



# **MARINE AND MARITIME STUDIES**

## **ATAR course examination 2022**

### **Marking key**

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

## Section One: Multiple-choice

20% (20 Marks)

Question	Answer
1	a
2	c
3	c
4	b
5	b
6	b
7	a
8	a
9	d
10	c
11	c
12	b
13	d
14	b
15	d
16	c
17	a
18	c
19	a
20	d

## Section Two: Short answer

50% (100 Marks)

## Question 21

(22 marks)

- (a) Explain the process of 'eutrophication'. (5 marks)

Description	Marks
Excess nutrients in water (from a source such as fertiliser).	1
Algal blooms occur (can say phytoplankton) which may cause submerged plants to die due to inadequate light/photosynthesis cannot occur.	1
Bacteria grow and multiply then feed off dead plant matter.	1
Bacteria will decompose dead matter using oxygen in this process.	1
Dissolved oxygen decreases in the water so aquatic organisms struggle to survive/dissolved oxygen does not meet biological oxygen demand (BOD).	1
<b>Total</b>	<b>5</b>

- (b) Identify
- two**
- pollutants that cause eutrophication and state the possible source of each pollutant. (4 marks)

Description	Marks
<b>Pollutant</b>	
Nitrogen – Accept nitrates	1
Phosphorous – Accept phosphates	1
<b>Subtotal</b>	<b>2</b>
<b>Source – any two of</b>	
<ul style="list-style-type: none"> <li>• land clearing</li> <li>• farming/agricultural run-off (fertiliser)</li> <li>• animal excrement run-off</li> <li>• urban run-off</li> <li>• sewage discharges</li> <li>• leaking wastewater systems e.g. septic tanks.</li> </ul>	1–2
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Accept other relevant answers.	

- (c) Propose a method to monitor eutrophication in a waterway. (5 marks)

Description	Marks
Collect/test water samples.	1
Measure nitrogen/phosphorous concentration.	1
Measure dissolved oxygen concentration.	1
Compare to a control (concentration levels when waterway is healthy).	1
Conduct multiple trials/water samples at different times of year.	1
<b>Total</b>	<b>5</b>

## Question 21 (continued)

- (d) Describe and account for the relationship shown by the graph. (4 marks)

Description	Marks
<b>Description</b>	
Photosynthesis decreases as depth increases.	1
Respiration rate is consistent throughout all depths/from 0 m to 250 m.	1
<b>Subtotal</b>	<b>2</b>
<b>Account</b>	
Insufficient light penetration to permit photosynthesis as light becomes limiting factor/photosynthetic organisms need light which disappears with depth.	1
Marine organisms can travel vertically through the water column therefore respiration is not restricted to a certain depth/respiration occurs at all depths.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>4</b>
Accept other relevant answers.	

- (e) Describe the significance of the point labelled A in the graph. (2 marks)

Description	Marks
This is where rate of respiration is equal to rate of photosynthesis.	1
Below this depth organisms may need to travel up to get sufficient O <sub>2</sub> .	1
<b>Total</b>	<b>2</b>

- (f) State a suitable hypothesis that the scientist gathering this data could have been investigating. (2 marks)

Description	Marks
Written as a testable statement.	1
Gives the relationship between the independent and dependent variables.	1
<b>Total</b>	<b>2</b>
Answers could include:	
If the depth of water increases, then the rate of photosynthesis will decrease.	
Accept other relevant answers.	

## Question 22

(19 marks)

- (a) Explain the process of 'ocean acidification'. (5 marks)

Description	Marks
Carbon dioxide dissolves into seawater.	1
Water and carbon dioxide combine to form carbonic acid/H <sub>2</sub> CO <sub>3</sub> .	1
Carbonic acid dissociates (breaks) into hydrogen ions/H <sup>+</sup> and bicarbonate ions/HCO <sub>3</sub> <sup>-</sup> .	1
As the ocean continues to absorb more CO <sub>2</sub> , the pH decreases.	1
The lower the pH, the less alkaline the ocean becomes.	1
<b>Total</b>	<b>5</b>
Note: Do not accept 'increases acidity'.	
Accept other relevant answers.	

- (b) Explain
- two**
- ways in which ocean acidification affects shell-building marine species such as the giant clam. (6 marks)

Description	Marks
<b>One</b>	
Fewer carbonate ions available for calcifying organisms (shell building/marine organisms with an exoskeleton) to build and maintain their shells.	1
Calcifying marine organisms make hard shells by combining calcium and carbonate from seawater.	1
As ocean acidification increases, available carbonate ions/CO <sub>3</sub> <sup>2-</sup> bond with excess hydrogen.	1
<b>Subtotal</b>	<b>3</b>
<b>Two</b>	
Reduced availability of CO <sub>3</sub> <sup>2-</sup> means organisms build weaker shells.	1
This makes them more susceptible to predation.	1
Potentially leading to population collapse/affect upon the food chain.	1
<b>Subtotal</b>	<b>3</b>
<b>Total</b>	<b>6</b>
Accept other relevant answers.	

