Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

MARINE SCIENCE **9693/22**

Paper 2 AS Level Data-handling and Investigative Skills **May/June 2025**

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. Any blank pages are indicated.

DC (WW/CB) 341726/6

Answer **all** questions.

1 Scientists in Australia monitored the population of the Green Turtle for five years.

They used the mark-release-recapture method to estimate the population of the turtles in the southern Great Barrier Reef.

(a) Describe an ethical method of mark-release-recapture that could be used by the scientists.

....

....

....

....

....

.... [3]

(b) This mark-release-recapture method was carried out each year from 2000 to 2004.

The results are shown in Table 1.1.

Table 1.1

year	2000	2001	2002	2003	2004
turtles captured in first sample (n_1)	247	253	292	230	309
turtles captured in second sample (both marked and unmarked) (n_2)	355	345	392	326	418
marked turtles recaptured in second sample (m_2)	108	92	100	115	109
estimated turtle population (N)	812	949	1145	....	1185

Use Table 1.1 and the Lincoln index to estimate the population of turtles in 2003.

The equation for the Lincoln index is shown.

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

Where:

N = estimated turtle population
n_1 = number of individuals captured in first sample
n_2 = number of individuals captured in second sample (both marked and unmarked)
m_2 = number of marked individuals recaptured in second sample.

Write your answer in Table 1.1.

[1]

(c) Plot a graph of the estimated turtle population (N) from 2000 to 2004.

[4]

(d) Use the data in Table 1.1 to describe the trend shown for the population of turtles.

....

....

....

.... [2]

(e) Turtles were not counted as being previously marked if it was not clear that the marks on their body were from the previous capture.

Evaluate the population estimates shown in Table 1.1 based on this observation.

....

....

....

.... [2]

[Total: 12]

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2 Fig. 2.1 shows a great white shark, *Carcharodon carcharias*.

Fig. 2.1

(a) **(i)** On Fig. 2.1 label the following features:

- gill slits
- caudal fin
- pectoral fin.

[2]

(ii) State the genus for the great white shark.

.... [1]

(b) Fig. 2.2 shows five other species of shark.

