Solutions

S1. Ans.(a)

Spindle fibers attach to kinetochores of chromosome in metaphase stage.

S2. Ans.(d)

- During leptotene stage the chromosomes become gradually visible under the light microscope.
- The beginning of diplotene is recognized by the dissolution of the synaptonemal complex and the tendency of the recombined homologous chromosomes of the bivalents to separate from each other except at the site of crossover.

  Thus both statement I and II are correct.

S3. Ans.(b)

(A) Diakinesis – Completion of terminalisation of chiasmata

(B) Pachytene – Appearance of recombination nodules

(C) Zygotene – Synaptonemal complex formation

(D) Leptotene – Chromosomes look like thin threads

A-II, B-IV, C-I, D-III

S4. Ans.(c)

The correct sequence of stages of cell division is

Gap 1 phase → Synthesis phase → Gap 2 phase
(E) (C) (A)

→ Karyokinesis → Cytokinesis
(D) (B)

The correct sequence will be → E → C → A → D → B

S5. Ans.(a)

Recombination nodules appear during the pachytene stage of prophase I in meiosis. These nodules are thought to be involved in crossing over, a process where homologous chromosomes exchange genetic material. This leads to genetic recombination, which is a significant source of genetic variation in sexually reproducing organisms.

S6. Ans.(d)

Splitting of centromere occurs during anaphase of mitosis or anaphase II of meiosis.

During Metaphase I and II, chromosomes align at the equator.

During telophase, chromosomes reach the respective poles.

S7. Ans.(c)

The process of recombination occurs at Pachytene stage of prophase I. This stage is characterised by the appearance of recombination nodules.

S8. Ans.(c)

Replication of DNA takes place in S-phase of cell cycle in eukaryotes. Most of the cell organelles duplicate in G, phase.

S9. Ans.(d)

M phase or mitosis is the phase where the actual cell division occurs. Mitosis is also called equational division.

During G_2 phase DNA synthesis stops but cell synthesis RNA, proteins, etc. for next phase.

Quiescent stage is inactive phase in which non-dividing cells enters.

G_1 phase is the interval between mitosis and initiation of DNA replication.

S10. Ans.(a)

1. Tetrad formation is seen during the Zygotene stage.

2. During Anaphase, the centromeres split and chromatids separate.

3. Terminalization of chiasmata takes place during Diakinesis.

4. Nucleolus, Golgi complex, and ER are reformed during Telophase.

5. Crossing over takes place between non-sister chromatids of homologous chromosomes.

S11. Ans.(c)

Statement I is incorrect. The GO phase is a state in the cell cycle in which cells exist in a quiescent or dormant stage. Statement II is correct. During the S phase (synthesis phase) of interphase, DNA replication occurs, and the centrosome, which plays a key role in cell division, also duplicates.

S12. Ans.(d)

The doubling of the number of chromosomes can be achieved by disrupting mitotic cell division soon after DNA replication has occurred and before the separation of sister chromatids. This stage of mitosis is the metaphase, where chromosomes align in the center of the cell, prior to separation in anaphase.

If mitosis is disrupted after this point, sister chromatids cannot separate, leading to a doubling of the chromosome number in the resulting cells.

S13. Ans.(d)

The centromere of each chromosome splits during the anaphase stage of both mitosis and meiosis.

In mitosis, this happens during anaphase, when sister chromatids separate and move to opposite poles of the cell.

In meiosis, the centromere splits during anaphase II, which is similar to anaphase of mitosis, and sister chromatids separate.

S14. Ans.(d)

In oocytes of some vertebrates, diplotene lasts for months or years. This stage is referred as dictyotene stage.

S15. Ans.(d)

Correct sequence of events during Prophase I of meiosis is: (b)→(a)→(c)→(e)→(d)

S16. Ans.(b)

Bivalent or tetrad formation is called synapsis which is accompanied by the formation of complex structure called synaptonemal complex.

S17. Ans.(d)

Metaphase chromosomes are not made up of four sister chromatids held together by the centromere. Instead, metaphase chromosomes consist of two sister chromatids held together by the centromere. The sister chromatids are identical copies of a single chromosome that have been replicated during the S phase of the cell cycle.

