# Chapter 7: Cell Division

## EXERCISE [PAGES 83 - 84]

### Exercise | Q 1. (A) | Page 83
**Choose the correct option.**

The connecting link between Meiosis-I and Meiosis-II is _____.

1. interphase - I
2. interphase - II
3. **interkinesis**
4. anaphase - I

*SOLUTION*

The connecting link between Meiosis-I and Meiosis-II is **interkinesis.**

### Exercise | Q 1. (B) | Page 83
**Choose the correct option.**

Synapsis is pairing of _____.

1. any two chromosomes
2. non-homologous chromosomes
3. sister chromatids
4. **homologous chromosomes**

*SOLUTION*

Synapsis is pairing of **homologous chromosomes**.

### Exercise | Q 1. (C) | Page 83
**Choose the correct option.**

Spindle apparatus is formed during which stage of mitosis?

1. Prophase
2. **Metaphase**
3. Anaphase
4. Telophase

*SOLUTION*

**Metaphase**

### Exercise | Q 1. (D) | Page 83
**Choose the correct option.**

Chromosome number of a cell is almost doubled up during _____.

1. $G_1$ - phase
2. **S - phase**
3. $G_2$ - phase
4. $G_0$ - phase

*SOLUTION*

Chromosome number of a cell is almost doubled up during **S - phase.**

**Exercise | Q 1. (E) | Page 83**

**Choose the correct option.**

How many meiotic divisions are necessary for the formation of 80 sperms?

1. 80
2. 40
3. **20**
4. 10

*SOLUTION*

**20**

**Exercise | Q 1. (F) | Page 83**

**Choose the correct option.**

How many chromatides are present in anaphase-I of meiosis-I of a diploid cell having 20 chromosomes?

1. 4
2. 6
3. 20
4. **40**

*SOLUTION*

**40**

**Exercise | Q 1. (G) | Page 83**

**Choose the correct option.**

In which of the following phase of mitosis chromosomes are arranged at the equatorial plane?

1. Prophase
2. **Metaphase**
3. Anaphase
4. Telophase

*SOLUTION*

**Metaphase**

**Exercise | Q 1. (H) | Page 83**

**Choose the correct option.**

Find incorrect statement.

1. Condensation of chromatin material occurs in prophase.
2. Daughter chromatids are formed in anaphase
3. **Daughter nuclei are formed at metaphase.**
4. Nuclear membrane reappears in telophase.

*SOLUTION*

**Daughter nuclei are formed at metaphase.**

**Exercise | Q 1. (I) | Page 83**
**Choose the correct option.**
Histone proteins are synthesized during _____.

1. $G_1$ phase
2. **S - phase**
3. $G_2$ phase
4. Interphase

*SOLUTION*

**S - phase**

**Exercise | Q 2. (A) | Page 83**
**Answer the following question.**
While observing a slide, student observed many cells with nuclei. But some of the nuclei were bigger as compared to others but their nuclear membrane was not so clear. Teacher inferred it as one of the phase in the cell division. Which phase may be inferred by the teacher?

*SOLUTION*

Prophase

**Exercise | Q 2. (B) | Page 83**
**Answer the following question.**
Students prepared a slide of onion root tip. There were many cells seen under a microscope. There was a cell seen under a microscope. There was a cell with two groups of chromosomes at opposite ends of the cell. This cell is in which phase of mitosis?

*SOLUTION*

Anaphase

**Exercise | Q 2. (C) | Page 83**
**Answer the following question.**
Students were shown some slides of cancerous cells. Teacher made a comment as if there would have been control at one of its cell cycle phase, there wouldn't have been a condition like this. Which phase the teacher was referring to?

*SOLUTION*

The phase teacher was referring would be $G_1$ phase.

**Exercise | Q 2. (D) | Page 83**
**Answer the following question.**

Some Mendelian crossing experimental results were shown to the students. Teacher informed that there are two genes located on the same chromosome. He enquired if they will be ever separated from each other?

*SOLUTION*

1. Genes are located on chromosomes at specific distances and positions.
2. The greater this distance, the greater the chance that a crossover can occur between the genes and the greater the chances of recombination.
3. The chances of recombination are less between the genes that are placed closed to each other on the chromosome.
4. Therefore, due to recombination, the two genes located on the same chromosome have the possibility of separating from each other.

