Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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4110163256

MARINE SCIENCE **9693/03**

Paper 3 A2 Structured Questions **October/November 2017**

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **14** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

Answer **all** the questions in the spaces provided.

1 Algae are primary producers and form the base of many food chains in the sea.

(a) (i) Name the type of habitat where red, green and brown algae can all be found.

.....[1]

(ii) Explain why algae are described as primary producers.

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.....[2]

(iii) The highest productivity of algae occurs in shallow, clear water.

Explain the effect of limiting factors on the productivity of algae in deep water.

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.....[3]

(b) An aquaculture company in Canada cultivates kelp on ropes next to fish cages in shallow water.
The presence of fish in cages increases the concentration of nitrogen-containing nutrients which can be used by the kelp.

(i) Explain why the presence of fish results in an increase in the concentration of nitrogen-containing nutrients.

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.....[2]

(ii) State how kelp uses the nitrogen-containing nutrients.

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.....[1]

(iii) Explain how growing kelp next to the cages can increase the oxygen concentration and reduce carbon dioxide concentration in the water around the fish cages.

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.....[2]

(c) Suggest how growing kelp can increase biodiversity in the surrounding water.

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.....[2]

[Total: 13]

2 Read the information about the whale shark and the minke whale.

> Whale sharks are the largest species of marine fish. They reach 12 m in length and weigh 9 tonnes. Young whale shark develop within egg capsules containing yolk. These egg capsules are retained inside the female's body. Females can have up to 300 capsules in their body. Live young are born in small numbers throughout the year and are about 40 to 60 cm in length. They grow rapidly in the first few months of life by feeding on plankton. They reach sexual maturity at about 30 years.
>
> Minke whales are one of the smallest whales found in colder seas. They reach 9 m in length and weigh 10 tonnes. Minke whales in the Atlantic Ocean breed between December and May. The young develop in the female's body and are supplied with food through a placenta. Females give birth to one calf, 2.8 m in length, every two years. The calf feeds on the mother's milk for 5 months but can stay with the mother up to a year. They reach sexual maturity at 6 years.

(a) (i) State **two** ways in which the reproduction of whale sharks and minke whales is similar.

1 .....

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2 .....

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[2]

(ii) State **three** ways in which the reproduction of whale sharks and minke whales is different.

1 .....

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2 .....

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3 .....

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[3]

(b) Suggest why whale sharks take five times longer than minke whales to reach sexual maturity.

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.....[2]

[Total: 7]

3 Mussels are osmoconformers commonly found in estuaries.

(a) (i) State the meaning of the term *osmoconformer*.

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.....[1]

(ii) On Fig. 3.1, sketch a line to show how the concentration of the body fluid of a mussel would change as the concentration of the external environment changes.

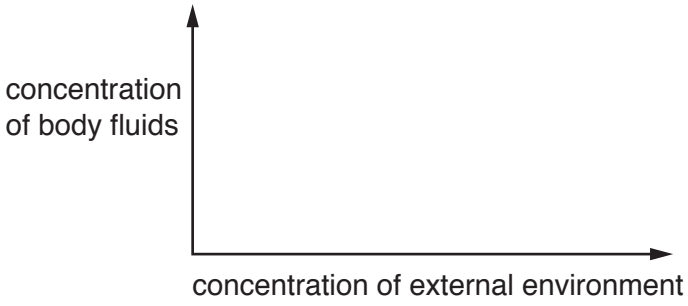

Fig. 3.1 [1]

(iii) On Fig. 3.2, sketch a line to show how the body mass of a mussel would change as the concentration of the external environment changes.

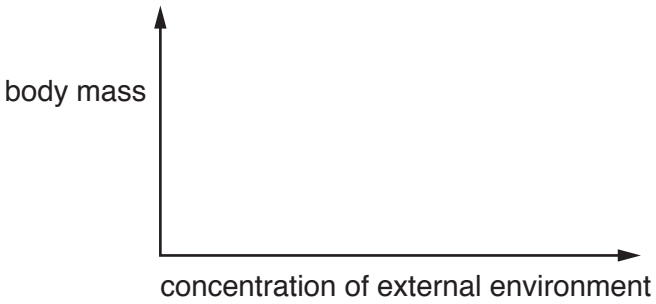

Fig. 3.2 [1]

(iv) Explain why the mass of a mussel changes when the concentration of the external environment changes.

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.....[3]

(b) Table 3.1 shows information about the composition of five liquids.

