

# Chapter 2

## Cell Cycle and Cell Division

### Solutions

#### SECTION - A

##### Objective Type Questions

##### (Cell Cycle, Phases of Cell Cycle, Interphase, M-Phase)

1. The sequence of events by which cells duplicate their genome, synthesize the other components of cell which eventually distribute into two daughter cells is called

(1) Quiescent stage      (2) Generation time      (3) Cell cycle      (4) Kinetochore

**Sol.** Answer (3)

*While :*

Quiescent stage → In this phase cell remains metabolically active but do not proliferate unless they are called on to do so.

Generation time → Time between two consecutive cell cycles i.e., Time taken by the number of cells to be doubled.

Kinetochore → Trilamellar proteinaceous structure present at centromere. It is attachment site for spindle fibers.

2. DNA replication occurs in

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

**Sol.** Answer (1)

*While*

$G_1$  phase – Organelles duplicate in this phase

$G_2$  phase – Tubulin protein synthesis

M phase – Mitotic phase

3. The phase between the two successive M phase is called as

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

**Sol.** Answer (4)

At interphase cell undergo growth.

4. A biosynthetic phase where cell organelle duplicate itself is

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

**Sol.** Answer (1)

*While*

*Prophase :* Condensation of chromatin begin.

*Anaphase :* Centromere splits and chromatid separation

*Metaphase :* Condensed chromosome align themselves at equator.

5. Yeast can progress through the cell cycle in about  
(1) 90 sec (2) 90 min (3) 90 hrs (4) 90 yrs

**Sol.** Answer (2)

Yeast cell completes its cell cycle in 90 min.

6. \_\_\_\_\_ represents the most active stage of the cell cycle.  
(1) Metaphase (2) Anaphase (3) Telophase (4) Interphase

**Sol.** Answer (4)

Because in this phase cell prepares itself for cell division.

7. Interphase is called the resting phase because  
(1) It is the most active phase of the cell cycle  
(2) There is no apparent activity related to cell division  
(3) It does not prepare cell for cell division  
(4) It is the phase where cell rests before entering into mitosis

**Sol.** Answer (2)

Interphase stage of cell cycle involves growth of cell and does not involve division of cell.

8. \_\_\_\_\_ phase synthesizes enzymes required during S phase.  
(1)  $G_2$  (2) M (3) S (4)  $G_1$

**Sol.** Answer (4)

While

M → Mitotic phase

$G_2$  → Organelle duplication like Mitochondria

S → DNA duplication

9. Non-dividing cells enter the  
(1)  $G_2$  phase (2) M phase (3)  $G_0$  phase (4) S phase

**Sol.** Answer (3)

$G_0$  phase also known Quiescent phase.

10. The cells which enter \_\_\_\_\_ phase start differentiating into specific types of cell.  
(1)  $G_1$  (2)  $G_2$  (3) S (4)  $G_0$

**Sol.** Answer (4)

$G_0$  phase is the phase of cell differentiation.

11. If the initial amount of DNA is 8 C, then after S phase the amount of DNA would be  
(1) 4 C (2) 8 C (3) 64 C (4) 16 C

**Sol.** Answer (4)

Because DNA duplicates during S phase.

12. The number of chromosomes in  $G_1$  phase is 36, the number of chromosomes in S phase is  
(1) 36 (2) 18 (3) 22 (4) 37

**Sol.** Answer (1)

Because after S phase only DNA content duplicates not the number therefore, each chromosome will be having two chromatids.

13. A phase of the cell cycle which lasts more than 95% of the total duration is  
(1) Prophase (2) Interphase (3) Anaphase (4) Telophase

**Sol.** Answer (2)

Because cell prepares itself for division during this phase.

14. Most dramatic period of cell cycle is  
(1)  $G_1$  phase (2)  $G_2$  phase (3) S phase (4) M phase

**Sol.** Answer (4)

Because during mitotic phase movement of chromosomes is visible.

15. Major check point of cell cycle is  
(1)  $G_1 \rightarrow S$  transition (2)  $S \rightarrow G_1$  transition (3)  $G_2 \rightarrow M$  transition (4)  $M \rightarrow G_2$  transition

**Sol.** Answer (1)

Cell cycle is controlled by two restriction points also called check points  $\Rightarrow G_1 \rightarrow S$  transition and  $G_2 - M$  cyclins.

16.  $G_1 \rightarrow S$  transition is regulated by  
(1) Cyclins only (2) Cyclin independent kinases  
(3) Mitotic cyclin and cdc2 kinase (4)  $G_1$  cyclin and cdc2 kinase

**Sol.** Answer (4)

$G_1 \rightarrow S$  transition controlled by  $G_1$  cyclins + cdc2 kinases

**(Mitosis, Significance of Mitosis)**

17. Two daughter cells formed after mitosis are  
(1) Non-identical to each other (2) Identical to each other  
(3) Non-identical to parents (4) Irregular in size

**Sol.** Answer (2)

Identical to each other because mitosis is an equational division.

18. A cell division in which a diploid somatic cell divides into two identical daughter cells is called  
(1) Meiosis I (2) Meiosis II (3) Mitosis (4) Cytokinesis

**Sol.** Answer (3)

Mitosis (equational division) occurs in somatic cells.

19. Which type of cell division is called somatic cell division?  
(1) Meiosis I (2) Meiosis II (3) Reduction division (4) Mitosis

**Sol.** Answer (4)

Mitosis cell division is also called somatic cell division.

20. Mitosis occurs in  
(1) Meristematic cells (2) Undifferentiated germ cells  
(3) Somatic cells (4) More than one option is correct

**Sol.** Answer (4)

Mitosis occurs in both somatic cells and undifferentiated germ cells of both plants and animals.

21. The first phase of mitosis which follows interphase is  
(1) Metaphase (2) Prophase (3) Telophase (4) Anaphase

**Sol.** Answer (2)

Prophase is the first phase of mitosis.

22. Initiation of condensation of chromatin material occurs in  
 (1) Prophase (2) Anaphase (3) Telophase (4) Metaphase

**Sol.** Answer (1)

Chromatin condenses to form chromosome in prophase.

23. Mitotic spindle initiates during  
 (1) Telophase (2) Anaphase (3) Prophase (4) Metaphase

**Sol.** Answer (3)

In late prophase mitotic spindle starts organising.

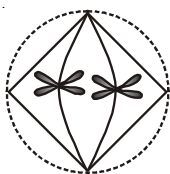
24. Nucleolus and nuclear membrane disappear during  
 (1) Anaphase (2) Interphase (3) Telophase (4) Prophase

**Sol.** Answer (4)

At the end of prophase (late) nuclear envelope and nucleolus disappear.

