Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2560266817

MARINE SCIENCE **9693/31**

Paper 3 A Level Theory **May/June 2023**

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 or correction fluid.
- 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.

DC (KN/SG) 316428/2

[Turn over

Section A

Answer **all** questions in this section.

1 **(a)** New River estuary in South Island, New Zealand, is a shallow tidal lagoon. The estuary has a wide range of wetland habitats, including extensive mudflats, saltmarsh and seagrass.

Fig. 1.1 shows a map of the estuary.

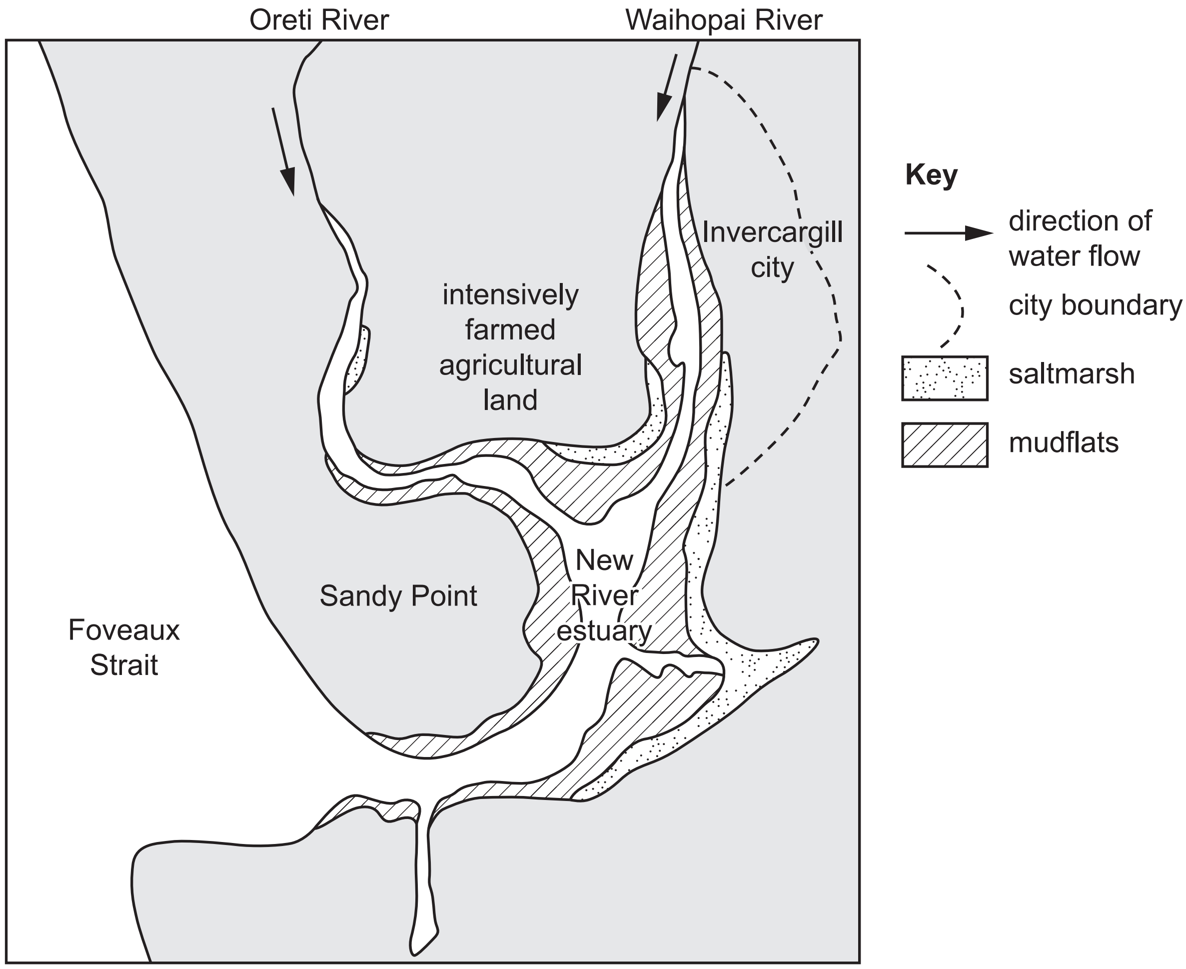

Fig. 1.1

(i) Explain why mudflats are formed in intertidal areas of the estuary.

