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Class	9th	Chapter	04
Subject	BIOLOGY	Board	Federal

CHAPTER 4: CELL CYCLE

Section I: Multiple Choice Questions

1. A bivalent consists of:

- **A) Two chromatids and one centromere | B) Four chromatids and two centromeres | C) Four chromatids and four centromeres | D) Two chromatids and two centromeres**
- *Answer:* **B**

2. During cell division spindle fibres attach a chromosome at:

- **A) Centromere | B) Telomere | C) upper arm of chromosome | D) lower arm of chromosome**
- *Answer:* **A**

3. Some student of SSC observed a thin cross section from root tip of onion plant under the microscope. They found dividing cells at different stages of their life cycle. One of the students found a cell at late prophase and counted 28 chromosomes in it. The number of chromosomes in daughter cells should be:

- **A) 14 | B) 28 | C) 56 | D) 07**
- *Answer:* **B**

4. Crossing over results in genetic recombination. It occurs between:

- **A) Two chromatids of the same chromosome. | B) Two chromatids of any two non-homologous chromosomes | C) Two chromatids of opposite gametes | D) Two chromatids of homologous chromosomes**
- *Answer:* **D**

5. The spindle apparatus of plants differs from that of animals in not having:

- **A) microtubules | B) equator of spindle | C) centrioles | D) centromere**
- *Answer:* **C**

6. Substance and energy required for the replication of DNA is accumulated in the cell during:

- **A) G_1 | B) G_0 | C) S phase | D) M phase**
- *Answer:* **A**

7. All of the following events take place both in mitosis and meiosis except:

- **A) Condensation of chromatin to form chromosomes | B) Formation of spindle apparatus | C) Nuclear envelope and nucleolus disappear | D) Chromosomes pair for crossing over**
- *Answer:* **D**

8. The cell shown in this diagram is passing through:

- **A) Prophase I of meiosis | B) prophase of mitosis | C) telophase of meiosis I | D) anaphase of meiosis II**
- *Answer:* **A**

9. The longest phase of meiosis is:

- **A) Interphase I | B) Prophase I | C) Interphase II | D) prophase II**
- *Answer:* **B**

10. What causes the number of chromosomes to reduce to half when a cell divides by meiosis?

- **A) replication of DNA during Interphase I | B) separation of homologous chromosomes during meiosis I | C) separation of sister chromatids of all the chromosomes during meiosis I | D) crossing over during meiosis I**
- *Answer:* **B**

11. Which of the following cell is at Metaphase I stage?

- **A) Homologous pairs aligned at metaphase plate | B) Anaphase pulling apart | C) Interphase nucleus | D) Telophase division**
- *Answer:* **A**

12. This diagram is showing different stages of crossing over. Which stage contains chiasma?

- **A) Stage A | B) Stage B | C) Stage C | D) Stage D**
- *Answer:* **B**

13. Which processes involve meiosis?

- **A) Region A | B) Region B | C) Region C | D) Region D**
- *Answer:* **B**

14. Diagram shows replication of chromosomes. What is the total number of chromosomes in this diagram?

- **A) 2 | B) 3 | C) 4 | D) 6**
- *Answer:* **A**

15. Chromosomal number of Fruit fly is 8. The gametes of fruit fly contain:

- **A) 2 chromosomes | B) 4 chromosomes | C) 8 chromosomes | D) 16 chromosomes**
- *Answer:* **B**

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Section II: Short Answer Questions

1. Explain spindle apparatus in detail.

- **Composition & Function:** The spindle apparatus is a temporary cytoskeletal structure made of microtubules that forms during cell division (mitosis and meiosis) to segregate chromosomes to opposite poles.
- **Components:** It consists of:
    - **Kinetochore fibers:** Attach to chromosomes at their kinetochores.
    - **Polar fibers:** Interdigitate and elongate the cell.
    - **Astral fibers:** Anchor centrosomes to the cell membrane in animal cells.

2. What is the significance of crossing over?

- **Genetic Variation:** Crossing over (exchange of segments between non-sister chromatids of homologous chromosomes during prophase I) produces new combinations of genes.
- **Evolutionary Adaptation:** This genetic diversity provides raw material for natural selection, evolution, and population survival in changing environments.

