basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MARINE SCIENCES P1

MAY/JUNE 2025

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 the margins in the ANSWER BOOK.

13. Write neatly and legibly. 2025

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 type of molecular bond between water molecules causing surface tension:

A Covalent bonds
B Hydrogen bonds
C Ionic bonds
D Valence bonds

1.1.2 The prevailing surface wind direction at mid-latitudes:

A South
B West
C North
D East

1.1.3 Which ONE of the following nature reserves is found along the KwaZulu-Natal North Coast of South Africa?

A Skilpad Wildflower Reserve
B Goegap Nature Reserve
C iSimangaliso Wetland Park
D Richtersveld National Park

1.1.4 The statements below refer to several processes that occur along the coast.

(i) The wind forces a swash to flow in an oblique direction up the shore.
(ii) Gravity causes backwash to the shoreline.
(iii) Swash moves sediment diagonally up the beach.
(iv) The wind blows in an oblique direction towards the shore.

Which ONE of the following options shows the CORRECT sequence for longshore drift?

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

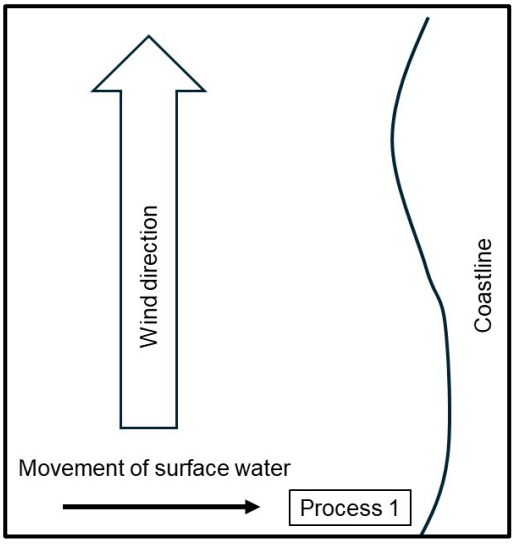
1.1.5 The image below shows the entrance to the Sibidu Cave in KwaZulu-Natal.

[Source: https://www.news24.com/you/education/youngyou/young-you-worlds]

Which of the following forms of archaeological evidence has NOT as yet been found in this cave?

A Presence of seafood shell middens
B Fossilised leaves of medicinal flora
C Middle Stone Age tools found in sediment
D Fossils showing changes in the climate

1.1.6 The illustration below represents Ekman Transport along a coastal region.

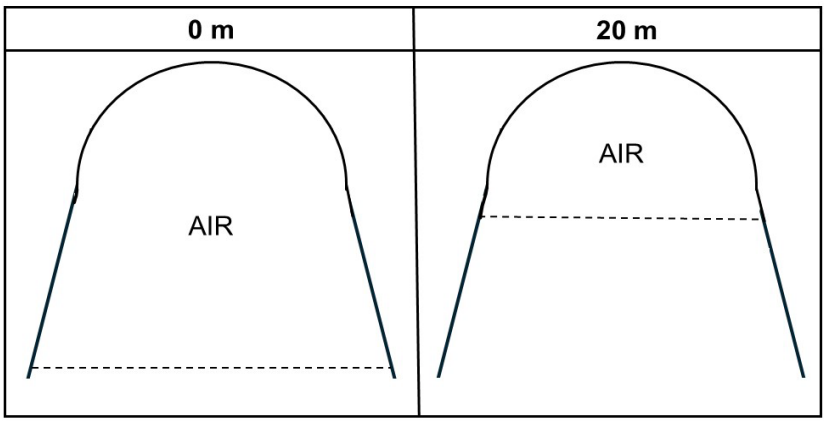


[Source: Examiner]

Which ONE of the following combinations is CORRECT for this diagram?

