



ICSE - Class 10 – Biology – Concise Selina Solution

Chapter 2 - Structure of Chromosomes, Cell Cycle and Cell Division

Review questions Page: 19

A. MULTIPLE CHOICE TYPE

(Choose the best option out of the four alternatives a, b, c and d)

1. The chromatin material is formed of

- (a) DNA only (b) DNA and Histones
(c) Histones only (d) Nucleotides

Solution:-

- (b) DNA and Histones

Chromatin material is formed of DNA about 40% and Histones 60%.

2. The term “chromosomes” literally means

- (a) Inherited bodies (b) Twisted threads
(c) Coloured bodies (d) Shining threads

Solution:-

- (c) Coloured bodies

Chroma means coloured and soma means body.

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

- (a) only testis (b) only ovary



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(c) both ovary and testis (d) all body cells

Solution:-

(c) both ovary and testis

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

(a) Prophase, metaphase, telophase, anaphase

(b) Prophase, metaphase, anaphase, telophase

(c) Anaphase, telophase, prophase, metaphase

(d) Telophase, anaphase, prophase, metaphase

Solution:-

(b) Prophase, metaphase, anaphase, telophase

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

(a) RNA (b) RNA and proteins

(c) DNA (d) Glucose

Solution:-

(c) DNA

B. VERY SHORT ANSWER TYPE

1. Name the following:

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



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Solution:-

Nucleotides

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

Solution:-

Nucleosome

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

Solution:-

Hydrogen Bond

(d) The three components of nucleotide.

Solution:-

Phosphate, Sugar and Nitrogenous base.

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

Cell A:

Cell B:

Solution:-

Cell A produces 2 cells

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Cell B produces 4 cells

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

Column "A" Column "B"

(a) Chromosomes become arranged in a Anaphase

horizontal plane at the equator.

(b) Daughter chromosomes move to the Prophase

opposite poles of a spindle

(c) Chromosomes become visible as fine long Telophase

threads.

(d) Chromosomes lose their distinctiveness and Metaphase

gradually become transformed into a chromatin

network.

Solution:-

Column "A" Column "B"

(a) Chromosomes become arranged in a Metaphase

horizontal plane at the equator.

(b) Daughter chromosomes move to the Telophase

opposite poles of a spindle

(c) Chromosomes become visible as fine long Prophase



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threads.

(d) Chromosomes lose their distinctiveness and Anaphase gradually become transformed into a chromatin network.

4. Fill in the blanks

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

Solution:-

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

(b) Mitosis occurs in our cells.

Solution:-

Mitosis occurs in our somatic (body) cells.

(c) Mitosis produces two daughter cells, whereas meiosis produces daughter cells.

Solution:-

Mitosis produces two daughter cells, whereas meiosis produces four daughter cells.

(d) Meiosis occurs only in cells.

Solution:-

Meiosis occurs only in reproductive cells.



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

Solution:-

Modern humans have 46 chromosomes. Their sperms and eggs will have 23 chromosomes each.

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

Solution:-

During the pairing of chromosomes in meiosis, the homologous chromosomes come to lie side by side.

C. SHORT ANSWER TYPE

1. What is the difference between chromatin fibre and chromosome?

Solution:-

Chromosome	Chromatin
The nucleus contains most of the cell's DNA which is organized into discrete units called chromosomes	A chromosome contains one long DNA molecule associated with many proteins is called the chromatin

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

Solution:-

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The rungs of the DNA ladder made of four types of nitrogenous bases. These are Adenine (A), Guanine (G), Cytosine (C) and Thymine (T).

3. Correct the following statements if there is any mistake.

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

Solution:-

The four nitrogenous bases in the DNA are Guanine, Thymine, Adenine and Cytosine.

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

Solution:-

Genes are specific sequences of nucleotides on a chromosome.

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

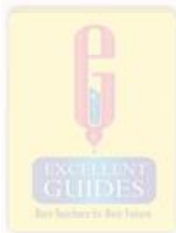
Solution:-

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

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

Solution:-

Nucleosomes are groups of histone molecules surrounded by DNA strands.



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

Solution:-

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

4. State the difference between:

(a) Chromosome and chromatid,

Solution:-

Chromosome	Chromatid
The nucleus contains most of the cell's DNA which is organized into discrete units called chromosomes	Each chromosome has already duplicated (having made its copy), to form two chromatids.

(b) Centrosome and Centromere,

Solution:-

Centrosome	Centromere
Centrosome (Animal cells only) is a region surrounding the centrioles,	Each chromosome in its condensed form as visible during the start of cell division, consists of



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located near the nucleus. It contains one or two centrioles.

Centrioles are surrounded by microtubules.

two chromatids joined at some point along the length. This point of attachment is called the centromere.

(c) Aster and spindle fibres.

Solution:-

Aster	Spindle fibres
The daughter centrioles move apart and occupy opposite “poles” of the cell. Each centriole is surrounded by radiating rays and is termed aster.	A number of fibres appear between the two daughter centrioles, which are called the spindle fibres.

(d) Haploid and diploid

Solution:-

Haploid	Diploid
Only half the number of chromosomes (only one member from each pair) is passed on to	Full Set of chromosomes is passed on to each daughter



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each daughter cell. This is the haploid (n).

cell. This is the diploid (2n) number of chromosomes.

