

**BIOLOGY
HIGHER LEVEL
PAPER 2**

Candidate number

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Friday 14 November 2003 (afternoon)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

- Write your candidate number in the box above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer two questions from Section B. Write your answers on answer sheets. Write your candidate number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

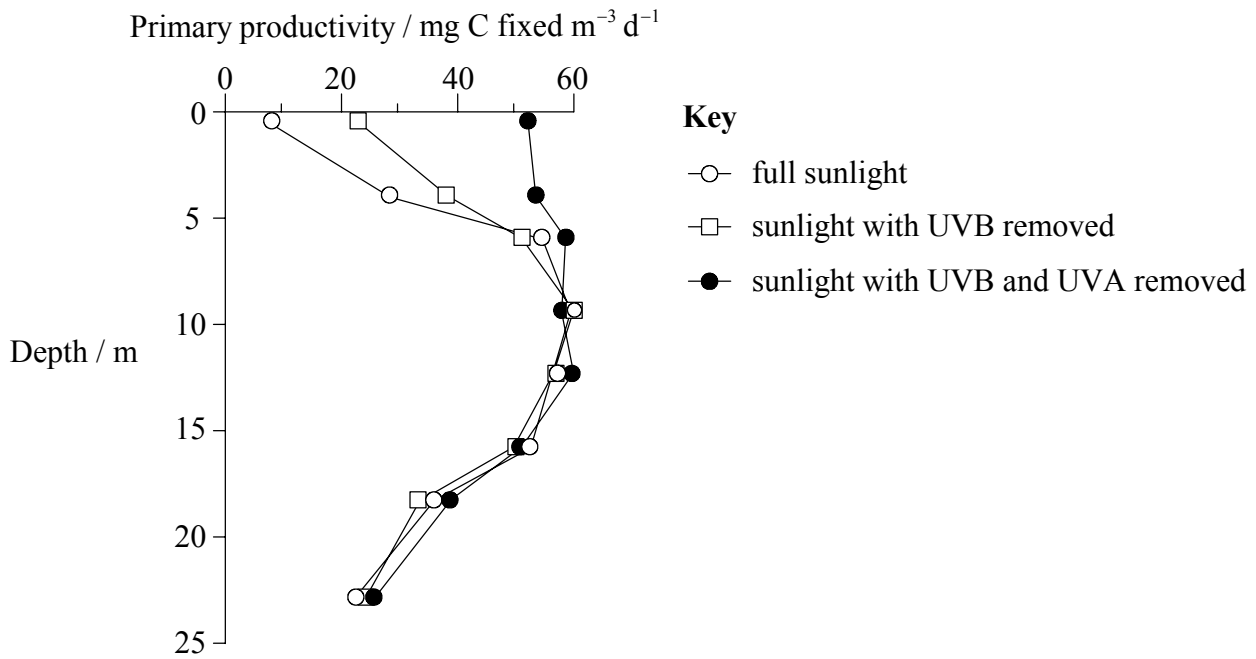
SECTION A

Answer **all** the questions in the spaces provided.

- The ozone layer in the atmosphere is an effective barrier to ultraviolet A (UVA) and ultraviolet B (UVB) light. UVA and UVB light penetrates the surface waters of the ocean and causes damage to marine organisms. The most extensive destruction of the ozone layer occurs over Antarctica and the Southern Ocean. This causes increased amounts of UVA and UVB light to reach Antarctic marine environments.

Primary productivity is the rate of production of organic material as a result of photosynthesis. The effect of light on the primary productivity of phytoplankton (microscopic photosynthetic organisms) at various depths was investigated in the Antarctic Ocean. Primary productivity was measured under three conditions:

- full sunlight
- sunlight with UVB removed using a suitable filter
- sunlight with both UVB and UVA removed using a suitable filter.



[Source: D Karentz and I Bosch 2001, *Amer Zoo*, 41, pages 3–16]

- Measure the level of primary productivity at a depth of 5 m under full sunlight. [1]

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- Outline the effect of depth on primary productivity under full sunlight. [2]

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(Question 1 continued)

- (c) Compare the effect of filtering UVB on primary productivity with the effects of filtering **both** UVB and UVA. [2]

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- (d) Discuss the effect of a reduction in the ozone layer on marine food chains. [3]