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(ii) Describe how seagrass and saltmarsh plants help reduce erosion of the surrounding land **and** reduce nutrient levels in the estuary.

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(b) Land drainage and clearance over the last 20 years have reduced the area of wetland. The volume and speed of water entering the estuary as run-off has increased, bringing with it more nutrients and microorganisms, such as bacteria.

(i) Use Fig. 1.1 to suggest **two** reasons why quantities of nutrients and microorganisms in run-off have increased over the last 20 years.

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[2]

(ii) Excess nutrients have resulted in blooms of macroalgae, which form large mats covering the water surface.

Explain how these mats reduce the numbers of seagrass and saltmarsh plants.

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(c) Water monitoring since 2001 shows that the estuary suffers from increasing eutrophication. Eutrophication occurs when excess nutrients stimulate an overgrowth of producers, which usually results in oxygen depletion. In 2001, 1% of the area was highly eutrophic, increasing to 15% in 2019.

(i) Suggest why an estuary is more likely to experience eutrophication than open seas.

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(ii) In the eutrophic areas there is black mud a few centimetres below the surface, which contains very little or no oxygen. Only specialised bacteria survive in this mud.

Describe the processes used by these bacteria to obtain and then release energy.

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[Total: 15]

2 **(a)** Greenland sharks can live for over 200 years and are found in the almost freezing waters of the North Atlantic and Arctic oceans. Most sharks, such as the blue shark, live in tropical and temperate waters.

Table 2.1 compares a Greenland shark with a blue shark.

Table 2.1

feature	Greenland shark	blue shark
water temperature range	–2 to 12 °C	12 to 20 °C
swimming depth	just above sea bed to depths below 2000 m, often under ice	mid-water to 350 m
swimming speed	0.3 to 1.1 m/s	0.7 to 10.9 m/s

Fig. 2.1 shows a Greenland shark and a blue shark.

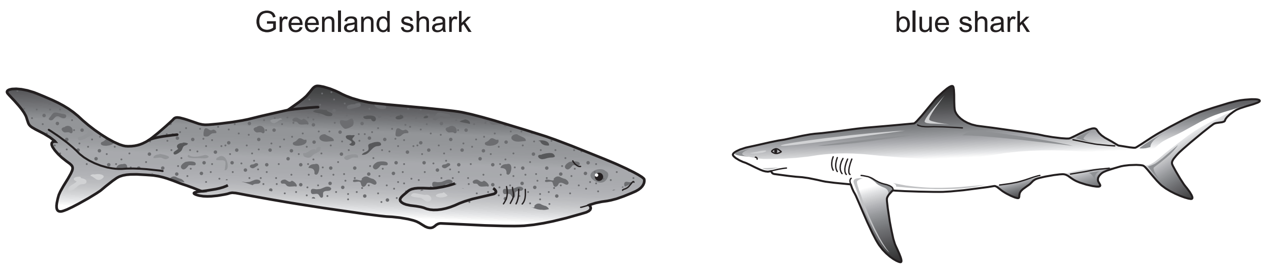

Fig. 2.1

(i) Use the information in Table 2.1 and Fig. 2.1 to explain how the Greenland shark is adapted for living in its habitat.

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(ii) Greenland sharks are apex predators, feeding on a wide variety of food including fish, seals and any dead animals on the sea bed. Most Greenland sharks are blind, due to a parasite which lives on their eyes.

Suggest why blindness is **not** a disadvantage for Greenland sharks when feeding.

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(b) Many animals, including sharks, produce urea as a waste product of protein breakdown. Urea is soluble, and is a toxic substance, and therefore most urea is removed in urine. The production of urea, and its removal in urine by kidneys, uses energy.

However, Greenland sharks retain most of the urea that is produced, which remains in solution in their blood. This makes the concentration of solutes in the blood greater than that of the surrounding sea water.

Explain why retaining a high level of urea in the blood is an advantage to Greenland sharks.