5. “First meiotic division is the reduction division”. What does the word ‘reduction’ refer to in this statement?

Solution:-

In the above statement, reduction means that the number of chromosomes in the sex cells is halved. For example, out of the 23 pairs of chromosomes in humans, only single chromosomes i.e. one number of each pair are passed on to the sex cells.

6. “Gametes must be produced by meiosis for sexual reproduction”. Why is it so?

Solution:-

Gametes must be produced by meiosis for sexual reproduction because, when the male and female gametes fuse during fertilization, the normal double number of chromosomes is reacquired.

7. Mention whether the following statements are true (T) or false (F). Give reason in support of your answer.

(a) As you grow from childhood to adulthood, your skin cells divide only to replace such cells that are lost from the surface.

Solution:-

False.

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Because surface skin cells are continuously lost and replaced by the underlying cells.

(b) The unfertilized human egg has half the number of chromosomes of the body cells.

Solution:-

True.

Because, all types of human cells, have 46 chromosomes. The only type of cell which does not have 46 chromosomes are the sex cells, which have only half of the number, so they have 23 chromosomes. The egg cell is a sex cell (found in female). So it must have 23 chromosomes.

(c) Nuclear membrane in a mitotically dividing cell remains intact up to the metaphase and disappears only in the telophase.

Solution:-

False.

Because, nuclear membrane disappears in Prophase itself, however, it reappears during Telophase.

(d) Mitotic cell division can be a mode of reproduction.

Solution:-

True.

Because, mitotic cell division can be a mode of asexual reproduction in unicellular organisms like amoeba or yeast cell which divides into two daughter cells.



(e) Crossing-over between chromatids can occur only between homologous chromosomes.

Solution:-

True.

Because, while the maternal and paternal chromosomes are separating, the chromatid material gets exchanged between the two members of a homologous pair resulting in genetic recombination.

D. LONG ANSWER TYPE

1. What are chromosomes?

Solution:-

When a normal unstained living cell is observed under a light microscope, its nucleus may not appear to contain any particular thing inside. But when the same cell is stained with suitable dyes, several structures become noticeable in the nucleus.

The nucleus contains most of the cell's DNA which is organized into discrete units called chromosomes. Each chromosome contains one long DNA molecule associated with many proteins. This complex of DNA and Proteins is called the chromatin. When a cell is not dividing, the chromatin under an electron microscope appears to be in the form of very long and extremely thin darkly stained fibre.

2. What are genes?

Solution:-



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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.

Lots of regions in between genes are just nonfunctional. Such areas (about 99 per cent of the total DNA) show tremendous variations from person to person and help in identification of the individual by what is popularly known as DNA fingerprinting.

3. Enumerate the various changes that occur in the nucleus of the cell during (a) prophase (b) anaphase of mitotic division.

Solution:-

(a) Prophase

- 1 Centrioles start moving apart and reach opposite poles.
- 2 Chromosomes become distinct.
- 3 Chromosomes are already duplicated as paired chromatids.
- 4 Sister chromatids attached to each other at a small region called centromere.
- 5 Spindle fibres appear between daughter centrioles forming the achromatic spindle.
- 6 Nuclear membrane and nucleolus disappear.

(b) Anaphase



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- 1 Centromere attaching the two chromatids divides/splits.
- 2 The two sister chromatids of each chromosome separate and are drawn apart towards opposite poles pulled by shortening of spindle fibres.
- 3 A furrow starts in the cell membrane at the middle in the animal cell.

4. Name and explain the various stages of the cell cycle.

Solution:-

The cell cycle is a series of events that take place in a cell leading to the duplication of its DNA and the subsequent division of the cell to produce two daughter cells.

A cell cycle consists of two phases:

- (i) a non-dividing phase called the interphase, and
- (ii) a dividing phase called the M-phase or simply mitosis.

Interphase

The two daughter cells produced from a mother cell are relatively small, with a full-sized nucleus but relatively little cytoplasm. These cells are said to be in interphase.

The interphase itself has three phases –

- (i) First growth phase (G_1):- RNA and proteins are synthesised the volume of cytoplasm increases.
- (ii) Synthesis phase (S):- More DNA is synthesised, the chromosomes are duplicated.



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(iii) Second growth phase (G_2):- This is a shorter growth phase, in which RNA and proteins necessary for cell division continues to be synthesised.

Mitosis

Mitosis is the cell division in which one parent cell divides into identical daughter cells.

Mitosis completed in two steps are Karyokinesis and Cytokinesis.

Karyokinesis: – It is the division of the nucleus during cell division.

It occurs in four phases:

Prophase:- Chromosomes have become short and thick and clearly visible inside the nucleus.

Metaphase:- The duplicate chromosomes arrange on the equatorial plane. Each chromosome gets attached to a spindle by its centromere.

Anaphase:- The centromere attaching the two chromatids divides and the two sister chromatids of each chromosome separate and are drawn apart towards opposite poles.

Telophase:- Spindle apparatus disappears. Chromosome become thinner and turns into a network of chromatin threads.