25. The chromosomes are shortest and thickest during  
 (1) Anaphase (2) Metaphase (3) Telophase (4) Interphase

**Sol.** Answer (2)



Because condensation is completed.

26. The chromosomes align at the equator during  
 (1) Interphase (2) Prophase (3) Metaphase (4) Telophase

**Sol.** Answer (3)

In Metaphase all chromosome arrange at equator of cell to form equatorial or metaphasic plate.

27. Read the following statements  
 (a) Complete disintegration of the nuclear envelope marks the start of the second phase of mitosis.  
 (b) Metaphase chromosome is made up of one sister chromatid.  
 (1) Only (b) is correct (2) Both (a) & (b) are incorrect  
 (3) Only (a) is correct (4) Both (a) & (b) are correct

**Sol.** Answer (3)

Complete disintegration of nuclear envelope marks the start of the second phase of mitosis. *i.e.*, Metaphase.  
 Metaphasic chromosome has two sister chromatids.

28. The morphology of the chromosomes is studied during  
 (1) Metaphase (2) Interphase (3) Prophase (4) Telophase

**Sol.** Answer (1)

Because chromosomes are completely condensed, shortest and thickest in this stage.

29. The point of attachment of microtubules on the chromosome is called as  
 (1) Centromere (2) Kinetochore (3) Chromatid (4) Spindle

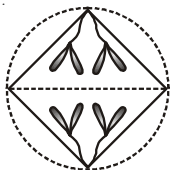
**Sol.** Answer (2)

Kinetochore which is a trilaminar proteinaceous structure present at centromere.

30. Chromosomes move towards the pole during

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

**Sol.** Answer (4)



Poleward movement is also called anaphasic movement.

31. The centromere splits during

- (1) Anaphase (2) Telophase (3) Interphase (4) Prophase

**Sol.** Answer (1)

At anaphase centromere splits and the chromatids move towards opposite poles.

32. The chromosomes cluster at opposite poles and their identity is lost as discrete elements during

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

**Sol.** Answer (1)

Because chromosomes start decondensing into chromatin network.



33. The mitotic spindle disappears in

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

**Sol.** Answer (4)

Because proper division and distribution of DNA has been done, so now there is no further use of spindle apparatus.

34. Decondensation of chromosomes occurs during

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

**Sol.** Answer (4)

Telophase shows decondensation of chromosome, and reappearance of chromatin.

35. The nuclear envelope reassembles during

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

**Sol.** Answer (2)

Telophase is marked by reassembling of nuclear envelope.

36. \_\_\_\_\_ phase marks the end of M-phase.

- (1) Karyokinesis (2) Prophase (3) Cytokinesis (4) Telophase

**Sol.** Answer (3)

M-phase begins with karyokinesis and ends with cytokinesis.

37. If karyokinesis is not followed by cytokinesis, then gives rise to
- |                             |                    |
|-----------------------------|--------------------|
| (1) Zygote                  | (2) Fertilised egg |
| (3) Multinucleate condition | (4) Embryo         |

**Sol.** Answer (3)

Because Karyokinesis means division of nucleus and cytokinesis means division of cytoplasm, So, if nucleus divides and cytoplasm does not divide, then more than one nucleus will be there in a single cell *i.e.*, multinucleate condition.  $\odot \rightarrow \odot \rightarrow \odot \odot$

38. A single cell containing large number of nuclei is called
- |               |                |           |              |
|---------------|----------------|-----------|--------------|
| (1) Syncytium | (2) Cell plate | (3) Monad | (4) Bivalent |
|---------------|----------------|-----------|--------------|

**Sol.** Answer (1)

Multinucleate cell

Cell plate forms cell wall in plant cell.

39. A type of cell division which reduces chromosome number to half is
- |             |                      |                   |             |
|-------------|----------------------|-------------------|-------------|
| (1) Mitosis | (2) Multiple fission | (3) Fragmentation | (4) Meiosis |
|-------------|----------------------|-------------------|-------------|

**Sol.** Answer (4)

Meiosis also known as reductional division one diploid cell divides to form 4 haploid cells.

40. What will be the total number of mitotic divisions in the formation of 64 daughter cells?
- |       |        |        |        |
|-------|--------|--------|--------|
| (1) 6 | (2) 32 | (3) 63 | (4) 16 |
|-------|--------|--------|--------|

**Sol.** Answer (3)

Number of cell = 64

Number of divisions =  $n - 1 = 64 - 1 = 63$

41. Agglutination of chromosomes is caused by a mitotic poison called
- |                 |                  |           |              |
|-----------------|------------------|-----------|--------------|
| (1) Mustard gas | (2) Ribonuclease | (3) Azide | (4) Chalones |
|-----------------|------------------|-----------|--------------|

**Sol.** Answer (1)

Mustard gas causes clumping of chromosomes.

**(Meiosis, Significance of Meiosis, Amitosis)**

42. In meiosis-I, condensation and coiling of chromatin fibres started during
- |               |               |                |               |
|---------------|---------------|----------------|---------------|
| (1) Metaphase | (2) Leptotene | (3) Diakinesis | (4) Diplotene |
|---------------|---------------|----------------|---------------|

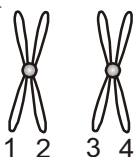
**Sol.** Answer (2)

Leptotene which is the first stage of prophase I.

43. In pachytene, each tetrad contains
- |                    |                   |                     |                      |
|--------------------|-------------------|---------------------|----------------------|
| (1) Two chromatids | (2) One chromatid | (3) Four chromatids | (4) Three chromatids |
|--------------------|-------------------|---------------------|----------------------|

**Sol.** Answer (3)

Two homologous (*i.e.*, homologous pair) chromosome each having 2 chromatids.



44. Crossing over occurs during
- |                |               |
|----------------|---------------|
| (1) Anaphase I | (2) Leptotene |
| (3) Diplotene  | (4) Pachytene |



**Sol.** Answer (4)

Prophase I of meiosis I shows exchange of genetic segments between non-sister chromatids of homologous chromosomes which results in recombination.

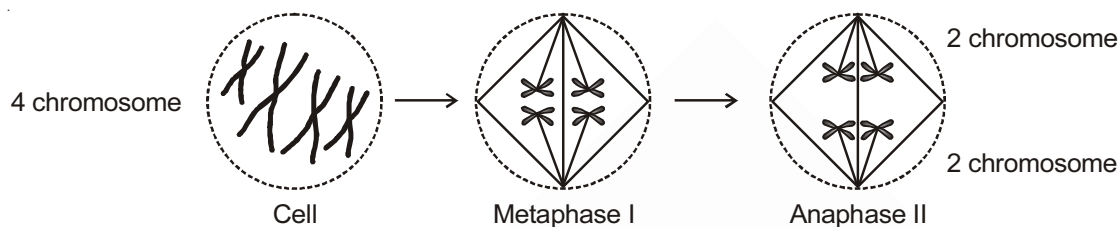


45. The homologous chromosomes move towards the opposite poles during

- (1) Anaphase I                      (2) Anaphase II                      (3) Leptotene                      (4) Pachytene

**Sol.** Answer (1)

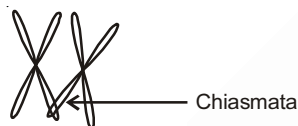
Segregation or separation of homologous chromosome at Anaphase-I results in reduction in chromosomes no.



