CLASS 10TH BIOLOGY WORKSHEET CHAPTER 2– STRUCTURE OF CHROMOSOMES, CELL CYCLE AND CELL DIVISION

(A) Fill in the blanks:

1. Chromatin fibre is made up of DNA and ..... .
2. The two sister chromatids of a chromosome are attached to each other at ..... .
3. The structure of DNA was first discovered by..... .
4. The three components of a nucleotide are ..... and ..... .
5. DNA strand wound around a histone octamer forms a complex called a ..... .
6. A specific sequence of nucleotides on a chromosome constitutes a ..... .

Answer

1. Chromatin fibre is made up of DNA and ***Histones*** .
2. The two sister chromatids of a chromosome are attached to each other at ***centromere*** .
3. The structure of DNA was first discovered by ***Rosalind Franklin*** .
4. The three components of a nucleotide are ***phosphate***, ***sugar*** and ***nitrogenous base***.
5. DNA strand wound around a histone octamer forms a complex called a ***nucleosome*** .
6. A specific sequence of nucleotides on a chromosome constitutes a ***gene*** .

(B) Multiple Choice Type

Question 1. The chromatin material is formed of

1. DNA only
2. DNA and Histones
3. Histones only
4. Nucleotides

Answer

DNA and Histones

Reason — DNA surrounds a core of 8 Histones to form a unit called nucleosome. These nucleosomes coil to form chromatin fibres.

Question 2. The term "chromosomes" literally means

1. Inherited bodies
2. Twisted threads
3. Coloured bodies
4. Shining threads

Answer

Coloured bodies

Reason — The chromosomes readily pick up certain dyes and get coloured, hence the name chromosomes.

Question 3.The number of chromosomes in a certain type of cell division is halved. This kind of cell division occurs in

1. only testis
2. only ovary
3. both ovary and testis
4. all body cells

Answer

both ovary and testis

Reason — In Meiosis, the number chromosomes is halved and it occurs in the sex cells or gametes. It takes place in the reproductive organs — testis and ovary.

Question 4. Synthesis phase in the cell cycle is called so for the synthesis of more of

1. RNA
2. RNA and proteins
3. DNA
4. Glucose

Answer

DNA

Reason — In synthesis phase, more DNA is synthesised and the chromosomes are duplicated.

Question 5. In which one of the following options the stages of mitosis have been given in correct sequence?

1. Prophase, metaphase, telophase, anaphase
2. Prophase, metaphase, anaphase, telophase
3. Anaphase, telophase, prophase, metaphase
4. Telophase, anaphase, prophase, metaphase

Answer

Prophase, metaphase, anaphase, telophase

Reason — The stages of mitosis in correct sequence are:

Prophase → metaphase → anaphase → telophase

Question 6. The new cells are to be produced for all except:

1. Growth
2. Movement
3. Repair
4. Replacement

Answer

Movement

Reason — New cells need to be produced for Growth, Repair, Replacement and Reproduction.

Question 7. The chromosomes are duplicated in :

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

Answer

S phase

Reason — In the S phase (i.e., Synthesis phase) more DNA is synthesised and the chromosomes are duplicated.

Question 8. Triple hydrogen bonds are present between :

1. Adenine and Thymine
2. Adenine and Cytosine

3. Adenine and Guanine
4. Guanine and Cytosine

Answer

Guanine and Cytosine

Reason — Triple hydrogen bonds are present between Guanine and Cytosine.

Question 9. In the cells of a human male body, the number of autosomes is :

1. 23 pairs
2. 22 pairs
3. 1 pair
4. 46 pairs

Answer

22 pairs

Reason — Out of total 23 pairs of chromosomes, 22 pairs are autosomes and 1 pair is sex chromosome.

Question 10. The basis of genetic variation in the living organisms during mitosis occurs due to :

1. Cell division
2. Mutation
3. Crossing over
4. Karyokinesis

Answer

Crossing over

Reason — Crossing over results in change of gene sequence which is responsible for variation.

Question 11. After a mitotic cell division, a human female cell will have :

1. 22 + X chromosomes
2. 44 + XY chromosomes
3. 44 + XX chromosomes
4. 22 + XX chromosomes

Answer

44 + XX chromosomes

Reason — After mitotic cell division, the resulting daughter cells will have the same number and type of chromosomes as the parent cell. A human female cell has 46 chromosomes. Out of these 46, two are sex chromosomes (XX).