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(c) Describe the possible impact of global warming on the distribution of the Greenland shark.

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[Total: 10]

3 **(a)** The United Nations achieved its aim of 10% of oceans on Earth becoming protected areas by 2020. Creating marine protected areas (MPAs) and placing endangered species on the IUCN Red List are two of the main ways to conserve marine species and increase biodiversity.

(i) Name **two** other strategies used for conserving marine species.

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[2]

(ii) Suggest why many MPAs are created in coastal areas which include mangroves, coral reefs or seagrass beds.

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(b) The European Union (EU) is made up of many separate nations. Industrial fishing takes place in the seas around the EU.

MPAs have been created by some of the nations in the EU. Each nation controls its own MPAs. However, fishing is regulated by the EU as a whole and not by individual nations.

MPAs cover 29% of European waters. A recent study found industrial bottom-trawling and dredging took place in 59% of these MPAs. Monitoring has shown that sharks and rays are five times more abundant in non-protected areas than in MPAs, indicating that MPAs have a relatively low biodiversity.

Suggest reasons why the MPAs around Europe have been largely unsuccessful at increasing biodiversity.

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[Total: 8]

4 **(a)** Sandeels in the North Sea are an important food source for many predators including fish, marine mammals and seabirds. Sandeels are a short-lived species which swim in large shoals just above the sea bed.

Sandeels support a large commercial fishery in the North Sea.

(i) State the trawling method used to catch sandeels and give a reason for your answer.

trawling method ....

reason .... [1]

Fig. 4.1 shows the mass of spawning adult sandeels between 1998 and 2019, in part of the North Sea.

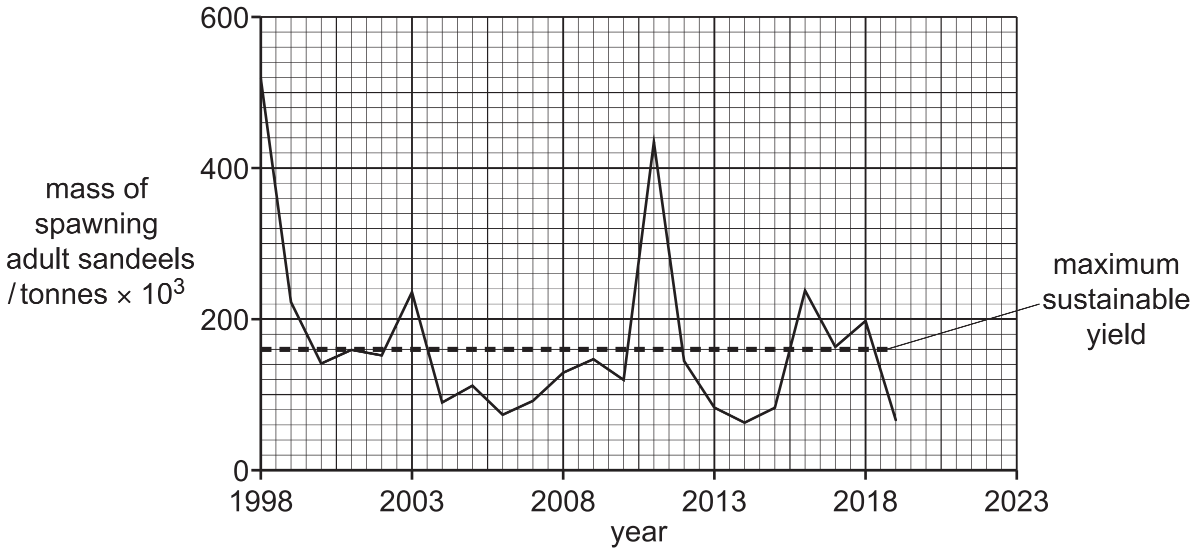

Fig. 4.1

(ii) Calculate the change in mass of spawning adult sandeels between 1998 and 2019.

Show your working.

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(iii) Quotas on catch limits were introduced in 2004 and are set each year. Quotas ensure that there are enough sandeels to support both the local ecosystem and commercial fishing.

Use the information in Fig. 4.1 to evaluate if quotas have been successful.

