Government of **Western Australia**
School Curriculum and Standards Authority

ATAR course examination, 2023

Question/Answer booklet

MARINE AND MARITIME STUDIES

Please place your student identification label in this box

WA student number: In figures

In words

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet
Multiple-choice answer sheet

Number of additional answer booklets used (if applicable):

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	20	20	20	20	20
Section Two Short answer	6	6	90	107	50
Section Three Extended answer	4	2	70	40	30
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2023: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Section Two: Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens. Wherever possible, confine your answers to the line spaces provided.

   Section Three: Consists of four questions. You must answer two questions. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

4. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

Section One: Multiple-choice **20% (20 Marks)**

This section has **20** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 20 minutes.

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1. For a groyne to be most effective against longshore drift, how should it be constructed in relation to the shoreline?

   (a) parallel
   (b) offshore
   (c) perpendicular
   (d) on the shoreline

2. Negative buoyancy during snorkelling can be defined as occurring when the

   (a) upthrust force on the snorkeller is less than their weight in water.
   (b) snorkeller is stuck on the bottom of the ocean and is unable to float to the surface.
   (c) weight of the snorkeller is less than the upthrust force.
   (d) weight of the snorkeller is equal to the upthrust force.

3. Which of the following is **not** a benefit of traditional open top snorkels (snorkels which do not have a splash guard)?

   (a) they do not require clearing when snorkelling at the surface
   (b) their streamlined design reduces drag when below the surface of the water
   (c) they are lightweight and feel more comfortable due to fewer accessory pieces
   (d) the simple design with no breakable mechanisms reduces maintenance issues

4. A scuba diver has an oversized wetsuit, with bagginess throughout the fit. This leads to the

   (a) diver being more comfortable, due to increased movement.
   (b) diver being less comfortable, due to reduced movement.
   (c) wetsuit pooling large amounts of water, which the body will not be able to heat.
   (d) wetsuit becoming very warm, so the diver will overheat.

See next page

5. Globally, the **main** threats to coral include

(a) weather related damage, decrease of sea surface temperature and parrot fish.
(b) increase in ocean temperature, lack of biodiversity and ecotourism rules.
(c) decrease in ocean temperature, invasive species and overfishing.
(d) weather related damage, increase of sea surface temperature and anthropogenic activities.

6. High levels of phosphorous in coastal water samples may indicate

(a) human and domestic wastes are present.
(b) heavy metals are present.
(c) nutrients are not present.
(d) petroleum oil is present.

7. What are three benefits of using sandbags to protect dunes from erosion?

(a) aesthetically appealing, inexpensive and able to slow longshore drift
(b) natural to the environment, inexpensive and able to build up the beach
(c) cheap to install and maintain and prevent longshore drift
(d) absorb wave energy, inexpensive and able to build up the beach

8. Calculate the volume of a snorkeller's lungs at 20 m, when the volume in air is 5 L.

(a) 1.33 L
(b) 1.67 L
(c) 1.93 L
(d) 2.50 L

9. The build up of which gas in the body signals to the brain to inhale?

(a) oxygen
(b) carbon dioxide
(c) carbon monoxide
(d) nitrogen

10. Which of the following measures is **not** used to manage fish stocks in Western Australia?

(a) closed seasons
(b) limiting community consultation
(c) equipment restrictions
(d) business support

See next page

11. A scientist monitoring corals on the Great Barrier Reef noted that they began to have a white appearance after heavy rains and flooding. What would the scientist **most** likely conclude from this?

(a) substantial cloud cover caused coral bleaching
(b) a change in salinity stressed the coral and caused bleaching
(c) a change in salinity stressed the coral and caused ocean acidification
(d) flooding from the mainland increased coral predators and caused coral bleaching

12. A red object found at 20 m depth in the water will appear to have a different colour. This is because

(a) reflection of the water makes red disappear with increased depth.
(b) blue light has a long wavelength and is absorbed as depth increases.
(c) red light has a long wavelength and is absorbed as depth increases.
(d) red light refracts more with depth.

13. When scuba diving, a person should **not** use swimming goggles because

(a) they could experience an eye squeeze.
(b) they will not be able to equalise their ears.
(c) their vision will be impaired.
(d) they could experience an ear squeeze.

