



Cell and nuclear division: practice questions

8 questions • 26 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 26

1 PAPER 1A STYLE [1 mark]

What achieves the splitting of the cytoplasm during cytokinesis in a plant cell?

- A. ☐ A ring of contractile actin and myosin proteins pinching the cell membrane inwards
- B. ☐ Vesicles that assemble sections of membrane and cell wall across the cell
- C. ☐ Spindle microtubules pulling the two halves of the cell apart
- D. ☐ The nuclear membrane re-forming across the middle of the cell

2 PAPER 1A STYLE [1 mark]

In a micrograph of a root tip, a cell shows two groups of V-shaped chromosomes moving towards opposite poles. Which phase of mitosis is the cell in?

- A. ☐ Prophase
- B. ☐ Metaphase
- C. ☐ Anaphase
- D. ☐ Telophase

3 PAPER 1A STYLE [1 mark]

An organism has a diploid number of 8. How many different combinations of chromosomes can be produced in its gametes by random orientation of bivalents alone?

- A. ☐ 4
- B. ☐ 8
- C. ☐ 16
- D. ☐ 256

4 PAPER 2A STYLE [3 marks]

Explain why cytokinesis is usually equal, and outline one example of unequal cytokinesis.

5 PAPER 2A STYLE

[4 marks]

Explain how non-disjunction can lead to a child with Down syndrome.

6 PAPER 1B STYLE

[5 marks]

HL only

Students counted cells in micrographs of normal tissue and of a tumour from the same organ (the data are for practice). (a) Calculate the mitotic index of the normal tissue. [1] (b) Calculate the mitotic index of the tumour tissue. [1] (c) Deduce, with a reason, which tissue is proliferating faster. [1] (d) Suggest two reasons why the mitotic index of a sample might be inaccurate. [2]

Cells counted in five fields of view			
Tissue	Cells in interphase	Cells in mitosis	Total cells
Normal	475	25	500
Tumour	352	88	440

Answer =

7 PAPER 2A STYLE

[4 marks]

HL only

Outline what happens during interphase and how cyclins control progression through the cell cycle.

8 PAPER 2B STYLE

[7 marks]

Explain how meiosis halves the chromosome number and produces genetically different haploid nuclei.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B

2. [1]

C C

3. [1]

C C ($2^4 = 16$, since $n = 4$)

4. [3]

- each daughter cell must receive at least one mitochondrion / chloroplast / organelles that can only be made by division of pre-existing ones [1]
- each daughter cell receives a nucleus / enough cytoplasm to survive OWTTE [1]
- oogenesis: almost all cytoplasm passes to the (secondary) oocyte / ovum, small polar bodies formed [1]
- OR budding in yeast: a small bud receives a nucleus and pinches off from the larger parent cell [1]
- max 3

5. [4]

- non-disjunction is failure of chromosomes / chromatids to separate in meiosis [1]
- homologous chromosomes fail to separate in meiosis I / sister chromatids fail to separate in meiosis II [1]
- a gamete receives two copies of chromosome 21 / 24 chromosomes [1]
- fertilised by a normal gamete with 23 chromosomes [1]
- zygote has three copies of chromosome 21 / trisomy 21 / 47 chromosomes [1]
- max 4

6. [5] **HL only**

- (a) $25 \div 500 = 0.05$ [1]
- (b) $88 \div 440 = 0.20$ [1] Accept answers as percentages (5%, 20%)
- (c) tumour, because a higher proportion of its cells are in mitosis / higher mitotic index [1] ECF from (a) and (b)
- (d) difficulty identifying early prophase / late telophase / cells overlapping [1]
- only a small number of fields / cells counted, not representative [1]
- cells counted twice / missed when counting [1]
- max 2 for (d)

7. [4] **HL only**

- interphase consists of G1, S and G2 [1]
- metabolically active / biosynthesis of proteins and other components / cell grows (in G1 and G2) [1]
- DNA is replicated in S phase [1]
- number of mitochondria / chloroplasts increases by growth and division [1]
- concentrations of different cyclins rise and fall during the cycle [1]
- a threshold level of a specific cyclin is needed to pass each checkpoint [1]
- max 4

8. [7]

- DNA is replicated before meiosis so each chromosome has two (sister) chromatids [1]
- chromosomes condense by supercoiling (around histones) [1]
- homologous chromosomes pair to form bivalents in prophase I [1]
- crossing over between non-sister chromatids at chiasmata [1]
- produces new combinations of alleles / recombinant chromatids [1]
- bivalents line up at the equator in metaphase I in random orientation [1]
- orientation of each bivalent is independent of the others, giving 2^n combinations [1]
- spindle microtubules / motor proteins move chromosomes to the poles [1]
- homologous chromosomes separate in meiosis I / first segregation, halving the chromosome number [1]
- sister chromatids separate in meiosis II / second segregation [1]
- four haploid nuclei are produced from one diploid nucleus [1]
- max 7