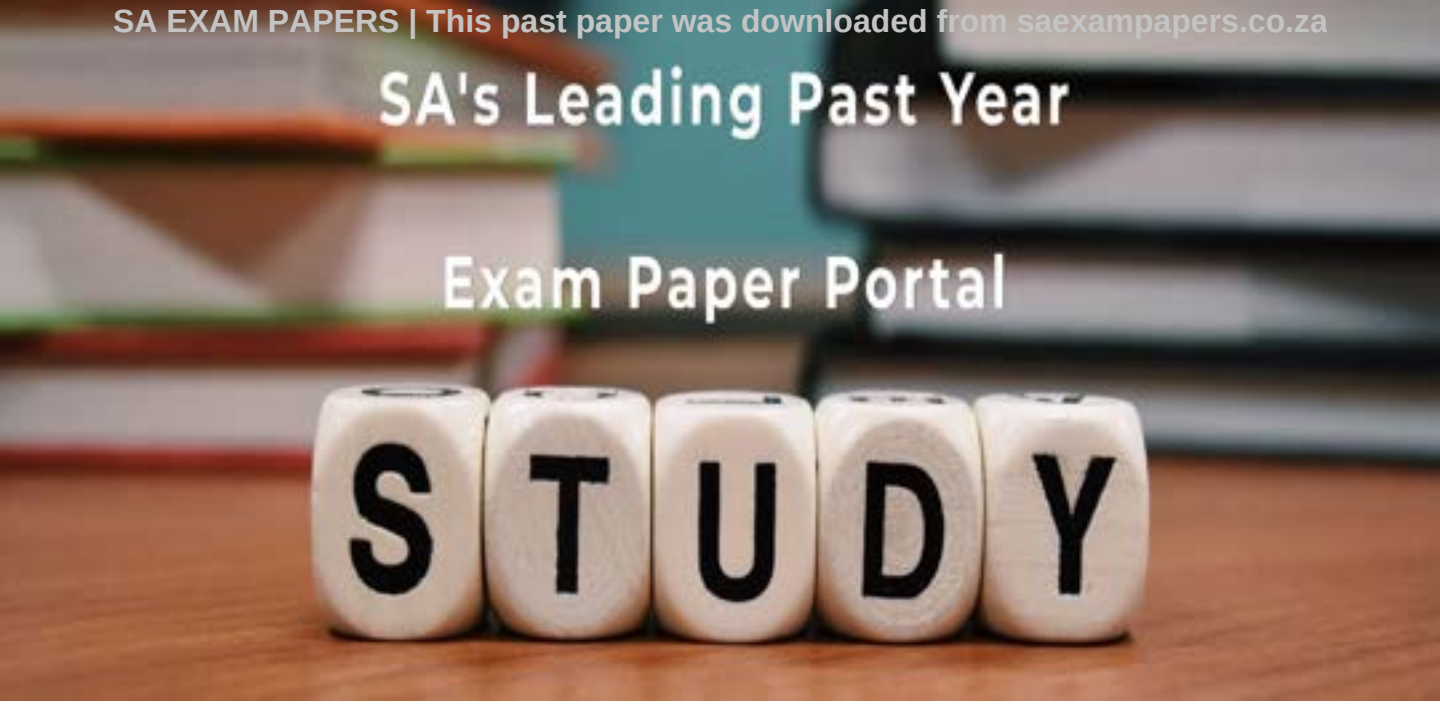


basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MARINE SCIENCES P1

MAY/JUNE 2024

MARKS: 150

TIME: 2½ hours

This question paper consists of 17 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: Consists of QUESTIONS 2 and 3.
   Answer BOTH questions in this section.
   SECTION C: Consists of QUESTIONS 4 and 5.
   Answer any 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 highest proportion of chemical elements in sea water is …

A calcium and magnesium ions.
B potassium and nitrogen ions.
C sodium and chloride ions.
D sulphate and chloride ions.

1.1.2 The image below represents a type of wave.

[Source: beadizzy.(blogspot.com)]

The image represents a …

A spilling wave.
B tidal bore.
C plunging wave.
D seismic wave.

1.1.3 The image below shows an aquaculture system.

[Source: Aquaponics system]

Which type of aquaculture system is shown?