46. \_\_\_\_\_ marks the site where crossing over had occurred.

- (1) Diakinesis                      (2) Synapsis                      (3) Chiasmata                      (4) Leptotene

**Sol.** Answer (3)



(x-shaped structure)

47. Terminalisation of chiasmata occurs during

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

**Sol.** Answer (1)

In Diplotene stage terminalisation of chiasmata occurs.



48. Bivalent chromosomes align themselves at the equator during

- (1) Metaphase I                      (2) Prophase I                      (3) Metaphase II                      (4) Anaphase II

**Sol.** Answer (1)

Pair of homologous chromosomes are termed as bivalents.



49. If there are 30 chromosomes in  $G_1$  phase then what will be number of bivalents in zygotene stage?

- (1) 30 (2) 15 (3) 45 (4) 60

**Sol.** Answer (2)

Number of bivalents *i.e.*, no. of pair of chromosome in Zygotene = 15

50. What will be the amount of DNA in meiosis II products if meiocyte contains 30 pg DNA in  $G_1$  phase?

- (1) 30 pg (2) 60 pg (3) 15 pg (4) 120 pg

**Sol.** Answer (3)

$$\text{Meiocyte } (2n, 2c) = 30 \text{ pg} \xrightarrow[\text{I}]{\text{meiosis}} \left( \frac{n}{2c} \right) \left( \frac{n}{2c} \right) \xrightarrow[\text{II}]{\text{meiosis}} \left( \frac{n}{c} \right) \left( \frac{n}{c} \right) \left( \frac{n}{c} \right) \left( \frac{n}{c} \right)$$

Therefore, 15 pg

## SECTION - B

### Objective Type Questions

**(Cell Cycle, Phases of Cell Cycle, Interphase, M-Phase)**

1. Select an **incorrect** statement w.r.t. cell cycle

- (1) Duplication of genes occurs twice in meiosis  
 (2) Karyokinesis occurs twice during meiotic division  
 (3) Cyclins are proteins that activate protein kinases to regulate the cell cycle  
 (4) After telophase-I, chromosome number is reduced to half.

**Sol.** Answer (1)

Duplication of genes or chromosome occurs only once during S-phase of interphase.

2. Maturation promoting factor formation triggers the cell to cross

- (1)  $G_1 \rightarrow S$  (2)  $S \rightarrow G_2$  (3)  $G_2 \rightarrow M$  (4)  $M \rightarrow G_1$

**Sol.** Answer (3)

It is formed by mitotic cyclin and cdc 2 kinase.

3. Cyclin Dependent Kinases (CDKs)

- (1) Act as mitotic poisons (2) Cause disassembly of the microtubules  
 (3) Control various phases of cell cycle (4) Arrest cell division due to non-formation of spindle

**Sol.** Answer (3)

CDKs are responsible for controlling cell cycle.

4. What is **not** true about cell cycle?

- a. During  $G_1$  phase there is active synthesis of RNA and proteins but no change in its DNA content  
 b. In synthesis or S phase, each chromosome carries a duplicate set of genes  
 c. During  $G_2$  phase, a cell contains double the amount (4C) of DNA present in the original diploid cell (2C)  
 d. In S-phase a cell doubles the original diploid (2n) chromosome number

- (1) c & d (2) b & c (3) d only (4) b, c & d

**Sol.** Answer (3)

Chromosome number remains same only DNA content doubles in S-phase of cell cycle.



5. Which phase of interphase is the most important point in regulation of the cell cycle, during which it must decide whether the cell will start a new cycle or will enter in  $G_0$  phase?

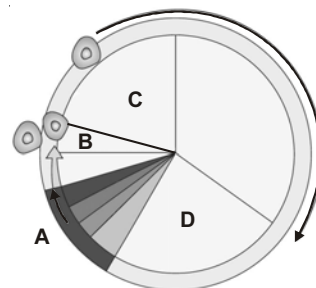
(1)  $G_1$  phase                      (2) S phase                      (3)  $G_2$  phase                      (4) Quiescent stage

**Sol.** Answer (1)

During this phase if cell is signalled not to divide further then it enters quiescent stage where cell remains metabolically active but do not proliferate unless they are called to do so.

6. Identify the mismatched pair

(1) A – Starts with karyokinesis and ends with cytokinesis  
 (2) B – Stage where cells are inactive metabolically  
 (3) C – Cell grows and carries out normal metabolism  
 (4) D – Period of cytoplasmic growth



**Sol.** Answer (2)

A – M-phase                      C –  $G_1$  phase  
 B –  $G_0$  phase                      D –  $G_2$  phase

7. 

Chromatin fibres duplication, Genetic material - 4C, Histone protein synthesis, Membranous organelle duplication, DNA replication, centriole duplication.

How many of the above features are associated with synthesis phase of cell cycle?

(1) Three                      (2) Five                      (3) Four                      (4) Six

**Sol.** Answer (2)

Chromatin fibre duplication  
 Genetic material - 4C  
 Chromosome duplication  
 DNA replication

} In nucleus

Centriole duplication in cytoplasm.

8. Most organelles show duplication in cell cycle during

(1)  $G_1$ -phase                      (2)  $G_0$ -phase                      (3) S-phase                      (4)  $G_2$ -phase

**Sol.** Answer (1)

Major cell organelles duplicate in  $G_1$  Phase.

### (Mitosis, Significance of Mitosis)

9. The two daughter cells formed during mitosis contains

(1) The same amount of DNA but a set of chromosomes different from those of parental cells  
 (2) The same amount of DNA and the same set of chromosomes as those of the parent cell  
 (3) Half the amount of DNA and the same set of chromosomes as those of the parent cell  
 (4) Double the amount of DNA and a set of chromosomes different from those of the parent cell

**Sol.** Answer (2)

Because mitosis is equational division occurring in somatic cells.

10. Higher plants differ from animals in having

- |                         |  |
|-------------------------|--|
| (1) Spindle microtubule | (2) Anastral mitosis                           |
| (3) Kinetochores        | (4) Disappearance of nucleolus during prophase |

**Sol.** Answer (2)

Because plant cell lack centriole and centrioles are responsible for formation of astral rays.