Table 3.1

liquid	sodium ions /mmol dm^{-3}	chloride ions /mmol dm^{-3}	urea /mmol dm^{-3}	total concentration /arbitrary units
sea water	450	513	0	1050
fresh water	0.3 to 5	0.23 to 10	0	1 to 20
skate blood	254	225	363	1035
skipjack tuna blood	204	177	4	415
eel blood	101	140	3.5	326

(i) Skate are marine fish.

Use the information in Table 3.1 to explain why skate do not need to drink sea water to maintain the concentration of their blood.

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.....[3]

(ii) Skipjack tuna drink sea water and excrete chloride ions.

Use the information in Table 3.1 to explain why they need to excrete chloride ions to maintain the concentration of their blood.

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.....[2]

(iii) Eels produce large volumes of very dilute urine when they are in fresh water.

Use the information in Table 3.1 to explain why.

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.....[2]

[Total: 13]

4 Peru has one of the world's largest sustainable anchovy fisheries. Fishing is normally allowed during two fishing seasons, one from May to July, and a second later in the year.

(a) Explain what is meant by sustainable exploitation.

.....

.....[1]

(b) Anchovy stocks are carefully monitored throughout the year to allocate a fishing quota and to determine the start dates of the first and second fishing seasons.

State **two** pieces of information required from the monitoring process.

1 .....

2 .....
[2]

(c) In late 2014, the second anchovy fishing season in Peru was suspended due to the presence of large numbers of juveniles.

Explain how fishing during this time would have affected sustainability.

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.....[2]

(d) Anchovy fishing can be suspended during El Niño events when warm water currents reach the coast of Peru, driving anchovies to colder waters.

A survey of anchovy stocks in March 2015 found large numbers of adult fish. In April 2015, the first fishing season was started early as sea temperatures were starting to increase.

Suggest why the first fishing season was started early.

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.....[2]

(e) Most of the anchovies caught are converted into fishmeal.

- Fishmeal can make up to 50% of feed for high value species such as shrimp, grouper and salmon.
- High value species require high protein and omega-3 oils in their diet.
- The Food and Agricultural Organization of the United Nations (FAO) predicts that fishmeal will make up less than 15% of fish feed by 2020, as it is gradually replaced by more sustainable and cheaper alternatives.

Table 4.1 compares fishmeal with two possible alternatives, insects and soya.

Table 4.1

source of protein	percentage protein content	omega-3 oils	other information
fishmeal	65 to 70	high	not sustainable in the future
insects e.g. black soldier flies	40 to 70	high	bred in manure, waste food or fish trimmings
soya	50	medium to high	grown on agricultural land

(i) Use the information in Table 4.1 to describe why insects and soya make suitable alternatives to fishmeal.

.....

.....[1]

(ii) State why fish feed should have a high protein content.

.....

.....[1]

(iii) With reference to Table 4.1, suggest **one** reason why the use of insects might be more sustainable than soya as an alternative to fishmeal.

.....

.....[1]

[Total: 10]

5 **(a)** The Gulf of California separates mainland Mexico from part of California.

Read the information about the effects of agricultural run-off on the water in the Gulf of California.

A study into the link between large scale coastal farming and algal blooms was carried out over a five year period. A satellite able to detect floating plankton was used to produce images of the narrow 1127 km long stretch of water.

The area studied has a high marine biodiversity and is an important commercial fishing centre. It has one of the highest natural nutrient contents in the oceans due to wind-driven upwellings and very high productivity.

Along one stretch of the Mexican coast line, there is an agricultural area of 2250 km^2 of irrigated wheat. The whole valley is irrigated and fertilised four times a year. The excess run-off enters the sea through the Yaqui river.

Images from the satellite showed that there was an algal bloom within a few days of each irrigation and fertilisation. Each bloom was very large, covering between 50 to 577 km^2.

(i) Explain what is meant by a wind-driven upwelling.

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.....[2]

(ii) Explain why the upwellings in the Gulf of California make it an important commercial fishing area.

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.....[3]

(b) Very large algal blooms can unbalance an ecosystem by causing an oxygen-depleted dead zone at the bottom of the sea.

(i) Explain why these oxygen-depleted zones occur at the bottom of the sea.

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.....[3]

(ii) Suggest why these oxygen-depleted zones can unbalance the ecosystem.

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.....[2]

(c) State **one** agricultural pollutant, other than fertiliser, that can reach the oceans. Describe its effect on the marine ecosystem.

pollutant .....

effect on the marine ecosystem .....

.....

.....

[2]

[Total: 12]

6 **(a)** Table 6.1 shows some information about the life cycle of salmon.

Complete Table 6.1 to match the stage of the life cycle of salmon to the habitat where it is most likely to be found.