A Fish culture cages
B Raceways
C Recirculation systems
D Fish pens

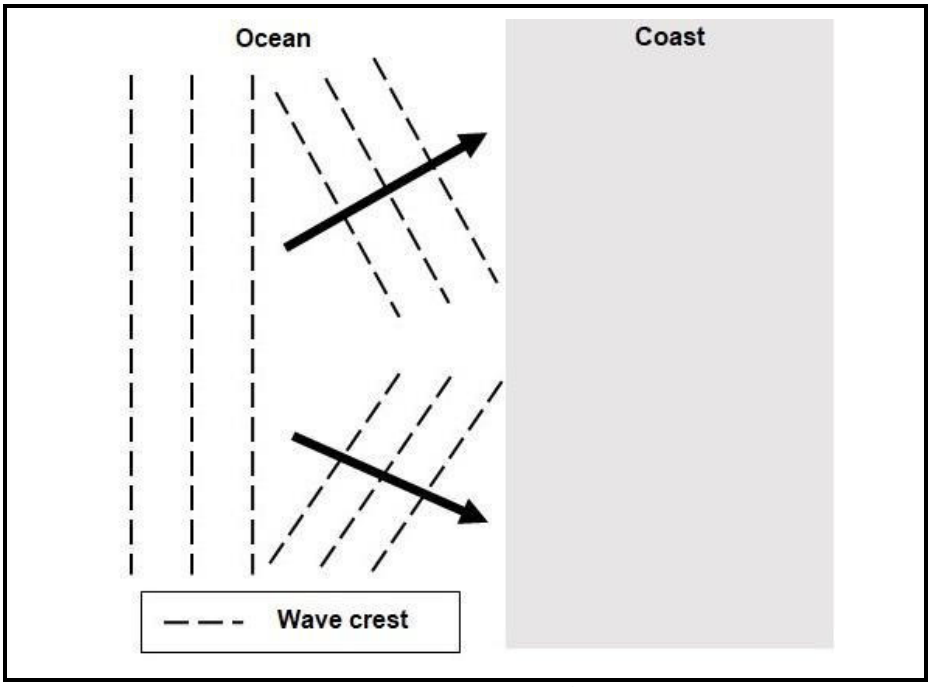
1.1.4 Which option is NOT a benefit of sustainable aquaculture?

A Lowering carbon emissions
B Creates employment opportunities
C Low environmental impact
D Reduces genetic diversity

1.1.5 A decrease in the Catch Per Unit Effort (CPUE) means that …

A fewer fish are being caught with less effort.
B more fish are being caught with the same effort.
C fewer fish are being caught with the same effort.
D more fish are being caught with less effort.

1.1.6 The diagram below represents the transformation of water wave energy.



[Source: Illustration by examiner]

Which phenomenon is indicated by the arrows in the diagram?

A Refraction
B Diffraction
C Reflection
D Deflection

1.1.7 Some of the variables below contribute to the formation of rip currents.

(i) Wave size
(ii) Tide
(iii) Water temperature
(iv) Sand bar development
(v) Wind direction

Which combination contains only CORRECT variables for controlling a rip current?

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

1.1.8 Which renewable ocean electricity harvesting solution is currently being applied along sections of the South African coast?

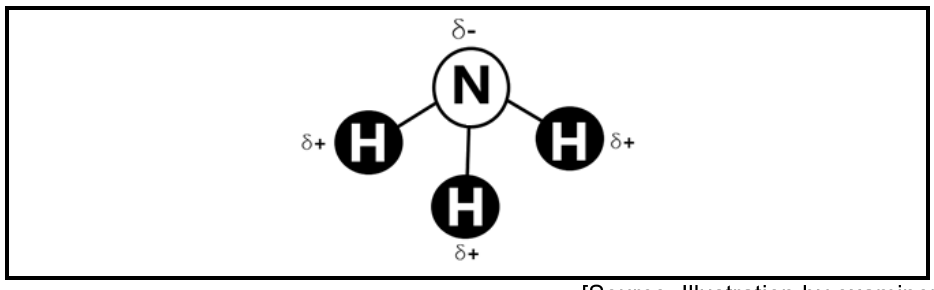
A Tidal
B Geothermal
C Wind
D Ocean thermal

1.1.9 Which combination of the Köppen-Geiger climate classification indicates the CORRECT meaning for each letter symbol?

