

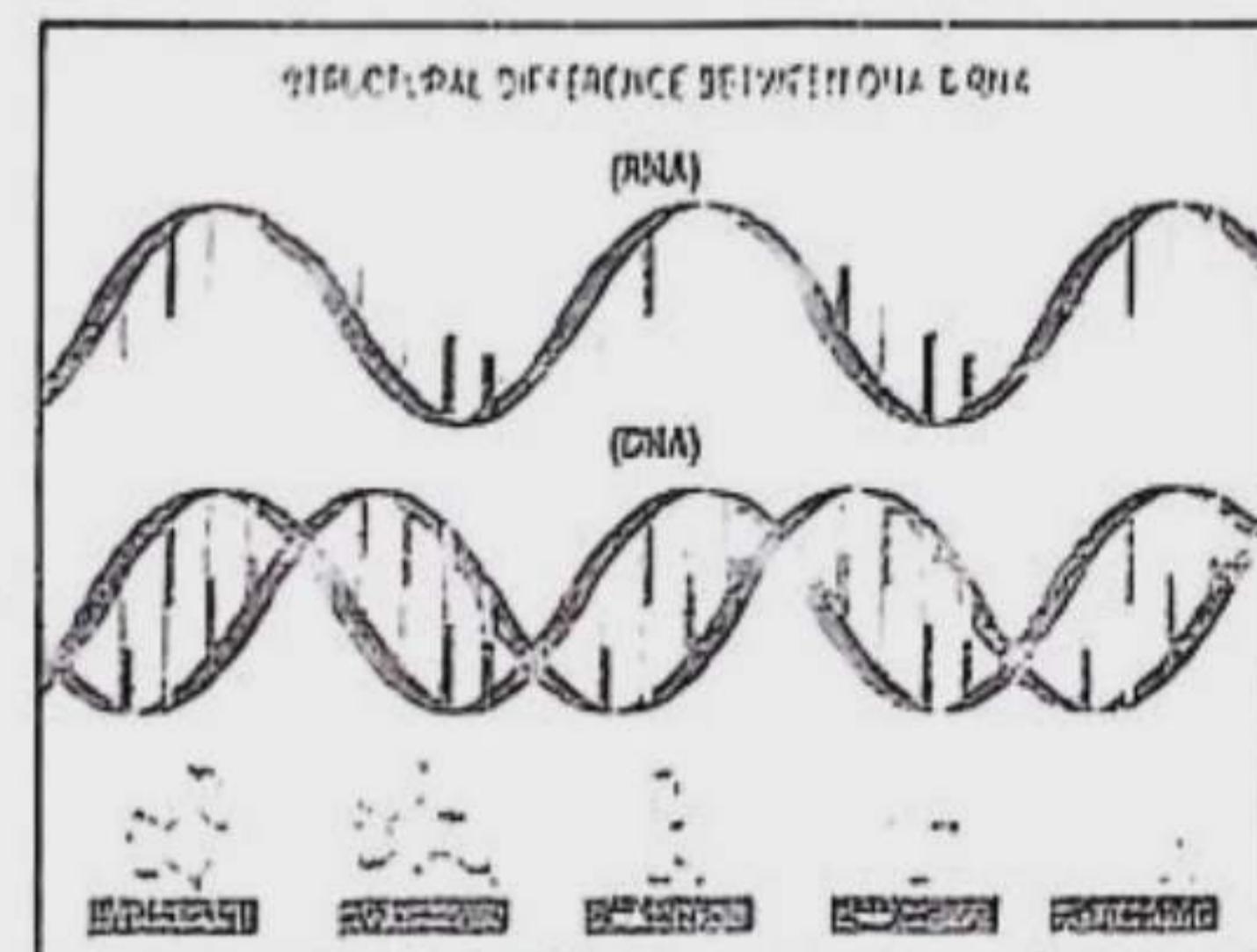
# Growth and Heredity of Living Organism

## Contents for Discussion

- Types of cell division
- The process of mitosis cell division
- Pro-metaphase, metaphase, anaphase and telophase
- Telophase
- Meiosis
- The role of chromosome, DNA and RNA in determining heredity

**Learning Outcomes :** After studying this chapter, I will be able to-

- explain the types of cell divisions;
- explain the growth and development of living organism through cell division;
- explain what role cell division plays to restore genetic trait.



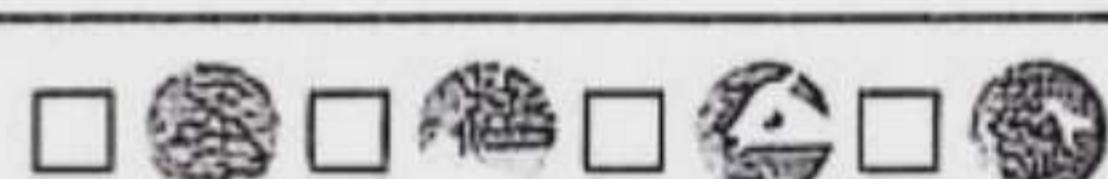
## Practice

Multiple Choice, Short & Creative Q/A  
following 100% accurate format for best prep.

Dear learners, the Q/A of this chapter have been divided into exercise, multiple choice, short, creative & exercise-based activities in light of the learning outcomes. Practice the questions well to ensure the best preparation in the exam.

## Textual Q/A

## Let's learn the textbook Q/A



### Fill in the Blanks

1. In — stage the chromosomes with their chromatid take position at the equatorial region.
  2. Reduction of chromosome occurs in — division.
  3. In *Amoeba* — is found.
  4. The nature of chromosome in somatic cells is —.
  5. The division of nucleus is called —.
- Ans. 1. metaphase; 2. meiosis; 3. amitosis; 4. diploid; 5. caryokinesis.

### MCQs with Answers

Put tick (✓) the correct answer :

1. In which stage of mitosis chromosomes become shorter and thicker?  
Ⓐ Prophase Ⓑ Pro-metaphase  
Ⓒ Metaphase Ⓒ Anaphase
2. Which of the following controls eye colour?  
Ⓐ DNA Ⓑ RNA  
Ⓒ Nucleolus Ⓒ Centromere

► **Explanation :** DNA is the main component of chromosomes. Normally the DNA molecules of chromosomes are the actual carriers of the organism's characteristics and carry the organism's characteristics through heredity. So the segment of DNA that controls the trait is called a gene. Multiple genes function for a single trait in an organism, and in some cases a single gene controls several traits. Human eye color, hair type, skin texture etc. are all controlled by genes i.e. DNA.

► **Read the following paragraph and answer questions no. 3 & 4 :**

Safwan was examining the root cell of onion under a microscope. In a cell division stage he found that there is no nuclear membrane and nucleolus, but chromosomes are located right in the middle.

3. Which stage of cell division Safwan observed?  
Ⓐ Prophase Ⓑ Pro-metaphase  
Ⓒ Metaphase Ⓒ Anaphase

► **Explanation :** Explanation: Safwan observed metaphase stage of cell division. At this stage the chromosomes arrive at the equatorial region of the spindle apparatus and are attached with the centromere by fibre. At this stage the chromosomes remain right in the middle of the cell.

4. In the next phase of Safwan's observation —  
 i. chromosomes get detached from centromere.  
 ii. chromatid segregates from each other.  
 iii. centromere divides into two sections.

Which one of the following is correct?

- C) @ i & ii    @ i & iii    © ii & iii    ® i, ii & iii  
 ► Explanation : The observed stage of Safwan is metaphase. The next stage is anaphase. In this stage, the centromere of each chromosome splits into two parts, so that each chromatid has one centromere. In this condition the chromatids are separated from each other.

### Creative Questions with Answers

**Ques. 01** Mr. Farabi, the class teacher, was discussing cell division in the science class. He said, "during a stage in cell division, thread like centromere in the nucleus divides into two parts. As a result the number of chromosomes remain unchanged in the divided cells."

- a. Which type of cell division produces germ cells? 1  
 b. What do you mean by amitosis?— Explain. 2  
 c. Describe with diagram the stage of cell division that Mr. Farabi describes. 3  
 d. Explain the role of thread like structure that Mr. Farabi describes. 4

#### Answer to Question No. 01 :

- a) Germ cells or reproductive cells are produced through meiosis cell division.  
 b) The process of cell division in unicellular prokaryotic organisms like bacteria, yeast, amoeba, etc. is called amitosis. During this process, the nuclear materials are directly divided into two portions and then the cell divides into two from the middle region. As a consequence, from one cell there develops two cells.  
 c) The 'certain stage' discussed by Mr Farabi is anaphase.

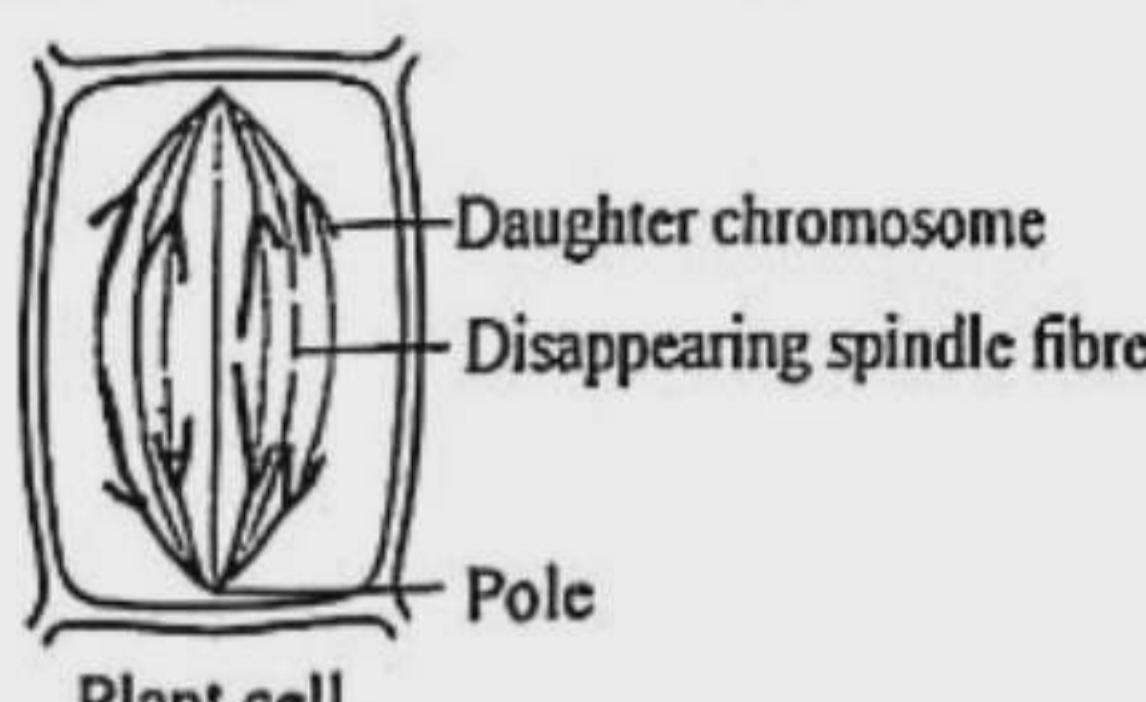


Fig : Anaphase.

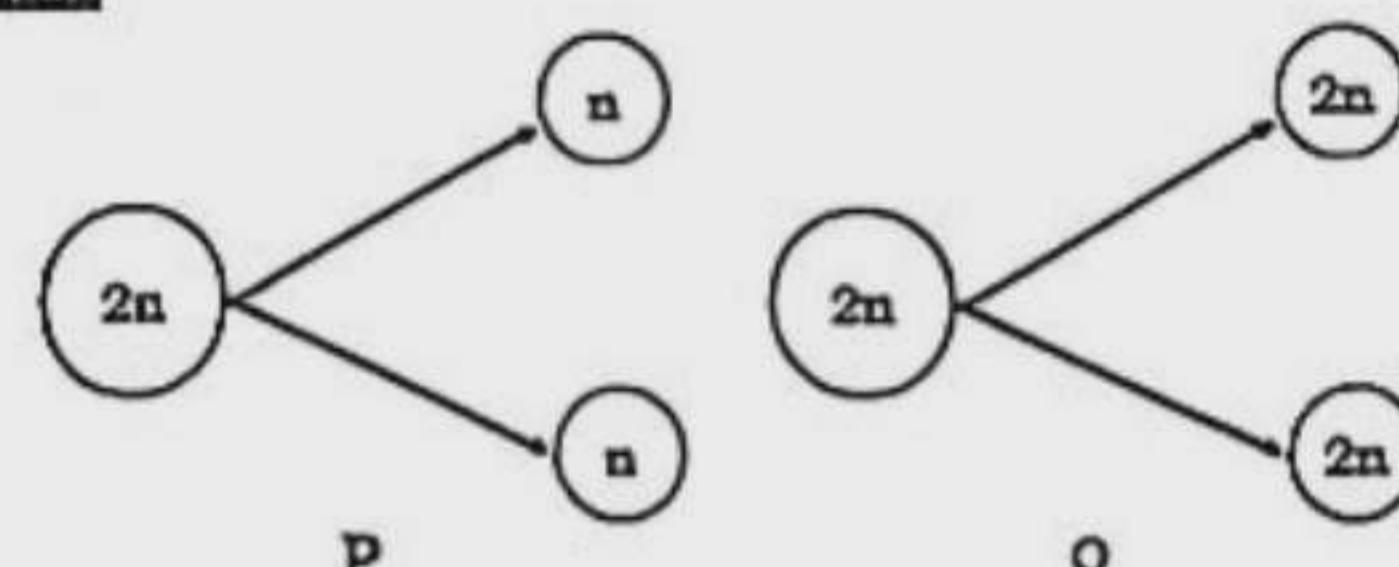
1. The centromere of the chromosome now splits so that two independent daughter chromosome, each with its own centromere, are formed.
2. The chromatids get separated from each other. At this stage each chromatid is called daughter chromosome.

3. Then the contraction of the attraction fibers attached to the chromosomes causes half of the daughter chromosome to move towards the north pole and half towards the south pole. In this time, the chromosomes take the shape of English letter V, L, J or I according to the position of centromere.

- d) The thread-like substance mentioned by Mr Farabi is chromosome. DNA is the main constituent of chromosome. It regulates hereditary features of living beings. It carries the characteristics of parents to offsprings. The small portion of a chromosome is called 'gene'. DNA molecule is the chemical form of gene. The trend of heredity goes on through meiotic cell division. So it is called the physical base of heredity.

A number of genes are responsible for a certain feature of a living being. In some cases, a single gene regulates a number of features. Complexion, hair pattern, colour of eyes — all are regulated by gene. Chromosome carries gene from one generation to another. It also determines the gender of an offspring — male or female.

#### Ques. 02



- a. How many chromosomes are there in a human somatic cells? 1  
 b. What do you mean by gene? 2  
 c. Explain cell division P. 3  
 d. In case of higher animals compare the cell divisions P and Q. 4

#### Answer to Question No. 02 :

- a) There are 23 pairs or 46 chromosomes in every somatic cell.

- b) Genes are DNA located on chromosomes. The DNA molecule is the chemical form of the gene. In organisms that do not have DNA, contain only RNA, RNA acts as a gene. Human eye color, hair type, skin color etc. are all controlled by genes. Chromosomes keep the line of heredity intact by acting as a carrier to carry genes from one generation to the next.

- c) According to the stimulus diagram, P cell division is meiosis cell division. During meiosis cell division a generative mother cell divides in two consecutive steps. The first division is called meiosis-1 and the second division is called

meiosis-2. The chromosome number of the two daughter cells produced during the first division is half that of the mother cell. The second division is similar to the mitosis division. That is, each cell produced in the first division divides again to form two daughter cells. In this case, the chromosome number of the offspring cell is equal to the chromosome number of the mother cell. As a result, four daughter cells ( $n$ ) are formed from one reproductive mother cell ( $2n$ ).

**d** In the stimulus diagram, P is meiosis and Q is mitosis cell division. Both divisions occur in intelligent animals. Below is a comparative analysis of meiosis and mitosis cell division in intelligent animals:

- Sexual reproduction is accomplished by meiosis. As a result, the chromosome number in the zygote is cell to the chromosome number of

the species. On the other hand, mitotic cell division is a type of cell division process.

- Meiosis cell division produces four cells from one cell. On the other hand, in the process of mitosis, the mother cell divides to produce two identical daughter cells.
- In meiosis the chromosomes divide once and the nucleus divides twice. On the other hand, in mitosis, the nucleus of the mother cell divides only once.
- The number of chromosomes in the four cell nuclei produced by meiosis division is half the number of chromosomes in the mother nucleus. On the other hand, in mitosis division, the chromosome number of the mother cell remains the same. That is, the number of chromosomes remains unchanged.



## Multiple Choice Q/A



Designed as per topic



### Lesson-1 : Types of cell division

► Textbook Page 14

- Life of a multicellular animal begins with —. (Application)
  - ab
  - bc****
- Amitosis takes place in —. (Comprehension)
  - cSpongilla    **dHydra    **cAmoeba    **dScypha********
- Amitosis does not take place in —. (Comprehension)
  - ab
  - dc****
- What is amitosis called? (Knowledge)
  - a
  - b
  - c
  - a********
- Direct cell division takes place in —. (Comprehension)
  - ab
  - bd****
- In case of plants, mitosis takes place in —. (Comprehension)
  - ab
  - cd****
- What does somatic cell produce? (Application)
  - abcd**
- Where does mitosis take place in plants? (Comprehension)
  - ab
  - dd****

### 9. Cytokinesis includes —. (Comprehension)

- i. deposition of plasmalemma particles
- ii. formation of cell plate
- iii. formation of cell wall

Which one is correct?

- dabcd**

### 10. Cytokinesis refers to —. (Higher ability)

- i. formation of cell plate
- ii. formation of cell wall
- iii. formation of daughter cell

Which one is correct?

- dabcd**

Read the following passage and answer the question numbers 11 and 12 :

*Amoeba* runs its reproduction through the process called amitosis. Amitosis is applicable to unicellular organisms only.

### 11. What phylum does amoeba belong to? (Knowledge)

- ab
- ad****

### 12. Amitosis refers to —. (Comprehension)

- i. division of nucleus
- ii. division of cytoplasm
- iii. formation of daughter cells

Which one is correct?

- dabcd**

Read the following passage and answer to the questions No. 13 and 14 :

A science teacher was discussing about cell division in the class. He said that though there are four chromosomes at the initial stage of cell division at the last stage there are two chromosomes.

[DB '19]

13. After the stem, where does the cell division occur? (Comprehension)  
 @ Inside the stamen      ⑤ Apex of root  
 ⑥ Buds      ⑦ In the stem
14. After the mentioned cell division the cells will be—. (Application)  
 i. gamete  
 ii. diploid  
 iii. haploid
- Which one is correct?  
 ⑥ ⑧ i & ii      ⑨ i & iii      ⑩ ii & iii      ⑪ i, ii & iii
15. How many types of cell division are there in the animal body? (Knowledge) [J.B.-'19]  
 ⑫ ⑬ 2      ⑭ 3      ⑮ 4      ⑯ 5
16. Where is direct cell division occurred? (Comprehension) [RB '18]  
 ⑰ Yeast      ⑱ Stem  
 ⑲ Radical      ⑳ Reproductive mother cell

### Lesson-2 : The process of mitosis cell division

► Textbook Page 16

17. What stage is the very beginning of cell division? (Knowledge)  
 ② Prophase      ④ Interphase  
 ③ Pro-metaphase      ⑤ Anaphase
18. How many phases has karyokinesis been divided into? (Knowledge)  
 ④ ⑤ 3      ⑥ 4      ⑦ 5      ⑧ 6
19. What phase does mitosis begin with? (Knowledge)  
 ① Metaphase      ③ Pro-metaphase  
 ② Interphase      ④ Prophase

■ Read the following passage and answer the question numbers 20 – 21 :

Teacher was talking about the longest lasting stage of mitosis. There are five phases in this stage. It takes place in both plant cells and animal cells.

20. What stage precedes mitosis? (Knowledge)  
 ③ Interphase      ⑤ Telophase  
 ④ Anaphase      ⑥ Metaphase
21. This process does not take place in —. (Higher ability)  
 i. nerve cells of animals  
 ii. red blood cells of mammals  
 iii. platelets of mammals
- Which one is correct?  
 ⑥ ⑦ i & ii      ⑧ ii & iii      ⑨ i & iii      ⑩ i, ii & iii

22. One of the followings is related to prophase state in animal cells only. What is it? (Application)

- ① Chromatid      ⑤ Centriole  
 ② Chromatin      ⑥ Centromere

23. Shorter lasting than prophase —. (Comprehension)  
 i. pro-metaphase  
 ii. metaphase  
 iii. anaphase

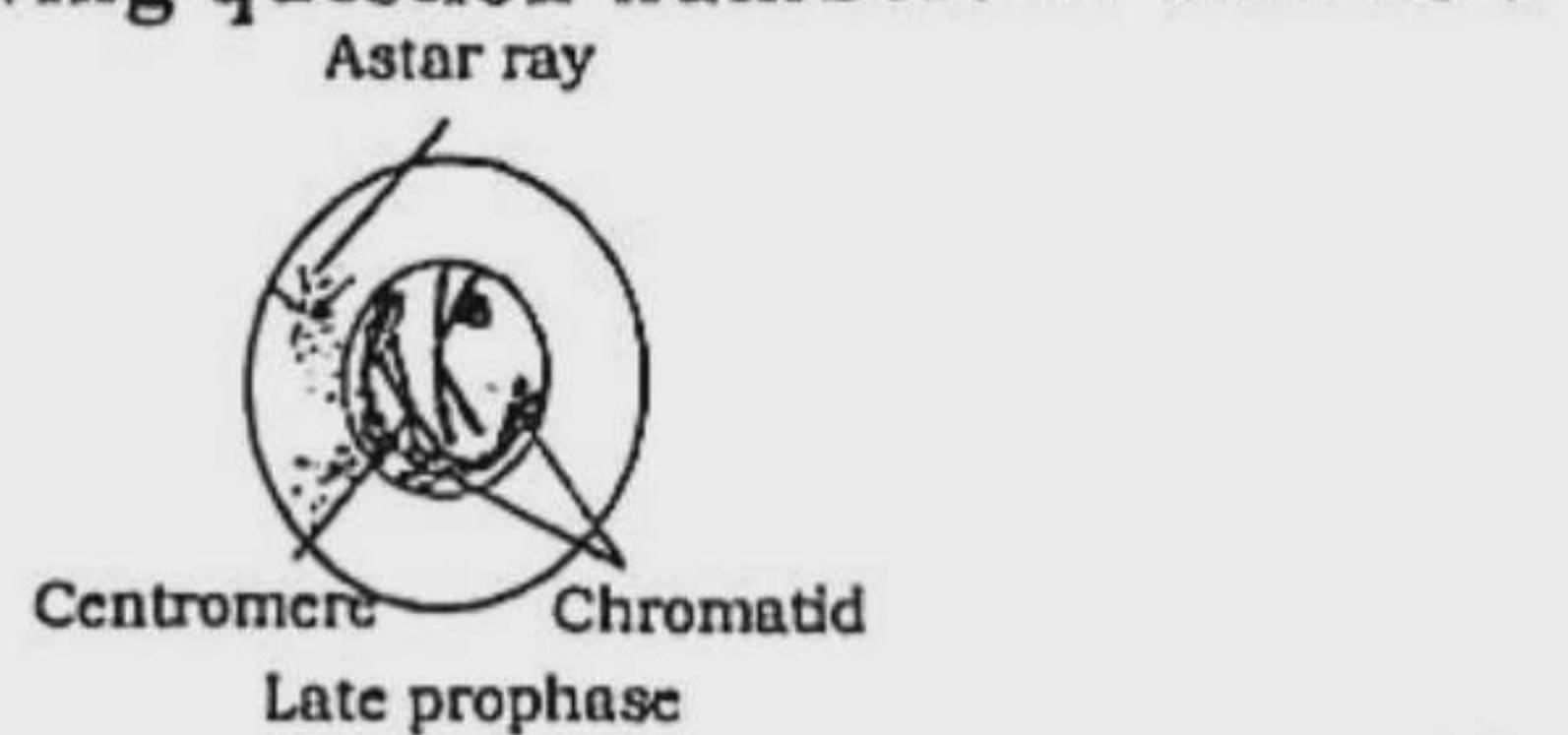
Which one is correct?

- ⑥ ⑦ i & ii      ⑧ ii & iii      ⑨ i & iii      ⑩ i, ii & iii

### Lesson-3 : Pro-metaphase, metaphase, anaphase and telophase ► Textbook Page 17

24. At what phase do the chromosomes stay along the equatorial plane? (Comprehension)  
 ② Metaphase      ④ Pro-metaphase  
 ③ Anaphase      ⑤ Telophase
25. At what stage the centromeres divide into two? (Comprehension)  
 ② Pro-metaphase      ④ Metaphase  
 ③ Anaphase      ⑤ Telophase
26. At what stage do the chromosomes proceed towards both poles of a cell? (Comprehension)  
 ② Telophase      ④ Anaphase  
 ③ Interphase      ⑤ Prophase

■ Look at the picture below and answer to the following question numbers 27 and 28 :



27. Which one of the following appears at this stage in case of animal cells? (Knowledge)  
 ② chromosome      ④ nucleolus  
 ③ aster ray      ⑤ centromere
28. The elements that disappear at this phase —. (Comprehension)  
 i. nucleolus  
 ii. nuclear membrane  
 iii. spindle fibre

- Which one is correct?  
 ⑥ ⑦ i & ii      ⑧ ii & iii      ⑨ i & iii      ⑩ i, ii & iii
29. In which stage the daughter chromosomes reached their opposite poles? (Comprehension) [RB '19]  
 ② Pro-metaphase      ④ Metaphase  
 ③ Anaphase      ⑤ Telophase
30. In which stage of cell division nucleolus almost disappears? (Comprehension) [S.B.-'19]  
 ② Prophase      ④ Pro-metaphase  
 ③ Metaphase      ⑤ Anaphase
31. In which stage of cell division centromere is found in every chromatid? (Knowledge) [BB '19]  
 ② Prophase      ④ Pro-metaphase  
 ③ Metaphase      ⑤ Anaphase
32. In which step the shape of the chromosomes as like English alphabet 'J' in Mitosis cell division? (Knowledge) [Din.B.-'19]  
 ② Prophase      ④ Metaphase  
 ③ Anaphase      ⑤ Telophase
33. Daughter chromosomes are created in which step of mitosis cell division? (Knowledge) [RB '18]  
 ② Pro-metaphase      ④ Metaphase  
 ③ Anaphase      ⑤ Telophase

34. At which stage the shapes of chromosomes look like V, L, J or I in mitosis cell division? (Higher ability) [JB '18]
- A Prophase       B Metaphase  
 C Anaphase       D Telophase
35. How many daughter cells will produce from three mother cells in mitosis cell division? (Higher ability) [CB '18]
- A 3       B 5       C 6       D 12
36. In which stage the centromere of the chromosome is divided into two parts? (Knowledge) [BB '18]
- A Prophase       B Metaphase  
 C Anaphase       D Telophase

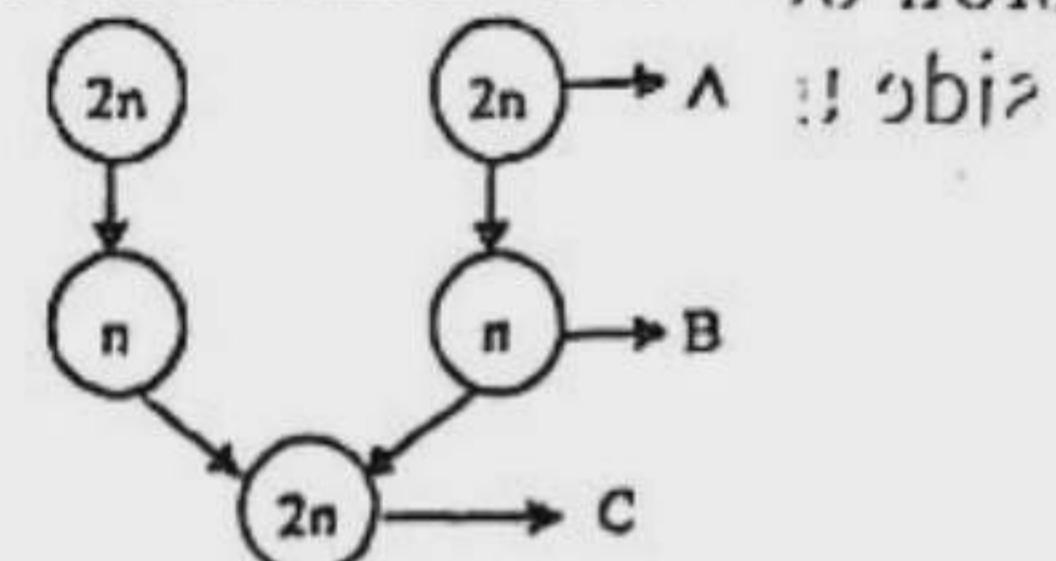
#### Lesson-4 : Telophase ► Textbook Page 18

37. Telophase includes —. (Comprehension)
- i. reappearance of nucleolus
  - ii. formation of centriole
  - iii. formation of nuclear reticulum
- Which one is correct?
- A i & ii       B ii & iii       C i & iii       D i, ii & iii
38. Telophase refers to —. (Comprehension)
- i. division of centromere
  - ii. formation of daughter nucleus
  - iii. end of karyokinesis
- Which one is correct?
- A i & ii       B ii & iii       C i & iii       D i, ii & iii

#### Lesson-5 & 6 : Meiosis ► Textbook Page 19

39. The vitality of meiosis lies in —. (Higher ability)
- i. sexual reproduction
  - ii. asexual reproduction
  - iii. growth
- Which one is correct?
- A i & ii       B ii & iii       C i & iii       D i, ii & iii
40. In which of the followings, meiosis cell division occurs? (Application) [CtgB '19]
- A Floral axis       B Apex of root  
 C Buds       D Stamen
41. In which part of a plant meiosis cell division takes place? (Comprehension) [SB '19]
- A In stem       B In buds  
 C In root       D In stamen

42. From the figure below answer the questions No. 42 and 43: (Higher ability) [MB '19]



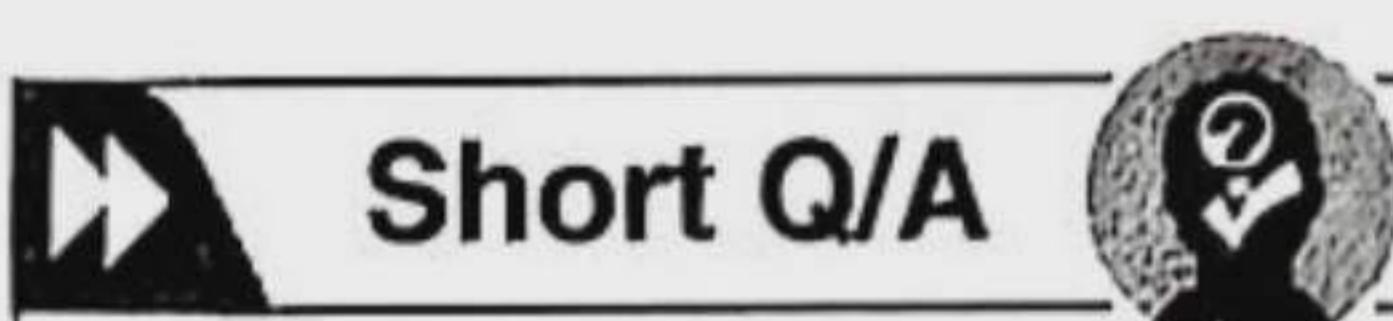
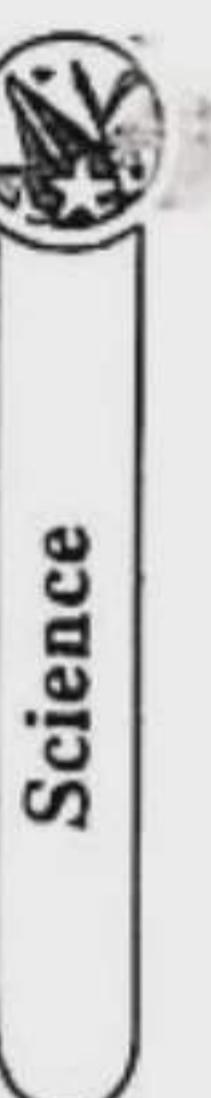
42. Which is the diploid? (Comprehension)
- A B and C       B A and C  
 C A and B       D A, B and C
43. Characteristics of the figure is— (Higher ability)
- i. the number of chromosomes of a species remains constant
  - ii. the number of chromosomes of gamete is half of the number of chromosomes of mother cell
  - iii. chromosomes divide once and the nucleus divides twice
- Which one is correct?
- A i & ii       B i & iii       C ii & iii       D i, ii & iii

44. Which one is the feature of meiosis cell division? (Comprehension) [MB '19]
- A It takes place in somatic cell  
 B It is an equational division  
 C Nucleus divides only once  
 D Chromosome divides only once
45. In which of the following meiosis occurs? (Comprehension) [JB '18]

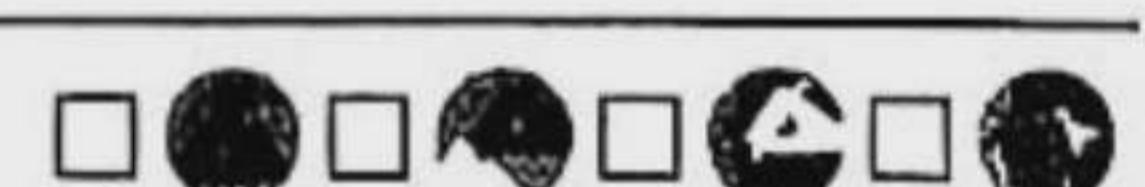
- A Neuron       B Body cell  
 C Mother cell       D Platelets

#### Lesson-7-9 : The role of chromosome, DNA and RNA in determination of heredity ► Textbook Page 21

46. Who is called the father of genetics? (Knowledge)
- A Gregor Mendel       B Charles Darwin  
 C Carolus Linnaeus       D Carl Landsteiner
47. How many types of nucleic acid are there? (Knowledge) [JB '19]
- A 1       B 2       C 3       D 4
48. How many pairs of chromosomes are there in the human body? (Knowledge) [DjB '19]
- A 22       B 23       C 24       D 25
49. The physical basis of heredity is —. (Knowledge) [SB '18]
- A Chromosome       B Gene  
 C DNA       D RNA



Designed as per topic



#### Lesson-1 : Types of cell division ► Textbook Page 14

##### Question 1. What is cell division? Explain.

Ans. Cell division is the process by which the number of cells increases for the purpose of growth and reproduction of an organism. Unicellular organisms divide from one to two, and from two to

four cells by cell division, and thus reproduce. The number of cells in a multicellular organism increases, resulting in the overall growth of the organism.

##### Question 2. How many types of cell division are there and what are they?

Ans. There are three types of cell division in organisms, namely :

1. Amitosis
2. Mitosis
3. Meiosis

**Question 3.** Write two characteristics of amitosis cell division.

**Ans.** Two characteristics of amitosis cell division are:

1. The nucleus and cytoplasm of the mother cell are directly divided to form two daughter cells.
2. The nucleus takes the shape of a dumb bell.

**Question 4.** Write the names of two organisms in which amitosis cell division occurs.

**Ans.** Two organisms in which amitosis cell division occurs are :

1. Yeast
2. Amoeba

**Question 5.** Why does amitosis not occur in the human body?

**Ans.** Primitive and unicellular organisms do not have a well-organized nucleus. Therefore, amitosis cell division is completed in these organisms. But humans are multicellular and have a well-organized nucleus. That is why amitosis does not occur in the human body.

**Question 6.** Write two characteristics of mitosis division.

**Ans.** Two characteristics of mitosis division are:

1. In this process, the nucleus of the mother cell is divided only once.
2. The number of chromosomes of the mother cell and the daughter cell remains the same.

**Question 7.** Why is mitosis cell division important for organisms?

**Ans.** Mitosis cell division is very important for organisms. Because as a result of mitosis cell division, the number of cells increases and plants and animals grow in length and width. If mitosis cell division did not occur, the physical growth of plants and animals would be disrupted. Even if the mitosis cell division process did not occur, the size, shape, and volume of the cell would not be correct. As a result, a chaotic situation would be created.

**Question 8.** What is meiosis cell division? Explain.

**Ans.** Meiosis cell division is a type of cell division in which the nucleus divides twice and the chromosomes divide once, and the number of chromosomes in the daughter cell is half that of the mother cell. This type of division is also called reduction division because the number of chromosomes is reduced. This type of cell division occurs during the formation of male and female gametes from the reproductive mother cell.

**Question 9.** Where does mitosis division occur?

**Ans.** Mitosis division occurs in somatic cells of organisms with a true nucleus. This type of division is seen in the dividing tissue of the growing part of the plant, such as the apex of the stem and root, radicle and plumule, growing leaves, buds, etc. This type of division occurs in somatic cells of the animal body, during embryo development, and during asexual reproduction of lower animals and plants.

**Question 10.** In which cells does mitosis division not occur?

**Ans.** Mitosis division does not occur in nerve cells (neurons) of the nervous tissue of animals, mature red blood cells and platelets of mammals, and cells of permanent tissue of plants.

**► Lesson-2 : The process of mitosis cell division**

► Textbook Page 16

**Question 11.** How many stages are there in mitosis cell division and what are they?

**Ans.** Mitosis cell division has been divided into five stages. The stages are:

1. Prophase
2. Pro-metaphase
3. Metaphase
4. Anaphase
5. Telophase

**Question 12.** Write two differences between amitosis and mitosis cell division.

**Ans.** Two differences between amitosis and mitosis cell division are :

Amitosis	Mitosis
1. Occurs without a complex and intermediate stage.	1. Occurs through a complex and continuous process.
2. In this process, the nucleus takes the shape of a dumb bell.	2. The nucleus does not form a dumb bell-shaped structure.

**Question 13.** Mention two characteristics of the prophase stage.

**Ans.** Two characteristics of the prophase stage are:

1. The nucleus of the cell becomes larger in size.
2. The nuclear network breaks down to form chromosomes.

**► Lesson-3 : Pro-metaphase, metaphase, anaphase and telophase**

► Textbook Page 17

**Question 14.** What is meant by the equatorial region?

**Ans.** In cell division, the equatorial region refers to a specific region in the center of the cell during mitosis or meiosis division. In this region, the chromosomes are located in a row in the intermediate stage of division.



**Question 15.** Give an idea about the attraction fiber.  
**Ans.** In the pro-metaphase stage of mitosis cell division, the attraction fibers are the fibers of the spindle apparatus that are attached to the centromere of the chromosome.

**Question 16.** Mention two characteristics of the pro-metaphase stage.

**Ans.** Two characteristics of the pro-metaphase stage are:

1. The nuclear membrane and nucleolus almost disappear.
2. The spindle apparatus appears in this stage.

**Question 17.** Write two characteristics of the metaphase stage.

**Ans.** Two characteristics of the metaphase stage are:

1. In this stage, the chromosomes are the shortest and thickest.
2. The chromosomes come to the equatorial region of the spindle apparatus and are attached to the centromere by fibers.

#### ► Lesson-4 : Telophase ► Textbook Page 18

**Question 18.** Write two characteristics of the telophase stage.

**Ans.** Two characteristics of the telophase stage are:

1. In this stage, the daughter chromosomes reach the opposite poles.
2. The nuclear membrane and nucleolus reappear around the chromosomes at both poles.

**Question 19.** In which stage of mitosis cell division do the chromosomes take positions at the poles?

**Ans.** In the anaphase stage of mitosis cell division, the daughter chromosomes take positions at the poles of the spindle apparatus and the length of the chromosomes continues to increase.

**Question 20.** Briefly describe the aster rays.

**Ans.** In the pro-metaphase stage of mitosis cell division, in addition to the formation of the spindle apparatus in animal cells, the previously divided centrioles are located at the two poles. At this time, rays radiate from around the two centrioles. These are called aster rays.

**Question 21.** How is the cell wall formed?

**Ans.** At the end of the telophase stage of mitosis cell division, small parts of the endoplasmic reticulum accumulate at the equatorial plane and then they combine to form the cell plate. The cell plate is transformed and developed into the cell wall.

#### ► Lesson-5 & 6 : Meiosis ► Textbook Page 19

**Question 22.** Mention two characteristics of meiosis.

**Ans.** Two characteristics of meiosis are:

1. The chromosomes divide once and the nucleus divides twice.
2. Four cells are created from a single cell.

**Question 23.** Where does meiosis occur?

**Ans.** Meiosis cell division mainly occurs in the reproductive mother cells of diploid ( $2n$ ) organisms during the creation of gametes. Meiosis occurs inside the stamen and carpel of flowering plants and in the testes and ovaries of higher animals. Meiosis also occurs in the zygote of haploid ( $n$ ) organisms.

**Question 24.** Why is meiosis-2 called analogous to mitosis division?

**Ans.** During meiosis cell division, a reproductive mother cell divides in two successive stages. The first division is called meiosis-1 and the second division is called meiosis-2. During the first division, the two daughter cells produced have half the number of chromosomes as the mother cell, which then, in the second division, each cell divides again to create two daughter cells. On the other hand, in mitosis cell division, the mother cell divides to create two identical daughter cells. This is why meiosis-2 is called analogous to mitosis division.

**Question 25.** Write two differences between mitosis and meiosis cell division.

**Ans.** Two differences between mitosis and meiosis cell division are :

Mitosis cell division	Meiosis cell division
1. Both the nucleus and chromosomes divide once.	1. The nucleus divides twice and the chromosomes divide once.
2. The number of chromosomes in the daughter cell is equal to the mother cell.	2. The number of chromosomes in the daughter cell is half that of the mother cell.

#### ► Lesson-7-9 : The role of chromosome, DNA and RNA in determination of heredity ► Textbook Page 21

**Question 26.** What are the parts of a chromosome?

**Ans.** Each chromosome has two main parts, namely:

1. Chromatid and
2. Centromere

**Question 27.** Write two differences between DNA and RNA.

**Ans.** Two differences between DNA and RNA are:

DNA	RNA
1. DNA is double-stranded.	1. RNA is single-stranded.
2. New DNA is created by replication in DNA.	2. No replication occurs in RNA.



**Question 28.** Why is Mendel called the father of heredity?

**Ans.** Once people's knowledge of heredity was imaginary. Later, scientists explained how the characteristics of parents are transmitted to their offspring. In the second half of the nineteenth

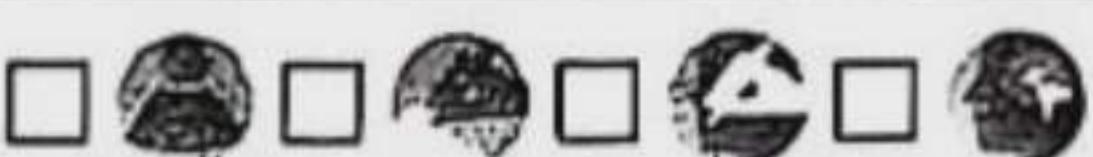
century, Gregor Johann Mendel first gave the correct idea about the laws of heredity. The modern theory of heredity that prevails today is based on the theory discovered by Mendel. This is why Mendel is called the father of heredity.



## Creative Q/A



## Designed as per learning outcomes



**Ques. 01** One evening Jitu kept some chick-peas in a bowl of water. The next morning she noticed a white substance that came out from each of the chick-peas. She asked her cousin, an intermediate student of science group, "How has it happened?" Her cousin replied, "It has formed from the embryo through the process of cell division called mitosis."

- What is the elaboration of TMV? 1
- How can you differentiate between amitosis and mitosis. 2
- Write the stages of mitosis cell division in a sequence and draw the labeled diagram of the last stage. 3
- At what phases of mitosis does the nuclear membrane disappear and re-appear? Describe the phases. 4

### Answer to Question No. 01 :

a) The elaboration of TMV is Tobacco Mosaic Virus.  
 b) I would like to mention it first that amitosis takes place in unicellular prokaryotic organisms like bacteria and amoeba but mitosis takes place in multicellular eukaryotic plant/animal cells. In amitosis, the nuclear materials are directly splitted into two portions and then the cells divides into two. But in mitosis, the nucleus and chromosome are divided once creating two daughter cells.

c) The stages of mitosis cell division : 1. Prophase, 2. Pro-metaphase, 3. Metaphase, 4. Anaphase. 5. Telophase.

Here is the labelled diagram of Telophase, the last stage of mitosis :

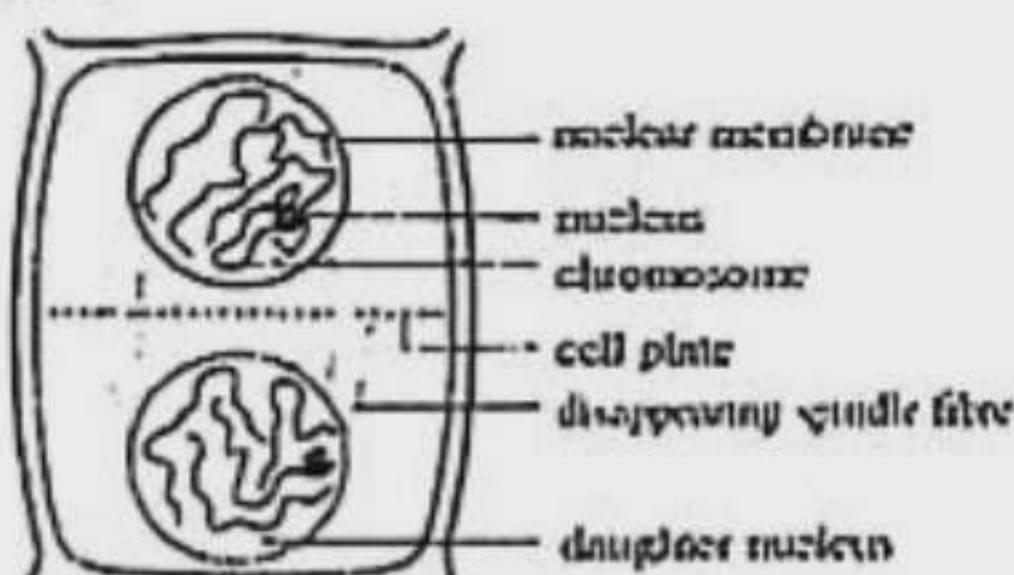


Fig : Telophase

d) The nuclear membrane disappears during the process pro-metaphase and it re-appears at the process telophase.

**Pro-metaphase :** At the beginnig of the stage, the fibrous protein converses to form bi-polar spindle apparatus. Each chromosome gets attached to a

fibre of the spindle apparatus by its centromere. In animal cells, aster rays are radiated from centrioles. **Telophase :** Daughter chromosomes take position at two opposite poles. Nuclear membrane and nucleolus re-appears. In case of animal cell, a centriole develops at each pole. The chromosomes become thin and long. They form nuclear reticulum. In this way two daughter cells are formed. Karyokinesis comes to an end.

**Ques. 02** Cell division occurs for growth and generation in animals with and without well-formed nucleus. It occurs directly in a number of cases and in sequential phases in other cases. Here is one of the phases of cell division.

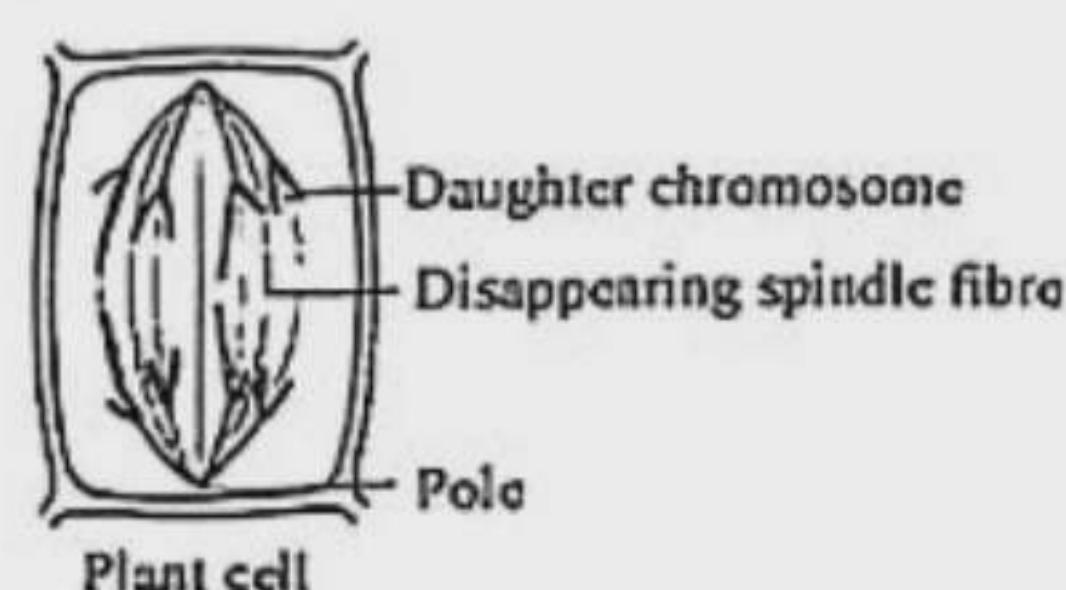


- What does DNA stand for? 1
- How is interphase related to Karyokinesis? 2
- What phase does the diagram denote? Copy and label the diagram. 3
- Who is the father of genetics? Represent the roles played by chromosome with regard to the proverb "Like father like son." 4

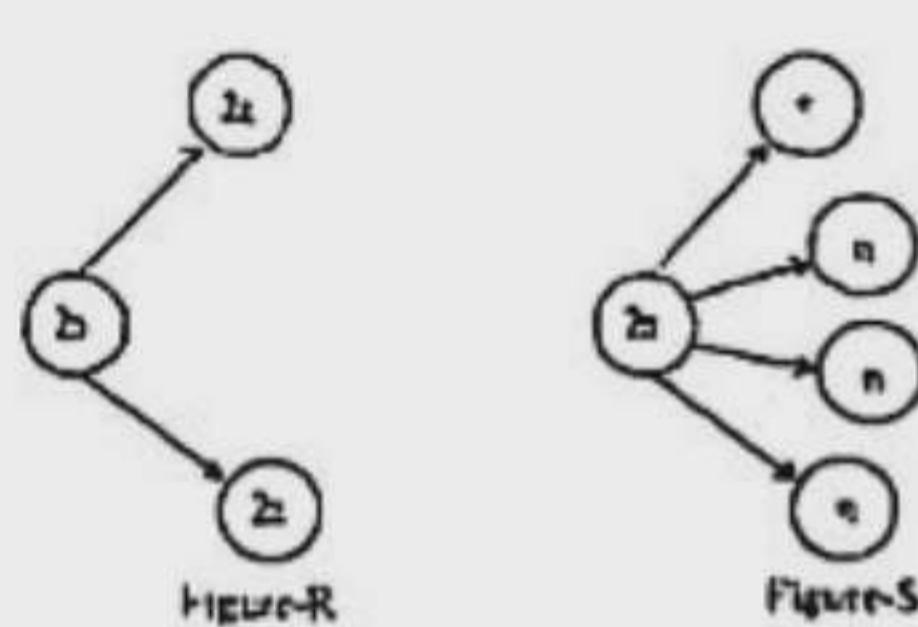
### Answer to Question No. 02 :

a) DNA stands for De-oxyribo Nucleic Acid.  
 b) Mitosis consists of two stages — Karyokinesis and Cytokinesis. The first stage is Karyokinesis which refers to the division of nucleus while the second stage is Cytokinesis which refers to the division of cytoplasm. But before these two processes, the nucleus has to perform certain preparatory activities. This stage is called interphase. Thus we have two consecutive phases named interphase and karyokinesis.

c) The diagram denotes anaphase.



**d** Gregor Johann Mendel is the father of genetics. The yarn-like substances in the nucleus are called chromosomes. They carry hereditary characteristics from parents to their kids. It is a continuous process and this is why there goes the proverb "Like father like son." The main element of chromosome is DNA which are the potential carrier of heredity. The DNA molecules in the chromosome is called gene. Different genes are responsible for different characteristics. Again, a single gene often regulates a number of characteristics. It controls complexion, hair pattern, facial structure, colour of the eyes, etc. A few diseases like asthma and diabetes are chromosomal or gene-borne. In some cases, mental illness is also a matter of heredity.

**Ques. 03**

- What is karyokinesis? 1
- Chromosome has a role in heredity—Explain. 2
- Draw a labelled figure of the fourth step of R. 3
- Analyze the importance of cell division in the figure-S in retaining heredity of the species. 4

• Dhaka Board 2019

**Answer to Question No. 03 :**

- In the process of mitosis, the division of nucleus is known as karyokinesis.
- Chromosome acts as carrier and transmit gene from one generation to next generation, thus maintains the continuity of hereditary traits.
- Fig-R of the stem represents mitosis cell division. The fourth step of mitosis cell division is anaphase. A labelled diagram of anaphase cell division is drawn below—.

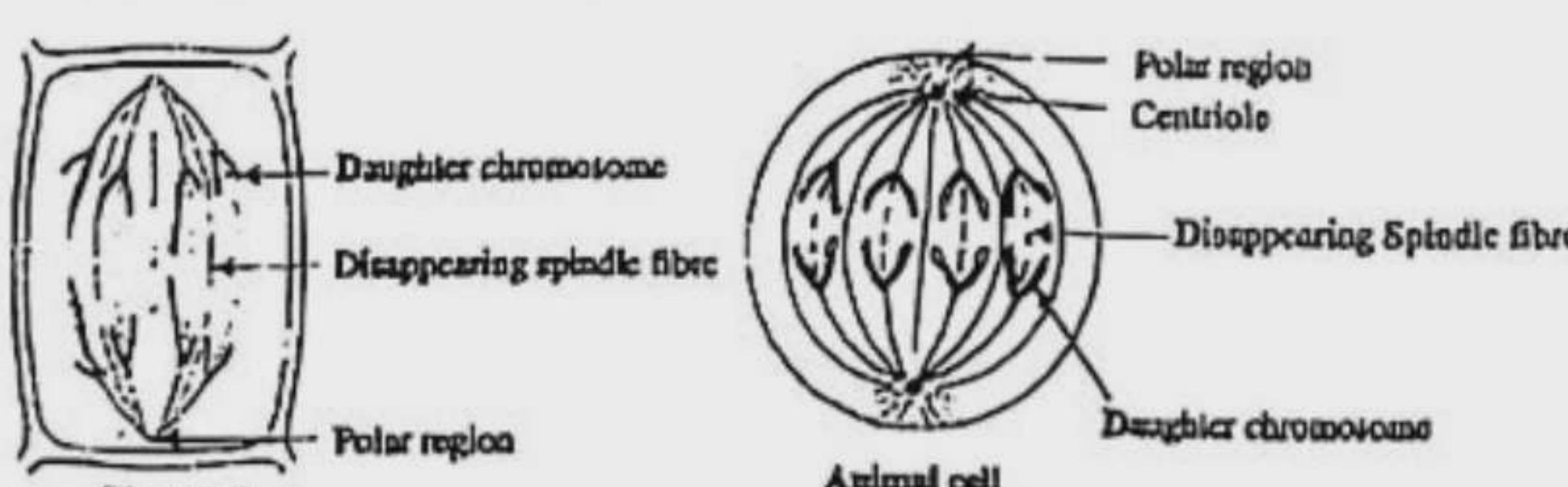
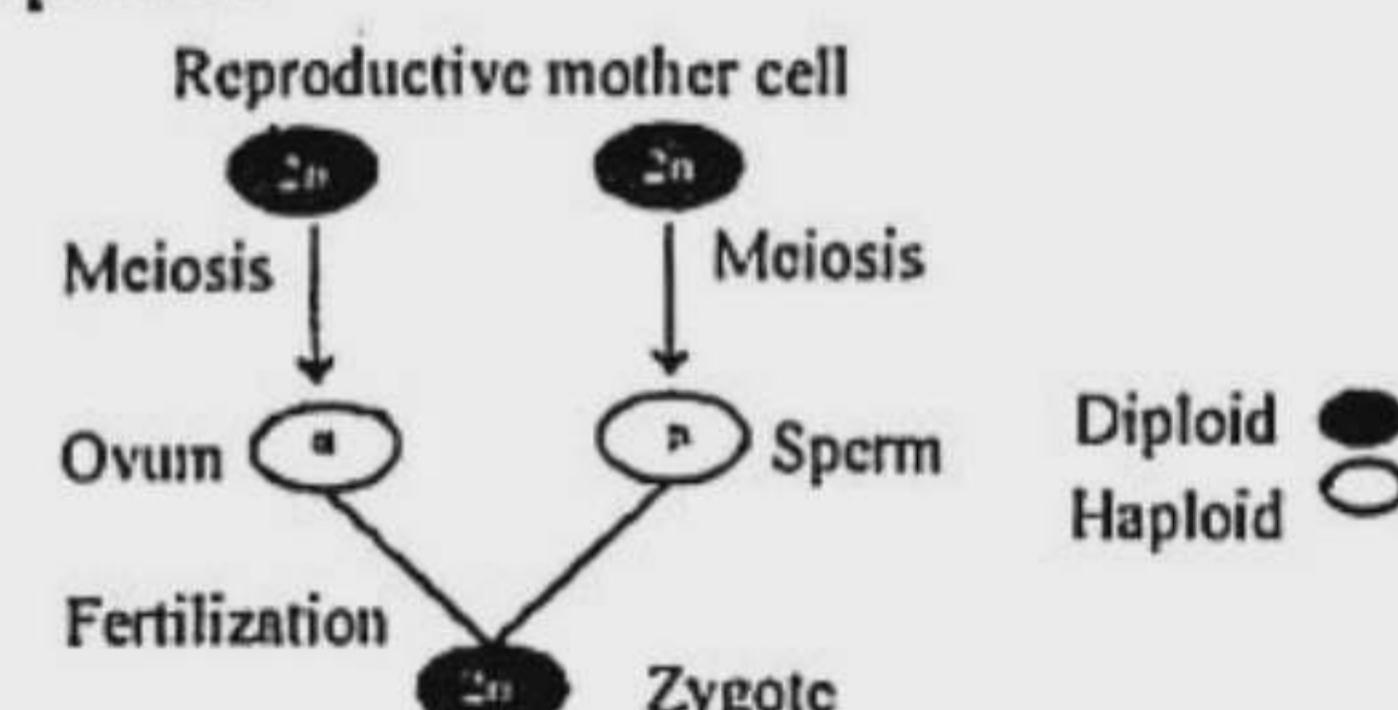


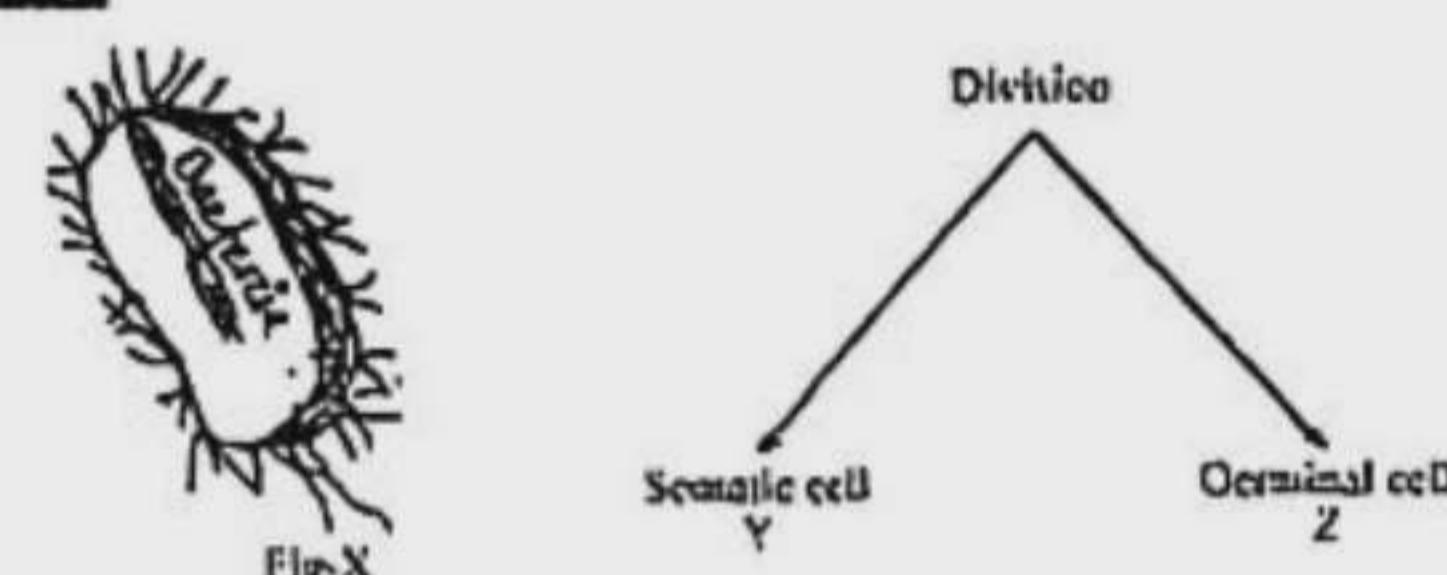
Fig. Anaphase

**c** Figure-'S' of the stem represents meiosis cell division. In case of sexual reproduction two gamete (male & female) cells unite together to form a zygote. So, if the number of chromosome in gamete cells does not reduce to half of the mother cell, the number of chromosome becomes double as a result of the union of the two gametes. In case of meiosis mother cell divides and produces daughter cells bearing half the number of chromosomes of mother cell. The number of chromosome remain same, as the mother cell, in the newly formed zygote resulted from the union of such two gamete cells. As a result of cell division by meiosis the number of chromosomes of a species remains constant generation after generation. This happens during formation of gamete and in certain stage of life cycle of the lower plant. This stage of chromosome is called haploid ( $n$ ). When two haploid cell unite, the state of chromosomes is called diploid.



Formation of zygote due to meiosis cell division.

So, the features of the organism are retained in the successive generation by meiotic cell division.

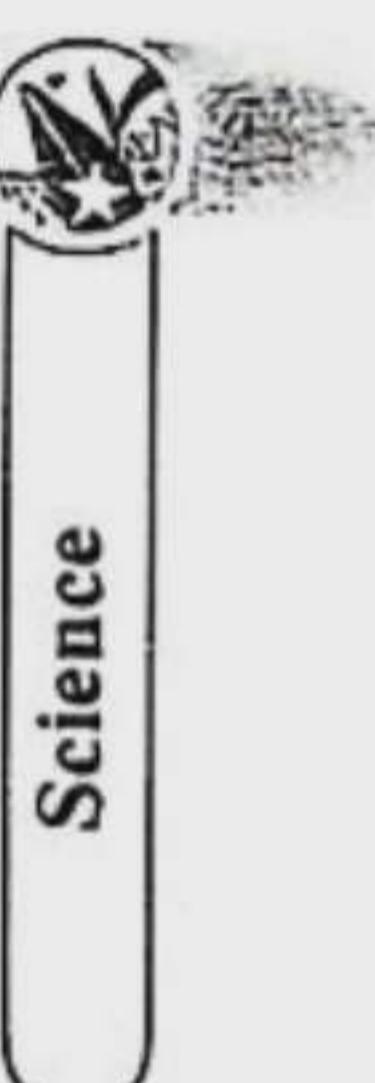
**Ques. 04**

- What is called Cytokinesis? 1
- Explain in which stage the chromosomes are found shortest and quite thick. 2
- Describe the reproduction process of 'X'. 3
- 'Y' and 'Z' play an important role to take sustainable number of human chromosome— Argument with logic. 4

• Rajshahi Board 2019

**Answer to Question No. 04 :**

- In the process of cell division, the division of cytoplasm is known as cytokinesis.
- In metaphase stage of mitosis cell division, chromosomes are found shortest and quite thick. In this stage all the chromosomes come and locate at the equator of spindle apparatus and get attached to the centromere by spindle fibre.



**C** 'X' of the stem is bacteria. Bacteria reproduces through amitosis cell division or binary fission. The process is described below— Amitosis cell division occurs in Bacteria, yeast, fungi and in amoeba. Unicellular prokaryotes procreate through amitosis cell division. The nucleus elongates and becomes dumb bell shaped and becomes slender in the middle and gets separated from each other to form tow nuclei. At the same time the cytoplasm also elongates in the middle to form tow cells. In this kind of cell division, the nucleus of mother cell and cytoplasm get directly separated to form two cells. Hence it is called direct cell division.

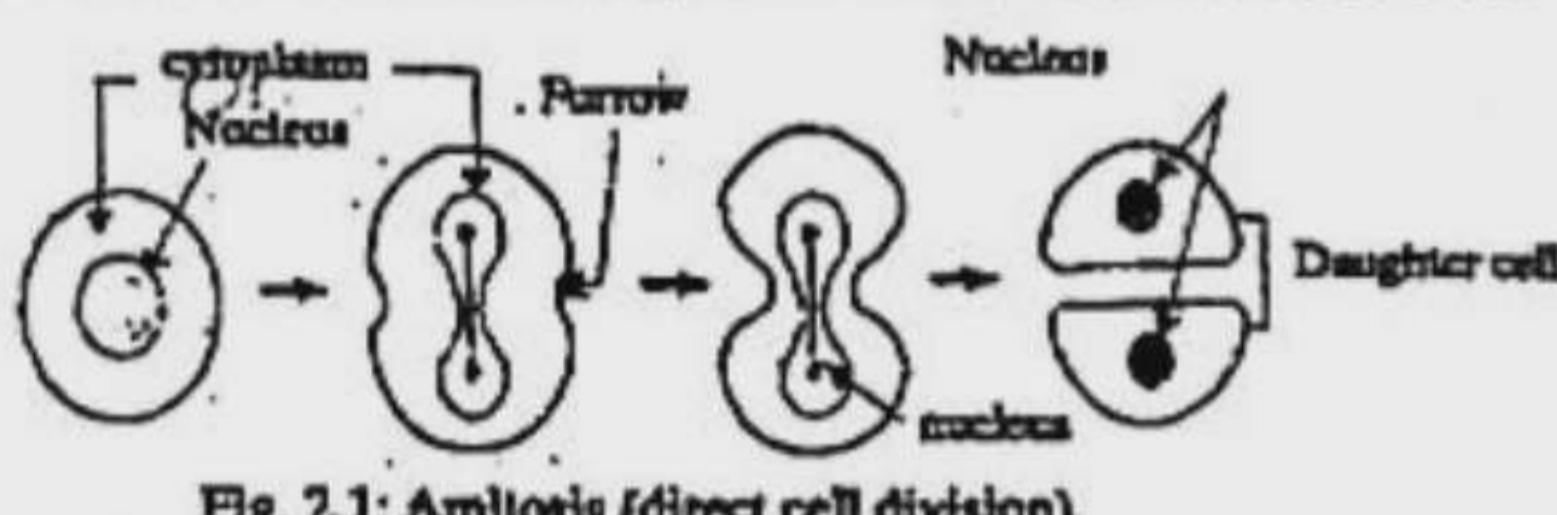


Fig. 2.1: Amitosis (direct cell division).

**d** 'Y' and 'Z' of the stem are mitosis and meiosis cell division respectively.

In mitosis, mother cell divides and produces two daughter cells bearing same number of chromosomes as in mother cell. Mitosis is essential for growth and asexual reproduction. In case of sexual reproduction two gamete (male & female) cells unite together to form a zygote. So, if the number of chromosome in gamete cells does not reduce to half of the mother cell, the number of chromosome becomes double as a result of the union of the two gametes. In case of meiosis mother cell divides and produces daughter cells bearing half the number of chromosomes of mother cell. The number of chromosome remain same, as the mother cell, in the newly formed zygote resulted from the union of such two gamete cells. As a result of cell division by meiosis the number of chromosomes of a species remains constant generation after generation. This happens during formation of gamete and in certain stage of life cycle of the lower plant. This stage of chromosome is called haploid ( $n$ ). When two haploid cell unite, the state of chromosomes is called diploid.

So, the features of the organism are retained in the successive generation by meiotic cell division.

So, 'Y' and 'Z' play an important role to take sustainable number of human chromosome.

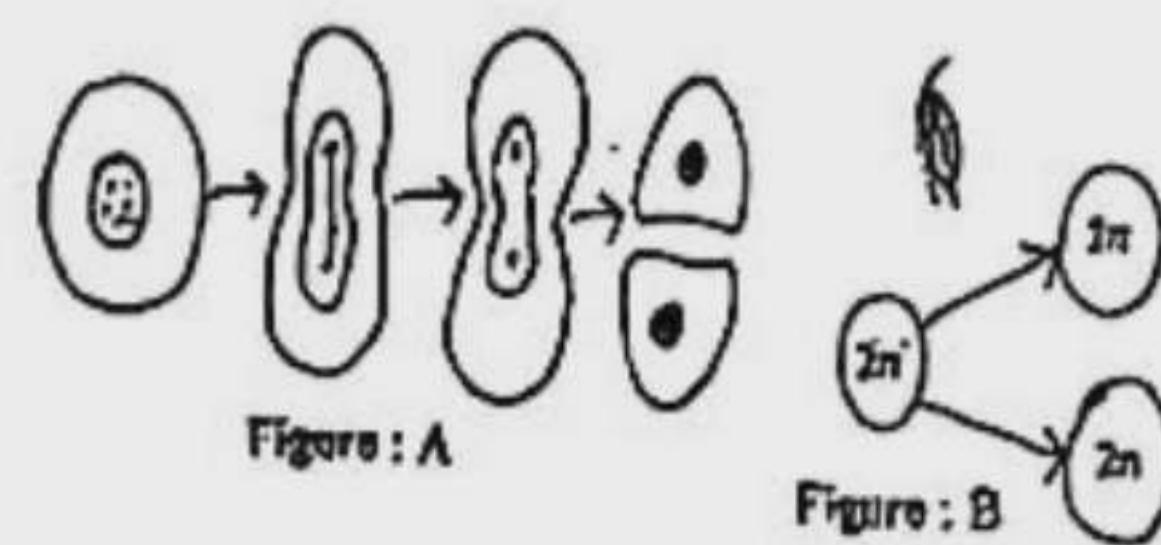
**Ques. 05**

Figure : A

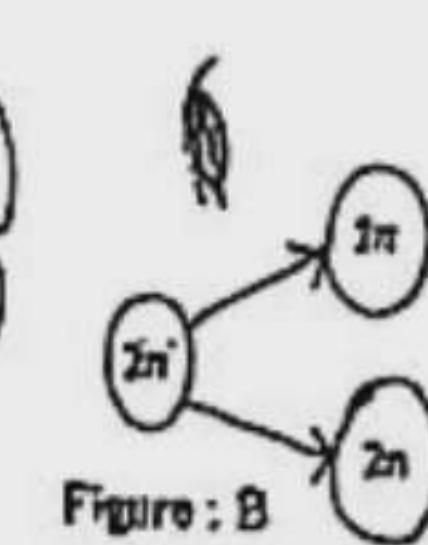


Figure : B

- What is Zygote? 1
- Why is meiosis called reductional division? Analyze. 2
- Explain the process A as shown in the figure. 3
- Analyze the difference between the fourth and fifth stages in the process B as shown in the figure. 4

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**Answer to Question No. 05 :**

**a** The diploid cell ( $2n$ ) formed by the union of sperm and ovum is called zygote.

**b** The characteristics of meiotic cell division is that the nucleus is divided twice and chromosomes divide once. As a result of cell division by meiosis, the number of chromosomes of the daughter cell becomes half of the number of chromosomes of mother reproductive cells. In this process, four new cells are produced which contain half of the chromosomes of the mother cell. hence it is called reduction division.

**c** Process - 'A' as shown in the figure of the stem is amitosis cell division. The process is described below – Amitosis cell division occurs in Bacteria, yeast, fungi and in amoeba. Unicellular prokaryotes procreate through amitosis cell division. The nucleus elongates and becomes dumb bell shaped and becomes slender in the middle and gets separated from each other to form tow nuclei. At the same time the cytoplasm also elongates in the middle to form tow cells. In this kind of cell division, the nucleus of mother cell and cytoplasm get directly separated to form two cells. Hence it is called direct cell division.

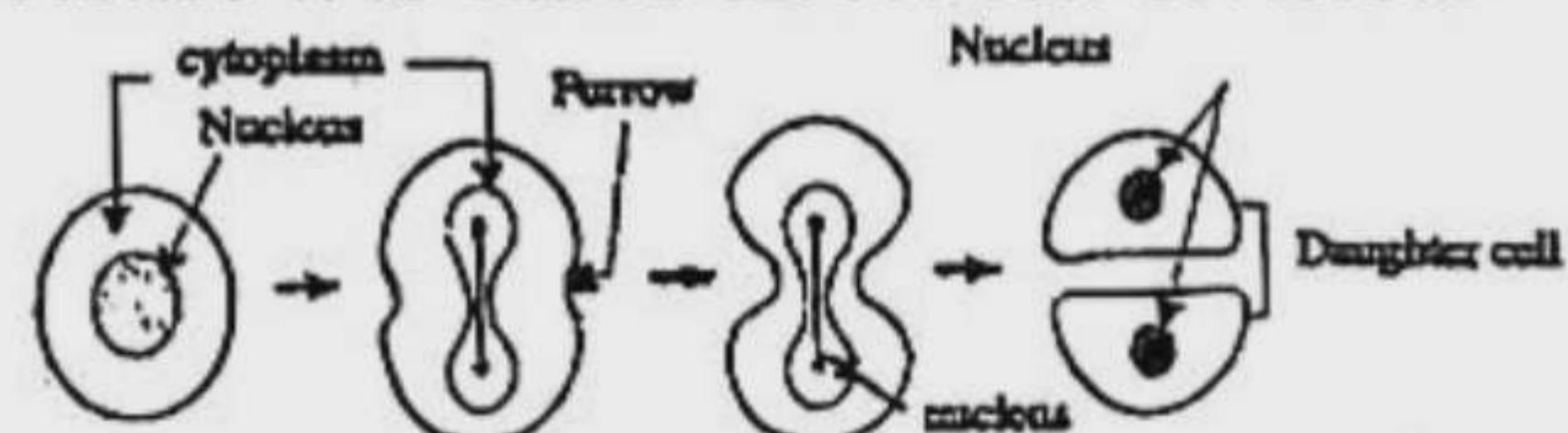


Fig. : Amitosis (direct cell division)

**d** Process 'B' of the stem is mitosis cell division. There are five stages of mitosis cell division. The fourth and fifth stages of mitosis are anaphase and telophase stage respectively.

The differences between anaphase and telophase stage are given below –

In anaphase stage –

- The centromere of the chromosome now splits so that two independent daughter chromosome, each with its own centromere, are formed.

- The chromatids get separated from each other. At this stage each chromatid is called daughter chromosome.
- In this movement, depending upon the location of the centromere chromosomes take different shapes such as V, L, J or I.

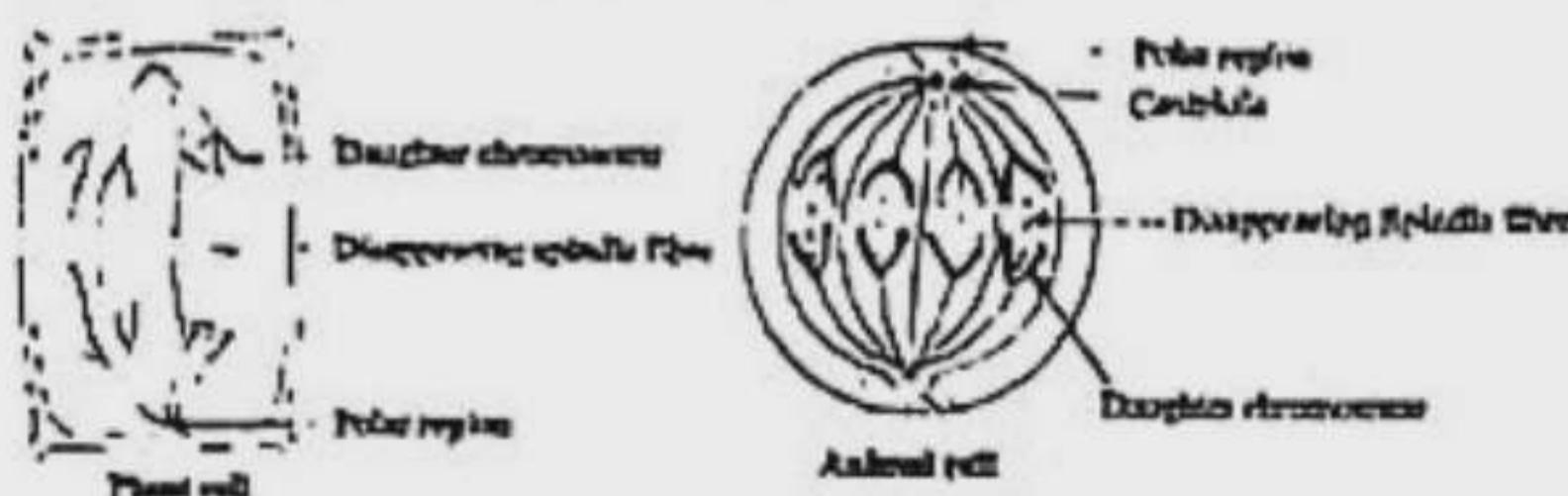


Fig. Anaphase

On the other hand, in telophase stage—

- Daughter chromosomes reach their opposite poles.
- Spindle fibre disappears and the chromosomes lose their identity, reverting to a diffuse chromatin network.
- Finally, nuclear membrane reappears around the two daughter nuclei. Nucleolus also reappears. In this way, two daughter nuclei formed at two poles and signal the end of karyokinesis.

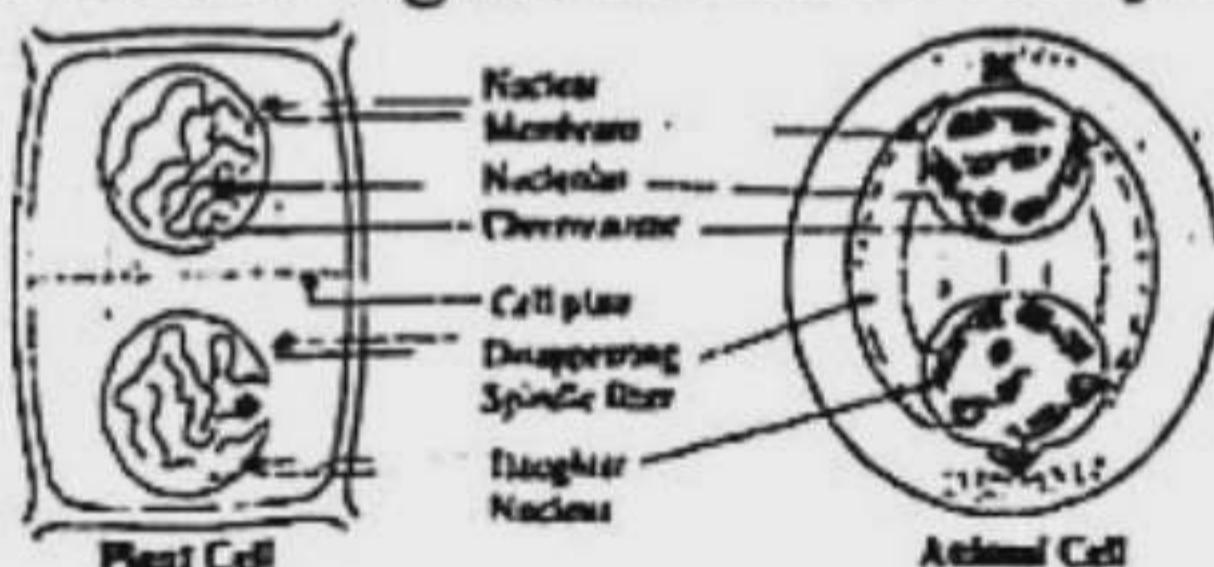


Fig. : Telophase

**Ques. 06** Scene-1 : Total growth of animal happen by the expansion of zygote.

Scene-2 : Multicellular animal reproduct babies and transmission of hereditary traits.

Scene-3 : Nucleic acid is the real hereditary traits of animals.

- What is called Caryokinesis? 1
- Explain when in stage the chromosomes are found shortest and quite thick. 2
- Explain the feature of activities which bappend in scene-1. 3
- To maintain the characteristics of species in scene-2 and scene-3 both have a vital role.— Analyze logically. 4

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**Answer to Question No. 06 :**

a In the process of cell division, the division of cytoplasm is called cytokinesis.

b In metaphase stage of mitosis cell division, chromosomes are found shortest and quite thick. In this stage all the chromosome come and locate at the equator of spindle apparatus and get attached to the Centromere by spindle fibre.

c The activities which happened in scene-1 of the stem is mitosis cell division. The features of mitosis cell division are given below—

- Mitotic cell division is the division of somatic cell.
- In this process the nucleus of the mother cell is divided only once.
- Mother cell is divided into two cells of same quality.
- The number of chromosome of daughter nucleus and mother nucleus remain identical after mitotic cell division.
- In mitosis division, each chromosomes equally divided lengthwise along the centromere. As a result, the number of chromosomes of the two new cells remain same as the number of chromosomes of the mother cell. So, mitosis is also known as equational division.

- d Scene-2 and Scene-3 of the stem indicate chromosome and DNA respectively.

Chromosome acts as carrier and transmit gene from one generation to next generation, thus maintains the continuity of hereditary traits. The continuity of such hereditary trait is maintained through meiotic cell division. To maintain hereditary trait, chromosome carries gene directly from parent to offsprings during cell division. For this reason, chromosome is known as the physical basis of heredity. DNA is the main component of chromosome. DNA & RNA play vital role in transmission of hereditary traits. It is accepted by all that the genes which are located in the chromosomes control the characteristics of organisms. It is proved from different experiments that, parts of DNA act as gene, i.e. DNA itself is gene. DNA is directly transmitted from the parents to the progeny. So, to maintain the characteristics of species in Scene-2 and Scene-3 both have vital role.

**Ques. 07**



- What is interphase? 1
- Explain the reason to be the hair of Rafi same to his father. 2
- Explain the next phase of the phase mentioned in above stem. 3
- How 'Y' restores the individuality of every species? Analyze. 4

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**Answer to Question No. 07 :**

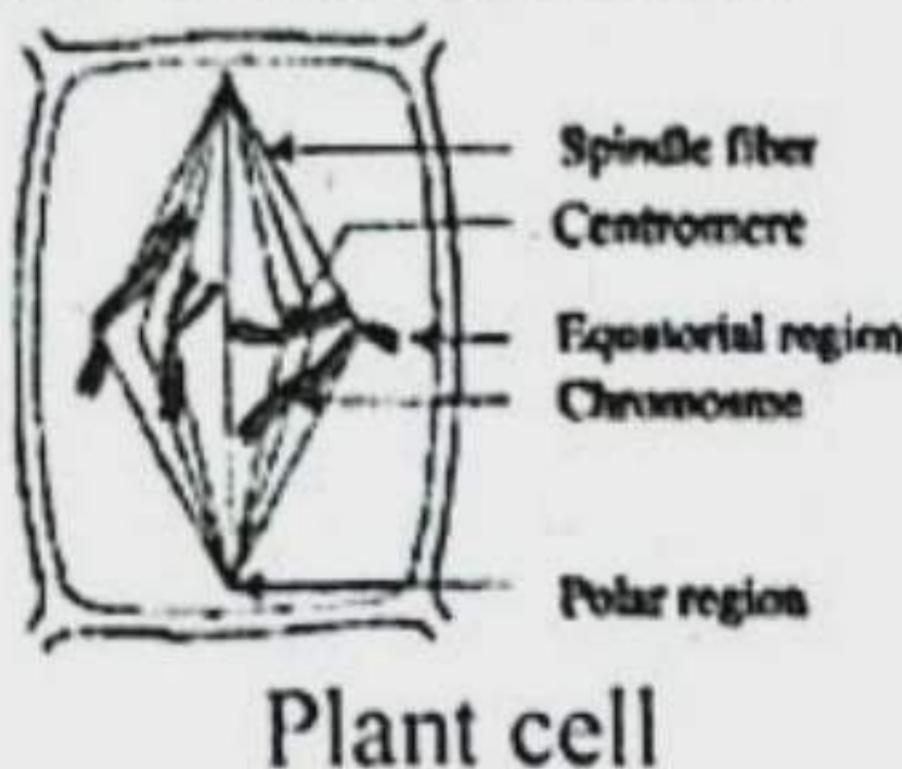
a The intermediate stage between the two consecutive cell divisions is known as interphase or resting stage.

b The reason to be the hair of Rafi same to his father due to heredity. A character of an organism is controlled by gene the eye colour, hair pattern, skin colour etc, of man are controlled by gene. Chromosome acts as carrier and transmit gene from one generation to next generation, thus maintains the continuity of hereditary traits.

**c** The phase mentioned in the stem is pro-metaphase stage of mitosis cell division. The next phase of it is metaphase stage.

Metaphase : In this step—

1. All the chromosomes come and locate at the equator of spindle apparatus and get attached to the Centromere by spindle fibre.
2. At this stage the chromosomes are found shortest, quite thick and clear.



**d** 'Y' of the stem is chromosome.

The nucleus of a cell contains a fixed number of thread-like objects that bear the hereditary characters of the organism are called chromosome. These are only visible when a cell is about to divide into two i.e. during prophase stage of mitotic cell division. Each chromosome consists of two parts—chromatid and centromere. At prophase stage of mitotic cell division, each chromosome divides longitudinally into two equal parts, known as chromatid. Chromosome acts as carrier and transmit gene from one generation to next generation, thus maintains the continuity of hereditary traits.

The continuity of such hereditary trait is maintained through meiotic cell division. To maintain hereditary trait, chromosome carries gene directly from parent to offsprings during cell division. For this reason, chromosome is known as the physical basis of heredity.

So, from the above discussion we understand that the hereditary trait is maintained by meiosis and through reduction of chromosome number, the individuality of every species is restored.

#### Ques. 08 X—Ending of Karyokinesis.

Y—Chromosomes divide once, nucleus divides twice.

- a. What is DNA? 1
- b. Why the colour of Mitu's eyes is similar to the colour of her grandmother's eyes? 2
- c. Explain the phase 'X'. 3
- d. How the hereditary trait is maintained by 'Y'? Analyze it. 4

• Barishal Board 2019

#### Answer to Question No. 08 :

- a. DNA is one kind of nucleic acid which stands for deoxyribonucleic acid. DNA is the main component of chromosome.

**b** The colour of Mitu's eyes is similar to the colour of her grandmother's eyes. This is because of the characteristics of Mitu's grandmother inherit to her body through heredity process. The eye colour, hair pattern, skin colour etc of man are controlled by gene. Chromosome acts as carrier and transmit gene from one generation to next generation.

**c** According to the stem, the phase X refers to the Telophase. It is explained below—

In this stage—

1. Daughter chromosomes reach their opposite poles.
2. Spindle fibre disappears and the chromosomes lose their identity, reverting to a diffuse chromatin network.
3. Finally, nuclear membrane reappears around the two daughter nuclei. Nucleolus also reappears. In this way, two daughter nuclei formed at two poles and signal the end of karyokinesis.

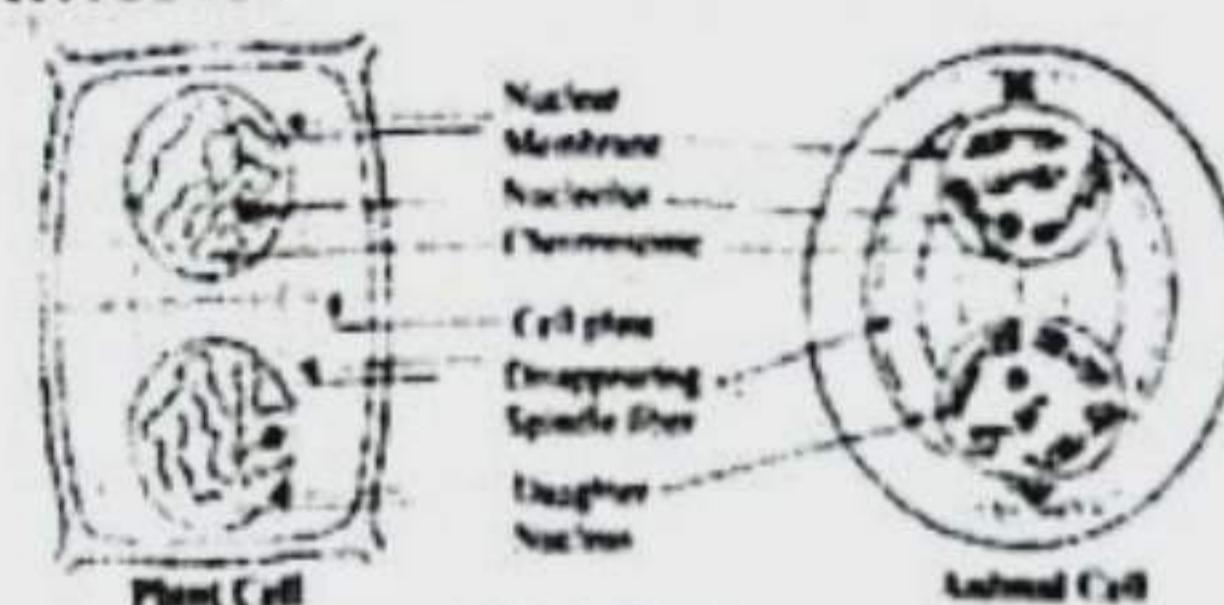
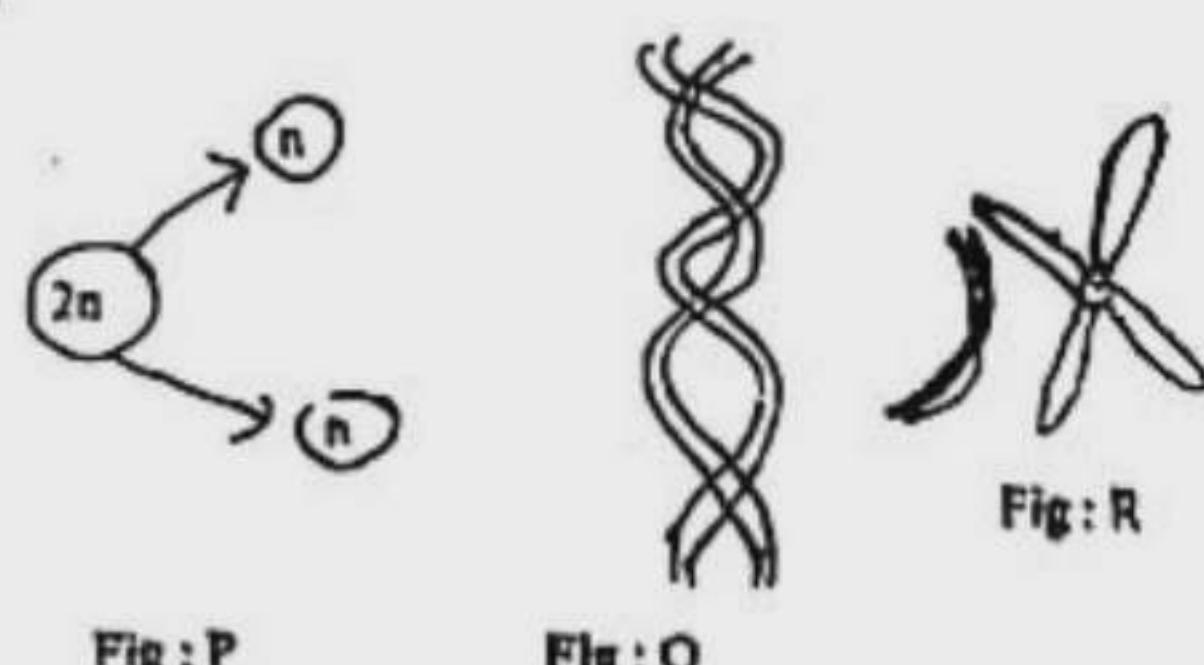


Fig. 2.7. Telophase

Fig : Telophase

**d** According to stem, Y refers to meiosis cell division. In mitosis, mother cell divides and produces two daughter cells bearing same number of chromosomes as in mother cell. Mitosis is essential for growth and asexual reproduction. In case of sexual reproduction two gamete (male & female) cells unite together to form a zygote. So, if the number of chromosome in gamete cells does not reduce to half of the mother cell, the number of chromosome becomes double as a result of the union of the two gametes. In case of meiosis mother cell divides and produces daughter cells bearing half the number of chromosomes of mother cell. The number of chromosome remain same, as the mother cell, in the newly formed zygote resulted from the union of such two gamete cells. As a result of cell division by meiosis the number of chromosomes of a species remains constant generation after generation. This happens during formation of gamete and in certain stage of life cycle of the lower plant. This stage of chromosome is called haploid ( $n$ ). When two haploid cell unite, the state of chromosomes is called diploid.

So, the features of the organism are retained in the successive generation by meiotic cell division.

**Ques. 09**

- a. What is caryokinesis? 1  
 b. Why the cell division in Amoeba is called direct cell division? 2  
 c. Explain the cell division of 'P'. 3  
 d. Analyze the role of 'Q' and 'R' far determining inheritance. 4

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**Answer to Question No. 09 :**

- a** In the process of mitosis, the division of nucleus is known as caryokinesis.
- b** Amoeba divides by amitosis cell division process. Amitosis cell division is called direct cell division, because in amitosis, the nucleus elongates and becomes dumbbell shaped and then directly divides in the middle forming two new daughter cells which gradually grows and ultimately develop into mother cells.
- c** Cell division of 'p' in the stem refers to meiosis cell division. Meiosis takes place in the reproductive mother cells during formation of gamete. The process of this type of cell division is described below—

During meiosis cell division, a primordial germ cell is divided in two successive phases. First phase is called meiosis-I and the second phase is known as meiosis-II. During the first division, chromosomes of the daughter cells become half of the mother cells. Second division is same as mitosis. It means that cells produced in the first division again divides into two daughter cells. As a result, four daughter cells ( $n$ ) are produced from each primordial germ cell ( $2n$ ).

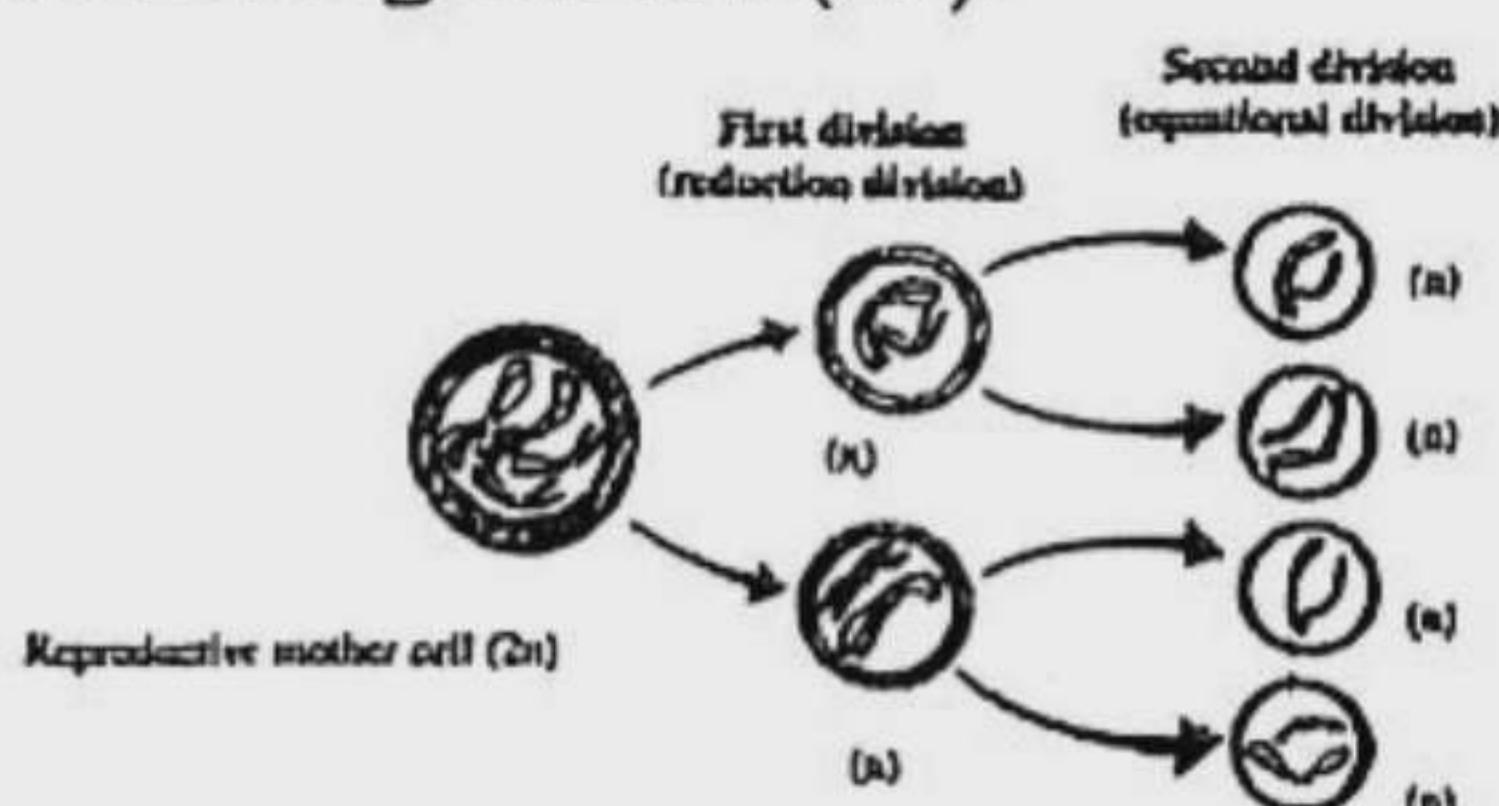


Fig. : Concept of meiosis cell division

- d** Fig 'Q' and 'R' in the stem refer to DNA and chromosome respectively. DNA and chromosome play an important role for determining inheritance. DNA is the main component of chromosome. DNA & RNA play vital role in transmission of

hereditary traits. It is accepted by all that the genes which are located in the chromosomes control the characteristics of organisms. It is proved from different experiments that, parts of DNA act as gene, i.e. DNA itself is gene. DNA is directly transmitted from the parents to the progeny.

Chromosome acts as carrier and transmit gene from one generation to next generation, thus maintains the continuity of hereditary traits. The continuity of such hereditary trait is maintained through meiotic cell division. To maintain hereditary trait, chromosome carries gene directly from parent to offspring's during cell division. For this reason, chromosome is known as the physical basis of heredity.

**Ques. 10** **Scene-1 :** The increase of height and breadth of the body of animals and plant occur through the increase of the number of meristematic cells and somatic cells.

**Scene-2 :** Every animal gives birth to his offspring and through this their characteristics are expressed.

- a. What is caryokinesis? 1  
 b. Why is the cell division occurs in the ovary of the flower Jaba called reduction division? 2  
 c. Describe in which cell division of the scene the increase of height and breadth of the body of animals and plants occurs. 3  
 d. To keep genetic trait which of the two scene plays the unquestionable role, analyze. 4

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**Answer to Question No. 10 :**

- a** In the process of mitosis, the division of nucleus is known as caryokinesis.
- b** The cell division which occurs in the ovary of the flower jaba is meiosis cell division. The characteristics of meiotic cell division is that the nucleus is divided twice and chromosomes divide once. As a result of cell division by meiosis, the number of chromosomes of the daughter cell becomes half of the number of chromosomes of mother reproductive cells. In this process, four new cells are produced which contain half of the chromosomes of the mother cell, hence it is called reduction division.

- c** In the stem, scene-1 represents mitosis cell division and Scene-2 represents meiosis cell division. The increase of height and breadth of the body of animals and plants occur through mitosis cell division. **Mitosis :** Somatic cells of higher plants and animals are divided in this way. The process of cell division by which nucleus and chromosomes of a



eukaryotic cell divided only once is known as mitosis. In this process the nucleus of the mother cell is divided only once and produces two daughter cells bearing similar characteristics and having same size, quality and number of chromosomes. Mitosis ensures increase of height and breadth of the body of animals and plants. The cells of the meristematic (apex of branch and roots) tissue of plant increase their number by mitotic division.

**d** To keep genetic trait scene-2 that is meiosis plays the unquestionable role.

Meiotic cell division occurs during the formation of reproductive cell from the reproductive mother cells. The characteristics of meiotic cell division is that the nucleus is divided twice and chromosomes divide once. As a result of cell division by meiosis the number of chromosomes of the daughter cells becomes half of the number of chromosomes of mother reproductive cells. In this process four new cells are produced which contain half of the chromosomes of the mother cell, hence called reduction division. Generally meiosis occurs in the reproductive mother cell during the formation of gametes.

The continuity of hereditary trait is maintained through meiotic cell division. To maintain hereditary trait, chromosome carries gene directly from parent to offsprings during cell division. For this reason, chromosome is known as the physical basis of heredity.

So, from the above discussion we understand that the hereditary trait is maintained by meiosis and through reduction of chromosome number, the individuality of every species is restored.

**Ques. 11** Tonima, a student of class eight, looks after her mother. A diagram of the step of cell division is hung on the wall in her reading room whose chromosomes are shaped in English alphabet.

- What is interphase? 1
- Why the cell division of Amoeba is called direct cell division? 2
- Explain the diagram hung in Tonima's room with labelling. 3
- According to stem, why the appearance of Tonima like this — analyze it. 4

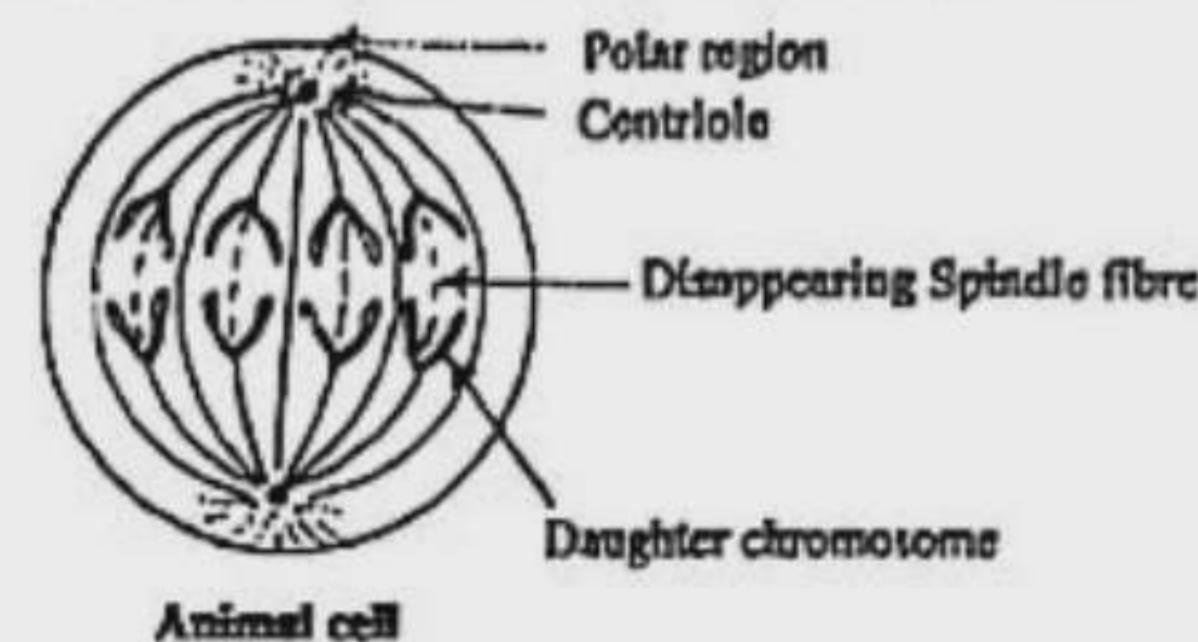
• Rajshahi Board 2018

#### Answer to Question No. 11 :

**a** The intermediate stage between the two consecutive cell divisions is known as interphase or resting stage.

**b** Amoeba divides by amitosis cell division process. Amitosis cell division is called direct cell division, because in amitosis, the nucleus elongates and becomes dumbbell shaped and then directly divides in the middle forming two new daughter cells which gradually grows and ultimately develop into mother cells.

**c** According to the stem, a diagram of the step of cell division is hung on the wall of Tonima's reading room whose chromosomes are shaped in English alphabet. So, the stage is anaphase of mitosis cell division. A labelled diagram of anaphase stage of mitosis cell division is drawn below —



**d** The appearance of Tonima is looked like her mother. This is because the physical characteristic of her mother has inherited to her body through hereditary process.

Children cannot inherit all the characteristics of both their parents. They inherit some characteristics from each parent. The process by which characteristics from parent are inherited to the offsprings is called heredity. Characters inherited to children is known as hereditary characters. Once the knowledge of heredity was imaginary. Later on, scientists explain how these characters inherit to offsprings from their parent.

The nucleus of a cell contains a fixed number of thread-like objects that bears the hereditary characters of the organism are called chromosome. DNA is the main component of chromosome. DNA & RNA plays vital role in transmission of hereditary traits. It is accepted by all that the genes which are located in the chromosomes control the characteristics of organisms. It is proved from different experiments that, parts of DNA act as gene, i.e. DNA itself is gene. DNA is directly transmitted from the parents to the progeny.

**Ques. 12** Ayesa is a student of class eight and she looks like her mother. A cell division picture is hanging on the wall and the chromosome of that picture looks English alphabet.

- What is called interphase? 1
- Why the cell division of amoeba called direct cell division? 2
- Explain with level diagram of the picture that is hanging on the wall in Ayesa's room. 3
- Justify why Ayesa looks like her mother. 4

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#### Answer to Question No. 12 :

**a** Before starting caryokinesis and cytokinesis the nucleus of the dividing cell need to take some preparations. This intermediary stage between the two consecutive cell division is known as interphase or resting stage.

**b** The cell division that occurs in amoeba is known as Amitosis cell division. This cell division occurs in Bacteria, Yeast, fungi etc.

Unicellular prokaryotes procreate through amitosis cell division. The nucleus elongates and becomes dumb bell shaped and becomes slender in the middle and gets separated from each other to form two nuclei. At the same time the protoplasm also elongates in the middle to form two cells. In this kind of cell division, the nucleus of mother cell and protoplasm get directly separated to form two cells. Hence it is called direct cell division.

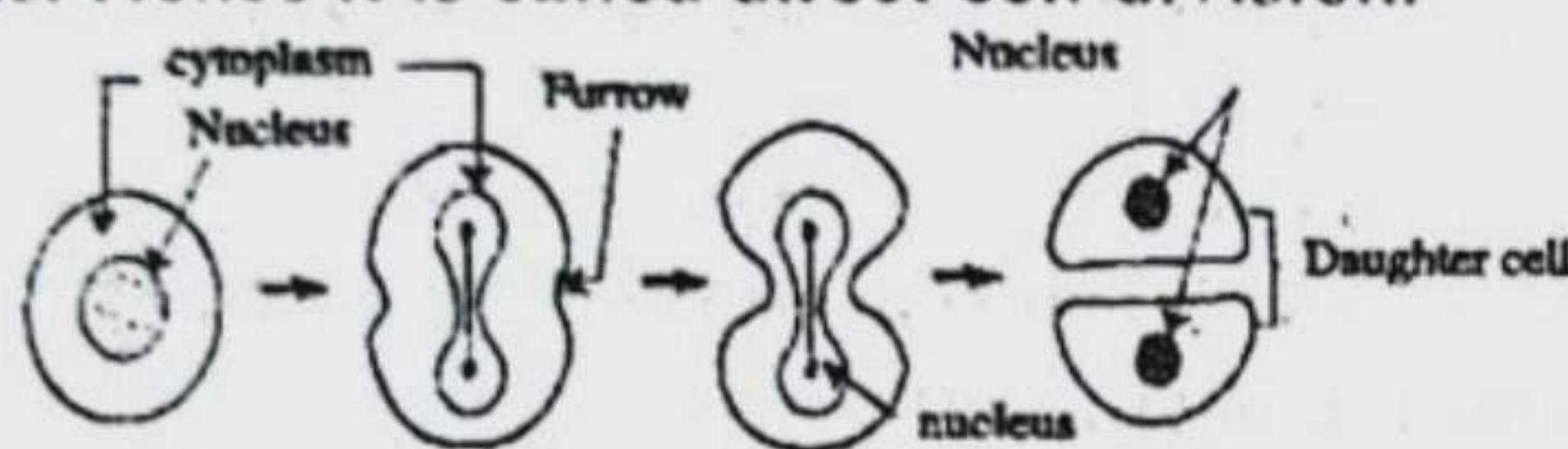


Fig : Amitosis (direct cell division)

**c** The picture in the Ayesa's wall is the following is laved diagram picture.

**Metaphase : In this step-**

1. All the chromosomes come and locate at the equator of spindle apparatus and get attached to the centromere by spindle fibre.
2. At this stage the chromosomes are found shortest, quite thick and clear.

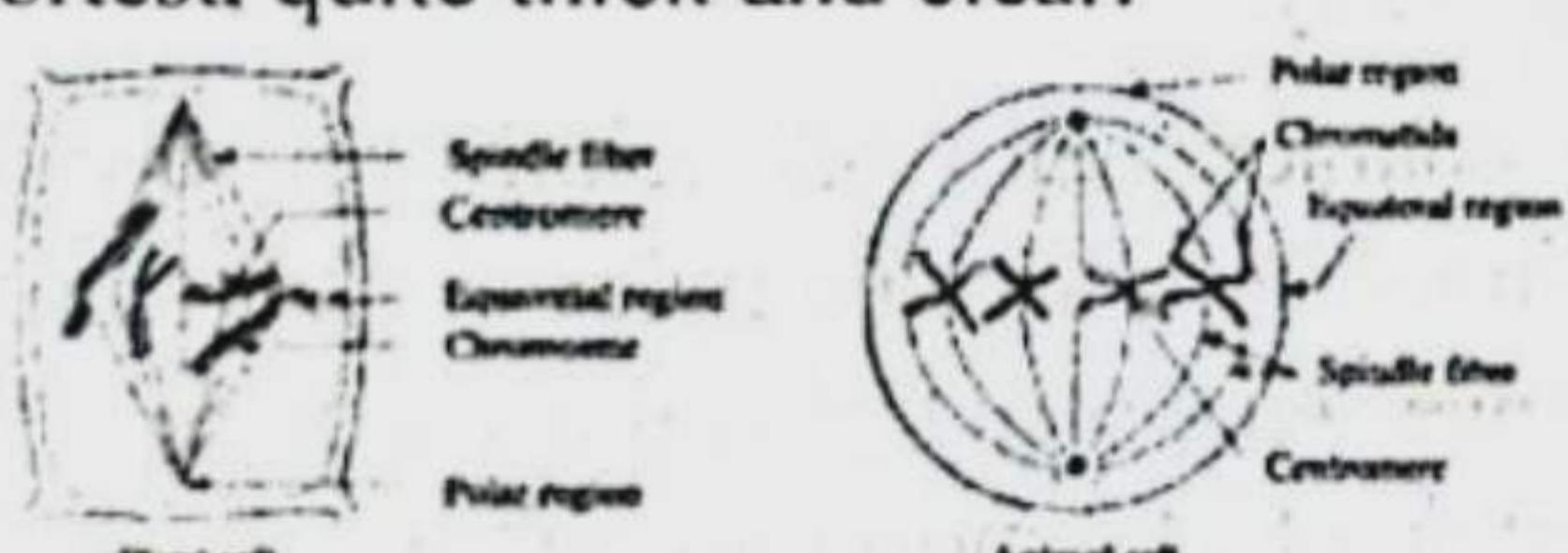


Fig : Metaphase

**d** Ayesa looks like her mother. Why she looks like her mother is explained below.

Children cannot inherit all the characteristics of both their parents. They inherit some characteristics from each parent. The process by which characteristics from parent are inherited to the offsprings is called heredity. Characters inherited to children is known as hereditary characters. Once, the knowledge of heredity was imaginary. Later on, scientists explain how these characters inherit to offsprings from their parent.

The nucleus of a cell contains a fixed number of thread-like objects that bears the hereditary characters of the organism are called chromosome. These are only visible when a cell is about to divide into two i.e. during prophase stage of mitotic cell division. Each chromosome consists of

two parts-chromatid and centromere. At prophase stage of mitotic cell division, each chromosome divides longitudinally into two equal parts, known as chromatid. The point where sister chromatids are joined is called centromere. During cell division, the spindle fibres are attached to centromere.

Nucleic acids are of two types-namely DNA (deoxyribonucleic acid) and RNA (Ribonucleic acid). DNA is the main component of chromosome. DNA & RNA play vital role in transmission of hereditary traits.

It is accepted by all that the genes which are located in the chromosomes control the characteristics of organisms. It is proved from different experiments that, parts of DNA act as gene, i.e. DNA itself is gene. DNA is directly transmitted from the parents to the progeny.

The continuity of such hereditary trait is maintained through meiotic cell division. To maintain hereditary trait, chromosome carries gene directly from parent to offsprings during cell division. For this reason, chromosome is known as the physical basis of heredity.

**Ques. 13**



Figure-(i)



Figure-(ii)

- a. What is Caryokinesis? 1
- b. What is the necessity meiosis? 2
- c. Mentioning its structure explain the prosperities of figure (ii). 3
- d. "Figure no. (i) bridge between Caryokinesis and Cytokinesis"- Explain it. 4

• Dinajpur Board 2018

**Answer to Question No. 13 :**

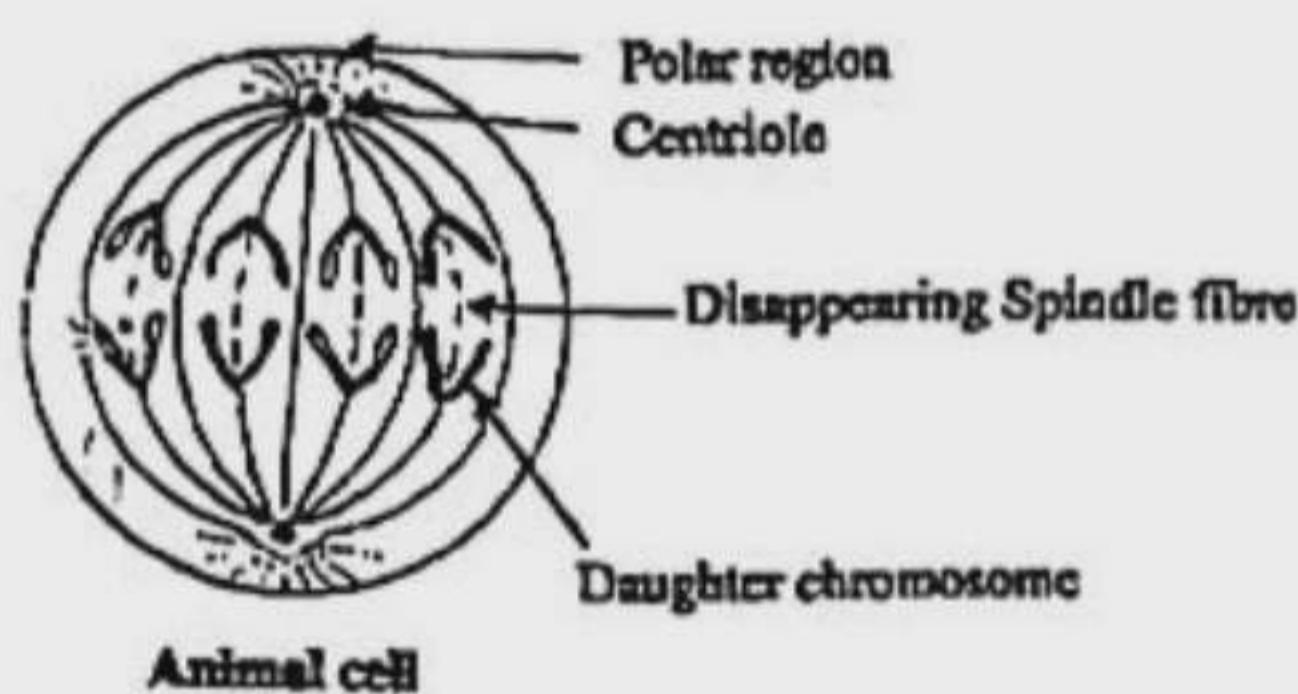
**a** In the process of mitosis cell division, the division of nucleus is known as caryokinesis.

**b** Necessity of meiosis cell division :

- i. As a result of meiosis cell division, the number of chromosomes of a species remains constant generation after generation.
- ii. The features of the organism are retained in the successive generation by meiotic cell divisor.
- iii. It maintains the hereditary triat.

**C** Figure (ii) of the stem represents anaphase stage of mitosis cell division and in this stage—

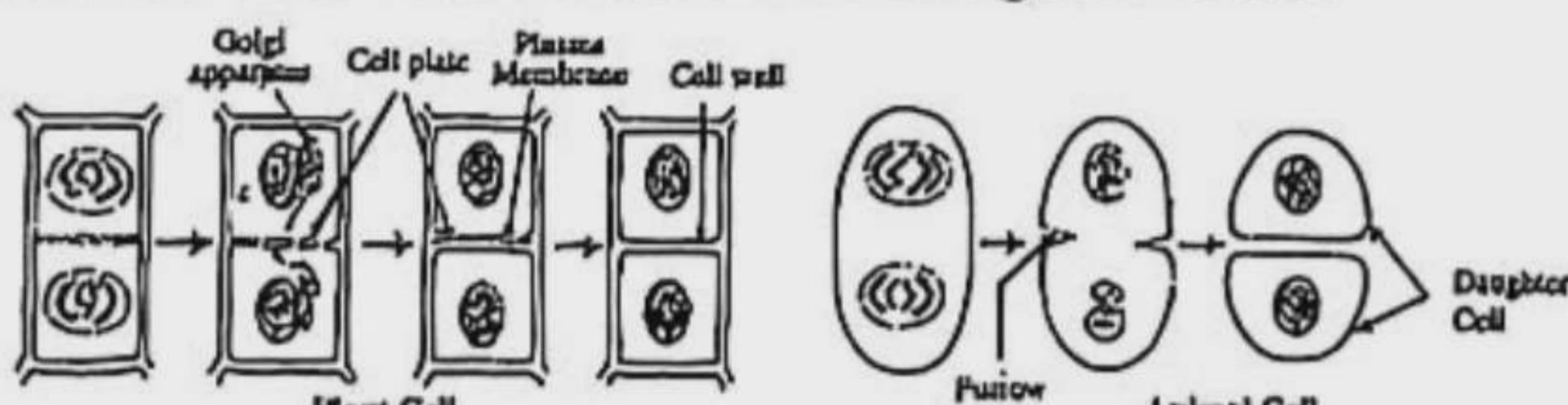
- The centromere of the chromosome splits so that two independent daughter chromosome, each with its own centromere, are formed.
- The chromosomes move towards the respective poles.
- In this movement, depending upon the location of the centromere, chromosomes take different shapes such as V, L, J or I.



**d** Figure (i) of the stem represents telophase stage of mitosis cell division.

The process of mitosis takes place in two phases. The nucleus divides in first phase and cytoplasm in the second phase. The division of nucleus is known as caryokinesis and the division of cytoplasm is cytokinesis.

At the end of telophase, cytokinesis starts. In plant cells the equatorial region of the spindle apparatus gradually becomes wide and touches the cell wall and the fibres disappear. At the equatorial region frgmoplast of the endoplasmic reticulum are deposited and they combine together to form a membrane called plasmalema. By deposition of other components on the plasmalema, cell plate is formed. Cell wall is developed by the deposition of hemicellulose and other components on the cell plate. By the development of the cell wall the mother cell divides into two daughter cells.



In animal cell, a cleavage furrow appears on the surface of the dividing cell and encircles it at the midline of the spindle. The cleavage furrow deepens and pinches the plasma membrane as though it were being tightened by an invisible rubber band and gradually draws the furrow

inward. Finally, the infolding edges of the plasma membrane meet and fuse, completing cell division. So, telophase is a bridge between caryokinesis and cytokinesis.

**Ques. 14**

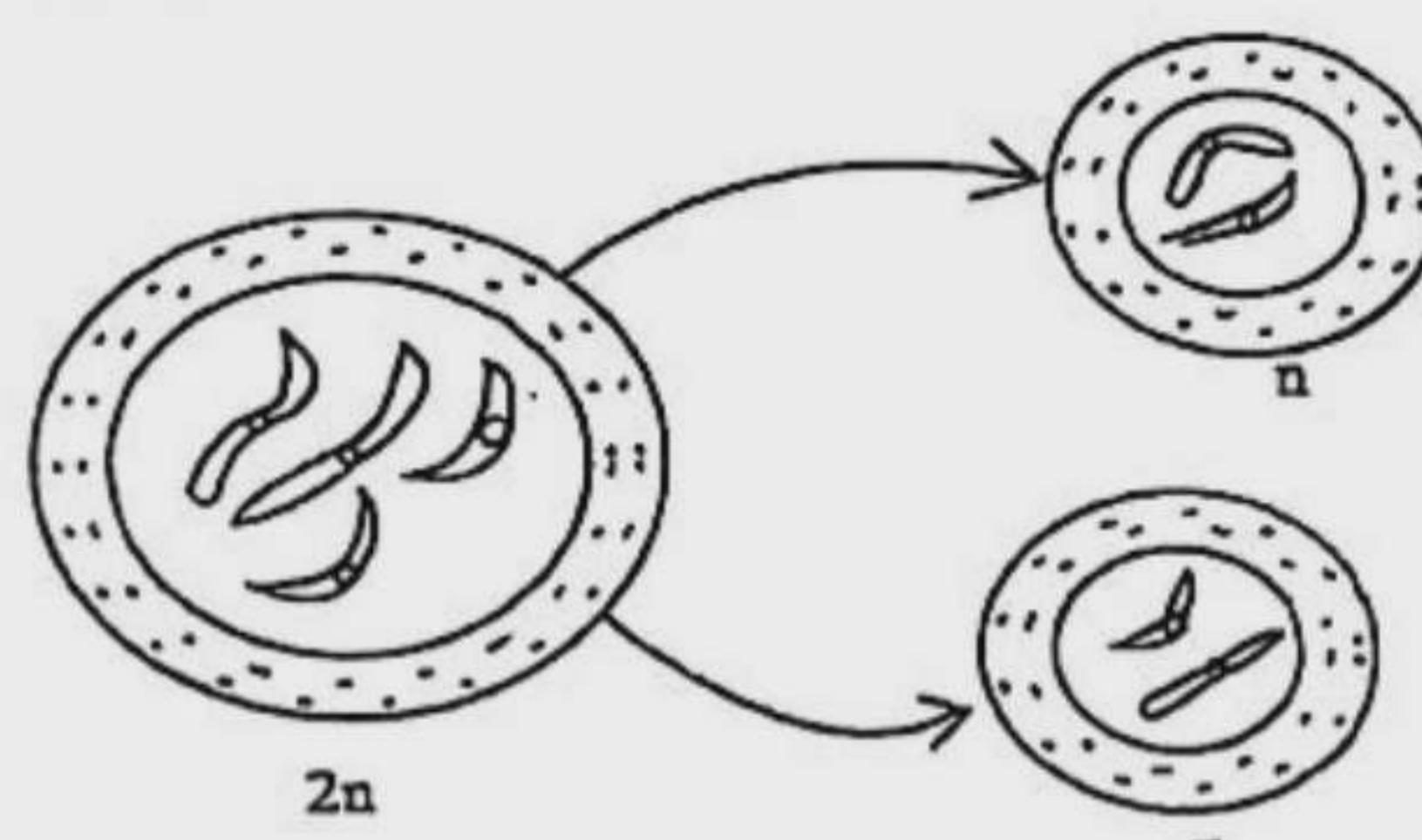


Fig : Reproductive mother cells

- How many chromosomes are there in a human somatic cell? 1
- Why meiosis is called reduction production? 2
- Explain the process of cell division of the stem. 3
- "The cell division process mentioned in the stem is completely different from mitosis cell division." Explain the justification of this statement. 4

• Dhaka Board 2017

**Answer to Question No. 14 :**

**a** There are 23 pairs of chromosome in every cell of human body.

**b** The characteristics of meiotic cell division is that the nucleus is divided twice and chromosomes divide once. As a result of cell division by meiosis, the number of chromosomes of the daughter cell becomes half of the number of chromosomes of mother reproductive cells. In this process, four new cells are produced which contain half of the chromosomes of the mother cell, hence it is called reduction division.

**c** The cell division of the stem is 'meiosis'. The process of this cell division is explained below : During meiosis cell division, a primordial germ cell is divided in two successive phases. First phase is called meiosis-I and the second phase is known as meiosis-II.

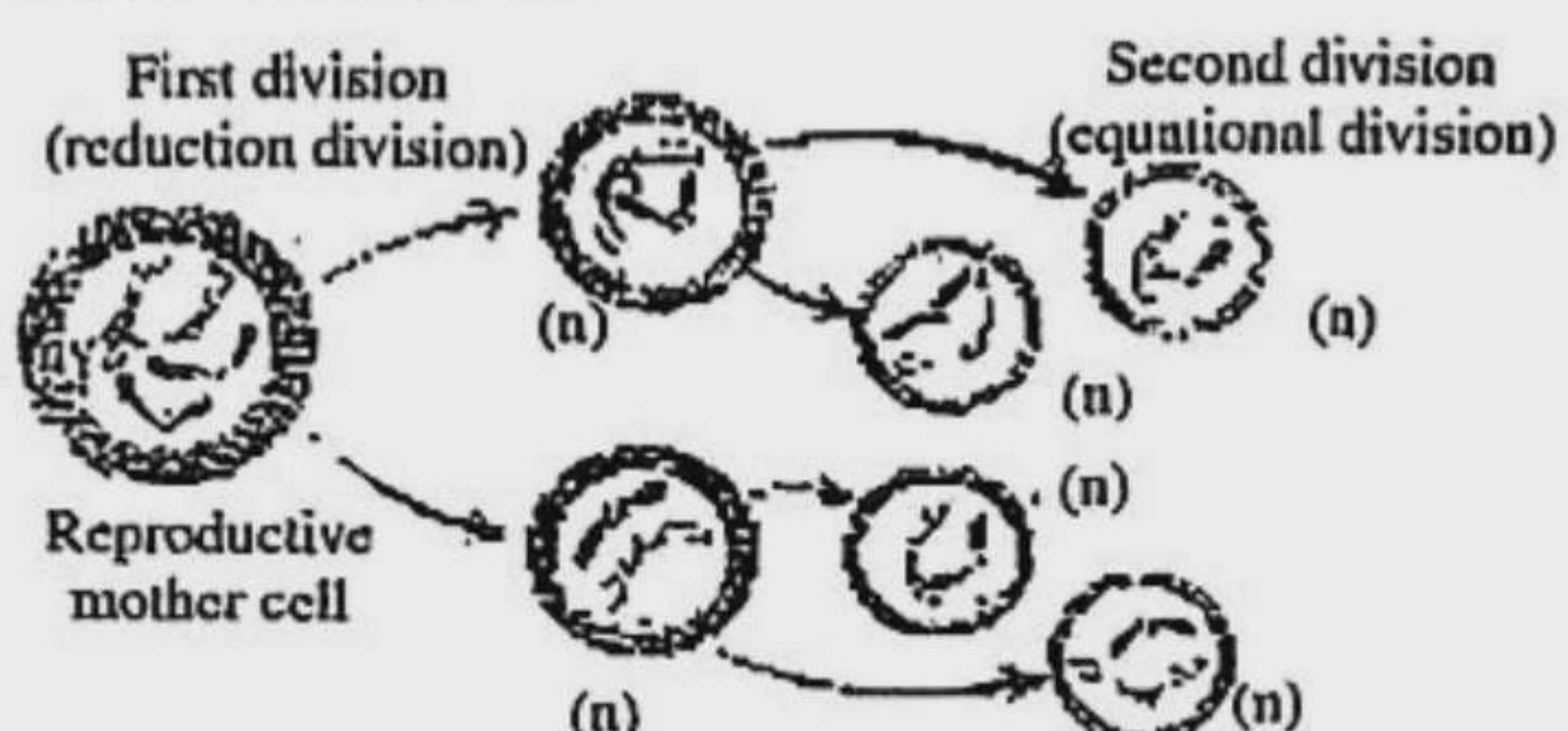


Fig : Concept of meiosis cell division.

During the first division, chromosomes of the daughter cells become half of the mother cells. Second division is same as mitosis. It means that cells produced in the first division again divides into two daughter cells. As a result, four daughter cells ( $n$ ) are produced from each primordial germ cell ( $2n$ ).

In case of meiosis mother cell divides and produces daughter cells bearing half the number of chromosomes of mother cell. The number of chromosome remain same, as the mother cell, in the newly formed zygote resulted from the union of such two gamete cells. As a result of cell division by meiosis the number of chromosomes of a species remains constant generation after generation. This happens during formation of gamete and in certain stage of life cycle of the lower plant. This stage of chromosome is called haploid ( $n$ ). When two haploid cell unite, the state of chromosomes is called diploid.

**Q** To justify the mentioned statement the features of mitosis and meiosis are given below :

#### Features of Mitosis :

1. Mitotic cell division is the division of somatic cell.
2. In this process the nucleus of the mother cell divides only once.

