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**Biology**  
**Standard level**  
**Paper 2**

Wednesday 27 October 2021 (morning)

Candidate session number

1 hour 15 minutes

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**Instructions to candidates**

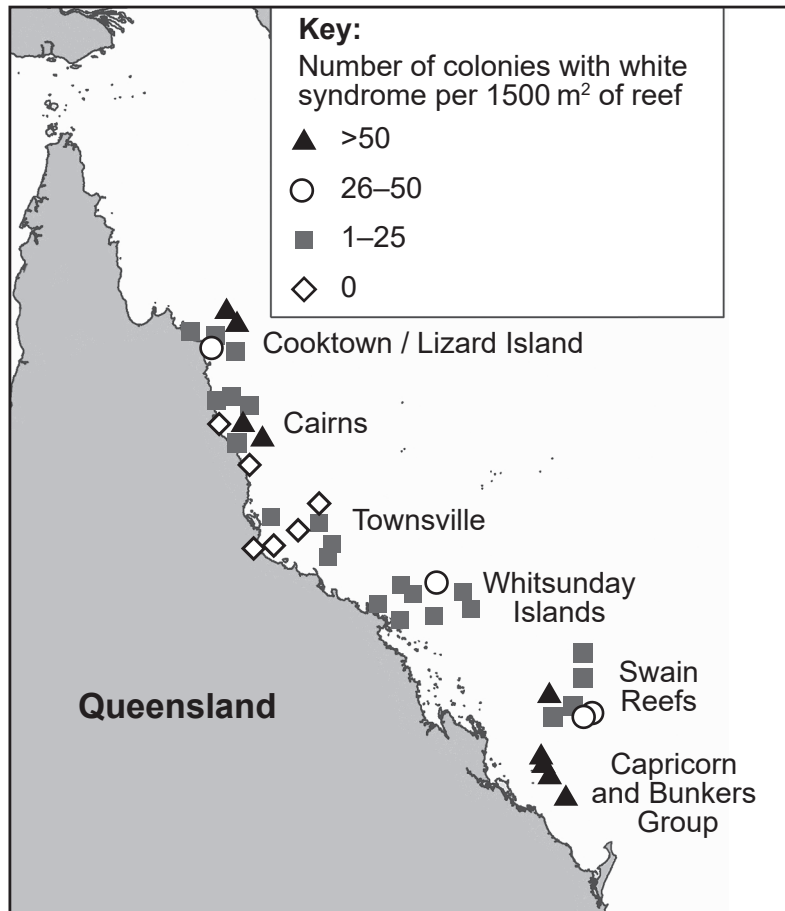
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



### Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. The incidence of white syndrome, an infectious disease of coral, was investigated in a six-year study on Australia's Great Barrier Reef. The map shows disease conditions on coral reefs at six study sites.



[Source: adapted from Bruno, J.F., Selig, E.R., Casey, K.S., Page, C.A., Willis, B.L., Harvell, C.D., Sweatman, H. and Melendy, A.M., 2007. *PLOS Biology*, [e-journal] 5(6), e124. <https://doi.org/10.1371/journal.pbio.0050124>.]

- (a) (i) Identify the site with the highest incidence of diseased colonies.

[1]

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(This question continues on the following page)



**(Question 1 continued)**

- (ii) Deduce whether there is a trend in the incidence of white syndrome over the north-south range of latitude.

[1]

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Satellites were used to record sea surface temperatures. The temperatures each week above a reef were compared with mean temperatures for that week between 1985 and 2004. If the sea surface temperature was 1 °C or more above the mean, this was recorded as a weekly sea surface temperature anomaly (WSSTA). The number of WSSTAs was calculated for the twelve months preceding the date on which a reef was surveyed for white syndrome.

On each reef, the number of cases of white syndrome in a 1500 m<sup>2</sup> sample area was surveyed once per year. The table shows these cases in relation to numbers of WSSTAs and coral cover on the reef. Low coral cover was 0–24 % and high coral cover was 50–75 %.

