



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARINE SCIENCES P1

NOVEMBER 2024

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

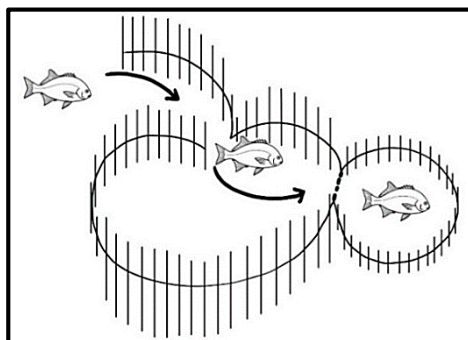
1. This question paper consists of THREE sections. Answer the questions as follows:

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 EACH question on a NEW page in the ANSWER BOOK.
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 the SECOND decimal place, where applicable.
12. Do NOT write outside of 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 The image below illustrates a fish trap used by both early and modern humans. The arrows indicate the direction of fish movement.



[Source: Examiner]

Where along the South African coastline is this type of fish trap used today?

- A Saldana Bay
 - B Gansbaai
 - C Kosi Bay
 - D Stilbaai
- 1.1.2 Which ONE of the following aquaculture holding systems uses a biological filtration system?
- A Raceways
 - B Sea cages
 - C Recirculation
 - D Ponds
- 1.1.3 The compound found in sea lettuce (*Ulva spp.*) characterised by a high nutrient content:
- A Agar
 - B Beta-carotene
 - C Carrageenan
 - D Alginate
- 1.1.4 Which ONE of the following is NOT considered in the Köppen-Geiger climate categories?
- A Precipitation
 - B Temperature
 - C Geography
 - D Vegetation

1.1.5 According to the Köppen-Geiger classification system, Durban's climate is ...

- A Cfa.
- B Afb.
- C Awa.
- D Cwc.

1.1.6 The phrases below refer to common factors contributing to climate change in the past.

- (i) Increase in the volume of greenhouse gases
- (ii) Large quantities of ice to reflect solar radiation
- (iii) Movement of continents away from the Poles
- (iv) Earth has a lower tilt angle of inclination
- (v) Earth's orbit is further away from the sun

Which ONE of the following combinations provide ONLY CORRECT options regarding factors that cause ice age periods?

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

1.1.7 An underwater photographer dives with a camera to a certain depth where the camera's light bulb collapses inward.

Which ONE of the following provides the CORRECT combination of factors to explain why the camera's light bulb collapsed inward?

	Pressure at the depth	Volume inside light bulb
A	Increases	Increases
B	Decreases	Increases
C	Increases	Decreases
D	Decreases	Decreases

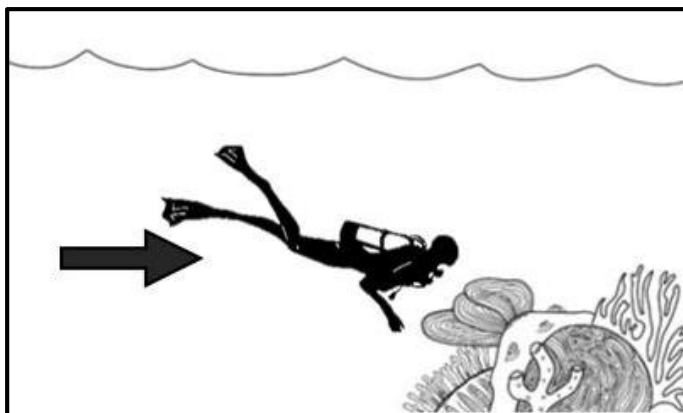
1.1.8 The statements below refer to the chemical process of ocean acidification.

- (i) Carbonic acid is formed.
- (ii) Carbon dioxide is absorbed by water.
- (iii) Free hydrogen ions lower available carbonate ions.
- (iv) Carbonic acid dissociates into bicarbonate and hydrogen ions.

Which ONE of the following combinations is in the CORRECT order?

- A (iii), (ii), (i), (iv)
- B (ii), (i), (iv), (iii)
- C (iii), (iv), (ii), (i)
- D (ii), (iii), (i), (iv)

- 1.1.9 The image below shows a scuba diver near a coral reef. The diver is wearing a buoyancy control device (BCD). The arrow indicates the direction of the ocean current.