Question 12. The correct sequence of phases in interphase is:

1. G_1, G_2 and S
2. S, G_2 and G_1
3. G_1, S and G_2
4. G_2, S and G_1

Answer

G1, S and G2

Reason — The correct sequence is G1 → S → G2.

Question 13. The phase of karyokinesis which is almost the reverse of prophase is :

1. Interphase
2. Metaphase
3. Anaphase
4. Telophase

Answer

Telophase

Reason — In telophase, chromatids thin out in the form of chromatin fibres. In prophase, chromosomes become distinct.

Question 14. The lengthwise arrangement of DNA mainly consists of a phosphate group attached with :

1. Hexose sugar
2. Purines
3. Pentose sugar
4. Pyrimidines

Answer

Pentose sugar

Reason — The lengthwise arrangement of DNA mainly consists of a phosphate group attached with five-carbon pentose (ribose) sugar.

Question 15. The number of histone proteins associated with the DNA in a nucleosome is:

1. 6
2. 8
3. 4
4. 1

Answer

8

Reason — A nucleosome has 8 histone proteins.

Question 16. The pyrimidine bases of DNA are:

1. Adenine and Guanine
2. Guanine and Cytosine
3. Adenine and Thymine
4. Thymine and Cytosine

Answer

Thymine and Cytosine

Reason — Thymine and Cytosine are pyrimidine; and Adenine and Guanine are purine.

Question 17. The female gamete/egg cell of a human cell will have:

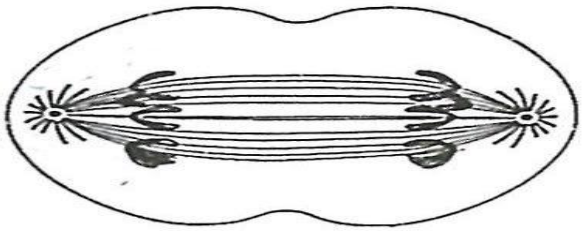
1. 44 + XX chromosomes
2. 44 + XY chromosomes
3. 22 + X chromosomes
4. 22 + Y chromosomes

Answer

22 + X chromosomes

Reason — Chromosome number is halved in gametes (sex cells) so the female gamete/egg cell of a human cell will have 22 + X chromosomes.

Question 18. The figure given alongside was shown to students of class 10 in the laboratory under a compound microscope. They were told to observe the slide, identify the stage of mitotic cell division and mention the number of chromosomes which would be found in the daughter cells. Which of the following will be the correct response?



1. Anaphase, 8 chromosomes
2. Metaphase, 8 chromosomes
3. Anaphase, 4 chromosomes
4. Telophase, 4 chromosomes

Answer

Anaphase, 4 chromosomes

Reason — During mitosis the chromosome number remains the same, and in anaphase the sister chromatids move towards opposite ends. During this phase, in animal cell, the furrow formation starts in the cell membrane at the middle by which the cytoplasm will divide after mitosis.

(C). Assertion Reason Type

Question 19

Assertion. Both centromere and centrosome are parts of chromosome.

Reason. The centromere is the region where spindle fibres attach, while the centrosome helps in the formation of spindle fibres.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
Centromere is the place where spindle fibres attach and centrosome is the organelle which helps in forming spindle fibres. Centromere and centrosome are not parts of chromosome.

Question 20

Assertion. The basic structural unit of DNA is nucleotide.

Reason. DNA is composed of repeating nucleosome which are made up of three components - pentose sugar, phosphate group and nitrogenous bases.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is True and R is False.

Explanation
DNA is composed of repeating nucleosome which are made up of nucleotide and histone proteins. Nucleotide are composed of pentose sugar, phosphate group and nitrogenous bases.

Question 21

Assertion. Centrosome is the point of attachment of two chromatids of a chromosome.

Reason. Centrosome initiates and regulates the process of cell division as it helps in the formation of spindle fibres.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
Centromere is the point of attachment of two chromatids of a chromosome. Centrosomes or centrioles are structures present in cell that initiate and regulate cell division.

Question 22

Assertion. Meiosis is the kind of cell-division which occurs during gamete formation in the gonads.

Reason. During meiosis, chromosome number remains the same in parent cell and daughter cells which is very significant to maintain the identity of the organism.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is True and R is False.