Cytokinesis:-

At the end of telophase, a furrow appears in the cell membrane in the middle, which deepens and finally splits the cytoplasm into two, thus producing two new cells.

5. Why is meiosis referred to as 'reductional division'?

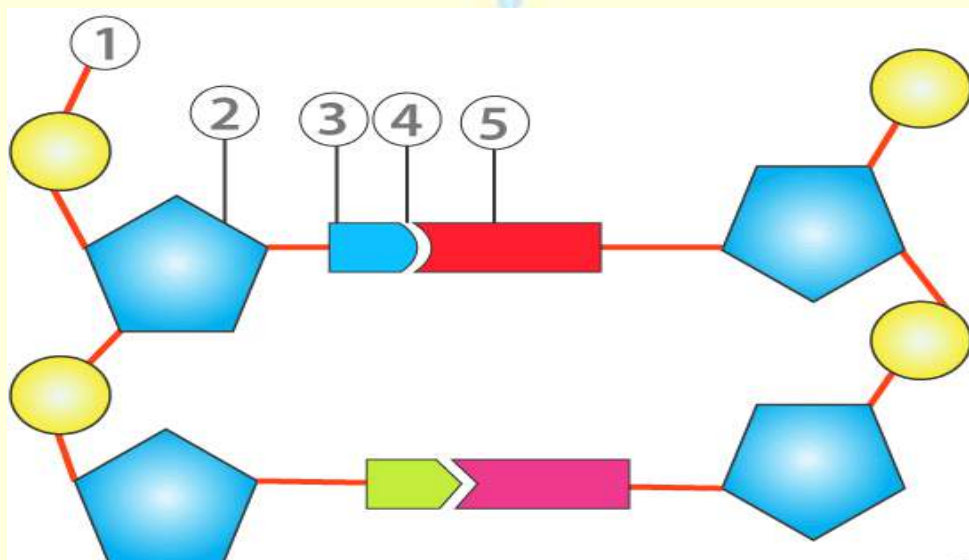
Solution:-

Meiosis (meion = to lessen, referring to the reduction of the chromosome number) is the kind of cell division that produces the sex cells or the gametes. It takes place in the reproductive organs (testis and ovary) in human to produce sperms and ova. In the flowering plants, it takes place in the anthers and the ovary to produce pollen grains and ovules.

The most significant aspect of meiosis is that the number of chromosomes in the sex cells is halved. For example, out of the 23 pairs of chromosomes in humans only single chromosomes i.e. one member of each pair (haploid) 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 ”.

E. STRUCTURED/APPLICATION/SKILL TYPE

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





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

Solution:-

There are 2 strands shown in the diagram.

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

Solution:-

There 2 nucleotides have been shown in each strand.

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

Solution:-

1 = Phosphate

2 = Sugar

3 = Bases

4 = Hydrogen Bond

5 = Base

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

Solution:-

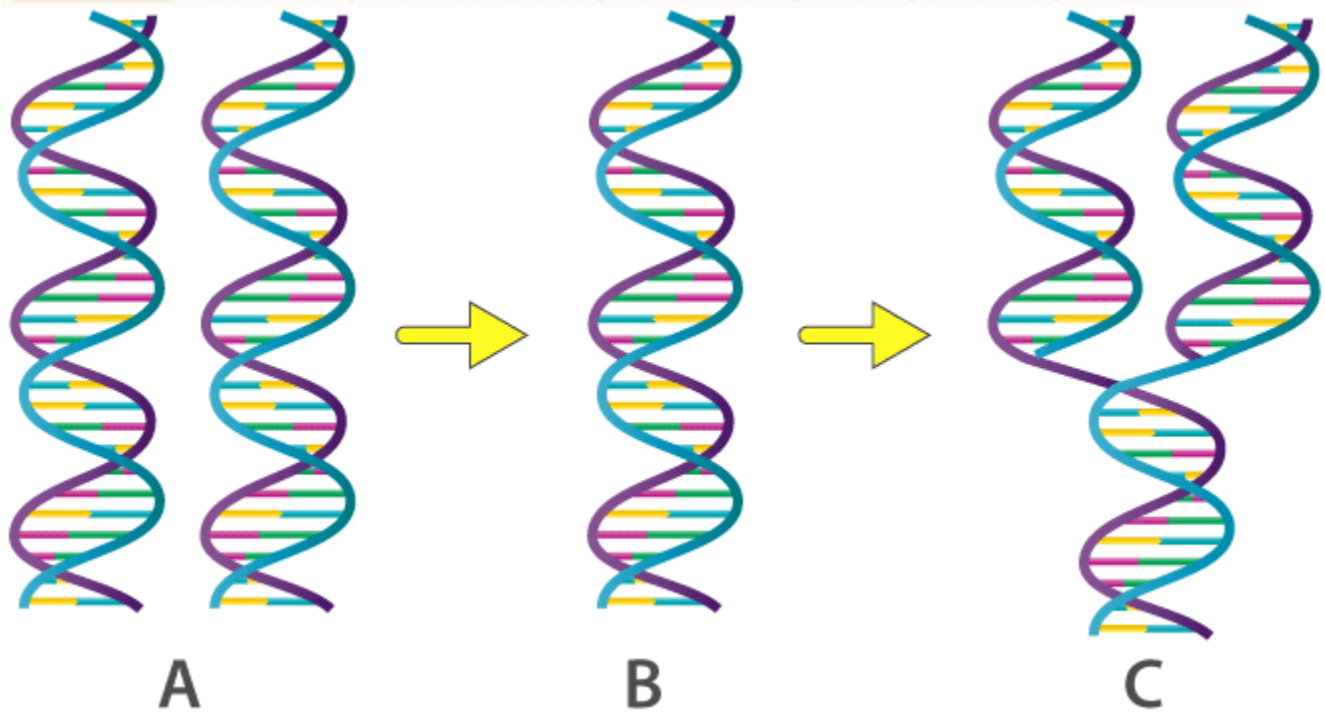
The DNA unit constituted by the parts 1, 2 and 3 collectively is Nucleotide.

