Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3263782492

MARINE SCIENCE **9693/04**

Paper 4 A2 Data-Handling and Free-Response **October/November 2021**

1 hour 15 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 50.
- The number of marks for each question or part question is shown in brackets [ ].

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

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Section A

Answer **both** questions in this section.

1 The effect of different wavelengths of light on the rate of photosynthesis of two species of marine algae, **A** and **B**, was investigated. Fig. 1.1 shows the apparatus used.

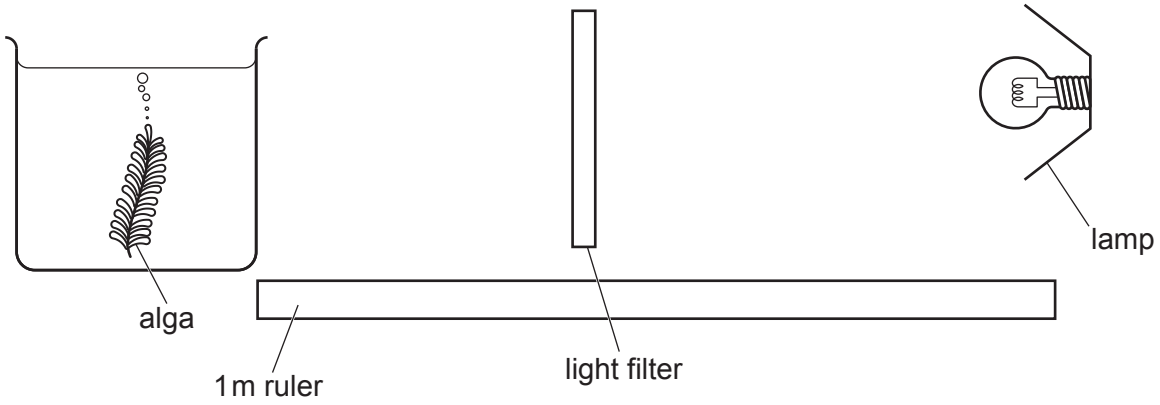

Fig. 1.1

Pieces of alga **A** were placed into a beaker of sea water and exposed to light of wavelength 450 nm for ten minutes. This was repeated four times and the mean rate of bubbles produced per minute was calculated.

This was repeated with light of different wavelengths using different coloured light filters.

The experiment was then repeated with alga **B**.

The results are shown in Table 1.1.

Table 1.1

wavelength of light / nm	mean rate of bubbles produced by algae / bubbles per minute	
	A	**B**
450	20	17
490	29	22
520	16	17
575	2	12
610	15	15
710	26	21

(a) The age, mass and surface areas of the algae were kept constant.

Suggest an explanation for keeping **one** other named variable constant.

named variable .....

explanation .....

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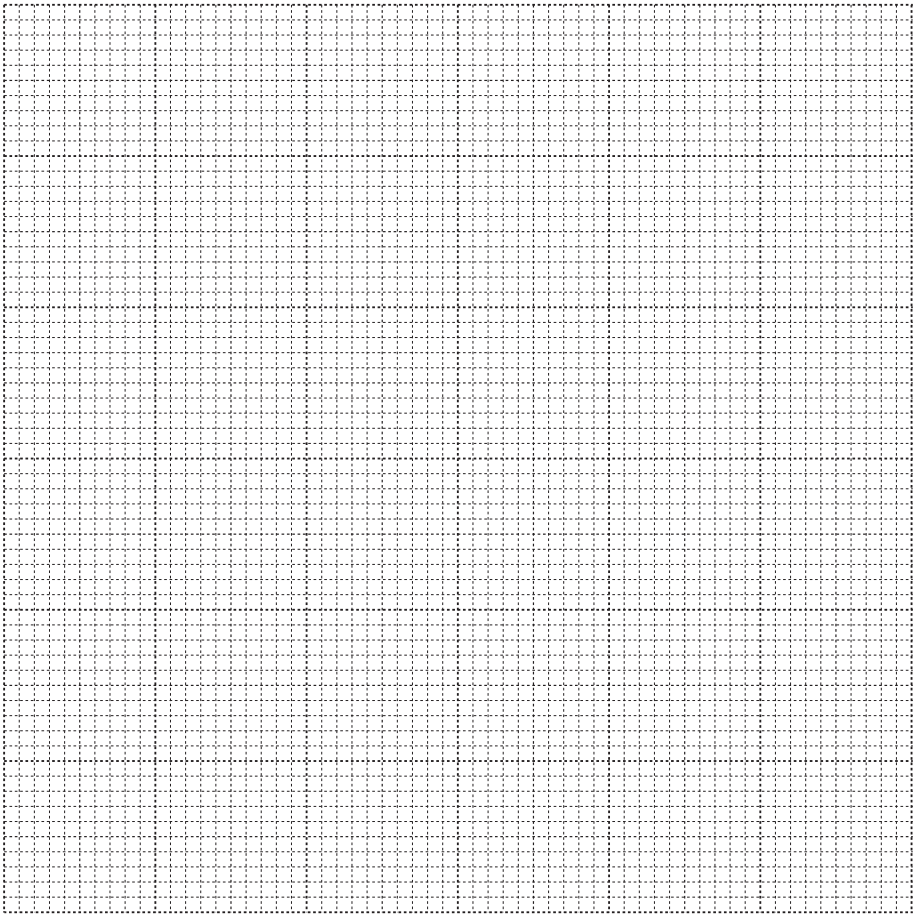
[2]

