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# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**MARINE SCIENCES (P1)**

**NOVEMBER 2022**

**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. 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.

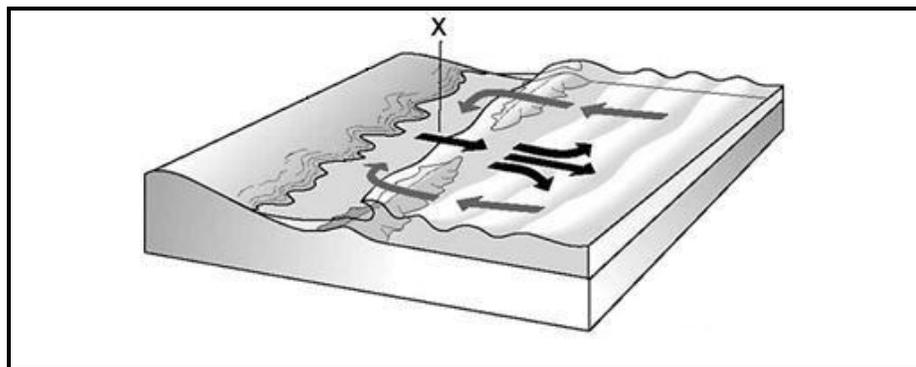
1.1.1 The average tidal range on South African coastlines, from spring low to spring high, is ...

- A 1 m.
- B 2 m.
- C 3 m.
- D 4 m.

1.1.2 Scientists use data to calculate the total amount or tonnage of fish that can be caught in the following season. This is called the ...

- A Total Allowable Catch.
- B Catch Per Unit Effort.
- C Maximum Sustainable Yield.
- D Sustainability Index.

1.1.3 The type of wave action illustrated by **X** in the diagram below:



[Source: <https://researchgate.net>]

- A Shallow waves
- B Rip currents
- C Waves in the surf zone
- D Longshore drift

1.1.4 The table below represents four organisms that can be found in estuaries.

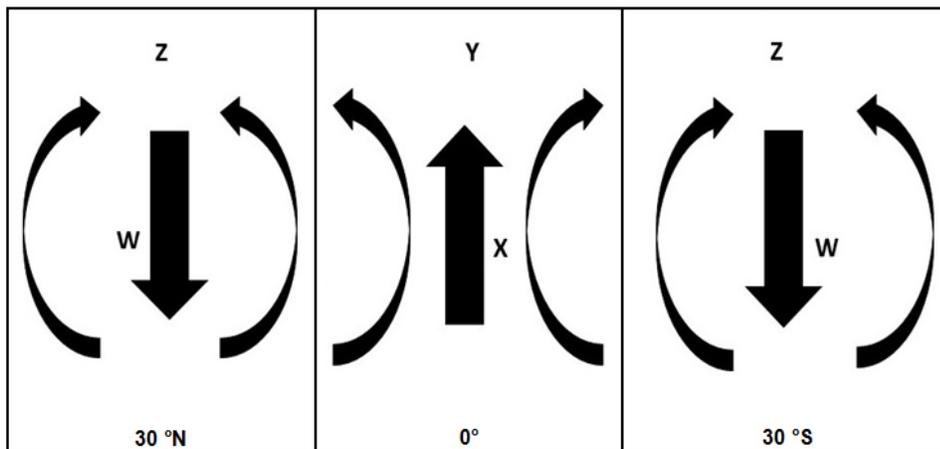
Which ONE of the following sequences correctly represents the adaptations used to overcome the anoxic conditions in estuarine sediments?

	MUD PRAWNS	MUSSELS	MANGROVES	BLOOD WORMS
A	Siphons	Self-built tubes	Pneumatophores	Burrows
B	Self-built tubes	Siphons	Burrows	Pneumatophores
C	Self-built tubes	Siphons	Pneumatophores	Burrows
D	Pneumatophores	Siphons	Self-built tubes	Burrows

1.1.5 The area between the spring low tide and neap low tide marks that is only exposed for a few low tide cycles:

- A Middle shore
- B Intermediate shore
- C Upper shore
- D Lower shore

1.1.6 Study the three diagrams below which illustrate the influence of Ekman transport on the movement of surface water at three different latitudes.



Which of the following options correctly represent processes **W**, **X**, **Y** and **Z**?

