



MARINE AND MARITIME STUDIES

ATAR course examination 2024

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

Section Two: Short answer

50% (105 Marks)

Question 21

(15 marks)

- (a) Identify the decay process that iron artefacts undergo when submerged in seawater. (1 mark)

Description	Marks
rusting/corrosion/electrochemical degradation	1
Total	1

- (b) Outline the main stabilisation process that can be used for *in situ* iron artefacts and describe **one** example of a way in which this stabilisation can be achieved. (4 marks)

Description	Marks
Outline	
sacrificial anode/cathodic protection/the iron artefact is made less reactive	1
the more reactive metal corrodes instead of the iron/electrons are provided to the iron	1
Subtotal	2
Example – any one of	
<ul style="list-style-type: none"> • sacrificial anode: <ul style="list-style-type: none"> ▪ a more reactive metal than iron/zinc is used ▪ and attached to the artefact • electrochemical cell: <ul style="list-style-type: none"> ▪ an external power source is connected to the iron artefact, ▪ providing a source of electrons, preventing further oxidation 	1–2
Subtotal	2
Total	4

- (c) Identify the process used to determine what artefacts may be contained within the mass. (1 mark)

Description	Marks
x-ray	1
Total	1

Question 21 (continued)

- (d) Outline the process of concretion and state **three** ways in which this process can slow the decay of some artefacts. (5 marks)

Description	Marks
Outline	
a solid crusting layer/calcium carbonate (CaCO ₃) forms around the artefact	1
is caused by encrusting calcareous organisms attaching to the outside of an artefact/a chemical reaction between oxidising iron and sea water	1
Subtotal	2
States any three of	
<ul style="list-style-type: none"> • isolates artefact from oxygen and further exposure to sea water or the atmosphere • slows the rate of corrosion of metal artefacts by acting as a barrier • protects artefact from abrasion and other physical damage • provides chemical stability by preventing gas/water exchange with artefact • allows for the preservation of surface details by providing a protective barrier 	1–3
Subtotal	3
Total	5
Accept other relevant answers.	

- (e) Suggest **two** ways in which climate change could affect the concretion process. (4 marks)

Description	Marks
Any two of	
<ul style="list-style-type: none"> • reduced biological activity due to lower pH/higher temperatures – results in a reduction in encrusting organisms • a reduction in pH which occurs alongside climate change slows the process of concretion/reduces the thickness/integrity of the concretion layer • increases to sea surface temperatures impacts the chemical process by increasing the rate of chemical reactions which increases the rate of concretion • availability of CaCO₃ within water column is reduced due to lower pH – results in lower concentrations available for the formation of a concreting layer • an increase in extreme weather events can slow the overall concretion rate due to physical damage that needs to be replaced 	1–4
Total	4
Accept other relevant answers.	

Question 22

(16 marks)

- (a) State Archimedes' principle. (1 mark)

Description	Marks
a body immersed in a fluid is subjected to an upwards/buoyant force equal to the weight of the displaced fluid	1
Total	1

- (b) Explain how Archimedes' principle relates to the process that free divers use to check they are neutrally buoyant at the surface. (3 marks)

Description	Marks
a free diver at the surface checks whether they have neutral buoyancy by floating at eye level with a normal breath	1
the diver modifies their buoyancy by modification of their volume or weight	1
relates changes to buoyancy to Archimedes principle	1
Total	3
Answers could include:	
With a normal breath in their lungs, the diver should sit at eye level. If the diver is above eye level, they need to increase the weight on their weight belt. This will increase the downward force of the diver to counteract the upthrust/buoyant force.	
Accept other relevant answers.	

- (c) (i) State which law of physics, other than Archimedes' principle, is relevant to this situation. (1 mark)

Description	Marks
Boyle's Law	1
Total	1

- (ii) Identify what effect this law has on a free diver's buoyancy as they descend. (1 mark)

Description	Marks
a free diver's buoyancy will decrease	1
Total	1

Question 22 (continued)

- (iii) Identify **one** advantage and **one** disadvantage of starting the dive positively buoyant, and suggest a way of overcoming the disadvantage. (3 marks)

Description	Marks
Advantage – any one of	
<ul style="list-style-type: none"> as the diver ascends to the surface, they will be positively buoyant, reducing the amount of energy required to reach the surface/remain at the surface in the event of a shallow water blackout, the diver will float to the surface no additional energy is expended to remain floating at the surface 	1
Subtotal	1
Disadvantage – any one of	
<ul style="list-style-type: none"> more energy is required to descend reduced bottom time because of the extra energy used to overcome positive buoyancy at the surface increased descent rate after positive buoyancy has been counteracted by depth 	1
Subtotal	1
Suggestion – any one of	
<ul style="list-style-type: none"> use of a descent line that the freediver can use to pull themselves down to a depth where they are neutrally/negatively buoyant use free diving fins to increase propulsion 	1
Subtotal	1
Total	3
Accept other relevant answers.	

