Class: 9th

Subject: Biology

Chapter 4: Cell Cycle

Exercise MCQs:

1. In which phase of cell cycle does maximum growth occur in the cell?

a) M phase

b) G1 phase ✅

c) G2 phase

d) S phase

2. In which phase of cell cycle are the chromosomes duplicated?

a) Mitosis

b) G1 phase

c) G2 phase

d) S phase ✅

3. Which of the following is NOT a characteristic of mitosis?

a) It occurs in somatic cells.

b) It results in genetically identical daughter cells.

c) The chromosome number is halved in daughter cells. ✅

d) It results in the formation of two daughter cells.

4. At which stage of mitosis do chromosomes line up in the center?

a) Prophase

b) Metaphase ✅

c) Anaphase

d) Telophase

5. If you observe a cell in which nuclear membrane is reforming around two sets of chromosomes, what stage of cell cycle is this?

a) Anaphase

b) Telophase ✅

c) Prophase

d) Metaphase

6. How does the centrosome contribute to mitosis?

a) Initiates DNA replication

b) Makes mitotic spindle ✅

c) Forms the nuclear envelope

d) Duplicates organelles

7. Centrosomes make mitotic spindle in:

a) Animal cells ✅

b) Plant cells

c) Prokaryotic cells

d) All of these

8. An organism has 4 pairs of chromosomes. After meiosis-I, how many chromosomes and chromatids will be present in each daughter cell?

a) 8 chromosomes and 16 chromatids

b) 4 chromosomes and 8 chromatids ✅

c) 4 chromosomes and 4 chromatids

d) 8 chromosomes and 8 chromatids

9. Which event is unique to meiosis but not mitosis?

a) DNA replication

b) Chromosome alignment

c) Crossing over ✅

d) Nuclear division

10. Why is meiosis-II necessary after meiosis-I?

a) To replicate chromosomes

b) To reduce chromosome number

c) To separate sister chromatids ✅

d) To ensure genetic recombination

Important MCQs:

1. Which phase of the cell cycle takes about 90% of the total time?

(a) G1 Phase

(b) Mitosis

(c) Interphase ✅

(d) S Phase

2. During which phase of interphase does DNA replication occur?

(a) G1 Phase

(b) S Phase ✅

(c) G2 Phase

(d) GO Phase

3. What is the primary event of the G1 phase?

(a) Chromosome duplication

(b) Nuclear division

(c) Growth and preparation for DNA synthesis ✅

(d) Spindle formation

4. What occurs during the G2 phase of the cell cycle?

(a) Cell stops dividing permanently

(b) DNA is copied

(c) Preparation for mitosis and DNA damage check

✅

(d) Formation of chromatin

5. Which cells remain in the GO phase for an indefinite period?

(a) Epithelial cells

(b) Liver cells

(c) Kidney cells

(**d**) Neurons ✅

6. Mitosis occurs in which type of cells?

(a) Germ cells

(**b**) Somatic cells ✅

(c) Red blood cells

(d) Prokaryotic cells

7. What happens to chromatin during prophase?

(a) It disappears completely

(b) It duplicates

(**c**) It condenses into visible chromosomes ✅

(d) It moves to the equator

8. What structure attaches spindle fibres to chromosomes during metaphase?

(a) Centrosome

(b) Nucleolus

(c) Kinetochore ✅

(d) Chromatin

9. What is the name of the plate formed by the arrangement of chromosomes at the cell's equator?

(a) Chromosome plate

(b) Metaphase plate ✅

(c) Division plate

(d) Spindle plate

10. What is the role of spindle fibres in mitosis?

(a) Condensation of chromosomes

(b) Formation of nuclear envelope

(c) Attachment and alignment of chromosomes ✅

(d) Synthesis of DNA

11. During which phase do spindle fibres pull sister

chromatids apart in mitosis?

