



Cambridge International AS & A Level

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



MARINE SCIENCE

9693/02

Paper 2 AS Level Data-handling and Investigative Skills

For examination from 2022

SPECIMEN PAPER

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 **20** pages. Blank pages are indicated.

Answer **all** questions.

1 Scientists surveyed the distribution of species on a coral reef in Indonesia.

(a) Fig. 1.1 shows some coral polyps on the reef.



Fig. 1.1

Add these labels to Fig. 1.1 to indicate the location of the following structures in a polyp.

nematocysts

mouth

stomach

tentacle

[4]

(b) Fig. 1.2 shows a granulated sea star, *Choriaster granulatus*, on the reef.

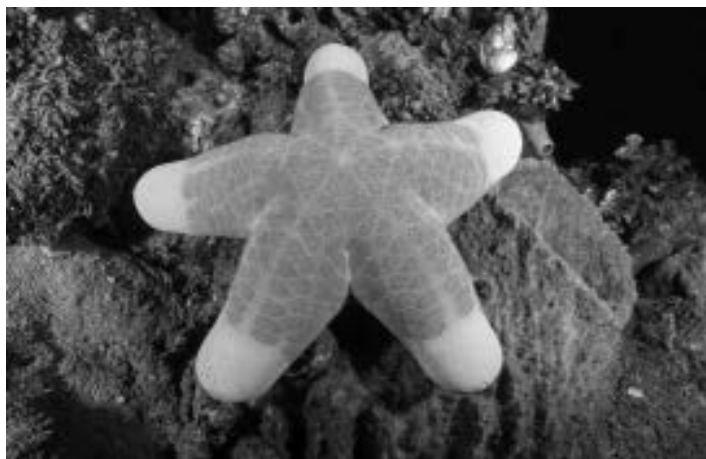


Fig. 1.2

(i) Sea stars are echinoderms.

State **two** main features of echinoderms.

1

.....

2

.....

[2]

(ii) Make a large drawing of the sea star shown in Fig. 1.2. Only show the markings on one of the arms.

Do **not** label your drawing.

Use a sharp pencil.

[4]

(c) The scientists observed a species of butterfly fish feeding on coral polyps. Fig. 1.3 is a diagram of this fish.



Fig. 1.3

Use the key below to identify the species of butterfly fish.

- | | | |
|---|--|-----------------------------|
| 1 | More than half of caudal fin is dark in colour | 2 |
| | Less than half of caudal fin is dark in colour | 3 |
| 2 | Dark bands through dorsal fin..... | <i>Chaetodon triangulum</i> |
| | No dark bands through dorsal fin..... | <i>C. trifascialis</i> |
| 3 | Dark lines across body | <i>C. melannotus</i> |
| | No dark lines across body | 4 |
| 4 | Faint spots over most of body..... | <i>C. citrinellus</i> |
| | Single large spot below dorsal fin..... | <i>C. interruptus</i> |

..... [1]

(d) Describe **one** method that the scientists could use to conduct a **systematic** survey of the reef.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 14]

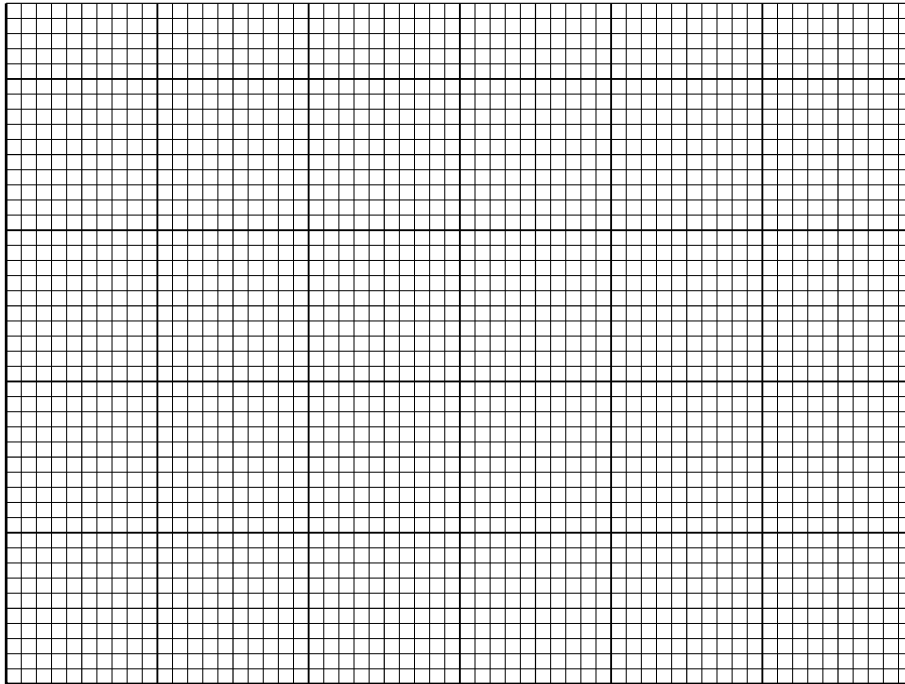
2 Table 2.1 shows how temperature affects the density of pure water.

