Chapter: Cell Cycle and Cell Division

Exercise

Question 1. What is the average cell cycle span for a mammalian cell?

Answer:

A mammalian cell's cell cycle lasts about 24 hours on average.

Question 2. Distinguish cytokinesis from karyokinesis?

Answer:

	Cytokinesis	Karyokinesis
1	Cytokinesis is a biological process in which a cell's cytoplasm divides during mitosis or meiosis.	Karyokinesis is a biological process in which a cell's nucleus divides during mitosis or meiosis.
2	Prophase, metaphase, anaphase, and telophase are the four stages of the cell cycle.	Prophase, metaphase, anaphase, and telophase are the four stages of the cell cycle.

Question 3. Describe the events taking place during the interphase.

Answer:

A sequence of changes characterise interphase, which prepares a cell for division. It is the period during which the cell grows and repeats its DNA in a controlled manner.

There are three stages to the interphase period.

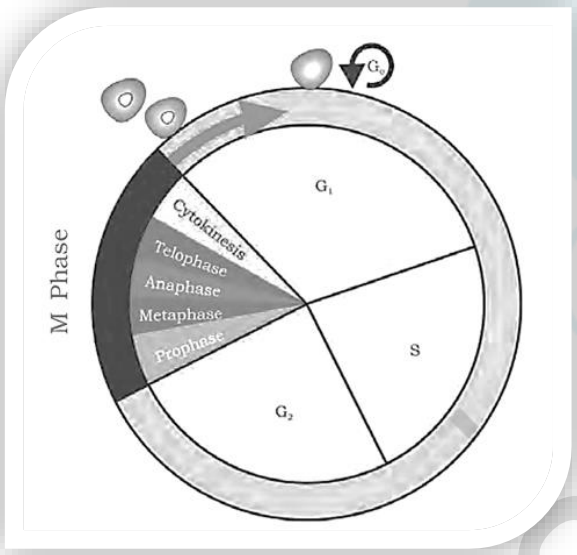
G1 phase, S phase, and G2 phase are the three stages of development.

The cell develops and DNA starts for replication during the G1 phase. The cell is metabolically active during this phase.

S phase - This is the stage during which DNA is synthesised. Although the amount of DNA (per cell) doubles, the number of chromosomes stays the same.

During the G2 phase, the cell continues to develop and prepares for division.

Proteins and RNA necessary for mitosis are generated during this stage.



Question 4. What is the G0 (quiescent phase) of the cell cycle?

Answer:

G_0, also known as the quiescent phase, is a stage in which cells remain metabolically active but do not proliferate unless instructed to do so. These cells are used to replace the cells that are lost during an injury.

Question 5. Why mitosis is called equational division?

Answer:

Mitosis is the process of cell division in which the chromosomes multiply and are uniformly divided across two daughter cells. The number of chromosomes in each daughter cell is the same as in the parent cell, suggesting that it is diploid. As a result, equational mitosis is the name given to mitosis.

Question 6. Name the stage of the cell cycle at which one of the following events occurs?

(i) Chromosomes are moved to the Meiosis cell division spindle equator

(ii) Centromere splits and chromatids separate

(iii)Pairing between homologous chromosomes takes place

(iv)Crossing over between homologous chromosomes takes place.

Answer:

(i) Metaphase

(ii) Anaphase

(iii) Zygotene of meiosis I

(iv) Pachytene of meiosis I

Question 7. Describe the following:

(a) synapsis

(b) bivalent

(c) chiasmata

Draw a diagram to illustrate your answer.

Answer:

(a) Synapsis

The pairing of homologous chromosomes is referred to as synapsis. This occurs during the zygotene stage of prophase I, also known as the second stage of the cell cycle.

(b) Bivalent- A pair of homologous chromosomes that have synapsed is known as a bivalent or tetrad. They arise during the zygotene stage of prophase I of meiosis.

(c) Chiasmata

Chiasmata are the points where two sister chromatids meet. It indicates the place where two paths cross. During prophase I of meiosis, it is generated during the diplotene stage.

Question 8. How does cytokinesis in plant cells differ from that in animal cells?

