Western Cape Government

Western Cape Education Department
Directorate: Curriculum FET

MARINE SCIENCES

REVISION BOOKLET
2026
TERM 3

Grade 12

This revision program is designed to assist you with the revision of topics covered in Term 3 and for the Trial Examination.

The revision program will contain the following content:

- SA Shorelines
- Harvesting of ocean Energy
- Global Ocean Circulation
- Climate Change
- El Niño
- Ocean Acidification

TOPIC: SA SHORELINES

Fill in the missing term in each block

Term	Definition
	Subregions of the Afrotropical realm containing plant and animal species found in the mountains of Africa and the southern Arabian Peninsula
	A broad shallow part of the southern African continental shelf, extending 250 km south of Cape Agulhas before falling steeply to the abyssal plain
	The region where the cold Atlantic waters meet the warm Indian waters
	Diamonds that have been removed from the primary Kimberlite source by natural erosive action over millions of years and eventually deposited in a new environment such as a riverbed, ocean floor or shoreline
	A genus of sea snails, marine gastropod molluscs in the family Nassariidae, the Nassa mud snails or dog whelks
	Poorly sorted sedimentary rock
	Typically dark-coloured shale that is carbon-rich owing to the high vegetation content of the original sediments
	A gemstone formed of red silicate mineral
	Metamorphic rocks with a banded or foliated structure, typically coarse-grained and consisting mainly of feldspar, quartz, and mica
	A depressed geological structure bordered by a fault along one

	side, unlike a full-Graben, where a depressed block of land is bordered by parallel faults
	Rock composed of a metamorphic (altered) host material that is streaked or veined with granite rock; the name means “mixed rock”
	Flora that can withstand salt spray, growing in loose sand, its roots hold the coastline together
	The shape and form of something
	In geography the shape and structure of coastal systems or subsystems
	Convention on wetlands of international importance, especially waterfowl habitat
	An oxide mineral used as a source of titanium dioxide pigment, for use in plastics, paper products, paints, sunscreen, and even food colouring
	Fine-grained sedimentary rock formed from mud that is a mix of flakes of clay minerals and tiny particles of other minerals, especially quartz and calcite
	When magma moves upward in the Earth by breaking off and engulfing blocks of overlying rocks
	A fragment of foreign rock trapped within a host rock and having a different composition from the host rock
	A mineral widely used in the foundry industry mainly for casting and refractory applications

TOPIC: Harvesting Ocean Energy

Question 1

The questions below are based on the hypothetical scenario in the text below.

> The president of South Africa has recently mentioned the proposed development of smart cities (powered by modern technology). These cities would be built close to large rivers in areas that have consistent, strong winds at the river mouth. According to this proposal, the cities would be powered using tidal energy by building dams across the mouths of the rivers. The first city is expected to be completed by 2035 with international, private investment in the project being encouraged.

1.1 Explain why it has been proposed that a river mouth needs to be dammed for effective tidal power electricity generation. (7)

1.2 Discuss TWO separate alternative forms of electricity generation with the ocean as a source, that can be used in this area. (2x6)

1.3 Discuss how South Africa can act immediately to manage energy supply. (6)

(25)

Question 2

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]

2.1 Identify the type of energy harvesting system used by the Ocean Hydro Omni. (1)
2.2 Name TWO challenges to using the Ocean Hydro Omni. (2)
2.3 In your opinion, is South Africa ready to use renewable energy sources? Motivate your response by giving TWO reasons. (2)
2.4 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 must be kept in mind before implementing renewable energy development in the ocean. (4)
(9)