- (d) Calculate how much weight you will need to wear to achieve neutral buoyancy at the surface. Show all workings. (3 marks)

Description	Marks
mass of water displaced $1.045 \times 100 = 104.5 \text{ kg}$	1
buoyancy = mass of water displaced - diver's mass $= 104.5 - 100 = 4.5 \text{ kg}$	1
therefore, diver needs 4.5 kg of additional weight	1
Total	3

- (e) Describe **two** problems that you may encounter in using this cylinder. (4 marks)

Description	Marks
<p>Any two of</p> <ul style="list-style-type: none"> • the cylinder supplies air at ambient pressure (similar to a scuba tank), therefore density is increased at depth – increases the chance of pulmonary barotrauma on ascent if person is untrained • no pressure gauge to read air pressure – not able to tell how much air remains during the freedive • no medical screening – people with asthma and other respiratory illnesses are at a greater risk of barotrauma • no control over the quality of air being pumped into the cylinder – could impact health of the free diver if air is contaminated by fumes • the system does not account for buoyancy alterations at depth due to full lungs – more difficult for a freediver to maintain neutral buoyancy when breathing pressurised air 	1–4
Total	4
Accept other relevant answers.	

Question 23

(20 marks)

- (a) State **three** roles that scientific research plays in managing the marine environment. (3 marks)

Description	Marks
Any three of	
<ul style="list-style-type: none"> • data analysis • management decisions are based on applicable data collected by scientific research • allows managing bodies to forecast, mitigate or guide human impact • understand the connections between ecosystems, organisms, biotic and abiotic factors to better manage areas • offers baseline information to measure future impacts against 	1–3
Total	3
Accept other relevant answers.	

- (b) Describe the term 'citizen science'. (2 marks)

Description	Marks
the collection of data by the public relating to a scientific investigation	1
in collaboration with scientists or research bodies	1
Total	2
Accept other relevant answers.	

- (c) Comment on the benefit that citizen science can have in scientific research associated with managing the marine environment. (4 marks)

Description	Marks
Any two of the following:	
collection of data is time consuming and expensive; citizen science increases the number of people collecting/analysing data	1–2
provides a larger data set/wider range of information than scientists would be able to collect without assistance from public	1–2
longitudinal data can be collected, improving the effectiveness of management decisions	1–2
increases public awareness and public ownership over environmental issues	1–2
Total	4
Accept other relevant answers.	

- (d) Describe **two** ways in which this initiative assists with the conservation of whale shark populations in Australia. (4 marks)

Description	Marks
For each of way (2 x 2 marks)	
Provides a feature	1
Relates the feature to the conservation of whale shark populations in Australia	1
Total	4
Answers may include:	
<ul style="list-style-type: none"> identifies population dynamics – measures the health and resilience of the population/ability to adapt to environmental pressures increases public awareness – provides a sense of ownership/stewardship increasing protection identifies biological patterns – assists in the measurement of population resilience which can influence the implementation of conservation measures. 	
Accept other relevant answers.	

- (e) Define 'ecotourism' and contrast this with regular tourism. (3 marks)

Description	Marks
Definition	
recreational activities that increase visitor awareness and understanding of natural/cultural values	1
Subtotal	1
Any one of	
<ul style="list-style-type: none"> the consideration of environmental impacts is secondary to that of individual enjoyment in regular tourism activities – ecotourism is focused primarily on conserving/maintaining an environment, focusing experiences around this regular tourism does not contribute to scientific research/conservation practices – ecotourism can contribute to scientific research 	1–2
Subtotal	2
Total	3

- (f) Explain why it is important to have clear rules regarding the protection of cetaceans when participating in water-based ecotourism activities. (4 marks)

Description	Marks
Any two of (2 x 2 marks)	
<ul style="list-style-type: none"> increases the longevity of ecotourism opportunities, by ensuring the return of the cetaceans to the area reduces the chance of injury to humans, by cetaceans when interacting in water provides protection for cetaceans, from both water craft injuries and negative human interactions minimises disturbance, reducing the impact on natural behaviours such as migration, breeding and feeding 	1–4
Total	4
Accept other relevant answers.	

Question 24

(20 marks)

- (a) Define 'overfishing'. (1 mark)

Description	Marks
the removal of a population of fish at a rate that is faster than which the population can replenish via reproduction	1
Total	1
Accept other relevant answers.	