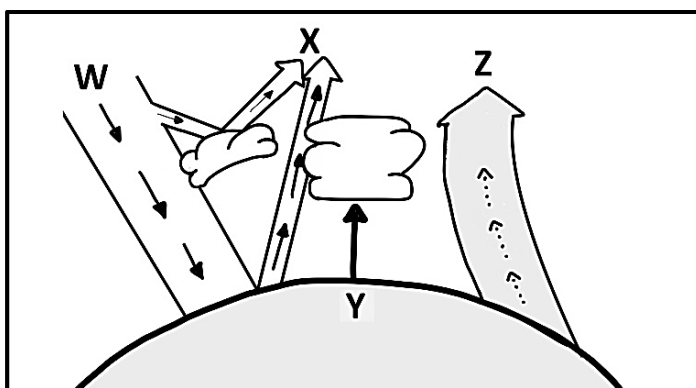


[Source: Examiner]

Which ONE of the following options is the best use of the BCD for the diver to stay away from the coral reef?

	BCD	BUOYANCY	EFFECT
A	Add air	Negative	Rise
B	No change	Neutral	None
C	Add air	Positive	Rise
D	Release air	Negative	Sink

- 1.1.10 The diagram below shows the energy balance of the Earth's atmosphere. The arrows indicate the movement of energy from a solar source.



[Adapted from

<https://upload.wikimedia.org/wikipedia/commons/e/e5/Diagram.png>]

Which letter CORRECTLY shows the process of albedo?

- A W
- B X
- C Y
- D Z

(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 long-term average atmospheric conditions of a region over 30 years
- 1.2.2 Air pumps that bubble air through the water column to enhance oxygen levels
- 1.2.3 The stable carbonate mineral CaCO_3 used in biological processes to build up parts of the body
- 1.2.4 A rectangular holding system, used in aquaculture, through which water can flow freely from one end to the other
- 1.2.5 The continuous area of water that the wind blows across in a consistent direction
- 1.2.6 A composite graph that illustrates a place's temperature and precipitation over a year
- 1.2.7 Intervention to decrease the negative impact of damage caused by humans
- 1.2.8 Mature individual fish used by the aquaculture industry for breeding
- 1.2.9 The period in which humans changed from an agrarian economy to one dominated by industry and machine manufacturing
- 1.2.10 The maximum distance of vertical displacement of water particles in a wave from the trough to the crest (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	Solution(s) to overfishing	A:	Establish mariculture facilities
		B:	Establish marine protected areas
1.3.2	Aquaculture system used for seawater trout	A:	Rafts
		B:	Ponds
1.3.3	Renewable electricity generation	A:	Osmotic gradient
		B:	Tidal differences
1.3.4	Cation	A:	H^+
		B:	CO_3^{-2}
1.3.5	Plunging waves	A:	Reduced seabed friction
		B:	Reduced wave speed

(5 x 2)

(10)**TOTAL SECTION A: 40**

SECTION B**QUESTION 2**

- 2.1 Read the information about bycatch landed by the crustacean-trawl fishery in KZN in 2021 below. The information was extracted from the 2023 Department of Forestry, Fisheries and the Environment (DFFE) report on the status of the South African marine fishery resources. Answer the questions that follow.

CRUSTY BYCATCH	
The crustacean-trawl fishery off the KwaZulu-Natal coast captures a large mass of bycatch, many of which are spawning adults.	
The data collected on deep-water trawl bycatch are shown in the table below.	
TABLE 2.1: Mass (tons) of bycatch landed from the KwaZulu-Natal crustacean trawl fishery for the 2021 fishing season	
BYCATCH SPECIES	MASS (TONS)
John Dory	30
Jacopever	70
Deep-water Hake	100
Greeneye	240
Cephalopods	340
[Adapted from https://www.dffe.gov.za/sites/default/files/reports/research/]	

- 2.1.1 Draw a pie chart to illustrate the mass of the different bycatch. (7)
- 2.1.2 Discuss how the continued removal of spawning adults as bycatch would affect fish stocks. (3)
- 2.1.3 Explain TWO decision variables that scientists need to take into account when calculating and assessing fish stocks. (2 x 2) (4)
- (14)**

- 2.2 Read the text below on the Wilderness Lakes and answer the questions that follow.

