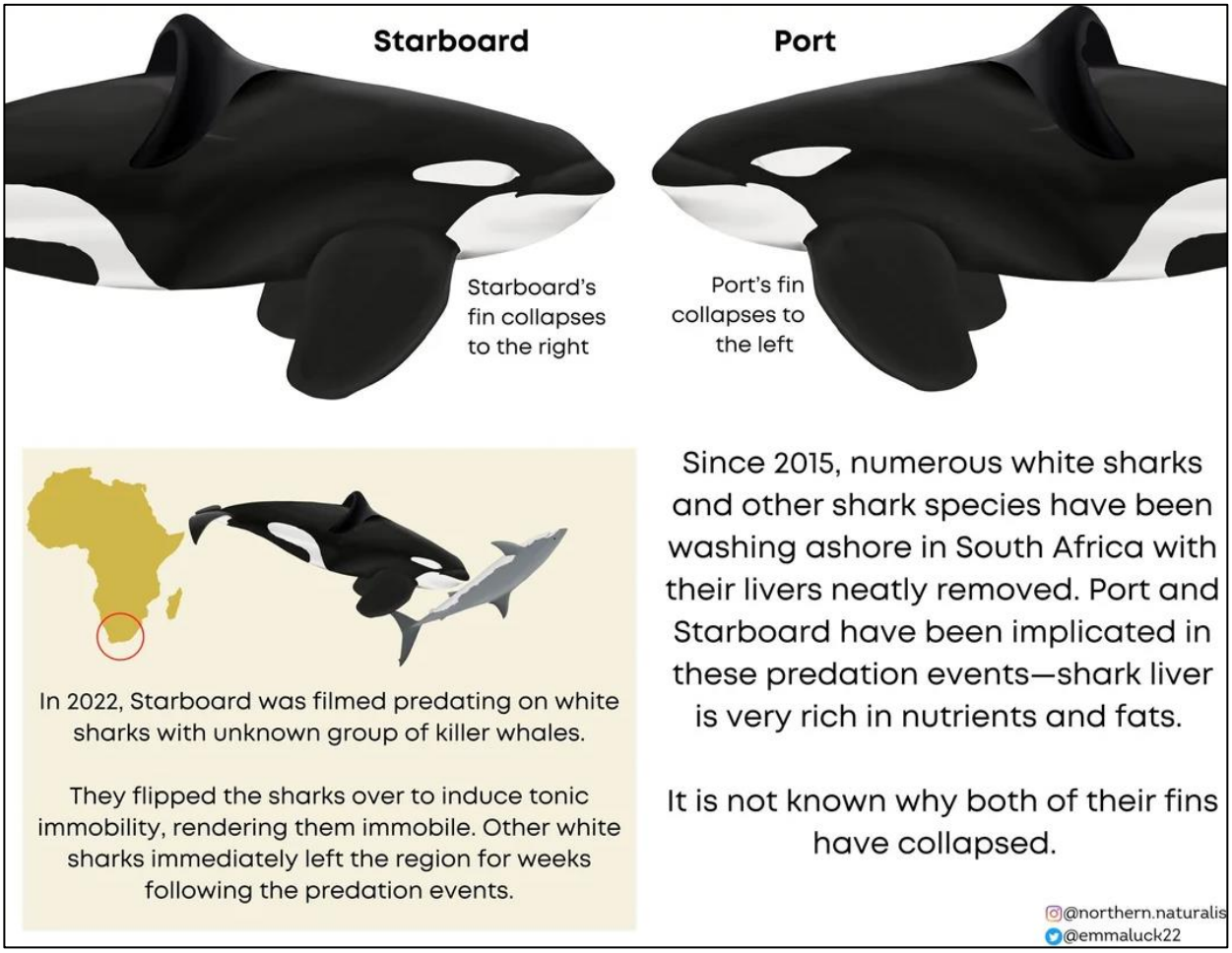

[<https://www.reddit.com/r/Damnthatsinteresting/comments/126opbi/two_male_orcas_believed_to_be_members_of_a_rare/>]

The motivations behind Port and Starboard's behaviour remain unclear. Speculations range from them being part of a subgroup of orcas that have moved closer to shore due to changes in their food sources, to the possibility of developing a new hunting technique to preserve their teeth. The latter theory suggests that targeting shark livers provides a full meal without the wear and tear associated with tearing apart shark bodies.

