Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0460281585

MARINE SCIENCE **9693/42**

Paper 4 A Level Data-handling and Investigative Skills **October/November 2022**

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.

Answer **all** questions.

1 **(a)** Outline the light-dependent stage of photosynthesis.

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(b) Fig. 1.1 shows the penetration of different colours of light into water in the open ocean and coastal water.

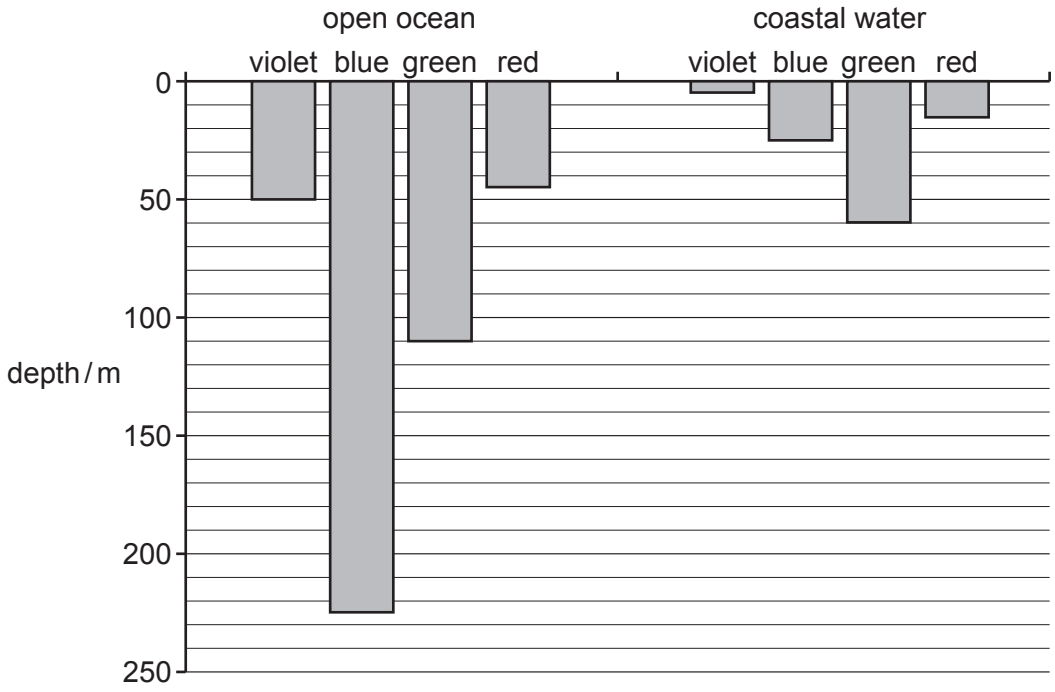

Fig. 1.1

(i) Use Fig. 1.1 to compare the depth of penetration of the four colours of light into water in the open ocean and coastal water.

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(ii) Suggest an explanation for the difference in penetration of light into open ocean water compared with coastal water.

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(c) A student investigated two species of seaweed that are found in coastal water. The student collected a sample of one species from a depth of 2 m, and a sample of the other species from a depth of 20 m.

They extracted the pigments from the seaweeds and carried out chromatography to identify the pigments.

The results are shown in Fig. 1.2.

