Q1. Which phase of the cell cycle is characterized by DNA replication?

A. G1 phase
B. G2 phase
C. M phase
D. S phase

✅Answer: D. S phase
Explanation: The S (synthesis) phase is when DNA replication occurs, doubling the genetic material.

Q2. In which phase of mitosis do chromosomes align at the equator of the cell?

A. Prophase
B. Metaphase
C. Anaphase
D. Telophase

✅Answer: B. Metaphase
Explanation: During metaphase, chromosomes align at the metaphase plate (equator) and attach to spindle fibers via their kinetochores.

Q3. Which of the following events is not associated with prophase of mitosis?

A. Chromatin condensation
B. Disappearance of nucleolus
C. Chromosome alignment at the equator
D. Spindle fiber formation

✅Answer: C. Chromosome alignment at the equator
Explanation: Alignment at the equator occurs in metaphase, not prophase.

Q4. The diploid number of chromosomes is reduced to haploid during:

A. Mitosis
B. Meiosis I
C. Meiosis II
D. S phase

✅Answer: B. Meiosis I
Explanation: Meiosis I is a reductional division where homologous chromosomes separate, reducing chromosome number from 2n to n.

Q5. Which of the following does not occur during anaphase of mitosis?

A. Separation of sister chromatids
B. Movement of chromatids to opposite poles
C. Reappearance of nuclear membrane
D. Shortening of spindle fibers

✅Answer: C. Reappearance of nuclear membrane
Explanation: The nuclear membrane reappears in telophase, not anaphase.

Q6. Which checkpoint ensures that the DNA has been correctly replicated before entering mitosis?

A. G1 checkpoint
B. G2 checkpoint
C. S checkpoint
D. Metaphase checkpoint

✅Answer: B. G2 checkpoint
Explanation: The G2 checkpoint verifies that DNA replication is complete and correct before mitosis begins.

Q7. Choose the correct sequence of cell cycle phases:

A. G1 → M → G2 → S
B. M → S → G2 → G1
C. G1 → S → G2 → M
D. S → G1 → G2 → M

✅Answer: C. G1 → S → G2 → M
Explanation: The correct order of the cell cycle is G1 → S → G2 → M phase (interphase + mitosis).

Q8. What is the major significance of meiosis?

A. Increase in cell size

B. Genetic uniformity
C. Production of genetically identical cells
D. Maintenance of chromosome number across generations

✅Answer: D. Maintenance of chromosome number across generations
Explanation: Meiosis reduces the chromosome number to haploid, so that fertilization restores the diploid number in offspring.

Q9. During which phase of meiosis does crossing over occur?

A. Leptotene
B. Zygotene
C. Pachytene
D. Diplotene

✅Answer: C. Pachytene
Explanation: Crossing over (exchange of genetic material) takes place in pachytene of prophase I.

Q10. Which protein complex regulates the transition from G1 to S phase?

A. Histone
B. Cyclin-CDK complex
C. Kinetochores
D. Topoisomerase

✅Answer: B. Cyclin-CDK complex
Explanation: Cyclin-dependent kinases (CDKs), when bound to cyclins, trigger transitions between cell cycle phases.

Q11. Which of the following is unique to meiosis and does not occur in mitosis?

A. Spindle formation
B. Disappearance of nuclear membrane
C. Crossing over
D. Replication of DNA

✅Answer: C. Crossing over

Explanation: Crossing over occurs during prophase I of meiosis and leads to genetic variation. It does not occur in mitosis.

Q12. Synapsis and formation of bivalents occur during:

A. Zygotene
B. Pachytene
C. Diplotene
D. Diakinesis

✅Answer: A. Zygotene
Explanation: In zygotene, homologous chromosomes start pairing and form bivalents through synapsis.

Q13. At what stage of meiosis do chiasmata become visible?

A. Zygotene
B. Pachytene
C. Diplotene
D. Metaphase I

✅Answer: C. Diplotene
Explanation: Chiasmata (sites of crossing over) become visible as homologous chromosomes begin to repel each other in diplotene.

Q14. In which of the following phases is the nuclear envelope reformed and nucleolus reappears?

A. Anaphase
B. Telophase
C. Metaphase
D. Prophase

✅Answer: B. Telophase
Explanation: During telophase, chromosomes decondense and the nuclear membrane and nucleolus reappear.

Q15. What would happen if cytokinesis did not follow mitosis?

A. Cell would become polyploid

B. Chromosomes would be lost
C. One nucleus would be degraded
D. A multinucleated cell would result

✅Answer: D. A multinucleated cell would result
Explanation: Cytokinesis is division of the cytoplasm. Without it, a multinucleated (syncytial) cell forms.

