bio letters

Biology
Standard and Higher level
C4.2 Transfer of energy and matter
Paper 2

13 May 2025

Zone A afternoon | **Zone B** morning | **Zone C** afternoon

Candidate name

4 hours 15 minutes

Instructions to candidates

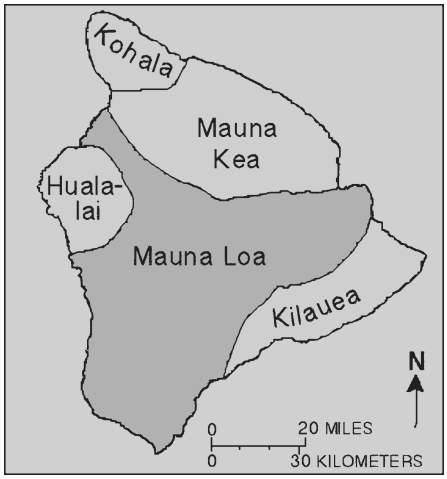
- Write your candidate name in the boxes above.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- This paper only includes short and long answer questions; database questions for each topic are in separate worksheets.
- Most of the questions are original and written by me. Several questions are inspired from external sources, which are referenced. None of the questions are from IB past papers.
- Although most questions focus on this topic only, some are linked to other topics. A few questions have intentionally similar answers to show you how questions can be phrased differently but ask about the same concept(s).
- The duration of this paper was scaled according to the number of marks available and based on how much time, on average, each mark is worth in examination settings. Since this is a practice paper, expect to need more time to complete it.
- The maximum mark for this paper is **[130 marks]**.

1305–2025

16 pages

Section A

1. The image shows the map of the Mauna Loa island in Hawaii.



(a) State the carbon compound monitored by the Mauna Loa observatory. [1]

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(b) Explain why Mauna Loa island was chosen for the observatory location. [3]

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(c) The island contains a volcano that frequently erupts. Suggest how scientists can reduce the impacts this may have on the observatory data. [1]

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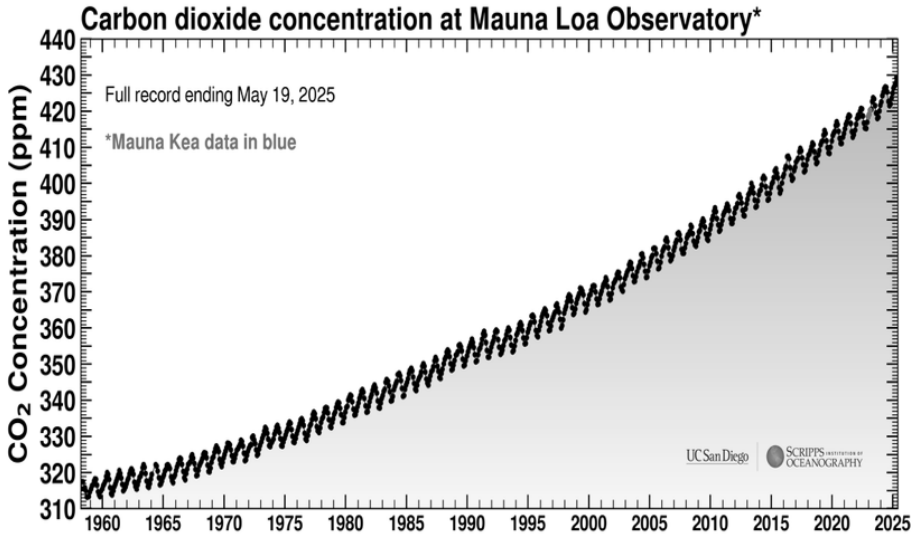
2. The graph shows the Keeling Curve.



