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.
• Write your answers in the boxes provided.
• A calculator is required for this paper.
• The maximum mark for this examination paper is [50 marks].
SECTION A

Answer all questions. Write your answers in the boxes provided.

1. The antibiotic ampicillin is an inhibitor of the enzyme transpeptidase. The growth in the number of cells of the eukaryotic green alga *Closterium* was monitored under a microscope every day after ampicillin treatment. Each *Closterium* cell contains two chloroplasts. The graph shows the growth curve of cells grown without and with ampicillin.

![Graph showing growth of cells without and with ampicillin](image)

Key:
- △ without ampicillin
- ■ 100 µmol dm⁻³ ampicillin


(a) Calculate the difference in the number of cells after five days of treatment without ampicillin and with ampicillin. [1]

\[ \text{................. } 10^3 \text{ cells cm}^{-3} \]

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(Question 1 continued)

(b) Outline the effect of 100 µmol dm$^{-3}$ ampicillin on the growth of cells. [2]

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The effect of ampicillin on chloroplast division was studied in *Closterium*. When *Closterium* cells enter the cell division process, chloroplasts start to divide, forming two new cells with two chloroplasts each. In the medium with 100 µmol dm⁻³ ampicillin, various types of cells can be observed. The bar chart shows the frequency of different cells produced without and with ampicillin.


(c) State the frequency of cells grown with ampicillin on day 3 that contain one chloroplast.  

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(This question continues on the following page)
(Question 1 continued)

(d) Compare the frequency of different types of cells grown without and with ampicillin on day 5.

(e) Analyse the effect of ampicillin on *Closterium* cells.
2. The diagram shows a section through the surface of an animal cell.

(a) On the diagram label the membrane components I and II. [2]

(b) (i) On the diagram label III. [1]

(ii) State **one** function of III. [1]

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3. (a) Explain how the following influence the enhanced greenhouse effect.

(i) Reforestation of desert

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(ii) Change in energy source from fossil fuels to solar energy

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(iii) Increase in the production of methane

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(Question 3 continued)

(b) Distinguish between

(i) autotrophs and heterotrophs. [1]

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(ii) detritivores and saprotrophs. [1]

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(iii) bryophyta and filicinophyta. [1]

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(Question 3 continued)

(c) Explain the energy flow in a food chain. [3]

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(d) Outline the precautionary principle, giving an example. [2]

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4. (a) The graph shows a population growth curve for collared doves in the UK.

![Population Growth Curve](image)

(i) State the name of the stage in the population growth curve occurring between 1961 and 1963. \[1\]

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(ii) Explain what is causing the population to rise between 1961 and 1963. \[2\]

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(b) State one example of evolution in response to an environmental change. \[2\]

Organism: .......................................................... Selection pressure: ..........................................................
SECTION B

Answer one question. Up to two additional marks are available for the construction of your answer. Write your answers in the boxes provided.

5. (a) Mitosis can only occur when the DNA of a cell has been replicated. Draw the stages in mitosis. [4]

(b) Describe DNA profiling. [6]

(c) Explain how a base pair substitution in DNA can cause the disease sickle-cell anemia. [8]

6. (a) Plants and animals both use disaccharides and polysaccharides in a variety of ways. State one function of
   • a named disaccharide and a named polysaccharide in plants.
   • a named disaccharide and a named polysaccharide in animals. [4]

(b) Explain how glucose is used in both anaerobic and aerobic cell respiration. [8]

(c) Describe the control of blood glucose concentration in humans. [6]

7. (a) Outline the mechanisms of defence against pathogens in humans. [6]

(b) *Escherichia coli* is a known pathogen. Draw a labelled diagram of the ultrastructure of *E. coli*. [4]

(c) Discuss the transmission and social implications of AIDS. [8]