14. A newly-qualified scuba diver was advised to purchase a mask with tempered glass. This type of glass will

(a) form a clearer image than traditional glass.
(b) crumble into small pieces when broken.
(c) withstand any amount of pressure.
(d) counteract issues with reflection.

15. An increase in which of the following is the primary cause of ocean acidification?

(a) temperature
(b) salinity
(c) pollution
(d) carbon dioxide

16. Demersal scalefish stocks are potentially at risk of collapse in the West Coast bioregion. Pink snapper is an example of such a species. Which of the following measures is used to manage this species during their spawning aggregations?

(a) size limits
(b) bag limits
(c) possession limits
(d) closed seasons

See next page

17. The National System for the Prevention and Management of Marine Pest Incursions provides guidelines on invasive marine species around Australia. These pest species can enter local waterways through

    (a) antifouling, cargo vessels and the illegal dumping of aquatic pets.
    (b) the illegal dumping of aquatic pets and transport of terrestrial vessels.
    (c) ballast water, cargo vessels and the aquarium trade.
    (d) ballast water, antifouling and hitchhiking on vessel hulls.

18. Government agencies monitor target invasive marine species. Monitoring should also consider the detection of new species that exhibit invasive characteristics. These characteristics are

    (a) low reproduction, accelerated colonisation of substrate site and a high growth rate.
    (b) high reproduction, accelerated colonisation of substrate site and a low growth rate.
    (c) high reproduction, slow colonisation of substrate site and a high growth rate.
    (d) high reproduction, accelerated colonisation of substrate site and a high growth rate.

19. Observations that contribute to the detection of an invasive species may include

    (a) elevated local abundance and an increase of degraded and artificial habitats.
    (b) elevated local abundance and a decrease of degraded and artificial habitats.
    (c) decreased population and density of native species
    (d) stable populations of native species in highly-biodiverse areas.

20. When metals corrode, they lose electrons. These electrons will move to another object, such as another metal. When two metals are in an electrolyte, such as sea water, the more reactive metal will lose electrons to the less-reactive metal. Identify the name of the more reactive metal.

    (a) ferride
    (b) cathode
    (c) anode
    (d) galvanic cell

End of Section One

See next page

Section Two: Short answer **50% (107 Marks)**

This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 21 **(22 marks)**

Weight belts and dive slates are two pieces of equipment often used by marine scientists when snorkelling to assess shallow marine ecosystems.

(a) Describe how to fit a weight belt correctly around the waist. (3 marks)

(b) State **two** purposes of a dive slate. (2 marks)

One:

Two:

Question 21 (continued)

If a snorkeller has a problem with their mask filling with water, they can simply remove it and replace the mask on the surface. This is not an option for scuba divers when at depth. The following steps are followed when a scuba diver is clearing a partially-flooded mask under water:

- Step 1: Create seal on top of mask (with index fingers) and tilt mask up slightly.
- Step 2: Exhale from nose while looking up.
- Step 3: If water remains, exhale again (check seal for trapped hair).

(c) Explain how this sequence of steps is effective in removing water from the mask. (3 marks)

(d) Propose a mistake the diver could likely make in performing these steps. (2 marks)

(e) Describe **one** method by which a snorkeller or scuba diver can relieve cramp in their calf muscles while diving. (3 marks)

See next page

Snorkelling and diving require an understanding of Archimedes' Principle to ensure a safe and successful dive.

(f) A scuba diver has a volume of 60 L and a mass of 65 kg, which has been determined by weighing the person on scales in air. Calculate the upthrust of the scuba diver in salt water and determine whether the scuba diver will float or sink. Show all workings. Assume a density of 1.03 kgL^{-1} for the salt water. (4 marks)

(g) The scuba diver chooses to wear a wetsuit, which changes their mass and volume. The scuba diver now weighs 66 kg and when immersed in water displaces 70 L. Their buoyancy will be affected.

(i) Calculate the upthrust to determine the type of buoyancy they would be experiencing. Show all workings. (3 marks)

(ii) Calculate the apparent mass and determine the weight the scuba diver requires to achieve neutral buoyancy. Show all workings. (2 marks)

See next page

Question 22 **(18 marks)**

In recent decades, advances in science have provided new ways of locating and conserving artefacts found at maritime archaeological sites. At the time of the discovery of the Batavia, science was much less advanced.