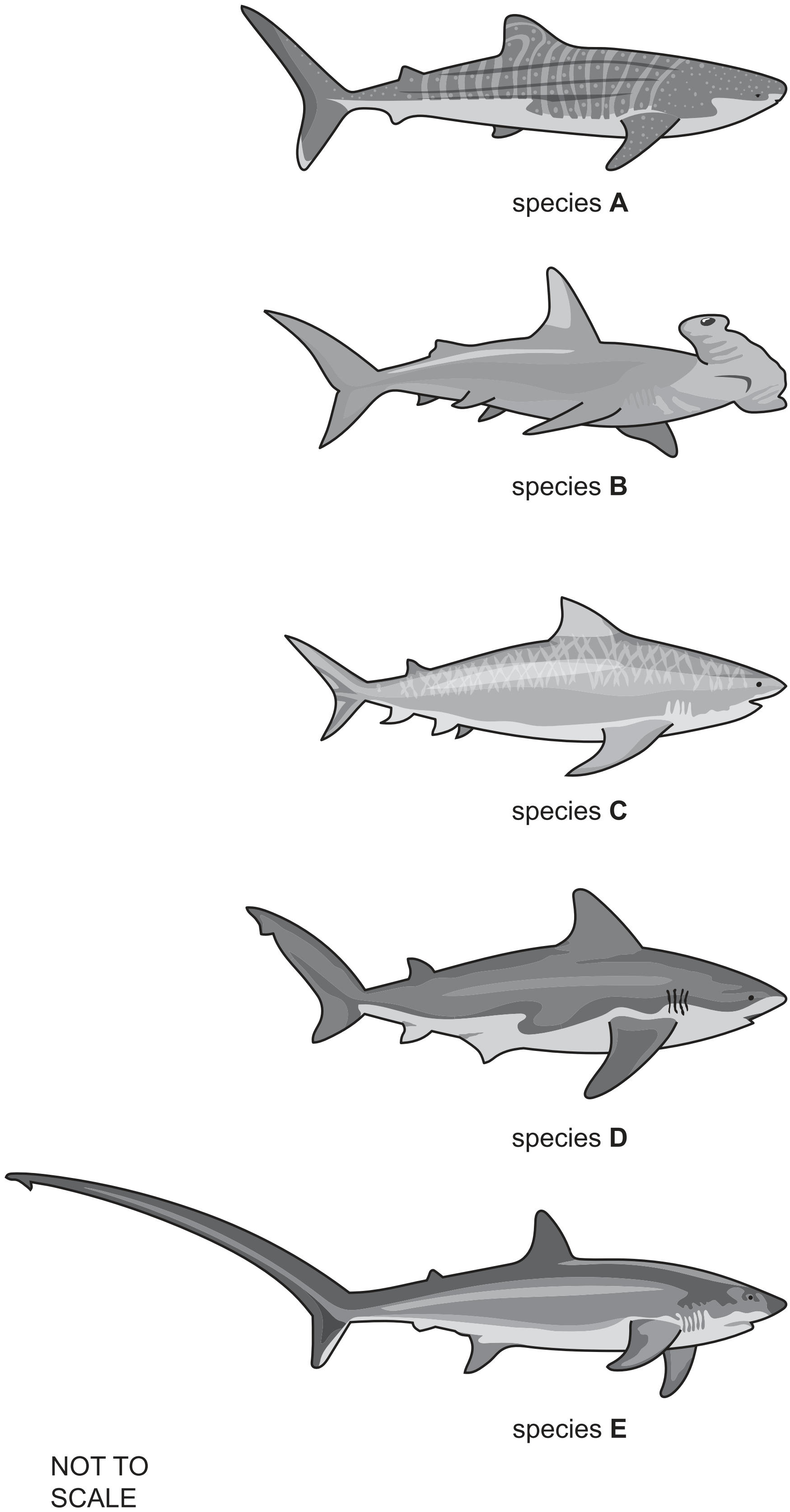

Fig. 2.2

Use the key to identify the binomial name of species **A**.

1	Dark coloured upper body Light coloured upper body	go to 2 go to 3
2	Tail similar length to body length Tail shorter than body length	*Alopias vulpinus* go to 4
3	T-shaped head Pointed head	*Sphyrna mokarran* *Galeocerdo cuvier*
4	Light-coloured spots on dark stripes on upper body No light-coloured spots	*Rhincodon typus* *Carcharhinus leucas*

Binomial name of species **A** is .... [1]

(c) A scientist studied sharks accidentally caught from commercial fishing. The sharks were analysed to identify parasites living both internally and externally.

(i) Suggest why scientists used sharks that had already been accidentally caught instead of hunting sharks especially for their research.

....

....

....

.... [2]

(ii) Suggest advantages **and** disadvantages to shark parasites of living internally instead of living externally.

advantages ....

....

....

....

disadvantages ....

....

....

....

[4]

(iii) Some parasites of sharks are crustaceans.

State **two** features of a typical adult crustacean.

1 ....

2 ....

[2]

(d) Scientists analysed the data from two different species of shark to compare the biodiversity of the parasites living in each species.

Simpson's index of diversity was used to calculate the species diversity of parasites in the two different species of shark, **F** and **G**.

The equation used to calculate Simpson's index of diversity is shown.

$$D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$$

Where:

D = Simpson's index of diversity
Σ = sum of (total)
n = number of individuals of each **different** species
N = the total number of individuals of **all** the species.

Table 2.1 shows the data calculated from the two types of shark.

Table 2.1

parasite	**shark species F**			**shark species G**		
	n	$\frac{n}{N}$	$\left(\frac{n}{N}\right)^2$	n	$\frac{n}{N}$	$\left(\frac{n}{N}\right)^2$
H. tergestinus	3	0.188	0.035	12	0.162	0.026
S. viridis	2	0.125	0.016	0	0.000	0.000
A. physeteris	0	0.000	0.000	43	....	....
L. galei	7	0.438	0.191	17	0.230	0.053
D. betencourti	4	0.250	0.063	2	0.027	0.001
N	16			74		
		Σ	0.305		Σ	....

(i) Complete Table 2.1 for shark species **G** using the data provided.

Give your answers to **three** significant figures.

[4]

(ii) Calculate Simpson's index of diversity for the parasites in shark species **F** and **G**.

Space for working.

shark species **F**: ....

shark species **G**: ....
[1]

(iii) Use the Simpson's index of diversity values you have calculated in **2(d)(ii)** to compare the relative biodiversity of parasites in the two species of shark.

....