Video footage of Starboard performing the shark-liver extraction technique in the presence of other orcas raises questions about the potential spread of this behaviour within the orca population. While orcas around South Africa are challenging to study due to their transient nature, the observed behaviour could have broader implications for the decline of shark populations, which are already under threat from unregulated overfishing.

The absence of seven-gills and great whites has led to a collapse in shark-cage tourism in Cape Town, impacting local industries and research opportunities. Despite the contribution of Port and Starboard to the decline, experts emphasise that unregulated overfishing poses a more significant threat to shark populations. However, the orcas add additional pressure to already vulnerable fish populations, potentially disrupting the delicate balance of coastal South Africa's ecosystem.

[Adapted from: <https://www.livescience.com/2-orcas-slaughter-19-sharks-in-a-single-day-in-south-africa-eating- their-livers-and-leaving-them-to-rot & https://www.nationalgeographic.co.uk/animals/2023/03/why-are-these-orcas-killing-sharks-and- removing-their-livers>]

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Source 2

What Do They Normally Eat?

Despite decades of intensive research, we still do not know for sure what orcas eat in most regions of the world. Orcas' diets vary across the oceans and also vary between individuals in the same population.

Orcas are top predators, and the amount and types of animals they eat can greatly impact a whole ecosystem.

There are different populations of orca in the higher latitudes of both hemispheres that specialise in eating very specific prey types. For example, the resident orcas in the North Pacific feed almost exclusively on salmon, or transient orcas from Argentina feed on sea lions and other pinnipeds. Off the coast of South Africa, orcas tend to be more generalised in their diets; however, a more specialised group has been identified and is believed to feed predominantly on sharks.

As quoted by a researcher, 'of course, shark livers are wonderfully rich and orcas love lipids. They are driven by high lipid content – lots of oil or fat – and that is why they selectively remove the tongue and the skin as well as the blubber of large whales that they prey on because these parts have the highest energetic yield'.

[Source: <https://whalescientists.com/baby-killer-whales- challenges/#:~:text=Unfortunately%2C%20newborn%20killer%20whales%20have,%25%20(see%20ref%2 0below> and <https://saveourseas.com/update/unpacking-the-epic-battle-between-sharks-and-orcas-in-south-africa/>]

2.1 Provide THREE reasons why shark livers are particularly attractive to orcas.

_____

_____

_____

_____

(3)

2.2 How do researchers identify the orcas, Port and Starboard?

_____

_____

(2)

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2.3 What is the potential consequence for the local ecosystem mentioned by shark biologists?

(3)

2.4 Why are orcas around South Africa challenging to study?

(2)

2.5 Orcas are social animals living in groups of up to 100 individuals. Why is this of concern to shark biologists?

(3)

2.6 Why do you think there has been a dramatic increase in the reporting of orca attacks on sharks in recent years?

(4)

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2.7 The table below represents possible attacks attributed to Port and Starboard.

Year	White Sharks	Seven-gill Sharks	Copper Sharks
2015		6	
2016		5	
2017	8		
2018			
2019	5		
2020			5
2021			
2022	5		
2023		19	

Calculate the percentage that the seven-gill shark kills contributed to the total estimated shark kills by Port and Starboard in the last 9 years. Show all calculations.

(2)

2.8 Some posts on social media have expressed frustration about how the orcas have impacted local businesses, particularly great white shark tourism. Explain why this has occurred.

(2)

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2.9 Should humans intervene in orca predation on great white sharks? Give TWO arguments for and TWO arguments against such intervention.

(4)
[25]

