

Cell Cycle and Cell Division — NEET MCQs with Solutions

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Q1. The term "proliferating cells" refers to cells that

- (A) Actively and continuously undergo the cell cycle
- (B) Are permanently differentiated and non-dividing
- (C) Have withdrawn into G₀ phase
- (D) Have undergone enucleation

Q2. In a diploid organism with $2n = 4$, how many DNA molecules are present during G₂ phase?

- (A) 4
- (B) 2
- (C) 16
- (D) 8

Q3. A cell that fails to cross the restriction point in G₁ will most likely

- (A) Proceed directly into S phase
- (B) Enter G₀ phase
- (C) Skip to G₂ phase
- (D) Undergo immediate apoptosis

Q4. In a diploid cell with $2n = 4$, DNA content changes from 2C to 4C during

- (A) G₁ phase
- (B) S phase
- (C) G₂ phase
- (D) M phase

Q5. The decision of a cell to either proceed with division or withdraw into G₀ is primarily made at the restriction point located in

- (A) S phase
- (B) G₂ phase
- (C) M phase
- (D) G₁ phase

Q6. A metabolically active cell that has exited the cell cycle and is not preparing for division is said to be in

- (A) G₀ phase
- (B) S phase
- (C) G₂ phase
- (D) Prophase

Q7. In a species with $2n = 6$, how many DNA molecules are present during G₁ phase?

- (A) 12
- (B) 3
- (C) 9
- (D) 6

Q8. DNA replication during S phase ensures which of the following outcomes in daughter cells?

- (A) Each daughter cell receives a complete, identical copy of the genome
- (B) Chromosome number is halved in each daughter
- (C) Homologous chromosomes pair before division
- (D) Ploidy level doubles in each daughter

Q9. At which checkpoint is a cell assessed for adequate size and favourable growth conditions before committing to DNA replication?

- (A) G2/M checkpoint
- (B) Spindle assembly checkpoint
- (C) G1/S checkpoint (restriction point)
- (D) Metaphase checkpoint

Q10. Which of the following best describes the primary molecular activity that distinguishes G2 phase from G1 phase?

- (A) Initiation of DNA replication
- (B) Synthesis of histones for chromatin packaging
- (C) Synthesis of proteins required for mitotic spindle assembly and chromosome condensation
- (D) Licensing of replication origins by MCM complex loading

Q11. Which of the following events correctly characterises telophase?

- (A) Centromere division and chromatid separation
- (B) Chromosome alignment at equatorial plate
- (C) Spindle fibre polymerisation
- (D) Chromosome decondensation and nuclear envelope reformation

Q12. Kinetochore is best described as

- (A) Protein complex at centromere for spindle attachment
- (B) Replication origin at telomere
- (C) Structural component of nucleolus
- (D) Microtubule-organising centre

Q13. In plant cells, a functional mitotic spindle forms despite the absence of

- (A) Tubulin
- (B) Centrioles
- (C) Cohesin
- (D) Kinetochores

Q14. Which of the following events during mitosis ensures that each daughter cell receives an identical copy of the genome?

- (A) Equal alignment and segregation of chromosomes at the metaphase plate
- (B) Dissolution of the nucleolus during prophase
- (C) Reformation of the nuclear envelope in telophase
- (D) Cytokinesis by cleavage furrow or cell plate

Q15. In a diploid cell with $2n = 10$, what is the total chromosome count in the cell during anaphase?

- (A) 10
- (B) 5
- (C) 15
- (D) 20

Q16. The mitotic spindle fibres originate from which structure?

- (A) Kinetochore
- (B) Centromere
- (C) Nucleolus
- (D) Centrosome

Q17. At metaphase of mitosis, chromosomes are arranged at the

- (A) Centrosome
- (B) Kinetochore
- (C) Nuclear membrane
- (D) Metaphase plate

Q18. If a diploid cell with $2n = 16$ undergoes meiosis I, each daughter cell has how many chromosomes?

- (A) 16
- (B) 32
- (C) 10
- (D) 8

Q19. Which of the following correctly distinguishes Meiosis II from Meiosis I in terms of what separates at anaphase?

- (A) Anaphase II: sister chromatids; Anaphase I: homologs
- (B) Anaphase II: homologs; Anaphase I: sister chromatids
- (C) Both separate sister chromatids at anaphase
- (D) Both separate homologs at anaphase

Q20. During anaphase I, what happens to the centromeres?