## Exercise | Q 2. (E) | Page 83

**Answer the following question.**
Students were observing a film on Paramoecium. It underwent a process of reproduction. Teacher said it is due to cell division. But students objected and said that there was no disappearance of the nuclear membrane and no spindle formation, how can it be cell division? Can you clarify?

*SOLUTION*

1. Paramoecium is a unicellular organism. The division in Paramoecium occurs by amitosis.
2. It is the simplest mode of cell division.
3. In amitosis, nucleus elongates and a constriction appears. This constriction deepens and divides the nucleus into two daughter nuclei followed by the division of cytoplasm.

## Exercise | Q 2. (F) | Page 84

**Answer the following question.**

Is the meiosis responsible for evolution? Justify your answer.

*SOLUTION*

1. Meiosis ensures that organisms produced by sexual reproduction contain the correct number of chromosomes.
2. Meiosis exhibits genetic variation by the process of recombination.
3. Variations increase further after the union of gametes during fertilization creating offspring with unique characteristics. Thus, it creates diversity of life and is responsible for evolution.

## Exercise | Q 2. (G) | Page 84

**Answer the following question.**

Why mitosis and meiosis – II are called as homotypic division?

*SOLUTION*

1. In mitosis, the chromosome number and genetic material of daughter cells remain the same as that of the parent cell.
2. In meiosis – II, two haploid cells formed during the first meiotic division divide further into four haploid cells. This division is identical to mitosis. The daughter cells formed in the second meiotic division are similar to their parent cells with respect to the chromosome number formed in meiosis – I. Hence mitosis and meiosis – II are called homotypic division.

## Exercise | Q 2. (H) | Page 84

Explain the significance of mitosis.

*SOLUTION 1*

(i) It helps to maintain linear heredity of an organism by keeping the chromosome number constant in daughter cells.
(ii) It helps in the development of an organism from zygotic stage to adult stage.
(iii) It is the means of repair and regeneration of cells.
(iv) Asexual reproduction is accomplished only through mitosis.
(v) Details of mitosis are similar in all organisms which emphasizes the unity of life.

*SOLUTION 2*

1. As mitosis is equational division, the chromosome number is maintained constant.
2. It ensures equal distribution of the nuclear and the cytoplasmic content between the daughter cells, both quantitatively and qualitatively. Therefore, the process of mitosis also maintains the nucleo-cytoplasmic ratio.
3. The DNA is also equally distributed.
4. It helps in the growth and development of organisms.
5. Old and worn-out cells are replaced through mitosis.
6. It helps in the asexual reproduction of organisms and vegetative propagation in plants.

## Exercise | Q 2. (I) | Page 84

**Answer the following question.**

Enlist the different stages of prophase – I.

*SOLUTION*

It is the most complicated and longest phase of the meiotic division. It is further divided into five sub-phases viz. leptotene, zygotene, pachytene, diplotene and diakinesis.

1. **Leptotene:**
   The volume of the nucleus increases. The chromosomes become long distinct and coiled. They orient themselves in a specific form known as bouquet stage. This is characterized by the ends of chromosomes converged towards the side of the nucleus where the centrosome lies. The centriole duplicates into two and migrates to opposite poles.

2. **Zygotene:**
   Pairing of non-sister chromatids of homologous chromosomes takes place by the formation of the synaptonemal complex. This pairing is called synapsis. Each pair consists of a maternal chromosome and a paternal chromosome. Chromosomal pairs are called bivalents or tetrads.

3. **Pachytene:**
   Each individual chromosome begins to split longitudinally into two similar chromatids. Therefore, each bivalent now appears as a tetrad consisting of four chromatids. The homologous chromosomes begin to separate but they do not separate completely and remain attached to one or more points. These points are called chiasmata (Appear like a cross-X). Chromatids break at these points and broken segments are exchanged between non-sister chromatids of homologous chromosomes resulting in recombination.

4. **Diplotene:**
   The chiasma becomes clearly visible in diplotene due to the beginning of repulsion between synapsed homologous chromosomes. This is known as desynapsis. Synaptonemal complex also starts to disappear.

5. **Diakinesis:**
   The chiasmata begin to move along the length of chromosomes from the centromere towards the ends of chromosomes. The displacement of chiasmata is termed as terminalization.
   The terminal chiasmata exist till the metaphase. The nucleolus and nuclear membrane completely disappear and spindle fibres begin to appear.