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QUESTION 3

3.1 Study the diagram below and answer the question that follows.

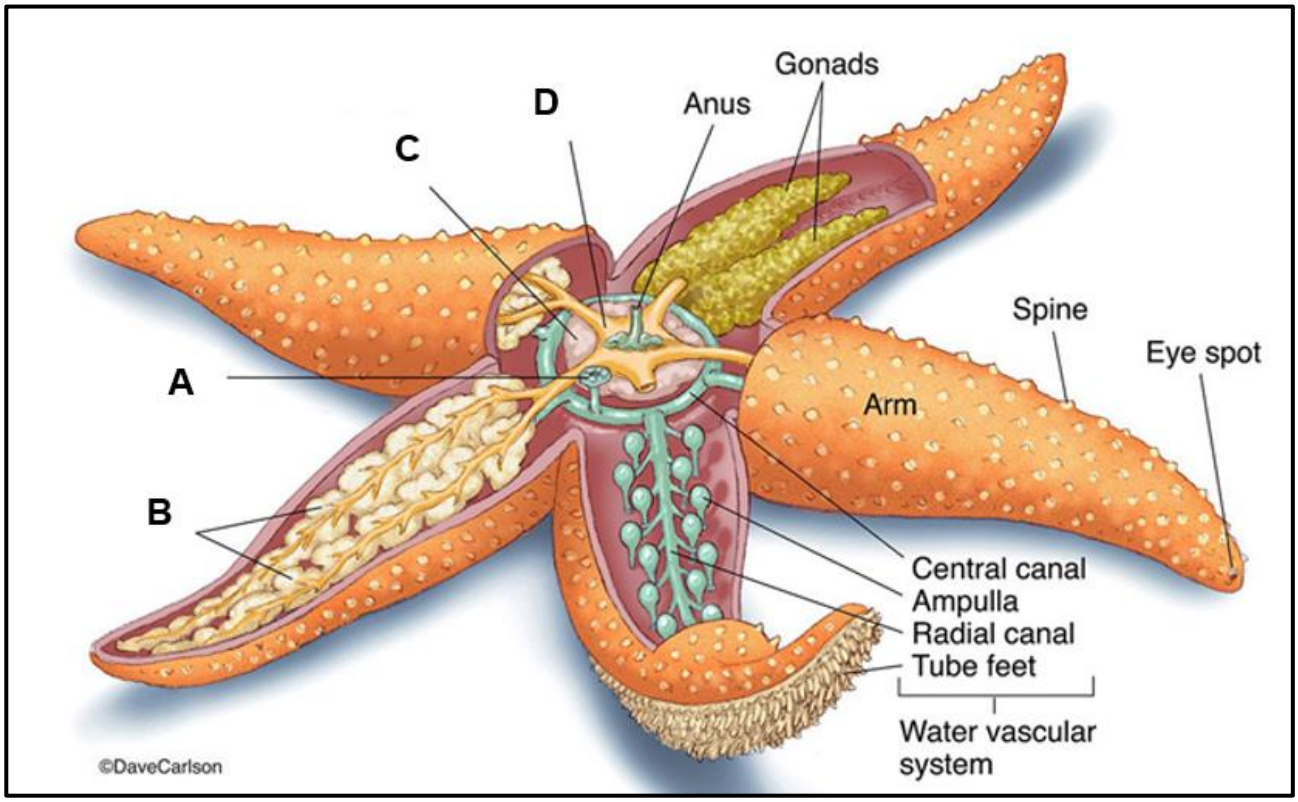


[Source: https://www.nationalgeographic.com/science/article/]

Echinoderms are found on rocky shores and sandy-bottomed environments and are eaten by many different animals including fish, sea turtles, snails, crabs, shrimp, otters, birds, and even sea stars. Echinoderms employ three major strategies (mechanical, chemical, and behavioural) to avoid predation. Describe the strategies employed by the two echinoderm classes illustrated above.

(10)

3.2 Study the diagram below and answer the questions that follow:



[Source: <https://sciencediagrams.com/starfish/>]

3.2.1 Provide the name for the structure labelled A in the diagram above.

_____

(1)

3.2.2 How would a malfunction in the structure labelled A of a sea star affect its water vascular system and overall movement?

_____

_____

_____

_____

_____

_____

(2)

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3.2.3 The small anus of the sea star is found on the aboral surface or is non-existent. Explain the absence of an anus.

_____

_____

_____

_____

(3)

3.2.4 Describe the advantages of the dual stomach system (labelled C and D), in sea stars compared to a single-chambered digestive system.

_____

_____

_____

_____

_____

_____

_____

(4)

[20]

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QUESTION 4

Study the diagram below and answer the question that follows.

Sea snake



[Source: <https://www.britannica.com>]

Sea eel

Gymnothorax
(Muraenidae)



Conger
(Congridae)



[Source: <https://www.britannica.com/animal/eel>]

Use the table below to compare the structure and function of a sea snake and a sea eel.

