CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

MARINE SCIENCE **9693/33**

Paper 3 A Level Theory **May/June 2026**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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Section A

Answer **all** questions in this section.

1 Chesapeake Bay is the largest and most productive estuary in the United States, with over 3600 species of animals and plants. It is surrounded by major cities, towns and agricultural land.

Figure 1.1 shows the Chesapeake Bay estuary.

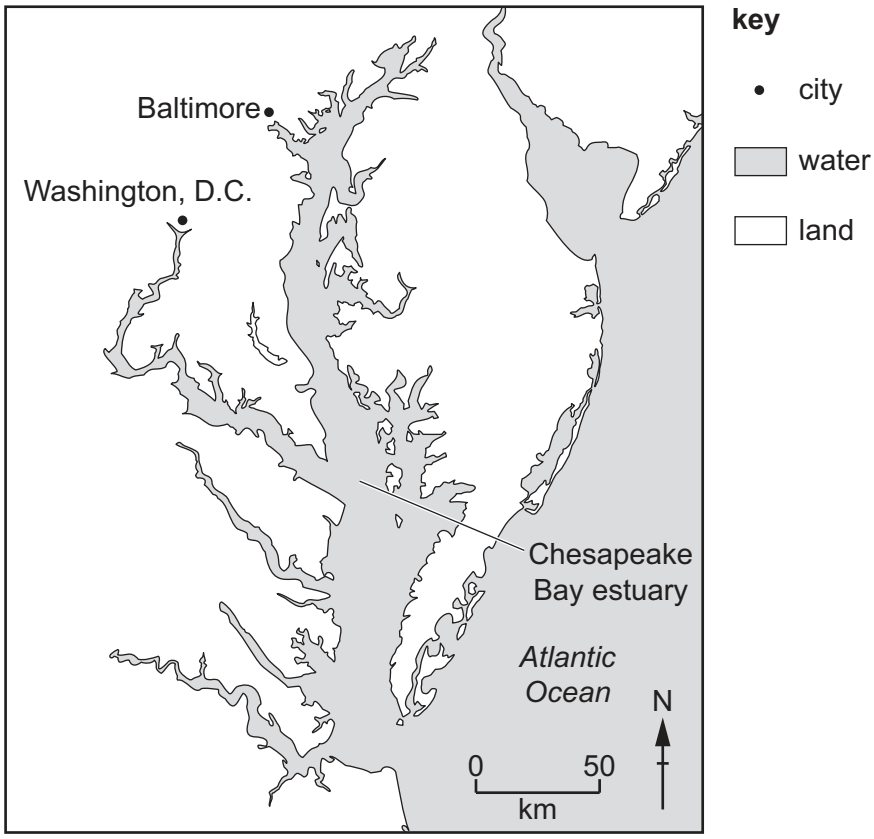

Figure 1.1

(a) **(i)** Oysters have been cultivated for centuries in the estuary, where they feed on phytoplankton.

State **two** features of estuaries which make them suitable for oyster cultivation.

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2 .....

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[2]

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(ii) Oyster numbers have declined by around 99% recently. Algal growth has increased.

Use **all** the information provided to explain the likely causes of the decline in oyster numbers.

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(b) As part of a restoration project, oysters are grown in the bay using three different methods:

- floating cages
- floating bags
- bottom cages.

Figure 1.2 shows these three growing methods and the abiotic sampling which takes place around them.