Mean number of corals with white syndrome per 1500 m <sup>2</sup>			
WSSTAs per year	Coral cover / %		
	0–24	25–49	50–75
0	0.9	0.9	10.4
1 to 5	3.6	9.8	23.3
> 5	4.7	4.5	80.1

[Source: adapted from Bruno, J.F., Selig, E.R., Casey, K.S., Page, C.A., Willis, B.L., Harvell, C.D., Sweatman, H. and Melendy, A.M., 2007. *PLOS Biology*, [e-journal] 5(6), e124. <https://doi.org/10.1371/journal.pbio.0050124>.]

- (b) (i) Describe the evidence that is provided by the data in the table for the harmful effects of rising sea temperatures on corals.

[2]

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**(This question continues on the following page)**



16EP03

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(Question 1 continued)

- (ii) The researchers concluded that there was a threshold coral cover percentage, below which infection rates tended to remain fairly low. Using the data in the table, identify this threshold level. [1]

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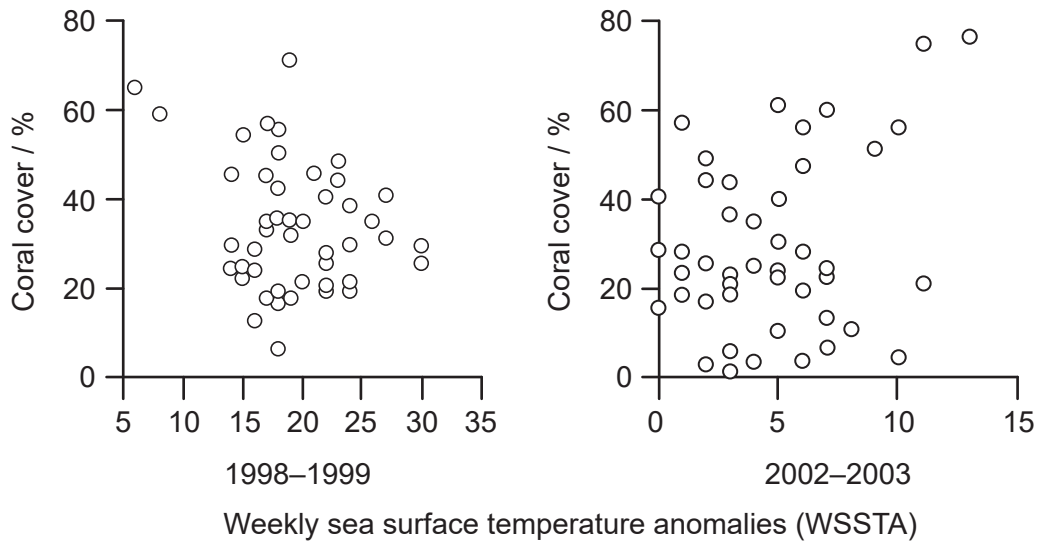
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- (iii) Suggest a reason for a larger percentage of corals being infected with white syndrome on reefs with a higher cover of corals. [1]

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The graphs show the relationship between the weekly sea surface temperature anomalies (WSSTA) and coral cover during two twelve-month periods (1998–99 and 2002–03), which were the warmest in the six-year study. Each dot represents one studied reef.



[Source: adapted from Bruno, J.F., Selig, E.R., Casey, K.S., Page, C.A., Willis, B.L., Harvell, C.D., Sweatman, H. and Melendy, A.M., 2007. *PLOS Biology*, [e-journal] 5(6), e124. <https://doi.org/10.1371/journal.pbio.0050124>.]