	1st letter	**2nd letter**	**3rd letter**
A	Distance from the equator	The heat level of the region	Season when the region is dry
B	The heat level of the region	Distance from the equator	Season when the region is dry
C	The heat level of the region	Season when the region is dry	Distance from the equator
D	Distance from the equator	Season when the region is dry	The heat/ temperature level of the region

1.1.10 Refer to the illustration below and consider the following options:

(i) Polar molecule
(ii) Consists of two elements
(iii) Non-polar molecule
(iv) NH_3
(v) Linear shape



[Source: Illustration by examiner]

Which combination of options about the molecule illustrated above is INCORRECT?

A (i) and (ii)
B (iii) and (v)
C (ii) and (vi)
D (i) and (v)

(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 composite graph that illustrates the weather and precipitation at a place over a year

1.2.2 The state of being suspended in the water column without upward or downward forces being experienced

1.2.3 The vertical distance from the crest OR trough to the equilibrium surface

1.2.4 The optimal amount of fish that can be harvested without compromising that fish stock's genetic and species diversity

1.2.5 A mechanism in which the force caused by steam, water or air movement is applied to curved blades, causing them to rotate on a central spindle

1.2.6 An atom that has lost one or more electrons and has a positive electric charge

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

1.2.8 The force moving wave particles to return to the undisturbed equilibrium position after a disturbance

1.2.9 Naturally occurring or artificially constructed banks or ridges to control water levels, typically along river edges

1.2.10 Substances that promote the growth of micro-organisms (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	Glacial periods	A: B:	Natural ice age Mainly affects the Northern Hemisphere
1.3.2	Up and down wave movement	A: B:	Heaving Pitching
1.3.3	Charles's law	A: B:	Volume of gas is in a rigid container Volume of gas expands when heated
1.3.4	Carrageenan	A: B:	Used as a yellow colourant Not found in red algae
1.3.5	Middens	A: B:	Indicates patterns of human occupation Evidence of seafood consumption

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

TOTAL SECTION A: 40

SECTION B

QUESTION 2

2.1 Read the text below and answer the questions that follow.

A deeper understanding of the characteristics of water waves is essential for designing efficient electricity harvesting devices. In particular, the orbital motion of wave particles has been of interest.

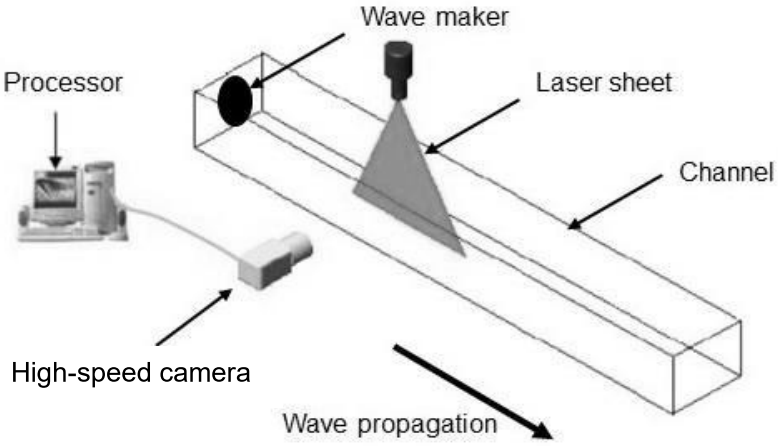
An experiment was conducted by varying the depth in a wave channel (see image below). This was done to determine the wavelengths AND wave power at different depths.

[Adapted from https://www.researchgate.net/publication/235634121]

The following method was used in this investigation:

- Sea water was added to the wave channel.
- A wave maker was attached to the channel to generate waves.
- The depth of the water was controlled.
- Four channel depths were used:
  - 240 mm
  - 260 mm
  - 280 mm
  - 300 mm

IMAGE SHOWING THE WAVE CHANNEL



[Source: https://www.researchgate.net/publication/235634121]

- A high-speed camera and a laser were used to calculate the wavelength (metres) and wave power (joules per second/J.s-1).
- At each depth, the experiment was repeated 1 000 times.
- The data was captured and averages were calculated.

The data collected for this study are indicated in the table below.