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?

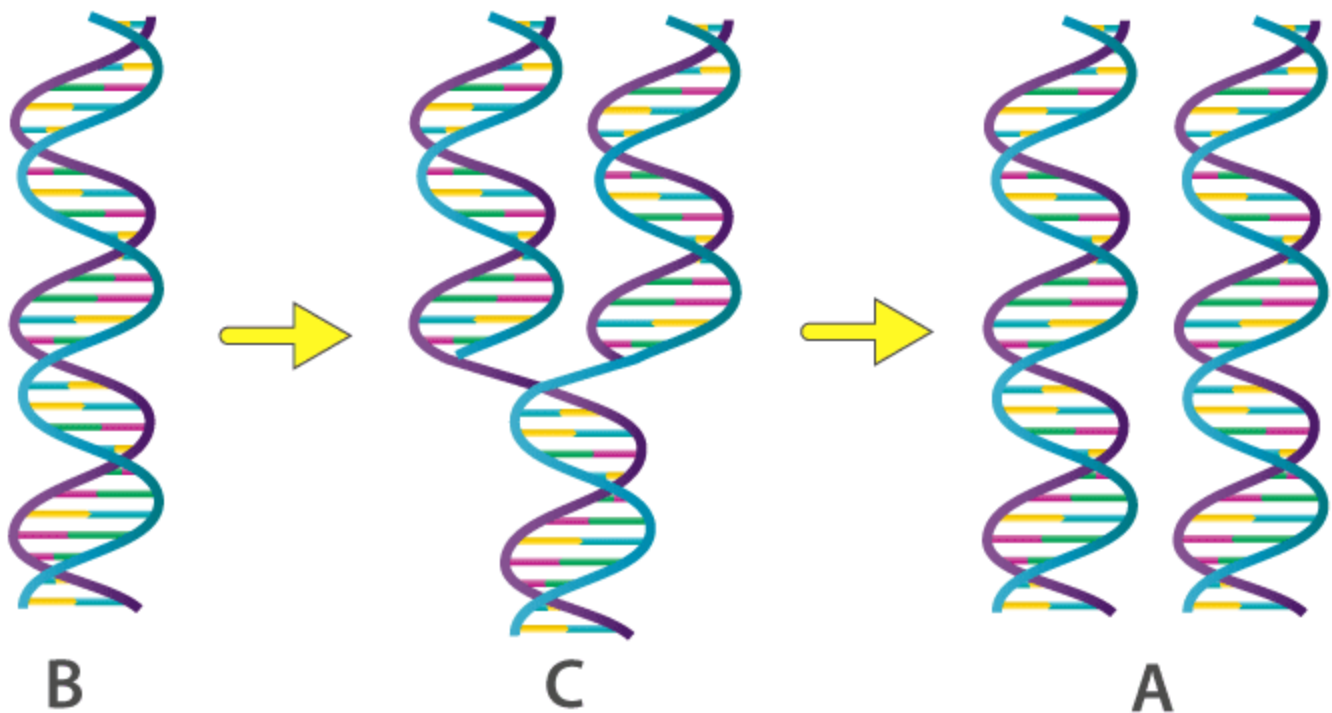


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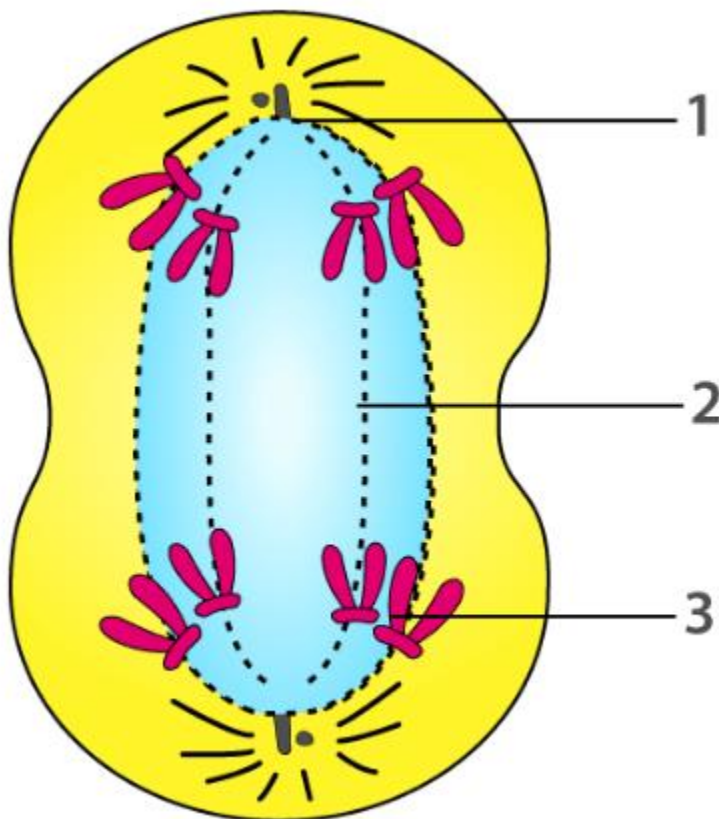