Table 2.1

temperature of water / °C	density / kg m ⁻³
4	1000
10	999
20	998
30	996
40	992
50	988

(a) (i) Plot a line graph of the data in Table 2.1. Use a ruler to join the points with straight lines.

Use a sharp pencil.



[4]

(ii) Use the data to describe the pattern shown by your graph.

.....

.....

.....

.....

.....

.....

.....

[3]

(b) Describe **and** explain how you would expect the density of pure water to change as it cools from 4 °C to 0 °C.

.....
.....
.....
..... [2]

(c) Describe **and** explain how data for samples of sea water would differ from the data for pure water shown in Table 2.1.

.....
.....
.....
..... [2]

(d) Use the data in Table 2.1 to explain the role of density in the formation of temperature layers in the ocean.

.....
.....
.....
..... [2]

[Total: 13]

- 3 Fig. 3.1 shows a shoal of blue-striped snapper, *Lutjanus kasmira*. In the 1950s, these fish were introduced to some Hawaiian islands, where their numbers have gradually increased.

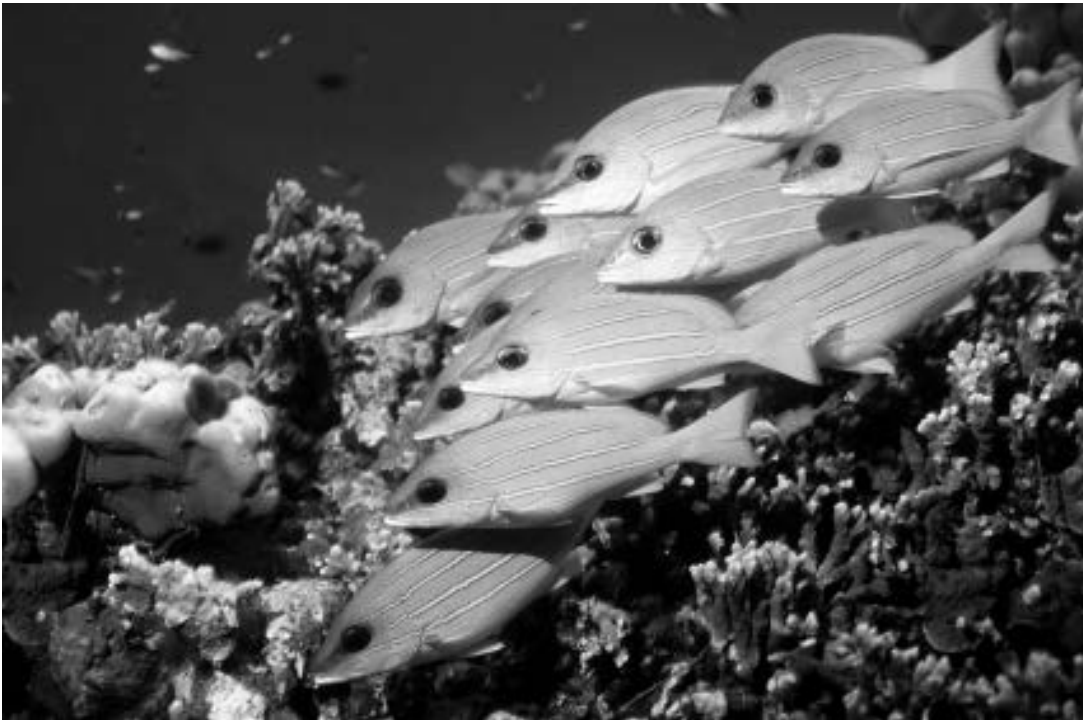


Fig. 3.1

Scientists used the mark-release-recapture method to estimate the population size of blue-striped snapper living on a Hawaiian reef.