	W	X	Y	Z
A	Downwelling	Upwelling	Divergence	Convergence
B	Downwelling	Upwelling	Convergence	Divergence
C	Upwelling	Downwelling	Divergence	Convergence
D	Upwelling	Downwelling	Convergence	Divergence

- 1.1.7 Which aquaculture holding system is used in inland freshwater dams?
- A Sea cages
  - B Ponds
  - C Raceways
  - D Fish culture cages
- 1.1.8 During an El Niño period, which ONE of the following events does NOT take place in the Pacific Basin?
- A The SE trade winds are stronger.
  - B There is less upwelling at the South American coast.
  - C Warm water builds up along the South American coast.
  - D Nutrient levels along the South American coast decrease.
- 1.1.9 A dive cylinder on a boat was filled to 220 bars at 06:00 when the temperature was 11°C. It was then left on the boat until 15:00 where the pressure in the cylinder reached 240 bars. The temperature at 15:00 would then be ...
- A 12,0 °C.
  - B 12,6 °C.
  - C 36,8 °C.
  - D 27,6 °C.
- 1.1.10 The factor that is NOT an abiotic factor of a rocky shore:
- A Desiccation
  - B Wave action
  - C Predation
  - D Light intensity
- (10 x 2)      **(20)**

- 1.2 Give the correct **scientific term/phrase** for each of the following descriptions. Write only the term next to the question numbers (1.2.1 to 1.2.10) in the ANSWER BOOK.
- 1.2.1 A middle shore eulittoral zone characterised by the presence of barnacles
- 1.2.2 Species that can be used to determine what is happening in their environment
- 1.2.3 The force moving a surface from its equilibrium state that starts a wave action
- 1.2.4 A marine protected area that promotes the conserving of nature and allows human use of the ecosystem in a sustainable way
- 1.2.5 The point on a surface wave where there is the highest upward displacement within the wave's cyclical movement
- 1.2.6 Waves that arrive at the seashore with less energy owing to the gradually shallowing seafloor below them
- 1.2.7 A mechanism which converts mechanical energy into electrical energy
- 1.2.8 A fishing method which involves towing trawl nets along the sea floor
- 1.2.9 A small opening at the bottom of a cliff where the weaker material has eroded
- 1.2.10 Giving false or misleading information of the environmental benefits of a product or service (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 number (1.3.1 to 1.3.5) in the ANSWER BOOK.

COLUMN I		COLUMN II	
1.3.1	Balanoid zone	A:	South Coast
		B:	East Coast
1.3.2	Plough snail	A:	Upper shore
		B:	Lower shore
1.3.3	Intermediate zone	A:	<i>Laminaria pallida</i>
		B:	<i>Ecklonia maxima</i>
1.3.4	Osmosis	A:	Tidal power
		B:	Salinity gradient power
1.3.5	Production of medicinal products	A:	Pharmaceutics
		B:	Biotechnology

(5 x 2)

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

**SECTION B****QUESTION 2**

- 2.1 Study the cartoon on nature-based tourism below and answer the questions that follow.



[Source: <https://www.dolphinwatch.ie/>]

- 2.1.1 Evaluate the impact of this type of tourism on the marine environment. (2)
- 2.1.2 Suggest TWO ways the tour company could improve the sustainability of its tourism activities. (2)  
(4)

- 2.2 A group of Marine Sciences learners wanted to determine the relationship between increased temperatures and the average oxygen content of the water in permanent rock pools.

The learners used the following method:

- 10 programmable water baths were filled with 15 litres of sea water.
- The water baths were programmed to increase the water temperature of the sea water by 5 °C every 60 minutes.
- An analogue sensor was placed in the water bath to record the oxygen content (mg/ℓ).
- The sensor sent the data to digital devices, which recorded the data.
- The data were recorded for a period of 7 hours.
- The average oxygen content was recorded for a range of temperatures from 0–40 °C.

The results are shown in the table below.

**Table showing the relationship between temperature and the average oxygen content of the sea water in 10 programmable water baths**

TEMPERATURE (°C)	AVERAGE OXYGEN CONTENT (mg/ℓ)
0	14
5	12
10	11
15	10
20	9,5
25	8
30	7,5
35	7
40	6,5

- 2.2.1 Identify the manipulated variable for this investigation. (1)
- 2.2.2 Give a suitable hypothesis for this investigation. (2)
- 2.2.3 Draw a line graph to illustrate the data in the table above. (9)
- 2.2.4 Based on the results of this experiment, explain how climate change would affect organisms that live in rocky pools. (3)
- (15)**

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

### SPAWNER BIOMASS DECLINES IN SOUTH AFRICA

For more than 100 000 years, South Africa's fish has been an important food source for humans. However, today we find ourselves in a position where the populations of targeted species such as dusky kob, spotted grunter, white steenbras and leervis (garrick) are considered to be collapsed. There has been a dramatic decrease in the spawner biomass over the last three decades. The destruction of estuaries has also contributed greatly to this decline.

