

*[73 marks]*

1a. Outline the significance of surface area to volume ratio in the limitation of cell size. [4 marks]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

1b. Describe transport across cell membranes by osmosis.

[4 marks]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no text or other markings on the paper.

1c. Explain the adaptations of the small intestine to its function.

[7 marks]

[illegible]





Organisms have evolved a great diversity of cell types.

2a. Describe the endosymbiotic theory.

*[4 marks]*

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2b. Explain the need for halving the chromosome number during a sexual life cycle and how this is done. [7 marks]

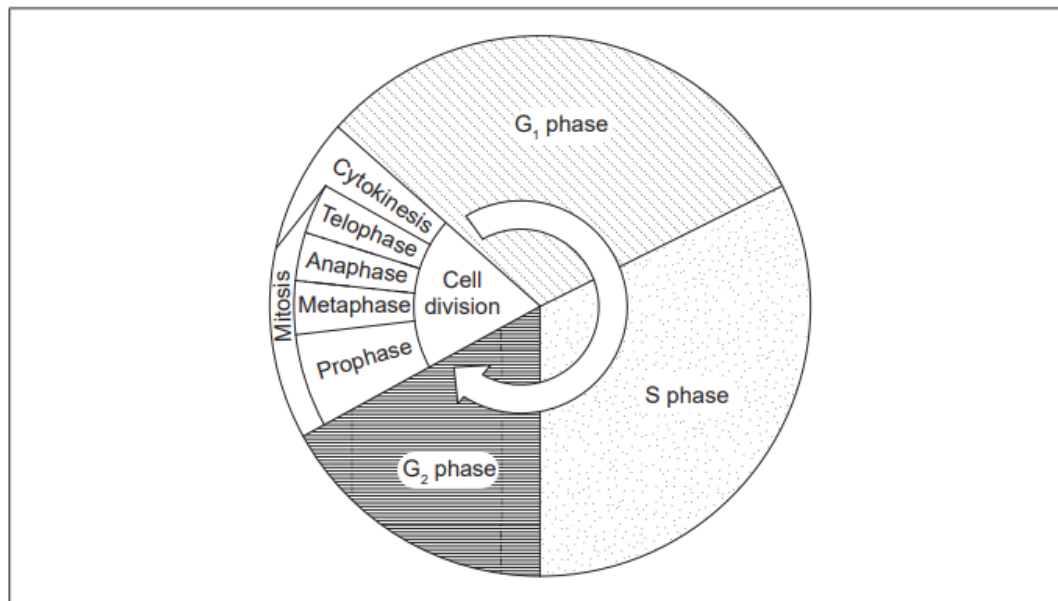
This image shows a full page of primary-ruled paper. It features multiple horizontal rows, each defined by two parallel dotted lines. The rows are evenly spaced and cover the majority of the page area, leaving small margins at the top and bottom. The paper itself is white, and the dotted lines are a light gray or blue color. There is no handwriting or other markings on the page.

2c. Outline the binomial system of classification.

*[4 marks]*

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The diagram shows the stages in the cell cycle.



3a. State processes occurring during interphase.

[2 marks]

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3b. Using the letter C, label the stage on the diagram where chromosome supercoiling occurs.

[1 mark]

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3c. Using the letter M, label the stage on the diagram where sister chromatids migrate to opposite poles.

[1 mark]

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3d. Distinguish between the outcomes of a cell dividing either by mitosis or meiosis. [2 marks]

3e. The mitotic index is an important prognostic tool for predicting the response of cancer cells to chemotherapy. Outline how the mitotic index is calculated. [1 mark]

Tuberculosis (TB) is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*.

4a. Outline the structures in *M. tuberculosis* that are not present in a human cell. [3 marks]

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4b. Explain the production of antibodies when a patient is infected with the TB bacterium. [7 marks]

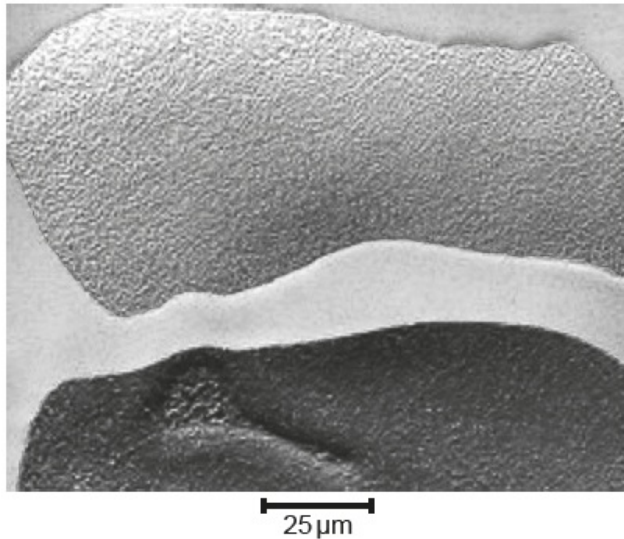
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*[5 marks]*

Membrane structure can be investigated using a technique known as freeze fracture.

Cells are frozen and then split. Fracturing often occurs between the two phospholipid layers of membranes in the cell. An electron micrograph of such a fractured membrane is shown.



[Source: © Science Photo Library]

5a. Using the scale bar, calculate the magnification of the image.

*[2 marks]*

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5b. Explain how electron micrographs such as this helped to falsify the Davson-Danielli model of membrane structure. [2 marks]

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5c. Explain how the amphipathic nature of phospholipids allows them to form bilayers. [2 marks]

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6a. Outline the stages in the production of mRNA by transcription.

[4 marks]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.

6b. Describe the functions of proteins in cell membranes.

[4 marks]

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[7 marks]