**Question 22** (continued)

- (c) (i) Outline what is meant by the term 'citizen science'. (2 marks)

Description	Marks
Citizen science is the practice of public participation.	1
Collaboration in scientific research/data collection to increase scientific knowledge.	1
<b>Total</b>	<b>2</b>
Accept other relevant answers.	

- (ii) Discuss how programs such as these can assist in the conservation of a species. (6 marks)

Description	Marks
Collection of scientific data in marine science is time consuming/costly.	1
Provides more data than scientists themselves are able to collect.	1
Provides data on demographics such as abundance and reproductive age, which help to determine health of species.	1-2
If significant changes to data occur, scientists will identify and can act to better conserve the species.	1
Helps public education and awareness.	1
<b>Total</b>	<b>6</b>
Accept other relevant answers.	

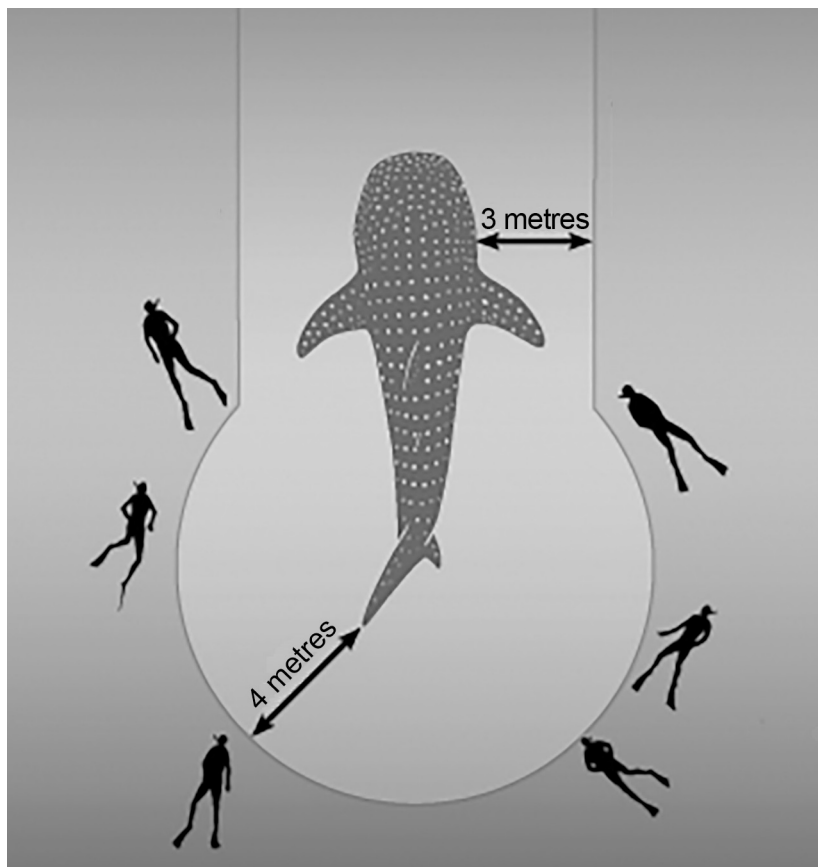
Question 23

(10 marks)

- (a) Define the term ‘ecotourism’ **and** state how it differs from regular tourism. (2 marks)

Description	Marks
Definition - Recreational activities that occur when people have an interest in helping the environment through sustainable actions or conservation efforts.	1
Regular tourism involves recreational activities that occur when people go on holiday to places of interest, with no effort or consideration towards the environment.	1
<b>Total</b>	<b>2</b>
Accept other relevant answers.	

- (b) (i) On the diagram below, add the mandated distances a swimmer must keep from the head **and** the tail of a whale shark. (2 marks)



Description	Marks
Head to swimmer 3 m	1
Tail to swimmer 4 m	1
<b>Total</b>	<b>2</b>

## Question 23 (continued)

- (ii) List **three** additional rules that swimmers are required to follow during their interactions with whale sharks. (3 marks)

Description	Marks
Any three of	
<ul style="list-style-type: none"> <li>• no touching or riding the whale shark (not considered as separate marks)</li> <li>• no flash photography</li> <li>• no cameras on extension poles</li> <li>• no motorised propulsion aids</li> <li>• do not restrict the normal movement or behaviour of the whale shark</li> <li>• do not exceed more than 10 people in the water at any one time</li> </ul>	1–3
<b>Total</b>	<b>3</b>

- (c) Explain why it is important to have clear rules in place for ecotourism operations such as the whale shark interactions in Western Australia. (3 marks)

Description	Marks
Any three of	
<ul style="list-style-type: none"> <li>• enables tourists to see the whale sharks clearly and for longer</li> <li>• minimises disturbance to the whale shark</li> <li>• enables us to see whale sharks behaving normally in their natural environment</li> <li>• contributes to longevity of the ecotourist opportunity as the whale sharks continue their normal behaviour.</li> </ul>	1–3
<b>Total</b>	<b>3</b>
Accept other relevant answers.	



