



Cambridge International AS & A Level

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MARINE SCIENCE

9693/31

Paper 3 A Level Theory

May/June 2025

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.



Section A

Answer **all** questions in this section.

1 (a) Mar Menor is the largest coastal lagoon in Spain and is a major tourist destination. There are no rivers entering the lagoon, so the water there is calm, and has a maximum depth of seven metres. The tidal range is small, ranging less than a metre.

Fig. 1.1 shows the location of Mar Menor next to the Mediterranean Sea.

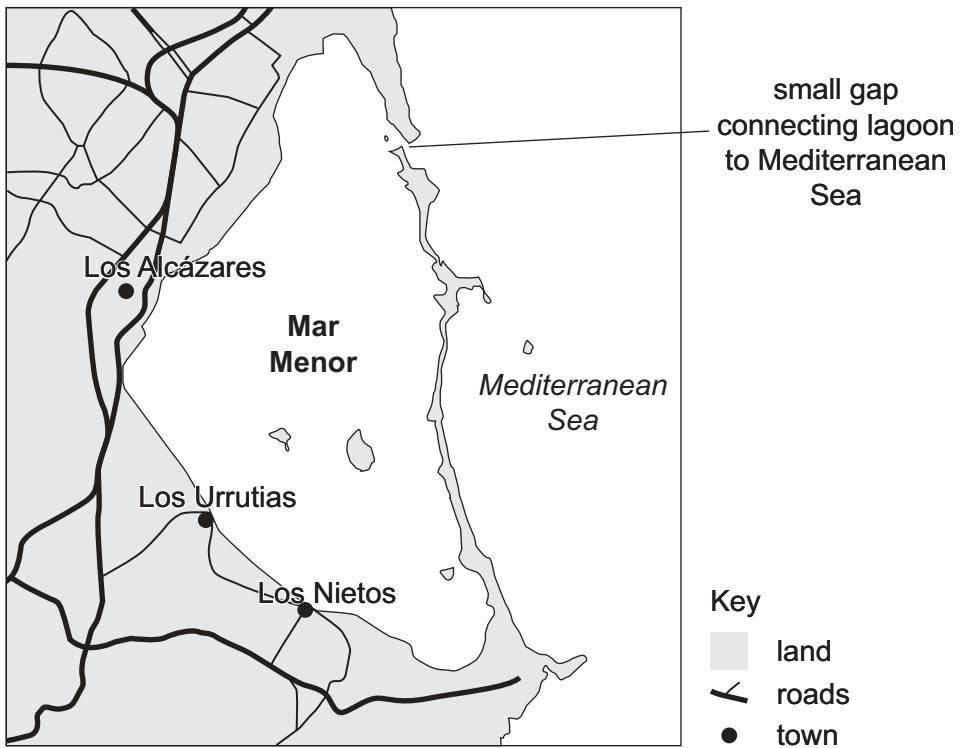


Fig. 1.1

(i) State the meaning of the term tidal range.

..... [1]

(ii) Use Fig. 1.1 to explain why the water in the lagoon generally has a temperature 5 °C higher than the water in the surrounding Mediterranean Sea.

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..... [2]





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(iii) Los Urrutias is a small town surrounded by intensively farmed land. Run-off from this farmland drains into the lagoon.

In 2016, a phytoplankton bloom in the lagoon caused the beaches around Los Urrutias to be closed.

Suggest how the phytoplankton bloom could be caused by intensive farming.

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[3]

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(iv) Most of the lagoon floor is covered by macroalgae and small patches of seagrass.

Explain why the phytoplankton bloom caused 80% of these plants to die.

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[3]





(b) (i) As there are no sources of fresh water around the lagoon, many farmers have invested in small desalination plants to provide fresh water to irrigate their crops.

State how the outflow of water from these desalination plants can affect water quality in the lagoon.

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[1]

(ii) Although there are no rivers entering the lagoon, storm drains are present to remove rainwater from the land after heavy rainfall. Severe flooding in 2019 caused the lagoon water to turn brown, due to silt washed into the lagoon. Thousands of fish and crustaceans died.

Explain reasons why increased silt caused these organisms to die.

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[4]

(c) In 2021, thousands of dead fish were again found in the lagoon. There was no phytoplankton bloom and no flooding, but water temperatures had increased suddenly from 28.2 °C to 31 °C in just two days.

Suggest how this increased temperature could cause fish to die.

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[2]

[Total: 16]





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2 (a) Oysters can grow in a range of salinities from 10 parts per thousand (ppt) in estuaries to 34 ppt in sea water.

Fig. 2.1 shows how the concentration of body fluids in oysters changes with increasing salinity of the surrounding sea water.