11. Which of the following phases are longest and shortest in mitosis?

- |                         |                         |
|-------------------------|-------------------------|
| (1) Metaphase, Anaphase | (2) Prophase, Anaphase  |
| (3) Telophase, Anaphase | (4) Prophase, Telophase |

**Sol.** Answer (2)

Longest phase – Prophase

Shortest phase – Anaphase

12. How many generations are required by a cell of meristem to produce 128 cells?

- |         |        |        |       |
|---------|--------|--------|-------|
| (1) 127 | (2) 64 | (3) 32 | (4) 7 |
|---------|--------|--------|-------|

**Sol.** Answer (4)

Because meristem cell will undergo mitosis and each mitotic division will yield 2 equal daughter cell from one diploid cell.

$$\therefore 1 \xrightarrow{(1)} 2 \xrightarrow{(2)} 4 \xrightarrow{(3)} 8 \xrightarrow{(4)} 16 \xrightarrow{(5)} 32 \xrightarrow{(6)} 64 \xrightarrow{(7)} 128$$

13. Select the **correct** match

- |   |  |
|---|--|
| (1) Reformation of ER and golgi complex – Telophase | (2) Invisible phase of cell cycle – Metaphase  |
| (3) Polar movement of chromatids – S-phase          | (4) Recombination nodules formation – Zygotene |

**Sol.** Answer (1)

Invisible phase of cell cycle – Interphase

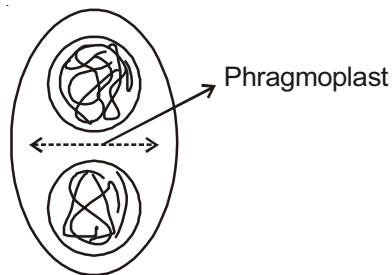
Polar movement of chromatids – Anaphase

Recombination nodules formation – Pachytene

14. Phragmoplast is formed by golgi complex and grows

- |  |   |
|--|---|
| (1) Centripetally to form cell plate           | (2) Centrifugally to form cell plate        |
| (3) Centripetally to produce a cleavage furrow | (4) Centrifugally to form a cleavage furrow |

**Sol.** Answer (2)



In plant cell, cytoplasm divides by cell plate formation.

15. Spireme stage of chromosomes is associated with  
(1) Early prophase (2) Late prophase (3) Metaphase (4) Telophase

**Sol.** Answer (1)

Early prophase when chromosome appear as ball of wool is known as spireme stage.

16. Which one of the following is correct for mitosis in most of the plants member?  
(1) Amphiastral, anastral and eumitosis (2) Anastral, acentric and premitosis  
(3) Anastral, acentric and eumitosis (4) Astral, centric and eumitosis

**Sol.** Answer (3)

Spindle apparatus without astral fibers and centrioles is called anastral and acentric.

17. Spindle fibres are made up of  
(1) Actin (2) Myosin (3) Alpha & beta tubulin (4) Flagellin

**Sol.** Answer (3)

Spindle fibres → Microtubules → Tubulin proteins

18. Cytokinesis in a plant cell is achieved by the formation of cell plate instead of a cleavage furrow, which is formed in  
(1) Centripetal manner (2) Centrifugal manner  
(3) Both centripetal and centrifugal manner (4) Equational manner

**Sol.** Answer (2)



19. Select an **incorrect** statement w.r.t. metaphase  
(1) Spindle fibres are attached to small disc shaped structures at the surface of centromeres called kinetochores  
(2) The plane of alignment of the homologous pair of chromosomes at metaphase is referred to as the metaphasic plate  
(3) Chromosome appears to be made up of two sister chromatids  
(4) The size of chromosomes can be studied in this phase

**Sol.** Answer (2)

Homologous pair of chromosome forms double metaphasic plate.

20. Best stages to study morphology and shape of chromosome are respectively  
(1) Metaphase, Telophase (2) Prophase, Anaphase  
(3) Telophase, Anaphase (4) Metaphase, Anaphase

**Sol.** Answer (4)

Morphology of chromosome → Metaphase

Shape of chromosome → Anaphase

**(Meiosis, Significance of Meiosis, Amitosis)**

21. All are the essential stages that take place during meiosis, **except**

- (1) Two successive divisions without any DNA replication occurring between them
- (2) Formation of chiasmata and crossing over
- (3) Segregation of homologous chromosomes
- (4) Number of chromosomes in daughter cells after meiosis II is reduced to half but the amount of DNA remains the same

**Sol.** Answer (4)

Amount of DNA is also reduced to half after meiosis II.

22. In the meiotic cell division, 56 daughter cells are produced by two successive divisions in which

- (1) First division is equational, second is reductional
- (2) First division is reductional, and second is equational
- (3) Both divisions are reductional
- (4) Both divisions are equational

**Sol.** Answer (2)

First division is reductional *i.e.*, Meiosis I and second is equational division *i.e.*, Meiosis II

23. If egg of an organism has 10 pg of DNA in its nucleus. How much DNA would a diploid cell of same organism have in  $G_2$  phase of meiosis?

- (1) 10 pg
- (2) 5 pg
- (3) 20 pg
- (4) 40 pg

**Sol.** Answer (4)

Egg of an organism = 10 pg DNA because egg is haploid

*i.e.*, (C) = 10 pg

Amount of DNA

Diploid cell = 2C after S-phase DNA contents doubles

$\therefore$  in  $G_2$  phase = DNA content = 4C

$\therefore$  (4) =  $4 \times 10$

= 40 Pg

24. To produce 102 pollen grains, how many meiotic divisions are required?

- (1) 25
- (2) 25.5
- (3) 26
- (4) 27

**Sol.** Answer (3)

Because 1 meiotic division will produce 4 haploid cell

For 102  $\Rightarrow$  Number of meiotic division (n)

$\Rightarrow$  But  $\frac{102}{4} = 25.5$ . But a division cannot be 0.5 so it must be 26.

25. Find out the **wrong** statement

- (1) Each metaphasic plate in heterotypic division of meiosis contains half the number of diploid set of chromosomes.
- (2) Interkinesis is generally short lived
- (3) Synaptonemal complex and nuclear membrane completely disappear in diplotene
- (4) Homologous chromosomes move to respective poles in anaphase-I

**Sol.** Answer (3)

Synaptonemal complex and nuclear envelope completely disappear in the end of diakinesis.