## Question 24

(11 marks)

- (a) Define the term 'marine pollutant' and name **two** other types of marine pollutants. (3 marks)

Description	Marks
Definition	
A material that can pose a risk to marine ecosystems.	1
<b>Subtotal</b>	<b>1</b>
Any two of the following marine pollutants	
<ul style="list-style-type: none"> <li>• plastic</li> <li>• human/domestic waste (sewage)</li> <li>• fertilisers</li> <li>• nutrients</li> <li>• heavy metals</li> </ul>	1–2
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>3</b>
Accept other relevant answers.	

- (b) Identify **four** sources through which petroleum oil could enter the marine environment. (4 marks)

Description	Marks
Any four of	
<ul style="list-style-type: none"> <li>• road run-off into stormwater drains</li> <li>• industry use/consumption</li> <li>• workshops and oil moving into storm water drains</li> <li>• transportation/ship discharge</li> <li>• boat/oil tanker accidents</li> <li>• extraction</li> <li>• oil rigs</li> <li>• refineries</li> <li>• natural seeps</li> <li>• tectonic activity</li> </ul>	1–4
<b>Total</b>	<b>4</b>

- (c) Describe **two** possible benefits of this plan. (4 marks)

Description	Marks
Any two of (2 x 2 marks)	
<ul style="list-style-type: none"> <li>• rig creates a habitat that can lead to increased biodiversity in an area</li> <li>• marine life on the rig can promote fisheries by providing a food supply</li> <li>• can provide protection to juveniles so creating a nursery/breeding ground.</li> </ul>	1–4
<b>Total</b>	<b>4</b>
Accept other relevant answers.	

## Question 25

(17 marks)

- (a) Complete the table below summarising the typical equipment used during snorkelling and diving. (5 marks)

Description		Marks
For each missing item in the table (5 x 1 mark)		
States the information required.		1
<b>Total</b>		<b>5</b>
Equipment	Main material(s) typically made from	How equipment helps during snorkelling and diving
Weights	Lead	Enables a diver to become neutrally buoyant/compensates for the buoyancy of diving equipment and wetsuit. (1)
Snorkel	Silicone and plastic (1)	Allows the diver to breathe at the surface.
Fins (1)	Rubber, plastic or carbon fibre	Allows the diver to move more efficiently in the water and swim without using their arms.
Wet suit	Neoprene (1)	Reduce heat loss whilst diving/protect divers from environmental conditions. (1)
Accept other relevant answers.		

- (b) Describe a probable cause of water filling the mask. (2 marks)

Description	Marks
Ill-fitting mask/strap not tight enough or too tight/strap too low/hair beneath the seal.	1
Preventing a snug fit to the face which allows water to enter when face is submerged.	1
<b>Total</b>	<b>2</b>
Accept other relevant answers.	

- (c) Explain why a snorkel is considered an essential piece of equipment when diving. (4 marks)

Description	Marks
Snorkel can assist diver on the surface if conditions are choppy.	1
Avoid swallowing water.	1
Safely breathing on surface if there is no air left in cylinder.	1
Can minimise ineffective use of air in cylinder to use for dive.	1
<b>Total</b>	<b>4</b>

- (d) Discuss how the length and/or bore (diameter) of a snorkel can influence its effectiveness. (6 marks)

Description	Marks
<b>Any three of (3 x 2 marks)</b>	
<ul style="list-style-type: none"><li>• if bore is too narrow there is too much resistance, making inhalation difficult and insufficient air will be drawn into the lungs</li><li>• too long increases distance air must travel making it difficult to breathe in fresh air and out expired air</li><li>• too long increases likelihood of snagging on things during use and so being pulled out of the divers mouth/mask</li><li>• too short would likely mean the top sits below the water surface and so the snorkel fills with water.</li></ul>	1-6
<b>Total</b>	<b>6</b>
Accept other relevant answers.	

## Question 26

(21 marks)

- (a) Explain how historical records can be useful in locating shipwreck sites. (3 marks)

Description	Marks
Any three of	
<ul style="list-style-type: none"> <li>records document the route of the vessel</li> <li>this could include it's intended destination</li> <li>the search for the wreck site can then be deduced</li> <li>this reduces the search area, increasing likelihood of locating.</li> </ul>	1-3
<b>Total</b>	<b>3</b>

- (b) Outline the steps that lead to the waterlogging of timber artefacts. (4 marks)

Description	Marks
On initial wrecking water is absorbed into the artefact.	1
Fungi, bacteria and boring organisms decay the timber artefact (wood is mainly composed of cellulose, lignin and water).	1
Cavities/space become available within the wood structure.	1
These spaces are then filled with water.	1
<b>Total</b>	<b>4</b>

- (c) Explain why special care is required for the management of waterlogged timber artefacts. (3 marks)

Description	Marks
They are typically not easily preserved/are very scarce.	1
They are very unstable when found and sensitive to rapid changes in environmental conditions.	1
Uncontrolled drying out can lead to total loss of evidence.	1
<b>Total</b>	<b>3</b>

- (d) Calculate the volume of air that will be required to make the artefact neutrally buoyant at 12 m. Show your workings in the space below.

