For BioResire students

NEET Biology Material

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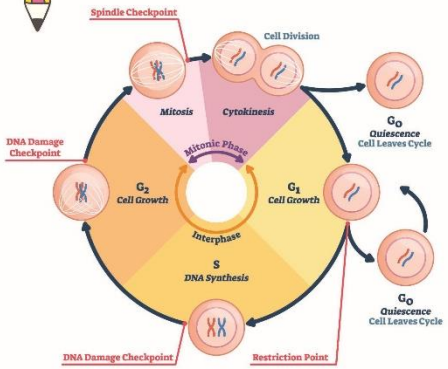
CELL CYCLE AND CELL DIVISION

Cell cycle is the sequence of events by which a cell duplicates its genome synthesize the other constituents of the cell and eventually divides into two daughter cells.



Phases of cell cycle

Quiescent Stage (G_0)

In this stage cell does not divide and exit phase to enter an inactive stage called G_0

Cell is metabolically active but does not proliferate

INTERPHASE

1) G_1 phase cell is metabolically active and grows continuously

2) In S- phase DNA synthesis occurs and its content increases from 2c to 4c

3) In G_2 phase proteins are synthesized in the preparation for mitosis while cell growth continues

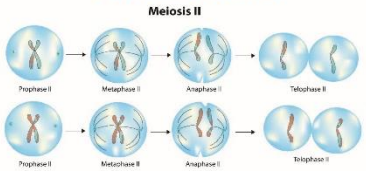
M- PHASE

It starts with nuclear division corresponding to chromosomes and ends with division of cytoplasm

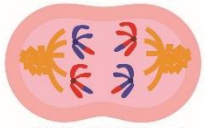
- **Metaphase-I**
  Bivalent chromosomes align on the equatorial plate Microtubules from opposite poles of the spindle attach to the pair of homologous chromosomes.
- **Anaphase - I**
  Homologous chromosomes separate while chromatids remain associated at the centromeres.
- **Telophase - I**
  Nuclear membrane and nucleolus reappear

Note - Inter Kinesis is the stage between two meiotic division (meiosis I and Meiosis II)

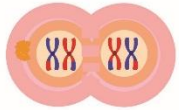
- **Meiosis II**
  It is the same as mitosis



METAPHASE - I



ANAPHASE - I



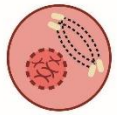
TELOPHASE - I

MITOSIS

Equational division" the number of chromosomes in the parental cell and in cells of the progenies are the same.

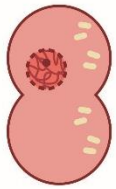
- **Prophase**
  First Stage of mitosis
  - Chromatin condenses to from chromosomes
  - Microtubules are assembled into mitotic spindle
  - Centriole moves to opposite poles

- **Metaphase**
  Second Stage of mitosis
  - Spindle fibers attached to Kinetochores of chromosomes
  - Chromosomes arranged at the equator of the spindle to form metaphase plate.



- **Anaphase**
  Third Phase of mitosis
  - Centromeres split and chromatids separate
  - Chromatids move to opposite poles

- **Telophase**
  Fourth Phase of mitosis
  - Chromosomes cluster at opposite poles
  - Nuclear envelope assembles around the chromosome clusters
  - Nucleolus, Golgi complex and ER reform



Cytokinesis

Division of cytoplasm

(i) Animal cell:-
Cell furrow formed in plasma membrane.

(ii) Plant cell:-
Cell Plate formed which represents the middle lamella between two adjacent cell walls

MEIOSIS

- MEIOSIS - I
- MEIOSIS - II

Four haploid daughter cells are formed

MEIOSIS-I

Prophase-I

Leptotene
Chromosomes compact throughout this stage.

Zygotene
Homologous chromosomes start pairing together and this process of association is called (Synapsis)
Synaptonemal complex is formed. The complex formed by a pair of synapsed homologous chromosome is called a divalent.

Pachytene
Site of crossing over it occurs between non sister chromatids of homologous chromosomes.

Note : Recombination between homologous chromosomes is completed by the end of Pachytene.

Diplotene
Synaptonemal Complex dissolves and the recombined chromosomes separate from each other except at the sites of crossing over.
These X- Shaped structure are called Chiasmata.

PROPHASE - I

Significance of Meiosis: -
(i) Gametes are formed (haploid).
(ii) Increases the genetic variability
(iii) Maintain the chromosome number.

Significance of Mitosis:-
(i) Growth of multicellular organisms.
(ii) Maintenance of surface/ volume ratio.
(iii) Maintenance of chromosome number.
(iv) Regeneration

CELL CYCLE AND CELL DIVISION

Cell cycle

The sequence of events by which a cell duplicates its genome, synthesizes the other constituents of cells and eventually divides into two daughter cells is called cell cycle.

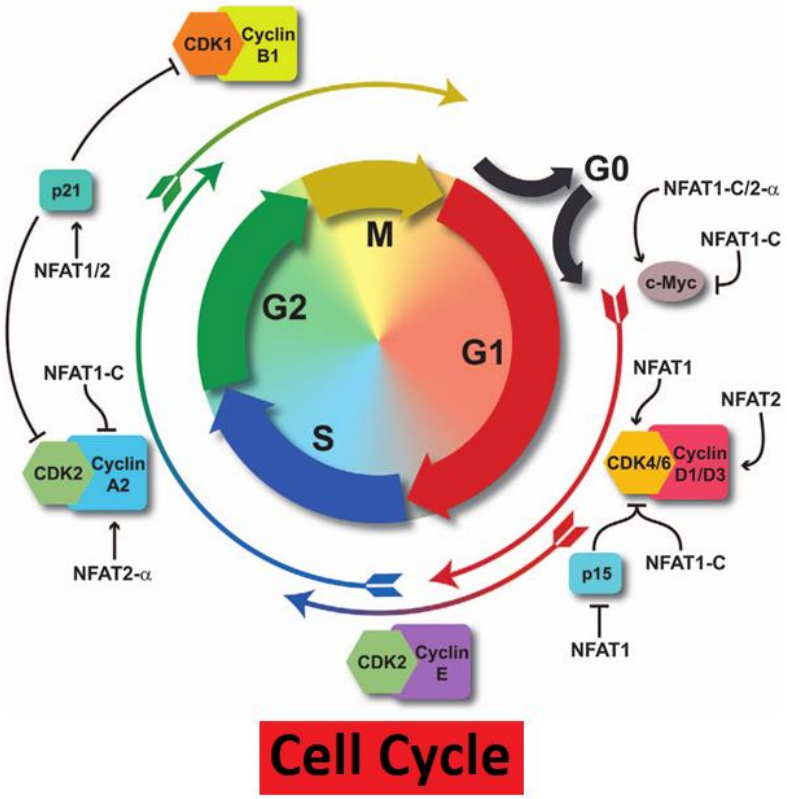
G_1 Phase: Cell metabolically active and grows continuously but does not replicate DNA

S Phase: DNA synthesis occurs, DNA content increases from 2C to 4C, but the number of chromosomes remains same i.e., 2n.

G_2 Phase: Proteins are synthesized in preparation for mitosis while cell b growth continues.

M Phase (Mitosis Phase): Starts with nuclear division, corresponding to separation of daughter chromosomes (karyokinesis) and usually ends with division of cytoplasm, (cytokinesis).

Quiescent stage (G_0): In adult animals cells that do not divide and exit G1 phase to enter an inactive stage called G0. Cells at this stage remain metabolically active but do not proliferate. e.g., Heart cells.



Difference between Mitosis and meiosis

Mitosis	Meiosis
Takes place in the somatic cells.	Takes place in reproductive cells.
It is a single division which produces two cells.	It is a double division which produces four cells.
Haploid and diploid both kind of cells may undergo mitosis.	Only diploid cells undergo in meiosis cell division.
Crossing over absent.	Crossing over takes place.
Pairing of chromosome does not occur.	Pairing of homologous chromosome occurs.