26. What will be the content of DNA in a somatic cell at  $G_2$  if its meiotic products have 20 picogram of DNA?

- (1) 40 pg
- (2) 20 pg
- (3) 80 pg
- (4) 160 pg

**Sol.** Answer (3)

Diploid cell will have 2C and after S phase it will become 4C

$$\therefore 4 \times 20 = 80 \text{ pg}$$

27. All chromosomes of a cell are directed towards one side and are attached to the nuclear membrane, can be observed in

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

**Sol.** Answer (1)

Leptotene  $\rightarrow$  Bouquet stage

28. Diplotene phase of meiosis is also characterised by

- a. Desynapsis
- b. Complete terminalisation of chiasmata
- c. Dictyotene stage
- d. Complete disappearance of nuclear membrane and nucleoli
- e. Complete development of astral rays and aster
- f. Longest phase of prophase-I

- (1) a, b, c and e
- (2) b, d, e and f
- (3) a, c and f
- (4) b, d and f

**Sol.** Answer (3)

i.e., a  $\rightarrow$  Desynapsis

c  $\rightarrow$  Dictyotene stage

f  $\rightarrow$  Longest phase of Prophase-I

29. The recombination nodules which mediate for chromosome recombination appear at intervals on the synaptonemal complex during

- (1) Zygotene stage
- (2) Meiosis
- (3) Pachytene stage
- (4) Diplotene stage

**Sol.** Answer (3)

Stage of crossing over  $\rightarrow$  Pachytene stage

30. In oocytes, which stage can last for months or years, since at this stage the chromosomes decondense and are engaged in RNA synthesis

- (1) Diakinesis
- (2) Telophase-I
- (3) Diplotene
- (4) Intrameiotic interphase

**Sol.** Answer (3)

Longest phase of prophase I-Diplotene

31. When synapsis is complete all along the chromosome, the cells are said to have entered a stage of prophase I, where exchange of genetic material takes place between homologous chromosomes. The stage is called

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

**Sol.** Answer (2)



32. The beginning of which stage of prophase is marked by complete terminalisation of chiasmata and inhibition of RNA synthesis?

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

**Sol.** Answer (3)

Chiasmata slips towards the end of chromosome.

33. What will be the amount of DNA in a pollen grain if its mother cell has 32 picogram DNA in  $G_2$  phase?

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

**Sol.** Answer (3)

Diploid cell initially =  $2C$

In S-phase =  $2 \times 2C = 4C$

$\therefore$  In  $G_2$  Phase =  $4C$

Meiotic products =  $C$

$$\therefore \frac{32}{4} = 8 \text{ pg}$$

34. The paradox of meiosis is

(1) Conservation of specific chromosome number from generation to generation  
(2) Produces four haploid cells after meiosis II  
(3) It is a double division  
(4) Does not involve DNA replication

**Sol.** Answer (1)

Meiosis reduces chromosome number to half in gametes thus maintains same chromosome number in species.

35. Temporarily suspended stage of diplotene during meiosis-I is

(1) Leptotene (2) Diakinesis  
(3) Dictyotene (4) Pachytene

**Sol.** Answer (3)

Diplotene stage is stranded in oocytes of some vertebrates.



## SECTION - C

## Previous Year Questions

1. Which of the following options gives the correct sequence of events during mitosis? [NEET - 2017]
- (1) Condensation → nuclear membrane disassembly → crossing over → segregation → telophase
  - (2) Condensation → nuclear membrane disassembly → arrangement at equator → centromere division → segregation → telophase
  - (3) Condensation → crossing over → nuclear membrane disassembly → segregation → telophase
  - (4) Condensation → arrangement at equator → centromere division → segregation → telophase

**Sol.** Answer (2)

The correct sequence of events during mitosis would be as follows

- (i) Condensation of DNA so that chromosomes become visible occurs during early to mid-prophase.
  - (ii) Nuclear membrane disassembly begins at late prophase or transition to metaphase.
  - (iii) Arrangement of chromosomes at equator occurs during metaphase, called congression.
  - (iv) Centromere division or splitting occurs during anaphase forming daughter chromosomes.
  - (v) Segregation also occurs during anaphase as daughter chromosomes separate and move to opposite poles.
  - (vi) Telophase leads to formation of two daughter nuclei.
2. 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? [NEET - 2017]
- (1) Chromosomes will not condense
  - (2) Chromosomes will be fragmented
  - (3) Chromosomes will not segregate
  - (4) Recombination of chromosome arms will occur

**Sol.** Answer (3)

Anaphase Promoting Complex (APC) is a protein necessary for separation of daughter chromosomes during anaphase. If APC is defective then the chromosomes will fail to segregate during anaphase.

3. During cell growth, DNA synthesis takes place in [NEET (Phase-2) 2016]
- (1) S phase
  - (2)  $G_1$  phase
  - (3)  $G_2$  phase
  - (4) M phase

**Sol.** Answer (1)

DNA replication occurs in S-phase of cell cycle.

4. When cell has stalled DNA replication fork, which checkpoint should be predominantly activated? [NEET (Phase-2) 2016]
- (1)  $G_1$  / S
  - (2)  $G_2$  / M
  - (3) M
  - (4) Both  $G_2$  / M and M

**Sol.** Answer (1)

$G_1$  / S check point of cell cycle is a major check point.

5. Match the stages of meiosis of Column-I to their characteristic features in Column-II and select the correct option using the codes given below: [NEET (Phase-2) 2016]

Column-I	Column-II
a. Pachytene	(i) Pairing of homologous chromosomes
b. Metaphase I	(ii) Terminalization of chiasmata
c. Diakinesis	(iii) Crossing-over takes place
d. Zygotene	(iv) Chromosomes align at equatorial plate
(1) a(iii), b(iv), c(ii), d(i)	(2) a(i), b(iv), c(ii), d(iii)
(3) a(ii), b(iv), c(iii), d(i)	(4) a(iv), b(iii), c(ii), d(i)

**Sol.** Answer (1)

Pachytene - Stage of crossing over

Metaphase-I - Chromosome align at equatorial plate

Diakinesis - Terminalisation of chiasmata

Zygotene - Pairing of homologous chromosome

6. In meiosis crossing over is initiated at

[NEET - 2016]

- (1) Diplotene (2) Pachytenep (3) Leptotene (4) Zygotene

**Sol.** Answer (2)

Leptotene - Condensation of chromatin

Zygotene - Synapsis of homologous chromosomes

Pachytene - Crossing over

Diplotene - Dissolution of synaptonemal complex and appearance of chiasmata

Diakinesis - Terminalisation of chiasmata

7. Spindle fibres attach on to

[NEET - 2016]

- (1) Kinetosome of the chromosome (2) Telomere of the chromosome  
(3) Kinetochore of the chromosome (4) Centromere of the chromosome

**Sol.** Answer (3)

Spindle fibres attach to kinetochores of chromosomes

8. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in [NEET - 2016]

- (1) Polyteny (2) Aneuploidy (3) Polyploidy (4) Somaclonal variation

**Sol.** Answer (3)

Polyploidy cells have a chromosome number that is more than double the haploid number.

