

Practice Test 04 — Answer Key

Module 8: Cell Division

Part A: Multiple Choice

1. **B** — DNA is replicated during S (Synthesis) phase.
2. **C** — Prophase, Metaphase, Anaphase, Telophase (PMAT).
3. **B** — Chromosomes line up at the cell equator during Metaphase.
4. **A** — Mitosis produces two genetically identical diploid cells.
5. **B** — Meiosis occurs only in germ cells to produce gametes (sex cells).
6. **B** — Crossing over occurs during Prophase I of Meiosis.
7. **C** — Gametes are haploid (n), so $46/2 = 23$ chromosomes.
8. **B** — Nondisjunction can result in trisomy conditions like Down Syndrome (Trisomy 21).
9. **C** — Sister chromatids separate at the centromere during Anaphase.
10. **B** — Homologous chromosomes (not sister chromatids) separate during Anaphase I of meiosis.
11. **B** — Diploid ($2n$) means two sets of chromosomes—one from each parent—forming homologous pairs.
12. **C** — Mitosis is for growth and tissue repair. Meiosis produces gametes and increases genetic variation.
13. **B** — Interphase consists of G1 (growth), S (DNA synthesis), and G2 (preparation for division).
14. **B** — After meiosis I, cells are haploid but each chromosome still consists of two sister chromatids joined at the centromere.
15. **B** — Independent assortment occurs during Metaphase I when homologous pairs line up randomly.
16. **B** — Cancer is the result of uncontrolled cell division due to mutations in genes regulating the cell cycle.

Part B: Fill in the Blank

1. Cytokinesis
2. **Gametes** (sex cells / sperm and eggs)
3. Centromere
4. **Synapsis; Tetrad** (or bivalent)
5. **Haploid** (n)

Part C: Short Answer

1. Three Differences Between Mitosis and Meiosis:

Feature	Mitosis	Meiosis
Divisions	1	2
Result	2 identical diploid cells	4 unique haploid cells
Purpose	Growth and repair	Produce gametes
Crossing over	No	Yes (Prophase I)

2. Phases of Mitosis:

- **Prophase:** Chromosomes condense and become visible. The nuclear envelope begins to break down. Centrioles move to opposite poles and spindle fibers form.
- **Metaphase:** Chromosomes line up at the cell's equator (metaphase plate). Spindle fibers attach to the centromere of each chromosome.
- **Anaphase:** Sister chromatids separate at the centromere and are pulled to opposite poles by the spindle fibers.
- **Telophase:** Chromosomes decondense. Nuclear envelopes reform around each set of chromosomes. Cytokinesis begins to divide the cytoplasm.

3. Crossing Over and Independent Assortment:

- **Crossing over** occurs during Prophase I of meiosis. Homologous chromosomes exchange segments of DNA, creating new allele combinations on the recombinant chromosomes.
- **Independent assortment** occurs during Metaphase I. Homologous pairs line up randomly at the cell equator, so the orientation of one pair does not affect any other pair. With 23 pairs in humans, this produces 2^{23} (over 8 million) possible gamete combinations.
- Both mechanisms increase genetic variation in sexually reproducing organisms.

4. **Nondisjunction:** Nondisjunction is the failure of homologous chromosomes or sister chromatids to separate properly during cell division. If nondisjunction occurs during meiosis, the resulting gametes have an abnormal number of chromosomes. For example, Down Syndrome (Trisomy 21) results when chromosome 21 fails to separate, producing a gamete with two copies of chromosome 21. When this gamete is fertilized, the offspring has three copies of chromosome 21 (47 total chromosomes instead of 46).