Stages of Mitosis

Since the number of chromosomes in the parent and progeny cells is the same, it is called as equational division.

Mitosis is divided into four sub stages:

Prophase:

- Replicated chromosomes, each consisting of 2 chromatids, condense and become visible.
- Microtubules are assembled into mitotic spindle.
- Nucleolus and nuclear envelope disappear.
- Centriole moves to opposite poles.

Metaphase:

- Spindle fibers attached to kinetochores (small disc-shaped structures at the surface of centromere) of chromosomes.
- Chromosomes line up at the equator of the spindle to form metaphase plate.

Anaphase:

- Centromeres split and chromatids separate.
- Chromatids move to opposite poles due to shortening of spindle fibers.

Telophase:

- Chromosomes cluster at opposite poles.
- Nuclear envelope assembles around chromosomes clusters'.
- Nucleolus, Golgi Complex, E.R. reforms.

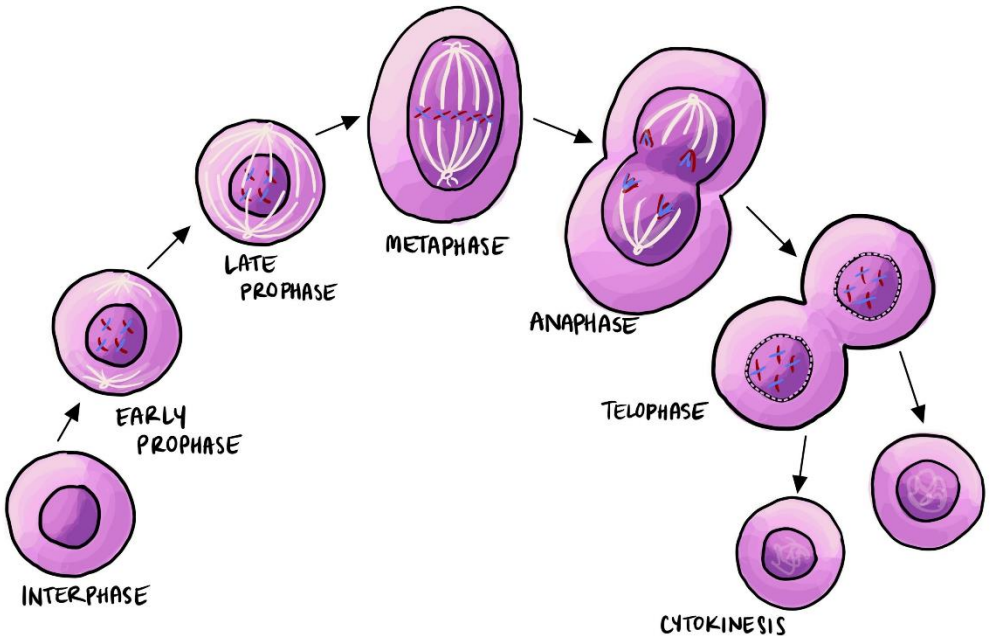
Cytokinesis

Is the division of protoplast of a cell into two daughter cells after karyokinesis (nuclear division).

Animal Cytokinesis: Appearance of furrow in plasma membrane which deepens and joins in the center, dividing cell cytoplasm into two.

Plant cytokinesis: Formation of new cell wall begins with the formation of a simple precursor cell plate which represents the middle lamella between the walls of two adjacent cells.

Syncytium: When karyokinesis is not followed by cytokinesis, a multinucleated condition arises. This is called syncytium.



Significance of Mitosis:

- Growth-addition of cells.
- Maintenance of surface/ volume ratio. Maintain Nucleo –cytoplasmic ratio.
- Maintenance of chromosomes number.
- Regeneration.
- Reproduction in unicellular organisms, lower plants and some insects.
- Repair and wound healing.
- Vegetative reproduction in plants takes place by mitosis.

Meiosis

- Specialized kind of cell division that reduces the chromosomes number by half. hence it is called reductional division.
- Occurs during gametogenesis in plants and animals.
- Involves two sequential cycles of nuclear and cell division called Meiosis I and Meiosis II.
- It results in 4 haploid daughter cells.
- Interphase occurs prior to meiosis which is similar to interphase of mitosis except the S phase is prolonged.

Meiosis I

Prophase I: Subdivided into 5 phases.

Leptotene:

- Chromosomes make their appearance as single stranded structures.
- Compaction of chromosomes continues.

Zygotene:

- Homologous chromosomes start pairing and this process of association is called synapsis.
- Chromosomal synapsis is accompanied by formation of Synaptonemal complex.
- Complex formed by a pair of synapsed homologous chromosomes is called bivalent or tetrad.

Pachytene: Crossing over occurs between non-sister chromatids of homologous chromosomes. The enzymes involved in the process is 'recombinase'. Recombination between homologous chromosomes is completed. Exchange of genetic material.

Diplotene: Dissolution of synaptonemal complex occurs and the recombined chromosomes separate separate from each other except at the sites of crossing over. These X-shaped structures are called chaismata. In oocytes of some vertebrates diplotene can last for month or years.

Diakinesis: Terminalization of chaismata.

- Chromosomes are fully condensed and meiotic spindles assembled.
- Nucleolus disappear and nuclear envelope breaks down.

Metaphase I

Bivalent chromosomes align on the equatorial plate.

Microtubules from opposite poles of the spindle attach to the pair of homologous chromosomes.

Anaphase I

Homologous chromosomes, separate while chromatids remain associated at their centromeres.

Telophase I:

- Nuclear membrane and nucleus reappear.
- Cytokinesis follows (diad of cells).

Interkinesis

Stage between two meiotic divisions, (meiosis I and meiosis II) generally short lived.

Meiosis II: (It resembles the normal mitosis).

Prophase II

- Nuclear membrane disappears.
- Chromosomes again become compact.

Metapahse II

- Chromosomes align at the equator.
- Microtubules from opposite poles of spindle get attached to kinetochores of sister chromatids.

Anaphase II

Simultaneous splitting of the centromere of each chromosome, allowing them to move towards opposite poles of the cell.

Telophase II

- Two groups of chromosomes get enclosed by a nuclear envelope.
- Cytokinesis follows resulting in the formation of tetrad of cells i.e., 4 haploid cells.

Significance of Meiosis:

- **Formation of gametes:** In sexually reproducing organisms.
- **Genetic variability:** Variations are very important for evolution.
- **Maintenance of chromosomal number:** By reducing the chromosome number in gametes. Chromosomal number is restored by fertilization of gametes.

NCERT LINE BY LINE QUESTIONS

1. All cells reproduce by dividing into _ _ _ _ _ , with each parental cells giving rise to_ _ _ _ _ cells each time they divide. **Easy Page No-162, Paragraph No-1**
A) One; four daughter B) Two; two daughter
C) One; two daughter D) Two; four daughter

10.1 Cell Cycle

2. A cell cycle comprises all the listed events, except: **Easy Page No-162, Paragraph No-2**
A) Cell growth B) DNA replication
C) Transcription D) Cell division
3. Consider the following statements-
Statement-I: cell growth (in terms of cytoplasmic increases) is a contingent process which occur during cell cycle.
Statement-II: DNA synthesis occur only during one specific stage in the cell cycle.
Statement-III: The event of cell cycle are under genetic control.
Difficult Page No-162, Paragraph No-2
A) Statement-I is false & statement-II and III are true
B) Statement-I and II are false & statement-III are true
C) All statement are true
D) None of the above stated statement are true.