TOPIC: Global Ocean Circulation

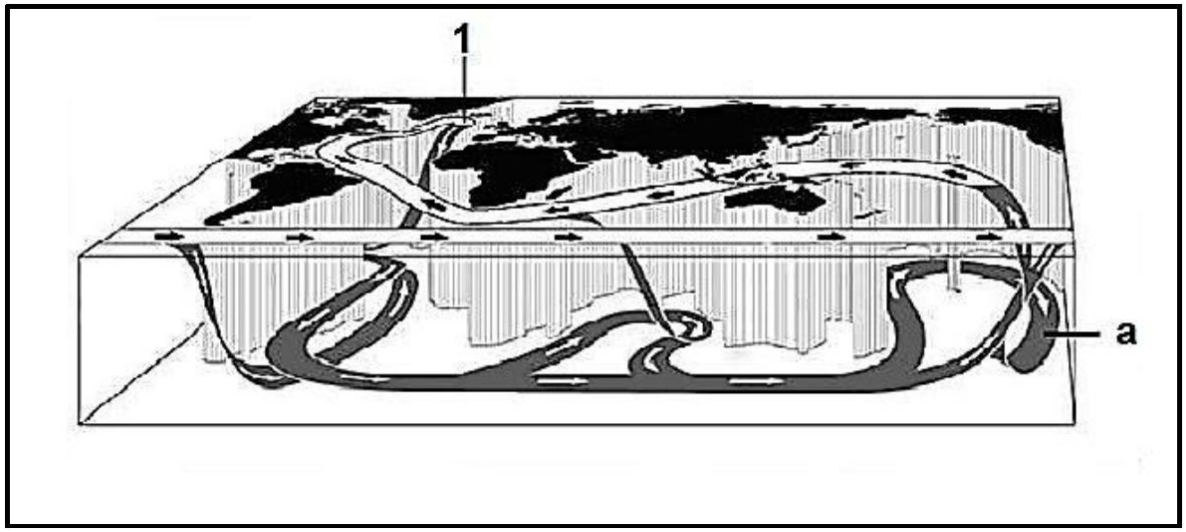
Fill in the missing term in each block

	A reference to the region around the southern-most continent
	Surface oceanic current encircling Antarctica south of the continental landmasses, also referred to as the West Wind Drift
	The horizontal inflow of surface water as surface currents, driven by wind
	When sea water piles up as winds drive surface waters towards each other
	The deflection that a mass undergoes when moving in a rotating system
	The deflection that a mass undergoes when the Earth rotates
	The horizontal outflow of surface water as surface currents, driven by wind
	The process where surface water moves away on either side of the Equator towards the Poles
	The vertical downward movement of fluid or atmospheric gases, for example in coastal water movement
	The circular movement of water resulting in a whirlpool

	The movement of surface water at 45° to the side due to the Coriolis effect; successive layers are displaced and at a given depth the water movement occurs in the opposite direction to the wind direction at the surface
	The movement of ocean water as the result of a balance between the Coriolis effect and the surface wind drag from the wind blowing over the surface
	A vast circular system of ocean currents that spirals about a central point
	Temporary swirling ocean currents that can be 100 km in diameter and these currents last up to a month
	The sinking of surface water and rising of bottom water in a water body caused by differences in salinity and temperature
	The direction of the wind that usually blows in a region
	The global movement of ocean water driven by variations in buoyancy as a result of changes in temperature and salinity
	The upward movement of nutrient rich water replacing surface waters that are blown away
	The tendency of currents along the western margin of an ocean basin to be narrower, stronger, quicker than currents on the eastern margin of the ocean basin, due to the rotation of the Earth

Question 1

Study the illustration representing the 'global ocean conveyor belt' below and answer the questions that follow.



1.1 Name this global large-scale current. (1)
1.2 State whether the water is WARM or COLD at location **a**. (1)
1.3 Analyse the effect of a warming climate at 1 on this circulation pattern. (3)
1.4 Explain how differences in the temperature of water masses can be used as a renewable resource. (3)
1.5 In which geographical region would the renewable resource stated in QUESTION 1.4 be most effective? Explain your answer. (3)
(11)

TOPIC: Climate Change

Fill in the missing term in each block

	The proportion of incident light or radiation reflectiveness of a surface
	The long-term average weather of a regions up to **30 years**
	A graph that illustrates a place's average temperatures and average precipitation over a year
	The release into the atmosphere of carbon dioxide from for example the burning of fossil fuels
	A geological interval of warmer global average temperature lasting thousands of years that separates consecutive glacial periods that include an ice age

	Actions to make something less severe
	The conditions of the atmosphere in the troposphere such as the degree to which it is wet or dry, hot or cold, windy or calm, clear or cloudy; measurements of weather that include temperature, humidity, atmospheric pressure, wind and precipitation

Question 1

Read the article below based on climate change and global ocean circulation.