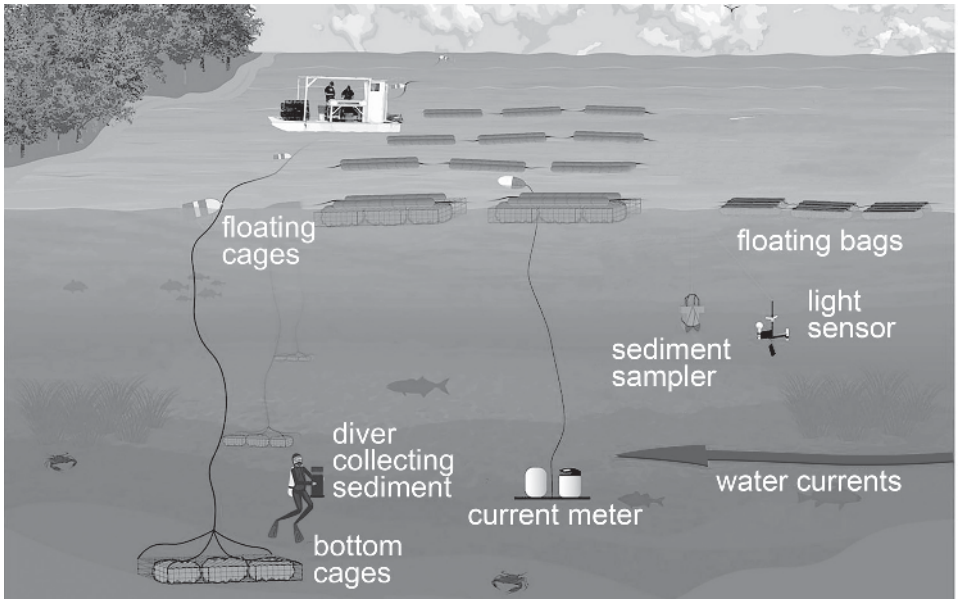

Figure 1.2

(i) Suggest **two** advantages of using floating cages or floating bags to grow oysters rather than using bottom cages.

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[2]

(ii) Suggest **two** advantages of growing oysters in bottom cages rather than in floating cages or floating bags.

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[2]

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(iii) Explain why light and sediment are sampled around oyster cultivation.

light .....

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sediment .....

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[2]

(c) Oysters are filter feeders. A single oyster can filter up to 225 litres of water per day.

Explain why this is an advantage to the surrounding ecosystem.

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[Total: 14]

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2 **(a)** Benthic trawling is used to capture bottom-dwelling fish and prawns. Scientists estimate that approximately 46% of all bycatch comes from benthic trawling.

(i) Explain why bycatch is harmful to fish populations.

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(ii) Outline other ways in which benthic trawling damages the marine environment, apart from harming fish populations.

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(b) New technology is constantly being developed and used in the fishing industry to increase catch and reduce waste.

Scientists in the UK have developed a device that uses AI (Artificial Intelligence) to identify catch. The device can fit into existing nets.

Figure 2.1 shows a fishing net containing this device. Figure 2.2 shows how this device works.