	HEMISPHERE	PROCESS 1
A	Northern	Upwelling
B	Southern	Downwelling
C	Southern	Upwelling
D	Northern	Downwelling

1.1.7 The illustration below shows the air in the same metal dive bell, first at 0 m and then at 20 m depth.



[Source: Examiner]

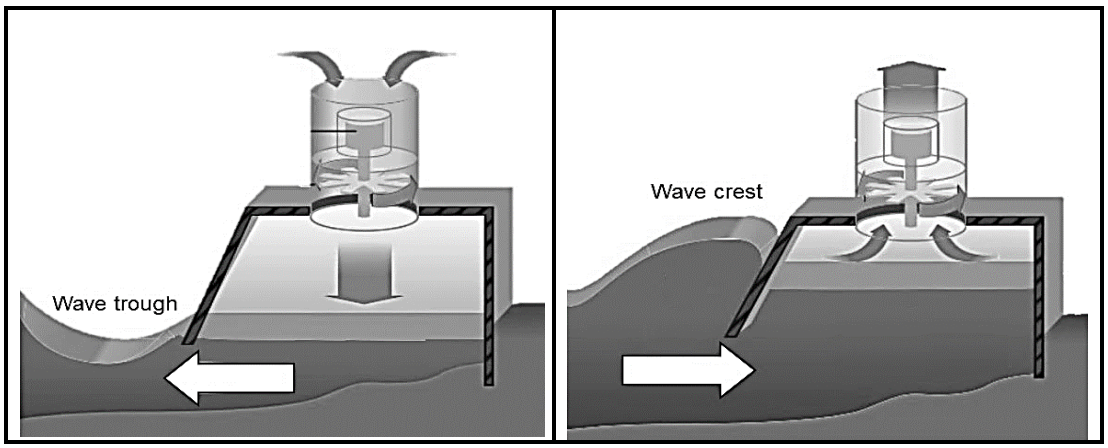
Which gas law will explain the compression of the volume of air in the dive bell as seen in the illustration above?

A Henry's law
B Charles' law
C Guy Lussac's law
D Boyle's law

1.1.8 Which ONE of the following factors does NOT influence the movement of sea water within a gyre?

A Wind
B Gravity
C Landmasses
D Eddies

1.1.9 The images below illustrate a type of wave ocean energy harvesting system. The white arrows show the direction of sea water movement.



[Source: https://www.coastalwiki.org/wiki/File:REWEC.jpg]

Which ONE of the following properties of waves is being utilised by the mechanism illustrated above?

A Heaving
B Pitching
C Rolling
D Surging

1.1.10 The variable that does NOT influence the energy balance of the Earth:

A The Earth's revolution around the sun
B The Earth's changing angle of inclination
C The force of the Moon on the atmosphere
D The amount of water vapour in the atmosphere (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 A mechanism that converts mechanical into electrical energy

1.2.2 When magma moves upward in the Earth by breaking off and engulfing blocks of overlying rocks

1.2.3 The sinking of surface water and rise of bottom water at the polar regions that drive thermohaline circulation

1.2.4 People can exert influence on the shops or markets where they purchase goods and choose products that have certain qualities, such as minimised environmental or social impacts

1.2.5 The circular movement of water in the ocean resulting in a whirlpool

1.2.6 The broad shallow area of the South African continental shelf where the cold Atlantic waters meet the warm Indian waters

1.2.7 The coastline first shaped by tectonic forces on the continental margins

1.2.8 The proportion of incident light or radiation reflectiveness of a surface

1.2.9 The oxide mineral used as a source of titanium dioxide pigment for use in plastics and paper products

1.2.10 Wind activity that erodes and shapes the surface of geological formations (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	An extended steep part of a beach	A: bar B: berm
1.3.2	Effective wave energy harvesting	A: on the ocean surface B: across a river mouth
1.3.3	The South Atlantic Ocean Basin gyre	A: eastern current moves to the equator B: western current moves to the pole
1.3.4	The second letter in the Köppen-Geiger classification	A: the region B: dry season
1.3.5	Salinity gradient power	A: movement of free water molecules towards fresh water B: movement of free water molecules towards sea water

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

TOTAL SECTION A: 40

SECTION B

QUESTION 2

2.1 Refer to the hypothetical investigation about recent flooding events along South Africa's East Coast to answer the questions that follow.