.... [1]

[Total: 18]

3 **(a)** State **three** conditions that affect the density of sea water.

1 ....

2 ....

3 ....
[2]

(b) **(i)** The density of small, irregular-shaped rocks was investigated.

Outline a method that could be used to collect the data needed to calculate the density.

....

....

....

....

....

.... [3]

(ii) Draw a table to record the data needed to calculate the density from the method planned in **3(b)(i)**.

Include full headings **and** units in the results table.

Do **not** write in any results.

[2]

(c) Pumice is one type of rock produced by volcanic activity along a mid-ocean ridge.

(i) Explain how a mid-ocean ridge is formed.

....

....

....

....

....

.... [3]

Fig. 3.1 shows a pumice rock.

Pumice contains large air spaces. These spaces are created by bubbles of gas in the lava when the rock forms.

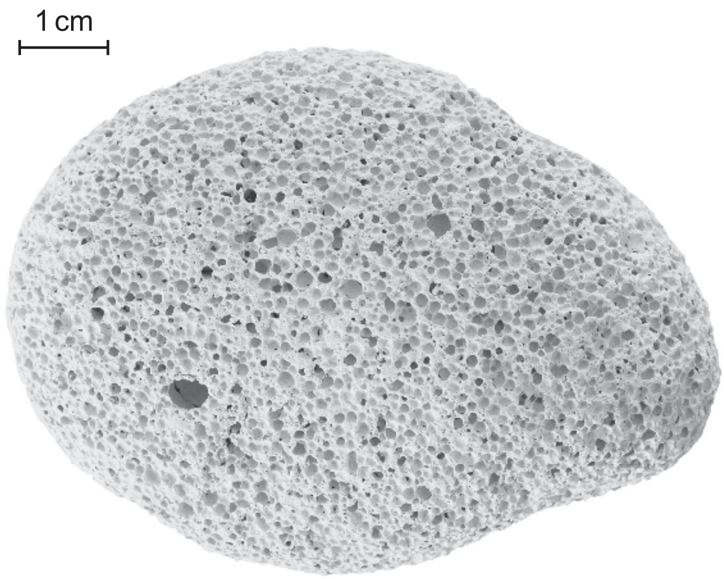

Fig. 3.1

A student investigated the density of pumice.

The results are shown in Table 3.1. The data contains an anomalous result.

Table 3.1

sample	density / kg m^{-3}
1	806
2	954
3	910
4	923
5	946
mean	....

(ii) Calculate the mean density for the samples. Do **not** include the anomalous result.

Write your answer in Table 3.1.

[1]

(iii) Suggest **two** reasons why the measurements for the density of pumice samples shown in Table 3.1 show a wide variation.

1 ....

....

2 ....

.... [2]

(iv) Pure water has a density of 998.2 kg m^{-3} at 20 °C.

Use Fig. 3.1 **and** your answer to **3(c)(ii)** to explain why recording accurate measurements of the density of the samples of pumice in Table 3.1 was difficult.

....

....

....

....

....

....

....

.... [4]

(d) Pumice is found as rounded porous rocks on shorelines and beaches at many locations around the world.

(i) Explain why pumice from the mid-ocean ridge in the Atlantic is found on beaches all around the world.

....

....

....

.... [2]

(ii) Suggest why pumice rocks are rounded in shape **and** found on beaches.

....

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....

....

.... [3]

[Total: 22]

