



# Cambridge International AS & A Level

CANDIDATE  
NAME

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**MARINE SCIENCE**

**9693/32**

Paper 3 A Level Theory

**October/November 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

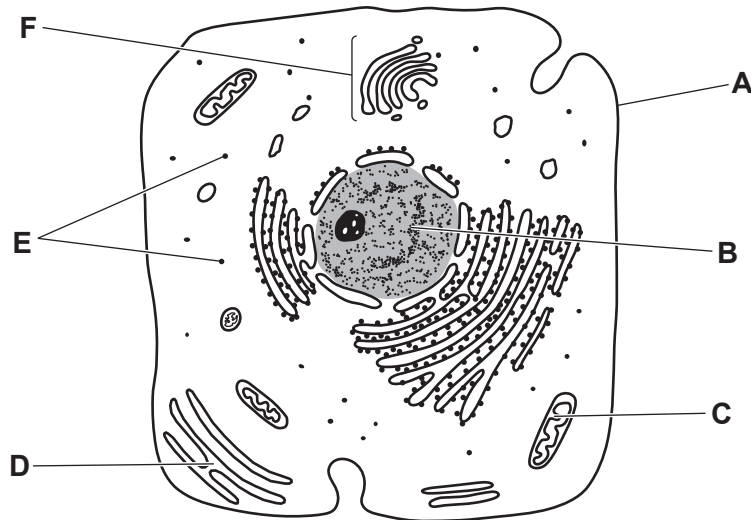
- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].

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

**Section A**

Answer **all** questions in this section.

- 1 (a) Fig. 1.1 shows an animal cell from a marine organism as seen under an electron microscope.



**Fig. 1.1**

- (i) Use Fig. 1.1 to complete Table 1.1 by matching the function of each structure with the correct letter.

**Table 1.1**

function	letter
site of aerobic respiration	
where lipids and steroids are made	
where protein synthesis occurs	
is a selectively permeable membrane	
contains hereditary material which determines protein structure	
collects and processes molecules	

[4]

- (ii) State how a leaf cell from seagrass would differ from the cell shown in Fig. 1.1.

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..... [2]

- (iii) Seagrass has spaces inside its leaves that allow oxygen to diffuse to the cells in its roots.

Explain the importance of oxygen for energy release in root cells.

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..... [2]

[Total: 8]

2 (a) In July 2020, an oil tanker ran aground on coral reefs just off the coast of Mauritius in the Indian Ocean. The ship began leaking oil and broke apart in August. The site is close to a marine protected area, an important habitat for seagrass, corals, mangroves, 72 fish species, nesting seabird colonies and the endangered green turtle.

(i) Explain how a layer of oil covering the water surface will reduce photosynthesis in seagrass and marine algae.

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..... [2]

(ii) As part of the clean-up operation, booms were placed on the sea surface to trap the oil and prevent it from spreading. Booms were held in place by ropes and chains anchored to the sea bed. Chemicals were used to disperse the oil.

Fig. 2.1 shows a boom that has trapped oil.



Fig. 2.1

Suggest **one** negative effect of using booms on local marine organisms and **one** negative effect of using chemicals on local marine organisms.

booms .....  
.....  
chemicals .....  
..... [2]

(b) Explain the negative effects of the oil spill on nesting seabird colonies.

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..... [3]

(c) Tourism and fishing are the main sources of employment in this area.

Suggest **and** explain the long-term effect of the oil spill on the local human population.

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..... [3]

[Total: 10]

- 3 (a) One effect of increasing global temperatures can be seen in the Arctic.

Sea ice covers part of the Arctic. The area of sea ice increases to a maximum during the Arctic winter, and then decreases to a minimum during the Arctic summer.

Fig. 3.1 shows the minimum extent of Arctic sea ice in 1980 and in 2020.