WILD WILD LAKES

The area of the Wilderness Lakes, also known as South Africa's Lake District, stretches over a distance of 38 kilometres. Over this distance the Knysna Estuary, Swartvlei, Rondevlei and Langvlei are found. These water bodies are considered to be of international importance and have received Ramsar status.

[Adapted from <https://www.thesaunter.co.za/listing/the-wilderness-lakes/>]

- 2.2.1 Along which coast of South Africa is this area? (1)
- 2.2.2 Name the climate region of this area. (1)
- 2.2.3 Discuss how the climate named in QUESTION 2.2.2 influences the type of vegetation found in South Africa's Lake District. (3)
- 2.2.4 This area has a number of human-built development projects.
- (a) State ONE potential impact that development could have on this area. (1)
- (b) Explain how the impact in QUESTION 2.2.4(a) might influence the Ramsar status of this area. (3)
- (9)**

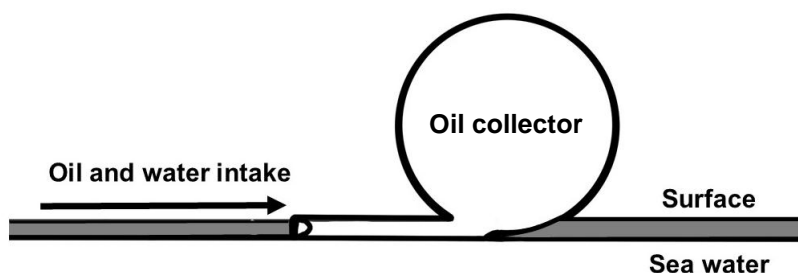
- 2.3 Read the hypothetical investigation below, illustrating the efficiency of oil collection in the ocean, and answer the questions that follow.

LAPPING UP THE OIL

Treatment of crude oil pollution in sea water has attracted global attention over the past decades. An innovative company made a prototype of a floatation device. This device can be deployed where major oil spills have been cleaned but traces of oil remain.

The illustration below shows how the floatation device works. The arrow indicates the movement of oil and water into the collector. The opening of the floatation device is kept at the surface to collect oil and water. The oil is channelled into a collector with a volume of 1 litre. The collector is filled with both oil and water with the ratio of oil to water depending on the diameter of the intake opening. The efficiency of the prototype is tested by using different diameters of the opening. These devices are placed in the water and collected after a few days. Once the devices are filled to a volume of 1 litre, they are collected and removed from the salt water.

[Source inspired by Zekri et al., 2022; <https://www.researchgate.net/publication/239296426>]



Example of the process from a side view

[Source: Examiner]

An investigation was done to test the efficiency to collect oil using floatation devices with different diameter openings (1 cm, 2 cm and 3 cm).

The following method was used:

- 2 litres of crude oil were added into a bath containing 1 000 litres of salt water.
- The salinity of the water was 33 parts per thousand.
- The temperature of the water was 16 °C.
- One device per diameter opening (1 cm, 2 cm and 3 cm) was used.
- The devices were placed in the water to collect oil and water.
- Once the devices were removed, the volume of oil and water in each device was recorded.

The results were recorded in the table on the next page.

TABLE 2.3: Volume of oil and water for three different diameters (cm) of tube openings

DIAMETER (cm)	VOLUME OF OIL (mℓ)	VOLUME OF WATER (mℓ)
1	750	250
2	800	200
3	900	100

- 2.3.1 Identify the independent variable for this investigation. (1)
- 2.3.2 Identify ONE constant variable mentioned for this investigation. (1)
- 2.3.3 Explain why this investigation was not reliable. (2)
- 2.3.4 Give the ratio of oil to water collected with the 1 cm diameter tube. (1)
- 2.3.5 Give a conclusion for this investigation. (2)
- 2.3.6 Explain why the oil is found on the surface. Refer to the chemical properties of the two liquids in your answer. (2)
- 2.3.7 The company decided to test the efficiency of a fourth opening with a diameter of 4 cm.

The results are shown in the table below.

TABLE 2.3.7: The volume of oil and water for the 4 cm tube opening

DIAMETER (cm)	VOLUME OF OIL (mℓ)	VOLUME OF WATER (mℓ)
4	450	550

Explain why the 4 cm-diameter opening was the least efficient in collecting oil. (2 x 1)

(2)
(11)
[34]

QUESTION 3

- 3.1 Study the hypothetical scenario below, outlining a summary on harvesting ocean energy and converting it to electrical energy. Answer the questions that follow.