10.1.1 Phases of Cell Cycle

4. Cell of human divide once in approximately-**Easy Page No-163, Paragraph No-1**
A) 60 minutes B) 90 minutes C) 24 hours D) None of these
5. Read the following statements and choose the correct option.
Medium
Page No-163, Paragraph No-1 and 2
Statement A: The M-phase represents the phase when actual cell division occurs
Statement B: Interphase represents the phase between two successive M-phases
A) Only statement A is correct
B) Only statement B is correct
C) Both the statements are incorrect
D) Both the statements are correct
6. Match the columns and choose the correct option
Medium
Page No-163, Paragraph No-1,2,3,4 and page No-164, paragraph No- 1 and 2

Column I	**Column II**
(a) G_1 phase	(i) Quiescent stage of the cell cycle.
(b) G_2 phase	(ii) DNA denoted as 2C, increases to 4C
(c) Synthesis phase	(iii) Proteins are synthesized in preparation for mitosis
(d) G_0 phase	(iv) Cell contain initial amount of DNA i.e., 2C

A) a-iv, b-iii, c-i, d-ii B) a-iv, b-iii, c-ii, d-i
C) a-iii, b-i, c-iv, d-ii D) a-ii, b-iv, c-ii, d-i
7. An average duration of yeast cell cycle is-
Easy **Page No-163, Paragraph No-1**
A) 60 minutes B) 90 minutes
C) 20 minutes D) One day

8. Cell cycle is divided into how many basic phases
Easy **Page No-163, Paragraph No-1**
A) One B) Two C) Four D) Six

9. Which of following is/are enlisted as basic phases of cell cycle?
Easy **Page No-163, Paragraph No-3**
A) G_0 phase B) S phase C) Interphase D) Metaphase

10. The phase of cell cycle during which mitosis occur is-
Easy **Page No-163, Paragraph No-2**
A) Interphase B) M-phase C) G-phase D) S-phase

11. The phase between two successive Mphase is-
Easy **Page No-163, Paragraph No-2**
A) Interphase B) G-phase C) S-phase D) M-phase

12. The time span of interphase and M-phase is an average human cell cycle is-
Easy **Page No-163, Paragraph No-2**
A) 12 hours each
B) 95% M-phase & one hour interphase
C) 8 hour M-phase & 16 hour interphase
D) One hour M-phase & 23 hour interphase

13. The correct sequence of cell is-
Easy **Page No-163, Figure No-10.1**
A) M -> G_2 -> S -> G_1 B) S -> G_2 -> G_1 -> M
C) M -> G_1 -> G_2 -> S D) G_1 -> S -> G2 -> M

14. The process which mark as start & usually end of M-phase are-
Medium **Page No-163, Paragraph No-3**
A) Division of cytoplasm & Karyokinesis respectively
B) Cytokinesis and division of cytoplasm respectively
C) Separation of daughter chromosome & cytokinesis respectively
D) Karyokinesis & karyokinesis respectively

15. Resting phase of cell-cycle is-
Easy **Page No-163, Paragraph No-3**
A) M-phase B) Interkinesis
C) G_1 & G_2 phase D) Interphase

16. Interphase is divided into_ _ _ phases further.
Easy **Page No-163, Paragraph No-3**
A) 4 B) 3 C) 2 D) 5

17. Which of following stage corresponds to the interval between mitosis & initiation of DNA replication?
Medium **Page No-163, Paragraph No-4**
A) S-phase B) G_2-phase C) M-phase D) G_1-phase

18. Select the correct statement about G_1 phase-
Easy **Page No-163, Paragraph No-4**
A) Cell is metabotically inactive B) DNA does not replicate
C) DNA replicate D) Chromosome number is doubled

19. Correct sequence of phase of M-phase is-
Easy **Page No-163, Figure No-10.1**
A) Cytokinesis -> Prophase -> Metaphase -> Anaphase -> Telophase
B) Prophase -> Anaphase -> Metaphase - > Telophase -> Cytokinesis
C) G_0 -> G_1 -> S -> G_2 D) None of these

20. What would be amount of DNA (C) and number of chromosome (N) in animal cell just after completion of S phase if the initial amount is 2C and 2N?
Difficult **Page No-163, Paragraph No-4**

A) 2C and 2N respectively
B) 4C and 4N respectively
C) 4C and 2N respectively
D) 2C and 4N respectively

21. Duplication of centriole occur in-
Easy **Page No-163, Paragraph No-5**
A) M-phase B) G_2-phase C) S-phase D) G_0-phase

22. The S-phase of animal cell marked by-
Easy **Page No-163, Paragraph No-5**
A) DNA replication
B) Centriole duplication
C) Cell growth and protein synthesis
D) A & B

23. The G_2 of cell cycle is pronounced by-
Easy **Page No-163, Paragraph No-5**
A) Cell growth and division
B) Cell duplication
C) Protein synthesis & centriole duplication
D) Cell growth & protein synthesis

24. Find mismatch column.
Difficult **Page No-163, Paragraph No-1,2,3,4**

Column-I	**Column-II**
A) Karyokinesis	Separation of daughter chromosome
B) cytokinesis	Division of cytoplasm
C) Interphase	Smallest phase of cell cycle
D) M-phase	Mitosis phase

25. The inactive stage of cell cycle is-
Easy **Page No-164, Paragraph No-1**
A) Quiescent stage B) G_1 C) S – Phase D) A & B

26. Choose the correct statement with respect to G_0 phase:
Medium **Page No-164, Paragraph No-1**
A) Also known as quiescent stage and start after G_2 phase
B) Cell of this stage remain unactive and no longer proliferation
C) Cell of this stage remain in active but no longer proliferation unless called to do so depending on the requirement of organism
D) Cell of this stage remain active and proliferation till death without any condition

27. How many chromosome does onion somatic cell have –
Easy **Page No-164, Top box**
A) 12 B) 14 C) 16 D) 20

28. What number of chromosome does onion somatic cell have in G, S, G2 & M – phase Respectively
Medium **Page No-164, Top box**
A) 32, 16, 16, 32 B) 16, 32, 16, 16 C) 16, 16, 16, 16 D) None of these

29. Mitotic division occur in –
Easy **Page No-164, Paragraph No-2**
A) Diploid somatic cell
B) Haploid male honey bee
C) A & B
D) Gametes

30. Match the following column:
Difficult
Page No-163 & 164, Paragraph No-1,2

Column – I	**Column – II**
a) G_1 Phase	i) Metabolically active cell, do not proliferate
b) S Phase	ii) Content of DNA doubled
c) G_0 phase	iii) Protein synthesised
d) G_2 Phase	iv) Metabolically active cell grows continuously

A) a – iv), b – ii), c – i), d – iii)
B) a – i), b – ii), c – iv), d – iii)
C) a – iv), b – iii), c – i), d – ii
D) None of these

10.2 M–Phase

31. M – phase refer to –
Easy **Page No-164, Paragraph No-3**
A) Metaphase
B) Meiosis
C) Karyokinesis
D) A & B both

32. Most dramatic period of cell cycle is-
Easy **Page No-164, Paragraph No-3**
A) Gap 1 only
B) M-phase
C) S-phase only
D) Interphase

33. Equational division refer to –
Easy **Page No-164, Paragraph No-3**
A) Meiosis
B) Mitosis
C) Number of cell chromosome in parent & progeny cell is same
D) B & C

34. Karyokinesis of mitosis is divided into _____ stages
Easy **Page No-164, Paragraph No-3**
A) 2
B) 3
C) 4
D) 8

35. Correct order of mitotic division is –
Easy **Page No-164, Paragraph No-3**
A) Metaphase → Anaphase → Prophase → Telophase
B) Prophase → Metaphase → Anaphase → Telophase
C) Anaphase → Telophase → Metaphase → Prophase
D) Telophase → Prophase → Anaphase → Metaphase

10.2.1 Prophase

36. Select the correct option:
I) Prophase is first stage of Karyokinesis.
II) It occur after completion of protein synthesis during cell cycle
Easy **Page No-164, Paragraph No-4**
A) Both (I) & (II) are true
B) Both (I) & (II) are false
C) (I) is true but (II) is false
D) (I) is false but (II) is true

37. During prophase, which of the following occurs?
Medium **Page No-164, Paragraph No-4**
A) Condensation of chromosomal material
B) Chromosomal material become tangled
C) Centrosome duplication
D) Movement of both centriole at one pole of cell

38. Choose the incorrect match
Difficult **Page No-164, Paragraph No-4; Page No-165, Paragraph No-2**
A) Beginning of movement of chromosome to opposite poles – Prophase
B) Two asters with spindle – Mitotic apparatus
C) Attachment of spindle – Metaphase
D) Chromosome move to opposite poles – Metaphase

39. Mitotic apparatus consist of –
Easy **Page No-164, Paragraph No-6**
A) Four asters with spindle fibres
B) One asters with spindle fibres
C) Two asters with spindle fibres
D) Centrosome with their microtubules without spindle fibres.