Explanation
During meiosis, chromosome number is halved. During fertilisation, two haploid gametes/cells fuse to restore normal chromosome count.

(D) Very Short Answer Type

Question 1

Name the following:

(a) The repeating components of each DNA strand lengthwise.

(b) The complex structure consisting of DNA strand and a core of histones.

(c) The type of bond which joins the complementary nitrogenous bases.

(d) The three components of nucleotide.

Answer

(a) Nucleotides

(b) Nucleosome

(c) Hydrogen Bond

(d) Phosphate, Sugar and Nitrogenous base.

Question 2

Imagine one cell (A) has undergone one mitotic division and another cell (B) has completed its meiotic division. How many daughter cells would the two produce?
Cell A: .....
Cell B: .....

Answer

Cell A produces 2 cells
Cell B produces 4 cells

Question 3 Match the events given in column A with the phase in mitotic cell division in column B

Column "A"	**Column "B"**
(a) Chromosomes get arranged in a horizontal plane at the equator.	Anaphase
(b) Daughter chromosomes move to the opposite poles of a spindle.	Prophase
(c) Chromosomes become visible as fine long threads.	Telophase
(d) Chromosomes lose their distinctiveness and gradually become transformed into a chromatin network.	Metaphase

Answer

Column "A"	**Column "B"**
(a) Chromosomes get arranged in a horizontal plane at the equator.	Metaphase
(b) Daughter chromosomes move to the opposite poles of a spindle.	Anaphase
(c) Chromosomes become visible as fine long threads.	Prophase
(d) Chromosomes lose their distinctiveness and gradually become transformed into a chromatin network.	Telophase

Question 4 Fill in the blanks

(a) DNA replicates in the ..... phase of the cell cycle.

(b) Mitosis occurs in our ..... cells.

(c) Meiosis occurs only in ..... cells.

(d) Modern humans have 46 chromosomes. Their sperms and eggs will have ..... chromosomes each.

(e) During the pairing of chromosomes in meiosis, the ..... chromosomes come to lie side by side.

(f) The two non-sister chromatids of a paired chromosome are attached to each other at ..... during the process of crossing over.

Answer

(a) DNA replicates in the ***synthesis*** phase of the cell cycle.

(b) Mitosis occurs in our ***somatic (body)*** cells.

(c) Meiosis occurs only in ***reproductive*** cells.

(d) Modern humans have 46 chromosomes. Their sperms and eggs will have ***23*** chromosomes each.

(e) During the pairing of chromosomes in meiosis, the ***homologous*** chromosomes come to lie side by side.

(f) The two non-sister chromatids of a paired chromosome are attached to each other at ***chiasma*** during the process of crossing over.

(E). Short Answer Type

Question 1. Name these:

(a) Two main constituents of Chromatin

(b) Two kinds of Nucleic acids

(c) Three components of a Nucleotide

(d) Four Nitrogenous bases

(e) Two kinds of Nitrogenous bases

(f) Two components of Nucleosome

(g) Two kinds of Cell division

(h) Four main phases of Karyokinesis

(i) Two steps of the process Mitosis

(j) Two kinds of haploid cells of human body

Answer

(a) DNA and Histones

(b) RNA and DNA

(c) Phosphate, Sugar and Nitrogenous bases

(d) Adenine, Guanine, Thymine and Cytosine

(e) Purine and Pyrimidine

(f) DNA and Histone

(g) Mitosis and Meiosis

(h) Prophase, Metaphase, Anaphase, Telophase

(i) Karyokinesis and Cytokinesis

(j) Male gamete (22 + Y) and Female gamete (22 + X)

Question 2. What are the rungs of the "DNA ladder" made of?

Answer

The rungs of the DNA ladder are made of four types of nitrogenous bases. These are:

1. Adenine (A)
2. Guanine (G)
3. Cytosine (C)
4. Thymine (T)

Question 3. Correct the following statements for mistakes, if any.

(a) The four nitrogenous bases in the DNA are Guanine, Thiamine, Adrenaline and Cytosine.

(b) Genes are specific sequences of bases on a chromosome.

(c) A nucleotide is composed of a sulphate, a sugar (pentose) and a nitrogenous base.

(d) Nucleosomes are groups of cysteine molecules surrounded by DNA strands.