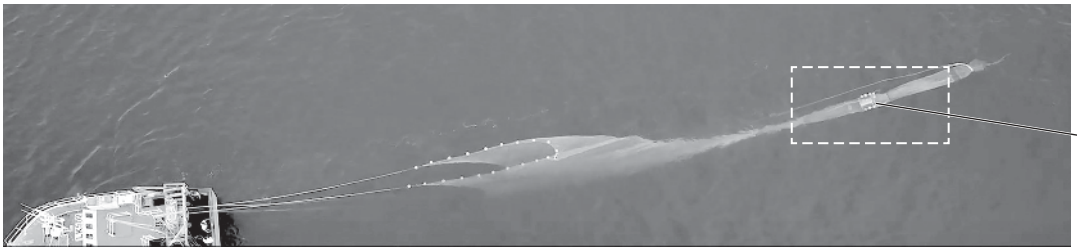

Figure 2.1

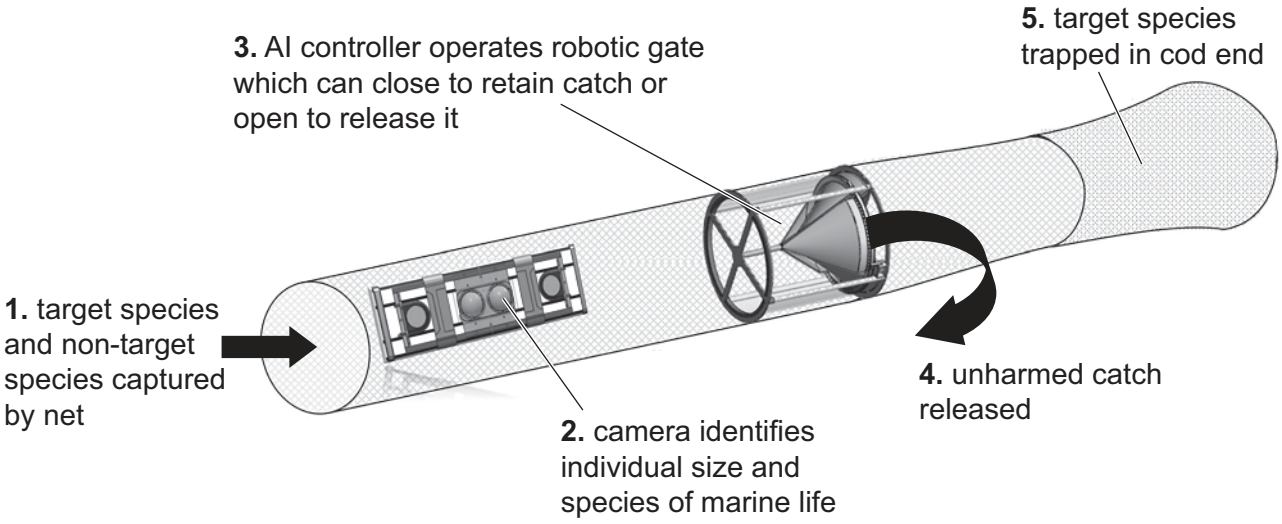

Figure 2.2

Use the information provided to suggest **and** explain the benefits to fishers of using this device.

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(c) Scallops are harvested by dredging. In Norway these were over-harvested, so dredging has been banned for the past 30 years to allow the scallop population to recover.

A new method of harvesting using AI technology was developed in 2023. Using undersea cameras, this type of harvesting does not touch the sea bed and can identify and collect only adult scallops using gentle suction.

Suggest how using AI technology could make scallop fishing sustainable.

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[Total: 13]

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3 Read the information about the pearl octopus, *Muusoctopus robustus*.

Pearl octopuses live in the abyss, some 3 km below the surface. Sea temperatures in the abyss are around 1.6 °C. At these temperatures scientists would expect pearl octopus embryos to take between 5 and 10 years to develop.

In 2018, scientists discovered that thousands of pearl octopuses migrate throughout the year to mating and nesting sites at hydrothermal springs. Here, warm water escapes from the sea bed at temperatures of between 5 °C and 10 °C.

Male pearl octopuses deposit sperm inside the female's body where fertilisation takes place. The males then die.

Each female lays around 60 eggs which are cemented to bare rock. The female then guards the eggs and forces water over them at regular intervals. The eggs hatch into baby octopuses in less than 2 years. The female does not eat during this time, so when the eggs hatch, she also dies.

The surrounding area provides a habitat for a community of organisms including scavengers such as anemones, whelks, sea stars, shrimp and fish.

(a) State the type of life cycle shown by the pearl octopus. Give a reason for your answer.

type of life cycle .....

reason .....

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[2]

(b) State **one** advantage of the type of fertilisation used by the pearl octopus.

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(c) Suggest reasons why the pearl octopus migrates to hydrothermal springs to produce its young.

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(d) Explain why the female forces water over the eggs at regular intervals during development.

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(e) Suggest why pearl octopuses are important to the community of organisms found at hydrothermal springs.

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(f) The water at hydrothermal springs is unpredictable and can be subject to sudden increases in temperature.

Predict **and** explain the effect of a sudden increase in temperature on pearl octopus eggs.

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[Total: 11]

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4 More than 300 million people around the world now rely on desalinated water. The number of desalination plants doubled between 2013 and 2023 and is predicted to increase by 9% each year to 2030. In most cases the energy supplied to run desalination plants comes from burning fossil fuels.

In 2023 a new type of floating desalination machine was developed, powered entirely by wave energy.

(a) State **three** advantages of using wave power instead of using fossil fuels as an energy source to power the desalination machine.

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2 .....

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[3]

(b) Desalination releases concentrated brine back into the sea. The brine is usually 50% saltier than sea water.

Explain why releasing concentrated brine is harmful to macroalgae. Use the term water potential in your answer.

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[Total: 7]

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Section B

Answer **all** questions in this section.

5 Discuss the importance of conserving seagrass beds.

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6 (a) Figure 6.1 shows a sea anemone which belongs to the phylum Cnidaria.

Figure 6.1

Describe **and** explain how gaseous exchange occurs in sea anemones.

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(b) Tuna live in the open ocean.

Explain how their method of gas exchange relates to their motility.

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[Total: 14]

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7 Outline the light-independent stage of photosynthesis **and** state where this stage occurs inside a plant cell.

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