The scientists used nets to catch the fish. To mark the fish a harmless tag was attached to the fins of the fish. The fish were then released, and a second sample was caught two weeks later.

The results are shown in Table 3.1.

Table 3.1

number of fish caught and marked in first sample	number of fish caught in second sample	number of marked fish in second sample
52	41	12

The population size was then estimated using the Lincoln index:

$$N = \frac{n_1 \times n_2}{m_2}$$

Where N = estimate of population size

n_1 = number of individuals captured in first sample

n_2 = number of individuals (both marked and unmarked) captured in second sample

m_2 = number of marked individuals recaptured in second sample

(a) (i) Calculate the total population size.

State your answer to **three** significant figures.

..... [2]

(ii) Discuss the factors that should be considered when collecting the samples so that an accurate estimate of population size of blue-striped snapper is obtained.

.....
.....
.....
.....
.....
..... [3]

(iii) Describe **and** explain **one** limitation when using the Lincoln index to estimate population size.

.....
.....
.....
..... [2]

(b) Blue-striped snapper are host to two types of parasite, **A** and **B**.

Samples of fish were caught each year for eight years. They were examined to identify whether they were carrying either parasite and an assessment of their overall health was made. Their overall health was expressed as a 'health index' where a **higher** number indicates **poor** health.

Fig. 3.2 shows the percentage of fish examined that carried each type of parasite, and the mean health index of the fish each year from 2001 to 2008.