TABLE 2.1: The average wavelength (metres) and average wave power (joules per second) produced in a wave channel at four different depths (millimetres)

DEPTH (mm)	AVERAGE WAVELENGTH (m)	AVERAGE WAVE POWER ($J.s^{-1}$)
240	0,06	3
260	0,07	5
280	0,10	8
300	0,12	12

2.1.1 Draw a composite graph showing two separate lines to illustrate the data of this investigation indicated in the table above. (10)

2.1.2 What would the maximum depth of orbitals be if waves are formed at the depth of 300 mm? Show ALL calculations. (2)

2.1.3 Describe the relationship between depth (mm) and average wavelength (m) as determined by this study. (2)

2.1.4 (a) Referring to the data, at which depth will the mechanism be most efficient? (1)

(b) Explain your answer to QUESTION 2.1.4(a). (2)
(17)

2.2 Study the infographic below to answer the questions that follow.

AQUACULTURE IN PERU

During the last two decades, aquaculture production off the west coast of Peru has increased from 10 000 tons in the year 2000 to approximately 150 000 tons in 2021.

In 2023, a large-scale fish die-off occurred in the waters where the aquaculture industry operated.

TABLE 2.2: Aquaculture output over a three-year period

YEAR	AVERAGE SEA SURFACE TEMPERATURE (°C)	AQUACULTURE OUTPUT (TONS)
2021	22,3	150 000
2022	22,4	170 000
2023	28,5	80 000

ATMOSPHERIC AND OCEANOGRAPHIC CONDITIONS

FIGURE 1: WALKER CIRCULATION

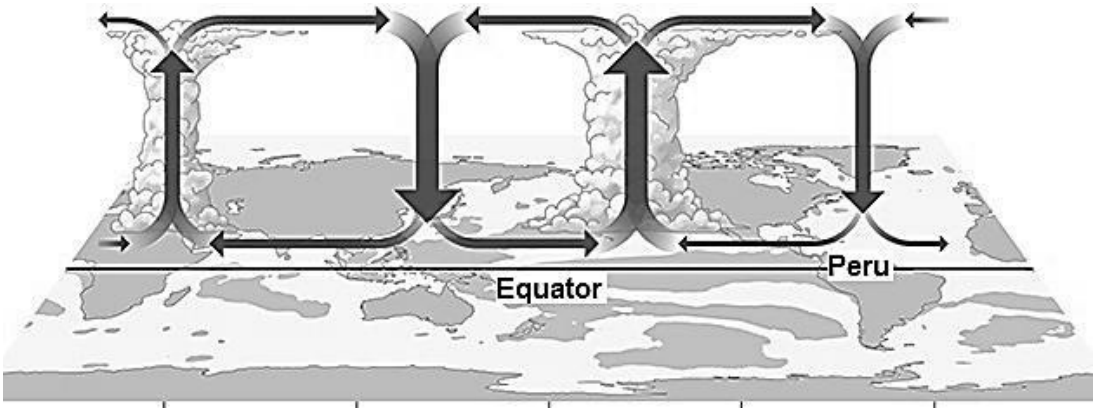
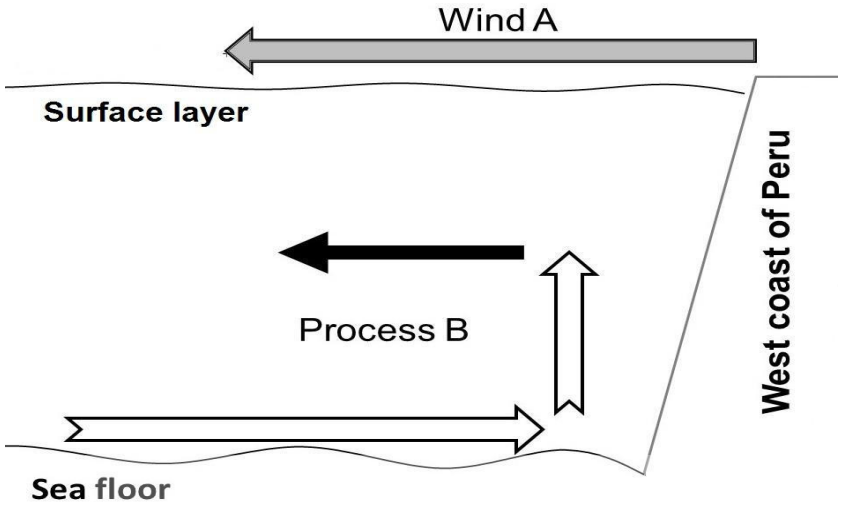


