

Candidate Name _____

Centre Number _____

Candidate Number _____

CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International
Advanced Subsidiary and Advanced Level

9693/04

MARINE SCIENCE

Paper 4 A2 Data-Handling and Free-Response

May/June 2018

TIME: 1 hour 15 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

**Candidates answer on the Question Paper.
No Additional Materials are required.**

READ INSTRUCTIONS OVERLEAF

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.

SECTION A

Answer BOTH questions in this section.

Write your answers in the spaces provided on the Question Paper.

SECTION B

Answer BOTH questions in this section.

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.

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SECTION A

Answer BOTH questions in this section.

- 1 Scientists carried out an investigation into the composition of water samples taken from an area of the Arctic Ocean.**

They measured the concentration of dissolved oxygen, and also the quantity of chlorophyll present in a 1 dm³ sample.

Sampling was carried out on the first day of each month from late winter, through spring and into early summer.

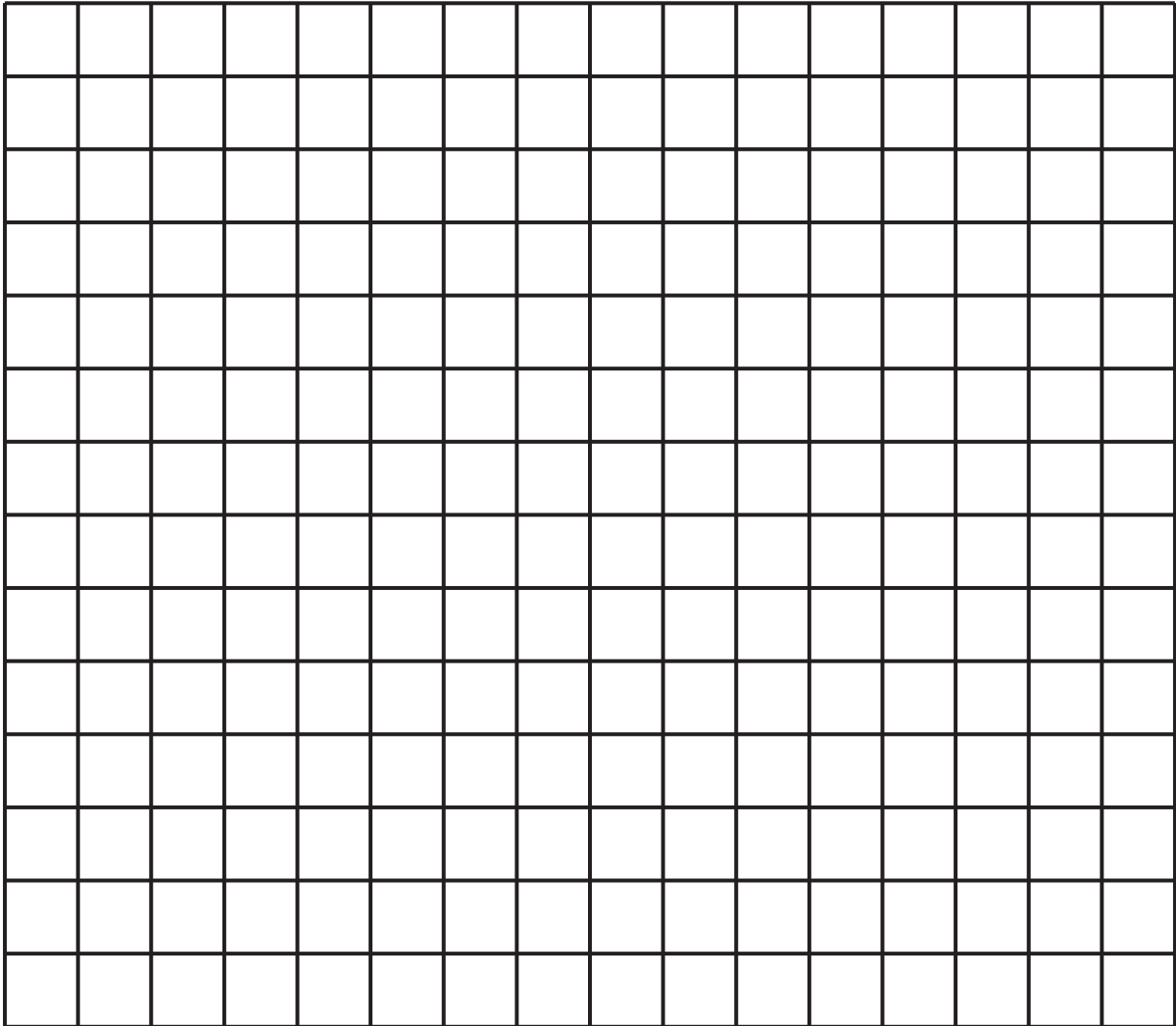
The condition of the surface ice on the water was also determined. It was assessed as increasing in size or melting.