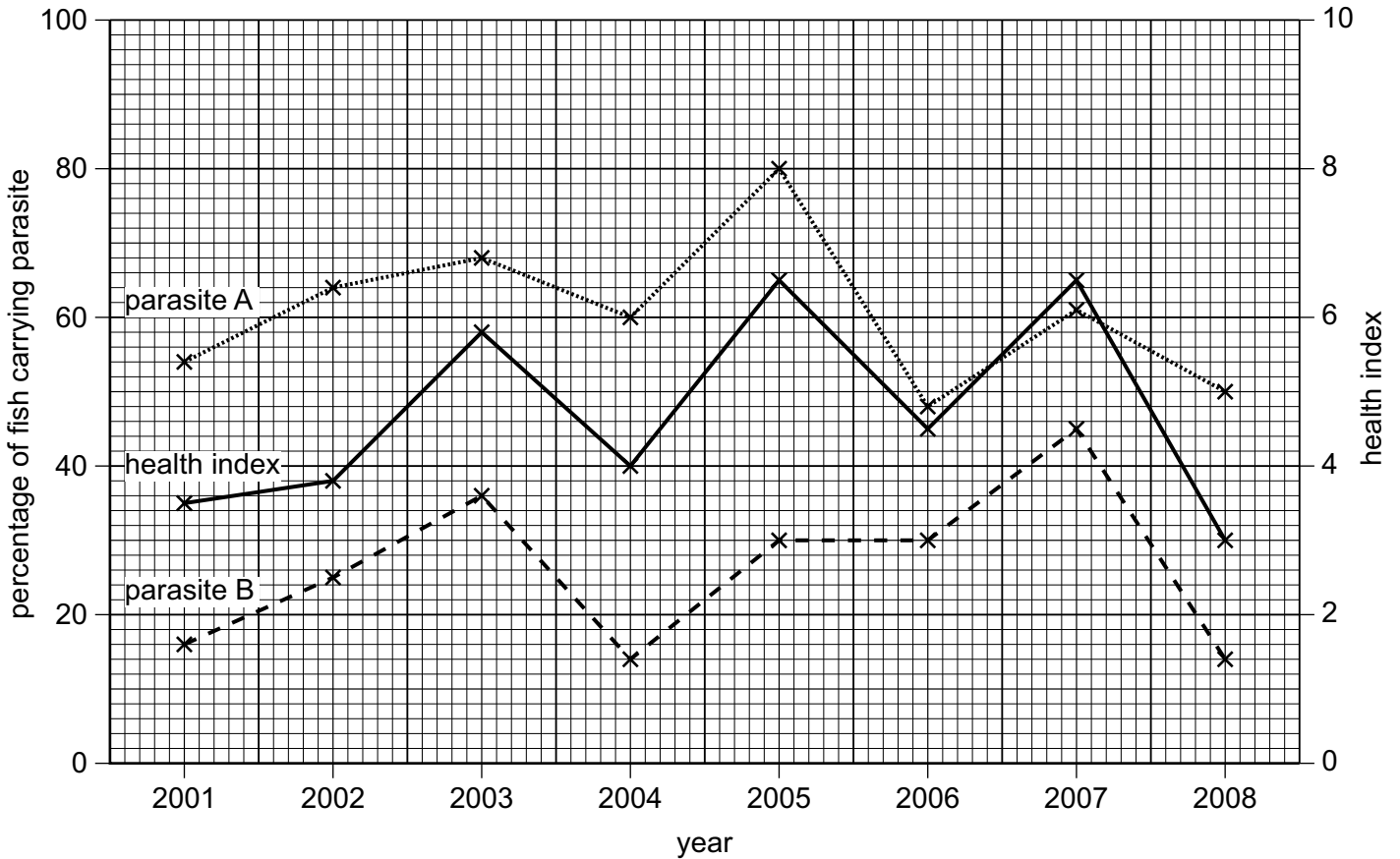


Fig. 3.2

With reference to Fig. 3.2, discuss the extent to which the data support the hypothesis that 'parasites decrease the health of the blue-striped snapper'.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

- 4 Fig. 4.1 shows a species of seagrass growing in the Mediterranean Sea.

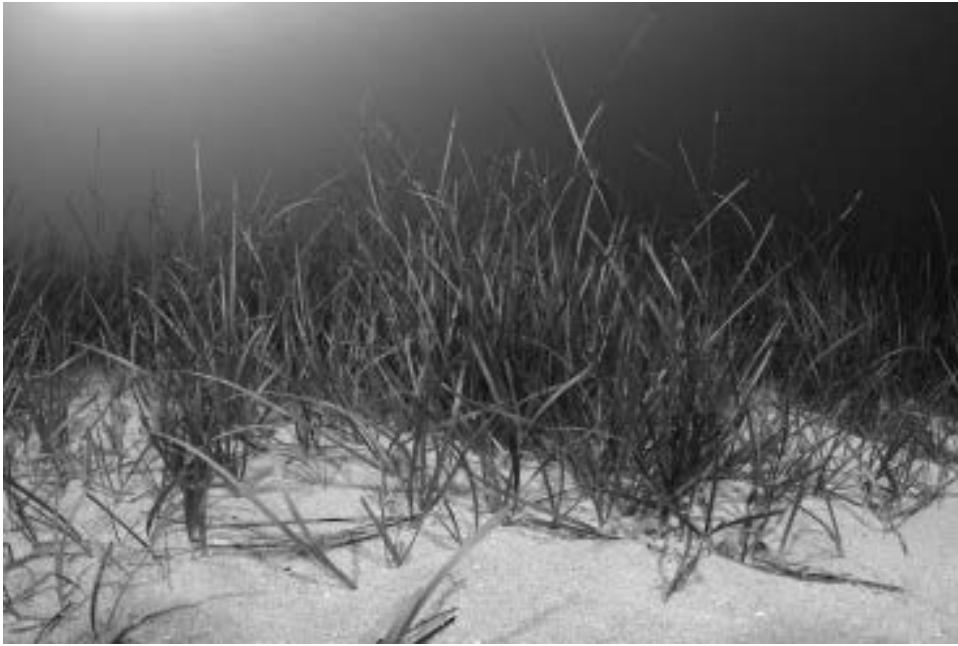


Fig. 4.1

Samples of seagrass can be used to investigate the rate of photosynthesis.

- (a) (i) State the **word** equation for photosynthesis.

