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TOTAL
MARKS

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NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2023

MARINE SCIENCES: PAPER I

EXAMINATION NUMBER

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Time: 2½ hours

150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 22 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 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. ONE blank page (page 22) is included at the end of the paper. If you run out of space for a question, use this page. Clearly indicate the question number of your answer should you use this extra space.

Allocation of marks

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

SECTION A**QUESTION 1**

- 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 The water molecule is ...

- A slightly negative at the hydrogen end and slightly positive at the oxygen end.
- B slightly positive in all areas of the molecule.
- C slightly negative at the oxygen end and slightly positive at the hydrogen atoms.
- D charged the same in all areas of the molecule.

(2)

1.1.2 Water can dissolve sodium chloride because ...

- A the polar ends of water molecules attract the oppositely charged ions of sodium chloride.
- B the shape of the water molecules pushes the sodium and chloride ions apart.
- C the oxygen in the water molecules reacts with the sodium and chloride ions.
- D water molecules and sodium chloride are covalently bonded.

(2)

1.1.3 Choose the combination in which BOTH factors will reduce the amount of dissolved O₂ in seawater.

	Salinity	Temperature
A	Increase	Increase
B	Increase	Decrease
C	Decrease	Increase
D	Decrease	Decrease

(2)

1.1.1	1.1.2	1.1.3

- 1.1.4 Which one of the following combinations describing the characteristics of ENSO events is correct?

	La Niña	El Niño
A	Warmer than average jet stream	Cooler than average jet stream
B	A low-pressure system over the Atlantic Ocean	A high-pressure system over the Atlantic Ocean
C	Weakening of the trade winds	Strengthening of the trade winds
D	Cooler-than-average sea surface temperatures in the central and eastern Pacific Ocean	Warmer-than-average sea surface temperatures in the central and eastern Pacific Ocean

(2)

- 1.1.5 Which of the following sandy shore residents is a scavenger?

- A White mussels
- B Mole crabs
- C Plough snails
- D Clams

(2)

- 1.1.6 Which one of the following combinations describing the characteristics of sandy beaches is correct?

	Sand grain size	Beach exposure and wave action	Size of air spaces between grains
A	small sand grains	exposed – intense wave action	small air spaces
B	large sand grains	exposed – intense wave action	large air spaces
C	small sand grains	sheltered – calm wave conditions	large air spaces
D	large sand grains	sheltered – calm wave conditions	small air spaces

(2)

1.1.4	1.1.5	1.1.6

1.1.7 What should divers do to reduce the risk of decompression sickness?

- A Descend slowly and ascend rapidly.
- B Limit the depth and duration of dives.
- C Ascend slowly and descend rapidly.
- D Ascend quickly while breathing deeply.

(2)

1.1.8 According to which gas law is the volume of any gas proportional to the number of gas molecules present at a constant pressure and temperature?

- A Gay-Lussac's law
- B Dalton's law
- C Avogadro's law
- D Henry's law

(2)

1.1.9 Which of the following statements about South African kelp forests is correct?

- A They are poorly adapted to withstand heavy wave action.
- B They occur at depths greater than 30 m.
- C There are only two species of kelp found in South African waters.
- D Kelp forests are found in cold, nutrient-rich water.

(2)

1.1.10 A diver releases 10 litres of air into a lift bag, at 30 m below the surface where the temperature is 15 °C. What volume will the gas in the lift bag occupy when it ascends to a depth of 5 m if the temperature of the water column remains constant?