(a) Prophase

(b) Metaphase

(c) Anaphase ✅

(d) Telophase

12. What reforms around each set of chromosomes during telophase?

(a) Spindle fibres

(b) Nucleolus only

(c) Chromatids

(d) Nuclear envelope ✅

13. In animal cells, cytokinesis occurs through:

(a) Cell plate formation

(b) Formation of furrow ✅

(c) Chromosome movement

(d) Cell wall breakdown

14. In plant cells, the structure formed during cytokinesis is:

(a) Cell furrow

(b) Mitotic spindle

(c) Phragmoplast ✅

(d) Centrosome

15. Which organelle forms vesicles for cytokinesis in plant cells?

(a) Nucleus

(b) Golgi apparatus ✅

(c) Ribosome

(d) Lysosome

16. The main role of mitosis in growth is:

(a) Production of gametes

(b) Increase in cell size

(c) Production of identical cells ✅

(d) DNA mutation

17. Which cells are replaced regularly due to mitosis?

(a) Brain cells

(b) Liver cells

(c) Skin and red blood cells ✅

(d) Bone cells

18. Which organism reproduces by budding with the help of mitosis?

(a) Amoeba

(b) Paramecium

(c) Hydra ✅

(d) Earthworm

19. What happens if sister chromatids fail to separate during anaphase?

(a) Equal distribution

(b) Mutation

(c) One cell gets both chromatids ✅

(d) Cell dies immediately

20. What is formed due to uncontrolled mitosis?

(a) Wound

(b) Tumor ✅

(c) Bud

(d) Furrow

21. A tumor that spreads to other tissues is called:

(a) Benign

(b) Malignant ✅

(c) Bud

(d) Chromatid

22. Meiosis produces how many daughter cells?

(a) 2

(b) 3

(c) 4 ✅

(d) 5

23. Meiosis results in daughter cells with:

(a) Same number of chromosomes

(b) Half number of chromosomes ✅

(c) Double number

(d) No chromosomes

24. The crossing over occurs during:

(a) Prophase-I ✅

(b) Anaphase-I

(c) Telophase-I

(d) Metaphase-II

25. The structure formed during synapsis is:

(a) Spindle

(b) Furrow

(c) Tetrad ✅

(d) Vesicle

26. Exchange of genetic material between non-sister chromatids is called:

(a) Mutation

(b) Transcription

(c) Crossing over ✅

(d) Cytokinesis

27. What attaches chromosomes with spindle fibres during metaphase-I?

(a) Centrosome

(b) Kinetochore ✅

(c) Golgi bodies

(d) Nucleolus

28. In meiosis-I, which chromosomes separate?

(a) Sister chromatids

(b) Homologous chromosomes ✅

(c) All chromosomes

(d) Single-stranded DNA

29. What ensures genetic diversity in meiosis?

(a) Cytokinesis

(b) Synapsis

(c) Crossing over ✅

(d) Chromosome condensation

30. If non-disjunction occurs during meiosis, the result is:

(a) Healthy offspring

(b) Budding

(c) Gametes with abnormal chromosome number

✅

(d) Identical daughter cells

Exercise Short Questions:

1. Enlist the events that occur during the G1 phase of interphase?

- Cell grows in size
- Organelles are duplicated
- Enzymes and proteins are synthesized
- Cell prepares for DNA replication

2. What is the main purpose of the S phase in the cell cycle?

The main purpose of the S phase is to duplicate the DNA, resulting in two identical sister chromatids for each chromosome.

3. During which phase of mitosis sister chromatids separate?

Sister chromatids separate during anaphase.

4. How does crossing over contribute to genetic variation in Meiosis?

Crossing over allows exchange of genetic material between homologous chromosomes, creating new combinations of genes, which increases genetic variation.

5. What is the role of spindle fibres in mitosis?

Spindle fibres attach to chromosomes and help pull sister chromatids apart toward opposite poles of the cell.

6. How is cytokinesis in animal cell different from plant cell?

In animal cells, cytokinesis occurs by cleavage furrow formation, while in plant cells, a cell plate forms between daughter cells.

7. What is the difference between prophase of mitosis and prophase-I of meiosis-I?

In mitotic prophase, homologous chromosomes do not pair or cross over. In prophase-I of meiosis, homologous chromosomes pair and crossing over

occurs.

8. How does meiosis differ from mitosis in terms of chromosome number?

Meiosis reduces the chromosome number by half (diploid to haploid), while mitosis maintains the same chromosome number in daughter cells.

9. What are the key events of anaphase in mitosis?

- Sister chromatids are pulled apart
- They move toward opposite poles
- Each chromatid becomes an independent chromosome

10. What is the function of the centrosome during cell division?

The centrosome organizes spindle fibres that help in the separation of chromosomes during cell division.

11. What are sister chromatids, and when do they separate in meiosis?

Sister chromatids are identical copies of a

chromosome. They separate during anaphase-II of meiosis.