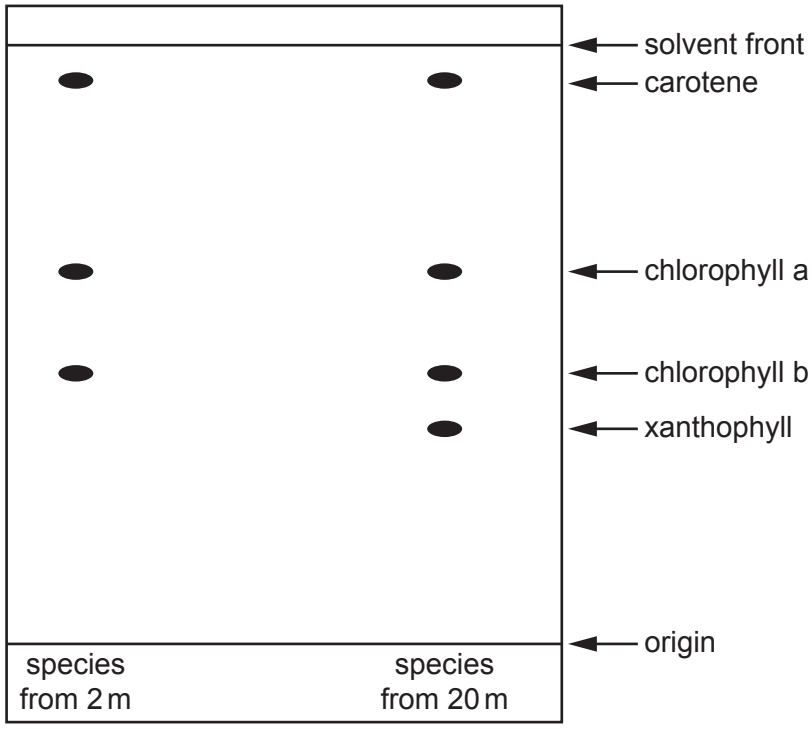

Fig. 1.2

(i) Use Fig. 1.2 to calculate the R_f value for xanthophyll.

Give your answer to **two** significant figures.

Show your working.

$$R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent}}$$

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[3]

(ii) Use Fig. 1.1 and Fig. 1.2 to suggest an explanation for the differences between the pigments found in the two species of seaweed.

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(d) Light wavelength can be changed by placing coloured, cellophane filters in front of a bench lamp. Plan a **laboratory-based** investigation into the effect of changing light wavelength on the rate of photosynthesis of a seaweed.

You are provided with standard laboratory apparatus and materials.

Your plan should:

- include a clear statement of the hypothesis
- identify the key variables
- include full details of the method
- describe how you would analyse your results
- be safe and ethical.

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.... [11]

[Total: 25]

2 Fig. 2.1 shows a light micrograph of some blood cells from a salmon.

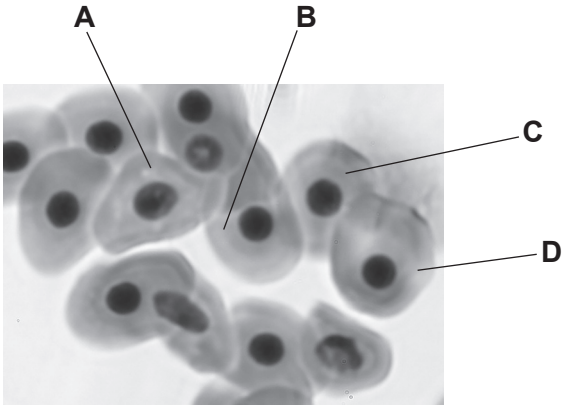

Fig. 2.1

(a) Draw the blood cells, **A**, **B**, **C** and **D**.

Label one nucleus and one cell membrane on your drawing.

[4]

(b) Fig. 2.2 shows the structure of the cell membrane of the salmon blood cells.

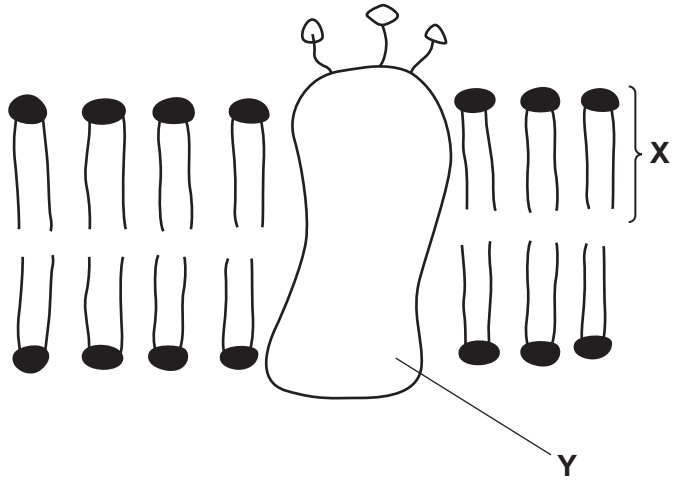

Fig. 2.2

(i) Name molecules **X** and **Y**.

molecule **X** .....

molecule **Y** .....
[2]

(ii) Explain why the cell membrane structure is described as a fluid mosaic.

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(c) Fig. 2.3 shows the effect of increasing the external concentration of sodium ions, Na^+, on the rate of movement of sodium ions into cells in a salmon gill.