3. Enlist the events taking place during G_1 phase.

- Intensive cellular growth and protein synthesis.
- Accumulation of energy reserves and building blocks (nucleotides and amino acids) needed for DNA replication.
- Synthesis of enzymes and structural proteins required for the subsequent S phase.
- Increase in the number of cytoplasmic organelles.

4. What will be the difference in materials they synthesize after the production of cell A and cell B?

- **Cell A (G_1 phase):** Synthesizes enzymes, nucleotides, and proteins required for DNA replication (S phase) and continued cell cycle progression.
- **Cell B (G_0 phase):** Enters a quiescent/resting state and synthesizes specialized functional proteins specific to its tissue type rather than division-related proteins.

5. Why do epithelial cells of skin divide continuously?

- Epithelial cells are constantly exposed to friction, wear, tear, and external damage. Continuous mitotic division is necessary to replace sloughed-off or dead cells and maintain the protective skin barrier.

6. Give differences between meiosis I and meiosis II.

- **Meiosis I:** Reductional division; homologous chromosomes pair up and cross over; chromosome number is halved from diploid ($2n$) to haploid (n); sister chromatids remain attached.
- **Meiosis II:** Equational division (similar to mitosis); sister chromatids separate; chromosome number remains haploid (n); no crossing over occurs.

7. In rapidly dividing cells which phase of cell cycle is reduced? Explain.

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- G_1 **Phase:** In rapidly dividing cells (e.g., early embryos), the G_1 phase is drastically shortened or skipped because the cells bypass extensive growth phases to maximize the speed of cell proliferation and DNA replication.

8. What is the difference between cytokinesis of a plant cell and an animal cell?

- **Animal Cells:** Cytokinesis occurs via **cleavage furrow formation**, where the plasma membrane pinches inward from the edges.
- **Plant Cells:** Due to a rigid cell wall, cytokinesis occurs via **cell plate formation**, where Golgi vesicles fuse at the center to form a phragmoplast that expands outward.

9. Both skin cells and cancerous cells divide rapidly. Why cancerous cells are harmful but skin cells are not?

- **Skin cells** divide in a controlled, regulated manner in response to physiological tissue repair and stop when normal density is reached.
- **Cancerous cells** divide uncontrollably due to mutations, ignore regulatory signals, form tumors, destroy surrounding tissues, and can spread (metastasize) throughout the body.

10. How haploid organisms produce gametes?

- Since haploid organisms already contain a single set of chromosomes (n), they cannot undergo standard meiosis. Instead, they produce gametes or spores through **mitosis** (or specialized mitotic divisions).

11. Why do people with Down syndrome have 47 chromosomes?

- Down syndrome is caused by **nondisjunction** (the failure of chromosome 21 to separate properly during meiosis). A gamete receives an extra copy of chromosome 21 (24 chromosomes), which upon fertilization with a normal gamete (23 chromosomes) results in a total of 47 chromosomes ($2n + 1$).

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Section III: Extensive Answer Questions

1. If a cell completes meiosis I but meiosis II fails to occur, what type of anomalies will appear in the two daughter cells thus formed?

- The resulting daughter cells will be **diploid in DNA content** (each chromosome still consists of two sister chromatids) even though reduction in chromosome number already occurred in meiosis I.
- They will carry abnormal ploidy states, disrupted genetic dosage, and segregation defects if they attempt further cell divisions.

2. A cell is shown in this diagram. Answer following questions after observing it.

- **a. Identify if it is an animal or plant cell:** It is an **animal cell** due to the presence of clearly visible **centrioles** at the poles.
- **b. Identify the stage of cell division: Anaphase** (specifically mitotic anaphase).
- **c. Enlist the reasons of your identification:** Sister chromatids have separated at their centromeres and are being pulled toward opposite poles by spindle fibers, forming characteristic V-shaped or U-shaped structures.

3. Meiosis II is identical to mitosis, explain.

- **Sister Chromatid Separation:** Just like mitosis, sister chromatids separate at the centromere during anaphase II.
- **Constant Ploidy:** The chromosome number remains constant throughout the division (haploid cells entering meiosis II produce haploid daughter cells).
- **Identical Phases:** It follows the same sequential phases: Prophase II, Metaphase II, Anaphase II, and Telophase II.

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