(b) Draw a line graph to show the effect of light wavelength on the rate of photosynthesis by both algae.



[5]

(c) Fig. 1.2 shows the colours of light of different wavelengths.

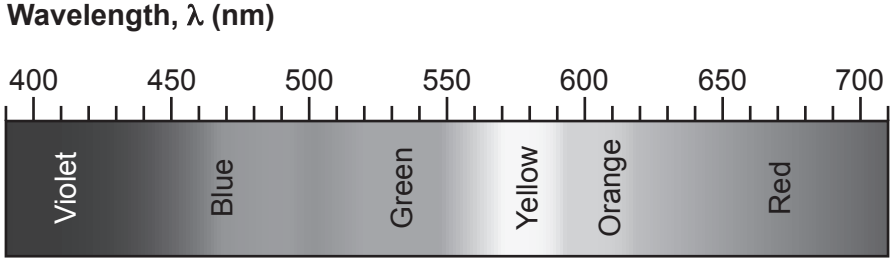


Fig. 1.2

One of the species of alga lives in surface waters. The other species lives in deeper water.

Use the information in Table 1.1, Fig. 1.2 and your graph to explain how the two species of algae are adapted to live at different depths.

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2 Tributyltin (TBT) was often added to antifouling paint and used extensively in the 20th century. It affects the development of larvae of molluscs such as oysters.

The effect of different concentrations of TBT on the development of the larvae of two species of mollusc, **A** and **B**, was investigated. Larvae were exposed to different concentrations of TBT and the percentage of larvae that developed normally was determined after 48 hours.

The results are shown in Fig. 2.1.