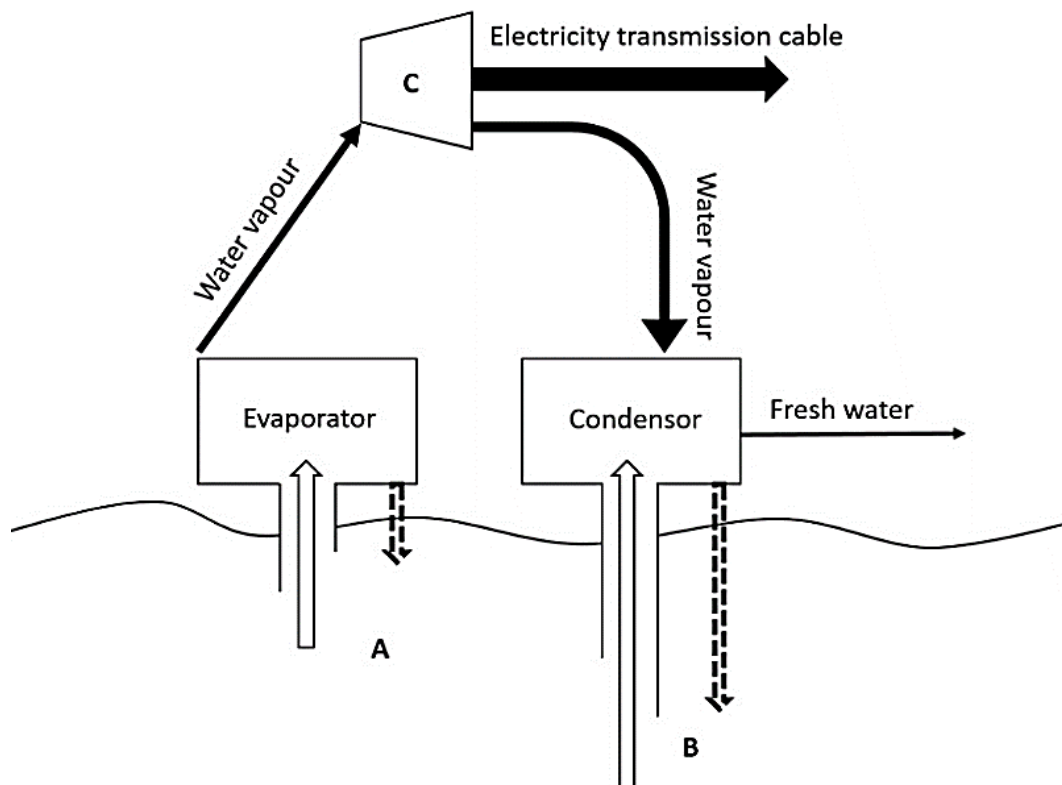
There is a need for cheap alternative energy sources. The Wesian Collective, a group of young inventors, has decided to investigate the harvesting of potential ocean energy and converting it to an electric source. They designed an ocean thermal energy conversion (OTEC) unit. Recycled materials that have more efficient heat exchange surfaces were used. The recycled materials will decrease the amount of energy used by the evaporator and condensor, compared to conventional materials. This will make the production of these units cheaper and reduce the price per kW/h of electricity, as shown in the table below.