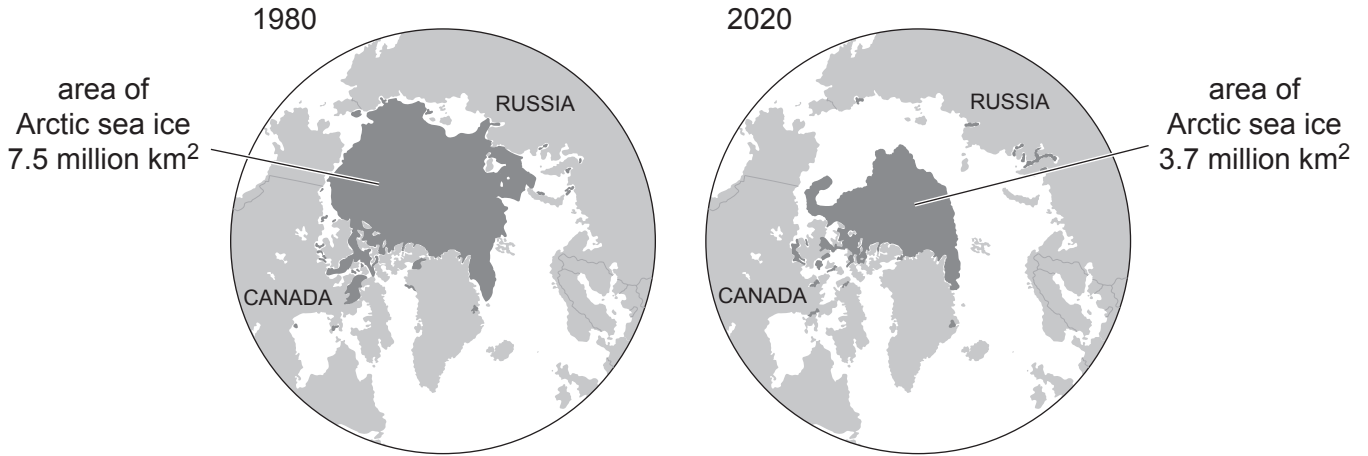


Fig. 3.1

- (i) Explain how Fig. 3.1 provides evidence for global warming.

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..... [2]

- (ii) Describe the possible impacts of global warming on the **abiotic** marine environment in the Arctic.

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.....  
.....  
..... [4]

- (b) Beluga whales live in the Arctic Ocean. They can swim beneath the sea ice and beneath glaciers around the coastlines to hunt for prey.

Fig. 3.2 shows a beluga whale.



**Fig. 3.2**

Beluga whales have no dorsal fin and their bodies contain up to 20% more fat than most other species of whale.

- (i) Suggest **two** advantages to beluga whales of **not** having a dorsal fin.

1 .....

.....

2 .....

.....

[2]

- (ii) Productivity in the Arctic Ocean is high during the short summer season but very low during the long winter months.

Suggest how beluga whales are able to survive in the Arctic Ocean throughout the year.

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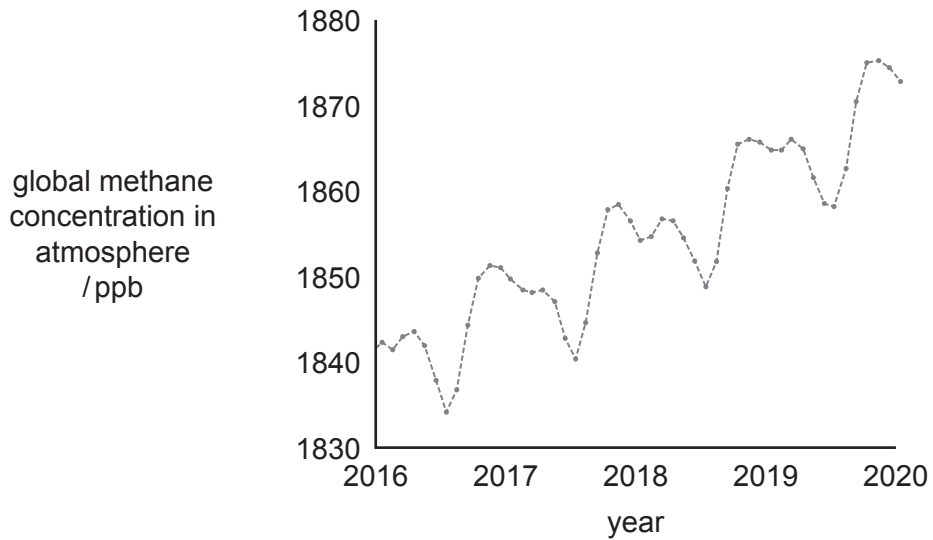
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..... [2]

- (c) The sediment in the continental shelf around northern Russia contains high levels of frozen methane and is a methane sink. Methane is a greenhouse gas.

Fig. 3.3 shows global methane concentration in parts per billion (ppb) in the atmosphere between 2016 and 2020.