The results are shown in Table 1.1.

TABLE 1.1

TIME (MONTH)	QUANTITY OF CHLOROPHYLL /ARBITRARY UNITS	OXYGEN CONCENTRATION /mg dm⁻³	CONDITION OF ICE SHEET
December	1000	8.5	increasing
January	500	8.5	increasing
February	500	7.8	increasing
March	500	6.9	increasing
April	2000	7.6	melting
May	6000	8.4	melting
June	3000	8.6	melting
July	1500	8.8	melting

(a) Plot a graph to show the changes in quantity of chlorophyll and oxygen concentration over time.



[5]

- (b) (i) Explain the relationship between the quantity of chlorophyll and the oxygen concentration shown in Table 1.1 and your graph.**

[2]

- (ii) Use the information in Table 1.1 to suggest TWO explanations, other than the changes in the quantity of chlorophyll, for the changes in oxygen concentration.**

[2]

(c) It has been suggested that global warming could affect ocean productivity.

Use the information in Table 1.1 and your graph to suggest how ocean productivity could be affected.

[2]

[Total: 11]

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- 2 A student carried out an investigation into the effect of size on the time taken for dye to diffuse to the centre of cubes of agar jelly.**

Cubes of agar jelly of different side length were placed into a solution of dye, as shown in Fig. 2.1.

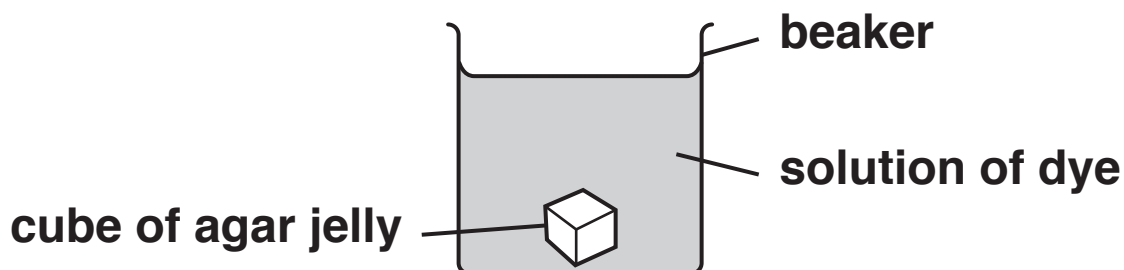


FIG. 2.1

The times taken for the dye to reach the centre of the cubes of agar jelly were recorded.

The results are shown in Table 2.1.

TABLE 2.1

SIDE LENGTH OF CUBE/mm	SURFACE AREA OF CUBE/mm²	VOLUME OF CUBE/mm³	SURFACE AREA: VOLUME RATIO OF CUBE	TIME TAKEN FOR DYE TO REACH CENTRE/s
5	150	125	1.2 : 1	35
10	600	1000	0.6 : 1	76
15	1350			174
20	2400	8000	0.3 : 1	296

- (a) (i) Calculate the surface area : volume ratio for the cube with a side length of 15 mm.**

Show your working.

[2]

- (ii) Use the information in Table 2.1 to explain why larger marine organisms require specialised gas exchange organs.**

[3]

- (b) Temperature also affects the time taken for dye to diffuse to the centre of a cube of agar jelly.**

Describe an experiment that you could do to investigate the effect of temperature on the rate of diffusion of the dye.

SECTION B

Answer BOTH questions in this section.

- 3 (a) (i) Explain why the precautionary principle is used when considering whether to permit the aquaculture of genetically engineered fish such as salmon.

[2]

[8]

[Total: 15]

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