Note: the density of seawater is 1.03 kg/L. (3 marks)

Description	Marks
$42 \times 1.03 \text{ kg/L} = 43.26 \text{ kg}$	1
Overall down = $120 \text{ kg} - 43.26 \text{ kg} = 76.74 \text{ kg}$	1
$76.74 \text{ kg} / 1.03 \text{ kg/L} = 74.5 \text{ L}$	1
<b>Total</b>	<b>3</b>
Answers could include:	
<ul style="list-style-type: none"> <li>Mass of water displaced = density x volume (<math>42 \times 1.03 \text{ kg/L} = 43.26 \text{ kg}</math>)</li> <li>Apparent mass = submerged mass - mass of water displaced (<math>120 \text{ kg} - 43.26 \text{ kg} = 76.74 \text{ kg}</math>)</li> <li>Volume = mass / density (<math>76.74 \text{ kg} / 1.03 \text{ kg/L} = 74.5 \text{ L}</math>)</li> </ul>	

- (e) Outline why more air would be required than the value calculated in part (d) to actually lift the object to the surface. (2 marks)

Description	Marks
At 12 m below the surface, the pressure acting on a volume of air increases/the pressure at 12 m is 2.2 ata.	1
Due to this, a greater volume of air would be required at the surface to compensate for the pressure acting on the volume of air at depth.	1
<b>Total</b>	<b>2</b>

- (f) A dive charter anchors at a mooring in water near the wreck that is 12 m deep. Identify the most suitable method of entry for divers in this location and summarise the steps. (6 marks)

Description	Marks
<b>Method</b>	
Identifies giant stride.	1
<b>Subtotal</b>	<b>1</b>
<b>Any five of the following steps</b>	
<ul style="list-style-type: none"> <li>• look to horizon</li> <li>• check entry area is clear</li> <li>• use hand to hold snorkel/regulator and mask in position</li> <li>• hold weight belt on waist with other hand</li> <li>• take a big step/stride out from boat</li> <li>• drop into water and signal OK</li> </ul>	1-5
<b>Subtotal</b>	<b>5</b>
<b>Total</b>	<b>6</b>
Alternative method and steps:  Method: Backwards roll <ul style="list-style-type: none"> <li>• Sit on side of boat.</li> <li>• Place one hand on weight belt.</li> <li>• Place other hand on mask and snorkel/regulator.</li> <li>• Roll backwards into water.</li> <li>• Signal OK.</li> </ul>	

Section Three: Extended answer

30% (40 Marks)