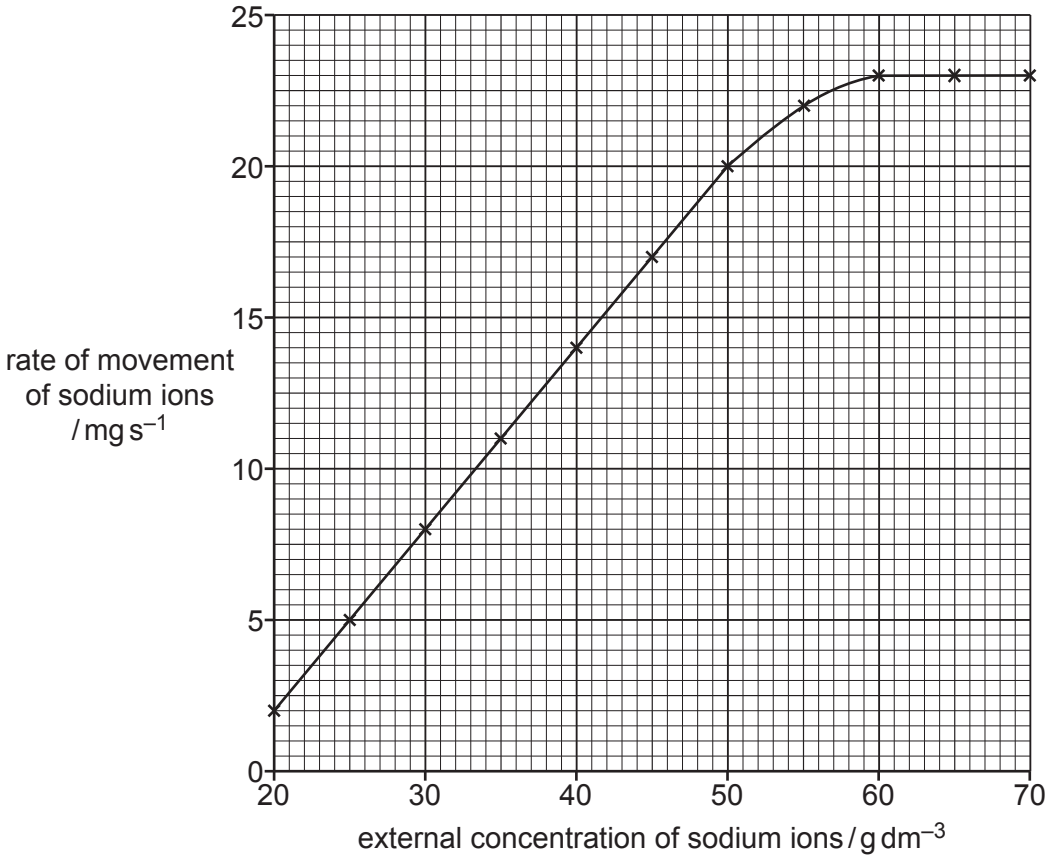

Fig. 2.3

(i) Describe the effect of increasing the external concentration of sodium ions on the rate of movement of sodium ions into the gill cells.

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(ii) Use your knowledge of membrane structure to explain the relationship between external concentration of sodium ions and the rate of movement of sodium ions into the gill cells, shown in Fig. 2.3.

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..... [4]

[Total: 14]

3 Myoglobin is a red protein that is found in the muscles of many vertebrate animals. It binds to oxygen and so can act as a store of oxygen within muscles.

Table 3.1 shows the mean total muscle mass and the mean concentration of myoglobin in the muscles of some species of marine fish. It also shows the swimming behaviour of these fish.

Table 3.1

fish species	mean total muscle mass / kg	mean concentration of myoglobin / mg per g of muscle	swimming behaviour
salmon shark	125	40	sustained, long distance
shortfin mako shark	47	25	sustained, long distance
smooth-hound	10	15	short periods, short distance
catshark	5	9	short periods, short distance
yellowfin tuna	120	32	sustained, long distance
skipjack tuna	19	23	sustained, long distance

(a) (i) Calculate the total mass of myoglobin found in a salmon shark with muscle mass of 125 kg.

Show your working and state the unit.