**Fig. 3.3**

Use **all** the information provided in this question to suggest why scientists think that methane levels in the atmosphere could increase significantly in future years.

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..... [3]

[Total: 13]



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- 4 (a) Antarctic krill feed on phytoplankton. Krill are prey for fish, squid, and several species of whale. They also provide food for seals and penguin colonies, which breed onshore.

Fig. 4.1 shows the life cycle of Antarctic krill.

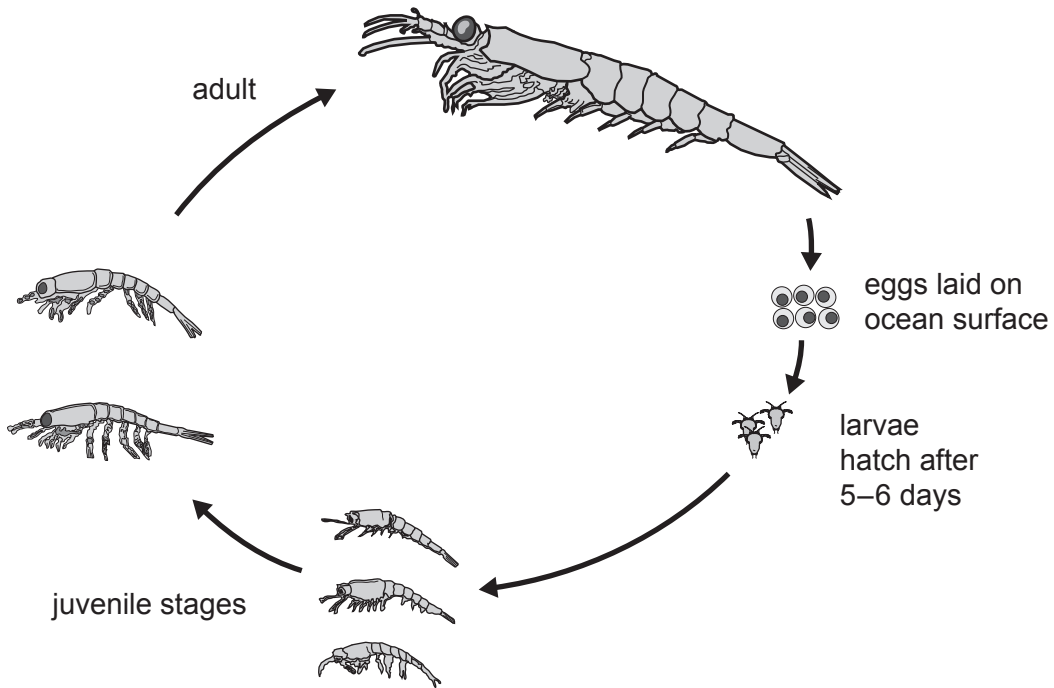


Fig. 4.1

- (i) The life cycle in Fig. 4.1 shows metamorphosis.

Explain what is meant by the term metamorphosis.

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

- (ii) Spawning season is from January to March and female krill can produce up to 10000 eggs at a time. As the eggs develop they become more dense and sink, so that the larvae hatch at a depth of below 1000m. The larvae then swim upwards through the water column to feed.

State how sea water conditions at 1000m differ from those at the surface.

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..... [2]

(b) Laboratory experiments have shown that krill eggs are sensitive to carbon dioxide concentration in sea water. The concentration of carbon dioxide in the sea around the Antarctic is around 250 ppm.

Fig. 4.2 shows the effect of increasing carbon dioxide concentration in sea water on the percentage of krill eggs that hatch.