> Approximately 11 700 years ago Earth entered an interglacial period, marking the end of the last ice age. The reduction in ice in the ocean resulted in a change the climate and the movement of water in the ocean.

1.1 Describe what the energy balance of the Earth is. (2)
1.2 Explain the variables that control the energy balance. (5x2)
1.3 Describe how the thermohaline circulation system works. (13)
1.4 Why is thermohaline circulation important for heat distribution across the planet. (3)
(28)

Question 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

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

TOPIC: El Niño

Question 1
Read the text on El Niño and La Niña, then answer the questions that follow.

La Niña typically brings extreme weather to the same regions most affected by El Niño, where people's coping capacities have already been eroded. La Niña causes opposite conditions to those associated with El Niño.

The effects of the 2015/2016 El Niño were felt over the coming for months after the actual event and it took years for communities to recover.

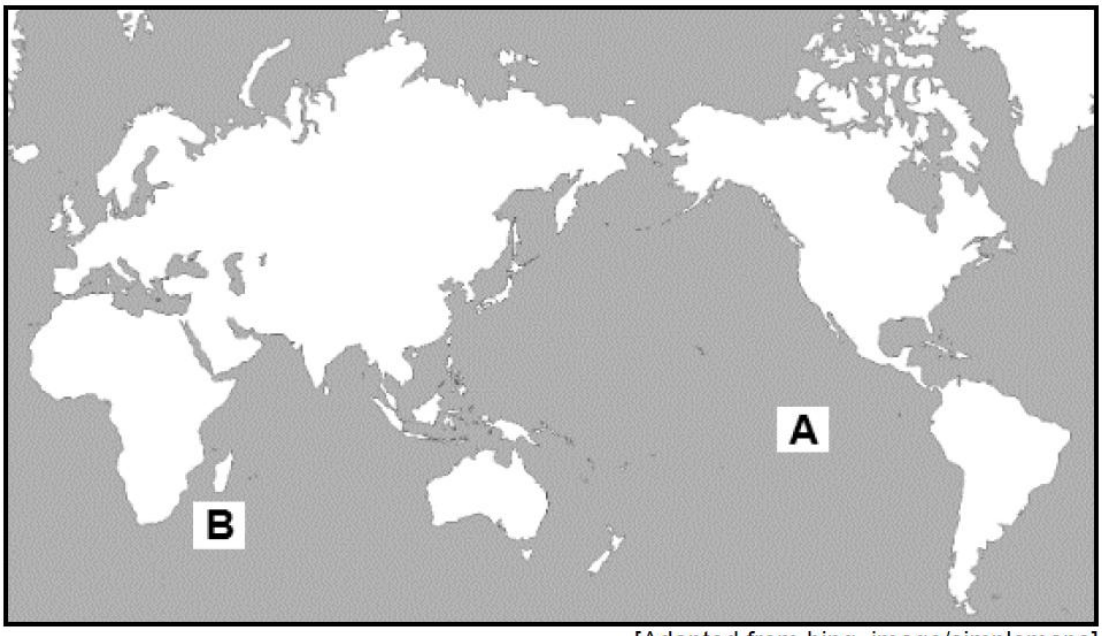
The La Niña of 2016/2017 exacerbated the negative impacts of El Niño and stretch affected communities to their absolute limits.

[Adapted from: https://reliefweb.int/report/malawi/la-ni-events-impacts-eastern-and-southern-africa]

1.1 What conditions would the La Niña event of 2016/2017 have brought to Mozambique? (1)
1.2 Describe the events that take place in the Pacific during a La Niña event? (5)
(6)

Question 2

Use the map below to answer the questions on ENSO events that influence global weather patterns.