Solution:-



B, C and A

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.

Solution:-

1= Centromere

2= Spindle fibres

3= Chromatids

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

Solution:-

By observing the above diagram we can say that it is the late anaphase of mitosis in an animal cell. It can be identified by the two sister chromatids of each chromosome separate and are drawn apart towards opposite poles pulled by spindle fibres. A furrow starts in the cell membrane at the middle in animal cell.

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

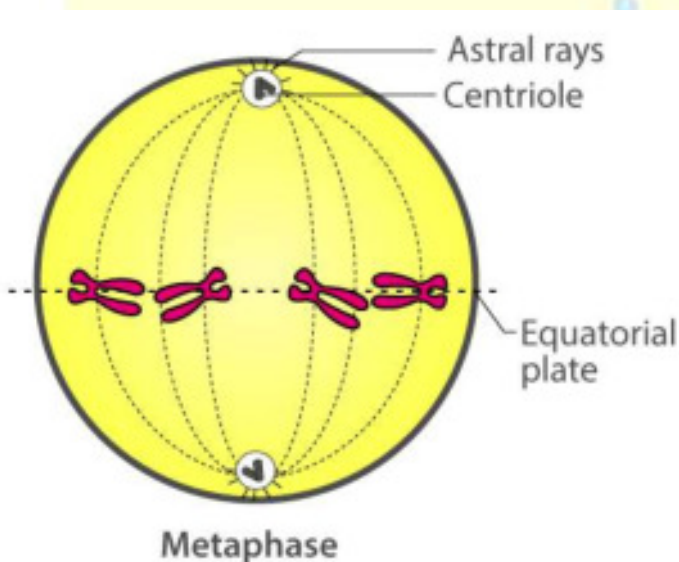
Solution:-

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

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

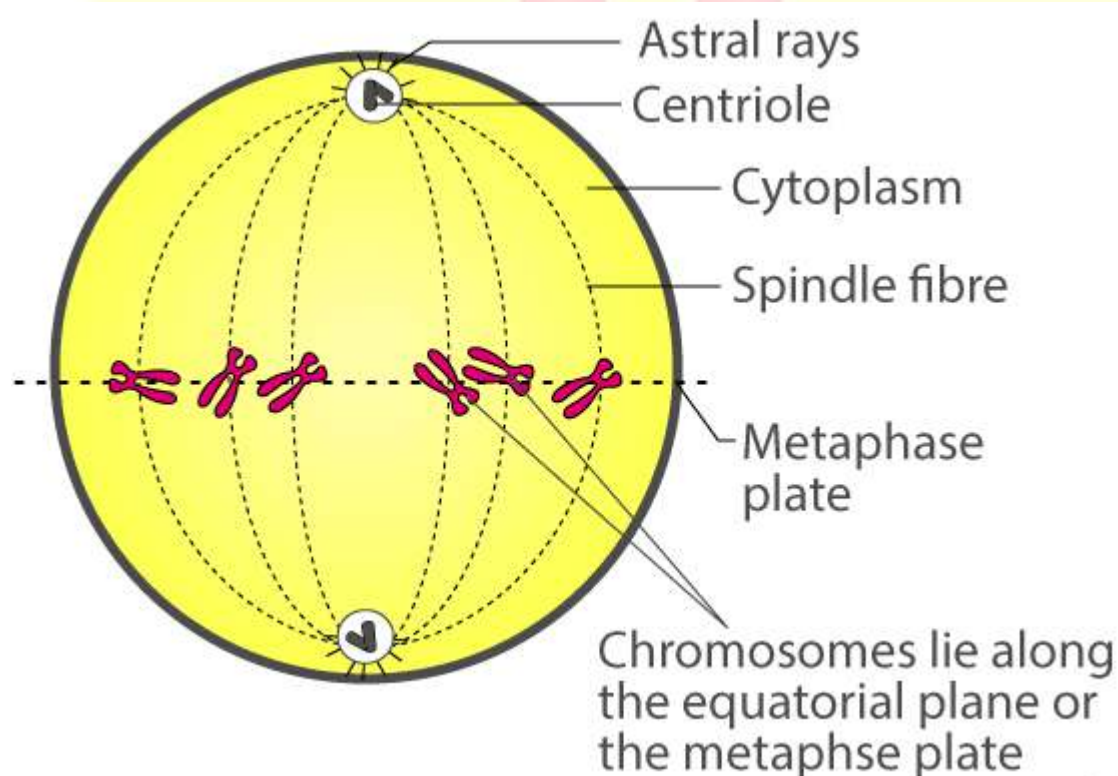
Solution:-

The stage prior to the late anaphase stage is metaphase.