12. How is mitosis related to the process of regeneration?

Mitosis helps in the replacement of lost or damaged cells, which is essential for regeneration of body parts in some organisms.

Exercise Long Questions:

Q1: Describe the events that occur during the phases of mitosis.

Mitosis consists of four main phases:

Prophase:

Chromatin condenses into visible chromosomes. Each chromosome consists of two sister chromatids. The nuclear membrane begins to break down, and the spindle fibres begin to form from the centrosomes.

Metaphase:

Chromosomes align along the equator (middle) of the cell. Spindle fibres attach to the centromeres of the chromosomes.

Anaphase:

Sister chromatids are pulled apart by spindle fibres toward opposite poles of the cell. Each chromatid becomes a separate chromosome.

Telophase:

Chromosomes uncoil back into chromatin. The nuclear envelope reforms around each set of chromosomes. Two nuclei are formed.

Q2: Describe cytokinesis in animal and plant cells.

In Animal Cells:

Cytokinesis occurs by the formation of a cleavage furrow, which pinches the cell membrane inward until the cell splits into two daughter cells.

In Plant Cells:

Cytokinesis occurs by the formation of a cell plate in the center of the cell. This plate gradually develops into a new cell wall, dividing the cell into

two.

Q3: Describe the significance of mitosis.

- Mitosis is essential for growth and development of multicellular organisms.
- It allows for repair and replacement of damaged or dead cells.
- It ensures genetic stability by producing genetically identical daughter cells.
- It is involved in asexual reproduction in some organisms.

Q4: Describe the events that occur during the phases of meiosis-I.

Meiosis-I includes the following phases:

Prophase-I:

Chromosomes condense, homologous chromosomes pair up in a process called synapsis. Crossing over occurs, leading to genetic variation. The nuclear envelope disappears.

Metaphase-I:

Homologous chromosome pairs line up along the equator of the cell. Spindle fibres attach to their centromeres.

Anaphase-I:

Homologous chromosomes (not chromatids) are separated and pulled to opposite poles.

Telophase-I:

Nuclear membranes may reform. The cell divides into two daughter cells, each with half the number of chromosomes (haploid).

Q5: Describe the significance of meiosis.

- Meiosis produces gametes (sperm and egg cells) with half the number of chromosomes.
- It ensures genetic variation through crossing over and independent assortment.
- It maintains chromosome number across generations.
- It is essential for sexual reproduction in

eukaryotic organisms.

Important Long Questions:

Q1: Explain the stages of the cell cycle, with a detailed description of the interphase.

The cell cycle consists of two main phases: Interphase and Mitosis. Interphase is the longest phase, where the cell grows, performs its functions, and prepares for division.

1. Interphase:

G1 Phase: The cell grows and synthesizes proteins and organelles, preparing for DNA replication.

S Phase: The DNA is replicated, doubling the chromosomes (each chromosome now has two sister chromatids).

G2 Phase: The cell continues to grow and produces proteins needed for cell division. It also checks for any DNA damage and repairs it.

2. Mitosis Phase (M-phase):

In this phase, the cell divides into two daughter cells, including stages like prophase, metaphase, anaphase, and telophase.

Q2: Discuss the significance of the G1, S, and G2 phases in preparing the cell for division.

- **G1 Phase:** The cell grows, synthesizes proteins and organelles, and prepares for DNA replication.
- **S Phase**: DNA replication occurs, ensuring each daughter cell gets a complete set of chromosomes.
- **G2 Phase**: The cell checks for DNA errors and ensures it has the proteins and structures needed for mitosis.

These phases are crucial because they ensure the cell is healthy, has enough resources, and its genetic material is accurately duplicated before division.

Q3: Describe the phases of mitosis with the help of

diagrams (if required). Explain the process of karyokinesis and cytokinesis in animal and plant cells.

Mitosis is a type of cell division in which a single cell divides to produce two genetically identical daughter cells, each having the same number of chromosomes as the parent cell. It mainly occurs in somatic cells.

Mitosis consists of two main phases:

A. Karyokinesis (Division of Nucleus):

It occurs in four stages:

1. Prophase:

- Chromatin condenses into visible chromosomes, each with two sister chromatids joined at a centromere.
- Nuclear envelope and nucleolus break down.
- Centrosomes form spindle fibres and move to opposite poles.
- In plant cells, spindle fibres form without centrosomes.

2. Metaphase:

- Spindle fibres attach to chromosomes at the centromere.
- Chromosomes align along the equator, forming the metaphase plate.