[Adapted from <https://mg.co.za/article/2019-05-31-00-fish-species-overexploited-or-collapsed>]

- 2.3.1 Name ONE type of traditional fish trap that was used in South Africa 100 000 years ago. (1)
- 2.3.2 Explain ONE way in which humans have contributed to the collapse in the South African fish stock of fish species that make use of estuaries. (2)
- 2.3.3 Estuarine waters and sediment have a high organic load, which is essential for primary production in this ecosystem.  
Describe how the high organic load is maintained in estuaries. (3)
- 2.3.4 A local government declared an estuary a marine protected area (MPA).  
List FOUR reasons why this MPA could be beneficial to fish stocks. (4)  
**(10)**

- 2.4 Read the article on kelp forests below and answer the questions that follow.

**SECRET GIANT KELP FOREST OFF CAPE TOWN CATCHES  
GLOBAL ATTENTION**

A giant forest along the South-west Coast of South Africa would have probably remained out of sight if it was not for the Netflix film *My Octopus Teacher* which, among other prizes, won the 2021 BAFTA Award for the Best Documentary. The film has also succeeded in drawing public attention to kelp forests around the world. In fact, activists of the Sea Change Project have renamed the kelp forest where the film was shot as The Great African Sea Forest to give it similar attention as the Great Barrier Reef.

[Adapted from <https://seachangeproject.com/great-african-seaforest>]

- 2.4.1 Other than the Southern Coast, where can kelp forests be found in South Africa? (1)

- 2.4.2 'The film has also succeeded in drawing public attention to kelp forests around the world.'

Explain THREE ecological significant roles of kelp forests that the public should be made aware of.

(6)  
(7)  
**[36]**

**QUESTION 3**

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

**THE FUTURE IS OCEAN HYDRO OMNI**

Ocean Hydro Omni is a simple but highly innovative technology that harnesses offshore wind – combined with the power of subsea oceanic pressure – to provide reliable, low-cost, clean electrical energy and energy storage.

The Ocean Hydro Omni uses vertical axis rotors solely to provide mechanical power to lift, altering the buoyancy of a submerged pressure vessel and fully absorbing the volatility of winds from 4 m/s right up to 40 m/s. Water flooding into an empty pressure vessel beneath the sea surface is used to generate electricity through a hydroelectric turbine.

[Adapted from <https://republic.com/hydro-wind-energy>]



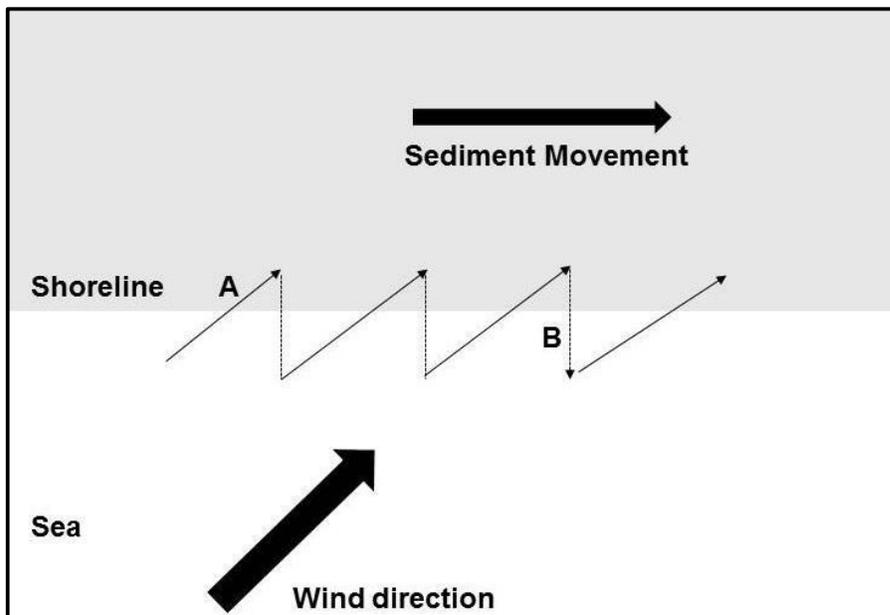
[Adapted from <https://republic.com/hydro-wind-energy>]

- 3.1.1 Identify the type of energy harvesting system used by the Ocean Hydro Omni. (1)
- 3.1.2 Name TWO challenges to using the Ocean Hydro Omni. (2)
- 3.1.3 In your opinion, is South Africa ready to use renewable energy sources? Motivate your response by giving TWO reasons. (2)
- 3.1.4 With loadshedding impacting both commercial and domestic consumers, most people would like to see more investment by government and private sector in renewable energy development.

Explain TWO negative cost considerations that currently have to be kept in mind before implementing renewable energy development in the ocean.

(4)  
(9)

3.2 Study the diagram below and answer the questions that follow.



- 3.2.1 Identify the process illustrated by this diagram. (1)
- 3.2.2 Label **A** and **B**. (2)
- 3.2.3 Describe the process represented by this diagram. (4)  
(7)

3.3 Read the extract on ghost crabs below and answer the questions that follow.

#### GHOSTLY EAST COAST

Ghost crabs (genus *Ocypode*) are among the most abundant and conspicuous macroscopic organisms inhabiting the east coast of South Africa. These crabs burrow into the sand during the day and are mostly active at night.