FIGURE 2: WATER CIRCULATION OFF THE WEST COAST OF PERU (SIDE VIEW)



1. Aquaculture [Adapted from https://www.manuchar.com/pe/en/news/]
2. Walker Circulation [Adapted from https://earthobservatory.nasa.gov/features]

2.2.1 Which phenomenon of the ENSO cycle is represented by the large scale atmospheric circulation in FIGURE 1? (1)

2.2.2 Use the water circulation shown in FIGURE 2 to describe ONE reason for your answer to QUESTION 2.2.1. (2)

2.2.3 Identify the wind A in FIGURE 2. (1)

2.2.4 Explain why process B indicated in FIGURE 2 is essential for aquaculture in this region. (2)

2.2.5 Explain the change in sea surface temperatures along the Peruvian west coast in 2023. (4)

2.2.6 Calculate the percentage increase in aquaculture output from 2000 to 2021. Show ALL calculations. (3)
(13)

2.3 Study the image of an aquaculture holding system used along the west coast of Peru and answer all the questions.

[Adapted from https://www.manuchar.com/pe/en/news/]

2.3.1 Name the type of holding system shown in the image above. (1)

2.3.2 Discuss the mitigation measures taken when using this type of holding system to reduce eutrophication impacts. (3)

2.3.3 Give your opinion on whether aquaculture would increase food security in Peru. (2)
(6)

2.4 Fisheries scientists are worried about the decline in fish stocks along the west coast of Peru.

Explain TWO decision variables scientists have to take into consideration when assessing and calculating fish stocks. (2 x 2) **(4)**
[40]

QUESTION 3

3.1 Read the extract about sea water below and answer the questions that follow.

> Fundamental changes in sea water chemistry are occurring throughout the world's ocean. Since the beginning of the industrial revolution, the release of carbon dioxide (CO_2) from humankind's industrial and agricultural activities has increased the levels of CO_2 in the atmosphere and in the ocean. Studies have also indicated that there is a link between the increased CO_2 levels in the ocean and sea surface temperatures.
>
> [Adapted from https://www.pmel.noaa.gov/co2/story/]

3.1.1 (a) What type of bonding is found in a CO_2 molecule? (1)

(b) Why does CO_2 not dissociate in water? (1)

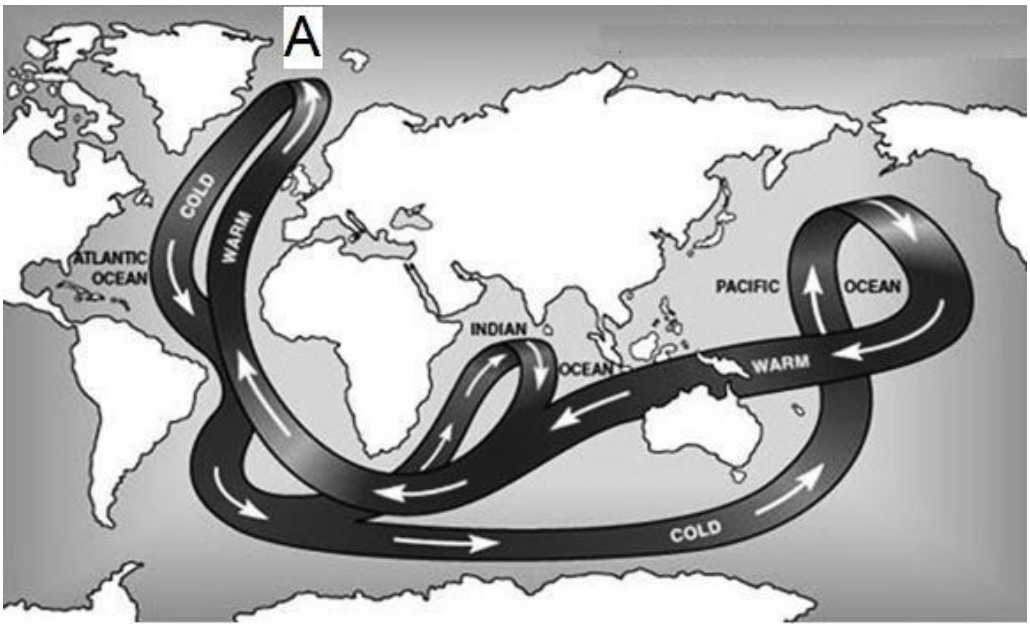
3.1.2 Due to its effect on atmospheric temperature, what type of gas is CO_2 considered to be? (1)