..... [2]

- (iii) Use the space below to draw a results table that you could use to record your results.
Include full headings in the results table, but do **not** write in any results.
Use a sharp pencil.

[2]

- (iv) Use the axes below to sketch a graph of the results you would expect if the hypothesis in 4(a)(ii) is correct.
Include labels on both axes. Do **not** include scales.
Use a sharp pencil.



[2]

- (v) Explain the relationship you have shown in your sketch graph in 4(a)(iv).

.....
.....
.....
..... [2]

(b) Phytoplankton can also be used to investigate the effect of light intensity on the rate of photosynthesis. The phytoplankton are trapped inside a gel-like substance, creating small beads. Fig. 4.2 shows some gel beads containing phytoplankton.

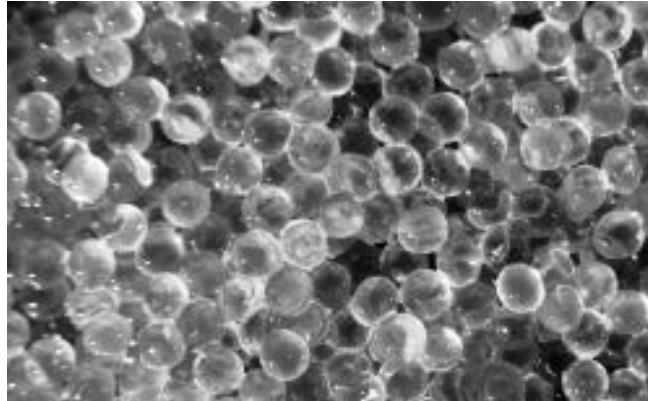


Fig. 4.2

Suggest **two** advantages of using the gel beads rather than seagrass to investigate the effect of light intensity on the rate of photosynthesis.

1

.....

2

.....

[2]

[Total: 15]

- 5 Fig. 5.1 shows measurements of temperature and dissolved sulfide, silicate and oxygen, as a sensor is passed slowly through a hydrothermal vent plume.