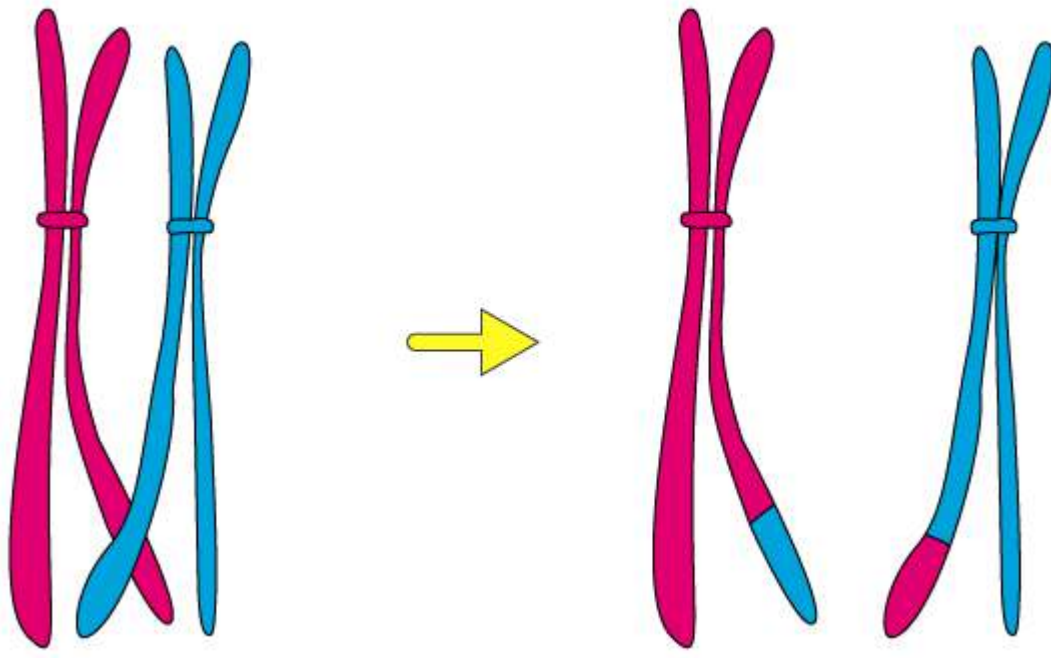


4. Draw a labelled diagram to show the metaphase stage of mitosis in an animal cell having '6' chromosomes.

Solution:-



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.



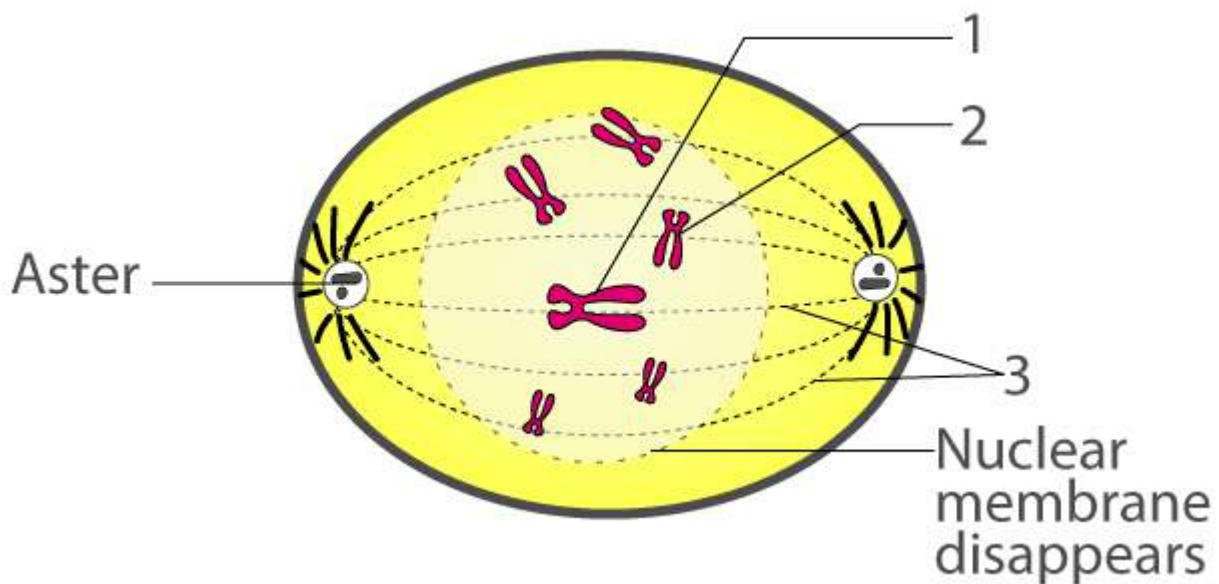
Solution:-

Crossing-over is the phenomenon is an exchange of chromatids between homologous.

1. Chromosome number is halved in gametes (sex cells) so that on fertilization, the normal number ($2n$) is restored.
2. It provides for mixing up of genes which occurs in two ways:
 - (i) The maternal and paternal chromosomes get mixed up during the first (reduction) division as they separate from the homologous pairs.
 - (ii) While the maternal and paternal chromosomes are separating, the chromatid material very often gets exchanged between the two members of a homologous pair.

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.

Solution:-



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

Solution:-

By observing the given figure we can say that it is the late prophase stage.

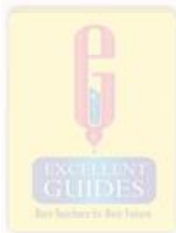
Because, the nuclear membrane and nucleolus have disappeared.

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

Solution:-

Centrioles is the cell organelle that form the aster.

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



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Solution:-

1= Centromere

2= Chromatids

3= Spindle fibre

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

Solution:-

By observing the given figure the stage that follows the one shown here is Metaphase.

It is identified by the centromere of chromosomes are drawn to the equator by the equal pull of two chromosomal spindle fibres that connect each centromere to the opposite poles, forming a metaphasic plate.

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

(i) The number of daughter cells produced.

(ii) The chromosome number in the daughter cells.

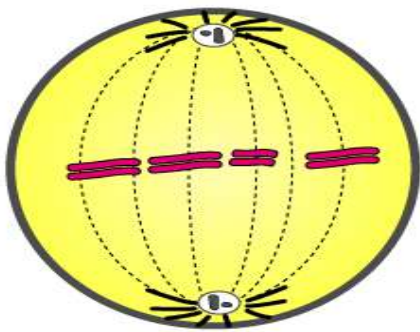
Solution:-

Mitosis	Meiosis
It produce two daughter cells	It produces Four daughter cells

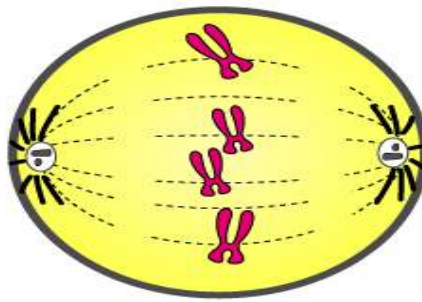
Full set of chromosomes is passed on to each daughter cell. This is the diploid ($2n$) number of chromosomes.

Only half the number of chromosomes are passed on to each daughter cell. This is the haploid (n) number of chromosomes.

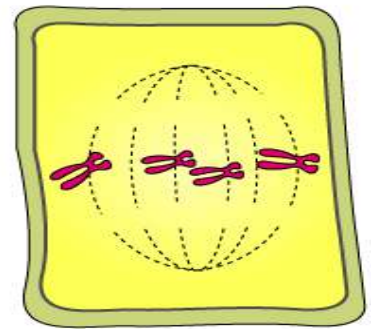
7. Given below are three diagrammatic sketches (A, B and C) of one and the same particular phase during mitotic type of cell division.



A



B



C

(a) Identify the phase.....

Solution:-

Metaphase

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

.....

Solution:-

The diploid number of chromosomes shown in them is 4

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

A.....

Solution:-

This is the animal cell.

B.....

Solution:-

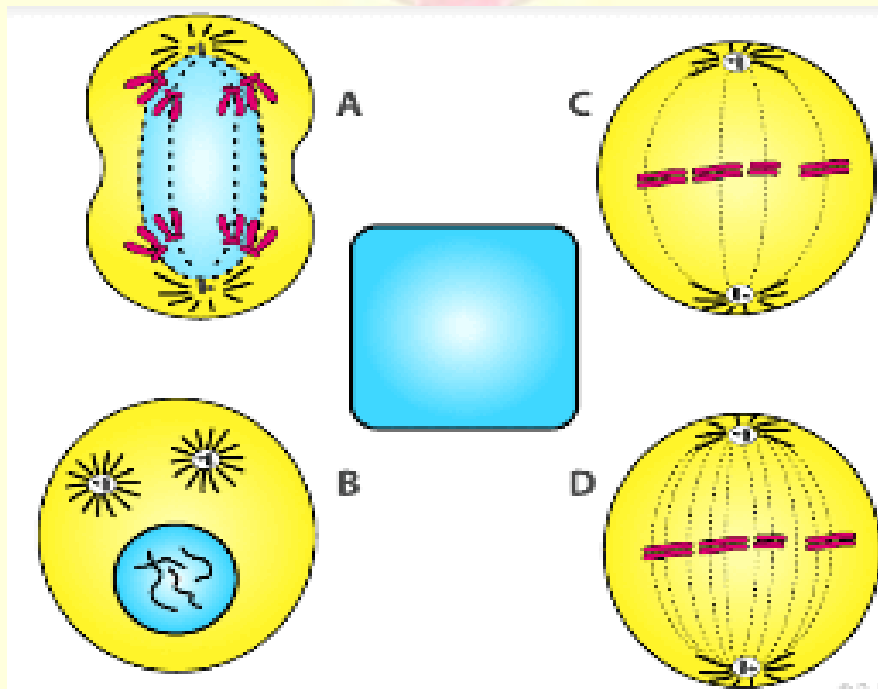
This is the animal cell.