(a) Explain how the Batavia and its artefacts were retrieved from the wreck site when its resting place was first discovered in 1963. (4 marks)

(b) State **two** limitations of each of the following methods of locating shipwrecks. (6 marks)

Method	Limitations
Aerial survey	One:
	Two:
Magnetometer	One:
	Two:
Sonar	One:
	Two:

See next page

(c) Propose why a combination of magnetometer, multibeam sonar and depth sounder should be used as a search technique for shipwrecks. (3 marks)

A storm at the Abrolhos Islands recently uncovered a previously hidden plank of wood from the sandy bottom of a lagoon. The plank was estimated to be 300 years old and from a Dutch East India Company trading ship.

(d) Summarise the restoration process maritime archaeologists would perform on the wooden plank after it had been retrieved from the wreck site. (5 marks)

See next page

Question 23 **(19 marks)**

ECOCEAN is an organisation responsible for the creation of a photo-identification database into which photographs and records of individual whale sharks can be uploaded. The photographs need to include the spot pattern behind the gills of each whale shark and any scars or markings that can be used for individual identification. The computer software was adapted from a NASA program that used the Hubble telescope to map stars. This monitoring of population dynamics uses photographs contributed by scientists, industry, tourists and members of the public.

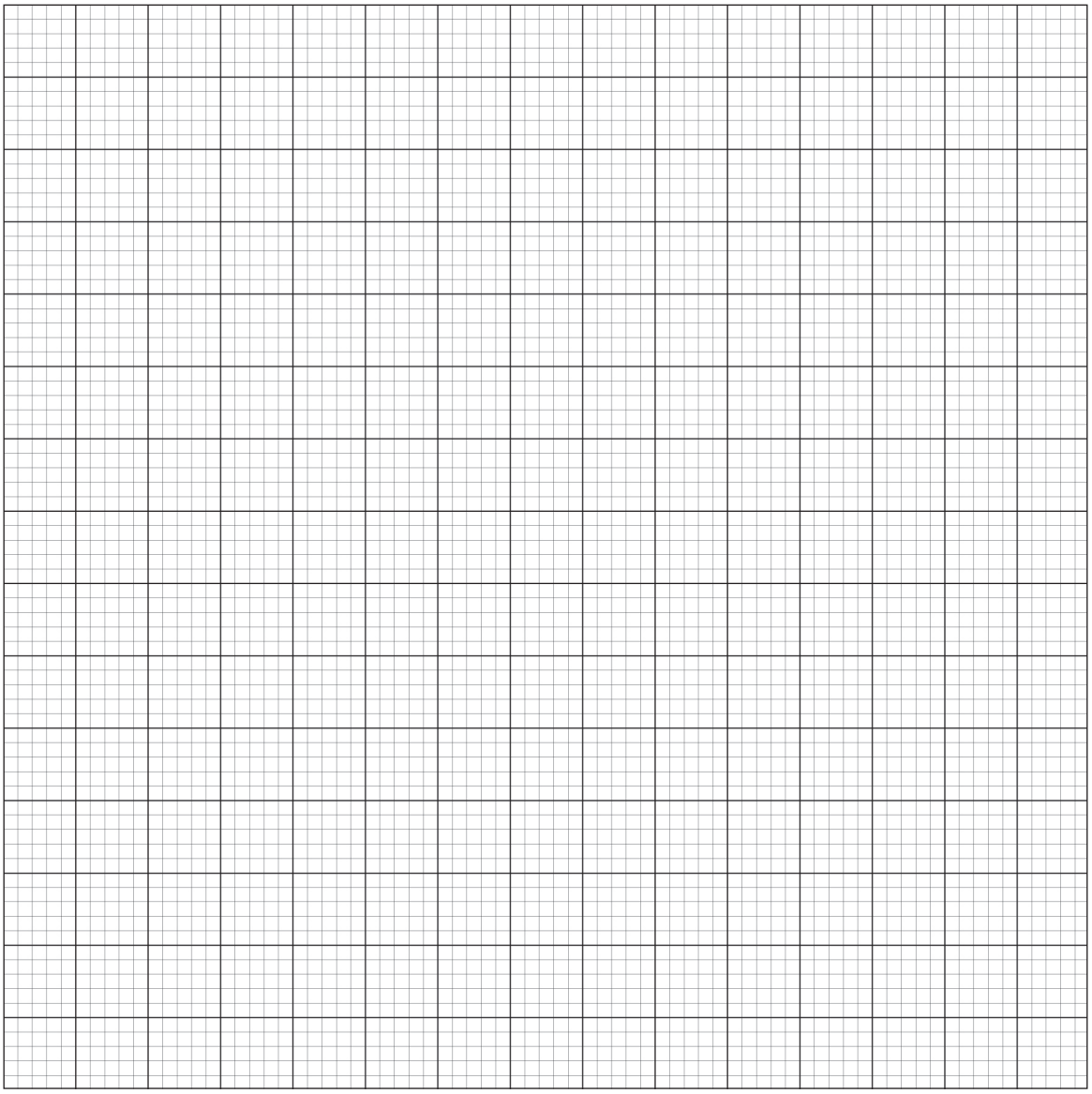
(a) Outline what is meant by the term 'longitudinal study'. (2 marks)