Answer:

	Cytokinesis in plant cells	**Cytokinesis in animal cells**
1	Cell plate development is responsible for cytoplasm division.	Cleavage is the process by which the cytoplasm is divided.
2	Cell plate creation begins in the cell's centre and spreads outward toward the cell's lateral walls.	Cleavage begins on the cell's edge and advances inward, separating it into two pieces.

Question 9. Find examples where the four daughter cells from meiosis are equal in size and where they are found unequal in size?

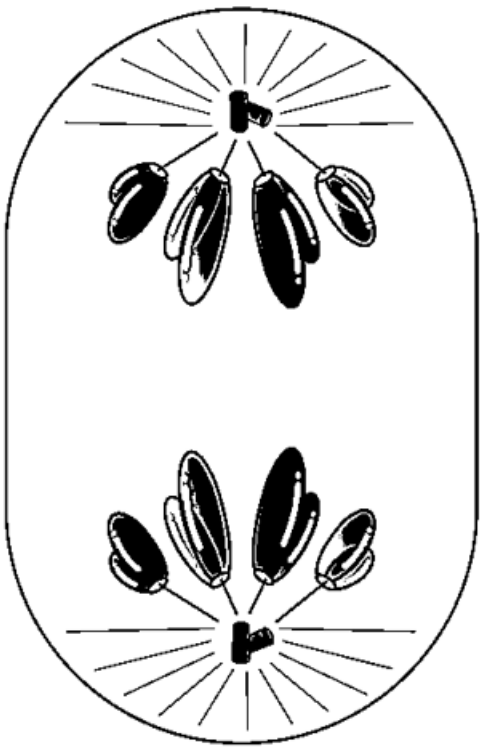
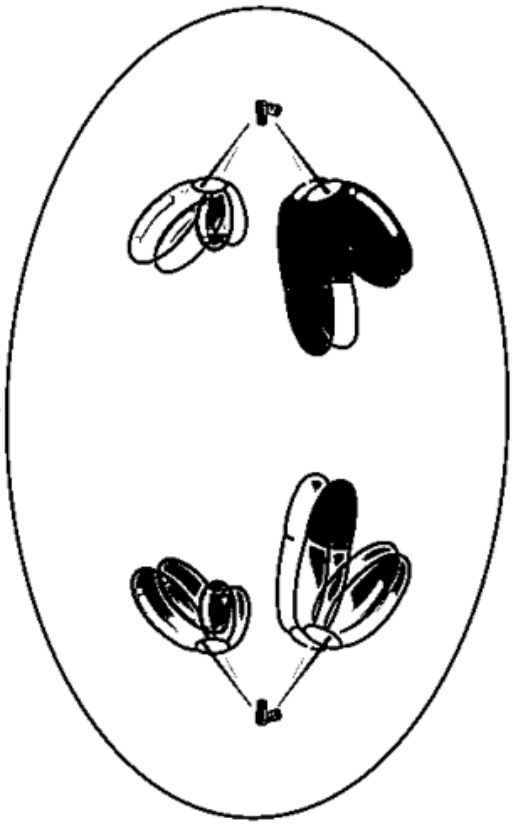
Answer:

(a) The process of meiosis is responsible for spermatogenesis, or the formation of sperms in humans. It results in the formation of four daughter cells of equal size.

(b) Oogenesis, or the formation of an egg, occurs in humans through the process of meiosis. It results in the formation of four unequally sized daughter cells.

Question 10. Distinguish anaphase of mitosis from anaphase I of meiosis?

Answer:

Anaphase of mitosis	Anaphase I of meiosis
The centromere divides and the chromatids separate during the anaphase stage. The chromosomes separate and travel toward opposite poles. Genetically, these chromosomes are identical. 	The homologous chromosomes separate during anaphase I, but the chromatids stay linked at their centromeres. As a result, in anaphase I, each bivalent pair's chromosomes separate while the sister chromatids remain together. 

Question 11. List the main differences between mitosis and meiosis?