3.1.3 Describe the relationship between CO_2 and global temperatures. (2)

3.1.4 Explain what impact increased levels of CO_2 in the ocean will have on sea urchins. (3)

3.1.5 In your opinion, will an increased proportion of CO_2 in the ocean be beneficial to algae? Give a detailed motivation for your answer. (3)
(11)

3.2 Study the illustration of a circulation pattern below and answer the questions that follow.



[Adapted from https://www.windows2universe.org/]

3.2.1 Name this type of water circulation. (1)

3.2.2 Name AND explain the process involving ice formation at **A** that drives the type of circulation named in QUESTION 3.2.1. (4)

3.2.3 Explain how slowing down of the process named in QUESTION 3.2.2 would affect the climate. (5)
(10)

3.3 Read the text based on a hypothetical scenario in the source below and answer the questions that follow.

> On an island in the Indian Ocean, women dive for seafood which is a source of income. They have the ability to hold their breath for 8 minutes while diving. These women dive to depths of 30 metres where they inflate balloons which carry their harvest to the surface.
>
> During training of the younger members of the village, some of the enthusiastic younger divers show signs of mild intoxication, as if they had consumed alcohol.
>
> When not diving, they collect seaweed that is sold to companies for commercial use.
>
> [Source: Text by examiner]

3.3.1 (a) Identify the medical condition that the young divers may be suffering from. (1)

(b) Describe the circumstances which lead to this medical condition. (3)

3.3.2 The balloon is filled to a volume of 2 litres at a depth of 16 metres and rises to the surface.

(a) Calculate the volume of the balloon at the surface. Assume that the temperature is constant. Show ALL calculations. (4)

(b) Explain why the balloon rises to the surface. (2)

3.3.3 Seaweed is also harvested in South Africa for commercial use. Give the common names of TWO species of seaweed used in the food industry in South Africa. (2)

3.3.4 In your opinion, do you think that the long-term harvesting of seaweed for commercial use is sustainable? (2)
(14)
[35]

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 charts or diagrams.

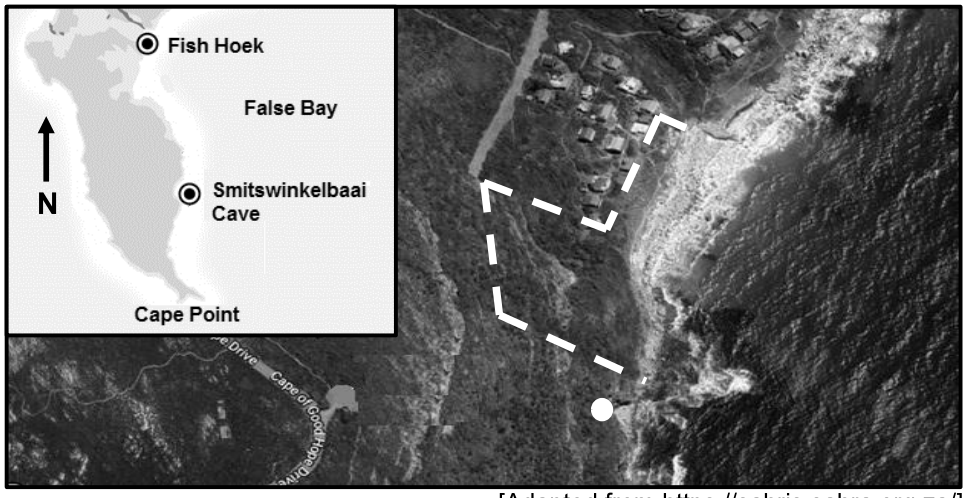
QUESTION 4

This question is based on the hypothetical scenario described below.

The south-west coast of South Africa is a dynamic shoreline. It experiences strong wave action that creates unique coastal formations. Smitswinkelbaai Cave (indicated by the white circle on the satellite image) is located along the south coast, south of Fish Hoek (indicated on the map). The cave is located on a wave-cut platform. Evidence has been found of early humans living in the cave. This area is therefore considered to be an important archaeological landscape. Today, this dynamic area is expanding as more space in this area is required for housing developments.

A proposal was recently made for a new housing development to be built in the area indicated by the broken line on the satellite image. The use of revetments and rock armour was recommended as an engineering approach.