TABLE 3.1: Costs of energy sources

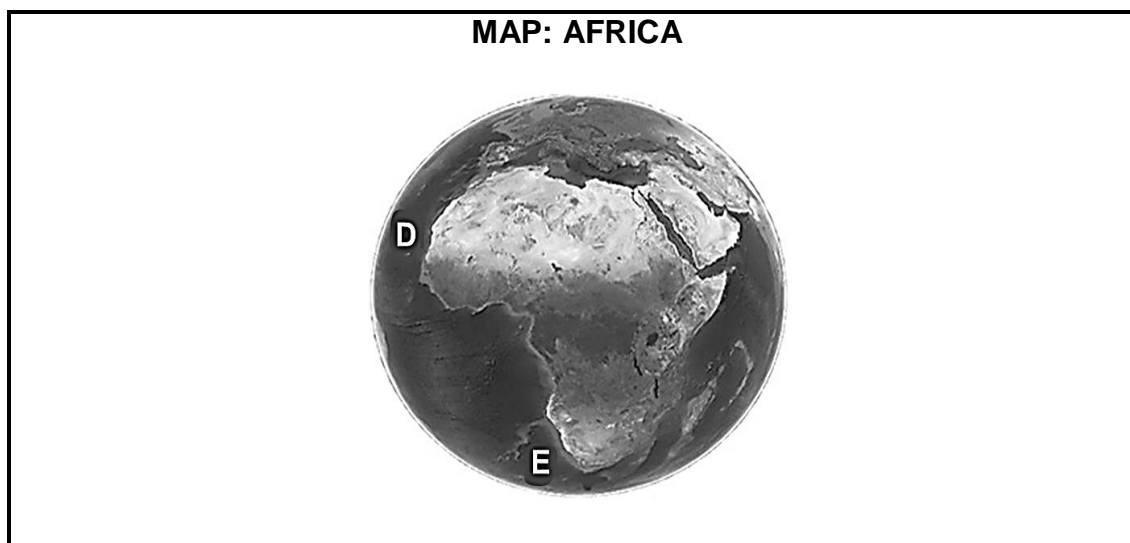
ENERGY SOURCE	COST (RSA CENTS PER kW/h)
Wind	56
Solar	77
Fossil Fuel	256
Conventional OTEC	216
New OTEC prototype	180

[Source: <https://www.researchgate.net> and <https://www.biznews.com>]

FIGURE 1: OTEC



[Adapted from <https://www.eia.gov/energyexplained/hydropower/images/oceanthermal.png>]



[Source: <https://www.usgs.gov/media/images/africa-google-earth>]

3.1.1 The following questions refer to FIGURE 1:

- (a) Identify the mechanism represented by **C**. (1)
- (b) Describe the difference in the physical property of sea water between **A** and **B** which drives OTEC electricity generation. (2)
- (c) Explain why the difference in QUESTION 3.1.1(b) results in electricity generation. (2)

3.1.2 Use the MAP to answer the following questions:

- (a) Where will the OTEC system be more efficient: at **D** or **E**? (1)
- (b) Explain your answer to QUESTION 3.1.2(a). (2)

- 3.1.3
- (a) Besides reducing the financial cost, as seen in the data, which OTHER cost does the new prototype also reduce? (1)
 - (b) Discuss ONE reason for your answer to QUESTION 3.1.3(a). (2)

- 3.1.4 In your opinion, would tax relief for new renewable energy start-up companies benefit the general public? (2)
- (13)**

- 3.2 Draw an annotated diagram from a **side view** perspective, illustrating a typical rip current. (8)

- 3.3 Read the text below about a recent ENSO update. Answer the questions that follow.

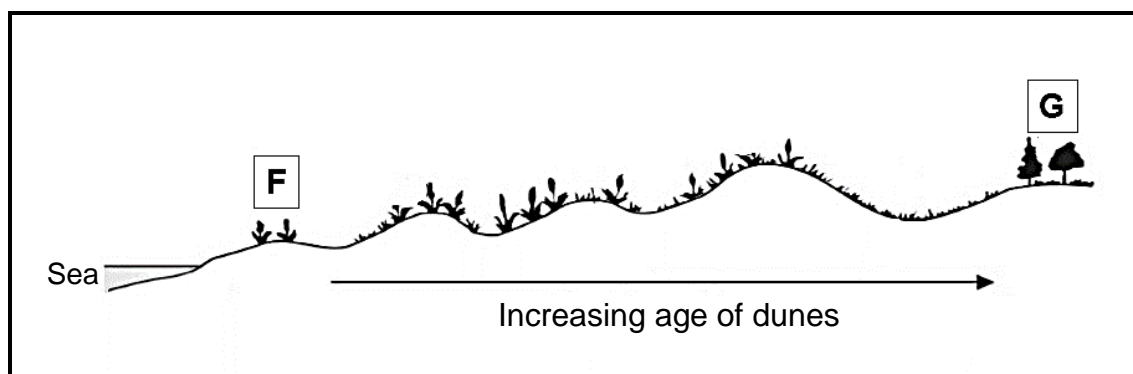
ENSO STATUS ALERT

As of 3 August 2024, equatorial sea surface temperatures were the normal average in the western Pacific and the normal average in the eastern Pacific. It is expected that between August and October 2024, the next event in the ENSO cycle will develop up until the Southern Hemisphere summer of 2024 to 2025. This event will result in the equatorial sea surface temperatures of the western Pacific increasing above the normal and decreasing below the normal in the eastern Pacific.