S18. Ans.(c)

Pairing of homologous chromosomes occurs during prophase I of meiosis.

Coiling and condensation of chromatids, spindle fibres attachment to the kinetochores and movement of centrioles towards opposite poles occur in both mitosis and meiosis.

S19. Ans.(c)

Pachytene stage of meiosis is characterized by the appearance of recombination nodules, the sites at which crossing over occurs between non sister chromatids of homologous chromosomes.

S20. Ans.(a)

In metacentric chromosome, centromere is in the middle of the chromosomes. Acrocentric chromosome has centromere close to the end of the chromosome. In submetacentric chromosome, centromere is slightly away from the middle of the chromosome. Telocentric chromosome has terminal centromere.

S21. Ans.(b)

Meiosis involves two sequential cycles of nuclear and cell division called meiosis-l and meiosis-II but only single cycle of DNA replication.

The stage between two meiotic divisions is called interkinesis and is generally short lived and involves no DNA replication.

S22. Ans.(b)

Spindle fibres attach to the kinetochores of chromosomes.

Kinetochores are the disc shaped structures present on sides of primary constriction or centromere of chromosomes.

S23. Ans.(b)

In anaphase-II, the centromeres separate and the sister chromatids—now individual chromosomes—move toward the opposite poles of the cell. The centromeres separate, and the two chromatids of each chromosome move to opposite poles on the spindle. The separated chromatids are now called chromosomes in their own right.

S24. Ans.(b)

A-(iv) B-(i) C-(ii) D-(iii)

S25. Ans.(d)

During mitotic cell cycle if the chromosome number in G_1 phase is 8, is remains same till metaphase.

Hence, even after S phase same chromosome number 8 is maintained in the cell of fruit fly.

S26. Ans.(b)

Terminalization of chiasma takes place throughout diplotene, after crossing over at pachytene, and terminalization completion takes region in diakinesis.

Zygotene is the sub-stage where synapsis among homologous chromosomes begins.

S27. Ans.(d)

During S-phase centriole get duplicate.

S28. Ans.(a)

Zygotene-The second stage of Prophase-I. Chromosomes starts pairing together in a process called synapsis.

Pachytene-The third stage of prophase-I, bivalent chromosomes clearly appears as tetrads, crossing over between homologous chromosomes occurs.

Diplotene-The fourth stage of the prophase of meiosis, following pachytene, during which the paired chromosomes begin to separate into two pairs of chromatids and chiasmata becomes visible.

Diakinesis-The fifth and last stage of the prophase of meiosis, following diplotene, when the separation of homologous chromosomes is complete and crossing over has occurred. Terminalization occurs as the chiasmata move towards the ends of the tetrad. Thus, the correct answer is

(A) - (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

S29. Ans.(a)

Some cells in the adult animals do not appear to exhibit division (e.g., heart cells) and many other cells divide only occasionally, as needed to replace cells that have been lost because of injury or cell death. These cells that do not divide further exit G_1 phase to enter an inactive stage called quiescent stage (G_0) of the cell cycle.

S30. Ans.(a)

During cell division, the cell cycle is divided into distinct phases. It is split into two sections. The M Phase is the time when a cell divides or undergoes mitosis, while the interphase is the time between two successive M phases. G_1 (first gap), S (synthesis), and G_2 (interphase) are the three phases of interphase (second gap).

S31. Ans.(c)

All of the chromosomes are present in metaphase. Coming to rest near the equator, with one chromatid of each chromosome attached to spindle fibres from one pole and its sibling chromatid joined to spindle fibres from the opposing pole by its kinetochore.

S32. Ans.(c)

Cytoplasmic proliferation in the G1 phase Only DNA replication occurs during the S phase, and the chromosome number remains constant.

G2 phase - Cell division and duplication of organelles. In M-phase, the chromosomes are aligned.

Note: Although the actions described in the question may not perfectly correspond to the phases of the cell cycle, the most accurate response is (c).