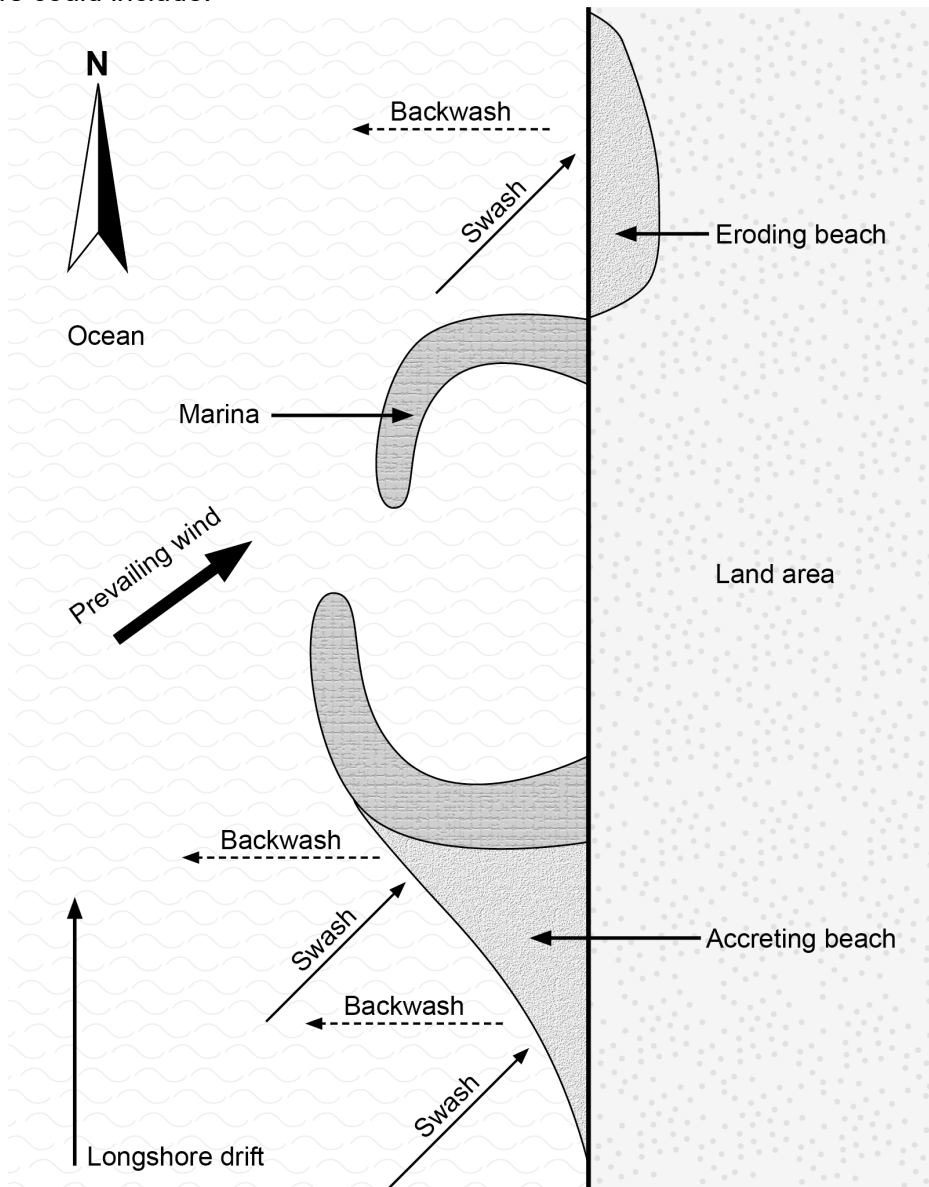
Question 27

(20 marks)

- (a) Construct a labelled diagram to show how a marina is expected to affect longshore drift in the surrounding area during the Western Australian summer. (6 marks)

Description	Marks
Constructs a suitable diagram.	1
<b>Subtotal</b>	<b>1</b>
<b>Diagram labels</b>	
Prevailing wind.	1
Swash and backwash (must include both).	1
Direction of longshore drift: South to North (must include cardinal directions).	1
Accretion on south side.	1
Erosion on north side.	1
<b>Subtotal</b>	<b>5</b>
<b>Total</b>	<b>6</b>

Answers could include:



Accept other relevant answers.

- (b) Propose **three** possible impacts of the expansion of the Ocean Reef Marina on the surrounding marine environment. For each, suggest a method to minimise the impact. (6 marks)

Description	Marks
For each (3 x 2 marks)	
Proposes an impact.	1
Suggests a method to minimise the impact.	1
<b>Total</b>	<b>6</b>
<p>Answers could include:</p> <ul style="list-style-type: none"> <li>• Impact: High turbidity (increased sediment/decreased clarity) Minimisation (any one of the following): <ul style="list-style-type: none"> <li>▪ sample surrounding habitat prior to construction to determine if species require water clarity</li> <li>▪ only dredge (dig channels) on calm days when wind is less likely to push out sediment plume</li> <li>▪ dredge in shoulder season between summer and winter</li> <li>▪ have a dredging schedule.</li> </ul> </li> <li>• Impact: Habitat Loss Minimisation: protect impacted species in local area by use of marine protected areas and appropriate zoning such as sanctuary zones.</li> <li>• Impact: Loss of benthic species such as seagrasses/corals/sponges Minimisation: protect impacted species in local area by use of marine protected areas and appropriate zoning such as sanctuary zones.</li> <li>• Impact: Loss of important fisheries such as abalone Minimisation: translocate abalone to another area – protected site if possible.</li> <li>• Impact: Changes to local currents such as the longshore drift that travels north Minimisation: ensure breakwaters only go a set distance out to sea to reduce changes in current movement and wave/swell direction.</li> <li>• Impact: Changes in sediment transport systems Minimisation: ensure breakwaters only go a set distance out to sea to reduce changes in current movement and wave/swell direction.</li> <li>• Impact: Changes to sand accretion and erosion on beaches nearby Minimisation (any one of the following): <ul style="list-style-type: none"> <li>▪ engage in beach nourishment where sand has eroded</li> <li>▪ engage a sand bypass system to move sand from an area of accretion to an area of erosion.</li> </ul> </li> </ul> <p>Accept other relevant answers.</p>	

**Question 27** (continued)(c) Describe the features, role **and** impacts of the following coastal engineering structures:

- sand bypass systems
- canals

(8 marks)