40. How many of following structures are observed when cells are viewed under the

microscope at end of prophase Golgi body, ER, Nucleolus, Nuclear envelop, centrosome

Medium **Page No-165, Paragraph No-1**

A) Zero B) One C) Three D) All of these

41. How do the chromosome appear during prophase of animal cell during mitosis

Easy **Page No-164, Paragraph No-6**

A) Consisting of four chromatid which remain attached to centromere
B) Consisting of two chromatid which remain attached to centromere
C) Consisting of four chromatid without centromere
D) As chromatin material without any defined structure

42. Asters formed during prophase are –

Easy **Page No-169, Paragraph No-6**

A) Composed of microtubules originate from centromere
B) Composed of protein which secreted by golgi body
C) Highly condensed area of chromosome
D) None of these

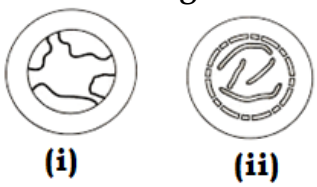
43. What difference would indicate early prophase & late prophase of animal cell.

Difficult **Page No-167 and 165, Paragraph No-**

Early Prophase	Late Prophase
A) Nucleolus & nuclear membrane present	Nucleolus & nuclear membrane are absent
B) Chromosomes are highly condensed	There is no condensation of chromosome
C) Nucleolus & centrosome are present	Nucleolus & centromere are absent
D) Other organelles like ER, golgi body complexes are not observed	Other organelles like ER, golgi complex are observed.

44. Identify correct stage of given diagram.

Difficult **Page No-165, Figure No-10.2 (a)**



A) Late prophase Early prophase
B) Early prophase Late prophase
C) Metaphase Prophase D) Prophase Metaphase

10.2.2 Metaphase

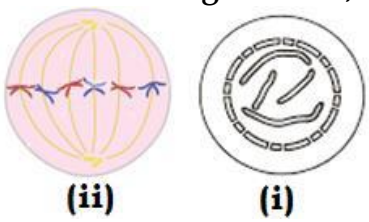
45. The complete disintegration of nuclear envelop marks start of:

Easy **Page No-165, Paragraph No-2**

A) Late prophase B) Metaphase
C) Anaphase D) None of these

46. Identify stage of given diagram

Difficult **Page No-165, Figure No-10.2**



A) Early prophase, metaphase
B) Late prophase, transition to metaphase
C) Early prophase, transition to metaphase
D) Late prophase, metaphase

47. Which stage of cell cycle is best to study chromosome morphology

Easy **Page No-165, Paragraph No-2**

A) Late prophase B) Early prophase
C) Anaphase D) Metaphase

48. Condensation of chromosome is completed in –

Easy **Page No-165, Paragraph No-2**

A) Stage where centrosome is duplicated
B) Stage where DNA content doubled
C) Stage where complete integration of nuclear envelope occurs
D) Stage where complete disintegration of nucleus envelope occurs

49. Metaphase chromosome is made up of –

Easy **Page No-165, Paragraph No-2**

A) Two non – sister chromatid which are held together by centromere
B) Four sister chromatid which are held together by centromere
C) Two sister chromatid which are held together by centromere
D) Four non – sister chromatid which are held together by centromere

50. Kinetochores are

Easy **Page No-165, Paragraph No-2**

A) Precursors of microtubules
B) Sites of attachment of spindle fibres
C) Site for origination of spindle fibres
D) Small disc – shaped structure at telomere of chromosome

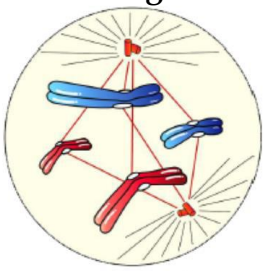
51. Metaphase is characterised by –

Easy **Page No-165, Paragraph No-2**

A) Some chromosomes coming to lie at the pole
B) One chromatid of each chromosome connected by its centromere to spindle fibres from one pole
C) Sister chromatid connected by its kinetochore to spindle fibres from opposite poles
D) All of these

52. Identify stage

Difficult **Page No-165, Figure No-2 Part b.**



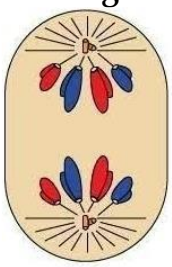
A) Transition to metaphase B) Anaphase
C) Metaphase D) Telophase

10.2.3 Anaphase

53. At the onset of anaphase, each chromosome split into –
Easy **Page No-165, Paragraph No-2**
A) One chromatid B) Four daughter chromatids
C) Two daughter chromosomes D) Eight chromatids

54. Anaphase is characterised by –
Easy **Page No-165, Paragraph No-3**
i) Migration of daughter chromatid toward equator.
ii) centromere of each chromosome remain directed toward pole
iii) centromere of each chromosome remain directed toward equator
iv) Chromatid split and centromere separate
v) Chromatid separate after centromere split
A) i, ii, v B) ii, v C) iii, v D) ii, iv

55. Identify stage –
Difficult **Page No-166, Figure No-10.2 (c)**



A) Anaphase B) Telophase C) Interphase D) Metaphase

10.2.4 Telophase

56. During telophase:
(i) Chromosome cluster at opposite spindle poles
(ii) Two daughter nuclei formed
(iii) Chromosomes lose their individuality
(iv) It is reversal of prophase
(v) Nucleolus is not reformed
Choose the incorrect statement:-
Medium **Page No-166, Paragraph No-2**
A) i), (ii) B) (iii), (iv) C) (v) only D) none of these

10.2.5 Cytokinesis:

57. Match the following column –
Difficult **Page No-166, Paragraph No-3**

Column I	**Column II**
a) Syncytium	i) Divide the cytoplasm of animal cell
b) Cell-plate	ii) Occur in liquid endosperm of coconut
c) Cell furrow	iii) Method of cytokinesis in plant cell

A) a-iii, b-ii, c-i B) a-ii, b-iii, c-i C) a-i, b-ii, c-iii D) a-ii, b-i, c-iii

58. Cell plate represent –
Easy **Page No-166, Paragraph No-3**
A) Primary lamella B) Middle lamella
C) Both D) formation of plate by lysosome

10.3 Cytokinesis:

59. Mitosis usually results in

Easy **Page No-167, Paragraph No-1**

A) haploid daughter cells with identical genetical complement
B) growth of multicellular organism
C) diploid daughter cells without identical genetical complement
D) haploid daughter cells without identical genetical complement

60. Which one is odd w.r.t. significance of meiosis?

Medium **Page No-167, Paragraph No-1-4, 170 paragraph 2**

A) Increase genetic variability in organisms
B) Helps in restoring of original chromosome number in a sexually reproducing species.
C) Ensure production of haploid phase
D) Cell repair

61. The growth in plant is/are contributed by

Easy **Page No-167, Paragraph No-1**

A) Mitotic division in apical meristem
B) Meiotic division in lateral meristem
C) Meiotic division in apical meristem
D) A & B both

62. a) The nucleo-cytoplasmic ratio in organism is restore by mitosis
b) The cells of the upper layer of the epidermis, cells of lining of gut, and blood cells are being constantly replaced by Mitotic division.
Choose the correct option from following :-

Medium **Page No-167, Paragraph No-2**

A) Statement (a) is true but (b) is false B) Statement (b) is true but (a) is false
C) Statement (a) & (b) are true D) Statement (a) & (b) are false

10.4 Meiosis:

63. Meiosis result in

Easy **Page No-167, Paragraph No-3**

A) production of gametes
B) reduction in number of chromosomes
C) introduction of variation
D) all of these

64. Meiosis ensure the production of …… phase in life cycle of sexually reproduction organisms whereas fertilization restore …….. phase.

