



Cambridge International AS & A Level

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MARINE SCIENCE

9693/31

Paper 3 A Level Theory

May/June 2022

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 Fig. 1.1 shows a part of a cell from a fish, as seen using an electron microscope.

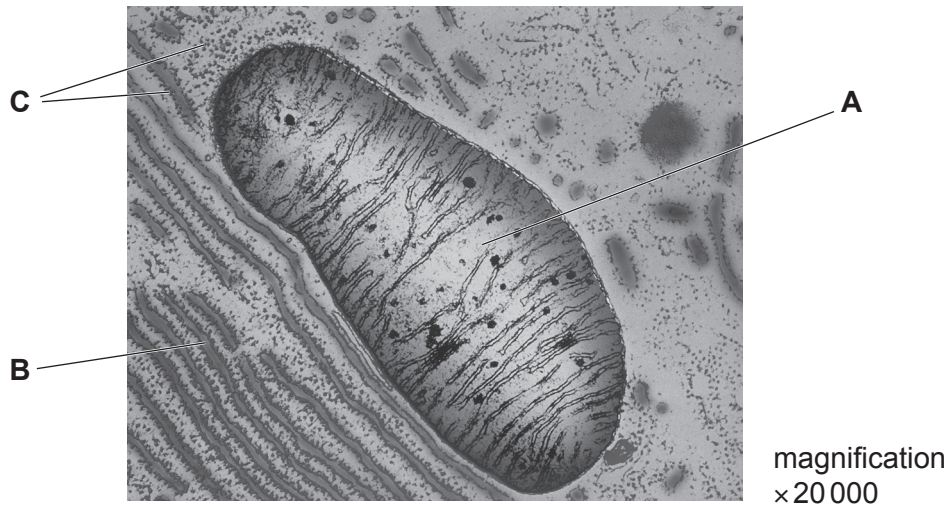


Fig. 1.1

- (a) (i) Complete Table 1.1 by identifying cell structures **A**, **B** and **C** and outlining their function.

Table 1.1

cell structure	name	function
A		
B		
C		

[6]

(ii) Suggest why large numbers of cell structure **A** are found in muscle cells of marine fish.

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..... [2]

(b) Describe how carrier proteins are arranged in cell membranes **and** outline their function.

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..... [4]

[Total: 12]

- 2 (a) Almost all marine producers carry out photosynthesis. Fig. 2.1 shows one of the stages involved in photosynthesis.

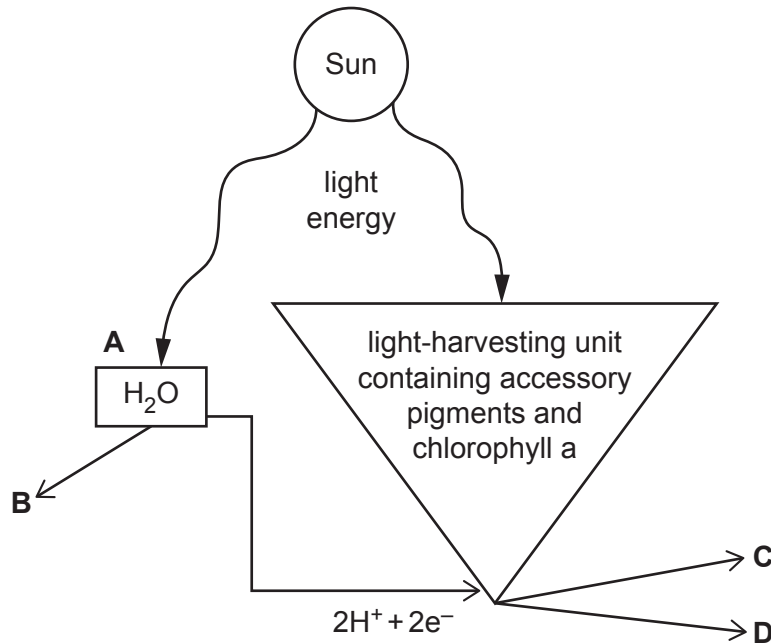


Fig. 2.1

- (i) Name the stage in photosynthesis shown in Fig. 2.1 and state where it occurs in a chloroplast.

name of stage

where it occurs

[2]

- (ii) Use Fig. 2.1 to identify the process occurring at **A**, waste product **B** and products **C** and **D**.

process **A**

waste product **B**

product **C**

product **D**

[4]

(b) Fig. 2.2 shows the effect of light intensity on the rate of photosynthesis in a mangrove leaf at a constant optimum temperature.

