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Biology
Standard level
Paper 2

12 May 2026

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

Session number

1 hour 30 minutes

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Instructions to students

- 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.

- Scientists investigated the allelopathic effects of root extracts from an invasive shrub, sumac (*Rhus typhina*), on the growth of marigold plants (*Tagetes erecta*), which are native to Mexico.

Sumac (*Rhus typhina*)



Marigold (*Tagetes erecta*)



After germination, five marigold plants were put into separate pots filled with soil. Each pot was watered daily with 20 ml of a different concentration of sumac root extract (2.5, 5.0, 7.5 and 10.0 mg ml⁻¹), or 20 ml of pure water (0.0 mg ml⁻¹ control). Each treatment was replicated three times. After 60 days, the growth of each plant was measured using four different parameters.

The table gives the mean values of marigold plant growth.

Concentration of sumac root extract / mg ml ⁻¹	Height / cm	Root length / cm	Above-ground biomass / g	Total biomass / g
0.0 (control)	16.5	16.3	18.7	25.0
2.5	19.1	15.3	17.9	24.4
5.0	17.8	15.6	16.9	22.4
7.5	15.9	15.2	16.7	23.2
10.0	15.3	14.2	13.5	18.3

(This question continues on the following page)



(Question 1 continued)

- (a) (i) Identify the relationship between root length of marigolds and the increase in the concentrations of sumac root extracts.

[1]

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- (ii) Compare and contrast how increasing the concentrations of sumac root extracts affects marigold height and above-ground biomass.

[2]

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- (iii) Calculate the percentage change in total biomass between the control and a concentration of sumac root extract of 10.0 mg ml^{-1} .

[1]

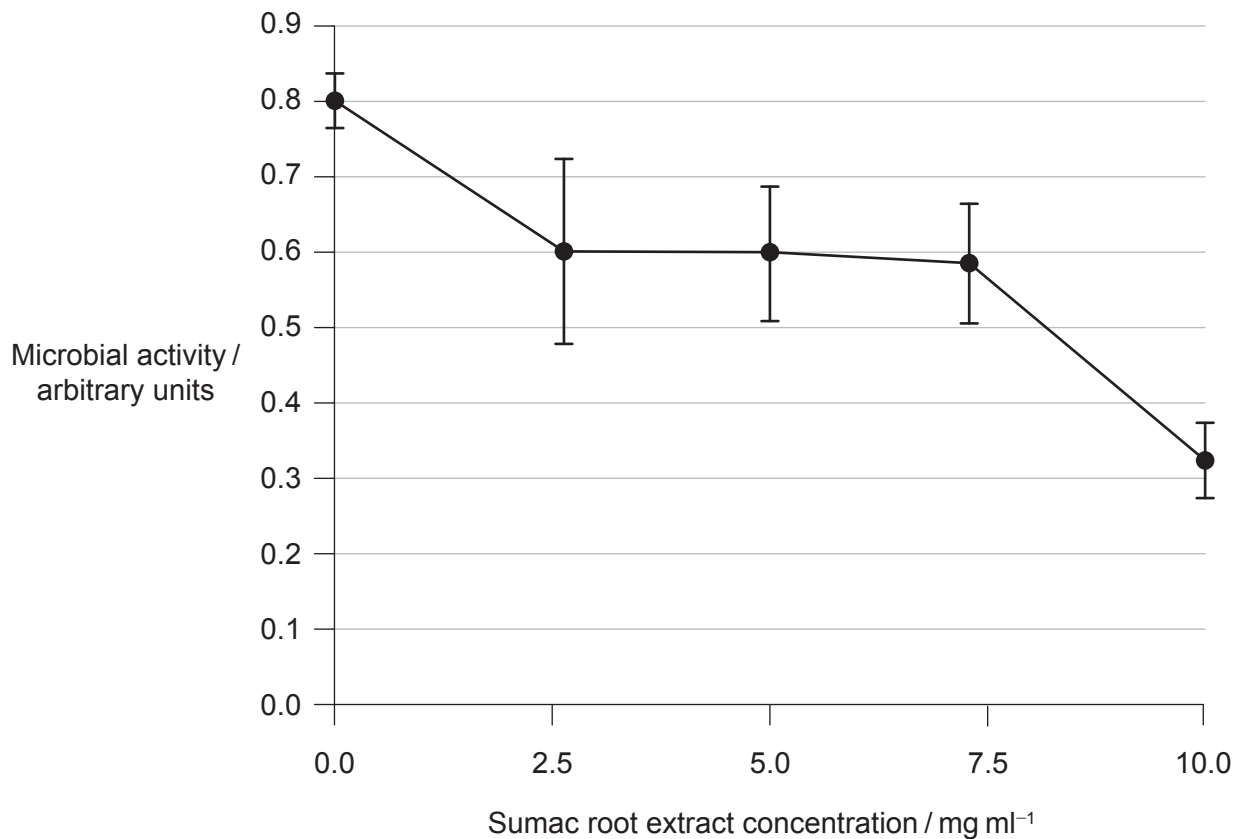
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(This question continues on the following page)