Annual counts of whale sharks submitted to the ECOCEAN database from 2011 to 2022 are shown in the table below.

Year	Number of sightings
2011	506
2012	678
2013	643
2014	598
2015	960
2016	1008
2017	1245
2018	1340
2019	1480
2020	86
2021	112
2022	1050

See next page

(b) Using the grid below, construct a column graph to represent the information in the table on page 12. (6 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

See next page

Question 23 (continued)

(c) Identify the trend shown in the graph and suggest reasons for any differences that are present. (4 marks)

The ECOCEAN study utilises both primary and secondary data.

(d) Complete the table by defining primary and secondary data and identifying a marine example for each. (4 marks)

Type of data	Definition	Marine example
Primary		
Secondary		

See next page

(e) State **three** benefits of using the photo-identification method of data collection, instead of tagging animals. (3 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

Question 24 **(15 marks)**

In 2016, Western Australia began a trial period for in-water interactions with humpback whales. This trial involved tourists swimming with the humpback whales in the Ningaloo Marine Park and the Muiron Islands Marine Management Area. The trial permitted whale shark tour operators to run humpback whale tours, with the trial set to continue until 2023.

(a) State **four** reasons why it was considered suitable for current whale shark tour operators to be granted permits during the trial period. (4 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

Four: _____

_____

The trial has been monitored and reviewed annually, resulting in it being expected to transition to a licensed industry in 2024. Licences to operate will be awarded through an application process.

(b) Suggest **three** criteria that would have been considered to allow the industry to move from the trial to a licensed operation. (3 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

Rules for in-water interactions with humpback whales are stipulated under State and Commonwealth regulations and guidelines.

(c) State **two** rules for each of the following areas of vessel interaction with whales. (4 marks)

No approach zone

One: _____

_____

Two: _____

_____

Caution zone

One: _____

_____

Two: _____

_____

Licences have conditions placed on them that must be adhered to by operators. Below are two such conditions:

- Prohibited whales are not to be interacted with.
- Interaction limits: limit pressure on individual whales or pods.

(d) (i) State **two** examples of prohibited whales. (2 marks)

One: _____

_____

Two: _____

_____

(ii) State **two** examples of interaction limits. (2 marks)

One: _____

_____

Two: _____

_____

See next page

Question 25 **(18 marks)**

In Western Australia, recreational boating is a common pastime. Even with many safety precautions, fires may damage or even destroy vessels. Recreational boating presents some problems, including the release of petroleum oil into the marine environment.