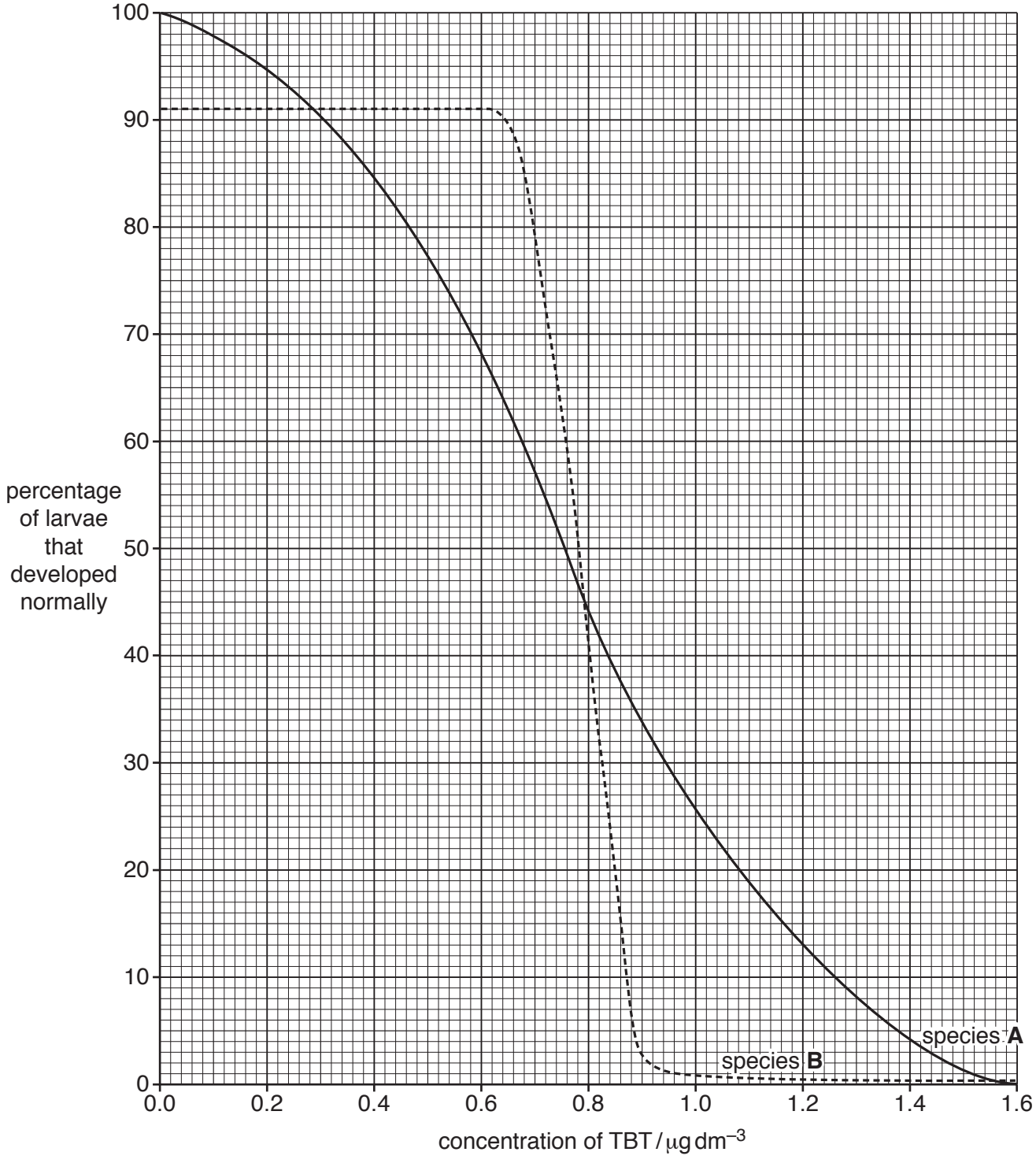

Fig. 2.1

(a) (i) A total of 500 larvae of each species were used.

Use Fig. 2.1 to determine the number of larvae from species **A** that developed normally after exposure to 0.6 $\mu g\,dm^{-3}$ of TBT.

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(ii) Compare the effect of increasing concentrations of TBT on the percentage of larvae that develop normally for species **A** and species **B**.

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(b) Tannin is a plant extract that is being tested for use as an 'environmentally friendly' antifouling agent. It can be added to paints before being placed onto metal surfaces.

Barnacles often attach to the underside of boats. Fig. 2.2 shows barnacles growing on metal.