(e) If there are 46 chromosomes in a cell, there will be 23 chromatin fibres inside the nucleus during interphase.

Answer

Corrected statements are as follows:

(a) The four nitrogenous bases in the DNA are Guanine, ***Thymine***, ***Adenine*** and Cytosine.

(b) Genes are specific sequences of ***nucleotides*** on a chromosome.

(c) A nucleotide is composed of a ***phosphate***, a sugar (pentose) and a nitrogenous base.

(d) Nucleosomes are groups of ***histone*** molecules surrounded by DNA strands.

(e) If there are 46 chromosomes in a cell there will be ***46*** chromatin fibres inside the nucleus during interphase.

(F). Descriptive Type

Question 1. Define the following terms:

(a) Chromosome

(b) Gene

(c) Cell division

(d) Chromatid

(e) Aster

Answer

(a) **Chromosome** — Chromosomes are formed of very long, highly coiled and condensed chromatin fibres which are made of DNA (about 40%) and histones (about 60%). They are present in the nucleus of the cell. They carry the chemical instructions for the reproduction of the cell.

(b) **Gene** — Genes are specific sequences of nucleotides on a chromosome that encode particular proteins which express in the form of some particular feature of the body. They are the units of heredity which are transferred from parents to offsprings and are responsible for some specific characteristics of the offspring.

(c) **Cell Division** — Cell division is the method in which the cell divides and the duplicated chromosomes get evenly distributed into the daughter cells.

(d) **Chromatid** — Duplicated chromosomes consist of two identical strands, each of these is called a chromatid. Before replication, one chromosome is composed of one DNA molecule. In replication, the DNA molecule is copied, and the two molecules are known as chromatids. During the later stages of cell division these chromatids separate longitudinally to become individual chromosomes.

(e) **Aster** — During mitosis in an animal cell, after the centrosome splits into two along with simultaneous duplication of the centrioles contained in it, each centriole is surrounded by radiating rays and is termed aster (meaning star).

Question 2. Give reason:

(a) Gametes must be produced by meiosis for sexual reproduction.

(b) Why is meiosis referred to as 'reductional division'?

(c) The children of the same parents, howsoever similar, are different from each other in certain aspects.

Answer

(a) Gametes must be produced by meiosis for sexual reproduction because the numbers of chromosomes are reduced to half during meiosis and then the normal diploid numbers of chromosomes are regained during the process of fertilization.

(b) Meiosis is referred to as 'reductional division' because the number of chromosomes are reduced to half i.e. out of the 23 pairs of chromosomes in humans, only single set of chromosomes are passed on to the sex cells. This is essential because when the male and female gametes fuse during fertilization, the normal double (diploid) number of chromosomes is reacquired. The diploid number, as a rule, is expressed as "2n" and the haploid number as "n".

(c) The mixing up or recombination of genes during meiotic division provides for the innumerable variations and diversity in the progeny. That is how, the children of the same parents, howsoever similar, are different from each other in certain aspects.

Question 3. Distinguish between the following pairs:

(a) Cytokinesis and Karyokinesis

(b) DNA and RNA

(c) Nucleosome and Nucleotide

(d) Centrosome and Centromere

(e) Haploid and Diploid

Answer

(a) Difference between Cytokinesis and Karyokinesis

Cytokinesis	**Karyokinesis**
It is the division of the cytoplasm.	It is the division of the nucleus.
It occurs after karyokinesis.	It is the first division.
It results in the formation of two daughter cells.	It results in the formation of two nuclei.

(b) Difference between DNA and RNA

DNA	**RNA**
DNA is Deoxyribonucleic acid.	RNA is Ribonucleic acid.
It consists of four distinct bases: Thymine, Adenine, Cytosine and Guanine.	It consists of four distinct bases: Uracil, Adenine, Cytosine and Guanine.
The DNA is a double-stranded molecule.	The RNA is a single-stranded molecule.

DNA	RNA
It is located in the nucleus of a cell and in the mitochondria.	It is found in the cytoplasm, nucleus, and in the ribosome.

(c) Difference between Nucleosome and Nucleotide

Nucleosome	Nucleotide
Nucleosome is the complex that is made up of DNA wrapped around histone proteins.	The chemical composition of nucleotide consists of a phosphate group, a sugar and a nitrogenous base.