(a) Name the Western Australian organisation that an incident would need to be reported to if a vessel leaks petroleum oil into the environment. (1 mark)

(b) State the type of source that petroleum oil coming from a recreational vessel would be. (1 mark)

(c) Using an example, describe each of the following petroleum oil clean-up methods. (6 marks)

Biological:

Chemical:

Mechanical:

See next page

(d) Identify **two** pieces of information relating to the site of a spill that would be beneficial in managing the clean-up process, and advise why for each. (4 marks)

One: _____

_____

_____

_____

Two: _____

_____

_____

_____

(e) List **four** potential impacts of oil spills on marine animals. (4 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

Four: _____

_____

(f) If petroleum oil remains in the environment, state, and account for, the issue that would affect filter feeders over time. (2 marks)

_____

_____

_____

_____

Question 26 **(15 marks)**

Fremantle Harbour, which operates 24 hours a day, is Western Australia's largest and busiest port.

(a) (i) Identify **two** roles of a port. (2 marks)

One: _____

_____

Two: _____

_____

(ii) Identify **one** physical feature a port needs and outline why this is important. (2 marks)

_____

_____

_____

_____

One of the disadvantages of a port is declining water quality.

(b) Identify the primary engineering process that leads to an increase in water turbidity in ports. Explain how this process decreases the quality of water and affects marine organisms. (5 marks)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

See next page

(c) Name and outline **one** technique used to measure water turbidity. (2 marks)

An artificial reef is a man-made structure that may mimic some of the characteristics of a natural reef.

(d) Draw an annotated diagram to demonstrate how an artificial reef is used to reduce erosion at a beach. (4 marks)

A spare diagram space is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it in the spare diagram space.

End of Section Two

See next page

Section Three: Extended answer **30% (40 Marks)**

This section contains **four** questions. You must answer **two** questions. Write your answers on the lined pages provided following Question 30.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 70 minutes.

Question 27 **(20 marks)**

The Leeuwin Current is a major ocean current that travels along the Western Australian coastline. One driver of this current is the process of thermohaline circulation.

(a) Explain how thermohaline circulation helps to drive the Leeuwin Current and discuss how the Leeuwin Current influences marine ecosystems. (10 marks)

The enhanced greenhouse effect will impact ocean currents and thermohaline circulation around the world.

(b) Explain the impact of the enhanced greenhouse effect on thermohaline circulation. (3 marks)

(c) Describe the potential impacts of the enhanced greenhouse effect and changes to thermohaline circulation on marine habitats. (7 marks)

Question 28 **(20 marks)**

The profile of Yanchep Lagoon, which is situated in a northern suburb of Perth, changes significantly throughout the year.

(a) Explain, with reference to the sand budget, how the coastal profile of a location can vary significantly with changes in the seasons. (8 marks)

A number of popular Perth beaches have been identified as being at 'extreme risk' of disappearing within the next 15 years as a result of coastal erosion.

(b) Identify **two** soft and **two** hard engineering strategies that could be implemented to minimise the impacts of coastal erosion. For each strategy, describe **one** advantage and **one** disadvantage. (12 marks)

See next page

Question 29 **(20 marks)**

Coral reef communities play a significant role in the marine environment.

(a) Using a labelled diagram, describe the structure of a typical coral polyp, including the surrounding hard structure. (8 marks)

(b) Identify **three** abiotic conditions required for coral reefs to occupy an area and state why each condition is necessary. (6 marks)

(c) Discuss the role and importance of a coral reef in the marine environment. (6 marks)

Question 30 **(20 marks)**

Snorkelling and diving require an understanding of the behaviour of gases when immersed in water. When completing a scuba qualification, divers are required to demonstrate the Controlled Emergency Swimming Ascent (CESA) skill. This skill is useful in situations where a diver needs to return to the surface quickly and has no air. It requires a diver to signal that they are out-of-air, look to the surface to open the airways and, on ascent, continuously exhale gently until reaching the surface. Whilst doing this, a diver should make adjustments to their Buoyancy Control Device (BCD), a jacket to which air can be added or removed and worn when scuba diving. This piece of diving equipment has been designed to enhance the safety of the user in situations such as an emergency ascent.

(a) Explain, with reference to Boyle's Law, what happens to a diver in situations where a CESA is used, and where a CESA is not used during an emergency ascent. Include in your answer the behaviour of gases and their effects on the body. (12 marks)

While duck diving, a snorkeller experiences pain in their left ear.