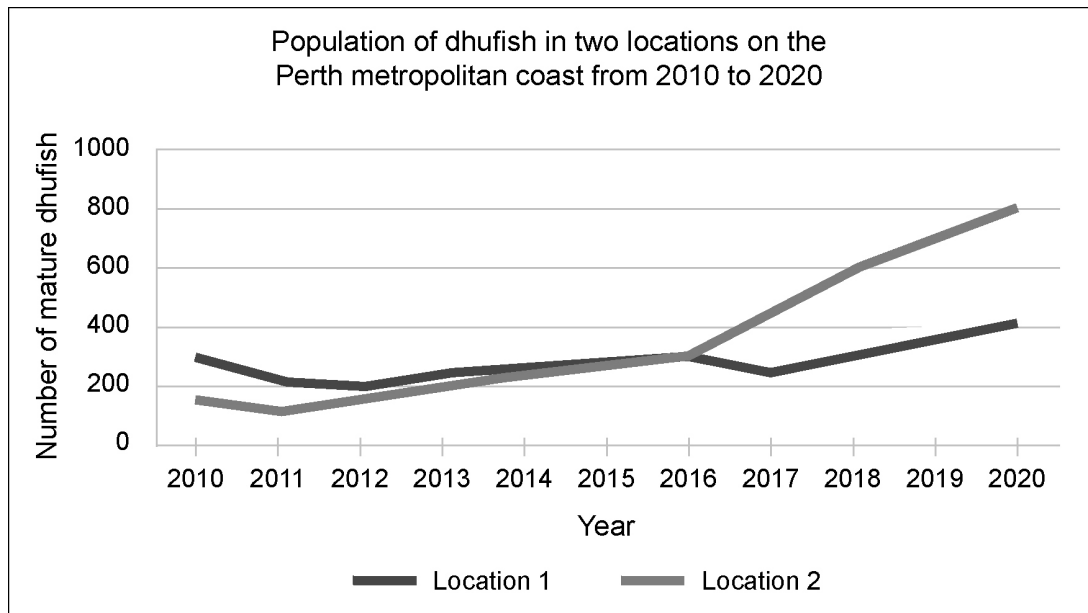
- (b) Propose a hypothesis that the DPIRD scientists could use for their research into the populations of mature dhufish. (2 marks)

Description	Marks
Proposes a testable statement that gives the relationship between the independent (location/protection) and dependent (population) variables	2
Proposes a statement that identifies the independent (location/protection) and dependent (population) variables	1
Total	2
Answers could include: The number of mature dhufish will increase in an area that is protected from fishing when compared to an area that is not protected.	
Accept other relevant answers.	

- (c) Using the grid below, construct a graph to represent the information in the table on page 14. (6 marks)

Description	Marks
Title (includes independent and dependent variables (location and population))	1
Suitable graph type (line or column graph)	1
Correct axis placement (X-axis independent variable/Y-axis dependent variable) and axes titles (no units required)	1
Includes legend	1
Scale	1
Correct data plotting	1
Total	6

Answers could include:



Accept other relevant answers.

- (d) Suggest a conclusion for these results. (3 marks)

Description	Marks
both locations experienced similar fishing pressure until 2015 and showed very slow recovery rates	1
location 2 experienced a much faster recovery after 2016 due to the removal of fishing pressure	1
conclusion refers to supporting data from the table/graph	1
Total	3
Accept other relevant answers.	

- (e) Suggest **one** reason why there was a delay in the recovery of the dhufish population at Location 2 after the demersal ban was implemented in 2015. (2 marks)

Description	Marks
individuals need to reproduce to replenish the population	1
delay could be associated with the growth of individuals to sexual maturity	1
Total	2
Accept other relevant answers.	

Question 24 (continued)