C.....

Solution:-

This is the plant.

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





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

Solution:-

By observing the figure we can say that it is the animal cell.

Because, the outline is circular and the cell wall is absent and centrosomes on centrioles are present.

(b) Is it undergoing mitosis or meiosis?

Solution:-

It is undergoing in mitosis.

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

Solution:-

The correct sequence is B, C, D and A

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

Solution:-

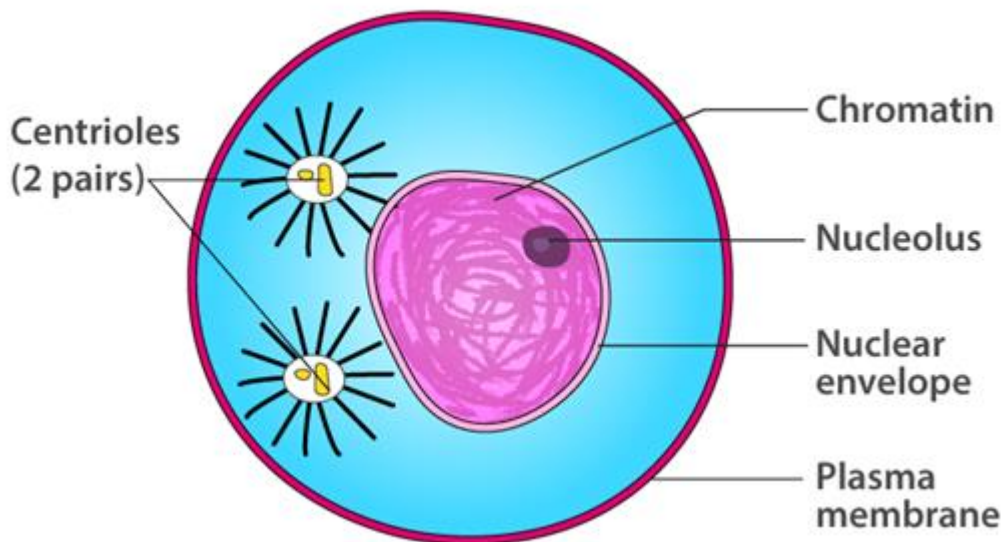
The stage that should precede the earliest of these stages interphase.

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

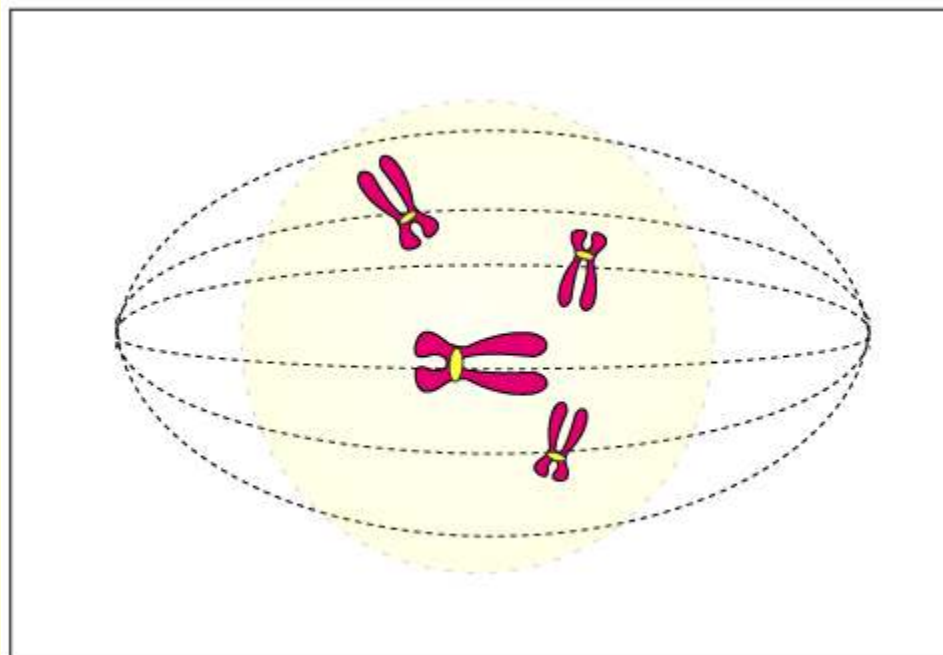
Solution:-



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9. Given below is a diagram representing a stage during mitotic cell division. Study it carefully and answer the questions that follow:



(a) Is it a plant cell or an animal cell? Give a reason to support your answer.



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Solution:-

By observing the given diagram we can say that it is the plant cell. Because centrioles are not shown in the diagram.

(b) Identify the stage shown.

Solution:-

Prophase is the stage that is given above.

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

Solution:-

The stage is Metaphase.

Chromosomes arrange themselves on the metaphase or equatorial plate.

(d) How will you differentiate between mitosis and meiosis on the basis of the chromosome number in the daughter cells?

Solution:-

Mitosis	Meiosis
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 are passed on to each daughter cell. This is the haploid (n) number of chromosomes.

(e) Draw a duplicated chromosome and label its parts.

Solution:-