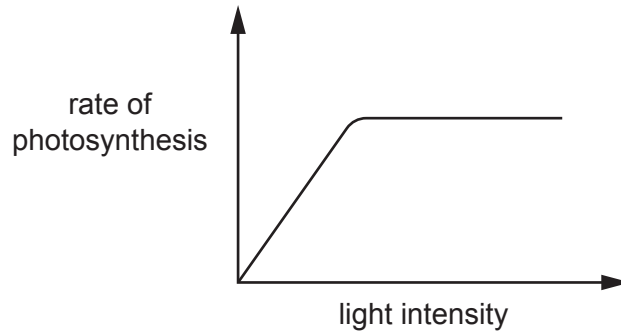


Fig. 2.2

(i) Use Fig. 2.2 to describe **and** explain the effect of increasing light intensity on the rate of photosynthesis.

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..... [3]

(ii) The temperature of the mangrove leaf was then increased by 10 °C.

Sketch a line on Fig. 2.2 to show what you would expect to happen to the rate of photosynthesis. [1]

(iii) State a reason for your answer to (ii).

.....
..... [1]

[Total: 11]

- 3 (a) The seas around North West Africa are important fishing locations. Small pelagic fish such as sardines and mackerel make up between 50% and 70% of the animal protein consumed by the local people.

Over the past decade, most of the fish that the local population depend on as a source of protein are being sent to foreign-owned factories. These factories use the fish to produce fishmeal and fish oil for export to Asia and Europe. The factories use fish caught by local people and by their own industrial fishing fleets.

Fig. 3.1 shows the fishing areas, and location and numbers of fish-processing factories in three countries in North West Africa.

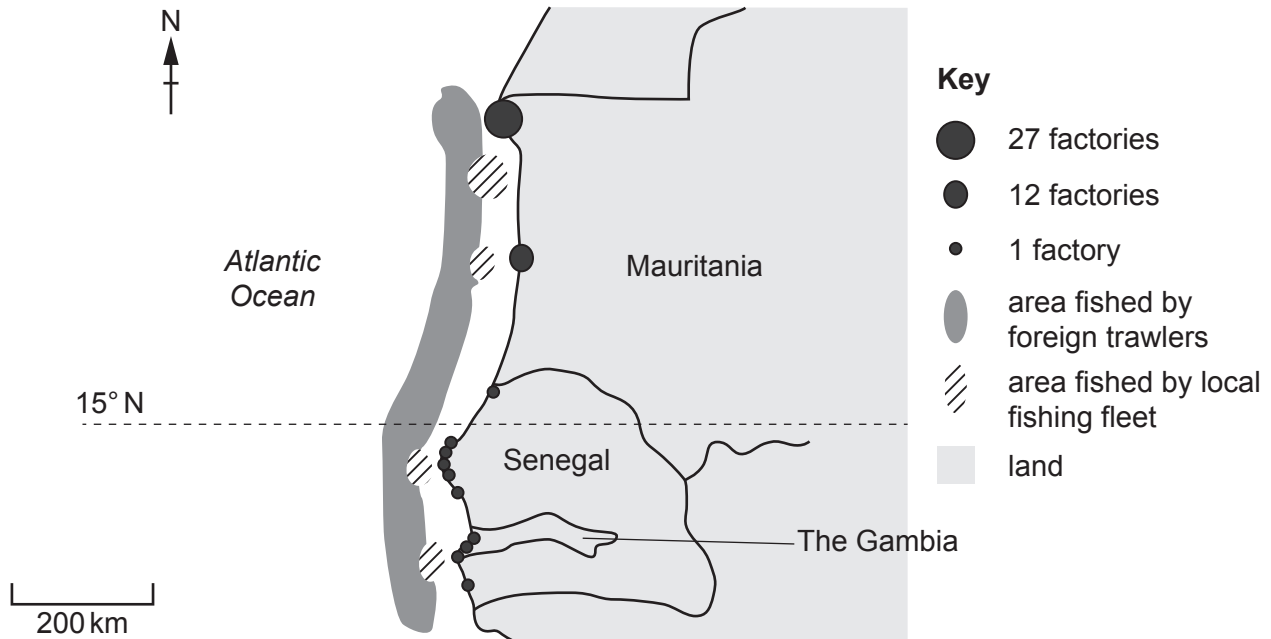


Fig. 3.1

Table 3.1 shows fishmeal and fish oil production for export in 2014 and 2018.