S33. Ans.(b)

The cell is metabolically active and expands continually during the G_1 phase, but it does not duplicate its DNA. The S phase, also known as the synthesis phase, is the time when DNA is synthesised or replicated. M-Phase involves the reorganisation of all cell components.

S34. Ans.(b)

The breakdown of the synaptonemal complex, as well as X-shaped structures known as chiasmata, characterise the diplotene stage.

S35. Ans.(a)

During zygotene, homologous chromosomes are paired (synapsis).

S36. Ans.(d)

$G_1 \rightarrow S \rightarrow G \rightarrow M$ is the correct sequence of cell cycle phases.

S37. Ans.(a)

Cells in the G_0 phase are considered to have exited the cell cycle. They are in a dormant state and do not proliferate unless they are stimulated, yet they are metabolically active.

S38. Ans.(b)

Diplotene is the fourth stage of prophase-I in meiosis, when the paired chromosomes begin to split and appear as a 0 or 8-shaped structure under the microscope.

S39. Ans.(d)

Nerve cells in adult human do not divide further.

These cells exit G_1 phase to enter an inactive stage called quiescent stage of the cell cycle. Cells in this stage remain metabolically active but no longer proliferate.

S40. Ans.(b)

The following is the right order of events during mitosis:

(i) During early to mid-prophase, DNA condenses, allowing chromosomes to be seen.

(ii) Disassembly of the nuclear membrane begins in late prophase or the transition to metaphase.

(iii) During metaphase, chromosomes are arranged along the equator, a process known as congression.

(iv) During anaphase, centromere division or splitting occurs, resulting in the formation of daughter chromosomes.

(v) During anaphase, daughter chromosomes divide and migrate to opposite poles, resulting in segregation.

(vi) The production of two daughter nuclei occurs during telophase.

S41. Ans.(c)

In bacteria, DNA replication occurs before fission. Because of their primordial origin, prokaryotes do not have a well-defined S-phase.

S42. Ans.(d)

The homologous chromosomes separate in anaphase -I, but sister chromatids stay connected at their centromeres.

S43. Ans.(c)

The S phase, also known as the synthesis phase, is the time when DNA is synthesised or replicated. The amount of DNA per cell doubles throughout this time.

S44. Ans.(d)

Only mitosis occurs in somatic cells. Meiosis, on the other hand, occurs in germ cells (sperm/ova). Chromosomes begin pairing together during the zygotene stage of meiosis-I, and this process is known as synapsis.

S45. Ans.(c)

Pachytene: With the help of an enzyme called recombinase, genetic material is exchanged between non-sister chromatids of two homologous chromosomes. Chromosomes align to the equatorial plate in Metaphase-I. Diakinesis is the process of the chiasmata being terminated.

Zygotene: A sophisticated structure called the synaptonemal complex helps similar chromosomes pair together (synapsis).

S46. Ans.(a)

- The exchange of genetic material between two non- sister chromatids of homologous chromosomes is known as crossing over.
- Crossing over is likewise an enzyme-Mediated process, with recombinase as the enzyme involved.

S47. Ans.(d)

A-(ii) B-(iii) C-(v) D-(iv)

S48. Ans.(a)

	Gametic	Somatic cell
Ploidy	n	2n
DNA	c	4C

S49. Ans.(a)

Synapsis - Zygotene

Pachytene - Crossing over

Diplotene - Chiasmata Termination

The nucleolus vanishes in diakinesis.

S50. Ans.(d)

	Ploidy level	Amount of DNA
G1	n	2C
S	n	4C
G2	n	4C
M	2n	2C

S51. Ans.(b)

The 'S' phase denotes the time when DNA is synthesised or replicated.

Per cell, the amount of DNA doubles.

S52. Ans.(b)

Crossing over is an enzyme-mediated process involving the recombinase enzyme. This can be found in pachytene.

S53. Ans.(b)

The nucleolus, Golgi complex, and ER reform during telophase.

S54. Ans.(d)

In the zygotene stage, bivalent or tetrad refers to paired homologous chromosomes.