- (A) They remain intact; homologous chromosomes separate
- (B) They split, allowing sister chromatids to move apart
- (C) They duplicate in preparation for meiosis II
- (D) They fuse with the synaptonemal complex

Q21. In diplotene stage, homologous chromosomes begin to

- (A) Undergo synapsis for the first time
- (B) Split at the centromere
- (C) Align at the equatorial plate
- (D) Repel each other but remain attached at chiasmata

Q22. Meiosis produces four haploid cells. Which of the following most precisely explains this outcome?

- (A) Two divisions occur; DNA replicates before each division
- (B) Two divisions occur; DNA replicates only before meiosis I, not between the two divisions
- (C) One division occurs with two rounds of chromatid separation
- (D) Meiosis I produces two haploid cells that divide without any further nuclear event

Q23. In leptotene stage of Prophase I, chromosomes

- (A) Undergo crossing over
- (B) Align at the equatorial plate
- (C) Split at the centromere
- (D) Begin to condense and become visible

Q24. Synapsis between homologous chromosomes occurs during

- (A) Zygotene
- (B) Pachytene
- (C) Diplotene
- (D) Diakinesis

Answer key and explanations

Q1. Answer: (A) Actively and continuously undergo the cell cycle

Proliferating cells are those continuously passing through the cell cycle — $G1 \rightarrow S \rightarrow G2 \rightarrow M$ — and actively dividing. Options B and C describe non-proliferating cells. Enucleation (Option D) is irrelevant to division status.

Q2. Answer: (D) 8

After S phase, each of the 4 chromosomes has 2 sister chromatids each containing 1 DNA molecule $\rightarrow 4 \times 2 = 8$ DNA molecules. Option A (4) confuses DNA molecule count with chromosome number — the most frequent error here.

Q3. Answer: (B) Enter G0 phase

The restriction point is the G1 gate — failure to cross it (due to insufficient growth factors or DNA damage signals) results in exit into G0. The cell does not proceed to S phase, G2, or necessarily undergo apoptosis at this stage.

Q4. Answer: (B) S phase

DNA content doubles from 2C to 4C exclusively during S phase due to semiconservative replication. G2 phase follows replication — DNA content is already 4C at G2 entry. Option C (G2) is the most common wrong answer here.

Q5. Answer: (D) G1 phase

The restriction point (R point) in late G1 is the critical decision gate — if growth signals are adequate, the cell commits to S phase; if not, it exits to G0. This is distinct from the G2/M checkpoint which operates later.

Q6. Answer: (A) G0 phase

G0 is the quiescent stage where cells remain metabolically active but have exited the proliferative cycle. Critically, G0 cells are not "dead" — they perform normal functions. Only specific signals can return them to G1.

Q7. Answer: (D) 6

In G1, replication has not occurred; each chromosome consists of one double-stranded DNA molecule, giving 6 DNA molecules for 6 chromosomes. Option A (12) is the post-S phase value and is the trap.

Q8. Answer: (A) Each daughter cell receives a complete, identical copy of the genome

Replication produces two identical genome copies (sister chromatids) so that after division each daughter cell inherits a complete genetic complement. Option D is a common misconception — ploidy does not change because chromosome sets remain diploid; only DNA amount temporarily doubles.

Q9. Answer: (C) G1/S checkpoint (restriction point)

The G1/S checkpoint (restriction point) is the primary decision point where a cell commits to S phase only if size, nutrient status, and growth signals are adequate. Passing this point is largely irreversible. Option A (G2/M) monitors DNA integrity before mitosis, not growth readiness.

Q10. Answer: (C) Synthesis of proteins required for mitotic spindle assembly and chromosome condensation

G2 is characterized by synthesis of tubulin, condensins, and other proteins needed for mitosis — not DNA replication (that occurred in S). Option D (MCM loading) occurs in G1, not G2. This concept is commonly confused with S phase functions.

Q11. Answer: (D) Chromosome decondensation and nuclear envelope reformation

Telophase reverses prophase events: chromosomes decondense into chromatin, nuclear envelope reforms around each chromosome set, and nucleolus reappears. Centromere division is anaphase; chromosome alignment is metaphase; spindle fibres depolymerise (not polymerise) in telophase.

Q12. Answer: (A) Protein complex at centromere for spindle attachment

Kinetochores are disc-shaped proteinaceous structures assembled on the centromere of each chromatid. It is the direct attachment site for kinetochore microtubules and is essential for chromosome movement during anaphase. MTOCs (centrosomes) organise spindle formation — distinct from kinetochore function.

Q13. Answer: (B) Centrioles

Plant cells lack centrioles (and thus asters) yet assemble a fully functional astral spindle using other microtubule-organising proteins. This is a key NEET trap — centrioles are not universally required for spindle formation, only for aster formation.