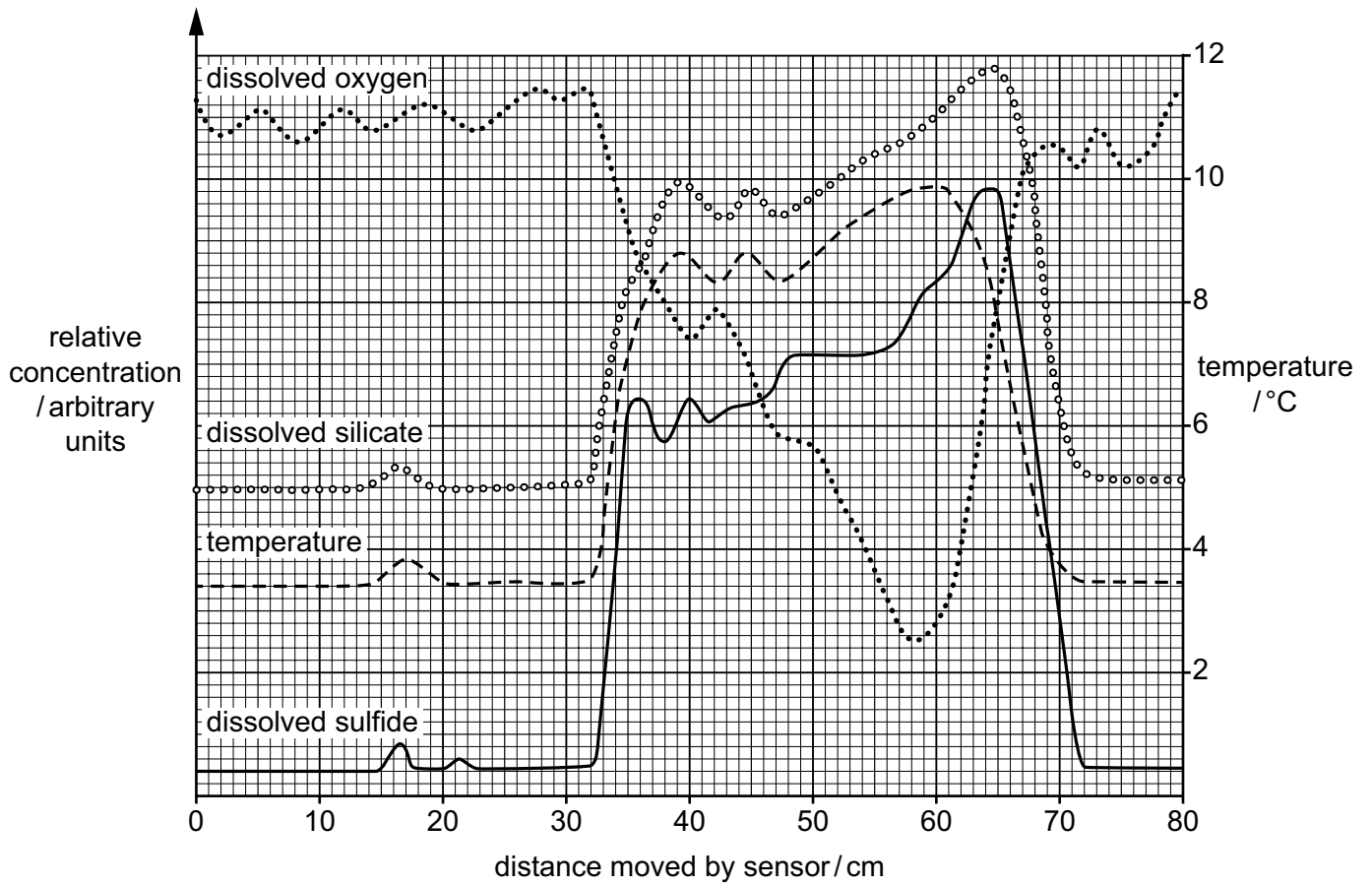


Fig. 5.1

- (a) (i) Use Fig. 5.1 to suggest the diameter of the vent plume. Include the unit.

..... [2]

- (ii) With reference to Fig. 5.1, describe **and** explain the relationship between dissolved oxygen concentration and sea water temperature.

.....

 [2]

(b) Explain why dissolved sulfide is in relatively high concentration in a hydrothermal vent plume.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Use Fig. 5.1 and your own knowledge to explain how chimneys form at hydrothermal vents.

.....

.....

.....

..... [2]

[Total: 9]

- 6 Fig. 6.1 shows the concentration of nitrate ions above an abyssal plain in the North Atlantic Ocean, down to depths of 160 m.