(a) Explain the seasonal fluctuations. [2]

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(b) Suggest **one** direct and **one** indirect consequence of rising carbon dioxide levels in the atmosphere. [2]

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(This question continues on the following page)

(Question 2 continued)

(c) Outline what the long-term trend reveals about the impact of human activities on the carbon cycle. [2]

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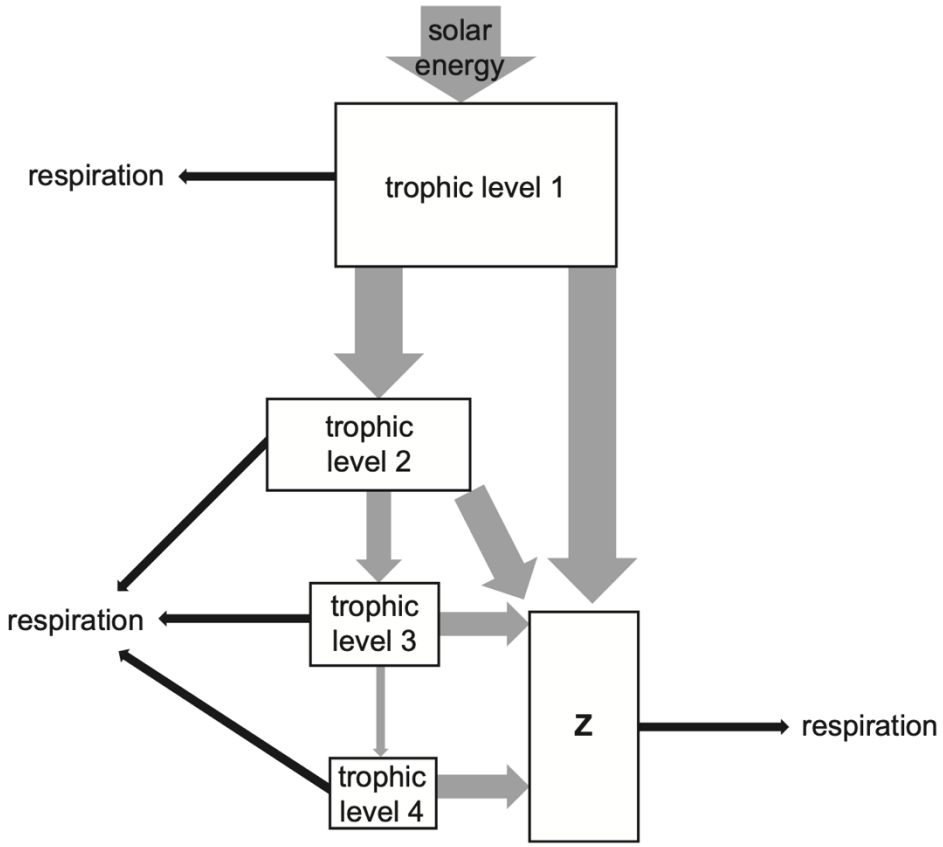
3. The diagram shows the flow of energy through a food chain. The size of each box represents the amount of energy available at each trophic level.



(a) State the unit typically used for energy. [1]

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(b) Identify the term given to the group of organisms represented by **Z**. [1]

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(This question continues on the following page)

(Question 3 continued)

(c) Explain why it is difficult for food chains to sustain five trophic levels. [2]

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(d) Explain how energy lost from ecosystems is replaced. [3]

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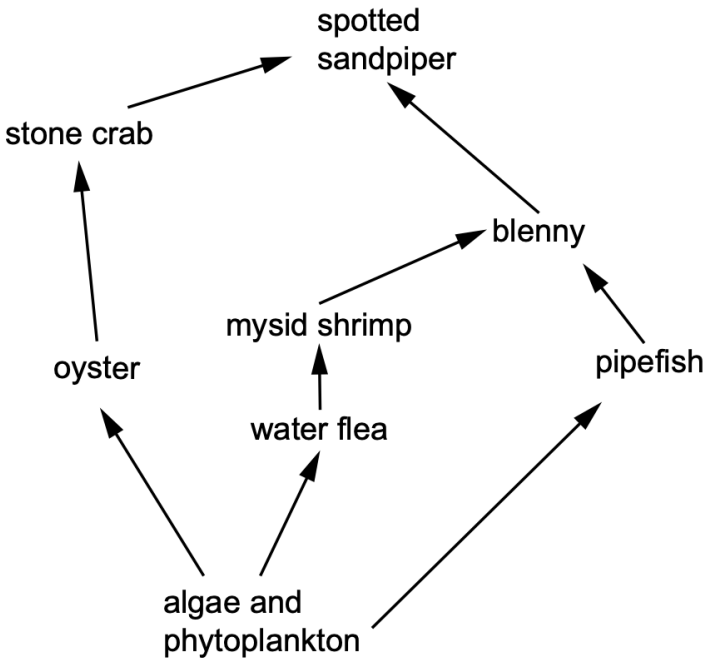
4. Wetlands are important ecosystems. The diagram shows part of a food web researchers studied to understand the feeding relationships between organisms in an area of coastal wetland.