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(b) Sandeels feed on zooplankton, particularly copepods. Copepods feed on phytoplankton.

The outer circle in Fig. 4.2 shows the life cycle of sandeels over one year. The middle circle shows the food source for each stage in the life cycle and its availability. The inner circle shows the temperature change with each season.

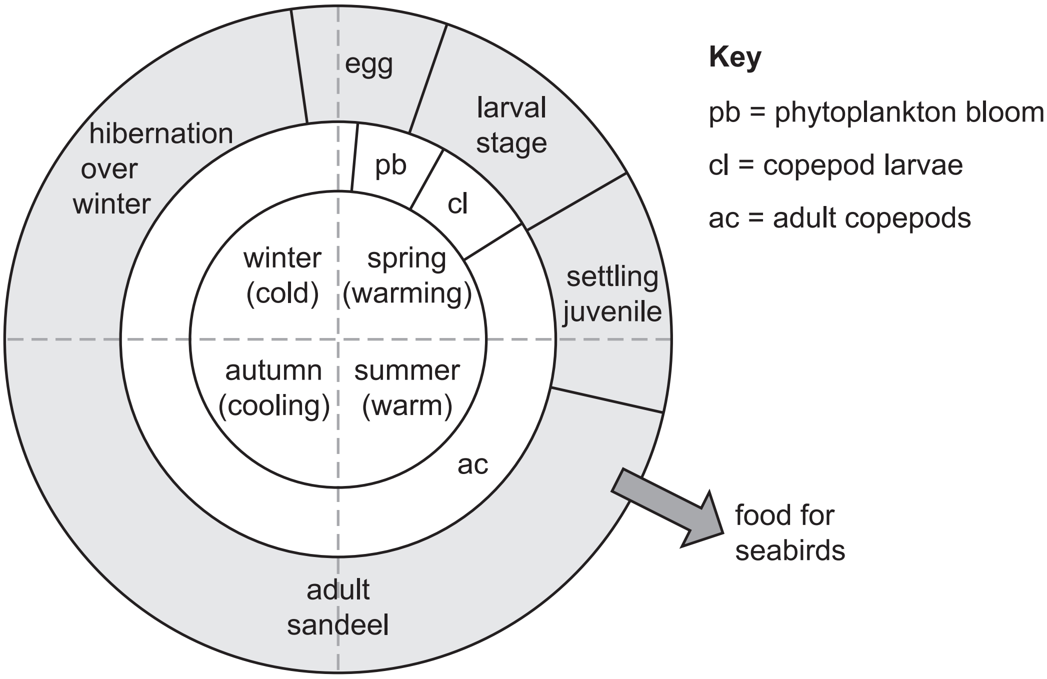

Fig. 4.2

Adult sandeels actively feed over the summer and autumn to build up energy stores for hibernation over winter. During hibernation adult sandeels ‘sleep’, buried in sand on the sea bed and do not feed. At the end of this time they produce eggs, ready for release onto the sea bed in January. The planktonic larvae hatch in early spring and drift with the currents until they settle on the sea bed.

Increasing sea temperatures have increased the rate at which adults use their energy stores while hibernating, so less energy is available for egg production, and egg release is delayed.

Use the information in Fig. 4.2 to suggest **and** explain the effect of increasing sea temperatures on sandeel eggs, larvae and juveniles.

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(c) Seabirds such as kittiwakes nest on sea cliffs and depend on adult sandeels to feed their chicks during early summer. Increasing wind farm construction in the North Sea close to shore has concerned conservationists. Wind farms have a negative effect on seabirds if they are within 75 km of their nesting sites. Seabirds either fly through a wind farm, or around the wind farm, to reach feeding areas.

Use **all** the information provided to suggest possible causes for the decline in numbers of seabirds such as kittiwakes, on sea cliffs around the North Sea.

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[Total: 12]

Section B

Answer **all** questions in this section.

5 Compare gaseous exchange in coral polyps and in tuna.

[10]

6 **(a)** Describe how ocean currents form.

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(b) Outline the importance of ocean currents.

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[Total: 13]

7 Describe how ions such as sodium pass through the cell membrane.

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