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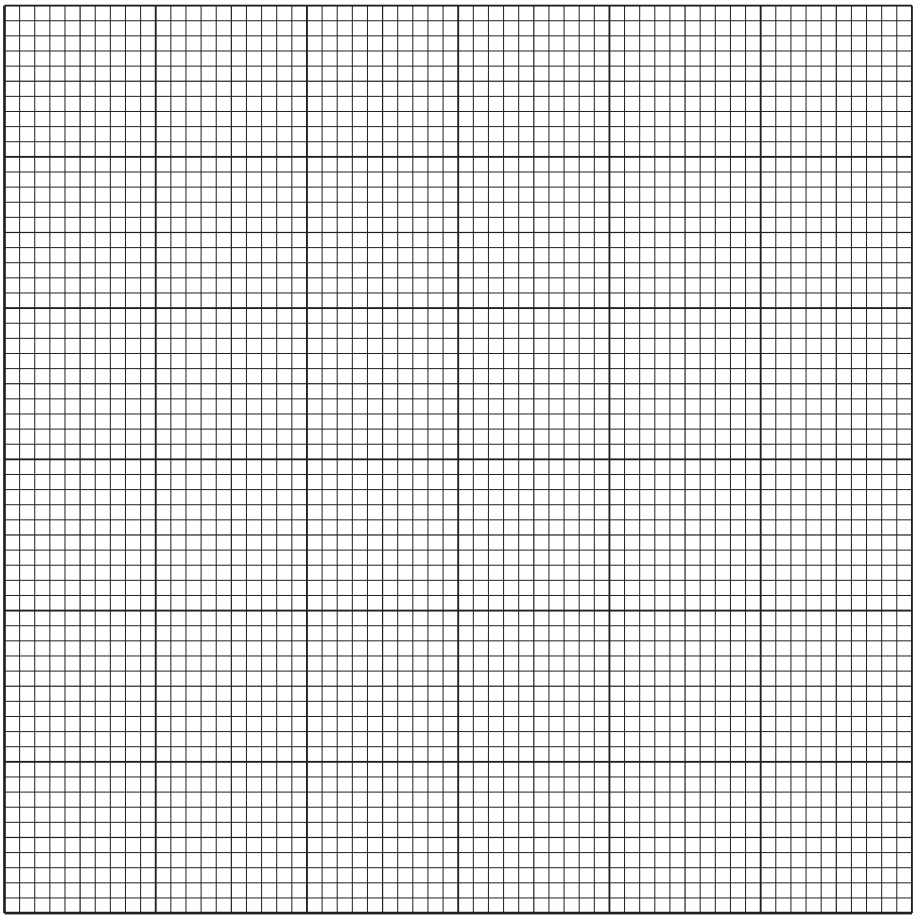
[2]

(ii) Draw a graph to compare the total muscle masses and concentrations of myoglobin in the fish shown in Table 3.1.



[5]

(b) (i) Give the balanced chemical equation for aerobic respiration.

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(ii) Explain the relationships shown between muscle mass, myoglobin concentration and swimming behaviour shown in Table 3.1.

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[Total: 13]

4 Plastics and microplastics can have a major impact on the marine environment.

(a) Explain why microplastics absorbed by plankton may pose a risk to humans.

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(b) A survey into the effect of discarded fishing gear on coral reefs was carried out in the sea around Thailand.

Areas of coral reefs were identified that had discarded fishing gear lying on top of them (above) or by the sides (adjacent). Each area of reef with discarded fishing gear was assessed for damage.

The results are shown in Table 4.1.

Table 4.1

type of discarded fishing gear on reef	number of reefs that were damaged		number of reefs that were not damaged	
	gear above	gear adjacent	gear above	gear adjacent
nets	193	174	49	719
ropes	14	10	5	59
nylon lines	18	18	75	114

(i) Calculate the total number of reefs that had nets found adjacent to them.

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[1]

(ii) Use your answer to **(b)(i)** and Table 4.1 to calculate the percentage of reefs with nets adjacent to them that were damaged.

..... %
[1]

(iii) Use Table 4.1 to assess the threats posed to coral reefs by different types of discarded fishing gear.

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..... [4]

(iv) Suggest **two** ways in which the survey could be improved to compare which of the discarded items had the largest impact on the coral reefs.

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[2]

(v) Suggest **one** other impact that discarded fishing gear has on the marine environment.

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..... [1]

[Total: 12]

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5 Gill nets are fishing nets that are often anchored underwater for 24 hours before being checked for the catch. Fish are caught by becoming entangled in the nets.

Bonefish are a species of fish that is caught commercially by using gill nets in many areas of the Pacific Ocean. The use of gill nets was banned around some islands of Hawaii in 2004 to make fishing more sustainable.

Fig. 5.1 shows the total catch of bonefish around an island where the use of gill nets was banned over a 13-year period.