Answer:

	Mitosis	Meiosis
1	Mitotic division produces two daughter cells from a single division.	Meiotic division is divided into two stages: meiosis I and meiosis II. There are four daughter cells as a result of these divisions.
2	Equational division is the name given to the process of mitosis. Because the daughter cells have the same diploid number of chromosomes as the parent cells, this is the case.	Reductional division is the name given to the first stage of meiosis. This is because the number of chromosomes is cut in half. Equational division is the name given to Meiosis II. Because the sister chromatids separate but the chromosome number remains the same, this happens.
3	The prophase is a brief period that does not include any other phases.	Leptotene, zygotene, pachytene, diplotene, and diakinesis are the five phases of prophase I.
4	During prophase, there is no chromosomal pairing, crossing-over, or chiasmata development.	During prophase, there is no chromosomal pairing, crossing-over, or chiasmata development.
5	There is no formation of a synaptonemal complex.	Synaptonemal complexes are produced during prophase I's zygotene stage.
6	The chromatids of each chromosome are separated during anaphase.	The homologous chromosomes separate during anaphase I, but the chromatids stay linked at their centromeres. The splitting of the centromere causes the chromatids to divide during anaphase II.
7	Mitosis is an important part of a cell's healing, repair, and development.	Meiosis causes chromosomal number fluctuation and maintains it from generation to generation.

Question 12. What is the significance of meiosis?

Answer:

The process of meiosis is the reduction of genetic material. It comprises two nuclear and cell divisions in quick succession, as well as a single DNA replication cycle. As a result, at the completion of meiosis II, four haploid cells are generated.

The process by which chromosomal numbers are passed down from generation to generation is called Meiosis. It halves the chromosomal number, allowing the fertilisation process to restore the zygote's original number.

Variations result from cross-over and the random distribution of homologous chromosomes between daughter cells, whereas chromosomal mutations result from the introduction of specific defects.

Question 13. Discuss with your teacher about

(i) haploid insects and lower plants where cell division occurs, and

(ii)some haploid cells in higher plants where cell division does not occur.

Answer:

(i) Fertilization is followed by zygotic meiosis in some insects and lower plants, resulting in the creation of haploid creatures. A haplontic life cycle is what this is called.

(ii) Polyploidy can be seen in haploid cells of higher plants where cell division is not possible. Polyploidy is a condition in which cells have more than the basic set of chromosomes. Colchicine can be used to artificially produce polyploidy in plants in cell culture.

Question 14. Can there be mitosis without DNA replication in the S phase?

Answer:

Without DNA replication in the S phase, mitotic cell division cannot occur. During the S phase, two important events occur the synthesis or duplication of DNA and the duplication of the centriole. DNA duplication is important because it keeps the chromosome number in the daughter cells constant. Mitosis is a division by equation. As a result, DNA duplication is a critical step.

Question 15. Can there be DNA replication without cell division?

Answer:

In the absence of cell division, DNA replication can take place. In cell division, two daughter cells by the division of one parent. However, if DNA replication continues regularly without cell division, the DNA inside the cell will continue to accumulate. By increasing the volume of the cell nucleus, this would drive cell expansion. DNA duplication without cell division is prevalent in Drosophila salivary glands. The term "polytene chromosome" refers to a chromosome that is duplicating DNA over and over again.

Question 16. Analyze the events during every stage of the cell cycle and notice how the following two parameters change

(i) Number of chromosomes (N) per cell

(ii)Amount of DNA content (C) per cell

Answer:

During meiosis, the number of chromosomes and the amount of DNA in a cell alter.

(I)In each cell, the number of chromosomes (N)

During anaphase I of the meiotic cycle, homologous chromosomes split and begin to migrate toward their respective poles. As a result, the bivalents divide into two sister chromatids, each receiving half of the parent cell's chromosomes.

As a result, during anaphase I, the number of chromosomes falls.

(ii) The amount of DNA in each cell (C).

The centromere splitting causes the chromatids to separate during anaphase II of the meiotic cycle.

The centromere connects the sister chromatids of each chromosome. The chromatids begin to migrate toward their respective poles as a result.

As a result, each pole has the same number of chromosomes as the other and the same amount of DNA.

During mitosis, the number of chromosomes remains constant.