[Adapted from bing_image/simplemaps]

2.1 (a) Name the atmospheric cell of air movement found above the Pacific Ocean Basin during normal weather patterns. (1)

(b) Explain the air movement in the atmospheric cell named in QUESTION 2.1(b). (2)

2.2 Explain TWO conditions that occur along the south-eastern side of ocean basin **A** during an El Niño period. (2x3)

2.3 The opposite phenomenon of El Niño is La Niña, which also has an influence on Southern Africa.

(a) What effect will this event have on the water at location **B**? (1)

(b) What will be the influence on the coastal weather of Southern Africa? (2)

2.4 Scientists predict that there will be an increase in the frequency of El Niño and La Niña events because of climate change.

(a) State how this change in the frequency of El Niño events would affect the Amazon region. (1)

(b) Explain how a change in the frequency of La Niña events would change the conditions for organisms living in rock pools in the upper eulittoral zone of rocky shores along the coast of Mozambique. (5)

(18)

TOPIC: Ocean acidification

Question 1

Read the passage about corrosion below and answer the questions that follow.

> Corrosion is the chemical action of sea water. The acids in the salt water slowly dissolve rocks on the coast. Limestone and chalk are particularly prone to this process.
>
> When insoluble calcium carbonate is treated with carbonic acid, the former dissolves to give a colourless aqueous solution of calcium bicarbonate.

1.1 Define the term corrosion mentioned in this passage. (1)
1.2 Write down the chemical formula for carbonic acid. (1)
1.3 State how carbonic acid is formed in the ocean. (1)
1.4 A study shows that the amount of CO_2 in the ocean is increasing. Describe how these increased amounts of CO_2 would impact coastal formations made of limestone. (2)
(5)

ANSWERS

TOPIC: 61 SA SHORELINES

Afromontane	Subregions of the Afrotropical realm containing plant and animal species found in the mountains of Africa and the southern Arabian Peninsula
Agulhas Bank	A broad shallow part of the southern African continental shelf, extending 250 km south of Cape Agulhas before falling steeply to the abyssal plain
Agulhas Bank	The region where the cold Atlantic waters meet the warm Indian waters
Alluvial diamonds	Diamonds that have been removed from the primary Kimberlite source by natural erosive action over millions of years and eventually deposited in a new environment such as a riverbed, ocean floor or shoreline

Bullia	A genus of sea snails, marine gastropod molluscs in the family Nassariidae, the Nassa mud snails or dog whelks
Dwyka tillite	Poorly sorted sedimentary rock
Ecca shales	Typically dark-coloured shale that is carbon-rich owing to the high vegetation content of the original sediments
Garnet	A gemstone formed of red silicate mineral
Gneisses	Metamorphic rocks with a banded or foliated structure, typically coarse-grained and consisting mainly of feldspar, quartz, and mica
half-Graben	A depressed geological structure bordered by a fault along one side, unlike a full-Graben, where a depressed block of land is bordered by parallel faults
Migmatite	Rock composed of a metamorphic (altered) host material that is streaked or veined with granite rock; the name means "mixed rock"
Littoral strand vegetation	Flora that can withstand salt spray, growing in loose sand, its roots hold the coastline together
Morphology	The shape and form of something
Morphology	In geography the shape and structure of coastal systems or subsystems
Ramsar	Convention on wetlands of international importance, especially waterfowl habitat
Rutile	An oxide mineral used as a source of titanium dioxide pigment, for use in plastics, paper products, paints, sunscreen, and even food colouring

Shales	Fine-grained sedimentary rock formed from mud that is a mix of flakes of clay minerals and tiny particles of other minerals, especially quartz and calcite
Stoping	When magma moves upward in the Earth by breaking off and engulfing blocks of overlying rocks
Xenolith	A fragment of foreign rock trapped within a host rock and having a different composition from the host rock
Zircon	A mineral widely used in the foundry industry mainly for casting and refractory applications