9. Which of the following is not a characteristic feature during mitosis in somatic cells?

[NEET - 2016]

- (1) Synapsis (2) Spindle fibres  
(3) Disappearance of nucleolus (4) Chromosome movement

**Sol.** Answer (1)

Synapsis is pairing of homologous chromosomes. It occurs during zygotene stage of meiosis.

10. Arrange the following events of meiosis in correct sequence :

[Re-AIPMT-2015]

- (a) Crossing over  
(b) Synapsis  
(c) Terminalisation of chiasmata  
(d) Disappearance of nucleolus  
(1) (b), (c), (d), (a) (2) (b), (a), (d), (c) (3) (b), (a), (c), (d) (4) (a), (b), (c), (d)

**Sol.** Answer (3)

The sequence of event during meiosis are

- (a) Synapsis (Zygotene) (b) Crossing over (Pachytene)  
(c) Terminalisation of chiasmata (d) Disappearance of nucleolus

11. Select the **correct** option

[AIPMT-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      |

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

**Sol.** Answer (3)

12. During which phase(s) of cell cycle, amount of DNA in a cell remains at  $4C$  level if the initial amount is denoted as  $2C$ ?

[AIPMT-2014]

- (1)  $G_0$  and  $G_1$     (2)  $G_1$  and S    (3) Only  $G_2$     (4)  $G_2$  and M

**Sol.** Answer (3)

$G_1 \rightarrow 2C$  ; S  $\rightarrow 4C$  ;  $G_2 \rightarrow 4C$  ; M  $\rightarrow 2C$

13. In 'S' phase of the cell cycle

[AIPMT-2014]

- (1) Amount of DNA doubles in each cell    (2) Amount of DNA remains same in each cell  
(3) Chromosome number is increased    (4) Amount of DNA is reduced to half in each cell

**Sol.** Answer (1)

S- phase  $\rightarrow$  Synthesis phase. DNA replication occurs in this phase.

14. The enzyme recombinase is required at which stage of meiosis

[AIPMT-2014]

- (1) Pachytene    (2) Zygotene    (3) Diplotene    (4) Diakinesis

**Sol.** Answer (1)

Recombinase enzyme is responsible for crossing over.

15. A stage in cell division is shown in the figure. Select the answer which gives correct identification of the stage with its characteristics



[NEET-2013]

(1)	Late Anaphase	Chromosomes move away from equatorial plate, golgi complex not present.
(2)	Cytokinesis	Cell plate formed, mitochondria distributed between two daughter cells.
(3)	Telophase	Endoplasmic reticulum and nucleolus not reformed yet.
(4)	Telophase	Nuclear envelop reforms, golgi complex reforms.

**Sol.** Answer (4)

16. The complex formed by a pair of synapsed homologous chromosomes is called :

[NEET-2013]

- (1) Kinetochore    (2) Bivalent    (3) Axoneme    (4) Equatorial plate

**Sol.** Answer (2)

17. Meiosis takes place in :

[NEET-2013]

- (1) Conidia (2) Gemmule (3) Megaspore (4) Meiocyte

**Sol.** Answer (4)

Reproductive cells or germ cells.

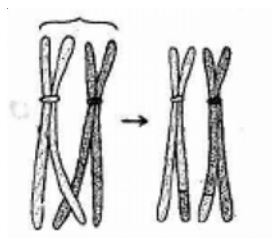
18. During gamete formation, the enzyme recombinase participates during

[AIPMT (Prelims)-2012]

- (1) Prophase – I (2) Prophase – II (3) Metaphase – I (4) Anaphase – II

**Sol.** Answer (1)

19. Given below is the representation of a certain event at a particular stage of a type of cell division. Which is the stage ?



[AIPMT (Prelims)-2012]

- (1) Prophase of Mitosis (2) Both prophase and metaphase of mitosis  
(3) Prophase I during meiosis (4) Prophase II during meiosis

**Sol.** Answer (3)

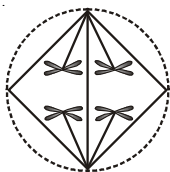
Because, representation is of exchange of genetic segment between non sister chromatids *i.e.*, crossing over which occurs during Pachytene stage of Prophase I of meiosis.

20. Identify the meiotic stage in which the homologous chromosomes separate while the sister chromatids remain associated at their centromeres :

[AIPMT (Mains)-2012]

- (1) Metaphase I (2) Metaphase II (3) Anaphase I (4) Anaphase II

**Sol.** Answer (3)



21. Select the **correct** option with respect to mitosis

[AIPMT (Prelims)-2011]

- (1) Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase  
(2) Chromatids separate but remain in the centre of the cell in anaphase  
(3) Chromatids start moving towards opposite poles in telophase  
(4) Golgi complex and endoplasmic reticulum are still visible at the end of prophase

**Sol.** Answer (1)

Poleward movement of chromosome → Anaphase

22. At metaphase, chromosomes are attached to the spindle fibres by their

[AIPMT (Mains)-2011]

- (1) Kinetochores (2) Centromere (3) Satellites (4) Secondary constrictions

**Sol.** Answer (1)

23. During mitosis ER and nucleolus begin to disappear at

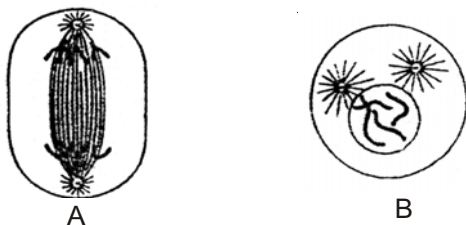
[AIPMT (Prelims)-2010]

- (1) Early prophase (2) Late prophase (3) Early metaphase (4) Late metaphase

**Sol.** Answer (1)

ER and nucleolus begin to disappear at early prophase where condensation of chromatin begins.

24. Which stages of cell division do the following figures A and B represent respectively?



[AIPMT (Prelims)-2010]

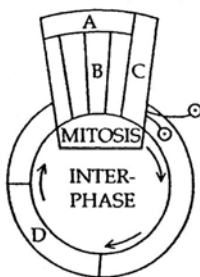
- |                           |                              |
|---------------------------|------------------------------|
| (1) Prophase — Anaphase   | (2) Metaphase — Telophase    |
| (3) Telophase — Metaphase | (4) Late Anaphase — Prophase |

**Sol.** Answer (4)

A – Late Anaphase : because chromatids have reached to their respective poles.

B – Prophase : Chromatin material condensation and centriole movement begins.

25. Given below is a schematic break-up of the phases/stages of cell cycle :



Which one of the following is the **correct** indication of the stage/phase in the cell cycle?

