

Cell and nuclear division: practice questions

6 questions • 17 marks • mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name

Total / 17

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.

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PAPER 2B STYLE

[7 marks]

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

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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. [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