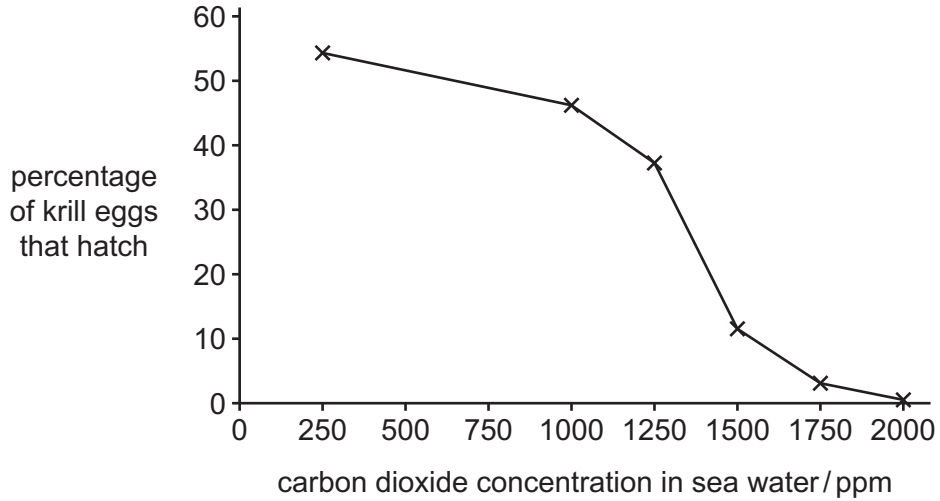


Fig. 4.2

Use Fig. 4.2 **and** your own knowledge to explain why increasing concentration of carbon dioxide in the atmosphere poses a threat to krill in the Antarctic Ocean.

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..... [4]

- (c) CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) was set up in 1980 to manage fishing, including Antarctic krill fishing, in Antarctica.

Krill fishing vessels are factory ships as the krill must be processed immediately. Fishing only takes place for a few months during the Antarctic summer season when the ice retreats.

Surveys take place annually to estimate krill populations. Computer modelling is used to predict total numbers and set catch limits for the following year. Krill fishing is only allowed in certain sectors. These are shown in Fig. 4.3.

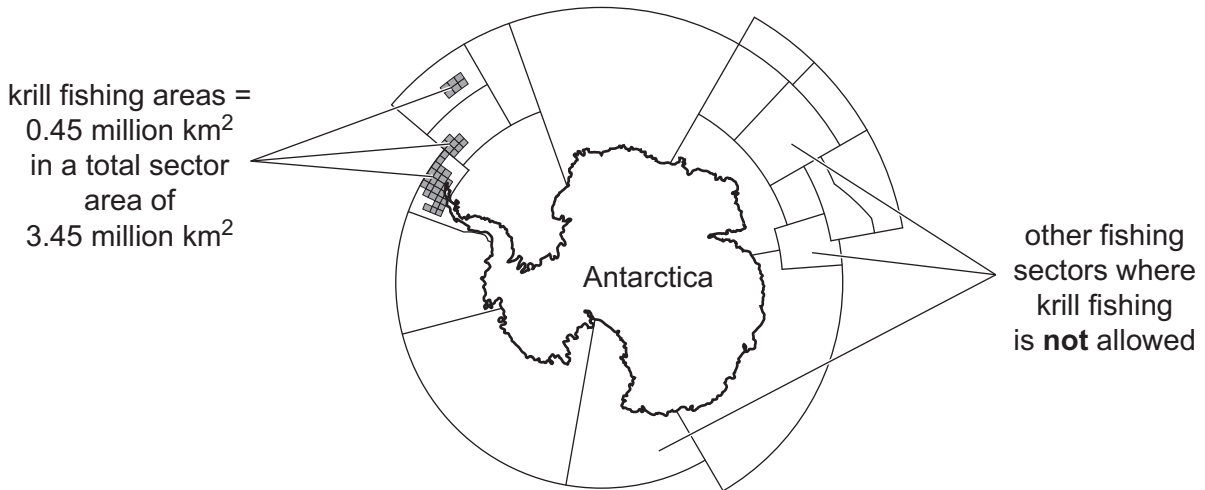


Fig. 4.3

- (i) Suggest **one** reason why all krill fishing vessels must be fitted with satellite tracking and **one** reason why most also have an independent observer from a regulatory body on board.

satellite tracking .....

.....

independent observer .....

.....

[2]

- (ii) In 2020, new sectors were surveyed to see if they could support sustainable krill fishing. The surveys included using sonar to locate krill shoals.

State what other information sonar could provide.

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..... [1]

- (iii) In the 2020/21 fishing season, Antarctic krill fishing areas were moved further from the shore, away from breeding colonies of penguins and seals.

Use **all** the information provided to suggest the advantages to fishers of factory ships fishing further from the shore.

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..... [2]

- (d) Only the 25 countries which are members of CCAMLR are licensed to fish in Antarctic waters.

Suggest what implications this has for conservation in Antarctic waters.

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..... [2]

[Total: 14]