> Over recent years, there have been more frequent floods in KwaZulu-Natal. These floods have had devastating effects on South Africa's communities, economy and environment. The flood in June 2024 was one of the worst in KwaZulu-Natal's recorded history.
>
> [Source: https://www.nsri.org.za/2024/06/climate-change-wreaks-havoc-major-floods-in-kwazulu-natal-and-eastern-cape /]

The eThekwini municipality in Durban (KwaZulu-Natal) is doing research to determine if flooding in the region can be better predicted. Better predictions could be used to improve management and prevent damage. A marine scientist analysed the data collected from 1999 to 2024, on average summer precipitation and average summer atmospheric pressure. All the data were collected at the weather station at uShaka International Airport. Data are shown in the table below.

TIME (YEARS)	AVERAGE SUMMER PRECIPITATION (mm)	AVERAGE SUMMER ATMOSPHERIC PRESSURE (hPa)	ENSO EVENT
1999	45	1 013	Normal
2004	50	1 000	La Niña
2009	55	1 008	La Niña
2014	35	1 020	El Niño
2019	40	1 023	El Niño
2024	100	1 006	La Niña

2.1.1 Identify the independent variable of this investigation. (1)

2.1.2 Draw a histogram to display the average summer precipitation at 5-year intervals from 1999 to 2024. (8)

2.1.3 Calculate the percentage increase in the average summer precipitation between 2019 and 2024. (3)

2.1.4 Give ONE condition in the Pacific Ocean Basin that results in El Niño formation. (1)

2.1.5 Refer to the table above to answer the questions that follow.

(a) What effect does an El Niño event usually have on South Africa's weather patterns? (1)

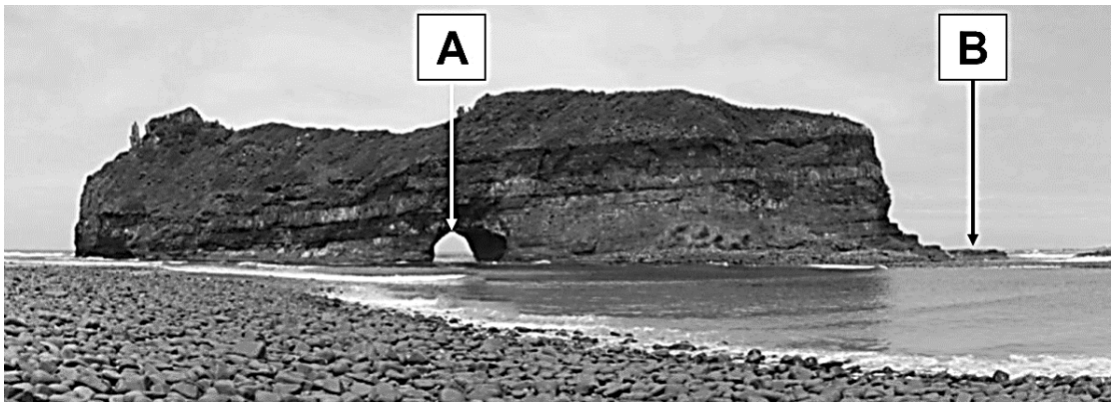
(b) State the relationship between the average summer atmospheric pressure and the type of ENSO event that takes place in South Africa. (1 x 2) (2)

2.1.6 Give your opinion on whether or not these flooding events can be predicted reliably. Motivate your answer. (2)

(18)

2.2 Refer to the image below illustrating the rock formation called the Hole in the Wall and answer the questions that follow.

HOLE IN THE WALL – WILD COAST OF SOUTH AFRICA



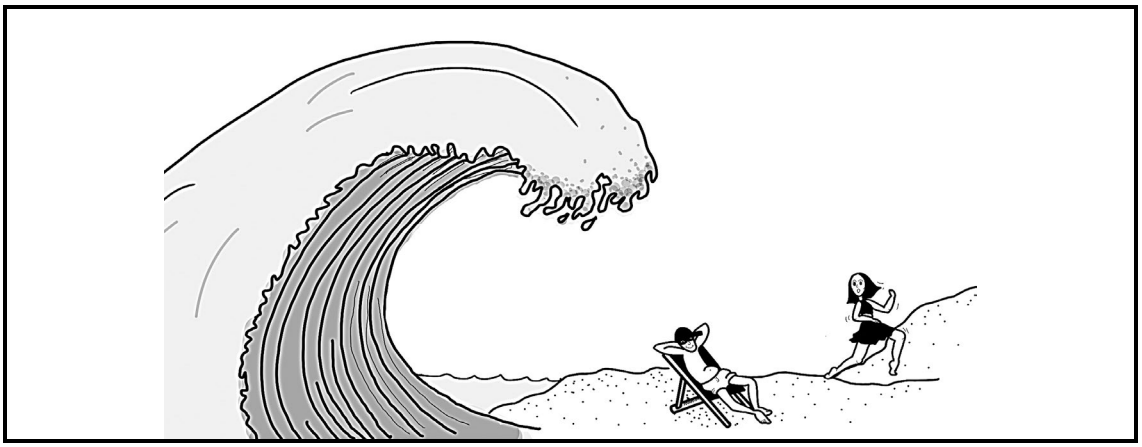
[Source: https://southafrica-info.com/land/gallery-eastern-cape-province-south-africa/attachment/hole-in-the-wall-coffee-bay-wild-coast-eastern-cape/]

2.2.1 Name the type of coastal rock formation at **A**, called the Hole in the Wall. (1)

2.2.2 Briefly describe the process of how landform **A** was formed. (4)

2.2.3 Draw an annotated diagram to illustrate the process by which the wave-cut platform shown at **B** was formed. (9)
(14)

2.3 Study the cartoon below and answer the questions that follow.



[Source: Examiner]

2.3.1 Name the type of wave shown in the cartoon above. (1)

2.3.2 Give ONE generating force for the type of wave illustrated above. (1)

2.3.3 Explain the process by which the wave height increases as the wave in the image approaches the shoreline. (2)
(4)
[36]

QUESTION 3

3.1 Study the infographic below about a hypothetical storm and answer the questions that follow.

CAPE OF BIG STORMS

Areas in Cape Town (in the Western Cape) have been severely impacted by gale-force winds that have swept across the province. Huge waves damaged the Hout Bay Seal Rescue Centre. The costs to repair the damage are estimated to be more than R30 000. As a result of the storms, a large oil tanker stranded on the rocks outside Hout Bay in the position indicated on the map below. This caused a large oil spill.

[Source: https://www.news24.com/news24/community-newspaper/peoples-post/hout]

Wave height was recorded at different wind speeds during stormy conditions, and the average data are presented in the table below.

AVERAGE WIND SPEED (m/s)	AVERAGE WAVE HEIGHT (m)
2,5	1,28
5,0	1,78
7,5	2,44
10,0	3,21
12,5	4,09
15,0	5,07
17,5	6,12
20,0	7,26

[Source: https://www.researchgate.net/figure/IMCA-Wind-Wave-relationship_tbl1_267606232]

MAP: HOUT BAY

The arrow indicates the movement of incoming waves and the anchor (⚓) shows the location of the oil tanker.

[Adapted from Google Maps and Apple Maps]

3.1.1 (a) Identify the type of wave energy transmission as the waves enter Hout Bay. (1)

(b) Give a reason for your answer to QUESTION 3.1.1(a). (1)

3.1.2 State the relationship between wind speed and wave height by referring to the table. (2)

3.1.3 Five days after the oil tanker got stranded on the rocks, oil was visible on the surface of the water.

(a) Name ONE property of oil that prevents it from dissolving into the ocean water. (1)

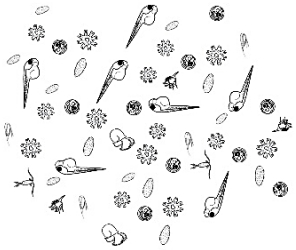
(b) Briefly discuss how the molecular structure of oil influences this property. (2)

3.1.4 Give your opinion on whether the remains of the shipwreck should be removed from the rock. Motivate your answer. (2)
(9)

3.2 Read the hypothetical scenario below relating to climate change and answer the questions that follow.

Marine scientists observed a decrease in calcifying zooplankton over the past decades. Researchers investigated whether the decrease in zooplankton in the area could be as a result of climate change. In 2004 and 2024, sea water samples were collected at a study site, using a CTD. These samples were then analysed for zooplankton biomass and carbon dioxide (CO_2). The results of these tests are shown in the table below.

TABLE 3.2: Average zooplankton biomass (mℓ per 1 000 m^3) and atmospheric carbon dioxide concentrations (ppm) collected in 2004 and 2024

YEAR	2004	2024
Zooplankton biomass (mℓ per 1 000 m^3)	 500	 250
Average CO_2 concentration (ppm)	385	425

3.2.1 Explain the relationship between atmospheric carbon dioxide concentrations and climate change. (2)

3.2.2 (a) State the effect that the difference in average CO_2 concentrations in 2004 and 2024 could have had on sea water pH levels. (1)

(b) Explain how the difference in CO_2 concentration could have resulted in the effect stated in QUESTION 3.2.2(a). (2)

3.2.3 Discuss how the effect on pH levels as stated in QUESTION 3.2.2 could potentially cause a change in calcifying zooplankton abundance. (3)

3.2.4 The change in zooplankton abundance has impacted local fish stocks in the area.

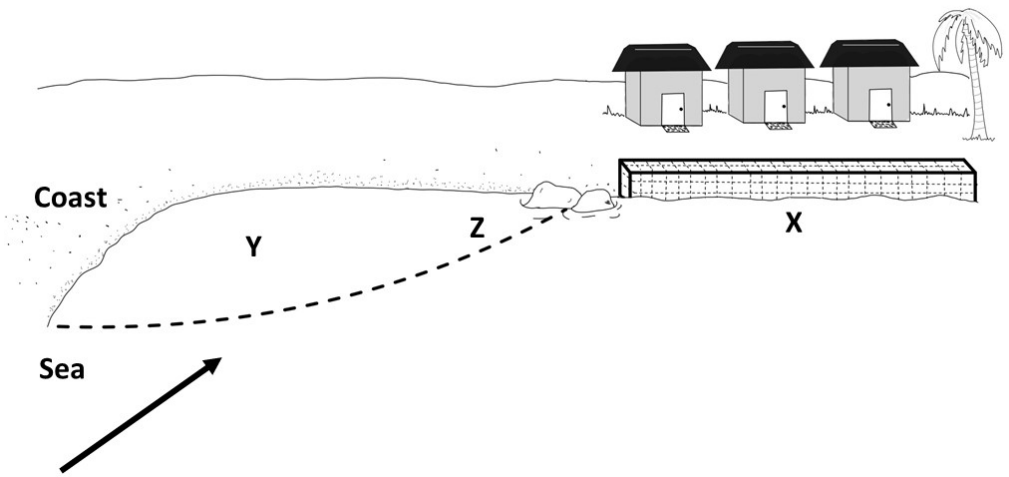
Explain ONE long-term mitigation measure that the local fish processing plant can put in place to minimise the effect on local zooplankton populations and assist in the increase of fish stocks. (3)
(11)

3.3 Study the diagram and hypothetical scenario below showing a beach holiday resort along a long beach. Answer the questions that follow.

A beach resort has experienced a decline in the number of tourists. The beach along the resort was the main attraction for tourists. However, the beach is disappearing as a result of coastal erosion. Location **Y** in the image below shows the area along the beach where erosion is occurring.

To protect the resort from erosion, the owner of the resort constructed the sea wall shown at **X** in the image below. The owner is considering additional beach management options to further restore the beach (location **Y**), thereby increasing the number of tourists to the resort.

The arrow in the image below indicates the direction of movement of the dominant prevailing wind. The dashed line shows the previous location of the shoreline.



[Source: Examiner]

3.3.1 Explain how the sea wall at **X** would prevent erosion at the beach resort. (3)

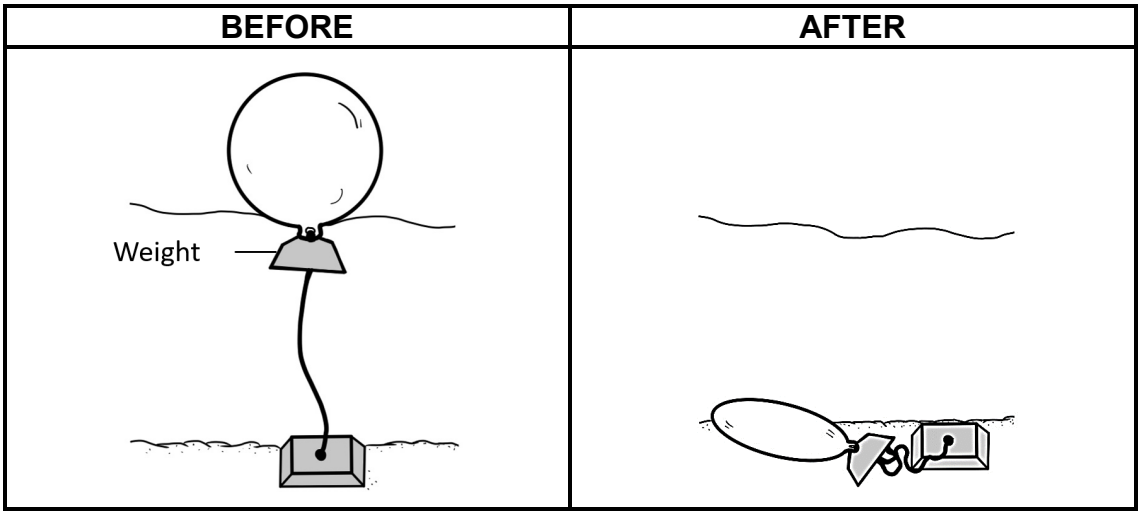
3.3.2 (a) Identify the type of permanent structure that can be constructed at location **Z** to prevent further erosion at **Y**. (1)

(b) Explain how the structure in QUESTION 3.3.2(a) may increase the deposition of sand at **Y**. (2)

3.3.3 In addition to the permanent structure identified in QUESTION 3.3.2(a), the resort plans to implement beach nourishment along the beach between locations **X** and **Z**.

Explain ONE reason why beach nourishment is NOT an environmentally friendly solution. (2)
(8)

3.4 A research vessel heading out to its dive site accidentally damaged a weighted diving buoy. The buoy started to deflate. The volume of air remaining in the device at the surface was 15 ℓ. The buoy sank to the ocean floor. When the buoy reached the sea floor, the volume of the remaining air was 6,5 ℓ.



[Source: Examiner]

3.4.1 (a) Calculate the water pressure that the weighted buoy was subjected to at the sea floor. Show ALL calculations. (4)

(b) Calculate the depth of the deflated buoy on the sea floor. Show ALL calculations. (2)

3.4.2 Two inexperienced divers went to retrieve the deflated device. They held their breath while surfacing.

(a) Identify the condition which the divers may have experienced as a result of holding their breath while ascending. Explain how this condition would affect the divers. (3)

(b) Motivate why the two inexperienced divers should NOT dive a second time to join the rest of the research team. (2)
(11)
[39]

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

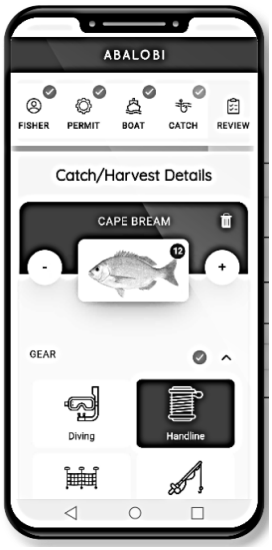
This question is based on a new South African smartphone app, ABALOBI. The image shows an example of details of the app. Answer the questions below based on a hypothetical scenario.

ABALOBI: THE APP THAT IS TRANSFORMING LIVES IN SOUTH AFRICAN FISHING COMMUNITIES

ABALOBI, meaning 'fisher' in isiXhosa, is an app that was launched in 2018 to help small-scale commercial fishers. Despite these fishers making up a significant number in the South African fisheries, they still struggle to make a sustainable income.

With ABALOBI, small-scale fishers' income has increased as the app allows them to sell their catch directly to customers. Fishers can upload details of their daily catch to a database. These data are then available to customers who are guaranteed fully traceable and fresh fish. Marine scientists have access to the fishers' data for their research.

The data uploaded by the fishers include: information on the fisher's permit details, when and where the fish were caught, the type of fishing vessel and gear used to catch the fish as well as the quantity and weight of fish caught.



[Adapted from https://www.theguardian.com/environment/article/2024]

In an effort to be more sustainable, the food service industry has employed you, a marine scientist, to advise on seafood awareness programmes. You are asked to write a report in which you compare the ABALOBI app with the SASSI programme. In your report you should refer to the following aspects:

- Discuss the challenges of overcoming overfishing in South Africa AND describe how these challenges influence the population of marine species.
- Describe how the SASSI awareness programme guides stakeholders towards making decisions that promote sustainable actions.
- Discuss the potential benefits of ABALOBI to marine sciences research.
- Explain how BOTH ABALOBI or SASSI potentially contribute to the long-term sustainability of South African fisheries.
- Give your opinion on which ONE, ABALOBI or SASSI, you think would be more effective to use. Motivate your answer.

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

QUESTION 5

This question is based on the hypothetical scenario below.

SMALL WEST COAST TOWN TO START AQUACULTURE

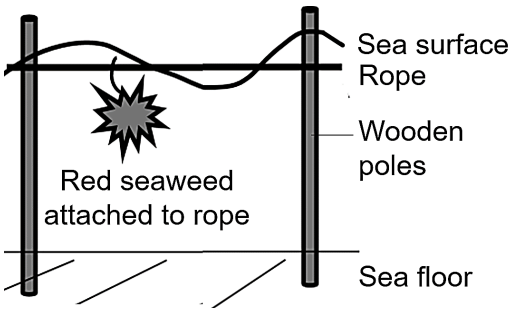
Over the last decade, a shift in weather patterns have caused South African fish populations to migrate away from their usual habitats. This has caused a small fishing town on South Africa's West Coast to lose income. In order to increase the socio-economic status of the town, seafood providers are considering building an aquaculture facility. After consulting with aquaculture experts, two aquaculture systems (as shown in the illustrations below) were identified as possible solutions:

System 1 is a sea-based rope technique. This involves cultivating only one red seaweed species. This fast-growing seaweed is attached to a rope which is placed just below the water surface of the ocean.[1]

System 2 is a land-based recirculation system and is known as an integrated multi-layered (IML) system. This involves cultivating multiple species together. Farming abalone produces excessive amounts of solid and dissolved waste nutrients. By including sea urchins and a green seaweed species into this system, the waste can be removed. Additionally, seaweed can be used for feed.[2]

[Adapted from 1. https://www.undp.org/south-africa/blog/sinking-seaweed
2. https://aquavitaeproject.eu/optimising-integrated-multi-trophic-aquaculture]

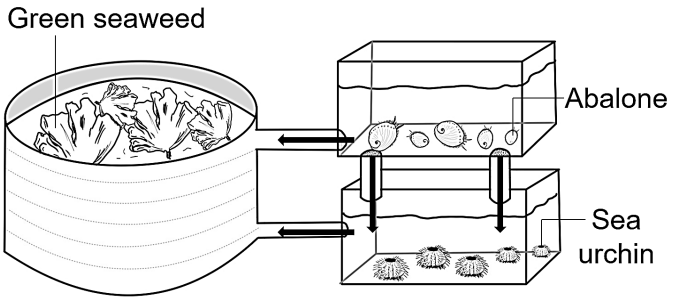
SYSTEM 1: ROPE TECHNIQUE



[Source: https://doi.org/10.1016/j.ejar]

SYSTEM 2: SIMPLIFIED INTEGRATED MULTI-LAYER

Arrows show direction of water movement



[Source: Examiner]

The Department of Forestry, Fisheries and the Environment (DFFE) has employed you, a skilled aquaculturalist, to give a presentation on the two different systems, to the coastal town. Your presentation should include the following aspects:

- Discuss TWO differences in the operational elements of System 1 AND System 2.
- Describe the commercial uses of the specific seaweeds cultivated in System 1 AND System 2.
- Discuss the advantages of BOTH aquaculture systems for THIS town.
- Discuss the disadvantages of BOTH aquaculture systems for THIS town.
- Give your opinion on which aquaculture system, rope techniques or integrated multi-layered (IMS) system, would increase the socio-economic status the most for this town. Motivate your answer.

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

TOTAL SECTION C: 35
GRAND TOTAL: 150