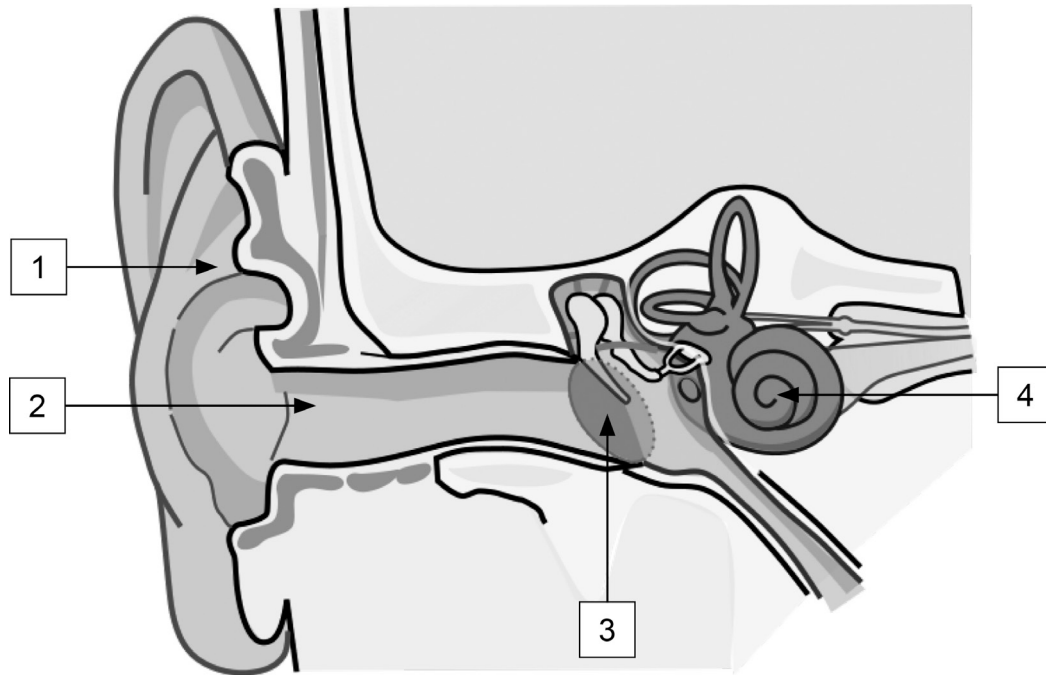
- (f) Outline how a demersal fishing ban could impact the overall biomass of Location 2 compared to Location 1. Draw a diagram of a biomass pyramid for each location to support your response. (6 marks)

Description	Marks
Outline	
demersal ban reduces fishing pressure resulting in more individuals remaining in the population/biomass in Location 2	1
increased dhufish leads to reduction in smaller fish/crustaceans/molluscs which can lead to increased zooplankton biomass	1
in turn this leads to reduced phytoplankton biomass/trophic cascade effects	1
Subtotal	3
Biomass pyramid	
includes four sections: <ul style="list-style-type: none"> • base: phytoplankton • 2nd level: zooplankton • 3rd level: small fish/crustaceans/molluscs • 4th level: dhufish 	1
pyramids show that the biomass of dhufish in Location 1 is less than that in Location 2	1
pyramids show that the biomass of crustaceans/small fish/molluscs is less in Location 2 than that in Location 1	1
Subtotal	3
Total	6
Accept other relevant answers.	
Note: Award a maximum 1 mark for pyramids if only 1 is shown.	

Question 25

(17 marks)

(a) In the table below, name the parts of the ear labelled 1 to 4 in the diagram. (4 marks)



Description	Marks
1. pinna/outer ear	1
2. ear canal/auditory canal	1
3. tympanic membrane/ear drum	1
4. cochlea	1
Total	4

(b) (i) Explain the effect water has on sound. (3 marks)

Description	Marks
water is denser than air, therefore particles are much closer together	1
sound energy can therefore travel much/four times faster in water than in air	1
sound travels much further under water	1
Total	3
Accept other relevant answers.	

Question 25 (continued)

- (ii) Identify **two** issues that this may cause for divers when under the water. (2 marks)

Description	Marks
Any two of	
<ul style="list-style-type: none"> • the direction of a sound is difficult to determine as sound moves much faster in water than in air • the distance of origin of a sound is difficult to determine • sound waves reflect off submerged/stationary objects making the origin/direction difficult to determine • verbal communication underwater is difficult and is replaced with hand signals • limited sound is transmitted from the surface of the water to below, making it difficult for those on the surface to communicate with someone below 	1–2
Total	2
Accept other relevant answers.	

- (c) Define an 'ear barotrauma' and explain how it can occur as a diver ascends. (5 marks)

Description	Marks
Definition	
pressure related injury to the ear	1
Subtotal	1
Explanation	
air expands on ascent as pressure decreases	1
expanding air must be released/equalised in the middle ear as you ascend	1
if there is a blockage expanding air cannot be released	1
this places pressure on the surrounding tissues causing damage	1
Subtotal	4
Total	5
Accept other relevant answers.	