TOPIC: Harvesting Ocean Energy

Antarctic	A reference to the region around the southern-most continent
Circumpolar Current	Surface oceanic current encircling Antarctica south of the continental landmasses, also referred to as the West Wind Drift
Convergence	The horizontal inflow of surface water as surface currents, driven by wind
Convergence	When sea water piles up as winds drive surface waters towards each other
Coriolis effect	The deflection that a mass undergoes when moving in a rotating system
Coriolis effect	The deflection that a mass undergoes when the Earth rotates
Divergence	The horizontal outflow of surface water as surface currents, driven by wind
Divergence	The process where surface water moves away on either side of the Equator towards the Poles
Downwelling	The vertical downward movement of fluid or atmospheric gases, for example in coastal water movement
Eddies	The circular movement of water resulting in a whirlpool

Ekman spiral	The movement of surface water at 45° to the side due to the Coriolis effect; successive layers are displaced and at a given depth the water movement occurs in the opposite direction to the wind direction at the surface
Ekman transport	The movement of ocean water as the result of a balance between the Coriolis effect and the surface wind drag from the wind blowing over the surface
Gyres	A vast circular system of ocean currents that spirals about a central point
Mesoscale eddies	Temporary swirling ocean currents that can be 100 km in diameter and these currents last up to a month
Overturn	The sinking of surface water and rising of bottom water in a water body caused by differences in salinity and temperature
Prevailing wind	The direction of the wind that usually blows in a region
Thermohaline circulation	The global movement of ocean water driven by variations in buoyancy as a result of changes in temperature and salinity
Upwelling	The upward movement of nutrient rich water replacing surface waters that are blown away
Western intensification	The tendency of currents along the western margin of an ocean basin to be narrower, stronger, quicker than currents on the eastern margin of the ocean basin, due to the rotation of the Earth

Question 1

1.1
- Harvesting of tidal flows is only effective if there is an average tidal difference greater than 5 m ✓
- South Africa has a tidal range of 1.8 m ✓ / approximately 2 m at spring tide
- therefore, only using tides is not going to work ✓ / be effective
- The dam needs to trap the water at high tide and then trap the incoming water at low tide ✓
- The volume of the water flow is increased ✓
- resulting in a greater generating force ✓ / more energy extraction
- And therefore, more cost effective ✓ (7)

1.2 **HARVESTING: SALINITY GRADIENT POWER (S) ✓***

- This is generation of electricity using the natural difference between high and low water salinity. ✓
- At the mouth of the river there is discharging fresh river water ✓
- and deep saline ocean water ✓
- The two concentrations of water are separated by a semi-permeable membrane ✓ in the generator
- Sea water is pumped into a pressure chamber ✓
- where the salinity pressure is greater than in the fresh water chamber. ✓
- As a result of the osmotic pressure difference between the two solutions, ✓
- fresh water molecules diffuse through the membrane and dilute the sea water solution, increasing its volume. ✓
- Pressure is then reduced by the release of brackish water from the chamber through a turbine, ✓
- causing the turbine to spin ✓

1 ✓*compulsory + any 5 (6)

HARVESTING: WIND (W) ✓*

- The strong winds that are associated with parts of the coast ✓ / some areas
- are ideal for driving wind turbines ✓
- In order for the system to be cost effective the winds have to be consistent ✓
- The winds turn the (propeller) blades ✓
- which turns the generator. ✓
- The blades are made of lightweight ✓ / sturdy materials
- Wind is the most effective renewable producer of electricity associated with the ocean ✓
- The gearing needs to slow the blades, to prevent bird kills ✓

1 ✓* compulsory + + any 5 (6)

1.3
- Managing our electricity supply ✓ / electricity footprint
- Lobbying politicians to include environmental costs ✓ in their decisions
- Stop tax relief ✓ for industries whose practices have long-term harmful environmental impact (such as coal fired power stations)
- (Urgently) develop renewable electricity generation equipment ✓ / fund research
- Putting more effort into making renewable energy sources cheaper ✓ / making it more affordable for the general public / provide tax incentives
- Using the real costs of fossil fuel ✓ / include environmental impact when making comparisons between renewable energy generators and generation from coal, oil, gas or nuclear
- Electricity generation needs to operate efficiently (work properly) ✓ / generate enough electricity / connect reliably to the national electricity grid
- Educate the public ✓ / businesses about the importance of renewable energy sources
- Provide tax relief for businesses who use renewable energy sources ✓

Any (6)
(25)