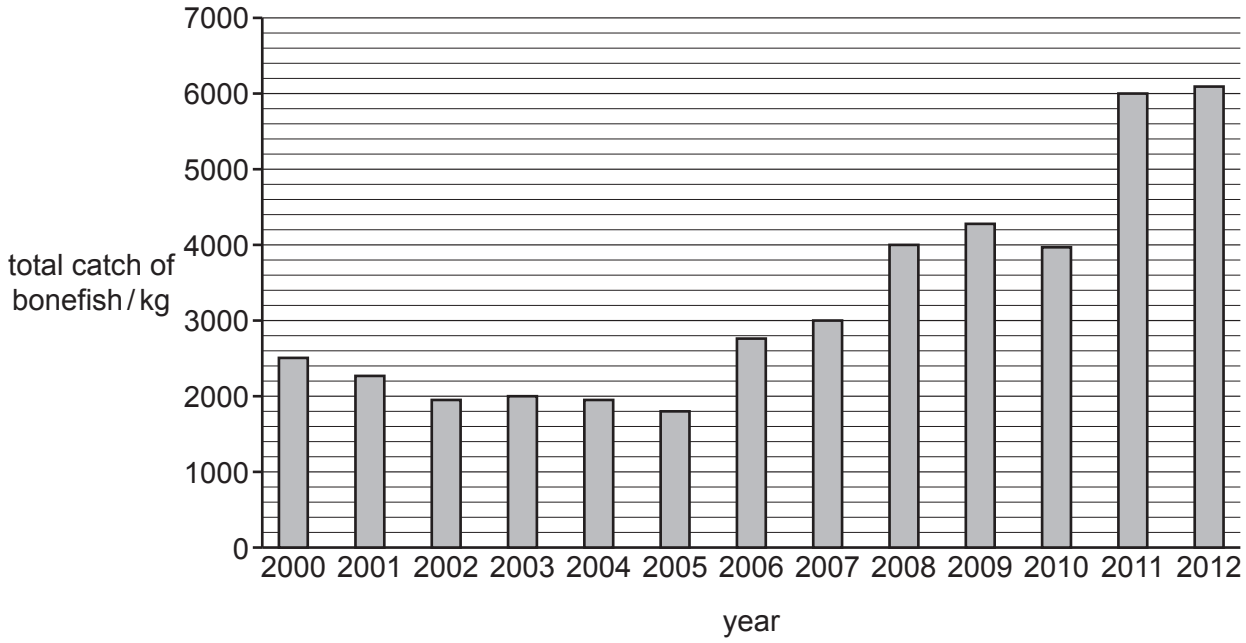

Fig. 5.1

(a) (i) Outline the general trends in total catch of bonefish between 2000 and 2012, shown in Fig. 5.1.

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(ii) Give **one** other tool, other than restricting fishing gear, that can be used to ensure that fisheries are exploited sustainably.

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..... [1]

(b) In 2012, scientists investigated the sizes of the bonefish around the island where the use of gill nets was banned.

They estimated the ratio of the number of bonefish in four length categories that would be required for a sustainable population.

The expected ratios for the different length categories are shown in Table 5.1.

Table 5.1

fish length category / cm	**<15**	**15 – 35**	**36 – 75**	**>75**
ratio	5	4	2	1

A sample of 1500 bonefish was caught. A chi-squared test was carried out to see if the numbers of fish caught in the sample fitted the expected ratios for a sustainable population.

The results are shown in Table 5.2.

Table 5.2

length category / cm	**expected ratio**	**number of bonefish in sample (*O*)**	**expected number of fish (*E*)**	**$(O - E)$**	**$(O - E)^2$**	**$\frac{(O - E)^2}{E}$**
< 15	5	605	625	–20	400	0.64
15 – 35	4	485	500	–15	225	0.45
36 – 75	2	265	250	15	225	0.90
> 75	1	145				

(i) Give a null hypothesis for the investigation.

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..... [1]

(ii) Complete Table 5.2. [1]

(iii) Calculate the value of chi-squared using the formula below:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

χ^2 = chi-squared

O = observed value

E = expected value

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[1]

(iv) Table 5.3 is a critical value table for chi-squared.

Table 5.3

degrees of freedom	*p* value				
	0.900	**0.500**	**0.100**	**0.050**	**0.010**
1	0.016	0.455	2.706	3.841	6.635
2	0.211	1.386	4.605	5.991	9.210
3	0.584	2.366	6.251	7.815	11.345
4	1.064	3.357	7.779	9.488	13.277

Use Table 5.3 and your answer to **(b)(iii)** to assess if the fish population is sustainable.

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(c) Use the information in Fig. 5.1, Table 5.2, and your answer to **(b)(iv)** to suggest an explanation for the effect of the ban on gill nets on bonefish catches.

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[Total: 11]

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