- A 20.0 litres
- B 17.5 litres
- C 15.0 litres
- D 12.5 litres

(2)

[20]

1.1.7	1.1.8	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 species that is restricted to a geographical area and does not occur naturally in any other geographic region.	
1.2.2	Giving false or misleading information about the environmental benefits of a product or service.	
1.2.3	The limit on the number of fish that an authorising body permits fishers to harvest.	
1.2.4	The almost microscopic heterotrophs in soil or sediment ecosystems.	
1.2.5	Organisms that can tolerate a wide range of salinities.	
1.2.6	An aerial root specialised for gaseous exchange.	
1.2.7	A type of seaweed that grows on the surface of another plant but does not derive nutrients from the host plant.	
1.2.8	Extracted from red algae and used as a stabiliser and gelling agent in meat, dairy, and vegetarian products.	
1.2.9	Mature, individual fish used by the aquaculture industry for breeding.	
1.2.10	A red-orange pigment found in certain seaweeds that is added to multivitamins as an antioxidant to protect the body from free radicals.	

(10)

- 1.3 Study the following table that consists of a term in COLUMN I and TWO items (numbered 1 and 2) in COLUMN II. Decide which item(s) relate to the term. Write down your choice in the space provided in the Answer column, making use of the following codes:

- 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	Ekman transport in the Southern Hemisphere.	1. Surface waters move at 90° anticlockwise from the wind direction. 2. The movement due to wind ceases at a depth of about 100 meters.	
1.3.2	Scavenger on the upper shore.	1. Plough snail (<i>Bullia</i> sp.) 2. Ghost crab (<i>Ocypode</i> sp.)	
1.3.3	South African kelp that occurs in the inshore zone.	1. <i>Ecklonia maxima</i> 2. <i>Laminaria pallida</i>	
1.3.4	Move sediment seaward through the surf zone.	1. Rip currents 2. Longshore drift	
1.3.5	Deposition of material by high-energy waves.	1. Scarp 2. Berm	

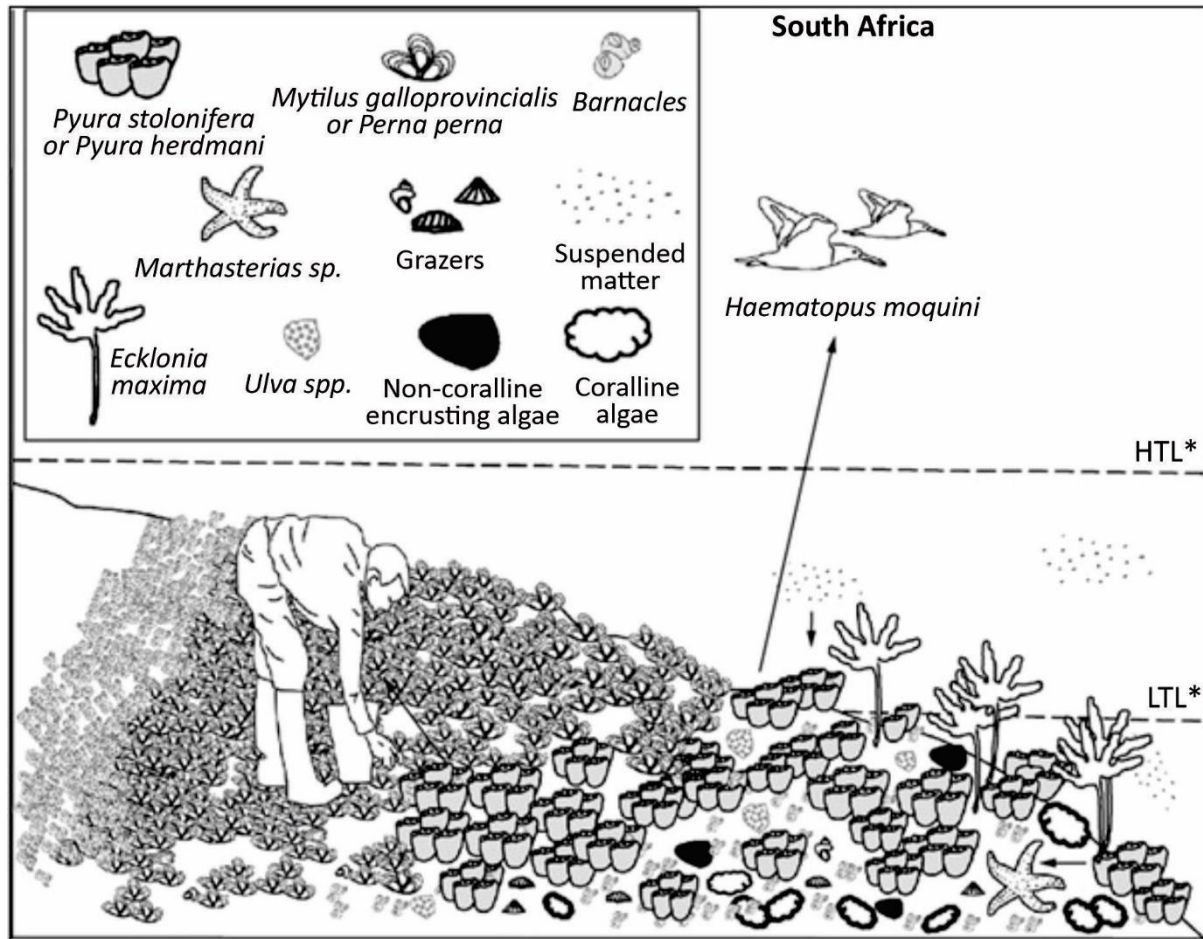
(10)

40 marks

SECTION B**QUESTION 2**

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

Figure 2.1 Diagrammatic representation of a South African rocky shore



[Source: <<https://www.researchgate.net/figure/Food-web-and-energy-transfer-on-intertidal-rocky-shores-in-South-Africa>>]

HTL: high-tide level

LTL: low-tide level

2.1.1 Which region along the South African coast is depicted in the diagram above? Provide TWO reasons for your answer.

(3)

2.1.2 On average, what is the maximum tidal range in South Africa?

(1)

2.1.3 Name the rocky shore ZONE that occurs below the spring low-tide mark.

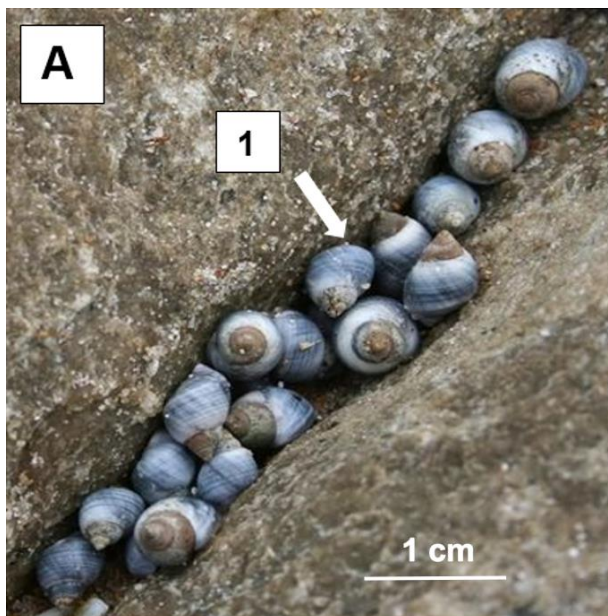
(1)

2.1.4 In the space provided below, draw a fully labelled food chain. Include at least one producer, one filter feeder, and one carnivore from the organisms labelled in Figure 2.1.

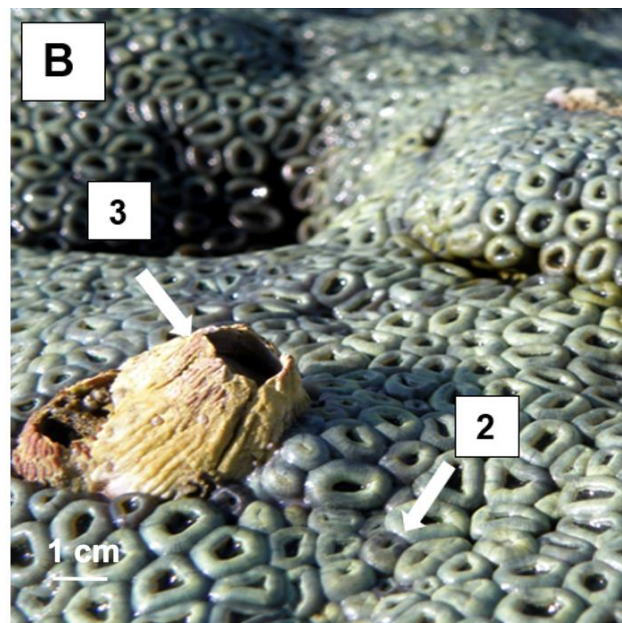
(6)

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

Figure 2.2 Organisms found on a South African rocky shore



[<<https://za.pinterest.com/pin/172051648236173839>>]



[<<https://commons.wikimedia.org/wiki/>>]

2.2.1 Name the rocky shore zone in which the organism labelled 1 is found.

(1)

2.2.2 Describe TWO behavioural adaptations to heat stress/desiccation experienced by these animals in the zone mentioned in Question 2.2.1.

(4)

2.2.3 Name the zone in which the organisms labelled 2 and 3 are found.

(1)

2.2.4 Describe the biological interaction that can take place between the organisms labelled 2 and 3.

(3)
[20]

QUESTION 3**SOURCE 1****What will it take to bring clean energy to South Africa?**

The Government's Integrated Resource Plan (IRP), which became law in 2019, states that 78 GW of energy capacity is needed by South Africa by 2030. However, the sheer estimated costs involved, coupled with the slow progress of government projects, suggest a bleak future for the country.

Currently, Eskom is unable to meet the country's energy demand resulting in frequent load shedding. Although Eskom's coal fleet can generate around 52 GW, almost half remains out of service. The energy availability factor is unlikely to improve, given the deteriorating performance of the country's coal power fleet and ageing infrastructure.

Based on the estimated availability of wave power along the entire coast of South Africa, this resource could contribute 8 GW to 10 GW towards South Africa's electricity supply. The dominant wave directions are from the southwest and the southeast. The southwest coast has the highest average wave power compared to the rest of the coastline.

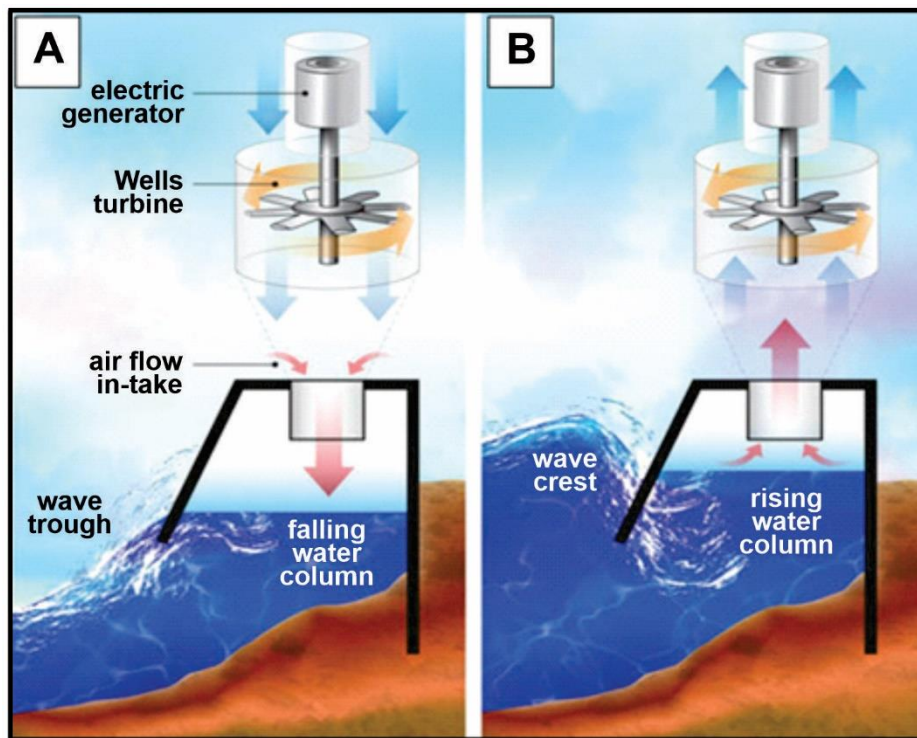
[Adapted from: <https://www.fordfoundation.org/news-and-stories/stories/posts/what-will-it-take-to-bring-clean-energy-to-south-africa/#>: & Source: <https://businesstech.co.za/news/energy/633233/meeting-south-africas-electricity-demand-why-the-numbers-are-not-likely-to-add-up/>]

SOURCE 2

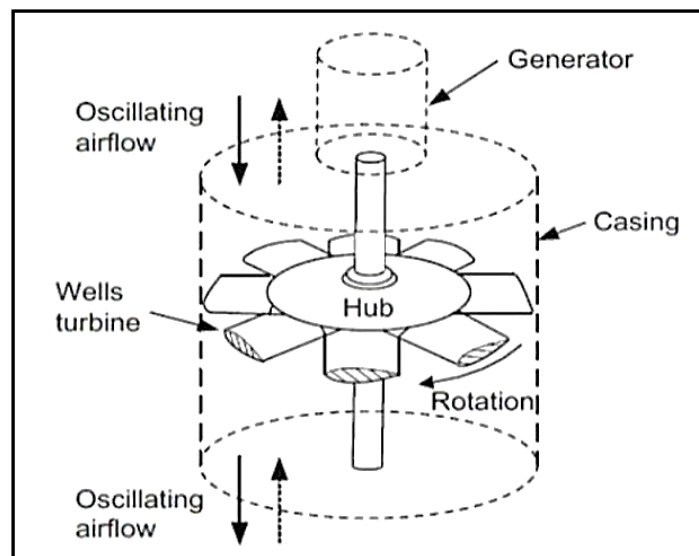
Research has suggested that the oscillating water column (OWC) concept might be a possible solution to our energy generation needs. An OWC comprises two key elements: a collector chamber, in which a rising wave compresses the air within the chamber, which converts the pneumatic power (mechanical energy generated or transmitted using compressed air or gases) into electricity. The air in the collector is alternately pressurised as the water column rises (diagram A) and rarefied, meaning the pressure is lowered (diagram B), as the water column falls. This air is then pushed out and returns while using a Wells bidirectional turbine and generator to convert the wave energy into electric power.

The concept is adaptable and can be used on a range of structures situated on the coastline, in the nearshore region, or floating offshore and it uses sea space efficiently. The attraction of the OWC concept with an air turbine stems from its simplicity. There are very few moving parts, there are no moving parts in the water, it is reliable, and it is easy to maintain.

A constraint of the South African Electricity grid is that only the urban areas along the coast are connected to high-capacity transmission lines.

Figure 3.1 Diagram of an oscillating water column (OWC)

[<https://www.researchgate.net/figure/OSCILLATING-WATER-COLUMN-WAVE-EN-ERGY-DEVICE-6_fig1_333934150>]

Figure 3.2 A Wells turbine is made up of symmetric aerofoil-type blades placed around a central hub and rotates in one direction irrespective of the direction of the airflow.

[<https://www.semanticscholar.org/paper/A-New-Operating-Concept-to-Enhance-Wells-Turbine-Hamed-Nawar>]

Watts = unit for power

GW = gigawatt (one billion watts)

- 3.1 According to the sources, what has been one of the major causes of the energy crisis in South Africa?

(1)

- 3.2 Provide a possible reason why the southwest coast has the greatest potential to provide power using the OWC (oscillating water column) system.

(1)

- 3.3 What advantage does wave energy generation have over most other forms of green energy, such as solar or wind?

(1)

- 3.4 Describe TWO advantages of Wells air turbines as provided in the sources over conventional underwater turbines.

(4)

- 3.5 Describe TWO additional advantages of OWC from the sources.

- ---

- ---

(4)

- 3.6 Describe any TWO problems you could anticipate in the construction of land-based OWC turbines.

(4)

- 3.7 Provide ONE negative environmental impact of using OWC to generate electricity.

(1)

- 3.8 The use of alternative electricity-generating methods often leads to the creation of new jobs. Explain why it is unlikely that the OWC energy industry would be able to absorb many of the jobs lost in the mining and power plant industry should we move away from coal generation.

(2)

- 3.9 Comment on the likelihood that OWC-generated electricity could realistically be the solution to South Africa's energy production by 2030. Give a reason for your answer based on the sources.

(2)

[20]

QUESTION 4

Describe the differences between the characteristics of tsunamis (seismic waves) and wind-driven waves.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

[10]

QUESTION 5

Read the information below and use it to answer the questions that follow:

Scientists aimed to identify the most popular Coastal and Marine Tourism (CMT) activities and study the spending patterns of CMT visitors in Cape Town, a popular international tourism destination.

Method: Trained fieldworkers conducted 907 face-to-face interviews at key CMT locations, including the harbour waterfront and sandy beaches, from September 2018 to January 2019. Individuals over the age of 18 were interviewed and asked whether they had or were planning to participate in various types of CMT activities during their visit to the selected locations. Respondents were allowed to choose more than one activity. Respondents were also asked to provide information about their annual income.

Fieldwork was conducted during both peak/vacation and off-peak periods, using a proportionate sampling approach to ensure that a greater number of surveys (650 of 907) were completed during peak periods.

The results of the research to identify the most popular CMT activities are recorded in Table 5 below:

Table 5 Table to show the number of respondents (n = 907) that had or were going to participate in various types of CMT activities during their visit to the selected locations.

	Coastal and Marine Tourism (CMT) activities	Number of respondents
1	Wildlife tourism (e.g. whale watching, turtle tours, seals, dolphins)	18
2	Recreational fishing (e.g. boat-based fishing, spearfishing, fishing competitions)	82
3	Scuba diving/snorkelling (e.g. shark cage diving)	9
4	Educational and scientific excursions (e.g. aquariums)	71
5	Water sports (e.g. big-wave surfing, kite surfing, stand-up paddle boarding (SUP), yachting, water skiing, water surfing)	27
6	Events (e.g. marine festivals and marine competitions, such as yacht races or regattas)	45
7	Sand/beach recreational activities (e.g. swimming, walking or running, kite-flying, beachcombing, sand dune surfing)	580
8	Coastal heritage activities (e.g. cultural tourism/history)	227
9	Sightseeing (e.g. lighthouse tourism, cycling, marathons)	354

[Adapted from: DOI: 10.30892/gtg.27402–421]

5.1 List THREE principles and guidelines for ecotourism according to The International Ecotourism Society (TIES).

(3)

5.2 Identify the dependent variable.

(1)

5.3 Give TWO quality control measures that were put in place by the researchers to ensure that the survey was reliable.

(2)

5.4 Provide TWO possible reasons why people under the age of 18 were not interviewed in this study.

- _____
- _____

5.5 List THREE fixed variables other than the age of the people interviewed.

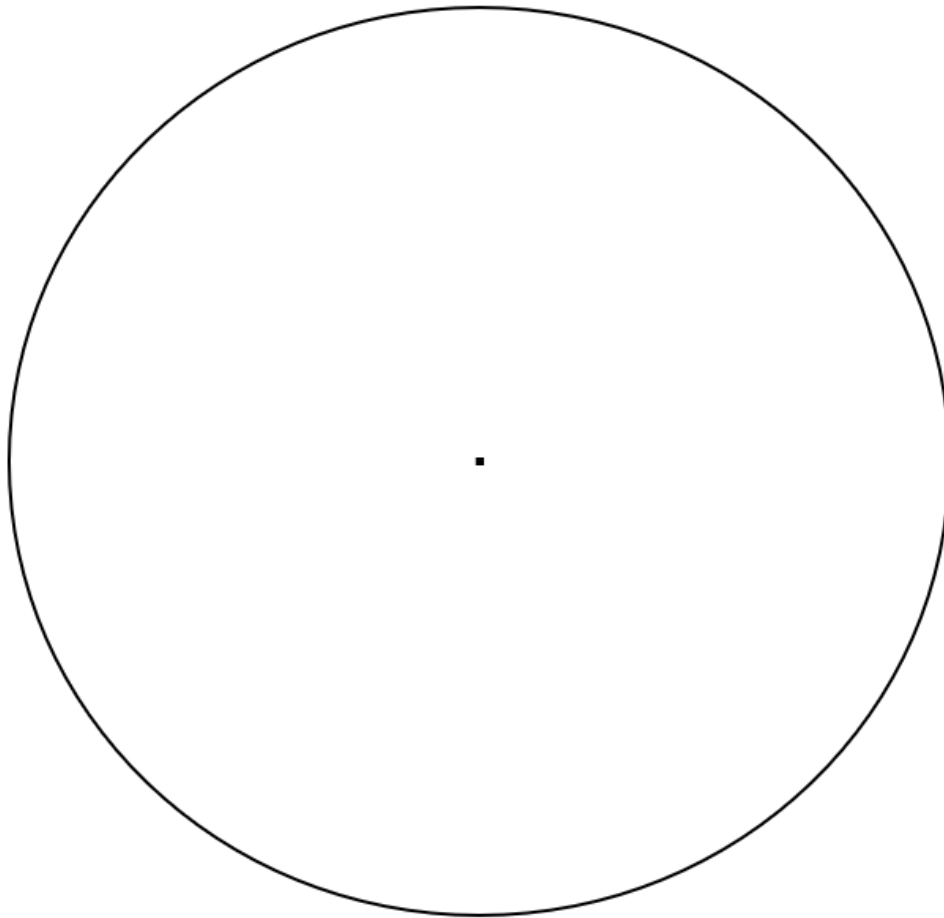
• _____

• _____

• _____

(3)

- 5.6 Use the data of the FIRST FOUR ACTIVITIES from Table 5 on page 15 to create a pie chart below, illustrating the percentage of respondents participating in activities related to MARINE LIFE.



(8)

- 5.7 Based on the research data presented in the source, what conclusions can be drawn regarding the significance of activities related to MARINE ORGANISMS compared to other activities chosen by tourists? Suggest TWO possible reasons for your observation.

(4)

[25]

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

Overfishing continues to pose a significant challenge in South Africa, impacting both the marine ecosystem and coastal communities that heavily depend on fishing. The establishment of an aquaculture industry could potentially offer a solution to alleviate the strain on wild-caught resources.

Write an essay that discusses the following:

- Problems associated with overfishing
- Possible solutions to combat overfishing
- Problems associated with aquaculture
- The potential role of aquaculture as a solution.

[35]

OR

QUESTION 7

Expanding the ocean's tourism sectors presents significant opportunities to boost economic growth and generate more employment. South Africa has the potential to significantly increase this contribution by responsibly utilising its abundant marine resources for the benefit of its economy and society. However, global climate change poses a real threat to this underutilised resource.

Write an essay discussing the following:

- The positive aspects of marine ecotourism
- The negative aspects of marine ecotourism
- The negative aspects of global warming on marine ecotourism
- Possible mitigation measures for each of these impacts.

[35]

[illegible]

[illegible]

[illegible]

[35]

35 marks

Total: 150 marks

PLEASE TURN OVER

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]