Question 2

2.1 Wind ✓ energy / subsea oceanic pressure (1)

2.2
- Corrosion✓
- (Friction caused by) Biofouling ✓

(Do not accept force and cost as an answer)
(Mark first 2 only) (2)

2.3 **If answer is YES**
- South Africa is the third best location for solar power ✓
- weather conditions experienced in South Africa is ideal for renewable energy ✓
- over-exploitation of fossil fuels which is currently our main source of energy ✓
- trying to keep up with first world countries ✓
- Environmental costs considered in a business plan make renewable energies competitive to fossil fuel generation. ✓

If answer is NO
- Too expensive to install ✓
- high cost of equipment ✓
- technology in South African is not advanced for installation and maintenance ✓

- questionable governance of resources ✓ / corruption / power failures

(Mark any logical relevant substantiating answer)
(Reasoning mark 2) (2)
(Mark first 2 only)

2.4
- Materials used for / building mechanisms / prototypes in the ocean is expensive ✓
- mechanisms have to withstand currents ✓/ wave action/ high winds / corrosion

- Generation costs of electricity from ocean energy sources cannot compete with fossil fuel ✓
- which is economically competitive ✓ / cheaper (4)

(Mark first 2 pairs only) **(9)**

TOPIC: Global Ocean Circulation

Question 1

1.1 Thermohaline circulation✓ (1)

1.2 Cold✓ (1)

1.3
- Less/no ice formating✓
- Less salt into water✓
- Less water sinking✓
- Less water displacement/overturning✓
- Disruption of the circulation pattern✓(Any 3 marks, reasoning) (3)

1.4
- The temperature difference between the warm, surface water and the colder, deeper water✓
- Can be used to turn a turbine✓
- Which generates electricity✓ (3)

1.5
- At the Equator✓
- Greatest difference✓
- Between the warm, surface waters and the cold, deeper waters✓ (3)

(11)

TOPIC: Climate Change

Albedo	The proportion of incident light or radiation reflectiveness of a surface
Climate	The long-term average weather of a regions up to **30 years**
Climograph / Climatograph	A graph that illustrates a place's average temperatures and average precipitation over a year

CO_2 emissions	The release into the atmosphere of carbon dioxide from for example the burning of fossil fuels
Interglacial period	A geological interval of warmer global average temperature lasting thousands of years that separates consecutive glacial periods that include an ice age
Mitigation measures	Actions to make something less severe
Weather	The conditions of the atmosphere in the troposphere such as the degree to which it is wet or dry, hot or cold, windy or calm, clear or cloudy; measurements of weather that include temperature, humidity, atmospheric pressure, wind and precipitation

Question 1

1.1
- Energy balance is the balance between the energy radiating to Earth from the sun ✓
- and the energy radiating from the Earth back into space ✓ (2)

1.2
- <u>The amount of available solar radiation</u> ✓
- which can vary by as much as 15% ✓
- <u>The quantity of ice</u> ✓
- determines the albedo (the greater the whiteness, the more the reflectiveness) ✓
- which affects the amount of solar radiation leaving the Earth's atmnopshere ✓
- <u>The movement of continental plates to and away from the Poles</u> ✓
- this impacts the amount of land close to the poles ✓
- and thus the amount of ice at the poles ✓
- <u>The amount of greenhouse gases in the atmosphere</u> ✓
- the more greenhouse gases, the greater the degree of heat insulation ✓
- and the lower the amount of heat to leave Earth's atmosphere back out into space. ✓
- <u>The changing angle of inclination of Earth</u> ✓
- When the tilt angle is greater, the polar areas are exposed to direct sun radiation for longer ✓
- resulting in more ice melting and the temperature of Earth increasing ✓
- <u>the Earth's orbit</u> ✓
- when the Earth moves closer to the Sun, the temperatures increase ✓
- when the Earth moves further from the Sun, the temperatures decrease ✓ (5x2)