(b) Suggest the most likely cause of this pain and describe what is occurring in the ear space when the snorkeller descends to a depth of 10 m. (4 marks)

(c) Identify and state how to perform **two** methods of equalisation for this situation. (4 marks)

End of questions

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____

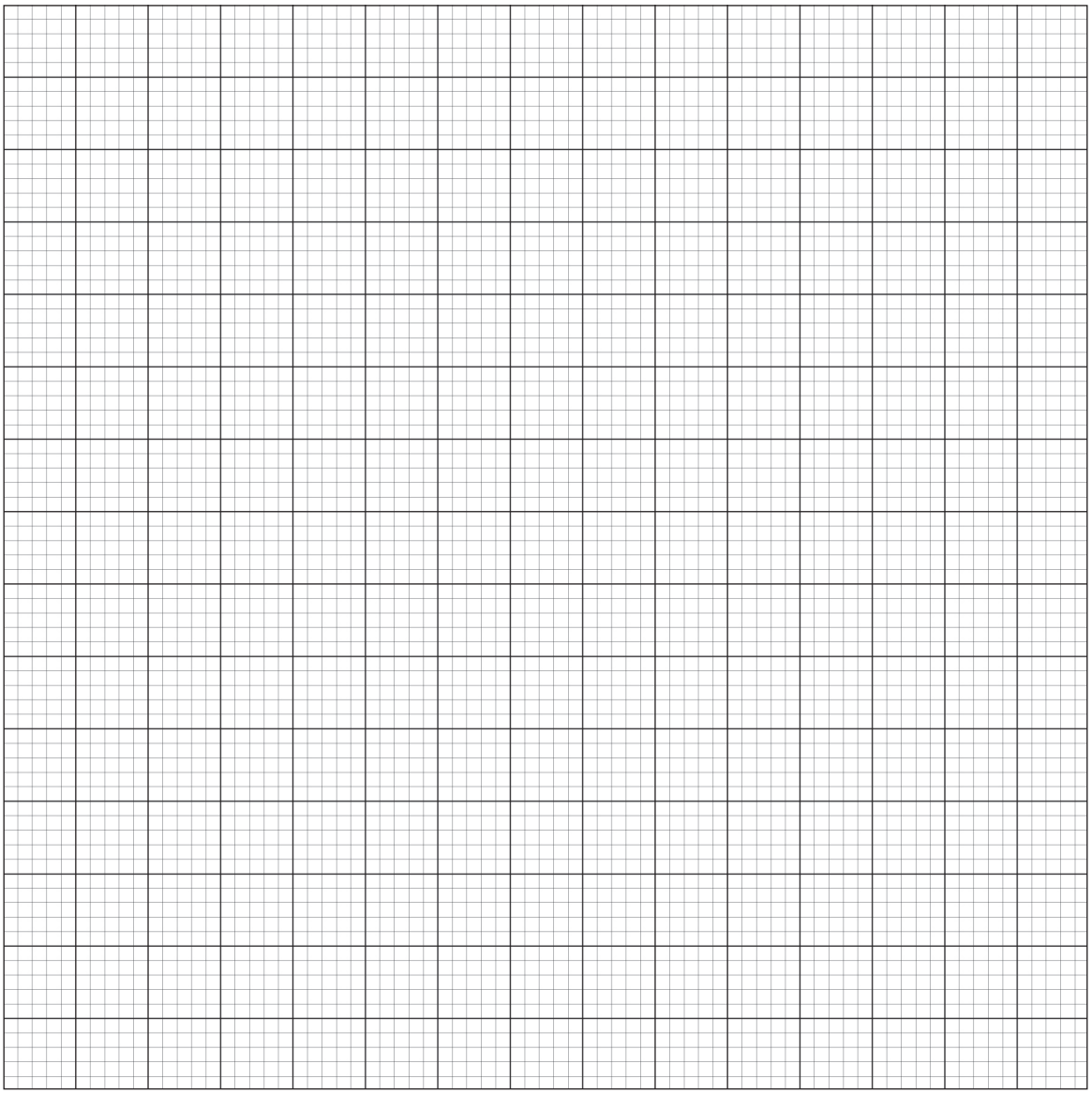
Supplementary page

Question number: _____