Q14. Answer: (A) Equal alignment and segregation of chromosomes at the metaphase plate

Precise alignment of chromosomes at the metaphase plate ensures that when centromeres split and chromatids migrate in anaphase, each pole receives one copy of every chromosome — this is the molecular basis of genetic constancy in mitosis.

Q15. Answer: (D) 20

When centromeres split at anaphase onset, each chromatid becomes an independent chromosome. A $2n=10$ cell has 10 chromosomes (20 chromatids) at metaphase; after splitting, 20 individual chromosomes are present — 10 moving to each pole. The count returns to 10 per daughter cell after division.

Q16. Answer: (D) Centrosome

Spindle fibres originate from centrosomes, which migrate to opposite poles during prophase. Kinetochore are attachment sites on chromosomes where spindle fibres bind — they do not generate fibres. Nucleolus disappears during prophase and plays no role in spindle formation.

Q17. Answer: (D) Metaphase plate

During metaphase, chromosomes align at the equatorial plane called the metaphase plate, equidistant from both poles. Centrosomes are at the poles; kinetochores are on chromosomes; the nuclear membrane has already disintegrated.

Q18. Answer: (D) 8

Meiosis I halves chromosome number: $2n = 16 \rightarrow n = 8$. Each chromosome still consists of two chromatids at this stage. Option A (16) is the pre-division diploid count — the most common error.

Q19. Answer: (A) Anaphase II: sister chromatids; Anaphase I: homologs

Anaphase I separates homologous chromosomes (reductional); anaphase II separates sister chromatids (equational, like mitosis). Reversing these (Option B) is the most frequently tested meiosis trap in NEET.

Q20. Answer: (A) They remain intact; homologous chromosomes separate

In anaphase I, centromeres do NOT divide — homologous chromosomes (each still with two chromatids) move to opposite poles. Centromere splitting (Option B) occurs in anaphase II, not anaphase I. This distinction is a top NEET trap.

Q21. Answer: (D) Repel each other but remain attached at chiasmata

In diplotene, the synaptonemal complex dissolves and homologs begin to separate. However, they remain held together only at chiasmata — the physical sites of earlier crossing over. Synapsis (Option A) belongs to zygotene, not diplotene.

Q22. Answer: (B) Two divisions occur; DNA replicates only before meiosis I, not between the two divisions

Meiosis produces four haploid cells because two successive divisions occur with only one round of DNA replication (before meiosis I). The absence of replication between meiosis I and II is the precise reason four — not two — genetically distinct haploid cells result. Option A is the classic high-frequency NEET trap.

Q23. Answer: (D) Begin to condense and become visible

In leptotene, chromosomes begin condensation and become visible as thin thread-like structures. Crossing over occurs in pachytene, equatorial alignment in metaphase I, and centromere splitting occurs in anaphase II, not leptotene.

Q24. Answer: (A) Zygotene

Synapsis — the intimate pairing of homologous chromosomes — begins in zygotene, facilitated by the synaptonemal complex. Pachytene follows zygotene and is the stage of crossing over. Diplotene marks the beginning of synaptonemal complex dissolution.

Stage-by-stage revision

Stage	What happens
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Duration	Human cell cycle about 24 hours (mitosis about 1 hour); yeast about 90 minutes
G1 phase	Cell grows and is metabolically active; no DNA replication
S phase	DNA doubles ($2C \rightarrow 4C$) but chromosome number stays the same; centriole duplicates in animal cells
G2 phase	Proteins for mitosis are made; cell keeps growing
G0 phase	Quiescent stage — cells stay active but stop dividing, e.g. heart cells
Prophase	Chromosomes condense; nucleolus, nuclear envelope, Golgi and ER disappear
Metaphase	Chromosomes on the metaphase plate; best stage to study chromosome morphology
Anaphase	Centromeres split; sister chromatids move to opposite poles
Telophase	Nuclear envelope, nucleolus, Golgi and ER reform
Cytokinesis	Cleavage furrow in animal cells; cell plate in plant cells; skipped in coconut liquid endosperm (syncytium)
Leptotene	Chromosomes start compacting
Zygotene	Synapsis — synaptonemal complex forms bivalents (tetrads)
Pachytene	Crossing over at recombination nodules, by recombinase
Diplotene	Synaptonemal complex dissolves; chiasmata visible; can last months or years in oocytes
Diakinesis	Terminalisation of chiasmata
Anaphase I vs II	Anaphase I: homologous chromosomes separate; anaphase II: sister chromatids separate
Interkinesis	Short gap between meiosis I and II; no DNA replication