Q16. Match the column:

Column I (Event) Column II (Phase)

a. Synapsis i. Zygotene
b. Terminalization ii. Diakinesis
c. Crossing over iii. Pachytene
d. Chiasmata visible iv. Diplotene

Options:
A. a-i, b-ii, c-iii, d-iv
B. a-iii, b-iv, c-i, d-ii
C. a-ii, b-i, c-iv, d-iii
D. a-i, b-iv, c-iii, d-ii

✅Answer: A. a-i, b-ii, c-iii, d-iv
Explanation:

Synapsis → Zygotene

Crossing over → Pachytene

Chiasmata visible → Diplotene

Terminalization → Diakinesis

Q17. Identify the incorrect statement about meiosis.

A. It results in genetic recombination
B. It involves two sequential divisions
C. DNA replicates twice

D. Homologous chromosomes separate in Meiosis I

✅Answer: C. DNA replicates twice
Explanation: DNA replicates only once (before Meiosis I). Two divisions follow without another round of replication.

Q18. Which cell type is most likely to remain in G0 phase?

A. Hepatocyte
B. Neuron
C. Epithelial cell
D. Spermatogonia

✅Answer: B. Neuron
Explanation: Neurons are terminally differentiated and remain in G0 phase permanently, i.e., do not divide.

Q19. What is the duration of the M phase in a typical mammalian cell cycle (~24 hours)?

A. 12 hours
B. 10 hours
C. 1 hour
D. 5 hours

✅Answer: C. 1 hour
Explanation: The M phase (mitosis + cytokinesis) takes about 1 hour in a 24-hour cell cycle.

Q20. Which of the following events distinguishes metaphase I of meiosis from metaphase of mitosis?

A. Chromosomes align at the equator
B. Individual chromatids line up
C. Homologous chromosomes align as bivalents
D. Centromeres split

✅Answer: C. Homologous chromosomes align as bivalents
Explanation: In metaphase I of meiosis, bivalents (paired homologous chromosomes) align. In mitosis, individual chromosomes align.

Q21. In which stage does the mitotic spindle attach to kinetochores of chromosomes?

A. Metaphase
B. Anaphase
C. Prometaphase
D. Telophase

✅Answer: C. Prometaphase
Explanation: In prometaphase, the nuclear envelope breaks down and spindle fibers attach to kinetochores, preparing for alignment.

Q22. During which phase of mitosis do the centromeres divide and sister chromatids separate?

A. Prophase
B. Anaphase
C. Metaphase
D. Telophase

✅Answer: B. Anaphase
Explanation: Centromere splitting and separation of sister chromatids mark anaphase, allowing movement toward opposite poles.

Q23. A checkpoint that assesses DNA damage and cell size before entering S phase is located in:

A. G1 phase
B. G2 phase
C. M phase
D. S phase

✅Answer: A. G1 phase
Explanation: The G1 checkpoint ensures DNA integrity and cell size are adequate before replication begins in S phase.

Q24. Which protein complex regulates cell cycle progression at checkpoints?

A. Ligase
B. Telomerase
C. Cyclin-CDK complex

D. Helicase

✅Answer: C. Cyclin-CDK complex
Explanation: Cyclins bind to CDKs (Cyclin-dependent kinases) to regulate key transitions like G1→S and G2→M.

Q25. Which of the following is a key mitotic checkpoint?

A. Whether cytokinesis has begun
B. Whether chromosomes are decondensed
C. Whether spindle fibers are attached to all kinetochores
D. Whether chromosomes are replicated

✅Answer: C. Whether spindle fibers are attached to all kinetochores
Explanation: The metaphase (spindle assembly) checkpoint ensures all chromosomes are properly attached before proceeding to anaphase.

Q26. What is the correct order of meiotic phases?

A. Leptotene → Zygotene → Diplotene → Pachytene → Diakinesis
B. Leptotene → Zygotene → Pachytene → Diplotene → Diakinesis
C. Zygotene → Leptotene → Diplotene → Pachytene → Diakinesis
D. Zygotene → Pachytene → Diplotene → Leptotene → Diakinesis

✅Answer: B. Leptotene → Zygotene → Pachytene → Diplotene → Diakinesis
Explanation: This is the correct sequential order of Prophase I sub-stages.

Q27. What happens to chromosome number after meiosis I?

A. Remains diploid
B. Becomes tetraploid
C. Becomes haploid
D. Doubles

✅Answer: C. Becomes haploid
Explanation: After Meiosis I, homologous chromosomes separate → each daughter cell gets half the chromosome number.

Q28. Which structure is responsible for moving chromosomes during mitosis?

A. Actin filaments
B. Centrioles
C. Mitotic spindle (microtubules)
D. Kinetochores only

✅Answer: C. Mitotic spindle (microtubules)
Explanation: The spindle fibers (microtubules) attach to kinetochores and pull chromosomes during mitosis.

Q29. Which phase of meiosis is most similar to mitosis?

A. Meiosis I
B. Metaphase I
C. Meiosis II
D. Prophase I

✅Answer: C. Meiosis II
Explanation: Meiosis II is similar to mitosis in that sister chromatids separate (not homologous chromosomes).

Q30. Which of the following cells do not undergo meiosis?

