

Cell Cycle and Cell Division — Assignment 2

Class 11 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

The Cell Cycle

1. Distinguish between interphase and M phase.
2. Name the phases of interphase and state what happens in each.
3. Describe the phases of the cell cycle.

Mitosis

1. Distinguish between metaphase and anaphase.
2. State the significance of mitosis.
3. Describe the events of prophase, metaphase, anaphase and telophase.

Meiosis

1. Distinguish between anaphase I and anaphase II.
2. What are the two divisions of meiosis?
3. Describe the events of meiosis I.

Significance of Meiosis

1. State two significances of meiosis.
2. How does crossing over create variation?
3. Explain the significance of meiosis.

Mitosis vs Meiosis — Key Differences

1. Give two differences between mitosis and meiosis.
2. Which division is responsible for growth?
3. Give a full comparison between mitosis and meiosis.

Ploidy and Chromosome Number — Quick Reference

1. Distinguish between haploid and diploid.
2. Why do gametes need to be haploid?
3. Show how the chromosome number is maintained through fertilisation.

Part B — Integrated problems (multi-topic)

1. Describe the cell cycle, naming each phase and the key event of each.
2. Describe the four stages of mitosis and state one key event of each.
3. Describe the events of prophase I of meiosis, including crossing over.
4. Give four differences between mitosis and meiosis.
5. Explain how meiosis maintains chromosome number and generates variation.
6. A human cell has 46 chromosomes. State the number of chromosomes and chromatids in G1, G2 and after meiosis I.

Answer Key

The Cell Cycle

Interphase is the growth and DNA-replication phase between divisions; M phase is the actual division (mitosis + cytokinesis). Interphase: G1 (growth, synthesis of RNA/proteins), S (DNA replication) and G2 (growth, preparation for division). The cell cycle is interphase (G1, S, G2) followed by M phase.

Mitosis

Metaphase: chromosomes line up at the equator; anaphase: sister chromatids separate and move to opposite poles. Significance of mitosis: growth, replacement of cells and maintenance of the chromosome number. Prophase: chromatin condenses, spindle forms; metaphase: chromosomes align at the equator; anaphase: chromatids separate; telophase: nuclear envelope reforms, chromosomes decondense.

Meiosis

Anaphase I: homologous chromosomes separate; anaphase II: sister chromatids separate. Meiosis I (reductional) and meiosis II (equational). Meiosis I: prophase I (with crossing over), metaphase I (homologues align as tetrads), anaphase I (homologues separate) and telophase I.

Significance of Meiosis

Meiosis halves the chromosome number so that fertilisation restores the diploid number, and it creates genetic variation. Crossing over exchanges segments between homologous chromosomes, producing new combinations of alleles. Meiosis is significant because it maintains chromosome number across generations and produces variation essential for evolution.

Mitosis vs Meiosis — Key Differences

Mitosis: one division, two diploid cells, no crossing over — for growth. Meiosis: two divisions, four haploid cells, with crossing over — for gamete formation. Mitosis produces two diploid cells; meiosis produces four haploid cells; mitosis has no crossing over; meiosis has crossing over in prophase I; mitosis occurs in somatic cells; meiosis in germ cells.

Ploidy and Chromosome Number — Quick Reference

Haploid (n) cells have one set of chromosomes; diploid (2n) cells have two sets. Gametes are haploid so that fusion restores the diploid number. Human $2n = 46$; after meiosis gametes have $n = 23$; fertilisation ($23 + 23$) restores $2n = 46$.

Integrated problems

1: Interphase (G1, S, G2) + M phase (mitosis + cytokinesis). 2: Prophase (chromatin condenses), metaphase (align at equator), anaphase (chromatids separate), telophase (envelope reforms). 3: Prophase I — synapsis, tetrad formation

and crossing over between non-sister chromatids. 4: Divisions (1 vs 2), daughter cells (2 diploid vs 4 haploid), crossing over (absent vs present), occurrence (somatic vs germ cells). 5: Halving the chromosome number in gametes and crossing over/independent assortment generate variation. 6: G1 — 46 chromosomes, 46 chromatids; G2 — 46 chromosomes, 92 chromatids; after meiosis I — 23 chromosomes, 46 chromatids.