		Sea snake	Sea eel
4.1	**Class**		
4.2	**Breathing Mechanism**		
4.3	**Body Shape**		
4.4	**Reproduction**		
4.5	**Fins**		

[10]

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QUESTION 5

Read the source below and answer the questions that follow.

The infraphylum Agnatha comprises jawless fish, including hagfishes and lampreys. Lampreys are parasitic, attaching themselves to other fish to feed on their blood. However, no lamprey species are known in South Africa.

Hagfish, on the other hand, are eel-like scavengers found in colder ocean environments, including the endemic six-gill hagfish (*Eptatretus hexatrema*) along the South African west and south coasts. They are non-migratory species typically inhabiting depths ranging from 10 to 460 meters, though they are commonly found between 10 and 45 meters, and they frequently burrow in muddy bottoms.

Hagfish are considered primitive vertebrates, having a cartilaginous skeleton, a notochord, pouch-like gills, and lacking jaws, image-forming eyes, taste buds, or scales. It is not clearly known to what extent these features represent the ancestral vertebrate condition or if they are unique to the hagfish. They are often referred to as living fossils due to their resemblance to ancient forms dating back about 330 million years. A hagfish fossil from the Cretaceous age suggests that hagfish, along with lampreys, are, in fact, vertebrates that diverged from all other vertebrates about 550 million years ago.

Despite lacking scales, their loose skin and defensive slime serve as effective protection. The skin of hagfish has a loose attachment to muscles, aiding in escaping predators by slipping out of their grasp. Hagfish are notorious for their ability to produce copious amounts of slime from their glandular skin when disturbed. This slime, composed of mucus and protein threads, expands rapidly upon contact with seawater, creating a sticky net that suffocates predators by clogging their gills. A single hagfish can produce enough slime to fill a 7-litre bucket in minutes. The slime also creates problems for the hagfish itself, but it has developed a manoeuvre that allows it to escape – it knots its tail and, by twisting the knot over its body, scrapes off the offending slime. The skin is also filled with a third of the body's blood volume, which creates the strange pink-orange-red-black colouration of the animal.

Ecologically, hagfish play a crucial role in marine ecosystems by scavenging dead animals on the seabed, a function that can occur at remarkably high densities, sometimes exceeding 50 000 individuals per square kilometre. They feed on soft rotting carcasses, small live fish, and are even known to enter large carcasses like dead whales to consume soft tissues from within. Hagfish can absorb dissolved organic matter through their skin and gills, demonstrating an efficient nutrient absorption capacity that complements their scavenging behaviour.

[Source: <https://www.aquarium.co.za/foundation/animals/hagfish/>
<https://www.aquarium.co.za/news/hagfish-are-too-weird>]

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5.1 What features of hagfish allow them to be classified as vertebrates?

(2)

5.2 Provide TWO reasons why the hagfish can absorb nutrients directly through its body wall.

(4)

5.3 Assess the advantage of the hagfish's ability to absorb dissolved organic matter through their skin and gills.

(2)

5.4 Why can hagfish only prey on small live fish?

(2)

5.5 Provide TWO reasons why lacking image-forming eyes would not be a hindrance to hagfish.

(4)

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5.6 How do hagfish protect themselves from predators?

(2)

5.7 Provide evidence from the source of the important ecological role the hagfish plays in marine ecosystems.

(4)
[20]

75 marks

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SECTION C

Answer any ONE question in this section.

Indicate the QUESTION NUMBER that you have chosen to answer.

NOTE: Your answer must be in the form of an essay. NO marks will be awarded for answers in the form of a table, flow chart, or diagram.

QUESTION 6

Birds evolved from reptiles, but unlike reptiles, they are warm-blooded. Write a comparative essay on the physiology of thermoregulation in marine birds and marine reptiles. Evaluate how each group's methods of regulating body temperature in ocean environments impact their survival and adaptation and argue which strategy you believe is more effective in the context of their respective environments.

[35]

OR

QUESTION 7

Birds evolved from terrestrial reptiles, so one might expect their reproductive strategies to share similarities. Write a comparative essay on parental care and nesting behaviour in marine birds and reptiles. Evaluate how parental care and nesting behaviour in ocean environments impact their survival and adaptation and argue which strategy you believe is more effective in the context of their respective environments.

[35]

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35 marks

Total: 150 marks

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ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.

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