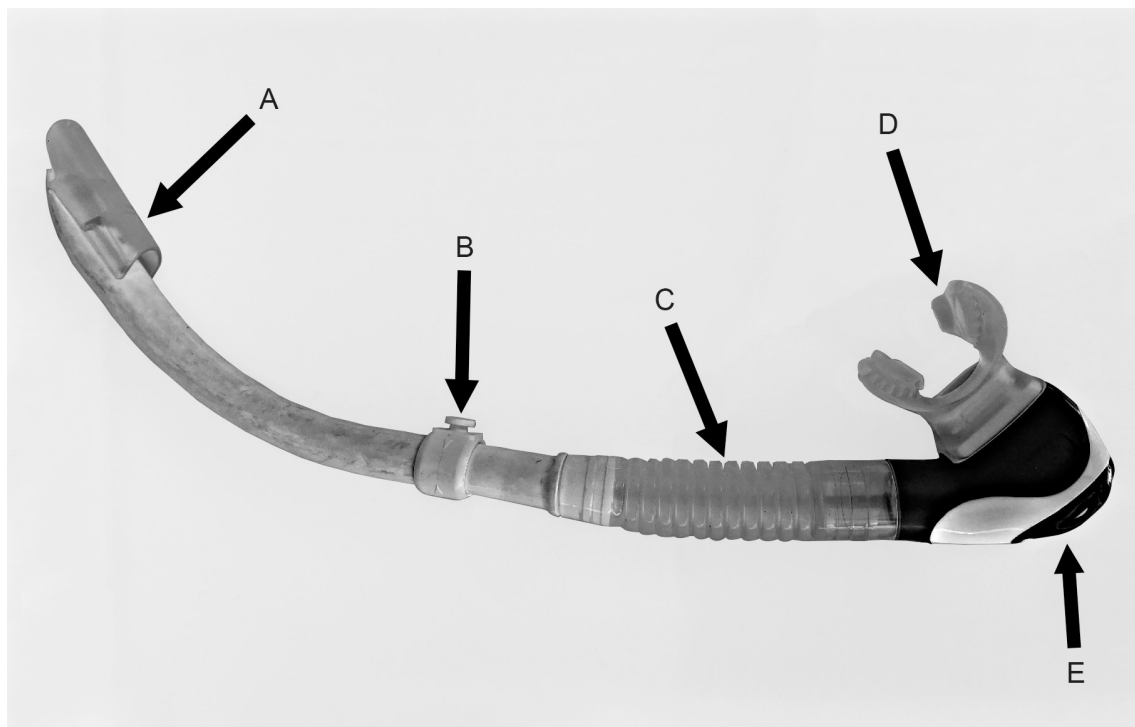
- (d) State **one** potential long-term outcome of an ear barotrauma and outline the associated symptoms. (3 marks)

Description	Marks
Any one of	
<ul style="list-style-type: none"> • deafness <ul style="list-style-type: none"> ▪ hearing loss can be complete, instant and permanent ▪ most divers lose high frequencies and retain some hearing • ringing in ears (tinnitus) <ul style="list-style-type: none"> ▪ divers can experience ringing in ears after a barotrauma ▪ this can be continuous or intermittent • vertigo <ul style="list-style-type: none"> ▪ inability to find balance and direction ▪ often accompanied by nausea • pain <ul style="list-style-type: none"> ▪ divers can experience persistent long-term pain/aching ▪ exacerbated when trying to equalise or in cold conditions 	1–3
Total	3
Accept other relevant answers.	

Question 26

(17 marks)

- (a) Examine the picture of a semi-dry snorkel. In the space below, name the **five** parts labelled A–E and state the purpose of each. (10 marks)



Description	Marks
A: splash guard – minimise water entry into the snorkel tube	1–2
B: mask strap attachment point/snorkel clip – secures the snorkel to the mask	1–2
C: flexible tube – allows for more comfortable positioning of mouthpiece	1–2
D: mouthpiece – soft silicone that helps snorkel to sit in the mouth comfortably	1–2
E: purge valve – allows for easier removal of water from the tube	1–2
Total	10

- (b) Explain how to clear a snorkel using the displacement method. (3 marks)

Description	Marks
upon ascent, look up or tilt head up (until the snorkel is in a horizontal position)	1
exhale into the snorkel (to add a small amount of air to the tube)	1
air in the snorkel will expand, pushing water out of the snorkel	1
Total	3
Accept other relevant answers.	

Question 26 (continued)

- (c) Outline **two** reasons why scuba divers must ascend differently from free divers. (4 marks)

Description	Marks
scuba divers are breathing compressed air at depth which has a higher density while free divers are breathing air at ambient atmospheric pressure and density	1–2
scuba divers will have a higher concentration of dissolved nitrogen in their tissues due to breathing compressed air, requiring a slow ascent while free divers do not tend to have high concentrations due to breathing surface air and therefore do not have the same ascent rate considerations	1–2
Total	4
Accept other relevant answers.	

Section Three: Extended answer

30% (40 Marks)

Question 27

(20 marks)

(a) Outline the Batavia's final ill-fated journey. Your response should include the following:

- **two** key individuals
- the wrecking event
- the mutiny, and
- the rescue.