1.3
- Thermohaline circulation moves 0.001 cm per second. ✓In December, in the Northern Hemisphere winter, the polar region freezes. Surface water is taken up into ice. ✓
- This surface water is replaced by warmer Atlantic equatorial water that moves northward on the surface. ✓
- Large quantities of water freeze and exude salt, making the frigid water even more dense and causing it to sink. ✓
- The salty, cold water from the Arctic moves southwards along the seabed towards Antarctica, where more cold, salty water is added from under the sea ice. ✓
- The current moves on the seabed in an easterly direction north of Antarctica and south of Australia, from where it moves northwards on the east of Australia and into the Pacific Ocean Basin. ✓
- In the Pacific, this water mixes with warmer Pacific water, where the force of the cold current dissipates and mixes with warmer surface water. ✓
- However, as a counter-current to this deep-water movement is a warm shallow surface current, ✓
- moving south-westwards through the Indonesian islands towards the southern tip of Africa as part of the Agulhas current,
- spilling out into the South Atlantic. ✓
- This 1,6 km-deep current reaches the tropical waters of the Atlantic, ✓
- where increased warmth increases evaporation rates and associated higher salinity. ✓
- The water flows northwards on the western side of the Atlantic as the warm Gulf Stream. ✓
- It moves northwards to Scandinavia where the flow cycle continues ✓

(13)

1.4
- It transfers heat from the Equator to the Poles, ✓
- functioning like a large engine or pump pushing a conveyor belt of heat around the planet from one ocean basin to another, ✓
- and forms a global circulation system of cold as well as warm water. ✓

(3)

(28)

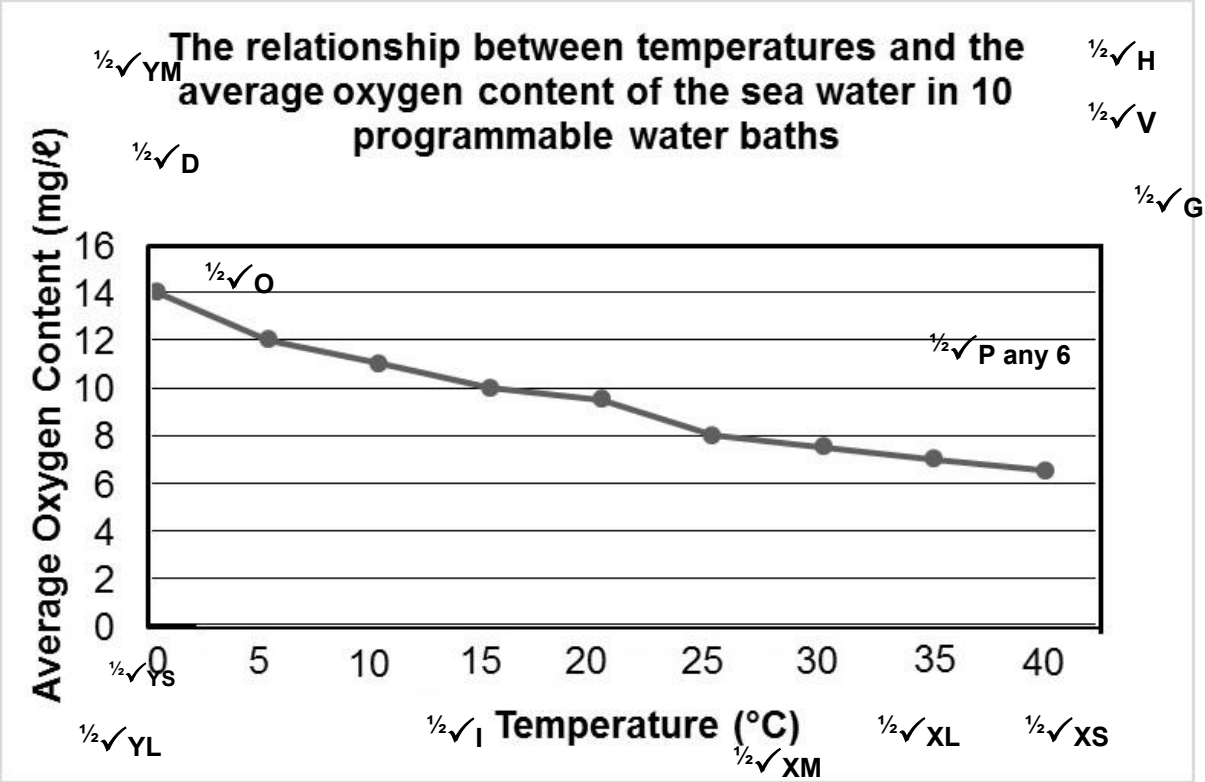
Question 2

2.1 (Water) Temperature ✓ (1)

