CHAPTER – 1

CELL CYCLE AND CELL DIVISION

P. 12 Check Your Progress 1

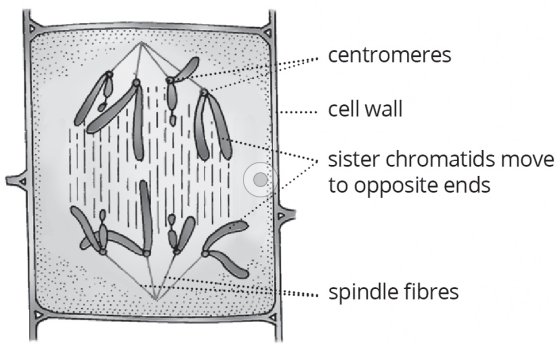
A. Answer these questions.

1. Mitosis and Meiosis

2. Mitosis is responsible for the growth of an organism. It plays a significant role in replacement of cells lost during wear and tear, and in wound healing. It is a method of asexual reproduction in unicellular organisms.

3. Cytokinesis is the division of cytoplasm to form two daughter cells. It begins during late anaphase and is completed soon after telophase. In plant cells, cytokinesis starts from the centre due to cell plate formation, and extends towards the periphery.

4.



Early anaphase

B. Name the stage of mitotic cell division showing following events.

1. Prophase

2. Metaphase

3. Anaphase

4. Cytokinesis

C. The diagram given below shows a stage during cell division. Study the same and answer the questions that follow.

1. The stage shown in the diagram is anaphase of mitotic cell division. The stage can be identified as anaphase because the sister chromatids separate and begin to move towards the opposite poles due to the contraction of spindle fibres.

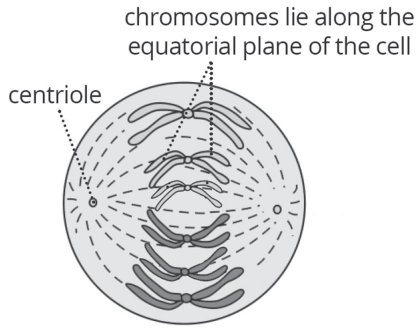
The given diagram is of an animal cell since centriole can be seen in the diagram, that is only present in an animal cell.

2. **i.** Centriole

ii. Chromosome

iii. Spindle fibre

3. The stage prior to this stage is metaphase.



Metaphase

4. The spindle fibres help in the chromosomal movement during mitosis.

5. Mitosis occurs in all the somatic cells of the body.

P. 16 Check Your Progress 2

A. Answer these questions.

1. **a.** Crossing over of meiosis

b. **i.** Homologous chromosomes

ii. Chromatids exchanging parts

c. During crossing over which occurs in meiosis, part of chromatids are exchanged between homologous chromosomes which bring about variations in the offsprings.

d. The non-sister chromatids of a tetrad break open and rejoin each other. Exchange of some genes or portions of chromatids takes place between paternal and maternal chromatids of a pair of homologous chromosomes during meiosis. This is known as crossing over.

P. 16 Exercises

I. Multiple-Choice Questions

A. Choose the most appropriate answer.

1. b	**2.** b	**3.** c	**4.** a
5. b	**6.** c	**7.** b	**8.** c
9. d	**10.** c	**11.** c	**12.** a

II. Assertion–Reason Type Questions

A. **1.** a **2.** b **3.** c **4.** c

III. Very Short Answer Type Questions

A. Complete the following paragraph by filling in the blanks (1) to (5) with appropriate words.

1. M **2.** G1 **3.** S **4.** G2 **5.** G0

B. Arrange and rewrite the terms in each group in the correct order so as to create a logical sequence beginning with the underlined term in the group.

1. G1 phase, S phase, G2 phase, M phase, Cytokinesis
2. Prophase, Metaphase, Anaphase, Telophase, Cytokinesis
3. Interphase, Prophase, Metaphase, Anaphase, Telophase
4. Meiosis I, Prophase I, Metaphase I, Anaphase I, Telophase I
5. G1 phase, S phase, G2 phase, M phase, Interphase

C. Match the items in Column A with those in Column B and write down the matching pairs.

1. c **2.** a **3.** d **4.** e **5.** b

IV. Short Answer Type Questions

A. Answer these questions.

1. Karyokinesis refers to the nuclear division leading to the division of parent nucleus into daughter nuclei. Whereas cytokinesis refers to the division of cytoplasm leading to the division of parent cells into daughter cells.
2. In meiotic cell division, crossing over takes place.
3. The spindle fibres help in the chromosomal movement during mitosis. The sister chromatids separate and begin to move towards the opposite poles due to the contraction of spindle fibres, and due to the repelling force developed between them.
4. Interphase is the growth period between two successive divisions of a cell. Thus it is a preparatory phase just before the cell starts dividing. The cell is metabolically most active and prepares itself for the division by synthesizing DNA (the genetic material) and RNA to almost double amount.