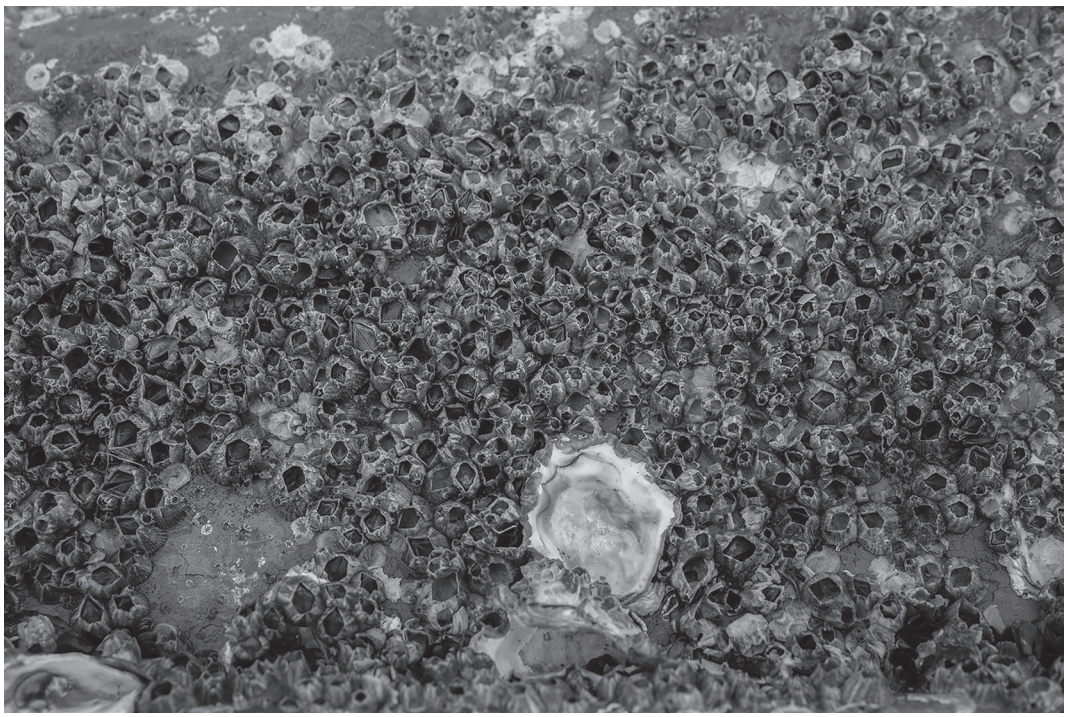

Fig. 2.2

Describe a method for a ***laboratory-based*** investigation to determine whether tannin prevents the growth of barnacles on the surface of metal.

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Section B

Answer **both** questions in this section.

3 (a) (i) Discuss how the size and shape of marine organisms affect the need for specialised gaseous exchange organs.

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Fig. 3.1 shows the transport systems of a whale and a species of fish.

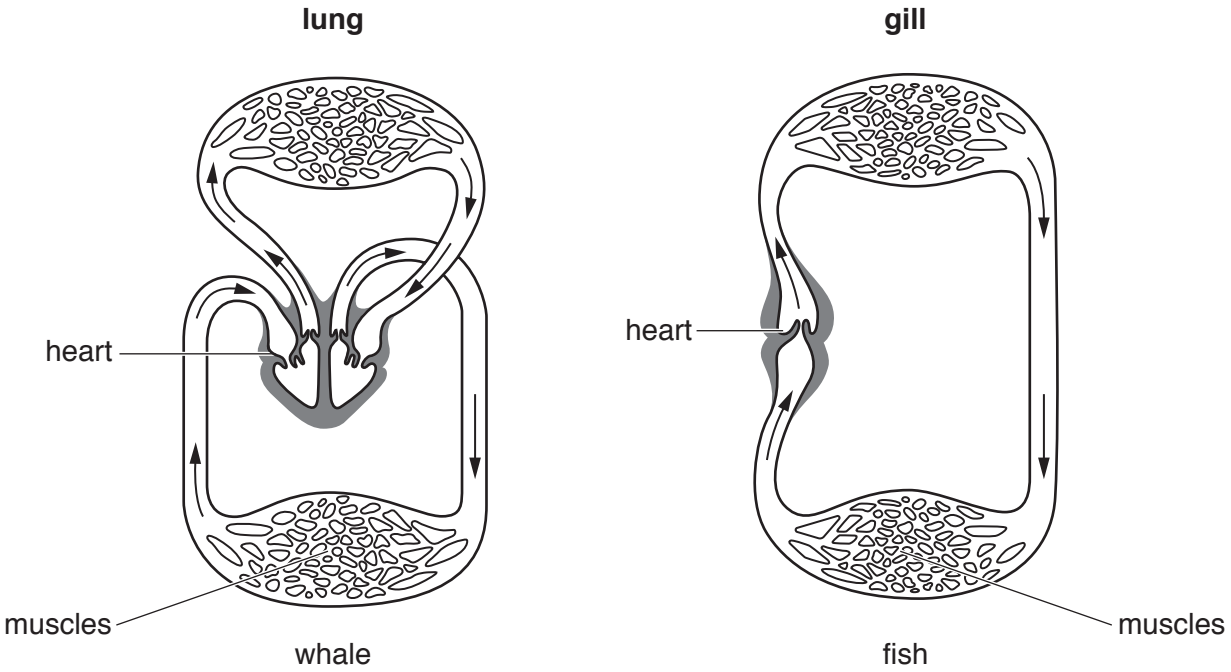

Fig. 3.1

Whales are large, active, air-breathing animals. This species of fish is smaller and less active than whales.

(ii) Use Fig. 3.1, and your own knowledge, to explain the differences in the transport systems of this whale and this species of fish.

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(b) Describe the life cycle of oysters. In your answer, include the principal habitats **and** the advantages of these habitats.

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4 **(a)** Discuss the sociological impacts of placing restrictions on fishing.

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(b) Describe how energy conservation methods in ecotourist resorts are beneficial to conservation.

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(c) Explain the negative effects of dredging on the marine environment.

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