Description	Marks
<b>Sand bypass system</b>	
Features: <ul style="list-style-type: none"> <li>• consist of pumps, pipe and supporting infrastructure – human-made and permanent.</li> </ul>	1
Role: <ul style="list-style-type: none"> <li>• a permanent solution to sand erosion and littoral drift problems affecting river mouths/navigation channels/groyne (close proximity).</li> </ul>	1
Impacts: <ul style="list-style-type: none"> <li>• redistribution of sand from one side of a waterway to another</li> <li>• construction would impact natural movement of sand within the sand budget.</li> </ul>	1–2
<b>Subtotal</b>	<b>4</b>
<b>Canals</b>	
Features: <ul style="list-style-type: none"> <li>• artificially, systematically engineered channels and waterways – human-made and permanent.</li> </ul>	1
Role: <ul style="list-style-type: none"> <li>• constructed for the passage of boats to housing and commercial developments with access to waterfronts/for draining management.</li> </ul>	1
Impacts: <ul style="list-style-type: none"> <li>• increased run-off into the ocean due to increased areas with unnatural filtration</li> <li>• increased boat traffic which may result in collisions with marine life</li> <li>• possible eutrophication from build-up of nutrients and reduction in flow of water</li> <li>• construction would impact natural movement of sand within the sand budget.</li> </ul>	1–2
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
Accept other relevant answers.	



## Question 28

(20 marks)

- (a) Identify **two** major Western Australian ocean currents and describe the influence of each on Western Australian marine ecosystems. (8 marks)

Description	Marks
<b>Leeuwin Current</b>	
Identifies the Leeuwin Current.	1
Any three of <ul style="list-style-type: none"> <li>the warm water allows establishment of tropical species typical of higher latitudes</li> <li>warm waters act as a spawning trigger for temperate marine species</li> <li>warm, low salinity water suppresses the upwelling of nutrients in the ecosystem</li> <li>the current is nutrient poor, which results in low biomass of finfish.</li> </ul>	1–3
<b>Subtotal</b>	<b>4</b>
<b>West Australian Current</b>	
Identifies the West Australian Current.	1
Any three of <ul style="list-style-type: none"> <li>interaction between Leeuwin and WA Current results in upwelling west of Perth Canyon, which results in nutrient-rich water</li> <li>nutrient-rich water, containing schools of krill, support organisms which feed on it, such as blue whales</li> <li>seasonally, the upwelling of nutrients causes larger predatory organisms, such as orcas, to migrate to the Perth Canyon to prey on the organisms feeding off the krill</li> <li>the cooler temperature of the WA current supports many temperate species.</li> </ul>	1–3
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>8</b>
Accept other relevant answers.	

## Question 28 (continued)

- (b) Discuss how ocean warming and increasing stratification will result in major changes in phytoplankton in terms of: (12 marks)

- abundance
- distribution, and
- seasonal fluctuations.

Description	Marks
<b>Abundance</b>	
Abundance refers to the quantity of phytoplankton throughout an ecosystem/or the number of individuals which are collected per sample.	1
<b>Subtotal</b>	<b>1</b>
<b>Distribution</b>	
Distribution refers to the location of the plankton.	1
<b>Subtotal</b>	<b>1</b>
<b>Seasonal fluctuations</b>	
Seasonal fluctuations refers to variation in phytoplankton composition annually.	1
<b>Subtotal</b>	<b>1</b>
<b>Any nine of</b>	
<ul style="list-style-type: none"> <li>• phytoplankton abundance changes with the season – a preference for warmer seasons such as spring</li> <li>• zooplankton abundance will increase as their food source (phytoplankton) increase due to warmer seasons</li> <li>• warmer waters encourage phytoplankton blooms which can be problematic</li> <li>• plankton distribution changes with stratification – surface waters of the ocean are warmer and density differences cause layers to form</li> <li>• stratification could impact diurnal migration of zooplankton and make it more challenging to travel between cool deep layers and warm surface layers</li> <li>• species that are found in surface layers at certain times of year for feeding, such as spring, may spend more of their lifecycle in surface layers</li> <li>• species that are found in the Southern Ocean or temperate waters off the West Australian coast may be pushed further south and into a new range.</li> <li>• seasonally phytoplankton will show less variation in warmer stratified conditions</li> <li>• the typical pattern of phytoplankton numbers and abundance change seasonally due to the conditions</li> <li>• phytoplankton can form blooms – high density in warmer waters in seasons such as spring and summer</li> <li>• zooplankton lifecycles will see eggs laid during the same time period as a phytoplankton bloom, to take advantage of this food source.</li> </ul>	1-9
<b>Subtotal</b>	<b>9</b>
<b>Total</b>	<b>12</b>
Accept other relevant answers.	