3. Anaphase:

- Spindle fibres pull sister chromatids apart.
- Separated chromatids move to opposite poles of the cell.

4. Telophase:

Nuclear envelope reforms around each set of chromosomes.

Chromosomes uncoil back into chromatin.

Nucleolus reappears.

B. Cytokinesis (Division of Cytoplasm):

1. In Animal Cells:

A furrow forms at the equator of the cell membrane.

A ring of microfilaments contracts inward and splits the cell into two daughter cells.

2. In Plant Cells:

Golgi vesicles move to the center and fuse to form a cell plate (phragmoplast).

The plate expands and divides the cell into two.

Q4: Explain the significance of mitosis in living organisms. How does an error in mitosis lead to problems like tumors or cancer?

Mitosis is essential for:

1. Growth:

- Organisms grow by increasing the number of cells through mitosis.
- New cells are identical copies of the original cell, maintaining uniformity.

2. Cell Replacement:

Dead or damaged cells (e.g., skin cells, intestinal lining, RBCs) are replaced by new cells via mitosis.

3. Regeneration:

Some organisms like starfish regenerate lost body parts using mitosis.

4. Asexual Reproduction:

- Organisms like Hydra reproduce asexually through budding.
- Mitosis helps in forming new individuals from parent cells.

Errors in Mitosis:

- If sister chromatids fail to separate in anaphase, one daughter cell may receive both while the other gets none.
- Chromosomal damage during mitosis can affect genetic material.
- Mutations in genes controlling mitosis can cause uncontrolled cell division, forming tumors.
- Benign tumors: Stay in one place.
- Malignant tumors (cancer): Spread and invade other tissues (metastasis).

Q5: Define meiosis and explain its phases in detail (Meiosis-I and Meiosis-II).

Definition:

Meiosis is a type of cell division in which a diploid parent cell divides to form four haploid daughter cells. Each daughter cell gets half the number of chromosomes compared to the parent cell.

Phases of Meiosis:

Meiosis-I:

This is the reduction division where homologous chromosomes separate.

Prophase-I:

Chromatin condenses into chromosomes. Homologous chromosomes pair up (synapsis) and form tetrads. Crossing over occurs at chiasmata. Nuclear envelope and nucleolus disappear, spindle fibres form.

Metaphase-I:

Tetrads align along the cell equator. Spindle fibres

attach to the centromeres.

Anaphase-I:

Homologous chromosomes separate and move to opposite poles. Sister chromatids remain attached.

Telophase-I:

Nuclear envelope reforms around two haploid sets. Cytokinesis occurs, forming two haploid cells.

Meiosis-II:

This is similar to mitosis, where sister chromatids separate.

Prophase-II:

Chromosomes condense again, nuclear envelope disappears, spindle forms.

Metaphase-II:

Chromosomes align at the equator. Spindle fibres attach to centromeres.

Anaphase-II:

Sister chromatids separate and move to opposite poles.

Telophase-II:

- Chromosomes uncoil, nuclear envelopes reform. Cytokinesis occurs.
- **Result**: Four haploid daughter cells are formed.

Q6: What is the significance of meiosis? How does it maintain chromosome number in organisms?

Significance of Meiosis:

Maintains Chromosome Number:

Meiosis reduces the chromosome number by half in gametes (sperm and egg). During fertilization, the zygote gets a complete set (restoring the diploid number).

In Animals:

Meiosis occurs in reproductive organs. Gametes (sperm and eggs) are haploid. When they fuse during fertilization, the zygote gets full set of chromosomes.

In Flowering Plants:

Meiosis takes place in specialized flower cells to produce haploid spores. These spores grow and later form gametes. Gametes fuse and form diploid zygote.

Genetic Variation:

Crossing over in prophase-I leads to new combinations of genes, increasing genetic diversity.

Q7: Differentiate between Meiosis-I and Meiosis-II with reference to their phases and outcomes.

Difference Between Meiosis-I and Meiosis-II

Feature	Meiosis-I	Meiosis-II
Type of Division	Reduction division	Equational division
Chromosome No.	Halved (diploid to haploid)	Remains same (haploid to haploid)
Homologous Chromosomes	Separated	Not involved
Sister Chromatids	Remain attached	Separated and move to opposite poles
Crossing Over	Occurs in Prophase-I	Does not occur
Result	Two haploid cells	Four haploid cells (each with single chrc

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.