[AIPMT (Prelims)-2009]

- |                    |                       |
|--------------------|-----------------------|
| (1) C-Karyokinesis | (2) D-Synthetic phase |
| (3) A-Cytokinesis  | (4) B-Metaphase       |

**Sol.** Answer (2)

A–Karyokinesis, B–Anaphase, C–Cytokinesis

26. Synapsis occurs between

[AIPMT (Prelims)-2009]

- |                                |                                   |
|--------------------------------|-----------------------------------|
| (1) mRNA and ribosomes         | (2) Spindle fibres and centromere |
| (3) Two homologous chromosomes | (4) A male and a female gamete    |

**Sol.** Answer (3)

Homologous chromosomes are two similar chromosomes contributed by both parents.

27. At what stage of the cell cycle are histone proteins synthesized in a eukaryotic cell ?

[AIPMT (Prelims)-2005]

- |                            |   |
|----------------------------|---|
| (1) During entire prophase | (2) During telophase                        |
| (3) During S-phase         | (4) During G <sub>2</sub> stage of prophase |

**Sol.** Answer (3)

DNA replication and histone protein synthesis occurs in S-phase.

28. Centromere is required for

[AIPMT (Prelims)-2005]

- |                          |   |
|--------------------------|---|
| (1) Transcription        | (2) Crossing over                         |
| (3) Cytoplasmic cleavage | (4) Movement of chromosomes towards poles |

**Sol.** Answer (4)

Movement of chromosomes towards poles, it provides site for attachment of spindle fibers.

29. Comparing small and large cells, which statement is **correct**?

- (1) Small cells have a small surface area per volume ratio
- (2) Exchange rate of nutrients is fast with large cells
- (3) Small cells have a large surface area per volume ratio
- (4) Exchange rate of nutrients is slow with small cells

**Sol.** Answer (3)

Small cells - Surface area to volume ratio high exchange rate of nutrients fast.

30. In a somatic cell cycle, DNA synthesis takes place in

- (1)  $G_1$  phase
- (2) Prophase of mitosis
- (3) S-phase
- (4)  $G_2$  phase

**Sol.** Answer (3)

In a cell cycle DNA synthesis occurs only in S-phase.

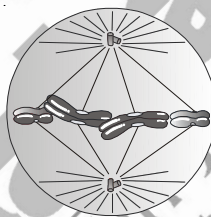
31. In the somatic cell cycle

- (1) In  $G_1$  phase, DNA content is double the amount of DNA present in the original cell
- (2) DNA replication takes place in S-phase
- (3) A short interphase is followed by a long mitotic phase
- (4)  $G_2$  phase followed by mitotic phase

**Sol.** Answer (2)

Interphase occupies 95% time of cell cycle.

32. A stage of mitosis is shown in the diagram. Which stage is it and what are its characteristics?



- (1) Late prophase – chromosomes move to spindle equator
- (2) Metaphase – spindle fibres attached to kinetochores, centromeres split and chromatids separate
- (3) Metaphase – chromosomes moved to spindle equator chromosomes made up of two sister chromatids
- (4) Anaphase – centromeres split and chromatids separate and start moving away

**Sol.** Answer (3)

Metaphase – Metaphasic plate

33. How many chromosomes will the cell have at  $G_1$ , after S and after M phase respectively, if it has 14 chromosomes at interphase?

- (1) 14, 14, 7
- (2) 14, 14, 14
- (3) 7, 7, 7
- (4) 7, 14, 14

**Sol.** Answer (2)

Because number of chromosome remain same in mitosis  $\therefore$  it equational division.

34. Which of the following represents the best stage to view the shape, size and number of chromosomes?

- (1) Prophase
- (2) Metaphase
- (3) Interphase
- (4) Telophase

**Sol.** Answer (2)

Because at this stage, chromosomes are completely condensed and clearly visible.



35. Each chromosome at the anaphase stage of a bone marrow cell in our body has

- |                    |                        |
|--------------------|------------------------|
| (1) Two chromatids | (2) Several chromatids |
| (3) No chromatids  | (4) Only one chromatid |

**Sol.** Answer (4)

Because centromere split and chromatid move towards respective poles.

36. Colchicine is an inhibitory chemical, which

- |   |   |
|---|---|
| (1) Stops the functioning of centriole        | (2) Prevents attaching of centromeres with rays |
| (3) Prevents the spindle formation in mitosis | (4) Prevents the formation of equatorial plane  |

**Sol.** Answer (3)

Colchicine checks assembly of microtubules and prevents their polymerisation.

37. During cell division in apical meristem, the nuclear membrane appears in

- |               |                 |               |              |
|---------------|-----------------|---------------|--------------|
| (1) Telophase | (2) Cytokinesis | (3) Metaphase | (4) Anaphase |
|---------------|-----------------|---------------|--------------|

**Sol.** Answer (1)

Nuclear envelope reappears in telophase.

38. How many mitotic divisions are needed for a single cell to make 128 cells?

- |        |        |         |        |
|--------|--------|---------|--------|
| (1) 28 | (2) 32 | (3) 127 | (4) 14 |
|--------|--------|---------|--------|

**Sol.** Answer (3)

Number of cells (n) = 128

Number of division =  $(n - 1) = 128 - 1 = 127$

39. Which of the following structure will not be common to mitotic cell of a higher plant?

- |               |                   |                |                |
|---------------|-------------------|----------------|----------------|
| (1) Centriole | (2) Spindle fibre | (3) Cell plate | (4) Centromere |
|---------------|-------------------|----------------|----------------|

**Sol.** Answer (1)

Centriole is not present in plant cell.

40. A bacterium divides every 35 minutes. If a culture containing  $10^5$  cells per ml is grown for 175 minutes, what will be the cell concentration per ml after 175 minutes?

- |                            |                            |                             |                            |
|----------------------------|----------------------------|-----------------------------|----------------------------|
| (1) $35 \times 10^5$ cells | (2) $32 \times 10^5$ cells | (3) $175 \times 10^5$ cells | (4) $85 \times 10^5$ cells |
|----------------------------|----------------------------|-----------------------------|----------------------------|

**Sol.** Answer (2)

In 175 minutes  $\rightarrow = \frac{175}{35} = 5$  time division will

$1 \xrightarrow{(1)} 2 \xrightarrow{(2)} 4 \xrightarrow{(3)} 8 \xrightarrow{(4)} 16 \xrightarrow{(5)} 32 \times 10^5$

41. Spindle fibre unite with which structure of chromosomes?

- |                  |                |                 |               |
|------------------|----------------|-----------------|---------------|
| (1) Chromocentre | (2) Chromomere | (3) Kinetochore | (4) Centriole |
|------------------|----------------|-----------------|---------------|

**Sol.** Answer (3)

Kinetochore is a disc like structure present at centromere.