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**(Question 1 continued)**

(c) (i) Compare and contrast the data for 1998–1999 and 2002–2003. [2]

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(ii) Suggest a reason for the correlation between coral cover and WSSTA in 1998–1999. [1]

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(d) Some scientists predict that, if humans continue to produce carbon dioxide at the current rate, the pH of the oceans will become more acidic. Suggest possible effects on the coral reefs. [3]

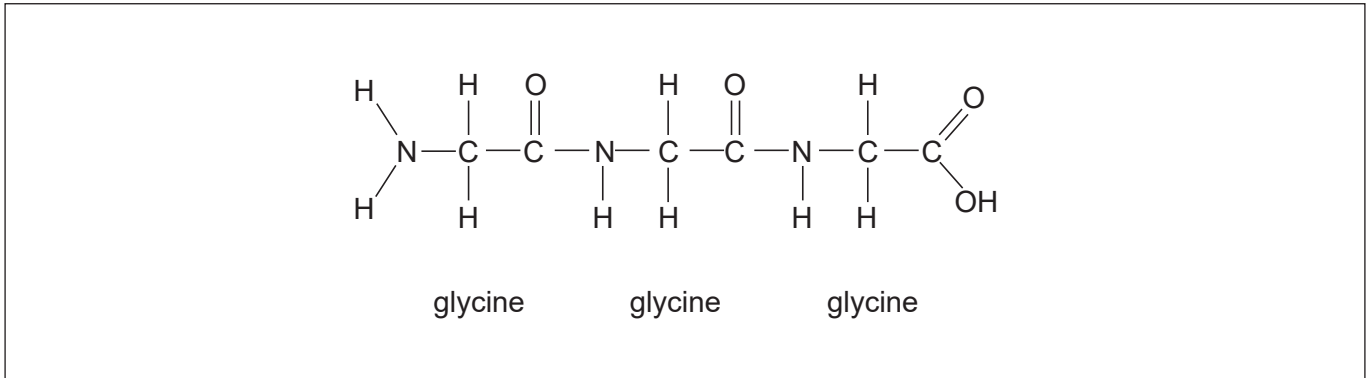
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(e) This study was carried out over six years on the Australian Great Barrier Reef. State **one** advantage of field investigations compared with mesocosm experiments to study ecological processes. [1]

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2. The figure shows a tripeptide.



- (a) Label **one** peptide bond in this molecule. [1]
- (b) Outline the specific functions of **three named** proteins. [3]

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- (c) Outline the action taken by the diaphragm during inhalation. [1]

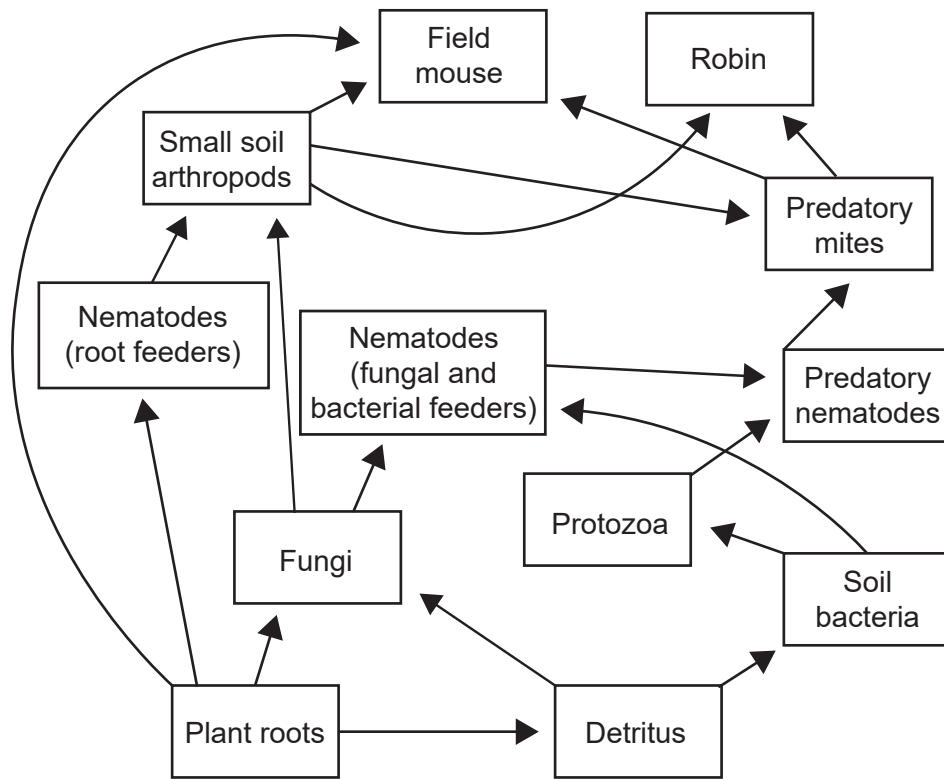
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3. (a) Compare and contrast the mode of nutrition of detritivores and saprotrophs. [2]