   It has three sub-phases:

   (i) **G1 or first growth phase:** This is the first gap (interval) phase of cell growth when RNA and proteins are synthesized.

   (ii) **S or synthesis phase:** This is the phase of DNA replication.

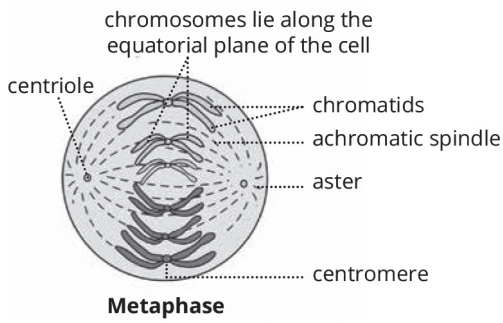
   (iii) **G2 or second growth phase:** It is the second gap phase after DNA replication in which RNA and proteins necessary for cell division continue to be synthesized.

   Since all these activities occur during the interphase, it is incorrect to call it as a resting stage.
5. Meiosis is a modified mitosis in which chromosomes divide once and the nucleus divides twice. As a result of which, the number of chromosomes is reduced to half. Thus, the four cells resulting from a meiotic division have a haploid number of chromosomes. Since the number of chromosomes is reduced to half in the daughter cells, meiosis is called a reductional cell division.
6. The non-sister chromatids of a tetrad break open and rejoin each other. Exchange of some genes or portions of chromatids takes place between paternal and maternal chromatids of a pair of homologous chromosomes during meiosis. This is known as crossing over.

   Crossing over brings variations in the offsprings.

V. Long Answer Type Questions

A. Draw a diagram of the nucleus of a cell, having 6 chromosomes, as it would appear in the metaphase stage of mitosis and label the following parts in the diagram.



Metaphase

B. Answer these questions.

1.

Cytokinesis in plant cells	Cytokinesis in animal cells
In plant cells, a cell plate is formed in the centre of the cell at the equator. The cell plate extends on either side until it completely divides the cell into two daughter cells.	In animal cells, a constriction (or furrow) appears in the cell (or plasma) membrane. This constriction deepens by the end of the telophase, finally completing the division of cytoplasm.
Cytokinesis starts from the centre due to cell plate formation, and extends towards the periphery.	Cytokinesis starts from the periphery and proceeds towards the centre.

2. Significance of mitosis

- Mitosis maintains the same number of chromosomes in all the cells of an individual. In other words, mitosis is an equational division in which two daughter cells produced are identical to each other and even to their parent cell. This type of cell division usually takes place in the somatic cells such as tips of roots, stems, etc.
- It plays a significant role in replacement of cells lost during wear and tear, and in wound healing.
- It is responsible for the growth of an organism. A fertilized cell develops into an embryo and finally into an adult as a result of mitotic cell division. It is a method of asexual reproduction in unicellular organisms.

3. Significance of meiosis

- It results in the formation of haploid sex cells (sperms and ova), which after fertilization restore the diploid number of chromosomes in the zygote.
- During crossing over which occurs in meiosis, part of chromatids are exchanged between homologous chromosomes which bring about variations in the offsprings.
- The four chromatids of a homologous pair of chromosomes are passed on to four different daughter cells. This also causes gametic variation.

4. In meiotic cell division, homologous chromosomes come together (associate) and subsequently segregate into daughter cells. Each daughter nucleus formed at the end of the meiosis I, has half the number of chromosomes as compared to the parent cell. Thus, the number of chromosomes is reduced from diploid (double) to the haploid (single) state. Hence, the word reduction here refers to decrease in number of chromosomes from diploid state to haploid state.

5. Meiosis takes place in the reproductive cells that produce gametes (sperms and ova). In meiotic cell division, chromosomes divide once and the nucleus divides twice. As a result of which the number of chromosomes is reduced to half. Thus, the four cells resulting from a meiotic division have a haploid number of chromosomes. It means that the number of chromosomes becomes half in each sex cell. This is because when the male and female gametes fuse during fertilization, the diploid (double) number of chromosome pairs is restored.

6. During meiotic cell division, homologous chromosomes come together and subsequently segregate into daughter cells. The non-sister chromatids of a tetrad break open and rejoin each other. Exchange of some genes or portions of chromatids takes place between paternal and maternal chromatids of a pair of homologous chromosomes during meiosis. This is known as crossing over.

Due to crossing over of homologous chromosomes, part of chromatids are exchanged between homologous chromosomes which bring about variations in the offsprings.