Table 6.1

habitat	stage in life cycle
nest in stream bed	
freshwater streams	
	smolt

[3]

(b) Fig. 6.1 shows part of the Bristol Bay area in the state of Alaska, United States of America, and the proposed location of a mine.

If constructed, the mine would be one of the largest gold and copper mines in the world.

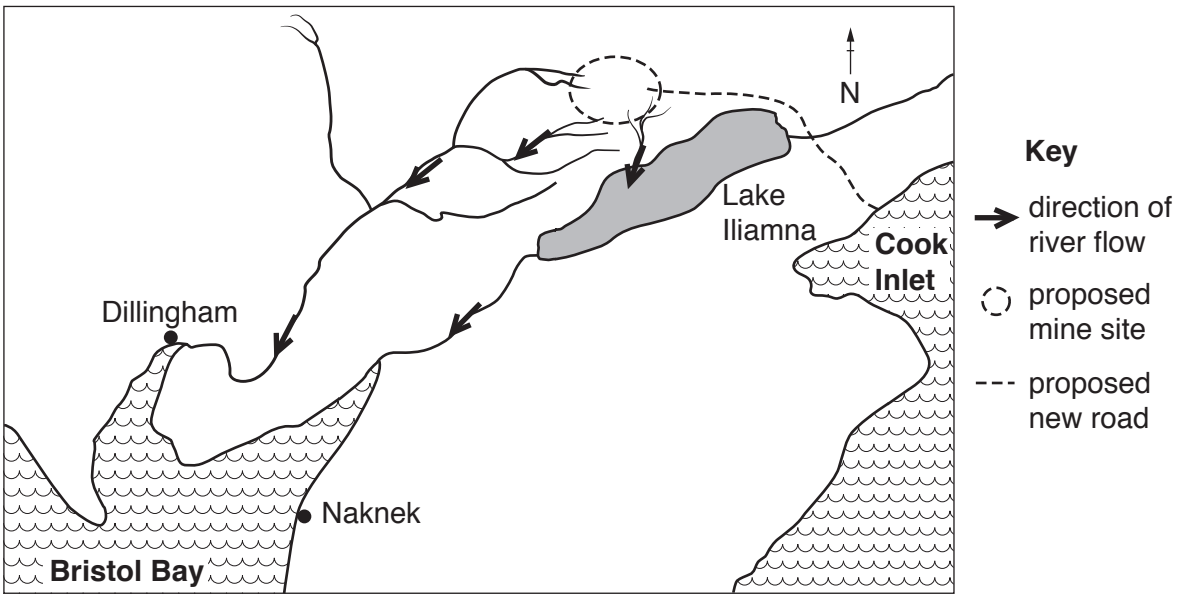

Fig. 6.1

The mining process will involve:

- extracting water from local streams and rivers,
- adding toxic chemicals to the rocks,
- using explosives on the highly permeable rocks,
- construction of large dams to contain the toxic liquid mine waste and over 10 billion tonnes of waste rock and silt.

The proposed site is in an area of unspoilt wilderness and the streams close to the site are spawning grounds for 25% of the world's sockeye salmon population.

(i) Explain why the mine could pose a threat to salmon spawning grounds.

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.....[3]

The human population is very small and lives in villages around Lake Iliamna and Cook Inlet. There are two small towns on the Bristol Bay coast.

Scattered hunting and fishing lodges found throughout the area generate vital income from tourism.

Bristol Bay is one of the largest sustainable commercial salmon fishing areas in the world.

A meeting took place between the owners of the proposed mine and other stakeholders to discuss the need to maintain biodiversity with economic activities for the local people.

(ii) State what is meant by the term stakeholder.

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.....[1]

(iii) Identify **two** stakeholders, other than the owners of the proposed mine, one who would support the mine project and another who would oppose the mine project.

For each stakeholder, give a reason for your answer.

support .....

reason .....

.....

oppose .....

reason .....

.....

[4]

[Total: 11]

7 **(a)** Table 7.1 shows some definitions of terms related to the commercial breeding of fish.

Complete Table 7.1 by stating the term that matches each of the definitions.

Table 7.1

definition	term
the industrial application of biological processes	
a section of DNA that controls the inheritance of a specific feature	
choosing parents with desired features to be bred together	

[3]

(b) In genetic engineering, genes are transferred from one species to another.

(i) Explain why genes cannot be accurately placed in a genome when being transferred.

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.....[2]

(ii) State why a promoter may need to be attached to a gene before it is transferred.

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.....[1]

(c) Explain why some people are concerned about the possible impacts of the escape of genetically engineered salmon into the wild.

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.....[3]

[Total: 9]

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