



Biology

Higher Level

Paper 2 — Mock Examination

Mock Exam 3

Calculator required

Time allowed: **2 hours 30 minutes**

Maximum mark: **80 marks**

Candidate information

Candidate name:

Session number:

Date:

Topic emphasis: interaction and interdependence in ecosystems, the carbon cycle and climate change, movement and muscle, hormonal communication and reproduction, osmoregulation and excretion, inheritance and pedigree analysis, biodiversity and its measurement, and bioenergetics.

Instructions to candidates

- Write your session number in the box on the cover.
- Do not open this examination paper until you are told to do so.
- **Section A**: answer **all** questions.
- **Section B**: answer **two** questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

The mark allocation is shown in square brackets at the end of each question or part question. Where a numerical answer is required, working should be shown and the answer given to an appropriate number of significant figures. In Section B, **one additional mark** is available for each question for the construction of your answer: this mark is awarded when the answer is clear enough to be understood without re-reading and when the question has been answered succinctly, with little or no repetition or irrelevant material.

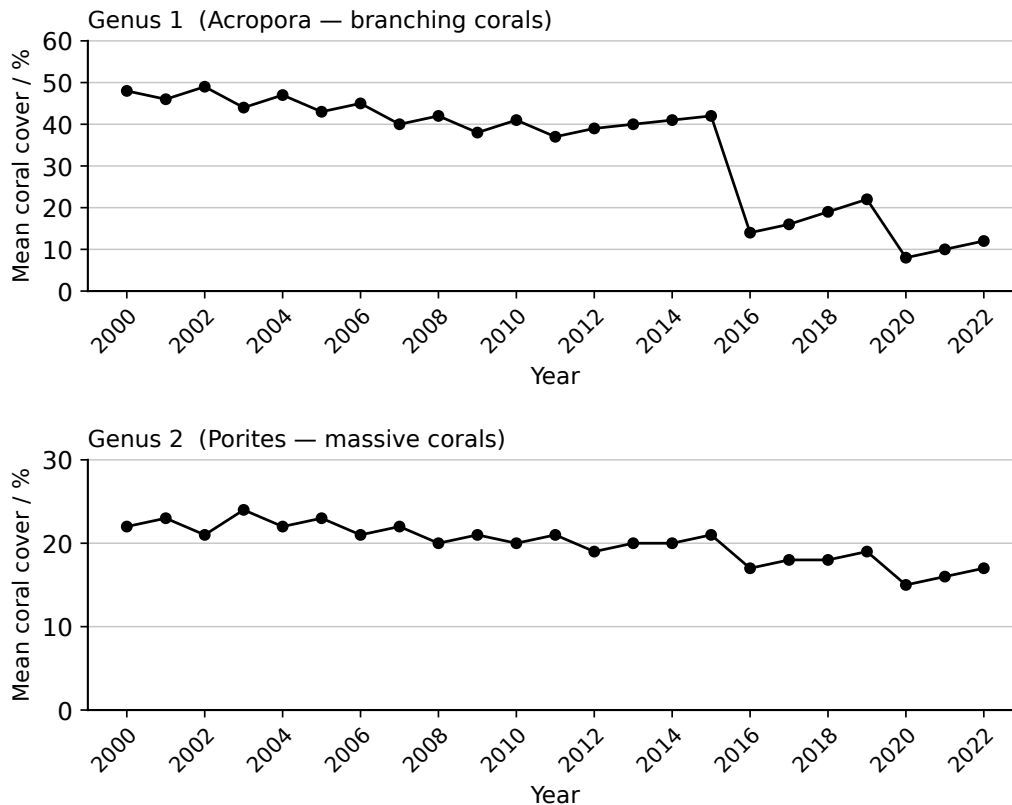
Mark allocation

Section A (questions 1–7)	[48 marks]
Section B (questions 8–10; answer two questions)	[32 marks]
Total	[80 marks]

Section A

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

1. Reef-building corals live in a mutualistic relationship with photosynthetic dinoflagellates that live inside their tissues. When the temperature of the sea water rises above the normal range, corals expel the dinoflagellates and become white. This is known as bleaching. Divers recorded the percentage of the sea floor covered by two genera of coral at fixed sites on a reef between 2000 and 2022.



(This question continues on the following page)

(Question 1 continued)

- (a)** State the year in which the mean cover of *Acropora* was lowest. **[1]**

- (b)** Compare and contrast the changes in the mean cover of the two genera between 2000 and 2022. **[3]**

- (c)** Calculate the percentage decrease in the mean cover of *Acropora* between 2015 and 2016. **[1]**

- (d)** Suggest **two** limitations of using the percentage cover recorded at fixed sites to monitor the condition of the whole reef. **[2]**

(This question continues on the following page)

(Question 1 continued)

During the warmest month of 2020, divers examined colonies of six genera of coral on the same reef and recorded the number that had bleached.