2.2 If the temperature increases, the average oxygen content of sea water will decrease

Both variables present ONE mark✓
Direction of prediction ONE mark ✓
Direction of prediction may vary as it is a hypothesis (2)

2.3



MARKING GUIDELINES	
CRITERIA	**MARK ALLOCATED**
Descriptive heading (**H**)	½
Both variables in caption (**V**)	½
Type of graph: line graph (**T**)	½
Independent variable (X-axis) (**I**)	½
Dependent variable (Y-axis) (**D**)	½
Label for X-axis (**XL**)	½
Label for Y-axis (**YL**)	½
Unit of measurement for X-axis (**XM**)	½
Unit of measurement for Y-axis (**YM**)	½
Appropriate scale for X-axis (**XS**)	½
Appropriate scale for Y-axis (**YS**)	½
Origin of line (**O**)	½
Plotting (**P**)	ANY (6 x ½) 3

If axes are transposed do not credit learner for variables (D and I)

(9)

2.2.4
- The higher temperatures ✓ brought about by climate change
- would result in less oxygen ✓ being available to organisms
- decreasing the organisms' ability to respire ✓ / exchange gases (3)

(15)

TOPIC: El Niño
Question 1

1.1 Cold-wet ✓ conditions (1)

1.2
- Stronger than normal SE trade winds. ✓
- Lower than normal sea surface temperatures in the eastern Pacific. ✓
- With increased upwelling ✓
- Resulting in more nutrient rich surface waters ✓
- Warmer than normal sea surface temperatures in the western Pacific. ✓ (5)

(6)

Question 2

2.1 (a)
- Walker circulation ✓ / Walker cell (1)

(b)
- <u>Warm moist air rises</u> ✓
- on the <u>western side</u> ✓of the Pacific Ocean <u>basin / East Australian coast</u>

OR
- <u>Cooler drier air sinks</u> ✓
- on the <u>eastern side</u> ✓ of the Pacific / West Peruvian coast

(Mark any pair) (2)

2.2 **1.The SE trade winds weaken ✓***
- pushing cooler surface water towards the western Pacific ✓
- and causing less / weakened upwelling at the South American coast. ✓

2.Warmer surface waters ✓*
- Lower amounts of cold water upwelled / moving to the surface ✓
- Less upwelling. ✓

3.Lower <u>amount of nutrients</u> available ✓*
- Less upwelling ✓
- Less <u>transport of nutrients</u> ✓

4.Overlying <u>low pressure storm (LPS)</u> <u>system</u> over the South American coast ✓*
- as a result of the <u>surges of warmer water</u> ✓
- Reducing the temperature difference across the Pacific ✓

(Mark condition ✓* and 2 descriptions. Mark first 2) (6)

2.3 (a) Water temperature will decrease ✓ (1)

(b)
- Increase in rainfall ✓ / wetter climate
- Colder environment ✓ / decrease in temperature (2)

2.4 (a) The frequency of droughts in the Amazon would increase✓ (1)

(b)
- The increase in the frequency of major rainfall events✓
- With the influx of fresh water✓
- cause decreased salinity✓of the rock pools,
- With lower temperatures✓
- The organisms would have to deal with greater fluctuations in temperature✓ (5)

(18)

TOPIC: Ocean acidification
Question 1

1.1 Corrosion is the chemical action of sea water on rocks✓ (1)

1.2 H_2CO_3✓ (1)

1.3 CO_2 combines with water ✓(to form carbonic acid) (1)

1.4
- This will lead to increased amounts of carbonic acid in the ocean / ocean acidification ✓
- This will lead to increased corrosion ✓

(2)
(5)