## Exercise | Q 3. (A) | Page 84

**Draw labelled diagram and write an explanation.**
With the help of a suitable diagram, describe the cell cycle.

*SOLUTION*

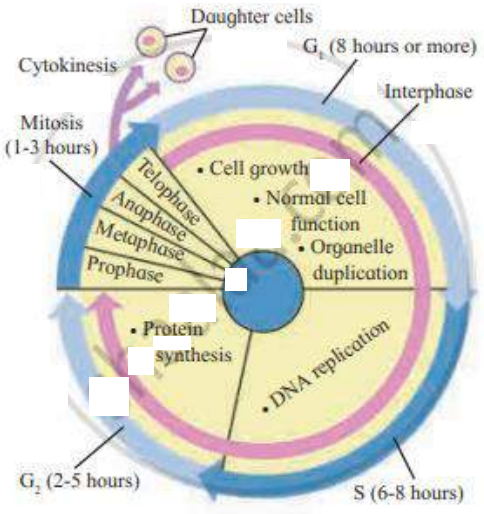
1. Series of events occurring in the life of a cell is called cell cycle. Interphase and M – phase are the two phases of cell cycle.

2. **Interphase:** It is the stage between two successive cell divisions. It is the longest phase of a cell cycle during which the cell is highly active and prepares itself for cell division.
   The interphase is subdivided into three sub-phases as $G_1$-phase, S-phase and $G_2$-phase.

i. **$G_1$ – phase (First gap period/First Gap Phase):**
It begins immediately after cell division. RNA (mRNA, rRNA and tRNA) synthesis, protein synthesis and synthesis of membranes take place during this phase.

ii. **S – phase (Synthesis phase):**
In this phase DNA is synthesized (replicated), so that amount of DNA per cell doubles. Synthesis of histone proteins takes place in this phase.

iii. **$G_2$ – phase (Second growth phase/Second Gap Phase):**
Metabolic activities essential for cell division occur during this phase. Various proteins which are necessary for the cell division are also synthesized in this phase. Apart from this, RNA synthesis also occurs during this phase. In animal cells, a daughter pair of centrioles appears near the pre-existing pair.



## Exercise | Q 3. (B) | Page 84

**Draw labelled diagrams and write an explanation.**

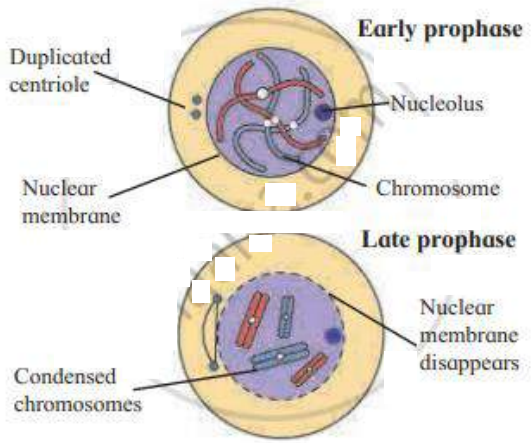
Distinguish between mitosis and meiosis.

SOLUTION

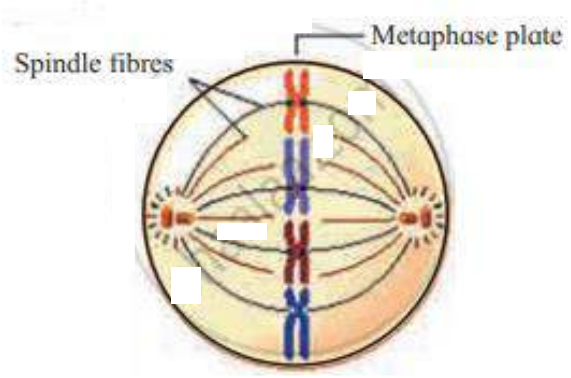
| | Mitosis | Meiosis |
|---|---|---|
| 1. | It occurs in somatic cells and stem cells. | It occurs in germ cells. |
| 2. | In this nucleus divides only once. | In this nucleus divides twice (Meiosis I and Meiosis II) |
| 3. | In these two daughter cells are formed. | In these four daughter cells are formed. |
| 4. | Daughter cells formed by mitotic division are diploid (2n). | Daughter cells formed by meiotic division are haploid (n). |
| 5. | In mitosis, crossing over does not take place. | In meiosis, crossing over takes place. |
| 6. | Mitosis plays an important role in growth, repair, healing and development. | Meiosis is important for the formation of haploid gametes and spores. |