## Question 29

(20 marks)

- (a) Distinguish between the terms 'greenhouse effect' and 'enhanced greenhouse effect'.  
(2 marks)

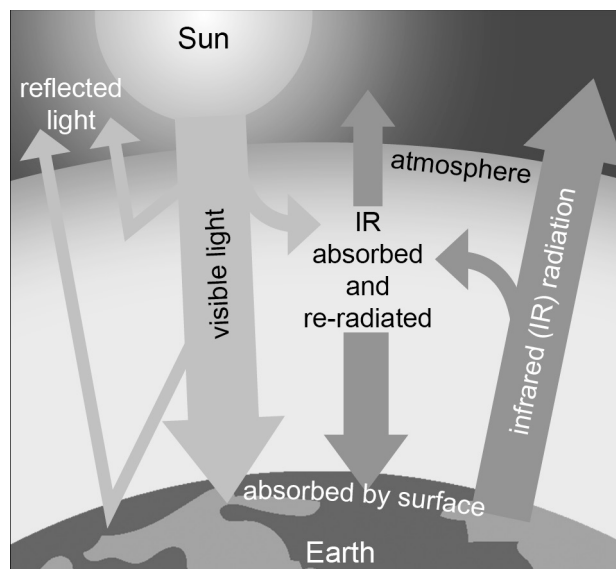
Description	Marks
Greenhouse effect is a natural process where the earth is heated through the trapping of radiation by greenhouse gases in the atmosphere.	1
Enhanced greenhouse effect is an anthropogenic process where the greenhouse effect has been increased by human activity.	1
<b>Total</b>	<b>2</b>

- (b) Explain the enhanced greenhouse effect. In your explanation include:

- a labelled diagram
  - **two** types of radiation
  - **two** greenhouse gases
  - the key features of the enhanced greenhouse effect.
- (10 marks)

Description	Marks
<b>Labelled diagram including</b>	
Incoming light striking the earth.	1
Some reflected infrared light is absorbed by greenhouse gases and some goes into space.	1
Note: Sample diagram on page 20.	
<b>Subtotal</b>	<b>2</b>
<b>Types of radiation</b>	
Solar/visible light/ultraviolet	1
Infrared	1
<b>Subtotal</b>	<b>2</b>
<b>Any two of the following greenhouse gases</b>	
<ul style="list-style-type: none"> <li>• carbon dioxide</li> <li>• water vapour</li> <li>• methane</li> <li>• nitrous oxide</li> <li>• ozone</li> </ul>	1-2
<b>Subtotal</b>	<b>2</b>
<b>Key features</b>	
Incoming solar radiation/light heating the Earth.	1
Infrared being re-radiated from heated Earth.	1
More of this infrared being absorbed by increased amount of greenhouse gases.	1
Heating the atmosphere and Earth.	1
<b>Subtotal</b>	<b>4</b>
<b>Total</b>	<b>10</b>

## Question 29 (continued)



- (c) Discuss the process of coral bleaching that can occur as a result of the enhanced greenhouse effect. (8 marks)

Description	Marks
Stress applied to corals through an environmental change.	1
Any one of the following possible environmental changes: <ul style="list-style-type: none"> <li>• temperature</li> <li>• salinity</li> <li>• light availability</li> <li>• exposure to air</li> <li>• nutrient level</li> <li>• pollutants</li> <li>• sedimentation</li> <li>• change in depth (sea level rise)</li> </ul>	1
Zooxanthellae live inside coral tissues in a symbiotic relationship.	1
When stressed, zooxanthellae produce wastes/toxins that can damage coral cells.	1
Corals expel zooxanthellae.	1
Zooxanthellae provide nutrient energy through photosynthesis.	1
Coral without zooxanthellae lose a nutrient energy source and colour.	1
Coral can die if sustained or recover if conditions are favourable.	1
<b>Total</b>	<b>8</b>
Accept other relevant answers.	

## Question 30

(20 marks)

- (a) Give an example of the type of artefact that could be left on-site and protected using a sacrificial anode. Explain how a sacrificial anode works and describe the environmental conditions that would be suitable for this method of conservation. (9 marks)