(d) Difference between Centrosome and Centromere

Centrosome	Centromere
It is an organelle of the animal cell surrounding the centrioles, located near the nucleus.	It is a non-stainable part of chromosome at which two chromatids join.
It contains one or two centrioles which move towards the opposite poles and forms spindle fibres during cell division.	It provides attachment of spindle fibres during cell division.

(e) Difference between Haploid and Diploid

Haploid	Diploid
Only half the number of chromosomes (only one member from each pair) is passed on to each daughter cell.	Full Set of chromosomes is passed on to each daughter cell.
It is denoted by n.	It is denoted by 2n.
This state is found during meiotic division.	This state is found during mitotic division.

Question 4. Write full form of the following abbreviations:

(a) DNA

(b) RNA

Answer

(a) DNA — Deoxyribonucleic acid

(b) RNA — Ribonucleic acid

Question 5 Given below are the sets of four terms. Choose the odd one and write the category of the remaining terms:

(a) Adenine, Guanine, Adrenaline, Thymine

(b) Pentose sugar, Histones, Phosphate group, Nitrogenous bases

(c) Metaphase, Anaphase, Interphase, Telophase

(d) G_1 phase, M phase, G_2 phase, S phase

(e) Chromoplast, Chromosome, Chloroplast, Leucoplast

Answer

(a) Odd one out — Adrenaline
Adenine, Guanine, Thymine — Nitrogenous bases

(b) Odd one out — Histones
Pentose sugar, Phosphate group, Nitrogenous bases — form nucleotide

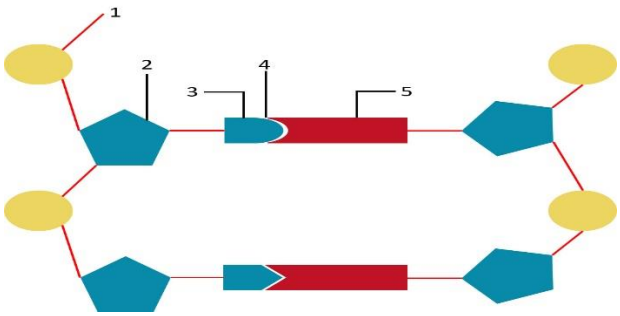
(c) Odd one out — Interphase
Metaphase, Anaphase, Telophase — Phases of Mitosis

(d) Odd one out — M phase
G1 phase, G2 phase, S phase — Phases of Interphase

(e) Odd one out — Chromosome
Chromoplast, Chloroplast, Leucoplast — Plastids

(G). Structured/ Application/ Skill Type

Question 1. Given below is a schematic diagram of a portion of DNA.



(a) How many strands are shown in the diagram?

(b) How many nucleotides have been shown in each strand?

(c) Name the parts numbered 1,2,3,4 and 5 respectively.

(d) Name the DNA unit constituted by the parts 1, 2 and 3 collectively.

Answer

(a) 2 strands are shown in the diagram.

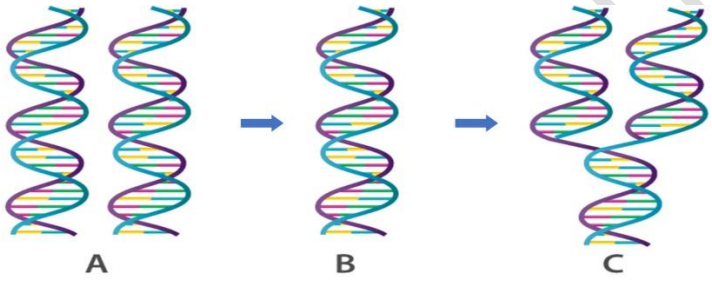
(b) 2 on each strand.

(c) The parts are as follows:

- 1 → Phosphate
- 2 → Sugar
- 3 → Bases
- 4 → Hydrogen Bond
- 5 → Base

(d) The DNA unit constituted by the parts 1, 2 and 3 collectively is called **Nucleotide**.

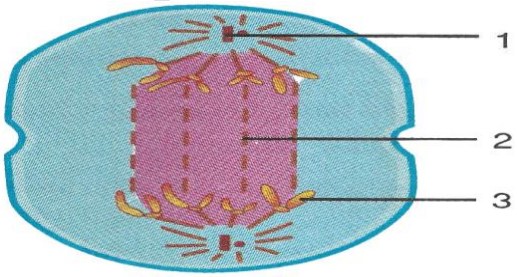
Question 2. The three sketches given below (A, B and C) are intended to represent the replication of DNA. What should be their correct sequence starting with the first and ending with the last?