**Mitosis:**

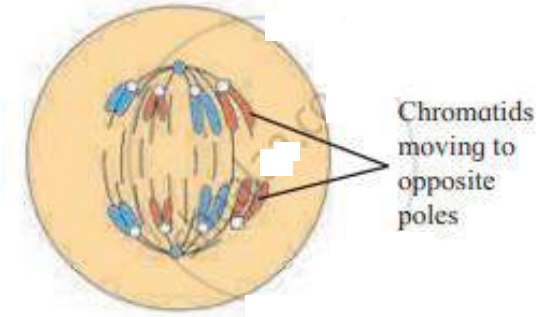
**Prophase:**



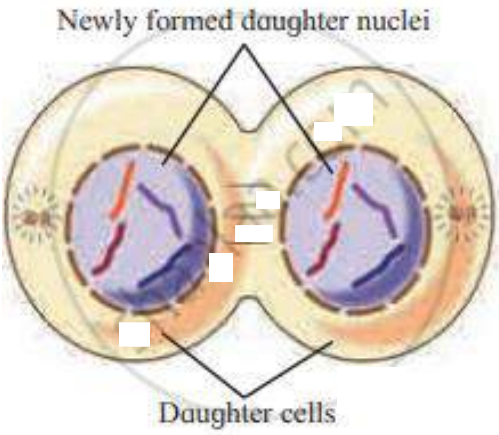

**Metaphase:**




**Anaphase:**

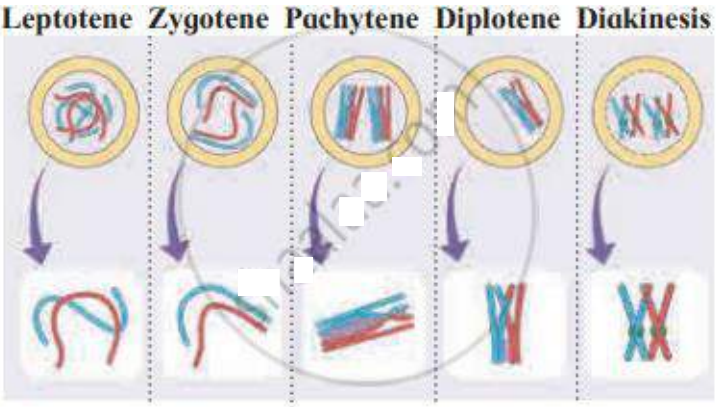



**Telophase:**

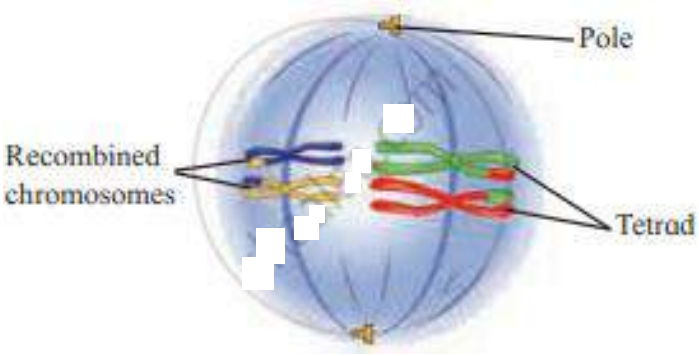



- **Meiosis:**

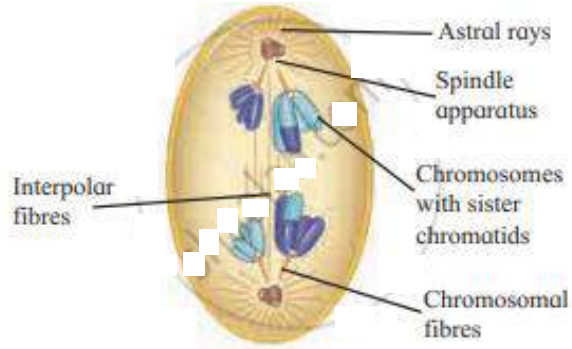
**Prophase I:**



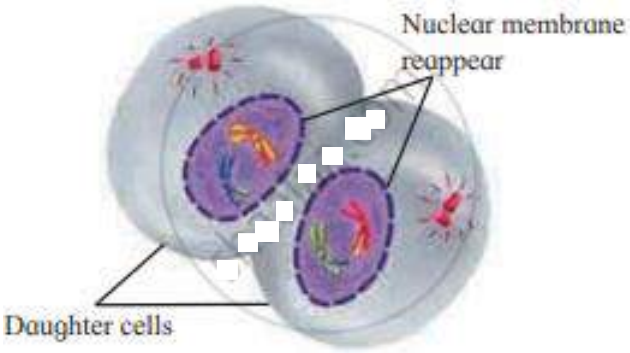

**Metaphase-I:**




**Anaphase-I:**




**Cytokinesis-I:**

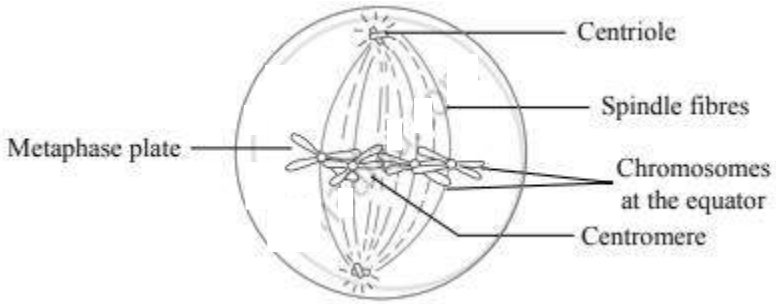


## Exercise | Q 3. (C) | Page 84

**Draw labelled diagrams and write an explanation.**

Draw the diagram of metaphase.

*SOLUTION*




1. Chromosomes are completely condensed and appear short.
2. Centromere and sister chromatids become very prominent.
3. All the chromosomes are arranged at the equatorial plane of cells. This is called the metaphase plate.
4. The mitotic spindle is fully formed in this phase. e. Centromere of each chromosome divides horizontally into two, each being associated with a chromatid.

## Exercise | Q 4 | Page 84

**Match the following column A with column B.**

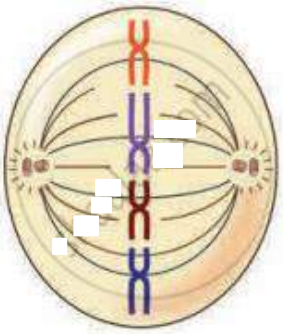
| Column-A (phases) | Column-B (Their events) |
|---|---|
| a. Leptotene | 1. Crossing over |
| b. Zygotene | 2. Desynapsis |
| c. Pachytene | 3. Synapsis |
| d. Diplotene | 4. Bouquet stage |