Easy **Page No-167, Paragraph No-3**

A) haploid & haploid respectively B) haploid & diploid respectively
C) diploid & diploid respectively D) diploid & haploid respectively

65. Which of the following statement is correct?

Medium **Page No-167, Paragraph No-3**

A) Meiosis involves single cycle of nuclear and cell division
B) Doubling of chromosomes occur once during s-phase
C) Recombination between sister chromatid of non-homologous chromosome
D) Pairing of homologous chromosome

66. At the end of meiosis-II, how many haploid cells are formed?

Easy **Page No-167, Paragraph No-3**

A) One B) Two C) Zero D) Four

67. Recombination occurs between –

Easy **Page No-167, Paragraph No-3**

A) sister chromatid of non-homologous chromosome
B) non-sister chromatid of non homologous chromosome
C) sister chromatid of homologous chromosome

D) non-sister chromatid of homologous chromosome

10.4.1 Meiosis-I

68. Longest phase of meiosis is :
Easy **Page No-168, Paragraph No-1**
A) Prophase-I B) Prophase-II
C) Metaphase-I D) Telophase-II

69. During which of the given phases, homologous chromosomes separate, while sister chromatids remain associated at their centromere?
Difficult **Page No-169, Paragraph No-1**
A) Anaphase of mitosis B) Anaphase II
C) Anaphase I D) Metaphase I

70. Prophase-I of meiosis is divided into ……. phase based on chromosomal behaviour.
Easy **Page No-168, Paragraph No-1**
A) 2 B) 3 C) 4 D) 5

71. Identify correct sequence of prophase-I.
Easy **Page No-168, Paragraph No-1**
A) leptotene, Diplotene, Zygotene B) Zygotene, pachytene, leptotene
C) Diplotene, Zygotene, Pachytene D) None of these

72. A bivalent is
Easy **Page No-168, Paragraph No-2**
A) Pair of non-homologous chromosomes
B) The complex formed by a pair of synapsed homologous chromosomes.
C) Formed during pachytene statge
D) More clearly visible at zygotene Stage

73. Synaptonemal complex dissolves during-
Easy **Page No-168, Paragraph No-2**
A) Leptotene B) Diakinesis C) Zygotene D) Diplotene

74. During which phase of meiosis centromere splits?
Easy **Page No-169, Paragraph No-2**
A) Anaphase I B) Anaphase II C) Telophase II D) Telophase I

75. Choose the correct option with respect to leptotene:
Medium **Page No-168, Paragraph No-2**
(i) It is the foremost and the short-lived stage of prophase
(ii) It begins when the process of compaction of chromosome is accomplished
(iii) chromosome become visible under light microscope
(iv) It followed by zygotene
A) One statement that is (ii) is incorrect
B) i, ii and iii are correct while (iv) is incorrect
C) iii & iv are correct while i, ii are incorrect
D) All statement are correct

76. Zygotene is characterized by –
Easy **Page No-168, Paragraph No-2**
(i) chromosome start pairing
(ii) non-homologous chromosome paired
(iii) synapsis occurs between nonhomologous chromosomes
(iv) formation of synaptomeal complex in homologous chromosomes
(v) formation of synaptonemal complex in non homologous chromosomes
A) i, ii, v B) i, iii, iv C) i, iv D) i, ii, iii, v

77. Bivalent stage is –

Easy **Page No-168, Paragraph No-2**

A) complex formed by a pair of synapsed homologous chromosomes
B) complex formed by a pair of synapsed non-homologous chromosomes
C) complex formed by four pair of synapsed homologous chromosomes
D) complex formed by four pair of synapsed non-homologous chromosomes

78. Crossing over occurs in –

Easy **Page No-168, Paragraph No-2**

A) leptotene B) zygotene C) Pachytene D) diplotene

79. Pachytene is stage that is/are :-

Easy **Page No-168, Paragraph No-2**

A) long lived than zygotene
B) two chromatid of each bivalent chromosomes becomes distinct
C) short lived than leptotene
D) long lived than leptotene & short lived than zygotene

80. Choose the correct statement from following:

Medium **Page No-168, Paragraph No-2**

A) Pachytene is characterised by appearance of recombination nodule
B) Recombination nodule is site of crossing over
C) Both A & B
D) Recombination nodule formed in diplotene

81. Given below are statements (I - VI). Choose correct set with respect to crossing over.

Medium **Page No-168, Paragraph No-2**

I) It occurred between sister chromatid of homologous chromosomes.
II) It is enzyme mediated process.
III) Recombinase enzyme involved in it.
IV) It occurs at recombination nodules.
V) It occurs between non sister chromatid of non-homologous chromosomes.
VI) It occurs between sister chromatid of non-homologous chromosomes.

A) I, II, III & IV B) V, II, III & IV C) II, III, IV & VI D) II, III & IV

82. Diplotene is not characterized by

Medium **Page No-168, Paragraph No-3**

A) Dissolution of synaptonemal complex.
B) Tendency of recombined homologous chromosomes of tetrad to separate from each other, except at sites of crossover crossovers.
C) Formation of chiasmata
D) Tendency of recombined non homologous chromosome of bivalent to separate from each other, except at sites of crossover.

83. Chiasmata is –

Easy **Page No-168, Paragraph No-3**

A) X – shaped structures
B) Formed by recombined chromosome yet to be separated
C) Site of cross over
D) All of these

84. Which stage of Meiosis – I last for months or year in some vertebrate oocytes?

Easy **Page No-168, Paragraph No-3**

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

85. Diakinesis marked by –

Easy **Page No-168, Paragraph No-4**

A) Terminalisation of chiasmata
B) Chromosomes are fully condensed

C) Meiotic spindle assembled
D) All of these

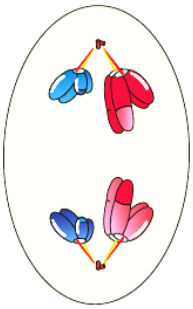
86. Meiotic spindle assembled to prepare –
Easy **Page No-168, Paragraph No-4**
A) Non homologous chromosome separation.
B) Formation of aster ray.
C) Homologous chromosome separation.
D) Both B & C

87. Match the following

Column I	**Column II**
I. Leptotene	a) Compaction of chromosome
II. Zygotene	b) Separation of chromosome except at crossover
III. Pachytene	c) Terminalisation of chiasmata
IV. Diakinesis	d) Appearance of recombination of nodules
V. Diplotene	e) Synapsis

Difficult **Page No-168, Paragraph No-1,2,3,4**
A) I-a, II-e, III-d, IV-c, V-b
B) I-a, II-b, III-d, IV-c, V-e
C) I-c, II-d, III-a, IV-e, V-b
D) None of these

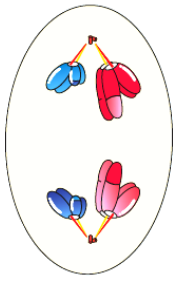
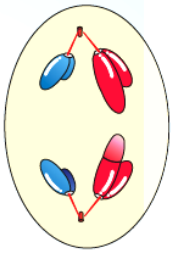
88. Identify stage
Medium **Page No-169, Figure No-10.3**



A) Homologous chromosome separate, while sister chromatid remain associated at centromere.
B) Homologous chromosome along with sister chromatid separate.
C) Spindle attached to Kinetochore in this stage.
D) This stage followed by diakinesis.