A. Oogonia
B. Spermatogonia
C. Zygote
D. Secondary oocyte

✅Answer: C. Zygote
Explanation: The zygote undergoes mitosis to form the multicellular embryo, not meiosis.

Q31. Match the following phases with their key features:

Column I (Phase)	Column II (Event)
A. Prophase	1. Chromosome alignment
B. Metaphase	2. Chromosome condensation
C. Anaphase	3. Nuclear envelope re-forms
D. Telophase	4. Sister chromatids separate

Options:
A. A–2, B–1, C–4, D–3
B. A–1, B–2, C–4, D–3
C. A–2, B–4, C–1, D–3
D. A–4, B–1, C–2, D–3

✅Answer: A. A–2, B–1, C–4, D–3
Explanation:

Prophase: Chromatin condenses

Metaphase: Chromosomes align

Anaphase: Sister chromatids separate

Telophase: Nuclear envelope reforms

Q32. Choose the incorrect match:

A. G1 phase – RNA & protein synthesis
B. S phase – DNA replication
C. G2 phase – Organelle duplication
D. M phase – Longest phase of interphase

✅Answer: D. M phase – Longest phase of interphase
Explanation: M phase is not part of interphase. Interphase includes G1, S, and G2.

Q33. During which phase do crossing over and chiasmata formation occur?

A. Zygotene
B. Pachytene
C. Leptotene
D. Diplotene

✅Answer: B. Pachytene
Explanation: Pachytene is the stage in meiosis I where crossing over occurs between non-sister chromatids.

Q34. Significance of meiosis includes all except:

A. Genetic recombination
B. Maintenance of chromosome number
C. Producing diploid gametes
D. Genetic variability

✅Answer: C. Producing diploid gametes
Explanation: Meiosis produces haploid gametes, not diploid.

Q35. Assertion (A): Meiosis I is called reductional division.

Reason (R): It reduces the chromosome number to half.**
A. Both A and R are true; R explains A
B. Both A and R are true; R doesn't explain A
C. A is true, R is false
D. Both A and R are false

✅Answer: A. Both A and R are true; R explains A
Explanation: Homologous chromosomes separate during Meiosis I, halving the chromosome number.

Q36. Which structure forms between homologous chromosomes during synapsis?

A. Kinetochore
B. Chiasma
C. Synaptonemal complex
D. Centromere

✅Answer: C. Synaptonemal complex
Explanation: The synaptonemal complex holds homologous chromosomes together during zygotene.

Q37. In meiosis, the number of chromatids per chromosome at metaphase II is:

A. 1
B. 2
C. 4
D. 0

✅Answer: B. 2
Explanation: Each chromosome still consists of two chromatids at metaphase II before separating.

Q38. Which checkpoint ensures DNA replication is complete before mitosis?

A. G0 checkpoint
B. G1 checkpoint
C. G2 checkpoint
D. M checkpoint

✅Answer: C. G2 checkpoint
Explanation: G2 checkpoint verifies DNA replication and damage before entering M phase.

Q39. In which organism is mitosis 'closed', i.e., nuclear envelope does not break?

A. Amoeba
B. Yeast
C. Onion root tip
D. Human cell

✅Answer: B. Yeast
Explanation: In some lower eukaryotes like yeast, mitosis is closed—the nuclear envelope remains intact.

Q40. Which of the following occurs in anaphase II but not in anaphase I?

A. Movement of chromosomes to poles
B. Splitting of centromeres
C. Synapsis
D. Crossing over

✅Answer: B. Splitting of centromeres
Explanation: In anaphase II, sister chromatids separate due to centromere splitting, unlike in anaphase I.

Q41. Which of the following processes occurs in both mitosis and meiosis II?

A. Synapsis

B. Crossing over
C. Separation of sister chromatids
D. Formation of tetrads

✅Answer: C. Separation of sister chromatids
Explanation: This occurs in anaphase of mitosis and anaphase II of meiosis.

Q42. The longest phase in meiosis is:

A. Anaphase I
B. Metaphase I
C. Prophase I
D. Telophase I

✅Answer: C. Prophase I
Explanation: Prophase I is prolonged and complex, with 5 substages (leptotene to diakinesis).

Q43. A cell with 20 chromosomes undergoes mitosis. The number of chromosomes in each daughter cell is:

A. 10
B. 20
C. 40
D. 5

✅Answer: B. 20
Explanation: Mitosis produces daughter cells with the same chromosome number as parent.

Q44. Which of these does not occur during mitosis?

A. Equational division
B. Pairing of homologous chromosomes
C. Spindle formation
D. Chromosome condensation

✅Answer: B. Pairing of homologous chromosomes
Explanation: Homologous pairing is a feature of meiosis, not mitosis.

Q45. Which of the following cells will be in G0 phase permanently?

A. Skin epithelial cells
B. Liver cells
C. Neurons
D. Spermatogonia

✅Answer: C. Neurons
Explanation: Neurons are terminally differentiated and stay in the G0 phase permanently.