Answer

The correct sequence is :
B, C and A

Question 3. The diagram below represents a stage during cell division. Study the same and then answer the questions that follow:



a. Name the parts labelled 1, 2 and 3.

b. Identify the above stage and give a reason to support your answer.

c. Mention the type of cells in our body where this type of cell division occurs.

d. Name the stage prior to this stage and draw a diagram to represent the same.

Answer

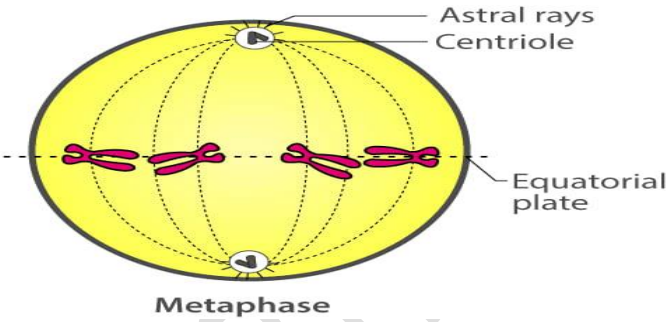
(a) The parts are as follows:

- 1 → Centrosome
- 2 → Spindle fibres
- 3 → Chromatids

(b) The stage described in the diagram is the late anaphase of mitosis in an animal cell. The stage can be identified by the presence of separated chromatids which are found at the two poles of the cell. The appearance of the furrow in the cell membrane classifies the stage as the late anaphase.

(c) The division is mitotic and this kind of cell division occurs in all the cells of the body except for the reproductive cells.

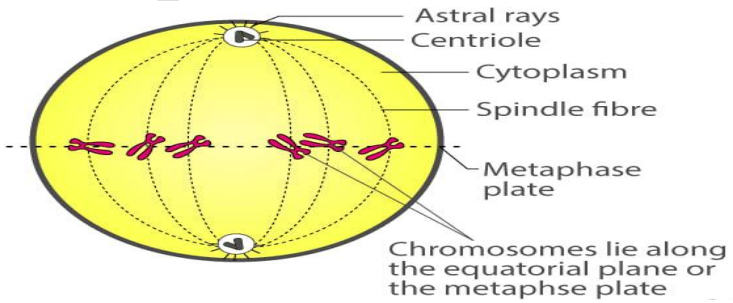
(d) The stage before anaphase is metaphase. Below diagram shows metaphase:



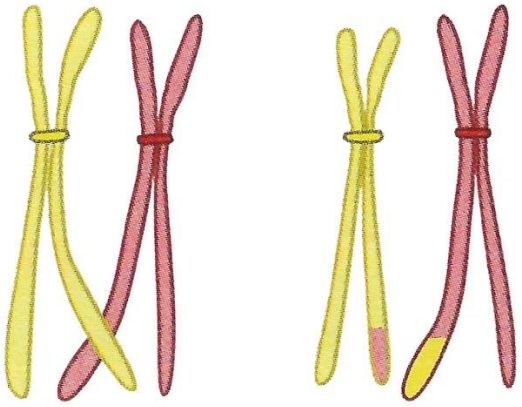
Question 4. Draw a labelled diagram to show the metaphase stage of mitosis in an animal cell having "6" chromosomes.

Answer

Below diagram shows the metaphase stage of mitosis in an animal cell having 6 chromosomes:



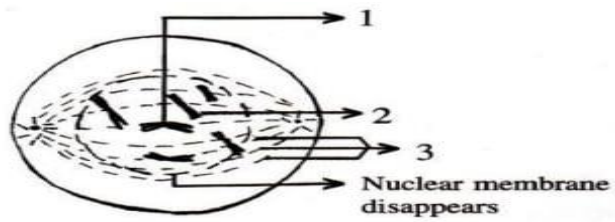
Question 5. The diagram given below represents a certain phenomenon which occurs during meiosis. Name and explain the phenomenon by using the terms - homologous chromosomes, chromatids, and crossing-over.



Answer

The phenomenon shown in the diagram is termed **Crossing-Over**. It is the exchange of chromatid material between the two members of a homologous pair of chromosomes while the maternal and paternal chromosomes are separating.