VI. Structured / Application / Skill Type Questions

A.

Feature	Mitosis	Meiosis
Occurrence	Occurs in somatic cells	Occurs in reproductive cells
Number of daughter cells formed at the end of division	Two daughter cells	Four daughter cells
Number of chromosomes in daughter cells (haploid/ diploid)	Diploid set	Haploid set
Exchange of genetic material between homologous chromosomes	No exchange takes place	Exchange of genetic material takes place

B. 1. Since centrioles can be seen in the given diagram, it can be said that this is an animal cell. Centrioles are only seen in animal cells and cannot be seen in plant cells.

2. The stage shown in the diagram is late prophase. This stage can be identified because of following reasons:

- Each chromosome has two sister chromatids. The two sister chromatids lie close to each other and remain attached at a point called centromere.
- Two radiating fibres known as asters can be seen around the centriole at each pole.
- The duplicated chromosomes can be seen moving towards the equator.
- Nuclear membrane disappears.

3. Centriole

4. **i.** Centromere **ii.** Chromatid **iii.** Spindle fibres

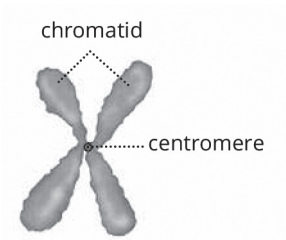
5. Metaphase follows this stage which can be identified by the arrangement of chromosomes on the equatorial plane in such a way that their centromeres lie on the equator and arms face towards the poles.

6. **a.** In mitotic cell division, two daughter cells are formed whereas in meiotic cell division, four daughter cells are formed.

   b. In mitotic cell division, the daughter cells contain the same number of chromosomes as in the parents cells.

   In meiotic cell division, the daughter cells contain half the normal number (diploid) of chromosomes.

7. Duplicated chromosome



C. 1. ii → i → v → viii → iii → vi → iv → vii

2. In **iii**, the sister chromatids separate and begin to move towards the opposite poles due to the contraction of spindle fibres.

   In **iv**, the chromatids uncoil, elongate and change into network of chromatin threads. The nuclear membrane reappears around the chromatin network at each pole.

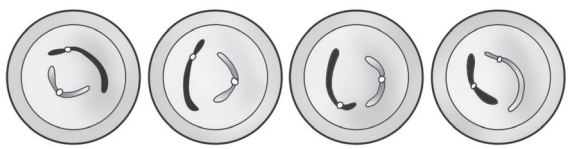
3. Mitosis is an equational division in which two daughter cells produced are identical to each other and even to their parent cell in every respect. The same diploid chromosome number of the parent cell is maintained at each stage of mitotic division of the cell. Since no crossing over takes place in mitosis, the daughter cells produced are genetically identical.

D. 1. Meiotic cell division

2. Animal cell

3. **iii → ii → iv → i**

4. These drawings show the stages of meiotic division. It will be followed by the cytokinesis.



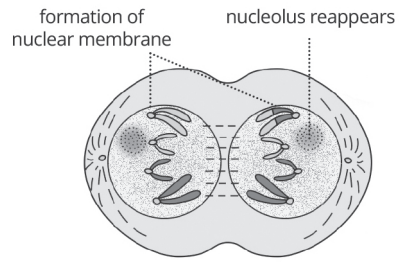
The cell divides into four parts each containing half the number of chromosomes possessed by the original cell.

E. 1. The stage shown in the diagram is anaphase of mitotic cell division. The stage can be identified as anaphase because the sister chromatids separate and begin to move towards the opposite poles due to the contraction of spindle fibres.

2. **i.** Centriole **ii.** Spindle fibres **iii.** Chromatid

3. Four

4.



Early telophase

5.

Mitosis in animal cells	Mitosis in plant cells
Spindle fibres and aster are formed by the centrioles.	Spindle fibres are formed by the microtubules in the cytoplasm.
Cytokinesis occurs by constriction or furrow formation in the cytoplasm. It starts from the periphery and proceeds towards the centre.	Cytokinesis occurs by cell plate formation. It starts at the center and proceeds towards the periphery.

F. 1. It is a plant cell. The cell can be identified as plant cell due to the presence of cell wall.

2. Anaphase

3. **i.** Chromatids

   ii. Pole

   iii. Spindle fibres

4. Sequence of events during anaphase:

   The centromere of each chromosome divides into two halves (sister chromatids) so that each chromatid has its own centromere.

   The sister chromatids separate and begin to move towards the opposite poles due to the contraction of spindle fibres, and due to the repelling force developed between them.

   The anaphase ends when all the chromatids (now behaving like chromosomes) reach the opposite poles.

5. **a.** Mitosis **b.** Meiosis