Genus	Number of colonies examined	Number of colonies bleached	% bleached	Growth form
<i>Acropora</i>	1420	1093	77.0	branching
<i>Pocillopora</i>	860	610	70.9	branching
<i>Montipora</i>	645	397	61.6	plating
<i>Favia</i>	512	174	34.0	massive
<i>Porites</i>	1180	342	29.0	massive
<i>Fungia</i>	96	21	21.9	free-living

- (e) State the genus with the greatest percentage of colonies bleached. [1]

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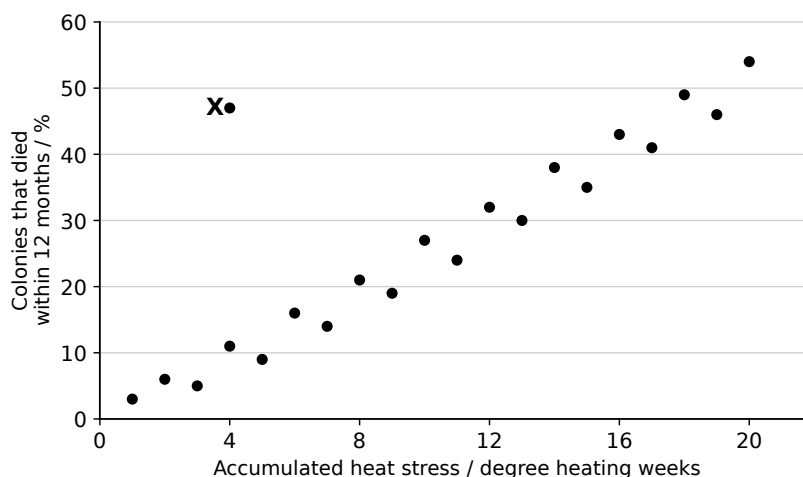
- (f) Suggest **one** reason for the difference between the percentages of colonies of each genus that bleached. [1]

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(Question 1 continued)

Heat stress on a reef can be measured in degree heating weeks, which combine the amount and the duration of the temperature rise above the normal maximum. The graph shows the heat stress recorded at 20 reef sites and the percentage of coral colonies at each site that died within the following 12 months.



- (g) State the relationship between accumulated heat stress and the percentage of colonies that died. [1]

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- (h) A student suggested that the point labelled **X** is atypical. Outline a reason for this suggestion. [1]

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- (i) Evaluate the hypothesis that rising sea temperature is the main cause of the loss of coral on this reef. [3]

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2. Carbon is exchanged between the atmosphere, the oceans and living organisms.

- (a)** Outline how carbon dioxide is removed from and returned to the atmosphere by living organisms. **[2]**

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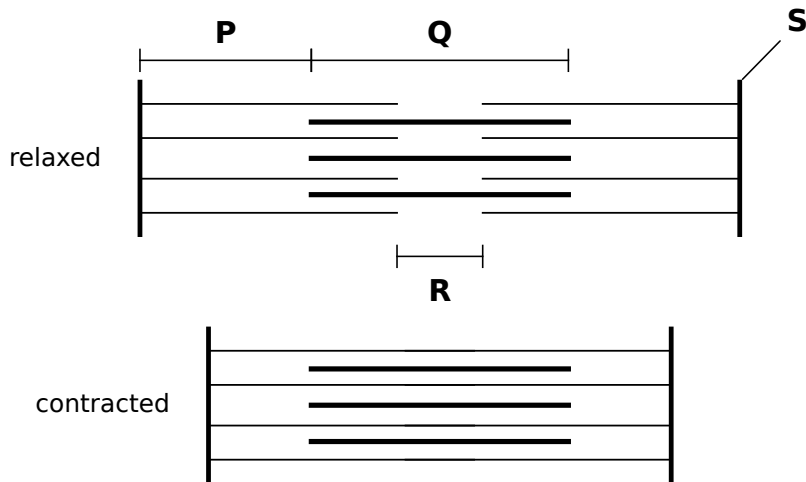
- (b)** Explain how an increase in the concentration of greenhouse gases raises the mean temperature of the Earth. **[3]**

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- (c)** State **one** consequence of ocean acidification for reef-building corals. **[1]**

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3. The diagram shows one sarcomere of a striated muscle fibre when relaxed and when contracted. Four features of the relaxed sarcomere are labelled **P** to **S**.



- (a) Identify the labelled feature that does **not** change in length when the muscle contracts.

[1]

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- (b) Explain the roles of calcium ions and ATP in the sliding filament model of muscle contraction.