(8 marks)

Description	Marks
Individuals – any two of	
<ul style="list-style-type: none"> • Francisco Pelseart – commander of the Batavia • Jeronimus Cornelisz – merchant and third in charge of vessel; orchestrator of mutiny with Jacobz • Adrian Jacobz – ship's captain and orchestrator of mutiny in conjunction with Cornelisz • Wiebbe Hayes – Dutch soldier • Lucretia van der Mijlen – survivor of the sinking 	1–2
Subtotal	2
Wrecking event	
Jacobz and Cornelisz had control over the ship during its journey. It is suspected that they facilitated the wrecking event off Morning Reef in the Abrolhos Islands	1
180 passengers and crew swam ashore after the wrecking event, 70 remained on the vessel	1
Subtotal	2
Mutiny	
Pelseart and Jacobz went to Batavia to get help, leaving Cornelisz in charge of the passengers and crew	1
soldiers and some crew were sent to adjacent islands, other people were drowned/killed, some women were kept alive to serve the men	1
Subtotal	2
Rescue	
after 63 days, Pelseart returned with assistance. Weibbe Hayes and his soldiers had survived and notified the rescue party of Cornelisz's activity	1
Cornelisz and complicit crew were arrested and tried on the island	1
Subtotal	2
Total	8
Accept other relevant answers.	

Question 27 (continued)

- (b) Explain the purpose of a maritime archaeological survey and describe **one** method that was used to survey the wreck site of the Batavia, including a reason why it was applied to the survey process. (6 marks)

Description	Marks
Purpose of survey	
to record information about a site using a variety of techniques	1
to determine the relative position of different objects in relation to a site of historical value	1
to determine the preservation status and management strategies of the wreck site and different artefacts	1
Subtotal	3
Methods – any one of	
<ul style="list-style-type: none"> • site preparation <ul style="list-style-type: none"> ▪ ensures the site can be surveyed accurately including the removal of seaweed and sand build up ▪ ensured that the area could be properly surveyed without the interference of excess marine growth • recording methods <ul style="list-style-type: none"> ▪ sketches, mud maps, plans, site drawings, photomosaics ▪ ensured accurate record keeping and allows researchers to refer back to site maps after artefacts have been removed • triangulation/trilateration <ul style="list-style-type: none"> ▪ two bearings are taken from a fixed datum point ▪ allowed for the accurate pinpointing of the location of artefacts for record purposes and to help researchers identify the debris zone • GPS <ul style="list-style-type: none"> ▪ satellite positioning used to assist in accurate record ▪ allowed researchers to accurately return to points of interest 	1–3
Subtotal	3
Total	6
Accept other relevant answers.	

- (c) Describe a method used to preserve the following artefacts found on the Batavia after retrieval from the water:

- a wooden piece of the hull
- silver coins. (6 marks)

Description	Marks
Wooden hull – any three of	
<ul style="list-style-type: none"> • kept in water from the site until conservation can occur • treated with fungicide to prevent biological attack • treated in a polyethylene glycol bath of increasing concentration so wax replaces the damaged cellulose • timbers stored at a controlled temperature and humidity to protect the conservation process 	1–3
Subtotal	3
Silver coins	
concretion removed after diagnostic x-rays	1
may require electrolysis or chemical reduction to remove tarnishing	1
coins are polished and coated with an acrylic polymer	1
Subtotal	3
Total	6
Accept other relevant answers.	

Question 28

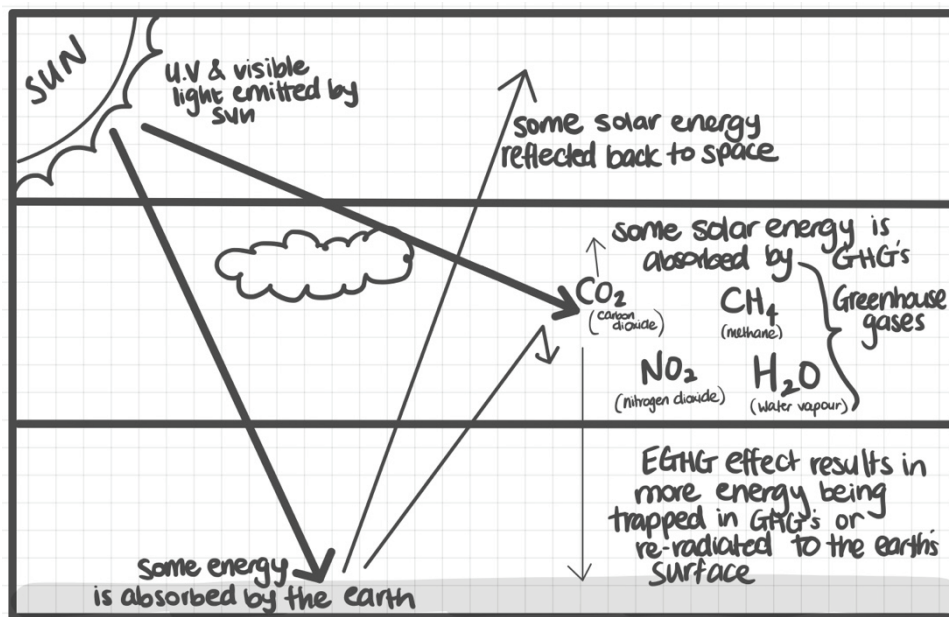
(20 marks)