89. Spindle fibre attach to kinetochores of homologous chromosome in –
Easy **Page No-168, Paragraph No-5**
A) Metaphase – I of meiosis
B) Metaphase – II of meiosis
C) Both A & B
D) Anaphase of mitosis

90. Identify stage
Easy **Page No-169, Figure No-10.3 & Page No-170, Figure No-10.4**

A	**B**
	

A) a = Anaphase I, b = Anaphase II
B) a = Anaphase II, b = Metaphase II

C) a = Anaphase II, b = Anaphase I
D) a = Anaphase I, b = Anaphase II

91. Dyads of cells are formed in –
Easy **Page No-169, Paragraph No-2**
A) Telophase – I
B) Telophase – II
C) Diakinesis
D) Both A & B

10.4.2 Meiosis-II

92. Meiosis – II initiated immediately after
Easy **Page No-169, Paragraph No-3**
A) Telophase – I
B) Prophase
C) Cytokinesis – I
D) Chromosome have fully elongated

93. Which of the following resembles with normal mitosis-
Medium **Page No-169, Paragraph No-3**
A) Meiosis – I
B) Meiosis – II
C) Both
D) None of these

94. In the beginning of Meiosis – II, a cell contain four chromatid. What number of chromatid is expected to be in each daughter cell at end of telophase – II
Medium **Page No-169, Paragraph No-3**
A) 4 B) 2 C) 8 D) 16

95. Find mismatched column
Difficult **Page No-169,314 & 170 Paragraph No-1**

Column I	Column II
A) Metaphase – II	Chromosomes align at equator and microtubule from opposite poles of spindle get attached to kinetochores of non-sister chromatid
B) Prophase – II	Nuclear membrane Disappear
C) Telophase – II	Formation of tetrad of cells
D) Anaphase – II	Splitting centromere which hold sister chromatid together, allow them to move toward opposite pole of cells

96. Movement of chromatid toward opposite pole is achieved by-
Easy **Page No-169, Paragraph No-4**
A) Shortening of microtubules attached to centromere
B) Shortening of microtubules attached to kinetochores
C) Elongating of microtubules attached to kinetochores
D) Elongating of microtubules attached to centromere

10.5 Significance of Meiosis

97. Conservation of specific chromosome number of each species is achieved across generations in sexually reproducing organism is done by –
Easy **Page No-170, Paragraph No-2**
A) Mitosis
B) Meiosis only
C) Meiosis & Mitosis
D) None of these

98. Choose the correct statement about meiosis
Medium **Page No-170, Paragraph No-2**
A) Increase genetic variability of an individual of an organism
B) decrease genetic variability of an organism from one generation to other
C) Reduction of chromosome by one fourth

D) Play an important role in evolution

NEET PREVIOUS YEARS QUESTIONS

1. The stage during which separation of the paired homologous chromosomes begins is: [2018]

(a) Pachytene (b) Diplotene (c) Zygotene (d) Diakinesis

2. DNA replication in bacteria occurs [2017]

(a) within nucleolus. (b) prior to fission. (c) just before transcription. (d) during S phase.

3. Which of the following options gives the correct sequence of events during mitosis? [2017]

(a) Condensation → nuclear membrane disassembly → arrangement at equator → centromere division → segregation → telophase

(b) Condensation → crossing over → nuclear membrane disassembly → segregation → telophase

(c) Condensation → arrangement at equator → centromere division → segregation → telophase

(d) Condensation → nuclear membrane disassembly → crossing over → segregation → telophase

4. Anaphase Promoting Complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cells. If APC is defective in a human cell, which of the following is expected to occur? [2017]

(a) Chromosomes will be fragmented. (b) Chromosomes will not segregate.

(c) Recombination of chromosome arms will occur. (d) Chromosomes will not condense.

5. Spindle fibres attach on to: [2016]

(a) Telomere of the chromosome. (b) Kinetochore of the chromosome.

(c) Centromere of the chromosome. (d) Kinetosome of the chromosome.

6. Which of the following is not a characteristic feature during mitosis in somatic cells? [2016]

(a) Spindle fibres (b) Disappearance of nucleolus

(c) Chromosome movement (d) Synapsis

7. In meiosis crossing over is initiated at: [2016]

(a) Pachytene (b) Leptotene (c) Zygotene (d) Diplotene

8. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has [2015]

(a) same number of chromosomes but twice the amount of DNA.

(b) twice the number of chromosomes and four times the amount of DNA.

(c) four times the number of chromosomes and twice the amount of DNA.

(d) twice the number of chromosomes and twice the amount of DNA.

9. Choose the correct option for the following events of meiosis in correct sequence. [2015]

(A) Crossing over (B) Synapsi s

(C) Terminalisation of chiasmata (D) Disappearance of nucleolus

(a) B → A → C → D (b) A → B → C → D

(c) A → B → D → C (d) D → C → B → A

10. Match the description given in column-I with their steps given in column-II and identify the correct answer. [2015]

Column-I	Column-II
A) Synapsis aligns homologous chromosomes	I) Anaphase-II
B) Synthesis of RNA and protein	II) Zygotene
C) Action of enzyme recombinase	III) G_2 - phase
D) Centromeres do not separate but chromatids move towards opposite poles	IV) Anaphase-I
	V) Pachytene

(a) A – II; B – III; C – V; D – IV (b) A – I; B – II; C – V; D – IV

(c) A – II; B – III; C – IV; D – V (d) A – II; B – I; C – III; D – IV

11. During which phase(s) of cell cycle, amount of DNA i n a cell remains at 4C level if the initial amount is denoted as 2C? [2014]

(a) G_0 and G_1 (b) G_1 and S (c) Only G_2 (d) G_2 and M

12. In 'S' phase of the cell cycle, [2014]

(a) amount of DNA doubles in each cell.

(b) amount of DNA remains same in each cell.

(c) chromosome number is increased.

(d) amount of DNA is reduced to half in each cell.

13. The enzyme recombinase is required at which stage of meiosis? [2014]

(a) Pachytene (b) Zygotene (c) Diplotene (d) Diakinesis

14. The correct sequence of phases of cell cycle is : (NEET-2019)

(1) M→ G1 → G2→ S (2) G1→ G2 → S→ M

(3) S→ G1 → G2→ M (4) G1→ S → G2→ M

15. Cells in G0 phase: **(NEET-2019)**

(1) exit the cell cycle (2) enter the cell cycle

(3) suspend the cell cycle (4) terminate the cell cycle

16. After meiosis-I, the resultant daughter cells have:- (NEET-2019 ODISSA)

(1) Same amount of DNA as in the parent cell in S phase

(2) Twice the amount of DNA in comparison to haploid gamete.

(3) Same amount of DNA in comparison to haploid gamete

(4) Four times the amount of DNA in comparison to haploid gamete

17. Crossing over takes place between which chromatids and in which stage of the cell cycle? (NEET-2019 ODISSA)

(1) Non-sister chromatids of non-homologous chromosomes at Zygotene stage of prophase I.

(2) Non-sister chromatids of homologous chromosomes at Pachytene stage of prophase I.

(3) Non-sister chromatids of homologous chromosomes at Zygotene stage of prophase I.

(4) Non-sister chromatids of non-homologous chromosomes at Pachytene stage of prophase I.