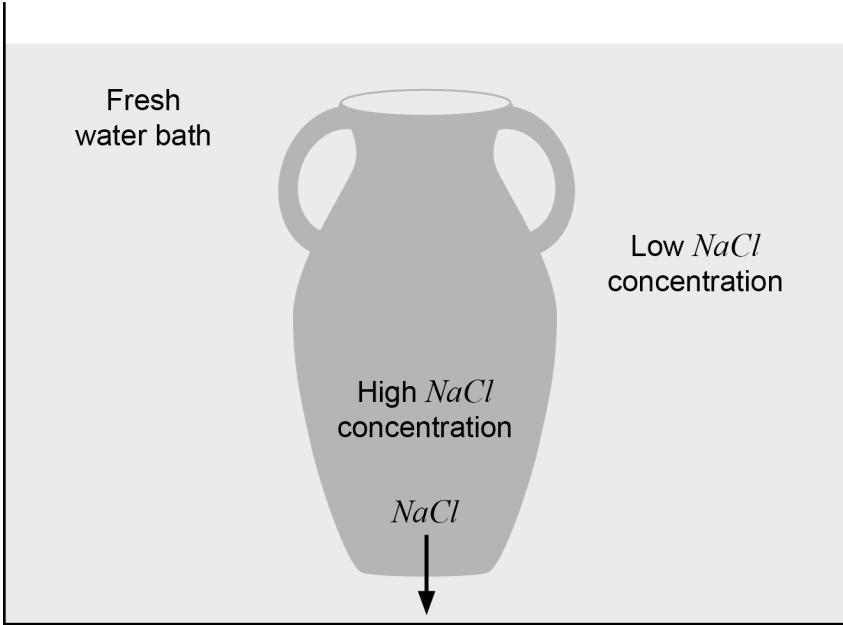
Description	Marks
States a relevant example of an artefact.	1
<b>Subtotal</b>	<b>1</b>
<b>Explanation</b>	
The sacrificial anode needs to be more reactive than the artefact.	1
The anode corrodes more readily.	1
The artefact becomes the cathode.	1
The anode will donate electrons to the cathode.	1
Electrical contact between anode and cathode (to allow electron flow).	1
An electrolyte to complete the electrical circuit (ion flow).	1
<b>Subtotal</b>	<b>6</b>
<b>Description – any two of the following conditions</b>	
<ul style="list-style-type: none"> <li>• little water movement</li> <li>• low energy environment</li> <li>• deeper water</li> <li>• no exposure to air.</li> </ul>	1–2
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>9</b>
Answers could include:	
Example artefacts could be cannon, anchor etc.	
Accept other relevant answers.	

- (b) Soluble salts can be absorbed by pottery artefacts. Describe how salts are absorbed by pottery and explain why the absorbed salt can affect an artefact once it has been recovered from a wreck site. (4 marks)

Description	Marks
Soluble salts are dissolved in seawater.	1
Pottery is a porous material/seawater with these salts moves through the pottery.	1
If pottery is not conserved properly then salts crystallise.	1
The salt crystals will then expand and crack pottery when dried.	1
<b>Total</b>	<b>4</b>
Accept other relevant answers.	

## Question 30 (continued)

- (c) With the aid of a diagram, explain how conservators remove insoluble salts from pottery artefacts. (7 marks)

Description	Marks
<b>Explanation</b>	
Desalinate artefact by keeping submerged in freshwater bath.	1
Salts move from artefact into bath water.	1
Movement of salt from high concentration to low concentration areas.	1
Periodically change water in bath as salt concentration increases.	1
Test water bath to determine salt concentration indicates that salts have been removed.	1
<b>Subtotal</b>	<b>5</b>
<b>Diagram</b>	
Diagram with appropriate labels.	1
Diagram shows salt movement from a high concentration inside the artefact to a low concentration in the surrounding water bath.	1
<b>Subtotal</b>	<b>2</b>
<b>Total</b>	<b>7</b>
Sample diagram:	
	
Accept other relevant answers.	

## ACKNOWLEDGEMENTS

**Question 22(a)(b)** Adapted from: National Oceanic and Atmospheric Administration. (2020). *Ocean Acidification*. Retrieved October, 2022, from <https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification>

**Question 23(b)** Diagram adapted from:  
Department of Biodiversity, Conservation and Attractions. (2022). *Whale Shark Swim Contact Zone* [Infographic]. Retrieved June, 2022, from <https://www.dpaw.wa.gov.au/plants-and-animals/animals/whale-sharks?showall=&start=2>  
Cinz. (n.d.). *Hand Drawn Whale Shark Ocean Life Free* [Graphic]. Retrieved June, 2022, from [https://pngtree.com/freepng/hand-drawn-whale-shark-ocean-life\\_6847776.html](https://pngtree.com/freepng/hand-drawn-whale-shark-ocean-life_6847776.html)  
[Graphic of diver silhouettes]. (n.d.). Retrieved June, 2022, from <https://365psd.com/vector/19-vector-diver-58724>

### Copyright

© School Curriculum and Standards Authority, 2022

This document – apart from any third party copyright material contained in it – may be freely copied, or communicated on an intranet, for non-commercial purposes in educational institutions, provided that it is not changed and that the School Curriculum and Standards Authority (the Authority) is acknowledged as the copyright owner, and that the Authority's moral rights are not infringed.

Copying or communication for any other purpose can be done only within the terms of the *Copyright Act 1968* or with prior written permission of the Authority. Copying or communication of any third party copyright material can be done only within the terms of the *Copyright Act 1968* or with permission of the copyright owners.

Any content in this document that has been derived from the Australian Curriculum may be used under the terms of the Creative Commons [Attribution 4.0 International \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) licence.

An *Acknowledgements variation* document is available on the Authority website.

*Published by the School Curriculum and Standards Authority of Western Australia  
303 Sevenoaks Street  
CANNINGTON WA 6107*