4 Fig. 4.1 shows a barrel jellyfish.

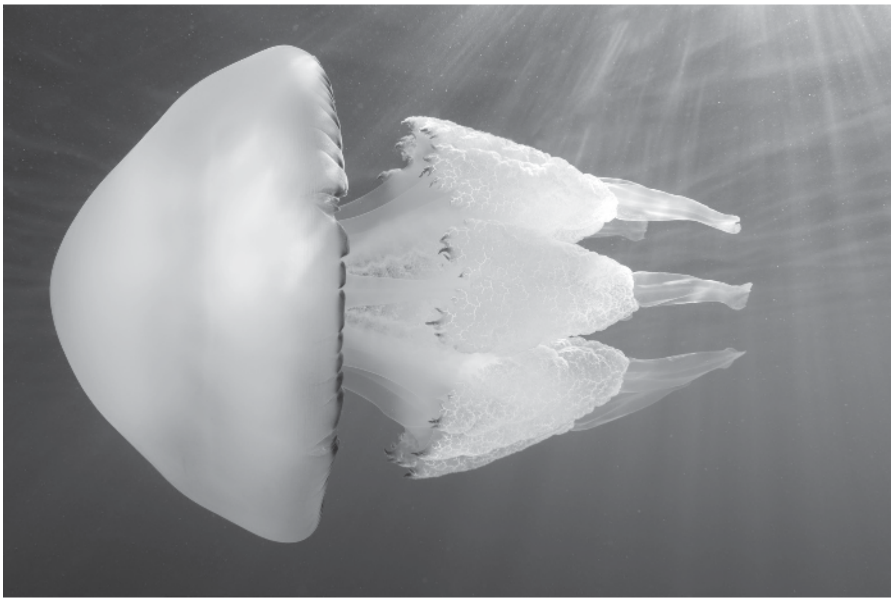

Fig. 4.1

(a) Make a large drawing of the jellyfish shown in Fig. 4.1.

Do **not** label your drawing.

[4]

(b) Citizen science projects encourage people to make observations in their environment and submit their observations to a research team.

Scientists sometimes use citizen science projects to collect data from many people. Citizen science projects can be used to collect data on jellyfish washed up on beaches.

(i) Suggest **three** advantages of collecting data from many people about jellyfish found on beaches instead of scientists collecting their own data.

1 ....

....

2 ....

....

3 ....

....
[3]

(ii) Suggest **one** disadvantage of collecting data from many people about jellyfish found on beaches instead of scientists collecting their own data.

....

.... [1]

(iii) Describe how the disadvantage you have given in **4(b)(ii)** could be limited.

....

.... [1]

(iv) Jellyfish are in the phylum Cnidaria and have nematocysts.

State the risk that jellyfish cause to people taking part in the study.

....

.... [1]

(v) Suggest **two** ways scientists can reduce the risk you have given in **4(b)(iv)**.

1 ....

....

2 ....

....
[2]

(c) Scientists investigated the relationship between nitrate ion (NO_3^-) and phosphate ion (PO_4^{3-}) concentration in the ocean and the number of jellyfish found on beaches.

(i) Explain why an increase in nitrate ion and phosphate ion concentration in the ocean can cause an increase in the jellyfish population.

....

....

....

.... [2]

(ii) State why the number of jellyfish found on beaches increases when the population of jellyfish increases.

....

.... [1]

(iii) Scientists made the hypothesis:

An increase in nitrate ion and phosphate ion concentration in the ocean causes an increase in the jellyfish population.

During one year, the scientists measured:

- the concentration of nitrate ions and phosphate ions
- the phytoplankton biomass
- the jellyfish population.

Fig. 4.2 shows some of the results collected.