[3]

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- (c) Outline the role of the sarcoplasmic reticulum in a muscle fibre.

[2]

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4. Hormones secreted by the pituitary gland and the ovaries control the menstrual cycle.

(a) Outline the roles of FSH and LH in the menstrual cycle. **[3]**

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(b) Explain how negative feedback prevents the development of further follicles after ovulation. **[2]**

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(c) State the structure that secretes progesterone after ovulation. **[1]**

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5. Mammals control the water content of their body fluids using the kidney.

(a) Explain how antidiuretic hormone (ADH) changes the volume of urine produced.

[3]

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(b) Outline **two** differences between the composition of blood plasma and the composition of glomerular filtrate.

[2]

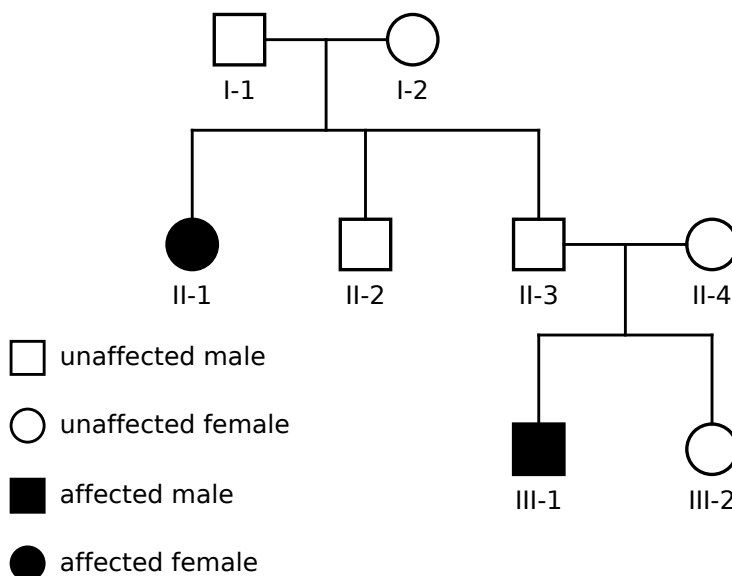
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(c) State **one** advantage to a desert mammal of producing urine that is hypertonic to its blood.

[1]

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6. The pedigree chart shows the inheritance of a genetic condition in one family. The condition is caused by an allele of a single gene that is not carried on a sex chromosome.



- (a) Deduce, with a reason, whether the allele that causes the condition is dominant or recessive. [2]

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- (b) State the genotypes of individuals I-1 and I-2, using the symbols **A** and **a**. [1]

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- (c) Determine the probability that individual III-2 is a carrier of the allele that causes the condition. Show your working. [2]

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7. Two areas of woodland were sampled using the same method. One had been managed for timber production and the other had been left undisturbed. The table shows the number of individuals of each of five species of ground plant found in 100 quadrats at each site.

Species	Number at site A (undisturbed)	Number at site B (managed)
Species 1	25	62
Species 2	20	20
Species 3	18	10
Species 4	22	5
Species 5	15	3
Total	100	100

Simpson's reciprocal diversity index is calculated using $D = \frac{N(N-1)}{\sum n(n-1)}$, where N is the total number of organisms of all species and n is the number of organisms of each species. For site A, $D = 5.06$.

(a) Calculate the value of D for site B. Show your working. [2]

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(b) Compare the biodiversity of the two sites, using the values of D . [1]

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(c) Outline why the number of species present is not by itself a reliable measure of the biodiversity of a site. [2]

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Section B

Answer **two** questions. **One additional mark** is available for the construction of your answer for each question. Answers must be written within the answer boxes provided.

8. Lipids and carbohydrates are both used as sources of energy, but they have different properties.

- (a) Using named examples, explain the relationships between the structure of lipids and their properties and functions in living organisms. [7]
- (b) Outline, with examples, the functions of the proteins found in plasma membranes. [5]
- (c) Distinguish between saturated, unsaturated and trans fatty acids. [3]

9. Chloroplasts and mitochondria both use gradients of protons to synthesize ATP.

- (a) Describe how a proton gradient is generated and used to make ATP in a mitochondrion. [4]
- (b) Explain the events of the light-dependent reactions of photosynthesis. [7]
- (c) Outline how the rate of photosynthesis can be measured, and the effect of limiting factors on this rate. [4]

10. Ecosystems depend on the transfer of energy and the recycling of nutrients between organisms.

- (a) Describe how energy and carbon move through an ecosystem. [5]
- (b) Outline how keystone species and mutualism contribute to the stability of a community. [3]
- (c) Explain the causes and the consequences of the loss of biodiversity in an ecosystem, using named examples. [7]

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End of examination.

Total: 80 marks