*SOLUTION*

| Column-A (phases) | Column-B (Their events) |
|---|---|
| a. Leptotene | 4. Bouquet stage |
| b. Zygotene | 3. Synapsis |
| c. Pachytene | 1. Crossing over |
| d. Diplotene | 2. Desynapsis |

### Exercise | Q 5 | Page 84

Is a given figure correct? why?



*SOLUTION*

1. The given figure is incorrect as the spindle fibres are not attached to the centromere of the chromosomes.
2. During metaphase, chromosomes are attached to spindle fibres with the help of centromeres.

### Exercise | Q 6 | Page 84

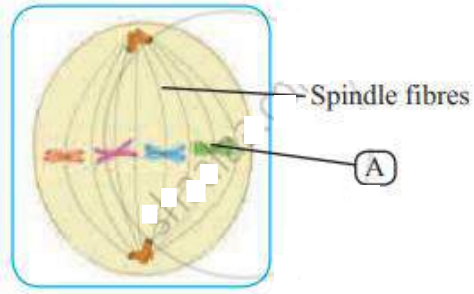
If an onion has 16 chromosomes in its leaf cell, how many chromosomes will be there in its root cell and pollen grain?

*SOLUTION*

1. The chromosomes in root cell will be 16 as root cell is a diploid cell.
2. The chromosomes in pollen grain will be 8 as pollen grain is a haploid cell.

### Exercise | Q 7 | Page 84

**Identify the following phase of mitosis and label the 'A' given in the diagram.**



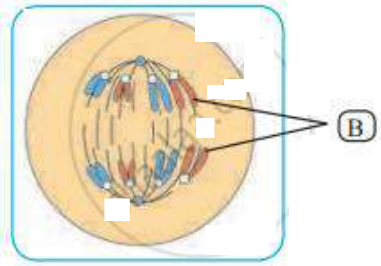

*SOLUTION*

The diagram shown is of Metaphase.

**A:** Chromosomes arranged on the metaphase plate

### Exercise | Q 7 | Page 84

**Identify the following phase of mitosis and label the 'B' given in the diagram.**




*SOLUTION*

The diagram shown is of Anaphase.

**B:** Chromatids moving to opposite poles.