18. Attachment of spindle fibers to kinetochores of chromosomes becomes evident in : (NEET-2020 COVID)

(1) Anaphase (2) Telophase (3) Prophase (4) Metaphase

19. In a mitotic cycle, the correct sequence of phases is (NEET-2020 COVID)

(1) S, G_1, G_2, M (2) G_1, S, G_2, M (3) M, G_1, G_2, S (4) G_1, G_2, S, M

20. During Meiosis 1, in which stage synapsis takes place ? (NEET-2020 COVID)

(1) Pachytene (2) Zygotene (3) Diplotene (4) Leptotene

21. Match the following columns and select the correct option : (NEET-2020 COVID)

Column - I	**Column - II**
(a) Smooth	(i) Protein synthesis endoplasmic reticulum
(b) Rough	(ii) Lipid synthesis endoplasmic reticulum
(c) Golgi complex	(iii) Glycosylation
(d) Centriole	(iv) Spindle formation

(1) (a)-(ii), (b)-(i), (c)-(iii). (d)-(iv)
(2) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)
(3) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
(4) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

22. Match the following events that occur in their respective phases of cell cycle and select the correct option : (NEET-2020 COVID)

(a) G_1phase	(i) Cell grows and organelle duplication
(b) S phase	(ii) DNA replication and chromosome duplication
(c) G_2 phase	(iii) Cytoplasmic growth
(d) Metaphase inM-phase	(iv) Alignment of chromosomes

(1) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
(2) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
(3) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
(4) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

23. Dissolution of the synaptonemal complex occurs during (NEET-2020)

1) Leptotene 2) Pachytene 3) Zygotene 4) Diplotene

24. Some dividing cells exist the cell cycle and enter vegetative inactive stage. This is called quiescent stage (G_0). This process occurs at the end of : (NEET-2020)

1) G_2 phase 2) M phase 3) G_1 phase 4) S phase

25. Identify the correct statement with regard and G_1 phase (Gap 1) of interphase (NEET-2020)

1) Nuclear Division takes place
2) DNA synthesis or replication takes place
3) Recognisation of all cell components takes place
4) Cell is metabolically active, grows but does not replicate its DNA

26. Meiotic division of the secondary oocyte is completed (NEET-2020)

1) At the time of fusion of a sperm with an ovum2) Prior to ovulation
3) At the time of copulation 4) After zygote formation

27. Match the following with respect to meiosis **(NEET-2020)**

a) Zygotene	i) Terminalization
b) pachytene	ii) Chiasmata

c) Diplotene iii) Crossing over

d) Diakinesis iv) Synapsis

Select the correct option

	A	b	c	d
1)	ii	iv	iii	i
2)	iii	iv	i	ii
3)	iv	iii	ii	i
4)	i	ii	iv	iii

28. Which of the following stages of meiosis involves division of centromere? **[NEET-2021]**

(1) Metaphase II (2) Anaphase II

(3) Telophase II (4) Metaphase I

29. Match List – I with List – II **[NEET-2021]**

	List – I		**List – II**
a)	S phase	i)	Proteins are synthesized
b)	G_2 phase	ii)	Inactive phase
c)	Quiescent stage	iii)	Interval between mitosis and initiation of DNA replication
d)	G_1 phase	iv)	DNA replication

	a	**b**	**c**	**d**
1)	iv	ii	iii	i
2)	iv	i	ii	iii
3)	ii	iv	iii	i
4)	iii	ii	i	iv

30. The fruit fly has 8 chromosomes (2n) in each cell. During interphase of Mitosis if the number of chromosomes at G_1 phase is 8, what would be the number of chromosomes after S phase? **[NEET-2021]**

1) 16 2) 4 3) 32 4) 8

31. The centrioleundergoes duplication during: **[NEET-2021]**

1) prophase 2) Metaphase 3) G_2 phase 4) s-phase

32. Which stage of meiotic prophase shows terminalisation of chiasmata as its distinctive feature? **[NEET-2021]**

1) Zygotene 2) Diakinesis 3) Pachytene 4) Leptotene

33. Which one of the following never occurs during mitotic cell division? **[NEET-2022]**

1) Spindle fibres attach to kinetochores of chromosomes
2) Movement of centrioles towards opposite poles
3) Pairing of homologous chromosomes
4) Coiling and condensation of the chromatids

34. The appearance of recombination nodules on homologous chromosomes during meiosis characterizes: **[NEET-2022]**

1) Synaptonemal complex
2) Bivalent
3) Sites at which crossing over occurs
4) Terminalization

35. Select the incorrect statement with reference to mitosis: **[NEET-2022]**

1) All the chromosomes lie at equator at metaphase.

2) Spindle fibres attach to centromere of chromosomes.
3) Chromosomes decondense at telophase
4) Splitting of centromere occurs at anaphase

36. Regarding Meiosis, which of the statements is incorrect? [NEET-2022]

1) There are two stages in Meiosis, Meiosis –I and II
2) DNA replication occurs in S phase of Meiosis-II
3) Pairing of homologous chromosomes and recombination occurs in Meiosis-I
4) Four haploid cells are formed at the end of Meiosis-II

37 Spindle fibers attach to kinetochores of chromosomes during
(a) Prophase (b) Metaphase
(c) Anaphase (d) Telophase

[NEET 2024]

38 The site at which crossing over occurs between non-sister chromatids of the homologous chromosomes. involves no DNA replication:
(a) Anaphase (b) Telophase
(c) Prophase (d) Metaphase

[NEET 2023 Manipur]

39 During which stages of mitosis and meiosis, respectively does the centromere of each chromosome split?

(a)Metaphase II	Metaphase
(b)Telophase I	Prophase,
(c) Anaphase I	Telophase,
(d)Anaphase II	Anaphase,

[NEET 2023 Manipur]

40 Select the correct statements.
A. Tetrad formation is seen during Leptotene.
B. During Anaphase, the centromeres split and chromatids separate.
C. Terminalization takes place during Pachytene.
D. Nucleolus, Golgi complex and ER are reformed during Telophase.
E. Crossing over takes place between sister chromatids of homologous chromosome.
Choose the correct answer from the options given below:
(a) B and D only (b) A, C and E only
(c) B and E only (d) A and C only

[NEET 2023]

41 Which one of the following never occurs during mitotic cell division?
(a) Spindle fibres attach to kinetochores of chromosomes
(b) Movement of centrioles towards opposite poles
(c) Pairing of homologous chromosomes
(d) Coiling and condensation of the chromatids

[NEET 2022]

42 Select the incorrect statement with reference to mitosis:
(a) All the chromosomes lie at the equator at metaphase
(b) Spindle fibres attach to centromere of chromosomes
(c) Chromosomes decondense at telophase
(d) Splitting of centromere occurs at anaphase

[NEET 2023]

43 Given below are two statements:
Statement I: Chromosomes become gradually visible under light microscope during leptotene stage.
Statement II: The beginning of diplotene stage is recognized by dissolution of synaptonemal complex.
In the light of the above statements, choose the correct answer from the options given below:

(a) Both Statement I and Statement II are true
(b) Both Statement I and Statement II are false
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

[NEET 2024]

44 Match List I with List II:

	List I (Sub Phases of Prophase I)		List II (Specific Characters)
A	Diakinesis	I.	Synaptonemal complex formation
B	Pachytene	II.	Completion of terminalisation of chiasmata
C	Zygotene	III.	Chromosomes look like thin threads
D	Leptotene	IV.	Appearance of recombination nodules

Choose the correct answer from the options given below
(a) A-IV, B-II, C-III, D-I
(b) A-I, B-II, C-IV, D-III
(c) A-II, B-IV, C-I, D-III
(d) A-IV, B-III, C-II, D-I

[NEET 2024]

45 Which of the following stages of meiosis involves division of centromere?
(a). Telophase (b). Metaphase I
(c). Metaphase II (d). Anaphase II

[NEET 2023]

46 The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?
(a) Diakinesis (b) Pachytene
(c)Zygotene (d) Diplotene

[NEET 2023]