(Question 1 continued)

The scientists then investigated the microbial communities in soil samples from the pots. They measured both microbial activity and the Simpson reciprocal index after exposure to different concentrations of sumac root extract after five days. The graph shows the results on microbial activity.



- (b) (i) Identify the microbial activity at the concentration of sumac root extract of 10.0 mg ml⁻¹ after five days.

[1]

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- (ii) Describe the effect of increasing sumac root extract concentration on microbial activity after five days.

[2]

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(This question continues on the following page)



(Question 1 continued)

The scientists found that, in addition to changes in microbial activity, the Simpson reciprocal index was lower in soils treated with sumac root extracts than in the control.

- (c) Outline the significance of this in terms of the microbial diversity in the soil. [1]

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- (d) The scientists' initial hypothesis was that a plant's invasive success depends on the plant's ability to release chemicals that inhibit native plant growth or create new plant–soil microbial interactions.

Discuss whether the data supports this hypothesis. [3]

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Answers written on this page
will not be marked.



2. Monosaccharides are essential molecules in the body.

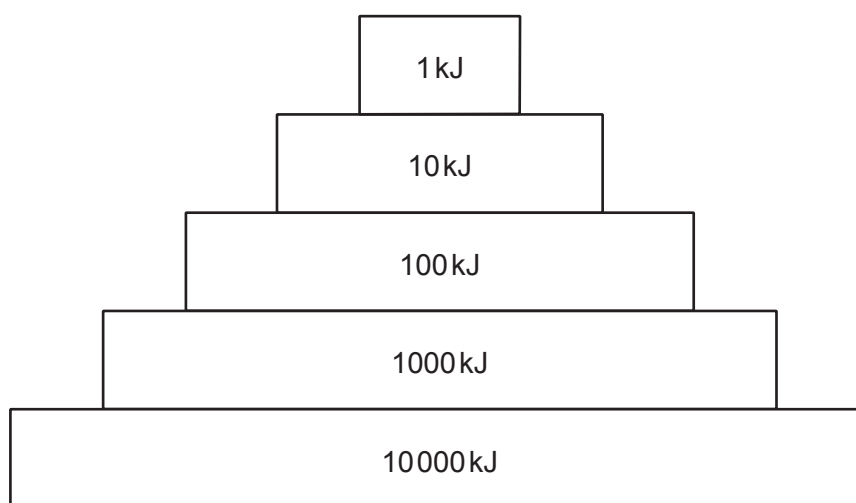
(a) Outline **one** property of monosaccharides **and** its related function. [2]

Property:

Function:

(b) The diagram shows the flow of energy between trophic levels of a food chain.

diagram not to scale



Explain the reduction of energy from one trophic level to the next. [3]

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3. Water is essential for life.

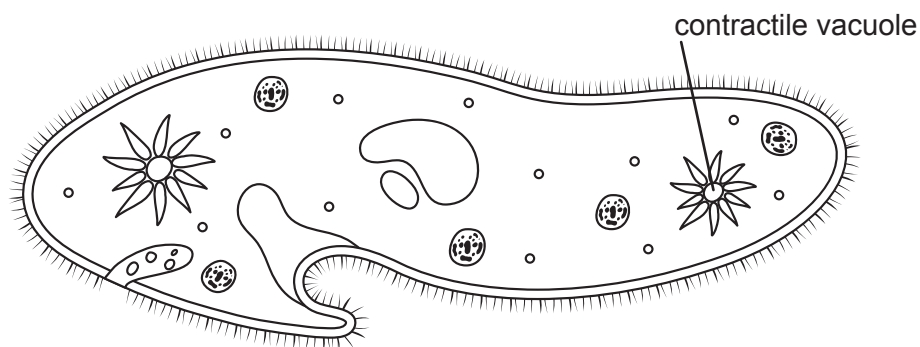
(a) Outline the importance of water's high specific heat capacity.