- (a) Describe the greenhouse gas effect and explain how global warming may result from an enhanced greenhouse effect. Draw a labelled diagram to support your response. (8 marks)

Description	Marks
Greenhouse gas (GHG) effect	
refers to the process where certain atmospheric gases (CO ₂ , CH ₄ , N ₂ O and water vapour) trap radiation	1
the gases absorb radiation before re-radiating it back into the atmosphere	1
Subtotal	2
Explanation	
caused by an increase in the concentration of GHG's due to anthropogenic activities	1
increases the potential for radiation to be trapped/re-emitted into the atmosphere	1
increase re-emissions of radiation increases global atmospheric temperatures	1
Subtotal	3
Diagram shows	
solar radiation enters atmosphere with some absorbed by the earth's surface and some reflected from the earth's surface	1
some radiation is absorbed by greenhouse gases (must identify at least one GHG (CO ₂ , CH ₄ , N ₂ O or water vapour))	1
enhanced GHG effect results in more heat energy being trapped/re-radiated to earth's surface	1
Subtotal	3
Total	8

Answers could include:

Diagram:



Accept other relevant answers.

Question 28 (continued)

- (b) Discuss how global sea levels and coral bleaching will be affected by the enhanced greenhouse effect. For each, describe **two** effects on relevant ecosystems. (12 marks)

Description	Marks
Global sea levels	
Effects of enhanced greenhouse effect – any two of	
melting icesheets (Greenland/Antarctica) due to higher temperatures and resulting influx of freshwater	1–2
thermal expansion as surface waters absorb heat from the atmosphere leading to an overall increase in ocean volume	1–2
increased frequency and intensity of weather events (storms/cyclones/hurricanes/storm surges) causing localised sea level increases	1–2
Subtotal	4
Ecosystem impacts – any two of	
<ul style="list-style-type: none"> • loss of coastal habitats such as breeding/nesting grounds due to encroaching sea levels • increased erosion, alterations to coastal sand budgets, disruption of littoral drift processes • increase in depth of shallow submerged habitats, reducing light penetration, photosynthetic ability 	1–2
Subtotal	2
Coral bleaching	
Effects of enhanced greenhouse effect	
warming ocean temperatures increase the occurrence and severity of coral bleaching events	1
zooxanthellae are expelled from the tissues of hermatypic corals when temperature stress is experienced	1
loss of the symbiotic relationship affects the corals' ability to produce sufficient food for growth and survival	1
increased ocean acidity from higher CO ₂ concentrations affects the corals ability to produce a skeleton. Reduces the ability of corals recover from bleaching	1
Subtotal	4
Ecosystem impacts – any two of	
<ul style="list-style-type: none"> • loss of habitat results in a loss of breeding and nursery areas for many fish species • increase in wave energy due to loss of hard reef structures • impact on migratory fish species who may use coral reefs as an interim location • wider ecosystem impacts such as loss of cleaning stations and disruptions to the movement of plankton affect the dynamics and behaviour of many tropical species 	1–2
Subtotal	2
Total	12
Accept other relevant answers.	

Question 29

(20 marks)

(a) Contrast phytoplankton and zooplankton by referring to the following:

- role in marine ecosystems
- life cycle
- daily and seasonal distribution
- significance to fish stocks.

(8 marks)

Description	Marks
Role	
phytoplankton are primary producers, using photosynthesis to produce energy	1
zooplankton are primary consumers, forming a link between primary producers and higher trophic levels	1
Subtotal	2
Life cycle	
phytoplankton remains planktonic for the duration of their life cycle	1
zooplankton exist as holoplankton (whole lifecycle) or meroplankton (partial lifecycle)	1
Subtotal	2
Daily and seasonal distribution	
phytoplankton ascend to the surface during the day for photosynthesis and zooplankton ascend at night to predate on phytoplankton	1
Seasonal distribution of phytoplankton is dependent on nutrient and light availability and zooplankton distribution follows the pattern of phytoplankton	1
Subtotal	2
Significance to fish stocks	
phytoplankton form the basis of marine food chains, providing energy to maintain fish stocks	1
many zooplankton are juveniles of fish stocks/consumed by smaller fish that support trophic levels	1
Subtotal	2
Total	8
Accept other relevant answers.	