[Adapted from <https://www.jstor.org/stable/20104707>]

- 3.3.1 Name the zone along the sandy beaches of the east coast of South Africa in which ghost crabs are most likely to be found. (1)
- 3.3.2 If you were to walk along the west coast of South Africa, which TWO types of crustaceans would you find instead of the ghost crab? (2)
- 3.3.3 Name ONE biotic factor that organisms living on sandy shores have to cope with. (1)

- 3.3.4 According to the text, the ghost crabs 'burrow into the sand'.
- (a) Why do ghost crabs burrow during the day but are active at night? (2)
- (b) Discuss TWO abiotic factors that could be the reason for this burrowing. (4)
- 3.3.5 Heavy rainfall in April 2022 caused major flooding in KwaZulu-Natal. This resulted in a large number of trees washing onto the beach.
- Explain how this could be fatal for the ghost crabs by explaining the possible changes to the medium in which their burrows are found. (4)
- (14)**

- 3.4 Read the article on the commercial use of kelp forests below and answer the questions that follow.

#### KELPING THE ECONOMY

*Ecklonia maxima* is a species of kelp that is commercially exploited in South Africa. *E. maxima* dominates the southern West Coast and provides most of the material for the South African kelp industry. A harvest of 5 000 tonnes of fresh weight is collected for abalone feed, whereas a further 1 000 tonnes is collected mainly for alginate extraction.

[Adapted from [https://www.researchgate.net/publication/233627502Mapping\\_and\\_quantifying\\_the\\_South\\_African\\_kelp\\_resource](https://www.researchgate.net/publication/233627502Mapping_and_quantifying_the_South_African_kelp_resource)]

- 3.4.1 Calculate the percentage *E. maxima* fronds that is used for alginate extraction. (3)
- 3.4.2 Name AND explain ONE use of alginates. (2)
- (5)**

3.5 Read the text on biomimicry below and answer the question that follows.

### EEL ENERGY MEMBRANE

The EEL Energy company found its inspiration from the ocean to develop an undulating tidal turbine that converts hydrokinetic energy into mechanical and then electrical energy. The EEL Energy membrane floats like a flag in the water and emulates the undulating movement of some aquatic vertebrates, notably eels. In order to move, these species propagate a wave along their body of which the eel is the most efficient example. Of interest is that this turbine produces energy from a tidal current at a speed of only 2 m/s, which is 10 times more efficient than other turbines.

[Adapted from <https://marine-oceans.com/en/the-sea-inspires-our-future>]

One of the underlying biological principles that guide responsible biomimicry, is the efficient use of resources (materials and energy).

Explain TWO recommendations to the EEL Energy company on how to go about using resources efficiently.

(4)  
[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 a table, flow charts or diagrams.

**QUESTION 4**

The South African Chamber of Commerce and Industry along with the Tourism Business Council of South Africa are interested in developing tourism that is based on aquaculture. The aim is to build recreational areas along the coast of South Africa, where restaurants source their seafood locally from aquaculture farms. However, the investors are worried about the health and quality of the fish that will be produced.

As part of the marketing team for a business group, you need to motivate why this should be done on the South-west Coast of South Africa by including the following aspects in your essay:

- Refer to the climate of the area.
- Discuss how the coastal geography and geology are suited for aquaculture and tourism.
- Provide examples of aquaculture and the locations where they can be found on the South-west Coast of South Africa.
- Discuss how farmers ensure the health and quality of the fish to meet the requirements of the investors
- Evaluate the effects that increased aquaculture would have on the South-west Coast.
- Your conclusion should address both aquaculture and tourism.

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

**QUESTION 5**

The South Coast of South Africa is rich in human indigenous content. Most of the sites where this content can be found, were once close to the shoreline or covered in water. It is thought that the shoreline receded due to a change in the energy balance of the Earth and ultimately a change in climate. In modern times we are once again faced with climate change; this time driven by man and it will eventually lead to a rise in sea levels. This rise in sea levels will see many places around the world losing many sites with historical significance.

Write the text for a podcast in which you include the following aspects:

- Discuss the human indigenous content found along the South Coast of South Africa.
- Describe how human activities may lead to a change in the energy balance of the Earth.
- Evaluate the effects climate change will have on coastal ecosystems.
- Discuss why civil engineers need to consider the effects of climate change and the rising of sea levels when planning coastal developments.
- Your conclusion should link the human indigenous content of the area and climate change.

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

**TOTAL SECTION C: 35**  
**GRAND TOTAL: 150**