[1]

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(b) The diagram of the unicellular aquatic protist *Paramecium* shows a contractile vacuole.



Outline the importance of contractile vacuoles in freshwater protists.

[2]

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(Question 3 continued)

- (c) The image shows a saguaro cactus (*Carnegiea gigantea*).



Explain how plants, such as a cactus, are adapted to live in a hot desert with little water.

[2]

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4. (a) Compare and contrast the structure of DNA and RNA. [3]

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- (b) Describe **two** types of mutations that may occur in DNA. [2]

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- (c) Explain how analysis of base sequences in DNA can be used as evidence for evolution. [2]

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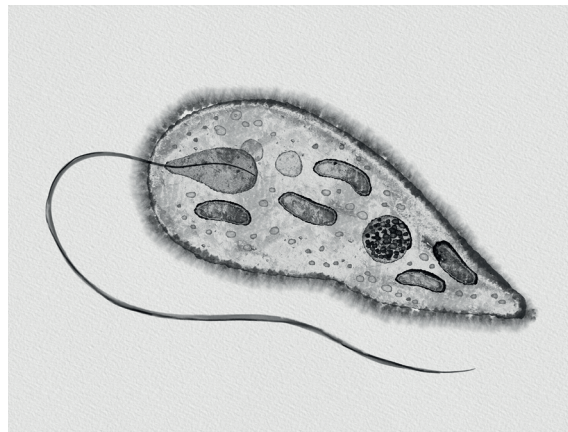
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5. The image shows *Euglena*, a freshwater protist that uses mixotrophic nutrition.



- (a) Describe mixotrophic nutrition.

[1]

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- (b) Distinguish between parasitism and mutualism, giving an example of each interspecific relationship.

[2]

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- (c) Explain how intraspecific competition affects natural selection.

[3]

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Section B

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

6. Proteins are essential structures in humans, playing many different basic roles in cells, tissues and organs.
 - (a) Outline the general structure of a peptide. [3]
 - (b) Glycoproteins are molecules that determine the different blood groups in humans. Describe the **four** different blood groups. [4]
 - (c) Explain adaptive immunity as a response to pathogens entering the body. [8]

7. Cells are the smallest basic unit of life, responsible for all life processes.
 - (a) Outline **three** structural differences between eukaryotic cells and prokaryotic cells. [3]
 - (b) Outline the advantages of compartmentalization in cells. [4]
 - (c) Explain sexual reproduction in flowering plants and methods to promote cross-pollination. [8]



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References:

1. Sumac: Gmihail at Serbian Wikipedia. https://commons.wikimedia.org/wiki/File:Rhus_typhina_habitus.jpg. Licensed under CC BY-SA 3.0 RS <https://creativecommons.org/licenses/by-sa/3.0/rs/deed.en>.
Marigold: Maina Tudu. https://commons.wikimedia.org/wiki/File:Marigold_plants_and_flowers.jpg. Public domain.
Table and graph: Qu T, Du X, Peng Y, Guo W, Zhao C, Losapio G (2021) Invasive species allelopathy decreases plant growth and soil microbial activity. *PLoS ONE* 16(2): e0246685. <https://doi.org/10.1371/journal.pone.0246685>.
- 2.(b) Entropyrider. https://commons.wikimedia.org/wiki/File:Trophic_pyramid.png Public domain.
- 3.(b) blueringmedia, 2021. *Paramecium in colour and doodle on white background*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/paramecium-in-colour-and-doodle-on-white-royalty-free-illustration/1314476550?adppopup=true> [Accessed 17 April 2025]. Source adapted.
- 3.(c) Cacti Choirmaster by Tony Fischer Photography is licensed under CC BY 2.0 <https://creativecommons.org/licenses/by/2.0/deed.en>.
5. Dubinina, S., 2021. *Unicellular organisms, amoeba, euglena, bodo*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/unicellular-organisms-amoeba-euglena-bodo-royalty-free-illustration/1335887501?adppopup=true> [Accessed 17 April 2025]. Source adapted.



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20EP20