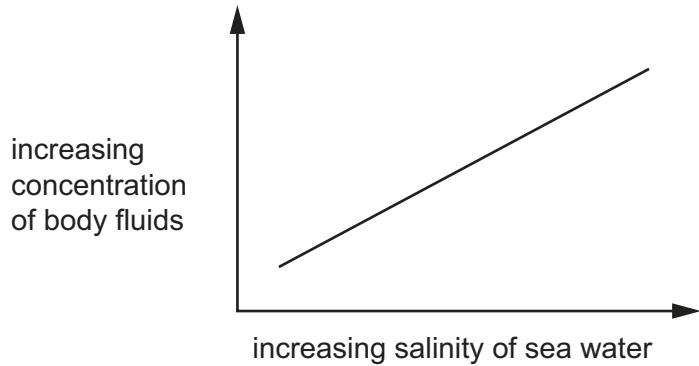


Fig. 2.1

(i) Explain the relationship between salinity of the surrounding sea water and the concentration of body fluids shown in Fig. 2.1.

.....

 [2]

(ii) Use the information from Fig. 2.1 to sketch a line on Fig. 2.2 to show how the body mass of oysters changes with increasing salinity of the surrounding sea water.

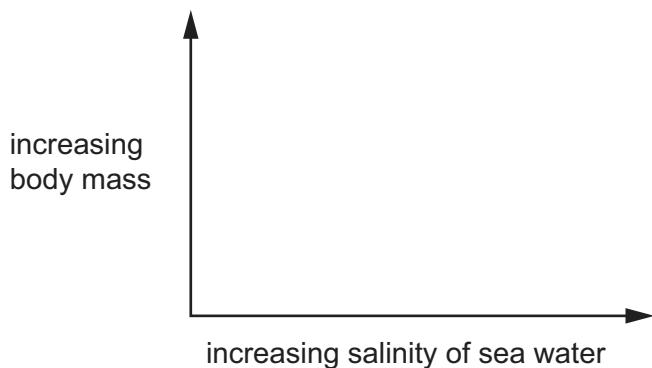


Fig. 2.2

[1]





(iii) Explain why the body mass of oysters changes with increasing salinity of the surrounding sea water.

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[3]

[Total: 6]

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3 (a) Salmon aquaculture can take place on land and in sea cages. In both places the salmon are fed on pellets.

Fig. 3.1 shows the percentage of raw materials used in salmon feed between 1990 and 2020, with predicted percentages to 2030.