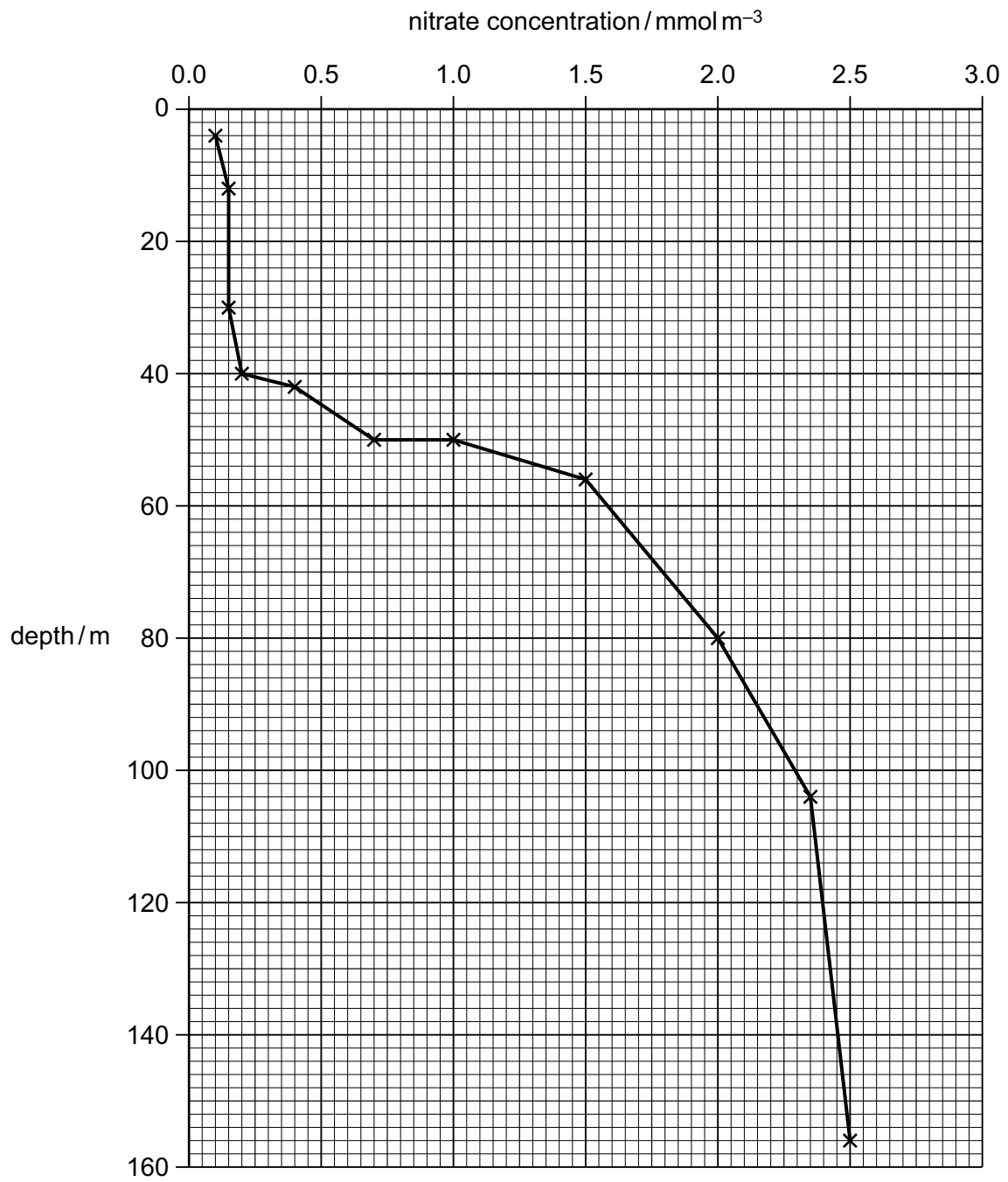


Fig. 6.1

(a) Describe the patterns shown by the data in Fig. 6.1.

.....

.....

.....

.....

.....

.....

..... [3]

(b) (i) Calculate the percentage increase in nitrate concentration in the region between 40 m and 80 m.

.....% [3]

(ii) Suggest why the region between 40 m and 80 m shows the greatest percentage change in nitrate concentration.

.....

.....

.....

.....

.....

..... [3]

- (c) The data shown in Fig. 6.1 were collected to investigate the effect of storms on the concentration of nitrate ions in the surface waters. They were collected during a period of calm weather.

Describe **and** explain the differences you would expect to find in the data after a storm with very strong winds.

.....
.....
.....
.....
.....
..... [3]

- (d) Suggest **and** explain the effect of an increase in the surface concentration of nitrate ions on the concentration of dissolved oxygen.

.....
.....
.....
..... [2]

[Total: 14]

Copyright Acknowledgements:

- Question 1(a) © Ref: C020/5761; ETHAN DANIELS/SCIENCE PHOTO LIBRARY; *Leather coral polyps*; www.sciencephoto.com
- Question 1(b) © Ref: C033/9329; ANDREW J. MARTINEZ/SCIENCE PHOTO LIBRARY; *Big-plated Sea Star*; www.sciencephoto.com
- Question 1(c) © Ref: C027/4913; EVAN OTO/SCIENCE PHOTO LIBRARY; *Chevron Butterflyfish, Illustration*; www.sciencephoto.com
- Question 3 © Ref: Z605/0779; GEORGETTE DOUWMA/SCIENCE PHOTO LIBRARY; *Blue-lined snappers*; www.sciencephoto.com
- Question 4 © Ref: C010/9347; ANGEL FITOR/SCIENCE PHOTO LIBRARY; *Little Neptune grass (Cymodocea nodosa)*; www.sciencephoto.com
- Question 4(b) © Ref: C016/4185 ; MATTEIS/LOOK AT SCIENCES/SCIENCE PHOTO LIBRARY; *Sodium alginate beads*; www.sciencephoto.com
- Question 6 © adapted: <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015G>

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.