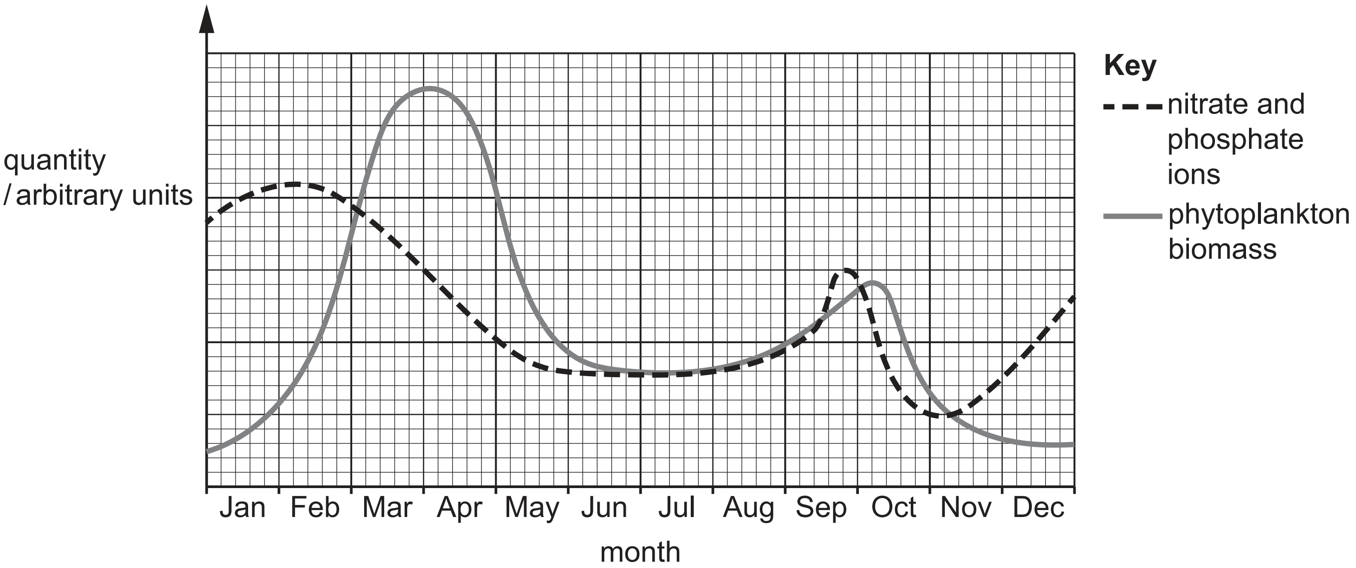

Fig. 4.2

Sketch a line on Fig. 4.2 to predict the change in population of jellyfish during the year if the hypothesis is supported.

[2]

(d) Fig. 4.3 shows the number of five species of jellyfish found on beaches of one country from 2009 to 2014.

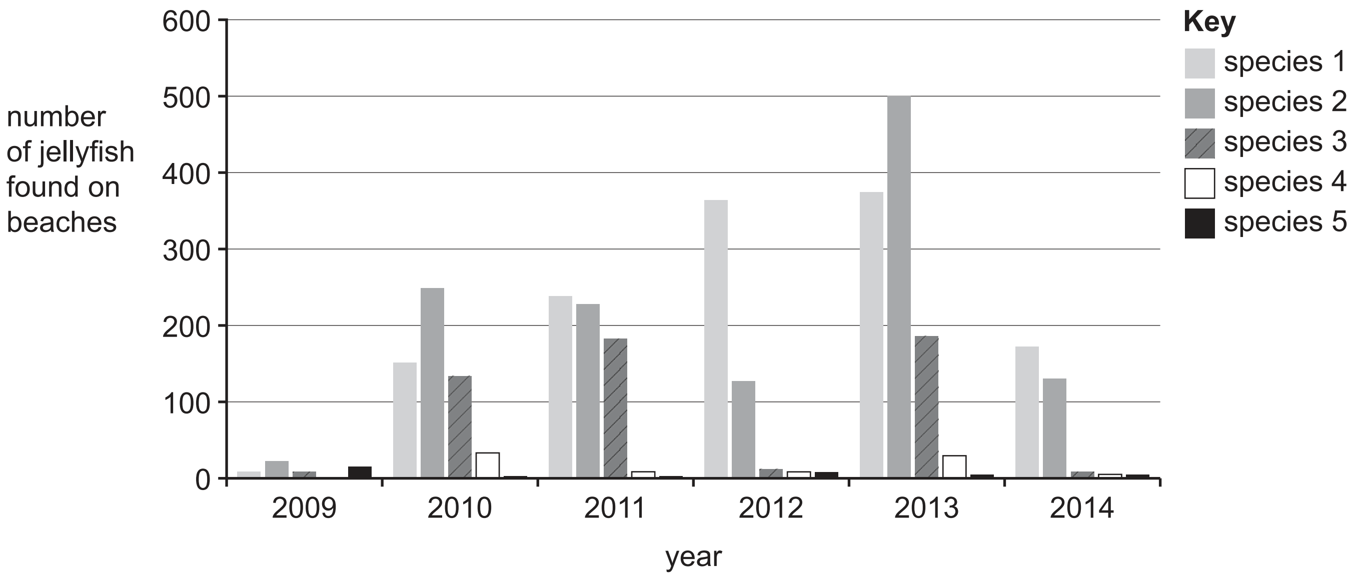

Fig. 4.3

(i) Describe the trend shown in Fig. 4.3 for species 1.

....

....

....

.... [2]

(ii) The number of species 2 found on beaches in 2012 was 125. In 2013 the number of species 2 found on beaches was 500.

Calculate the percentage increase of species 2 found on beaches from 2012 to 2013.

.... % [1]

(iii) Discuss why the results shown in Fig. 4.3 do **not** provide evidence to support the hypothesis:

An increase in nitrate ion and phosphate ion concentration in the ocean causes an increase in the jellyfish population.

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....

.... [3]

[Total: 23]

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