Question 6. Given below is a diagram representing a stage during mitotic cell division in an animal cell. Examine it carefully and answer the questions which follow.



(a) Identify the stage. Give one reason in support of your answer.

(b) Name the cell organelle that forms the 'aster'.

(c) Name the parts labelled 1, 2 and 3.

(d) Name the stage that follows the one shown here. How is that stage identified?

(e) Mention two points of difference between mitosis and meiosis with regard to:

1. The number of daughter cells produced.
2. The chromosome number in the daughter cells.

Answer

(a) By observing the given figure we can say that it is the late prophase stage because the nuclear membrane and nucleolus have disappeared.

(b) Centrioles is the cell organelle that form the aster.

(c) The parts are as follows:

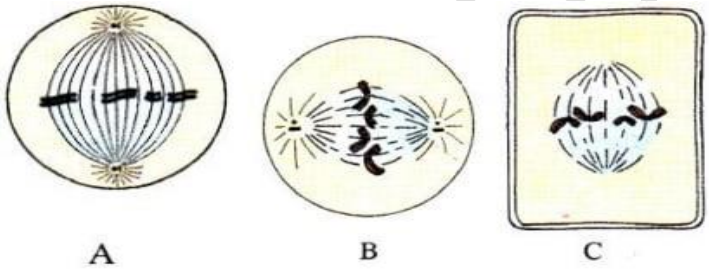
- 1 → Centromere
- 2 → Chromatids
- 3 → Spindle fibre

(d) The stage that follows the one shown here is Metaphase. In Metaphase, the centromeres of chromosomes are drawn to the equator by equal pull of two chromosomal spindle fibres that connects each centromere to the opposite poles, forming a metaphasic plate.

(e) Difference between mitosis and meiosis :

Mitosis	**Meiosis**
It produce two daughter cells.	It produce Four daughter cells.
Full set of chromosomes is passed on to each daughter cell. This is the diploid (2n) number of chromosomes.	Only half the number of chromosomes is passed on to each daughter cell. This is the haploid (n) number of chromosomes.

Question 7. Given below are three diagrammatic sketches (A, B and C) of one and the same particular phase during mitotic type of cell division.



(a) Identify the phase.

(b) What is the diploid number of chromosomes shown in them?

(c) Identify whether these are animal cells or plant cell? Give reasons.

Answer

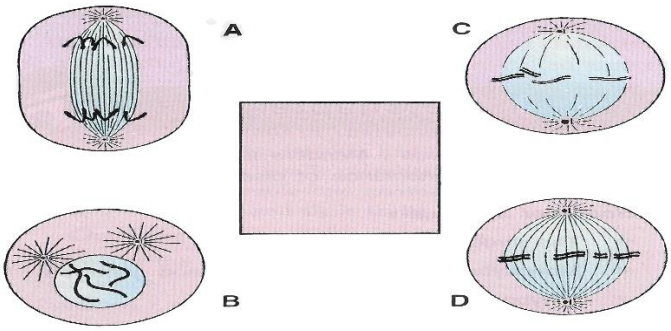
(a) It is Metaphase.

(b) The diploid number of chromosomes shown in them is 4.

(c) Categorisation of cell A, B and C are as given below:

- Cell A - It is an animal cell as the centrosome has split into two centrioles and the centrioles have formed asters. Also, no cell wall is present.
- Cell B - It is an animal cell as the centrosome has split into two centrioles and the centrioles have formed asters. Also, no cell wall is present.
- Cell C - It is a plant cell as no centrioles are seen and cell wall is present.

Question 8. Shown below are four stages (A, B, C, D) (not in sequence) of a certain kind of cell division.



(a) Is it a plant cell or an animal cell? Give two reasons.

(b) Is it undergoing mitosis or meiosis?

(c) What should be the correct sequence of these four stages among themselves?

(d) Name the stage that should precede the earliest of these stages.

(e) Draw the stage named above inside the blank space provided.

Answer

(a) This figure is of the animal cell because:

1. Centrosomes on centrioles are present.
2. Cell wall is absent

(b) It is undergoing mitosis.

(c) The correct sequence is B, C, D and A

(d) The stage that should precede the earliest of these stages is interphase.

(e) Below diagram shows interphase stage of mitosis: