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TOTAL
MARKS

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NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2023

MARINE SCIENCES: PAPER II

EXAMINATION NUMBER

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Time: 2½ hours

150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 24 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 any 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. THREE blank pages (pages 22, 23 and 24) 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	35	10	20	10	35		35	150

SECTION A**QUESTION 1 MULTIPLE-CHOICE**

1.1 Ten multiple-choice questions are given below. Choose the most 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 A swim bladder is found in ...

- A jawless fish.
- B bony fish.
- C cartilaginous fish.
- D lancelets.

(2)

1.1.2 The fins on the side of a fish's body, close to its gills, are the ...

- A pectoral fins.
- B tail fins.
- C pelvic fins.
- D dorsal fins.

(2)

1.1.3 Echinoderms and chordates are both considered to be deuterostomes because ...

- A their larvae are free-swimming.
- B this is the most primitive form of embryonic development.
- C the second embryonic opening becomes the mouth.
- D the coelom forms by outpocketing of the primitive gut.

(2)

1.1.4 What is the purpose of the ampullae of Lorenzini?

- A To produce bioluminescence.
- B To generate electrical signals.
- C To detect electric fields.
- D To emit pheromones.

(2)

1.1.5 Which one of the following comparisons between cartilaginous and bony fish is correct?

	Characteristic	Chondrichthyes	Osteichthyes
A	Scales	Placoid	Cycloid, ctenoid
B	Mouth	Terminal	Ventral
C	Gills	4 pairs with gill covers	5–9 pairs of gill slits
D	Skeleton	Bone	Cartilage

(2)

1.1.1	1.1.2	1.1.3	1.1.4	1.1.5

1.1.6 Members of the Class Myxini feed on ...

- A molluscs.
 B algae.
 C plankton.
 D dead animals. (2)

1.1.7 Most marine fish have body fluids with a salt concentration ...

- A nearly the same as fresh water.
 B about one-third that of seawater
 C nearly the same as sea water.
 D much greater than sea water. (2)

1.1.8 Which of the bird species below is a specialist limpet eater?

	
<p>A Cape Gannet [<https://ebird.org/species/capgan1>]</p>	<p>B Common Tern [<https://ebird.org/species/comter>]</p>
	
<p>C Cape Cormorant [<https://ebird.org/species/capcor1>]</p>	<p>D African Black Oystercatcher [<https://ebird.org/species/afroys>]</p>

(2)

1.1.6	1.1.7	1.1.8

1.1.9 Which one of the following is correctly paired?

- A Class Asteroidea – sea cucumber
- B Class Ophiuroidea – brittle star
- C Class Echinoidea – sea star
- D Class Holothuroidea – sea urchin (2)

1.1.10 Which one of the following features is found in adult ascidians (sea squirts)?

- A Notochord
- B Hollow ventral nerve chord
- C Pharyngeal pouches and slits
- D Post anal tail (2)

1.1.9	1.1.10

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	A perforated plate by which the entry of seawater into the vascular system of an echinoderm is controlled.	
1.2.2	A range of tiny protective nippers extending from the skin of some echinoderms.	
1.2.3	The small bones in the inner ear of a fish, which assist with hearing.	
1.2.4	A rod of firm connective tissue supporting and possibly enclosing a dorsal nerve cord.	
1.2.5	Offspring are born at a relatively advanced stage of development and can fend for themselves with limited parental care.	
1.2.6	Producing young by means of eggs hatched within the parent's body.	
1.2.7	Sensory outgrowths around the mouths of hagfish.	
1.2.8	Increases the length and surface area of a shark intestine, enabling efficient digestion and absorption.	
1.2.9	A group of animals having a notochord that is divided into vertebral segments.	
1.2.10	Male sharks use these to introduce sperm into the female's cloaca.	

(10)

1.3 Use the following codes (A–D) to determine which of the items in COLUMN II relate to the term 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	Hagfish	1. Teeth made of keratin. 2. Eyes do not form images.	
1.3.2	Deuterostomes	1. Urochordata 2. Echinodermata	
1.3.3	Red bait	1. Pharyngeal gill slits extract food. 2. Tunic is made of tough protein.	
1.3.4	Tunicate	1. Tadpole-like larva swims and does not feed. 2. Adult sessile and filter feeds.	
1.3.5	Baleen whales	1. Have one blowhole on top of their head. 2. Females are usually smaller than the males.	

(10)

40 marks

SECTION B**QUESTION 2**

Study the sources below and answer the questions that follow.

SOURCE 1

Sea urchins play a significant ecological role in marine ecosystems. As herbivores, they consume kelp and help control its growth, preventing overgrowth that could smother other marine life.

In some regions, sea urchins are harvested for food. The demand for urchin gonad (the part of the sea urchin that is consumed) has led to overharvesting in some areas, resulting in depleted sea urchin populations. This depletion disrupts the balance they maintain within ecosystems, causing detrimental effects such as the overgrowth of algae, habitat degradation, and loss of biodiversity.

In other regions where sea urchins are not harvested for food, the sea urchin populations have increased dramatically. The removal of larger fish that prey on sea urchins reduces predation pressure on sea urchin populations, leading to increased population numbers. Warmer waters and altered ocean conditions can further favour sea urchin survival and reproduction, contributing to rapid population increases.

A study was conducted in 2019 to determine urchin and kelp abundance across a range of sites in False Bay. The results of the research are presented in Source 2.

The dominant grazer in False Bay is the Cape sea urchin (*Parechinus angulosus*), which is abundant in shallow waters of two to five metres and feeds almost exclusively on kelp, predominantly the species *Ecklonia maxima*.

The Cape sea urchin is considered more of a debris feeder than a grazer; if kelp scraps are plentiful enough to feed a given urchin population, the creatures would consume the kelp scraps from the safety of cracks and crevices in the ocean floor where they are protected from predators. However, if the supply of kelp scraps is not enough, the urchins would emerge from safety and feed on live kelp. This can lead to "urchin barrens," where these creatures have wiped out the kelp, leaving a barren environment behind. This ecosystem shift threatens the habitats of other marine species that depend on kelp forests for survival.

Five kelp forest sites (A – E) with depths of two to five metres were surveyed along the western side of False Bay in South Africa. Four 10 meter-long transects were placed randomly within each site, and the transects were placed five metres apart from each other. Along each transect, five quadrats (each 1 m²) were placed at one metre intervals. In each quadrat, the number of urchins and adult kelp (>150 mm stipe length) of *E. maxima* were counted.

SOURCE 2

The results of the research are represented below:

Figure 2.1: Abundance of *Ecklonia maxima* and sea urchins (no. m⁻²) at five sites in False Bay

Site	Abundance of <i>E. maxima</i> (no. m ⁻²)	Abundance of sea urchins (no. m ⁻²)
A	3.8	76.0
B	4.5	53.1
C	4.9	46.0
D	7.6	39.1
E	12.9	30.6

[Adapted from: <<https://doi.org/10.2989/1814232X.2018.1536614>>]

2.1 2.1.1 Describe THREE positive ecological roles mentioned in the text that sea urchins play in marine ecosystems.

- _____

- _____

- _____

(3)

2.1.2 Describe TWO ecological roles NOT mentioned in the text that sea urchins play in marine ecosystems.

- _____

 - _____

- (2)

2.2 List TWO factors that can lead to an INCREASE in sea urchin numbers.

- _____

 - _____

- (2)

2.3 Sea urchins are highly effective grazers due to their specialised adaptations and behaviours that enable them to efficiently consume kelp in marine environments.

2.3.1 Describe ONE such adaptation/behaviour mentioned in the text.

(2)

2.3.2 Describe ONE such adaptation/behaviour NOT mentioned in the text.

(2)

2.4 Name the dependent variable in this experiment.

(1)

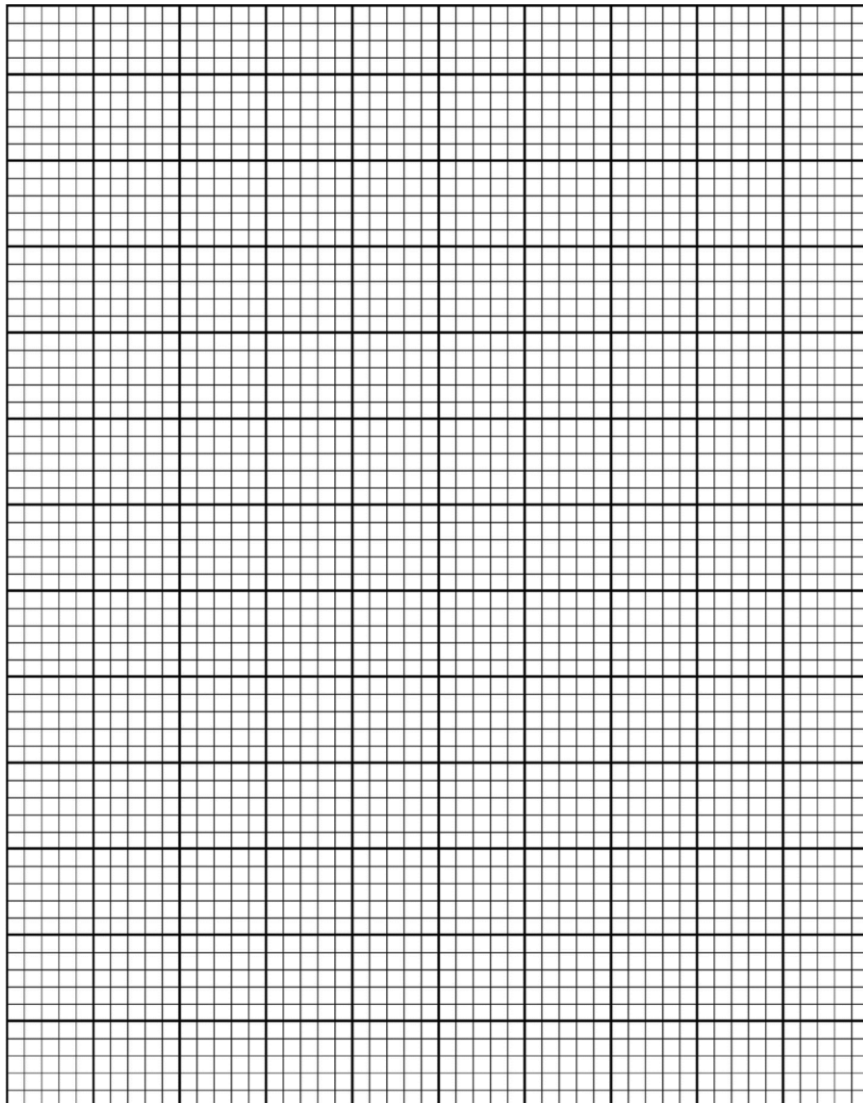
2.5 Give TWO fixed variables for the experiment.

- _____
 - _____
- (2)

- 2.6 Calculate the percentage that the quadrats represent of the total area sampled.
Show your calculations.

(3)

- 2.7 Plot a bar graph of the data for kelp abundance on the graph paper provided below.



(7)

2.8 Write a conclusion for the relationship between kelp and urchin abundance.

(3)

2.9 Urchin gonad content only reaches a maximum of about 15% to 20% of total body mass when harvested for human consumption, yet the gonads appear to fill the bulk of the inside of the animal test. Give TWO possible reasons for this apparent difference.

- ---

- ---

(4)

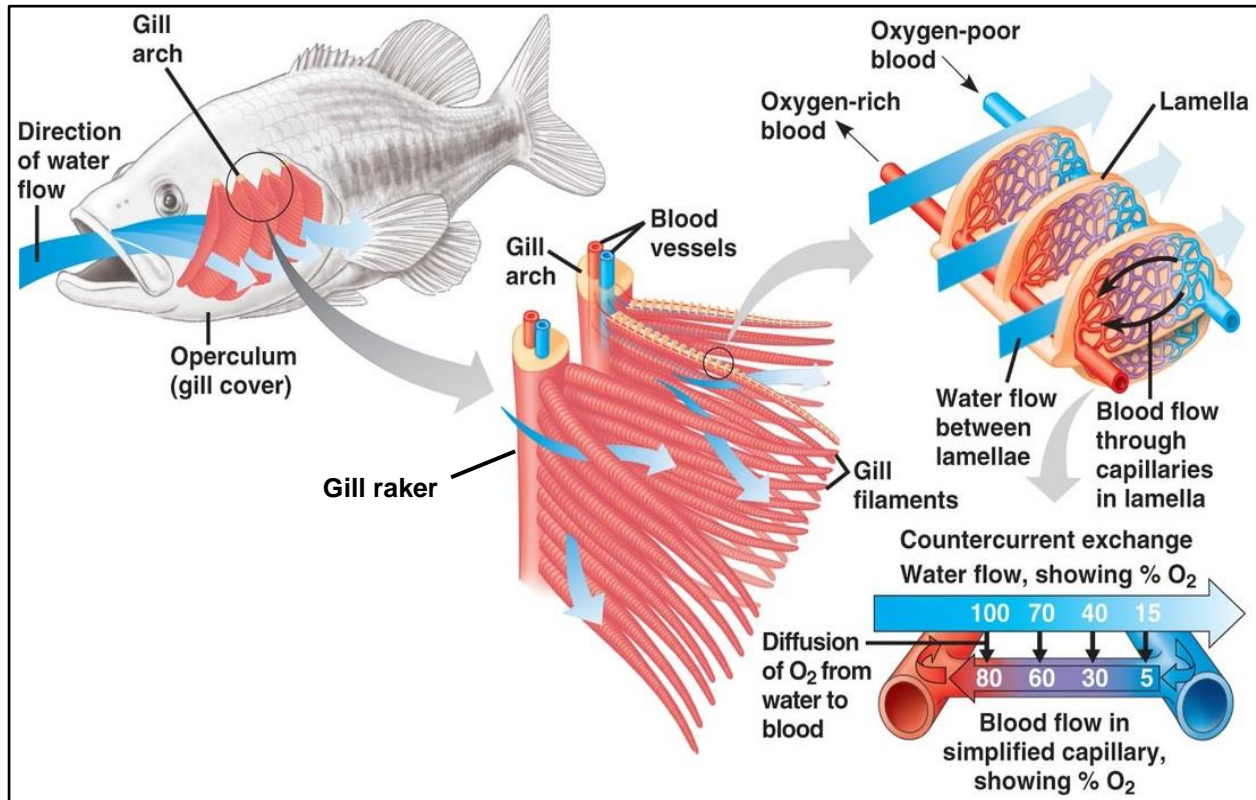
2.10 Urchin gonad is often eaten live and raw with a bit of lemon or soy sauce after cutting open the live animal. Some people believe that this is inhumane or cruel because it causes the animal pain. Using your knowledge of echinoderm anatomy and behaviour, comment on this belief.

(4)
[35]

QUESTION 4

Study the sources below illustrating the gaseous exchange system occurring in most bony fish, then answer the questions that follow.

Figure 4: Diagram representing the gaseous exchange system in bony fish.



[Source: <<https://338373gasexchange.weebly.com/fish.html>>]

- 4.1 Provide ONE reason why a gaseous exchange in water requires more energy than a gaseous exchange in air.

(2)

- 4.2 What is the function of the gill rakers?

(2)

- 4.3 List TWO structures in a fish's gills that increase the absorptive surface area.

- _____
- _____

(2)

- 4.4 Explain the phrase "Fish have a circulatory system, so their size is not limited as the size of animals without a circulatory system would be".

(4)

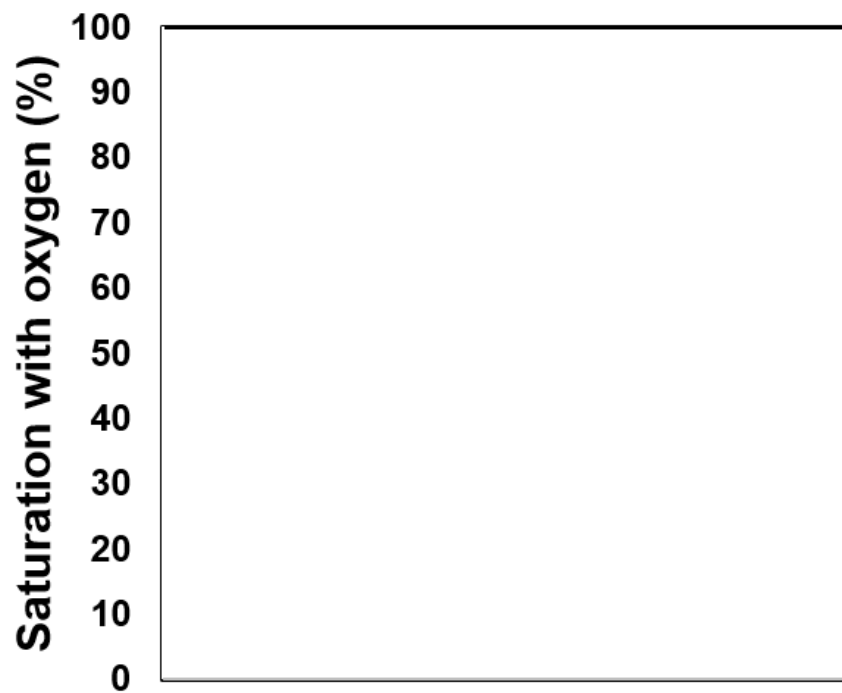
- 4.5 Fish gills are ventilated by a flow of water in one direction over the gills. This system has TWO advantages over two-directional ventilation in animals such as reptiles and mammals. Describe these advantages.

- ---

- ---

(4)

- 4.6 In the graph below, draw TWO labelled lines that would represent the correct relationship between the direction of water flow and blood flow in a countercurrent system.



Distance along gill plate

(2)

- 4.7 In addition to the gills, where else in their bodies do bony fish make use of countercurrents?

(2)

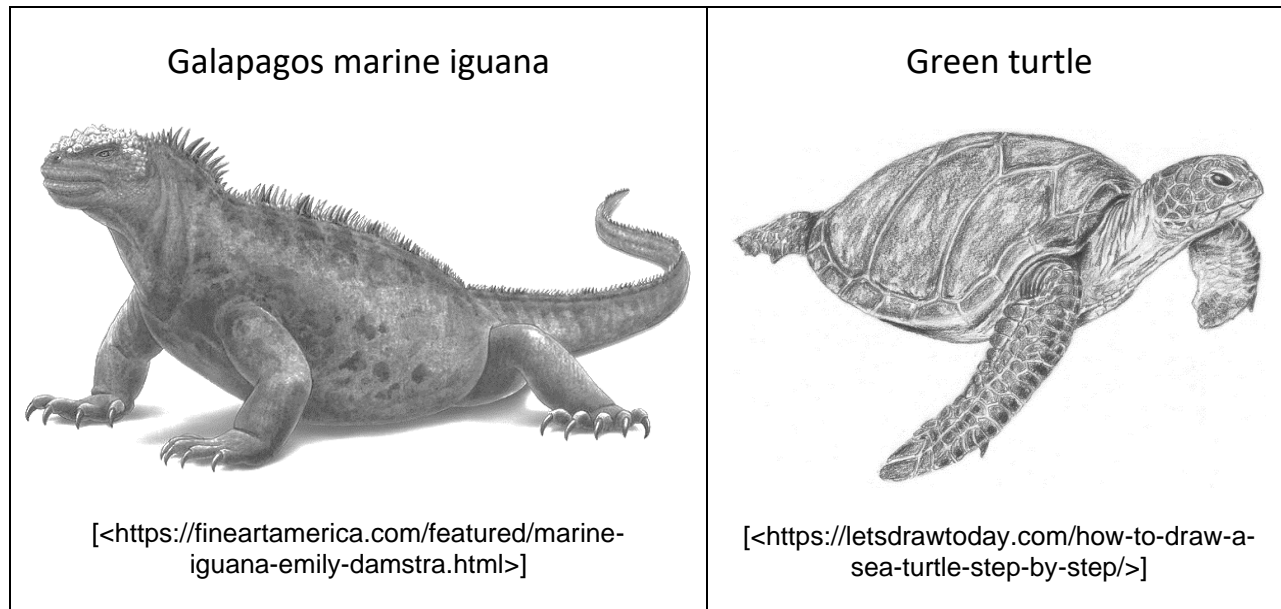
- 4.8 For what purpose would the bony fish require this countercurrent system mentioned in Question 4.7 above?

(2)

[20]

QUESTION 5

The diagrams below represent two marine organisms. Both organisms are mainly vegetarian and feed on submerged marine algae. Study the diagrams and answer the questions that follow.



5.1 Which mode of reproduction is used by these organisms?

_____ (1)

5.2 Name TWO features of this vertebrate class that enabled them to colonise the land.

- _____

 - _____

- (2)

- 5.3 Based on the **VISIBLE FEATURES** of these two organisms, describe how each organism is suited to swimming to the ocean floor, and how each organism can maintain its position while feeding.

(4)

- 5.4 Temperature-dependent sex determination in this class may be particularly threatened by climate change, as increasing temperatures could lead to skewed sex ratios.

5.4.1 Which sex would global warming favour?

(1)

5.4.2 What behavioural response would reduce the effect of skewed sex ratios in turtles?

(2)
[10]

75 marks

SECTION C

Answer any ONE question in this section.

Clearly indicate the NUMBER of the question 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 charts, or diagrams.

QUESTION 6

Cetaceans have a permanent aquatic lifestyle, while pinnipeds are predominantly aquatic and utilise land or icebergs only for sunbathing and reproduction. Write an essay comparing and contrasting the anatomical and behavioural differences between the cetaceans and the pinnipeds under the following topics:

- Body shape and streamlining
- Limb modification
- Feeding behaviour, social structure, communication and reproduction

Discuss which of these lifestyles you think is most effective, giving reasons for your answer.

[35]

OR

QUESTION 7

Cetaceans employ two primary feeding strategies: filter feeding and predation. Write an essay contrasting the anatomical and behavioural differences between cetaceans that use these two feeding methods under the following topics:

- Anatomy and feeding
- Size and movement
- Communication and social interactions

Discuss which of these feeding strategies you think is most effective, giving reasons for your answer.

[35]

[illegible]

[illegible]

[illegible]

35 marks

Total: 150 marks

ADDITIONAL SPACE (ALL QUESTIONS)

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

[illegible]

[illegible]

[illegible]