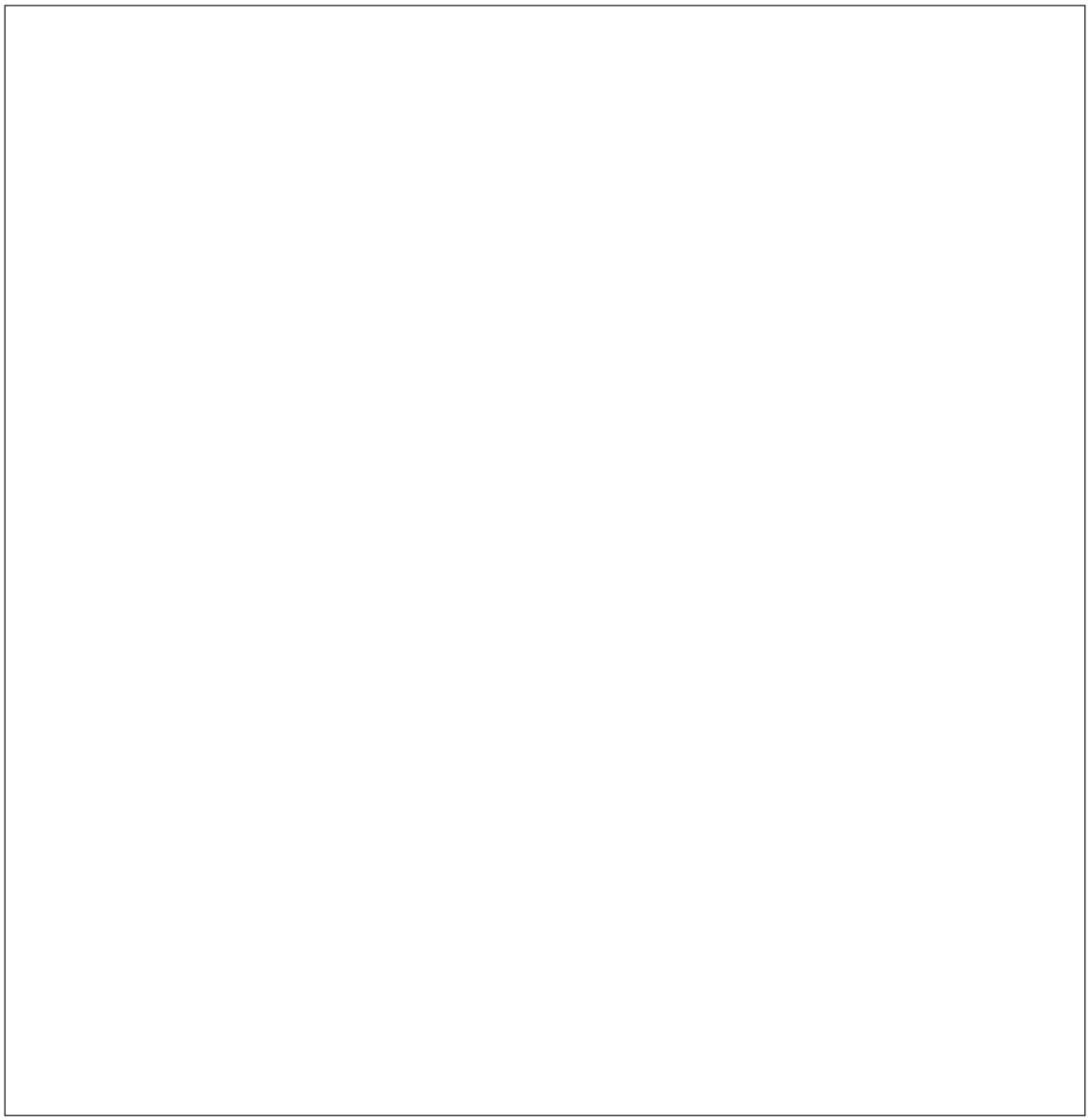
Supplementary page

Question number: _____

Spare grid for Question 23(b)



Spare diagram space for Question 26(d)



ACKNOWLEDGEMENTS

Question 26(d) National Oceanic and Atmospheric Administration. (2021). *What is an Artificial Reef?* Retrieved June, 2023, from https://oceanservice.noaa.gov/facts/artificial-reef.html

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