Table 3.1

country	fishmeal production / tonnes		fish oil production / tonnes	
	2014	2018	2014	2018
Mauritania	66 783	127 940	19 752	40 430
Senegal	14 315	9 116	249	2 604
The Gambia	0	1 969	0	823

- (i) Total catches of small pelagic fish off North West Africa increased from 1.2 million tonnes (MT) in 1994 to 2.7 MT in 2017. During these years, the effort required to harvest catch has increased and mean fish size has decreased.

Suggest why the effort required to harvest catch has increased and fish sizes have decreased since 2014.

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..... [2]

- (ii) Local fishermen use small fishing boats and traditional methods, catching fish for women to process for food to be sold locally.

Use the information provided in Fig. 3.1 and Table 3.1 to suggest **and** explain the sociological and economic effect of unrestricted fishing by foreign fishing fleets on the local population.

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..... [3]

- (iii) Before 2017 data on stocks of small pelagic fish were limited. The data were collected using acoustic surveys (sonar) and from records of catch.

State what information can be obtained from acoustic surveys and records of catch.

acoustic surveys
.....
records of catch
..... [2]

- (iv) Data from 2019 confirm that stocks of small pelagic fish have decreased significantly. Fishing restrictions are urgently required to improve stocks and one suggestion has been to ban all foreign-owned fishing fleets from fishing around the North West African coast. This would initially provide more fish for the local population and eventually result in a surplus of fish available for export.

Suggest how consumer-orientated tools could be used to increase the sale of these surplus fish globally.

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..... [3]

- (b) A recent survey predicts that increasing water temperatures due to climate change will cause the small pelagic fish to migrate 1000 km further north.

Suggest why the warmer water will be an unsuitable environment for the small pelagic fish.

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[Total: 13]

4 (a) Combustion of fossil fuels, particularly coal, releases mercury and other substances into the atmosphere.

(i) State **two** examples of 'other substances' released by combustion of fossil fuels.

1 2 [1]

(ii) Describe how mercury in the atmosphere can be passed to marine phytoplankton.

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(iii) Explain why top predators such as tuna contain higher concentrations of mercury than marine phytoplankton.

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..... [3]

- (b) From 1990 to 2007 the United States of America (USA) reduced its emissions from burning fossil fuels by 2.8% per year.

Table 4.1 shows mercury concentrations in the atmosphere and in sea water in the North Atlantic from 1990 to 2005.

Table 4.1

year	mercury concentration in air / arbitrary units	mercury concentration in sea water / arbitrary units
1990	2.25	no data
1995	1.95	no data
2000	1.80	255
2005	1.55	175

- (i) Use Table 4.1 to suggest why there might be a possible link between the effects of the reduction in fossil fuels emissions by the USA, and mercury concentrations in the North Atlantic.

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 [2]

- (ii) More recent data suggests that mercury concentrations in the North Atlantic have not increased since 2005.

Suggest a factor that might cause mercury concentrations in the North Atlantic to increase in future.

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 [1]

[Total: 9]

Section B

Answer **all** questions in this section.

- 5 Salmon farmers usually transfer smolt (juvenile fish) from land-based hatcheries to sea cages to grow them to adult size in shallow inshore waters. Now, several aquaculture businesses are growing the smolt to adult size in land-based buildings using recirculation systems, instead of transferring the smolt to sea cages.

Discuss the benefits **and** challenges of growing smolt to adult size in land-based buildings instead of in sea cages.

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[10]

(b) Describe how increasing levels of carbon dioxide in the atmosphere can affect marine molluscs.

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[Total: 14]

- 7 Discuss the role of marine zoos and aquaria in the conservation of marine species.

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