42. Best material for the study of mitosis in laboratory is

- |            |              |              |           |
|------------|--------------|--------------|-----------|
| (1) Anther | (2) Root tip | (3) Leaf tip | (4) Ovary |
|------------|--------------|--------------|-----------|

**Sol.** Answer (2)

Because it is apical meristem where actively dividing cells are present.

43. If a diploid cell is treated with colchicine then it becomes  
(1) Triploid (2) Tetraploid (3) Diploid (4) Monoploid

**Sol.** Answer (2)

Because colchicine affects microtubules synthesis  
thus, arrest cell division at anaphase stage,  $2n \rightarrow 4n$

44. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into?  
(1) Metaphase (2) Telophase (3) Anaphase (4) Prophase

**Sol.** Answer (1)

Metaphase stage can be most conveniently looked because at this stage chromosomes are completely condensed.

45. Which one of the following precedes re-formation of the nuclear envelope during M phase of the cell cycle?  
(1) Decondensation from chromosomes, and reassembly of the nuclear lamina  
(2) Transcription from chromosomes, and reassembly of the nuclear lamina  
(3) Formation of the contractile ring, and formation of the phragmoplast  
(4) Formation of the contractile ring, and transcription from chromosomes

**Sol.** Answer (3)

Microtubules form contractile ring which helps in invagination of plasma membrane at late anaphase.

46. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?  
(1) 75 (2) 100 (3) 25 (4) 50

**Sol.** Answer (3)

1 micro spore mother cell  $\rightarrow$  4 pollen grain

$\therefore$  For 1 pollen grain =  $\frac{1}{4}$  microsphere mother cell

$\therefore$  For 100 pollen grain =  $\frac{1}{4} \times 100 = 25$

47. If there are 4 pollen mother cells in anthers, what will be the number of pollen grains?  
(1) 16 (2) 12 (3) 8 (4) 4

**Sol.** Answer (1)

$1 \rightarrow 4$

$\therefore 4 \rightarrow 4 \times 4 = 16$

48. A gymnospermic leaf carries 16 chromosomes. The number of chromosomes in its endosperm will be  
(1) 12 (2) 8 (3) 16 (4) 24

**Sol.** Answer (2)

Leaf cell ( $2n$ ) = 16

(diploid)

Endosperm of gymnosperm is haploid ( $n$ )

$\therefore = \frac{16}{2} = 8$

$\therefore \rightarrow 8$

49. The term "Meiosis" was given by  
(1) A. Flemming (2) Farmer and Moore (3) Johansen (4) Knoll and Ruska

**Sol.** Answer (2)

Farmer and Moore coined the term meiosis.

50. What will be DNA amount in Meiotic II products if DNA is 20 picogram in meiocyte at  $G_2$ -stage?

- (1) 5 pg                                      (2) 10 pg                                      (3) 20 pg                                      (4) 40 pg

**Sol.** Answer (1)

Meiocyte =  $2C$

at  $G_2$  stage =  $4C = 20$

Meiotic II products =  $C = \frac{20}{4} = 5$  pg

$\therefore$  5 pg

51. In ferns, meiosis takes place at the time of

- (1) Spore formation                                      (2) Spore germination  
(3) Gamete formation                                      (4) Antheridia and archegonia formation

**Sol.** Answer (1)

Ferns show sporic meiosis.

52. Mitotic spindle is mainly composed of which protein?

- (1) Actin                                      (2) Myosin                                      (3) Tubulin                                      (4) Myoglobin

**Sol.** Answer (3)

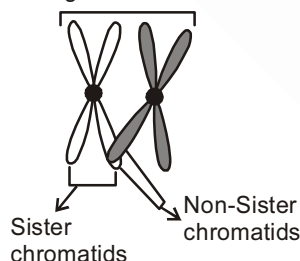
Tubulin protein is composition of microtubules which in turn form mitotic spindle.

53. Crossing over that results in genetic recombination in higher organisms occurs between

- (1) Sister chromatids of a bivalent                                      (2) Non-sister chromatids of a bivalent  
(3) Two daughter nuclei                                      (4) Two different bivalents

**Sol.** Answer (2)

Homologous chromosomes



## SECTION - D

### Assertion-Reason Type Questions

1. A : Endomitosis does not cause karyokinesis or cytokinesis.

R : In endomitosis, mitosis occurs within nucleus.

**Sol.** Answer (1)

Endomitosis involves multiplication of chromosomes without karyokinesis and cytokinesis.

2. A : Synaptonemal complex develops between two synapsed homologous chromosomes.

R : Mitosis cannot be completed without the synaptonemal complex.

**Sol.** Answer (3)

Meiosis can not be completed without the synaptonemal complex.

3. A : During anaphase-II, chromatids of a chromosome separate.  
R : Centromere of a mitotic chromosome divides during anaphase.

**Sol.** Answer (2)

Meiosis II and mitosis both are equational division and involve splitting of centromere at anaphase-II and anaphase respectively.

4. A : Dictyotene stage occurs in female only.  
R : Gametogenesis rests for a long period at diplotene stage in female.

**Sol.** Answer (1)

Dictyotene occurs in oocytes.

5. A : Each chromosome of bivalent attaches with two spindles in metaphase.  
R : In metaphase bivalents migrate towards metaphasic plate.

**Sol.** Answer (4)

Each chromosomes of bivalent attaches with a single spindle in Metaphase I  
In metaphase I one chromosome from each homologous pair migrate towards pole.

6. A :  $G_2$ -phase is pre-mitotic phase.  
R : Chromosomes undergo condensation in this phase.

**Sol.** Answer (3)

Proteins and organelles like mitochondria and chloroplast duplicate in  $G_2$ -phase.

7. A : Anaphase-I is actual phase of reduction in number of chromosomes.  
R : Homologous chromosomes move to the opposite poles with both their chromatids.

**Sol.** Answer (1)

Anaphase-I involves splitting of homologous chromosome.

8. A : Golgi bodies and ER disappear in early prophase.  
R : Their reorganisation stage is anaphase.

**Sol.** Answer (4)

Golgi bodies and ER disappear in Late prophase.  
Their reorganisation occurs in telophase.

9. A : The complete disintegration of the nuclear envelope marks the start of metaphase.  
R : Chromosomes are distinct with two chromatids at this stage.

**Sol.** Answer (2)

Complete disintegration of the nuclear envelope marks beginning of metaphase chromosomes at this phase have two distinct chromatids.

10. A : Chiasmata counting stage is diplotene.  
R : Dissolution of the synaptonemal complex occurs except at the sites of cross overs.

**Sol.** Answer (1)

Chiasmata represents the site of crossing over.