[Adapted from <https://www.cpc.ncep.noaa.gov/>]

- 3.3.1 Which phenomenon of the ENSO cycle is expected to develop between August and October 2024? (1)
- 3.3.2 Explain why equatorial sea surface temperatures will increase above the normal in the western Pacific AND decrease below the normal in the eastern Pacific in August 2024. (2 x 2) (4)
(5)

- 3.4 Study the diagram below, illustrating a coastal dune system, to answer the questions that follow.



[Adapted from <https://newbreweress.weebly.com/>]

- 3.4.1 (a) At which point, **F** or **G**, is the calcium carbonate content of the soil likely to be the highest? (1)
- (b) Give a reason for your answer to QUESTION 3.4.1(a) above. (3)
- 3.4.2 Would planting of indigenous dune plants to promote dune formation at **F** be beneficial to the ecosystem? Give and motivate your opinion. (2)
(6)

- 3.5 Read the text below based on a hypothetical scenario of a treasure hunter's dive. Answer the questions that follow.

STORM BURSTS SCUBA DIVER'S BUBBLE

A treasure hunter was scuba diving and exploring shipwrecks off the shore of Cape Town. The treasure hunter came across a wreck at a depth of 23 m. The treasure hunter collected valuable artefacts, which were placed in a basket attached to a balloon. When the balloon surfaced, it had a volume of 2,5 litres. As the treasure hunter surfaced, the winds picked up and produced waves with a wavelength of 6 m. While ascending, the treasure hunter started to experience turbulence at 3 m depth.

[Source: Examiner]

- 3.5.1 Calculate the volume of the balloon at 23 m. Show ALL calculations. (4)
- 3.5.2 Name the medical condition potentially resulting from the diver ascending too quickly. (1)
- 3.5.3 Explain why the treasure hunter experienced turbulence at 3 m depth. (4)
- (9)**
- [41]**

TOTAL SECTION B: 75

SECTION C

Answer any ONE question in this section.

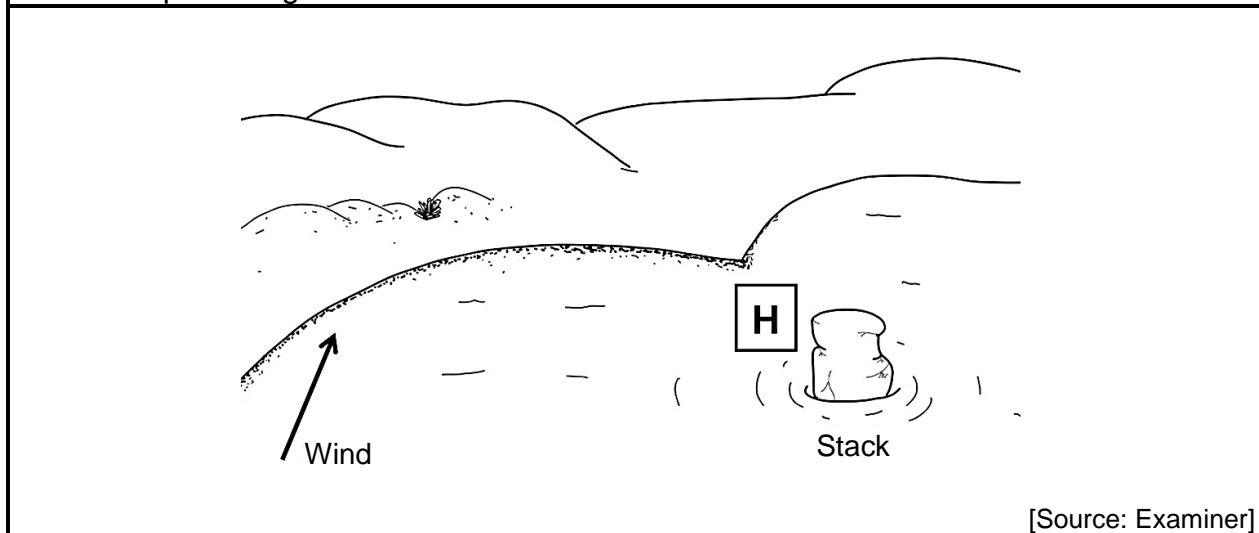
Clearly indicate the QUESTION NUMBER of the chosen question.

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

QUESTION 4

This question is based on the hypothetical scenario below.

'Leje le le lentle', meaning 'beautiful rock' in Setswana, is a stack that has been a big tourist attraction in a coastal village in the past, due to its unique shape. Tourists could walk on a natural walkway that connected the beach to the stack, climb to the top and take photographs. Over time, due to the strong current and wave action, this walkway has been eroded, removing the safe access to the stack. This has led to a drastic decline in tourism. The arrow in the illustration below indicates the direction in which the dominant prevailing wind blows.



[Source: Examiner]

In the hope of bringing tourists back to this coastal village, the local municipality plans to recreate access to the stack. As a marine scientist, you have been asked to share your knowledge and provide your opinion on how to gain access to the stack. In your presentation to the local municipality, refer to the following key aspects:

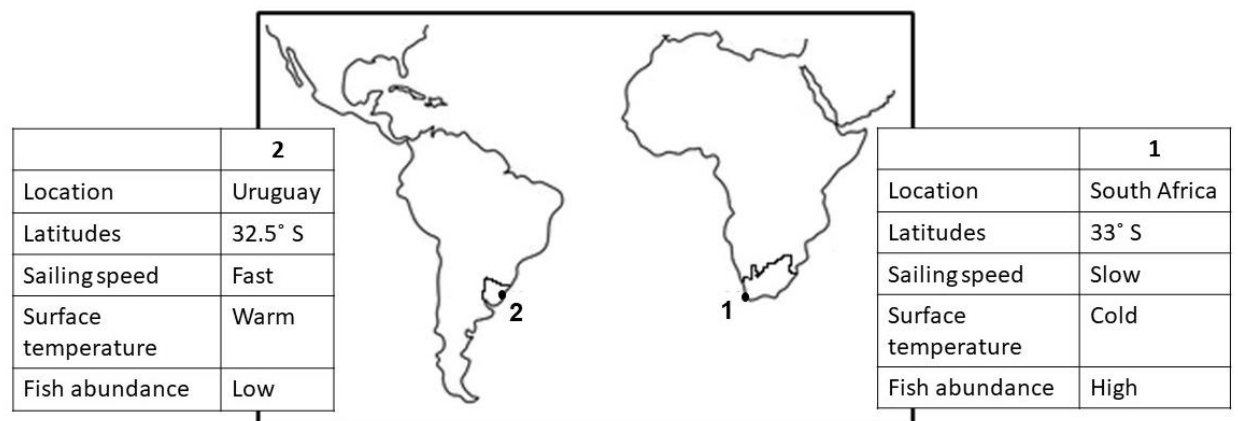
- Describe how the stack formed.
- Identify AND discuss examples of structures of the engineering approach you would advise the municipality to implement at **H** to create a human-made walkway to the stack.
- Explain how longshore drift would assist the engineering approach you have chosen to gain access to the stack.
- Discuss why an environmental impact assessment (EIA) would be necessary for this engineering process to regain access to the stack.
- Give your opinion and motivate your answer on whether a human-made walkway to the stack should be created or not.

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

QUESTION 5

This question is based on the hypothetical scenario below.

A group of citizen scientists departed from Cape Town harbour (1) on board a sailing (wind-powered) research vessel. Their voyage followed a circular path that was influenced by the natural elements. They restocked their supplies at Uruguay (2) before sailing back to Cape Town. During their trip, they noticed various differences along these coastlines and recorded their data in the tables below.



[Source: Examiner]

The group of citizen scientists approached you as a marine scientist with a sailing background in the hope of making sense of their findings. Use your knowledge of global ocean circulation to present the following:

- Name the ocean basin in which the vessel sailed AND describe why their route had a circular pattern.
- Discuss the differences in fish abundance along the coasts of **location 1** and **location 2**.
- Explain how Ekman transport and the Ekman spiral will affect the different depth levels of water.
- State some safety considerations to be used onboard the sailing vessel by the group of citizen scientists during their next journey.
- Give an opinion and motivate your answer on whether citizen scientists should continue to collect data onboard such research vessels.

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

TOTAL SECTION C: 35
GRAND TOTAL: 150