(a) Complete this table by stating the name of one organism from the food web in each row. [3]

	Name of organism
Producer	…… ……
Secondary consumer	…… ……
An animal that feeds at two trophic levels	…… ……

(This question continues on the following page)

(Question 4 continued)

(b) Explain the impacts of removing pipefish on **two** organisms. [2]

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(c) Outline how omnivores can complicate energy flow calculations. [2]

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5. Photosynthesis and respiration are dependent on each other.

(a) Identify one carbon compound that is shared by photosynthesis and respiration. [1]

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(b) Outline the interdependence of photosynthesis and respiration. [2]

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(c) All organisms respire. Compare the net carbon flux from respiration in autotrophs and heterotrophs. [2]

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(d) Describe the role of oxidation reactions in respiration. [2]

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6. The desert biome has many unique characteristics.

(a) State **one** abiotic factor that limits biomass accumulation in deserts. [1]

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(b) Explain why biomes vary in their capacity to accumulate biomass. [2]

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(c) Compare and contrast the abiotic factors that affect primary productivity in tropical rainforests and desert biomes. [2]

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(d) Outline how net primary production data could be used to rank biomes by biodiversity potential. [3]

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Section B

There are not enough answer boxes for all the questions in this section in order to save on printing paper. You can use the few answer boxes for brainstorming your responses, and then record your answers on a separate sheet of paper.

7. Carbon is an important element to living organisms.

(a) Distinguish between the mechanisms used by photoautotrophs and chemoautotrophs to produce carbon compounds. [4]

(b) Outline how ecosystems can be sustained without sunlight as the main energy source. [4]

(c) Explain how the Keeling Curve provides evidence for anthropogenic effects on the carbon cycle. [7]

8. There are many processes that ensure organisms have enough energy to survive.

(a) Explain the role of metabolic reactions in energy flow between ecosystems. [7]

(b) Outline how energy is lost between trophic levels. [4]

(c) Describe the role of oxidation reactions in energy transfers between trophic levels. [4]

9. The movement of carbon within ecosystems is essential to their viability.

(a) Compare how decomposition and combustion release carbon from biomass. [4]

(b) Discuss how human activities have caused imbalances between carbon sinks and sources. [7]

(c) Outline how a shift from a tropical forest to a grassland would affect the productivity of an ecosystem. [4]

10. Ecosystems depend on interactions between species.

(a) Describe the role of primary and secondary production in biomass accumulation. [4]

(b) Outline how interactions between species impose limits on trophic levels. [4]

(c) Explain, using examples, the effects of abiotic factors on primary production. [7]

11. Ecosystems are composed of interacting and interdependent components.

(a) Describe the different ways by which carbon dioxide can be released into the atmosphere. [7]

(b) Outline how data from specific ecosystems can be used to represent energy transfer between trophic levels. [4]

(c) Explain why most food chains cannot sustain more than four trophic levels. [4]

12. Interconnected processes are vital in living organisms and their ecosystems.

(a) "Open systems allow for transfers of energy and matter." Discuss this statement with reference to ecosystems and the human body. [7]

(b) Distinguish between the roles of saprotrophs and detritivores. [4]

(c) Outline, using an example, the usefulness of generalizations in ecology. [4]

References:

1. Wikimedia Commons. https://en.m.wikipedia.org/wiki/File:Mauna_Loa_map.gif

2. Monroe, Robert. “The Keeling Curve.” The Keeling Curve, keelingcurve.ucsd.edu.

3. Physics and Math Tutor. https://pmt.physicsandmathstutor.com/download/Biology/GCSE/Past-Papers/CIE/Paper-4/9-1/QP/November%202020%20%289-1%29%20%28v2%29%20QP.pdf

4. IGCSE Cambridge IGCSE Biology Specimen Paper 4 2023. https://www.cambridgeinternational.org/Images/595634-2023-specimen-paper-4.pdf