10. Cell Cycle and Cell Division

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

Answer: The average cell cycle span for a mammalian cells is 24 hours.

Question 2. Distinguish cytokinesis from karyokinesis.

Answer:

Cytokinesis	Karyokinesis
Cytokinesis is the biological process that involves the division of a cytoplasm of the cell during mitosis or meiosis.	It is the biological process that involves the division of nucleus of the cell during mitosis or meiosis.
Stages are not present.	It involves four stages – prophase, metaphase , anaphase and telophase.

Question 3. Describe the events taking place during interphase.

Answer: Interphase is the resting phase of the cell cycle which covers 95% of the total duration of a cell cycle. It involves a series of changes which prepare cell for division. It is the period in which the cell experiences growth and DNA replication in an orderly manner. It is divided into three phases:
(i) G1 phase: It is the interval between mitosis and initiation of DNA replication. It is the period where the cell grows and prepares its DNA for replication. The cell is metabolically active but no replication occurs.
(ii) S phase: This is the synthesis phase during which DNA replication occurs. The amount of DNA doubles but chromosome number remains same.
(iii) G2 phase: The cell continues to grow and prepare itself for division. The proteins and RNA re required for mitosis.

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

Answer: G0 (quiescent phase) also known as the inactive stage of the cell cycle, is the stage when the cell remains metabolically active, but do not proliferate unless called on to do so. Such cells are used for replacing the cells lost during injury.

Question 5. Why is mitosis called equational division?

Answer: Mitosis is known as equational division because the daughter cells produced in this process have the same number of chromosomes as that in the parent cell.

Question 6. Name the stage of cell cycle at which one of the following events occur:

(i) Chromosomes are moved to 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 of mitosis

(ii) Anaphase of mitosis

(iii) Zygotene stage of meiosis I

(iv) Pachytene stage of meiosis I

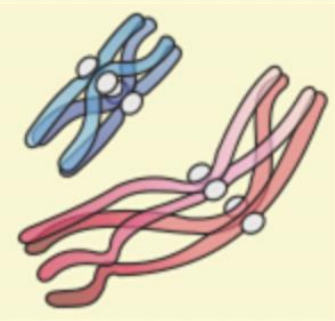
Question 7. Describe the following:

(a) synapsis (b) bivalent (c) chiasmata

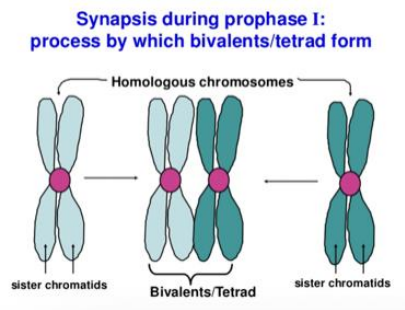
Draw a diagram to illustrate your answer.

Answer:

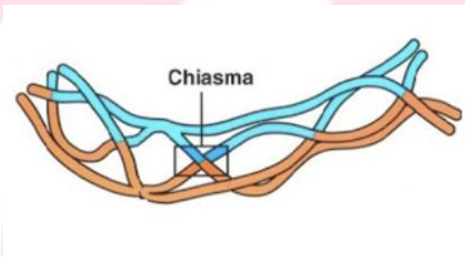
(i) The pairing of homologous chromosomes is called synapsis. This occurs during the second stage of prophase I or zygotene.



(ii) Bivalent or tetrad is a pair of synapsed homologous chromosomes. They are formed during the zygotene stage of prophase I of meiosis.



(iii) Chiasmata is the site where two non-sister chromatids of homologous chromosomes have crossed over. It represents the site of cross-over. It is formed during the diplotene stage of prophase I of meiosis.



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

Answer:

Plant cytokinesis	Animal cytokinesis
Cell plate formation takes place.	Cleavage takes place.
Cell wall formation starts in the middle and grows outwards.	The furrow begins from the plasma membrane and joins in the centre.
During cell plate formation, vesicle fusion takes place.	The contraction of peripheral ring of microfilaments initiates cleavage.

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) Spermatogenesis is the formation of sperms in human beings which takes place by meiosis and results in formation of four equal sized daughter cells.
(b) Oogenesis is the formation of ovum in human beings takes place by the process of meiosis. It results in the formation of four daughter cells which are unequal in size.

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

Answer:
Anaphase of mitosis :

1. Anaphase stage is characterised by the following key events:
(i) Centromeres split and chromatids separate. (ii)Chromatids move to opposite poles.

2. Each chromosome arranged at the metaphase plate gets split simultaneously and the two daughter chromatids, now referred to as chromosomes of the future daughter nuclei, begin their migration towards the two opposite poles.
3. As each chromosome moves away from the equatorial plate, the centromere of each chromosome is towards the pole and hence at the leading edge, with the arms of the chromosome trailing behind.

Anaphase I of meiosis :

1.The homologous chromosomes separate, while sister chromatids remain associated at their centromeres.

2.The spindle fibres contract and pull the centromeres of homologous chromosome towards the opposite poles.

3.The centromere is not divided. Thus half of the chromosomes of the parent nucleus go to one pole and the remaining half in the opposite pole.

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

Answer:

Mitosis	Meiosis
Involves one cell division	Involves two successive cell divisions.
Results in two daughter cells	Results in four daughter cells
Diploid daughter cells are formed which is same as parent cell.	Haploid daughter cells are formed which are half the number of chromosomes as parent cell.
Identical daughter cells are formed.	Genetically different daughter cells are produced.
Prophase is shorter.	Prophase I is longer.
No recombination/crossing over takes place.	It involves recombination/crossing over in prophase I.

Question 12. What is the significance of meiosis?

Answer:

- Specific chromosome number of each species is achieved across generations in sexually reproducing organisms by meiosis.
- It also increases the genetic variability in the population of organisms.
- It results in reduction of chromosome number by half.

Question 13. Discuss with your teacher about

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

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

Answer:

(i) Male bees, wasps and ants are haploid as they are produced from unfertilized eggs.

(ii) Cell division does not happen in synergids and antipodal cells; in the ovule.

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

Answer: Mitotic cell division cannot take place without DNA replication in S phase. Two important events take place during S phase – one is the synthesis or duplication of DNA and the other is the duplication of the centriole. DNA duplication is important as it maintains the chromosome number in the daughter cells. Mitosis is an equational division. Therefore, the duplication of DNA is an important step.

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

Answer: Yes, DNA replication can occur without being followed by cell division. For example, polyteny is a condition in which chromosomes repeatedly replicates but the cells do not divide and as a result of this, DNA accumulates in the cell.

Question 16. Analyse the events during every stage of 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: The number of chromosomes and amount of DNA are changed in Anaphase and S phase respectively.
(i) In S phase, the number of chromosomes remain same but each chromosome replicates so that it has two chromatids. Due to this the DNA contents doubles from 1C to 2C or 2C to 4C depending on haploid/diploid nature of cell.
(ii) In Anaphase, number of chromosome remains same. It is only sister chromatids which move towards their respective poles. DNA contents remain unchanged. In Anaphase-I of meiosis, number of chromosomes re reduced to half from 2N to 1N. DNA content decrease to one half in Anaphase I of meiosis.