

2.3 Mitosis, the cell cycle and mitotic index

Name: _____ Class: _____ Date: _____ **Total: 19 marks**

KEY WORDS prophase • metaphase • anaphase • telophase
• cytokinesis • mitotic index

Objective

Practise statements 3.14-3.16 with Core Practical 6: the cell cycle, the four stages of mitosis, the mitotic index and its calculation.

1 Key knowledge and worked examples

■ The cycle and the four stages

Interphase (*G*₁ growth, **S** DNA replication, *G*₂ preparation) fills most of the cycle. Mitosis: **prophase** – chromosomes condense and become visible, spindle forms; **metaphase** – chromosomes line up on the equator; **anaphase** – spindle fibres shorten and pull chromatids to opposite poles; **telophase** – nuclear membranes reform, chromosomes uncoil. Then **cytokinesis** divides the cytoplasm.

■ Mitotic index

$$\text{mitotic index} = \frac{\text{cells in mitosis}}{\text{total cells counted}}$$

High index = fast division (growing tissue, tumour).

■ Worked example: index to time

450 root-tip cells: 36 in mitosis → index 0.08. If the full cycle takes 16 hours, mitosis lasts $0.08 \times 16 = 1.3$ hours. A tumour sample with index 0.35 is dividing over four times faster – and the fraction in S phase tells you how many cells are copying DNA, the target of several cancer drugs.

2 Practice

2.1 Name the stage of mitosis in which chromosomes first condense, and the stage in which chromatids separate. [2]

2.2 State two roles of mitosis in a plant. [2]

2.3 A tissue sample of 600 cells shows 42 in mitosis. Calculate the mitotic index. [1]

3 Exam-style questions

3.1 Describe what happens to chromosomes and to the spindle in metaphase and anaphase of mitosis, and state one difference you would see under the microscope between a cell in anaphase and one in telophase. [5]

3.2 The table shows the mitotic index of two tissue samples taken from a patient.

Sample	Cells counted	Cells in mitosis
A (skin)	500	25
B (biopsy)	500	210

Calculate both mitotic indices, state which sample is more likely to be tumour tissue, and explain what a high index means about the proportion of cells in interphase. [4]

3.3 A student prepares a root-tip squash to observe mitosis. Describe how the root tip should be treated before observation, why the cells can be seen without cutting sections, and how the student should decide which stage a cell is in. [5]