[Adapted from https://www.jstor.org/stable/4297964]



[Adapted from https://sahris.sahra.org.za/]

Write an essay in which you address the following aspects:

- Describe TWO types of erosive forces.
- Explain the formation AND characteristics of a wave-cut platform.
- Compare the structure AND effectiveness of both revetments and rock armour that are recommended to be used in this expansion.
- Discuss the evidence of early human occupants found in and alongside Smitswinkelbaai Cave AND discuss whether an environmental impact assessment (EIA) would be necessary for this archaeological site.
- In your opinion, evaluate whether archaeological sites have any relevance to our modern-day lives.

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

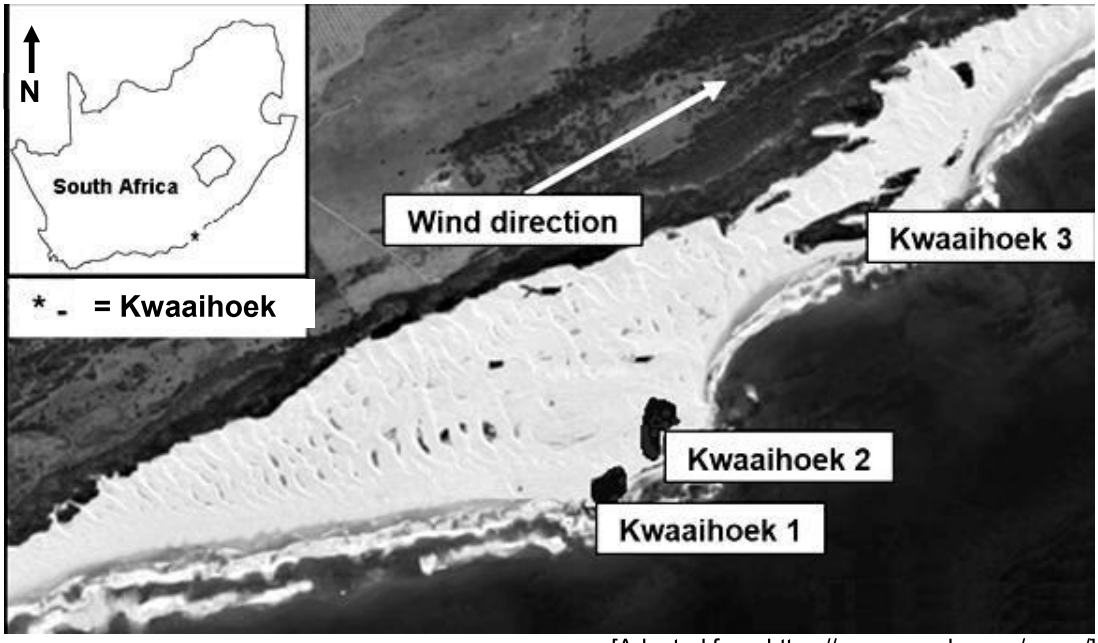
QUESTION 5

This question is based on the hypothetical scenario described below.

Kwaaihoek is a coastal region found along the east coast of South Africa near East London. This 8 km long stretch of largely unspoiled dune fields consists of three headland areas with dense vegetation (indicated on the satellite image as Kwaaihoek 1, Kwaaihoek 2 and Kwaaihoek 3). During prolonged periods of increased winds and heavy wave action due to sand movements causing sand build-up, Kwaaihoek 2 and Kwaaihoek 3 become inaccessible to tourists and residents.

The local municipality is considering an engineering approach that can be used to mitigate sand build-up during prolonged periods of wind causing sand movement. The engineering solution needs to ensure that the popular tourism locations remain accessible.

[Adapted from https://www.jstor.org/stable/4297964]



[Adapted from https://www.google.com/maps/]

Write a newspaper article for the Kwaaihoek local newspaper in which you address the following aspects:

- Explain how dunes are formed.
- Discuss the role that vegetation plays in the formation of a stable dune ecosystem.
- Describe the TWO different engineering approaches that can be used AND compare their effectiveness for this site.
- Motivate whether it is important to conduct an environmental impact assessment (EIA) before deciding on the type of engineering approach to use.
- Justify whether constructing an engineering structure would benefit the local municipality.

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

TOTAL SECTION C: 35
GRAND TOTAL: 150