3. Mother cell divides into two cells and they are of same quality.
4. The number of chromosome of daughter nucleus and mother nucleus remain identical after mitotic cell division.
5. In mitosis division each chromosomes equally divides lengthwise along the centromere. As a result the number of chromosomes of the two new cells remain same as the number of chromosomes of the mother cell. So, mitosis is also known as equational division.

#### Features of Meiosis :

1. Meiosis takes place in the reproductive mother cell of diploid organism and in the zygote of haploid organisms (lower plants).
2. Four haploid daughter cells are produced from a single cell.
3. In this process the nucleus divides twice and chromosomes divide once.
4. The four daughter cell thus formed contains half the number of chromosome of the mother cells.

From the above discussion it is justified to say that the meiosis cell division is completely different from mitosis cell division.



#### Knowledge & Comprehension-based Q/A



Designed as per topic



#### Preparatory Knowledge-based Q/A

##### Question 1. What is a cell?

**Ans.** The smallest unit of living things that can exist on its own is called a cell.

##### Question 2. What are the main types of cell divisions found in the living organisms?

**Ans.** The main types of cell divisions found in living organisms are— amitosis, mitosis and meiosis.

##### Question 3. Which of the cell divisions ensures increase of height and breadth of the body of animals and plants?

**Ans.** By the cell division named mitosis, increase of height and breadth of the body of animals and plants are ensured.

##### Question 4. How does growth of organisms occur?

**Ans.** Growth of organisms occurs by cell division.

##### Question 5. Where does mitosis occur?

**Ans.** Mitosis occurs in somatic cells of all living organisms.

##### Question 6. What is caryokinesis?

**Ans.** In the process of mitosis, the division of nucleus is known as caryokinesis.

##### Question 7. What does play vital role in transmission of hereditary traits?

**Ans.** DNA & RNA plays vital role in transmission of hereditary traits.

##### Question 8. Who is known as the father of genetics?

**Ans.** Gregor Johann Mendel is known as the father of genetics.

##### Question 9. What is the factor that controls the eye colour, hair pattern, skin colour of man?

**Ans.** The factor like gene controls the eye colour, hair pattern, skin colour of man.

##### Question 10. What is the main component of chromosomes?

**Ans.** DNA is the main component of chromosomes.

**Question 11. What does control the characteristics of organisms?**

**Ans.** Chromosomes controls the characteristics of organisms.

**Question 12. How many chromosomes are there in each somatic cell of human body?**

**Ans.** There are 46 chromosomes in each somatic cell of human body.

### Preparatory Comprehension-based Q/A □

**Question 1. Why is mitosis known as equational division?**

**Ans.** By the process of mitosis division, each chromosomes equally divides lengthwise along the centromere. As a result, the number of chromosomes of the two new daughter cells remain same as the number of chromosomes of the mother cell. This is why, mitosis is known as equational division.

**Question 2. How is the body of the living organism developed and a matured body is built?**

**Ans.** The origin of most multicellular organisms is the Zygote, a single cell which is the product of union of an egg and a sperm. By the process of cell division, the Zygote, in course of time, divides into two cells. In this way, through repeated divisions of cell, body of the living organisms are developed and a matured body is built.

**Question 3. Why is amitosis known as direct cell division?**

**Ans.** In amitosis, the nucleus elongates and becomes dumbbell shaped and then directly

divides in the middle forming two new daughter cells which gradually grows and ultimately develop into mother cells. This is why, amitosis is known as direct cell division.

**Question 4. What do you mean by interphase or resting stage?**

**Ans.** The process of mitosis takes place in two phases namely caryokinesis (division of nucleus) and cytokinesis (division of cytoplasm). Before starting caryokinesis and cytokinesis, the nucleus of the dividing cell takes some time for preparation. This intermediate stage between the two consecutive cell divisions is meant for interphase or resting stage.

**Question 5. What do you mean by heredity?**

**Ans.** Children inherit some but all characteristics from each parent. The process by which the springs inherit characteristics from the parents is called heredity. Noted that the characters inherited to children is known as hereditary character.

**Question 6. Chromosome maintains the continuity of hereditary traits— Explain.**

**Ans.** DNA & RNA are the components of chromosome and they play the vital role in transmission of hereditary traits. It is experimentally proved that the gene like DNA is directly transmitted from the parents to the children and thus transmission of genes from one generation to the next generation is a continuous process. So, it is said that chromosome maintains the continuity of hereditary traits.



### Super Suggestions



Super Suggestions with 100% preparatory questions selected by the Master Trainer Panel

Dear learners, important multiple choice, short, creative, knowledge & comprehension-based questions of this chapter selected by Master Trainer Panel for Half-Yearly and Annual Exams are presented below. Learn the answers to the mentioned questions well to ensure 100% preparation.

Question Pattern	7*	5*
○ MCQs with Answers	Learn each MCQs in this chapter thoroughly.	
○ Short Q/A	3, 8, 12, 15, 21, 27, 28	6, 17, 18, 23, 25
○ Creative Q/A	2, 3, 5, 6, 8, 12	7, 14
○ Knowledge-based Q/A	3, 4, 10	5, 7, 9, 12
○ Comprehension-based Q/A	2, 5, 6	1, 3

**Exclusive Tips** ► Master the solutions to all the activities in this chapter along with exercise and other Q/A to develop the creative thinking and assess your talent.



# Assessment & Evaluation



A question bank presented in the form  
of a class test to assess the preparation

## Class Test

Time : 3 hours

## Science

### Class : Eight

Full marks : 100

#### Multiple Choice Questions (Each question carries 1 mark)

$1 \times 30 = 30$

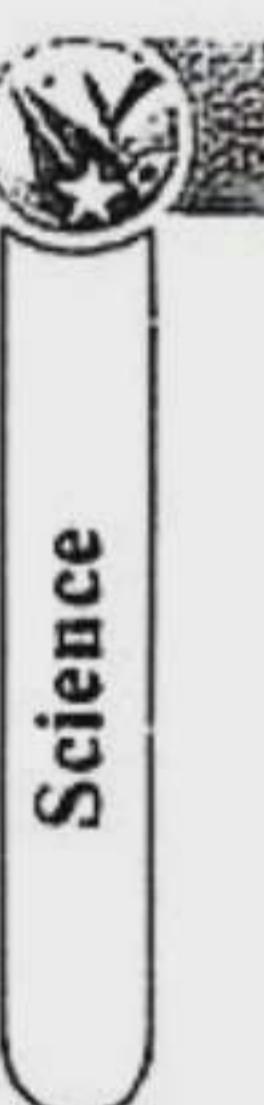
[N.B. : Answer all the questions. Each question carries one mark. Block fully, with a ball-point pen, the circle of the letter that stands for the correct/best answer in the "Answer Sheet" for Multiple Choice Question Type Examination.]

1. Amitosis takes place in —  
 A Spongilla     B Hydra     C Amoeba     D Scypha
  2. Amitosis does not take place in —  
 A yeast     B fungi     C bacteria     D euglena
  3. Direct cell division takes place in —  
 A Porifera     B Protozoa     C Cnidaria     D Nematoda
- Read the following passage and answer the question numbers 4 and 5 :
- Amoeba* runs its reproduction through the process called amitosis. Amitosis is applicable to unicellular organisms only.
4. What phylum does amoeba belong to?  
 A Protozoa     B Porifera  
 C Platyhelminthes     D Cnidaria
  5. Amitosis refers to —  
 i. division of nucleus  
 ii. division of cytoplasm  
 iii. formation of daughter cells  
 Which one is correct?  
 A i & ii     B ii & iii     C i & iii     D i, ii & iii
  6. What does somatic cell produce?  
 A Gamete     B Zygote     C Pollen     D Cuticle
  7. What stage is the very beginning of cell division?  
 A Prophase     B Interphase  
 C Pro-metaphase     D Anaphase
  8. How many phases has karyokinesis been divided into?  
 A 3     B 4     C 5     D 6
  9. At what phase do the chromosomes stay along the equatorial plane?  
 A Metaphase     B Pro-metaphase  
 C Anaphase     D Telophase
  10. At what stage the centromeres divide into two?  
 A Pro-metaphase     B Metaphase  
 C Anaphase     D Telophase
  11. Telophase includes —  
 i. reappearance of nucleolus  
 ii. formation of centriole  
 iii. formation of nuclear reticulum  
 Which one is correct?  
 A i & ii     B ii & iii     C i & iii     D i, ii & iii
  12. In which of the followings, meiosis cell division occurs?  
 A Floral axis     B Apex of root  
 C Buds     D Stamen
  13. In which part of a plant meiosis cell division takes place?  
 A In stem     B In buds     C In root     D In stamen
  14. Who is called the father of genetics?  
 A Gregor Mendel     B Charles Darwin  
 C Carolus Linnacus     D Carl Landsteiner
  15. How many types of nucleic acid are there?  
 A 1     B 2     C 3     D 4
  16. How many pairs of chromosomes are there in the human body?  
 A 22     B 23     C 24     D 25

17. The physical basis of heredity is —  
 A Chromosome     B Gene  
 C DNA     D RNA
  18. In which of the following meiosis occurs?  
 A Neuron     B Body cell     C Mother cell     D Platelets
  19. At which stage the shapes of chromosomes look like V, L, J or I in mitosis cell division?  
 A Prophase     B Metaphase  
 C Anaphase     D Telophase
  20. Shorter lasting than prophase —  
 i. pro-metaphase  
 ii. metaphase  
 iii. anaphase  
 Which one is correct?  
 A i & ii     B ii & iii     C i & iii     D i, ii & iii
  21. Daughter chromosomes are created in which step of mitosis cell division?  
 A Pro-metaphase     B Metaphase  
 C Anaphase     D Telophase
- Read the following passage and answer the question numbers 22 and 23 :
- Teacher was talking about the longest lasting stage of mitosis. There are five phases in this stage. It takes place in both plant cells and animal cells.
22. What stage precedes mitosis?  
 A Interphase     B Telophase  
 C Anaphase     D Metaphase
  23. This process does not take place in —  
 i. nerve cells of animals  
 ii. red blood cells of mammals  
 iii. platelets of mammals  
 Which one is correct?  
 A i & ii     B ii & iii     C i & iii     D i, ii & iii
  24. In which stage the daughter chromosomes reached their opposite poles?  
 A Pro-metaphase     B Metaphase  
 C Anaphase     D Telophase
  25. At what stage do the chromosomes proceed towards both poles of a cell?  
 A Telophase     B Anaphase  
 C Interphase     D Prophase
  26. How many types of cell division are there in the animal body?  
 A 2     B 3     C 4     D 5
  27. Where is direct cell division occurred?  
 A Yeast     B Stem  
 C Radical     D Reproductive mother cell
  28. In case of plants, mitosis takes place in —  
 A cell membrane     B reproductive tissue  
 C meristematic tissue     D all the above
  29. Where does mitosis take place in plants?  
 A Root end     B Tender leaf  
 C Bud     D All the above
  30. Life of a multicellular animal begins with —  
 A multicellular zygote     B single cell zygote  
 C double cell zygote     D triple cell zygote

## Answer Sheet ▶ Multiple Choice Questions

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16	<input type="radio"/>	17	<input type="radio"/>	18	<input type="radio"/>	19	<input type="radio"/>	20	<input type="radio"/>	21	<input type="radio"/>	22	<input type="radio"/>	23	<input type="radio"/>	24	<input type="radio"/>	25	<input type="radio"/>	26	<input type="radio"/>	27	<input type="radio"/>	28	<input type="radio"/>	29	<input type="radio"/>	30	<input type="radio"/>



**Short-Answer Question (Each question carries 2 marks)****Answer any 10 of the following questions :** $2 \times 10 = 20$ 

1. What is cell division? Explain.
2. How many types of cell division are there and what are they?
3. Why does amitosis not occur in the human body?
4. Write two characteristics of mitosis division.
5. Why is mitosis cell division important for organisms?
6. What is meiosis cell division? Explain.
7. Where does mitosis division occur?
8. What is meant by the equatorial region?

9. Give an idea about the attraction fiber.
10. How is the cell wall formed?
11. Where does meiosis occur?
12. Why is meiosis-2 called analogous to mitosis division?
13. Write two differences between mitosis and meiosis cell division.
14. What are the parts of a chromosome?
15. Why is Mendel called the father of heredity?

**Creative Question (Each question carries 10 marks)****Answer any 5 of the following questions :** $10 \times 5 = 50$ 

1.

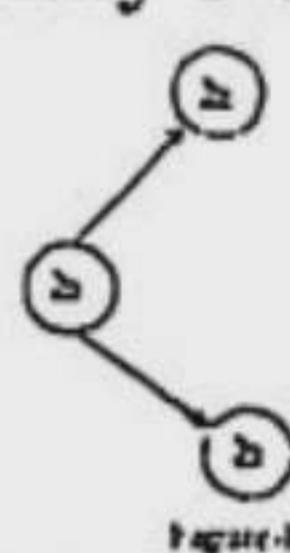


Figure-I

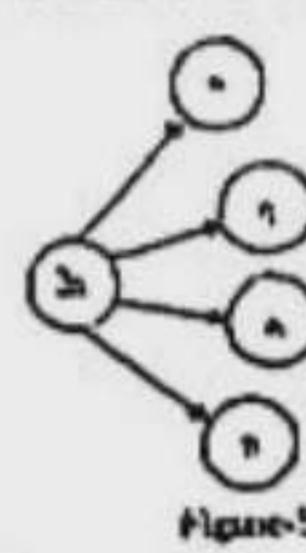


Figure-II

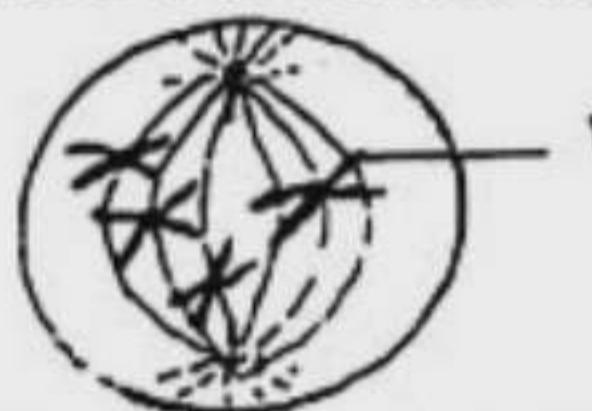
- a. What is karyokinesis? 1
- b. Chromosome has a role in heredity—Explain. 2
- c. Draw a labelled figure of the fourth step of R. 3
- d. Analyze the importance of cell division in the figure-S in retaining heredity of the species. 4

2.



- a. What is called Cytokinesis? 1
- b. Explain in which stage the chromosomes are found shortest and quite thick. 2
- c. Describe the reproduction process of 'X'. 3
- d. 'Y' and 'Z' play an important role to take sustainable number of human chromosome—Argument with logic. 4

3.



- a. What is interphase? 1
- b. Explain the reason to be the hair of Rafi same to his father. 2
- c. Explain the next phase of the phase mentioned in above stem. 3
- d. How 'Y' restores the individuality of every species? Analyze. 4

4. X—Ending of Karyokinesis.

Y—Chromosomes divide once, nucleus divides twice.

- a. What is DNA? 1
- b. Why the colour of Mitu's eyes is similar to the colour of her grandmother's eyes? 2
- c. Explain the phase 'X'. 3
- d. How the hereditary trait is maintained by 'Y'? Analyze it. 4

5.

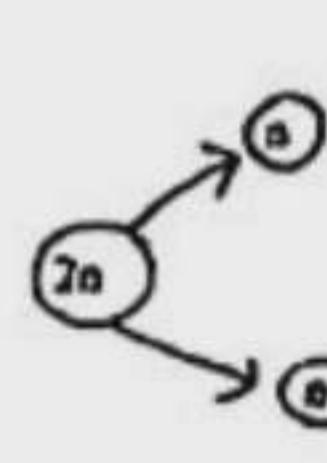


Fig : P



Fig : Q



Fig : R

- a. What is caryokinesis? 1
- b. Why the cell division in Amoeba is called direct cell division? 2
- c. Explain the cell division of 'P'. 3
- d. Analyze the role of 'Q' and 'R' for determining inheritance. 4
6. Tonima, a student of class eight, looks after her mother. A diagram of the step of cell division is hung on the wall in her reading room whose chromosomes are shaped in English alphabet.
  - a. What is interphase? 1
  - b. Why the cell division of Amoeba is called direct cell division? 2
  - c. Explain the diagram hung in Tonima's room with labelling. 3
  - d. According to stem, why the appearance of Tonima like this—analyze it. 4
7. Ayesa is a student of class eight and she looks like her mother. A cell division picture is hanging on the wall and the chromosome of that picture looks English alphabet.
  - a. What is called interphase? 1
  - b. Why the cell division of amoeba called direct cell division? 2
  - c. Explain with level diagram of the picture that is hanging on the wall in Ayesa's room. 3
  - d. Justify why Ayesa looks like her mother. 4

8.



Figure-(i)



Figure-(ii)

- a. What is Caryokinesis? 1
- b. What is the necessity meiosis? 2
- c. Mentioning its structure explain the prosperities of Figure (ii). 3
- d. "Figure no. (i) bridge between Caryokinesis and Cytokinesis"—Explain it. 4

**✓ Answering Reference ► Short-Answer Questions**

- |                                |                                |                                 |                                 |
|--------------------------------|--------------------------------|---------------------------------|---------------------------------|
| 1 ▶ See this Chapter, Ques. 01 | 5 ▶ See this Chapter, Ques. 07 | 9 ▶ See this Chapter, Ques. 15  | 13 ▶ See this Chapter, Ques. 25 |
| 2 ▶ See this Chapter, Ques. 02 | 6 ▶ See this Chapter, Ques. 08 | 10 ▶ See this Chapter, Ques. 21 | 14 ▶ See this Chapter, Ques. 26 |
| 3 ▶ See this Chapter, Ques. 05 | 7 ▶ See this Chapter, Ques. 09 | 11 ▶ See this Chapter, Ques. 23 | 15 ▶ See this Chapter, Ques. 28 |
| 4 ▶ See this Chapter, Ques. 06 | 8 ▶ See this Chapter, Ques. 14 | 12 ▶ See this Chapter, Ques. 24 |                                 |

**✓ Answering Reference ► Creative Questions**

- |                                |                                |                                |                                |
|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1 ▶ See this Chapter, Ques. 03 | 3 ▶ See this Chapter, Ques. 07 | 5 ▶ See this Chapter, Ques. 09 | 7 ▶ See this Chapter, Ques. 12 |
| 2 ▶ See this Chapter, Ques. 04 | 4 ▶ See this Chapter, Ques. 08 | 6 ▶ See this Chapter, Ques. 11 | 8 ▶ See this Chapter, Ques. 13 |