47 The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?
(a) Pachytene (b)Diplotene
(c) Diakinesis (d)Zygotene

[NEET 2023]

48 Which of the following stages of meiosis involves division of centromere?
(a) Metaphase II. (b) Anaphase II
(c) Telophase (d) Metaphase I

[NEET 2023]

49. What is the main function of the spindle fibers during mitosis?
(a) To separate the chromosomes
(b) To synthesize new DNA
(c) To repair damaged DNA
(d) To regulate cell growth

[NEET 2025]

NCERT LINE BY LINE QUESTIONS - ANSWERS

1	2	3	4	5	6	7	8	9	10
B	C	A	C	D	D	B	B	C	A
11	12	13	14	15	16	17	18	19	20
A	D	D	C	D	B	D	B	A	C
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**

C	D	D	C	A	C	C	C	A	A
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	B	D	C	B	A	A	A	C	A
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
D	A	B	B	B	D	D	D	C	B
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
A	C	C	B	A	B	B	B	A	D
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
A	C	D	D	D	D	C	A	C	D
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
C	B	D	B	C	A	A	C	A	C
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
D	D	B	D	D	C	A	A	A	A
91	**92**	**93**	**94**	**95**	**96**	**97**			
A	C	B	B	B	B	D			

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1) b	**2)** b	**3)** a	**4)** b	**5)** b	**6)** d	**7)** a	**8)** b	**9)** a	**10)** a
11) c	**12)** a	**13)** a	**14)** 4	**15)** 1	**16)** 2	**17)** 2	**18)** 4	**19)** 2	**20)** 2
21) 1	**22)** 4	**23)** 4	**24)** 3	**25)** 4	**26)** 1	**27)** 3	**28)** 2	**29)** 2	**30)** 4
31) 4	**32)** 2	**33)** 3	**34)** 3	**35)** 2	**36)** 2				
37) b	**38)** d	**39)** d	**40)** a	**41)** c	**42)** b				
43) a	**44)** c	**45)** d	**46)** b	**47)** a	**48)** b	49.(a)			

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. **(b)**

2. **(b)** In bacteria DNA replication occurs in cytoplasm prior to fission. Prokaryotes due to their primitive nature do not show well marked S-phase.

3. **(a)**

4. **(b)**

5. **(b)** Attachment of microtubules to chromosomes is mediated by kinetochores, which actively monitor spindle formation and prevent premature anaphase onset during mitosis.

6. **(d)**

7. **(a)** Crossing over, the process by which two chromosomes exchange some distal part of their DNA, occurs in the pachytene stage of Prophase I of meiosis.

8. **(b)** When S-phase completes, a somatic cell contains 2n number of chromosomes and 4C content of DNA.

9. **(a)** Synapsis → Crossing over → Terminalisation of chiasmata → Disappearance of nucleolus

10. **(a)**

11. **(c)**

12. **(a)** During S or synthesis phase, replication or duplication of chromosomal DNA and synthesis of histone proteins takes place. During this time the amount of DNA Per cell doubles.

13. **(a)** The enzyme recombinase is required at pachytene stage of meiosis. It catalyses the exchange of short pieces of DNA between two long DNA strands, particularly the exchange of homologous regions between the paired maternal and paternal chromosomes.

23 Dissolution of the synaptonemal complex occurs during diplotene stage

24 Cells exist from cell cycle and enter vegetative inactive stage. This is called quiescent stage (G_0). It exist out from G_1 phase of cell cycle

25. G_1 phase is resting phase cell is metabolically active, synthesis RNA and proteins

26. Meiotic division of secondary oocyte is completed after the entry of sperm in secondary oocyte.

27. a) Zygotene- Synapsis
b) pachytene - Crossing over
c) Diplotene - Chiasmata
d) Diakinesis - Terminalization

28 •Division of centromere occurs in anaphase II.
• Telophase II is the last stage of meiosis II.
During this phase, the chromatids reach the poles and start uncoiling.
• Chromosomes form two parallel plates in metaphase I and one plate in metaphase II.

29 • In S phase DNA replication takes place.
• In G_2 phase there is synthesis of proteins, RNA etc.
• Quiescent stage is inactive stage of cell cycle but cells remain metabolically active in this stage.
• G_1 phase is the interval between mitosis and initiation of DNA replication.

30. G1 and S sub-stages has the same number of chromosomes
But DNA is doubled

31. Duplication of centriole occurs during s Sub stage in Cytoplasm

32. Diakinesis shows terminalisation

33. Pairing of Homologues chromosomes doesn't occur in Mitoses

34. Sites at which crossing over occurs

35. Spindle fibres attach to kinetochore of centromere

36. During Meiosis-II there is no S-phase

37 Ans **(b)**

Explanation
Spindle fibers attach to kinetochores of chromosome in metaphase stage.

38 Ans **(d)**

Explanation
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.
So, the correct answer is:
Option D: Metaphase.

39 Ans **(d)**

Explanation
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.
So, the correct answer is :
Option D: Anaphase, Anaphase II.

40 Ans **(a)**

Explanation

1. Tetrad formation is seen during the Zygotene stage : During the Zygotene stage of Prophase I in meiosis, homologous chromosomes pair up, forming tetrads or bivalents.
2. During Anaphase, the centromeres split and chromatids separate : In Anaphase, the centromeres divide, and the sister chromatids are pulled apart towards opposite poles of the cell.
3. Terminalization of chiasmata takes place during Diakinesis : Diakinesis is the final stage of Prophase I in meiosis. Nucleolus, Golgi complex, and ER are reformed during Telophase : During Telophase, the nuclear envelope starts to reassemble around the separated chromosomes, and the nucleolus, Golgi complex, and endoplasmic reticulum (ER) are reformed.
4. Crossing over takes place between non-sister chromatids of homologous chromosomes : This 28el28wa occurs during the Pachytene stage of Prophase I in meiosis, leading to the exchange of genetic material between the non-sister chromatids, which increases genetic diversity in the resulting gametes.

41 Ans **(c)**

Explanation
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.

42 Ans **(b)**

Explanation
Spindle fibres attach to the kinetochores of chromosomes.
Kinetochores are the disc shaped structures present on sides of primary constriction or centromere of chromosomes.

43 Ans **(a)**

Explanation
During leptotene stage the chromosomes become gradually visible under the light microscope.
The beginning of diplotene is recognised 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.

44 Ans **(c)**

Explanation
(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

45 Ans **(d)**

Explanation
Anaphase stage is characterised by the following key events:
Centromeres split and chromatids separate.
Doubling of the number of chromosomes can be achieved by disrupting mitotic cell division soon after.

46 Ans **(b)**

Explanation
The first two stages of prophase I are relatively shortlived compared to the next stage that is pachytene. During this stage the four chromatids of each bivalent chromosomes became distinct and clearly appears as tetrads. This stage is characterized by the appearance of recombination nodules.

47 Ans **(a)**

Explanation
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.
So, the correct answer is:
Option A: Pachytene.

48. Ans **(b)**
Explanation
The correct answer is Option (b): Anaphase II.
During meiosis, the division of the centromere occurs in Anaphase II. At this stage, the sister chromatids of each chromosome (which are attached at the
centromere) are pulled apart and move toward opposite poles of the cell. This is similar to what happens in anaphase of mitosis. In contrast, during Anaphase I of meiosis, homologous chromosomes are separated but the centromeres do not divide, meaning the sister chromatids stay together.

49. Ans. **(a)**
Explanation
Small disc-shaped structures at the surface of the centromeres are called kinetochores. These structures serve as the sites of attachment of spindle fibres to the chromosomes. At the onset of anaphase, each chromosome arranged at the metaphase plate is split simultaneously and the
two daughter chromatids, now referred to as daughter chromosomes of the future daughter nuclei, begin their migration towards the two opposite poles. This is assisted by simultaneous elongation of spindle fibres.

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