	Detritivores	Saprotrophs
Similarity		
Difference		

- (b) The image shows an example of a soil food web.



- (i) Draw a food chain from this food web, showing at least three organisms. [1]

(This question continues on the following page)





(Question 3 continued)

- (ii) Explain the reasons for food chains rarely containing more than four or five trophic levels.

[3]

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- (c) The amount of food passing into food chains can be affected by the rate of photosynthesis. Explain the effect of **one** limiting factor on photosynthesis.

[3]

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- (d) All of the leaves in the image are from *Solanum*, a wild genus of tomato.



State **one** cause of variation in a plant such as the tomato.

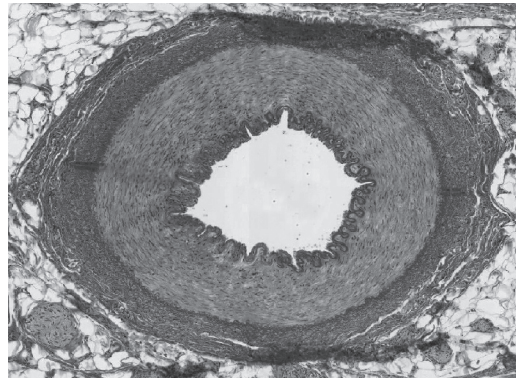
[1]

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4. This micrograph shows a transverse section of an artery.



x 100

(a) Explain how the specialized structures of arteries help them to achieve their functions. [3]

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(b) (i) State **one** process that produces ATP. [1]

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(ii) Outline the use of ATP. [1]

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(c) State **one** function of epinephrine in the human body. [1]

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## Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Answers must be written within the answer boxes provided.

5. Substances can move into and out of cells through the cell membrane.
- (a) Outline the significance of surface area to volume ratio in the limitation of cell size. [4]
  - (b) Describe transport across cell membranes by osmosis. [4]
  - (c) Explain the adaptations of the small intestine to its function. [7]
6. Organisms have evolved a great diversity of cell types.
- (a) Describe the endosymbiotic theory. [4]
  - (b) Explain the need for halving the chromosome number during a sexual life cycle and how this is done. [7]
  - (c) Outline the binomial system of classification. [4]



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16EP11

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16EP13

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#### References:

1. (a) (b) (c) Bruno, J.F., Selig, E.R., Casey, K.S., Page, C.A., Willis, B.L., Harvell, C.D., Sweatman, H. and Melendy, A.M., 2007. *PLOS Biology*, [e-journal] 5(6), e124. <https://doi.org/10.1371/journal.pbio.0050124>.
3. (b) Anon., n.d. The Soil Food Web. [image online] Available at: <https://www.nrcs.usda.gov/wps/portal/nrcs/photogallery/soils/health/biology/gallery/?cid=1788&position=Promo> [Accessed 11 March 2020].
3. (d) Courtesy: National Science Foundation, Credit Leonie Moyle.
4. OpenStax College, 2013. Comparison of artery and vein. [image online] Available at: [https://en.wikipedia.org/wiki/File:2102\\_Comparison\\_of\\_Artery\\_and\\_Vein.jpg](https://en.wikipedia.org/wiki/File:2102_Comparison_of_Artery_and_Vein.jpg) Attribution 3.0 Unported (CC BY 3.0) <https://creativecommons.org/licenses/by/3.0/deed.en> [Accessed 11 March 2020].

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