Question 29 (continued)

- (b) Describe the AusCPR initiative and discuss how data collected from it can be used to assist the conservation of plankton in a warming climate, including the methodology used to collect plankton samples and the relevance of collected data. (12 marks)

Description	Marks
AusCPR	
citizen science initiative	1
involves commercial/non-research ships/Ships of Opportunity towing plankton recorders behind the vessel to collect plankton samples	1
aim is to continuously monitor Australia's plankton populations	1
Subtotal	3
Conservation	
collection methodology is reliable and allows for patterns and trends to be identified	1
allows for impacts on populations of plankton to be measured as sea surface temperatures change	1
changes in populations can be more effectively managed through the use of restrictions of krill fishing and greenhouse gas offset schemes	1
Subtotal	3
Methodology used to collect samples	
automatic sampler is towed at 100 m behind the ship at approximately 10 m depth	1
torpedo shape with an entrance that filters plankton through two sheets of silk mesh	1
CPR measures the rate of collection to ensure that accurate population estimates can be made	1
Subtotal	3
Relevance of collected data – any three of	
<ul style="list-style-type: none"> • can be used to map plankton biodiversity and distribution • contributes to the long-term monitoring of Australian waters • provides information about food stocks for fish populations • detects harmful algal blooms 	1–3
Subtotal	3
Total	12
Accept other relevant answers.	

Question 30

(20 marks)

- (a) Name **two** major marine pollutants and identify the role each plays in the loss of marine species and/or habitats. (4 marks)

Description	Marks
Any two of the following marine pollutants	
<ul style="list-style-type: none"> • plastic: ingestion can cause the death of organisms, interrupting food chains/disrupting population dynamics/trophic interactions OR marine debris could entangle, crush, damage or smother sensitive organisms • nutrients/fertiliser: can cause algal blooms resulting in reduced water quality/decrease in light penetration/anoxic events • runoff: suspended particles from runoff can reduce light penetration/may be high in nutrients increasing algal blooms/bring heavy metals/toxic chemicals into the marine environment • light: can disrupt migratory and breeding behaviour/increase predation of vulnerable species as they are more visible/damage sensitive vision • noise: can affect sensitive auditory nerves in cetaceans/damage benthic habitats/disorientate or disrupt migratory behaviour • industrial chemicals: introduce heavy metals to the environment increasing the chance of bioaccumulation or biomagnification/can disrupt reproductive behaviours or viability 	1–4
Total	4
Accept other relevant answers.	

- (b) Assess the effectiveness of implementing marine protected areas as a tool to conserve marine biodiversity. (6 marks)

Description	Marks
For each aspect of MPAs (3 x 2 marks)	
Makes a judgement about the effectiveness of MPAs as a tool to conserve marine biodiversity (can be effective or not effective)	1
Provides evidence to support the judgement	1
Total	6
Answers can include:	
<ul style="list-style-type: none"> • MPAs can be effective at conserving biodiversity through habitat protection which allows for replenishment of populations and protection of vulnerable species • MPAs can be effective by providing a baseline to measure the degradation or recovery of other similar areas. Impacts of environmental stress can be measured by comparing impacted areas to MPAs • MPAs can be effective at conserving biodiversity by maintaining biological connections between different marine habitats. This allows for the exchange of larvae, assists in migratory patterns and prevents fragmentation of marine populations • some MPAs can be ineffective at conserving biodiversity because they allow commercial and recreational activities that directly impact the health/resilience of marine habitats. 	
Accept other relevant answers.	

Question 30 (continued)

- (c) Describe **three** major ways in which marine species can be introduced to Australian marine waters and outline **two** methods Australia uses to counter the biosecurity threat posed by introduced species. (10 marks)

Description	Marks
Introduction of marine species	
<ul style="list-style-type: none"> • biofouling/micro-organisms attach to the hull of vessels as soon as submerged, providing a substrate for larger organisms (such as algae, barnacles, molluscs, bryozoans, to attach) – these organisms are then transported to different waters where they can detach and settle • ballast water can contain marine species (usually eggs, larvae or juveniles) from port(s) of origin – if exchanged in the harbor can release thousands of invasive species into local waters • commercial shipments of seafood, aquarium supplies and aquaculture from overseas can bring unwanted species with them – these organisms may be attached to the seafood or be in the water used to transport them 	1–6
Subtotal	6
Methods – any two of	
<ul style="list-style-type: none"> • early identification of invasive species before they have the opportunity to establish viable populations – enabled by border security, quarantine and inspections • quick response – reduces the chance invasive species can gain a foothold • legislation/regulation – such as ballast water management, mandatory quarantine periods, turning back vessels without the correct paperwork • vessels over a certain length are required to have some kind of anti-fouling treatment on the hull – reduces the chance introduction of invasive species via biofouling 	1–4
Subtotal	4
Total	10
Accept other relevant answers.	

ACKNOWLEDGEMENTS

Question 25(a)

Adapted from: Komorniczak, M. (2009). *Anatomy of the Human ear* [Diagram]. Retrieved May, 2024, from https://commons.wikimedia.org/wiki/File:Anatomy_of_the_Human_Ear_blank.svg
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