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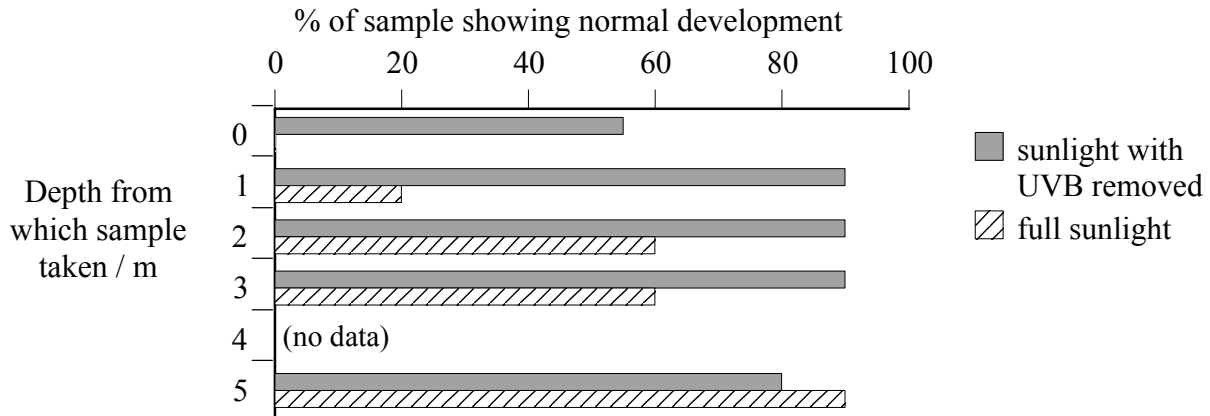
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(Question 1 continued)

Many marine organisms that live on the ocean floor have a free floating planktonic stage. Researchers measured the effect of full sunlight and sunlight which had UVB light filtered out on the early development of *Psilaster charcotti* (Antarctic sea star) at various depths. The results are shown in the graph below.



(e) Based upon the data for full sunlight and sunlight with UVB removed, identify the depth at which there is the

(i) least difference in the development of *P. charcotti*. [1]

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(ii) most difference in the development of *P. charcotti*. [1]

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(f) Predict **one** effect of a reduction in the ozone layer on the development of *P. charcotti*. [1]

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(Question 1 continued)

One of the major effects of UV light on the cell is damage to the DNA molecule. UV-induced damage results in adjacent thymine bases in the same strand bonding to each other (to form thymine dimers) instead of bonding to the complementary DNA strand. This results in random bases being incorporated into the new DNA strand during replication.

The effect of UV light on DNA in plankton at various depths was investigated on calm and windy days. The results are shown below.

DNA damage / number of
thymine dimers per 10⁶ bases

Depth / m	Calm day	Windy day
0	175	75
5	175	90
9	190	125
15	100	75
20	75	---
30	25	---

(g) Outline the effect of depth on DNA damage on a calm day. [2]

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(h) (i) Compare the amount of DNA damage on windy days with DNA damage on calm days. [1]

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(ii) Suggest a reason for the effect of wind on DNA damage. [1]

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(Question 1 continued)

(i) (i) Identify the type of mutation that results from the incorporation of random bases. [1]

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(ii) Predict the effects of this type of mutation on protein synthesis. [3]

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2. (a) Outline the role of human chorionic gonadotropin (HCG) in early pregnancy. [2]

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(b) State the role of the amniotic sac and the amniotic fluid. [2]

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(c) Define the term *genetic screening*. [1]

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3. (a) Outline the process of crossing-over. [2]

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(b) Explain the inheritance of skin colour in humans. [3]

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(c) Outline the evolution of bacteria in response to the use of antibiotics. [2]

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(d) Distinguish between the terms *population* and *community*. [1]

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SECTION B

Answer two questions. Up to two additional marks are available for the construction of your answers. Write your answers on the answer sheets provided. Write your candidate number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.

4. (a) Draw a low power diagram showing the distribution of tissues in a dicotyledenous leaf. [5]
- (b) Outline the process of glycolysis. [5]
- (c) Compare the structure of a chloroplast and a mitochondrion in relation to function. [8]
5. (a) Describe the process of clotting. [5]
- (b) Describe how skin and mucous membranes act as barriers. [5]
- (c) Explain the role of antibody production and the principle of vaccination in immunity. [8]
6. (a) Draw the structure of a motor neurone. [5]
- (b) Describe the control of body temperature. [5]
- (c) Discuss the relationship between the excretion of nitrogenous waste products and the habitat of an organism. [8]
7. (a) Draw a diagram of a plasma membrane. [5]
- (b) Describe the significance of polar and non-polar amino acids. [5]
- (c) Explain the role of vesicles in transportation of materials within cells. [8]
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