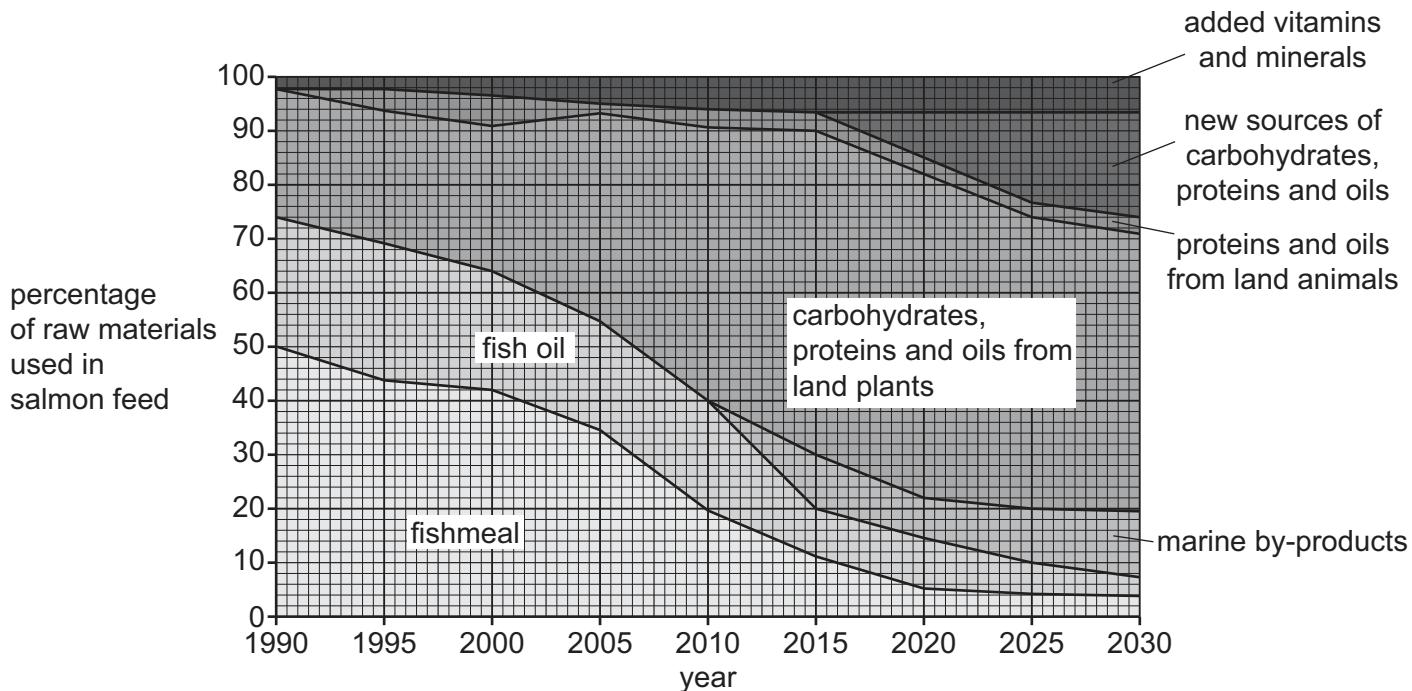


Fig. 3.1

(i) Oils are lipids.

Compare the percentages of fishmeal and fish oil used in salmon feed in 1990 with those predicted in 2030.

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[2]

(ii) Suggest reasons for the differences you have described in (a)(i).

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[2]





(iii) Fig. 3.1 shows that plants grown on agricultural land are predicted to make up the highest percentage of salmon feed by 2030. These plants include soya, corn, peas, beans and wheat.

Suggest a reason why the predicted percentages of carbohydrates, proteins and oils from plants might be an overestimation.

..... [1]

(iv) Suggest why the percentage of added vitamins and minerals in the salmon feed remains the same after 2015.

[1]

(b) Fig. 3.1 shows that new sources of carbohydrates, proteins and oils were introduced into salmon feed in 2015.

Some of these new sources are produced by bacteria which are grown in large tanks on land. The bacteria are provided with nutrients from waste products produced by industry.

(i) Fig. 3.2 shows the molecular structure of one nutrient provided to the bacteria.

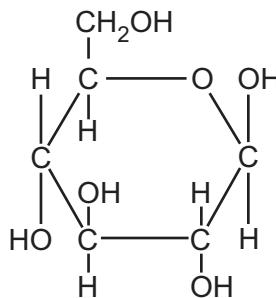


Fig. 3.2

Identify the molecule shown in Fig. 3.2.

..... [1]

(ii) Outline the benefits of using bacteria in salmon feed compared with using plant sources.

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[Total: 9]





4 Seahorses belong to the phylum Chordata. They are small bony fish which live in shallow sheltered waters such as seagrass beds and estuaries. They are poor swimmers and rest by winding their tail around seagrass or seaweed. They feed on phytoplankton, small shrimp and fish larvae.

Fig. 4.1 shows a seahorse.



Fig. 4.1

(a) (i) State **two** features that are shared by all organisms in the phylum Chordata.

1

2

[1]

(ii) Fig. 4.1 shows that seahorses have bony plates in their bodies.

State **one other** feature, visible in Fig. 4.1, that is present in all bony fish.

.....

[1]

(iii) State **one** reason why seahorses are **not** typical bony fish.

.....

[1]





(b) At the start of the 20th century the Ria Formosa National Park in southern Portugal was home to the largest seahorse population in the world. By the 21st century seahorse numbers had fallen by more than 90%. The area is important for commercial fishing and is also a tourist destination.

Fig. 4.2 shows part of the Ria Formosa National Park.

Beaches next
to the Atlantic
Ocean.



Small channels
containing
seaweed and/or
seagrass.

A series of rivers and
channels form a
transport route for
tourist boats to reach
the beaches.

Land areas
contain a mix of
marsh, scrub
and small tidal
pools, much of
which is flooded
at high tide.

They are also widely
used by commercial
fishermen to harvest
fish and shellfish.

Fig. 4.2

Use Fig 4.2 **and** all the information provided to suggest reasons why seahorse numbers have decreased by 90% in the Ria Formosa National Park.

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[4]





(c) Little is known about seahorses, but research over the past decade on why seahorse numbers have declined in Ria Formosa National Park has allowed scientists to learn more about them.

Identify **three** research topics about seahorses that the scientists would have focused on to explain the decline in their numbers.

1

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2

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[3]

(d) Suggest strategies that could be introduced to increase seahorse numbers in Ria Formosa National Park.

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[4]

[Total: 14]





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Section B

Answer **all** questions in this section.

5 Photosynthesis takes place in chloroplasts.

Explain how chloroplast structure is related to this function.

[10]





6 (a) Describe the different ways that carbon compounds can enter the ocean.

[6]

(b) Describe how the oceans help to limit the increase in carbon dioxide in the atmosphere.

[6]

[Total: 12]





7 Discuss the advantages **and** disadvantages of releasing adult salmon produced in a hatchery into the ocean.

[8]

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