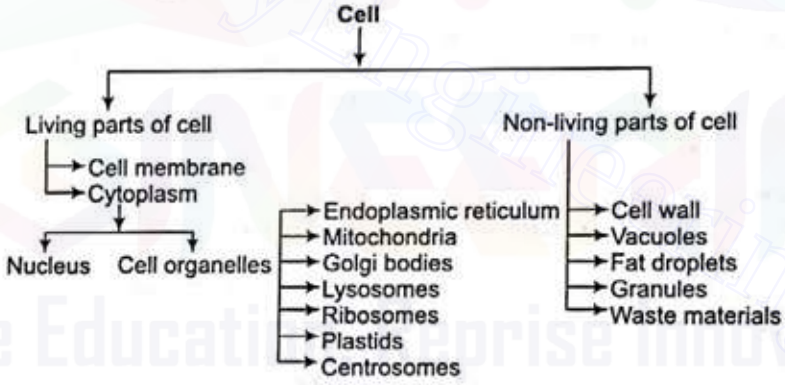
Biology

CHAPTER 1

The Cell and Inheritance

- Biology (coined by *Lamarck* and *Treviranus*) is a natural science concerned with the study of living organisms.
- The study of plants is called **Botany**, while study of animals is called **Zoology**.
- Cell is the basic structural and functional unit of all the living organisms. It is often called the building block of life. The word cell comes from the Latin word *cellula* meaning a small room.



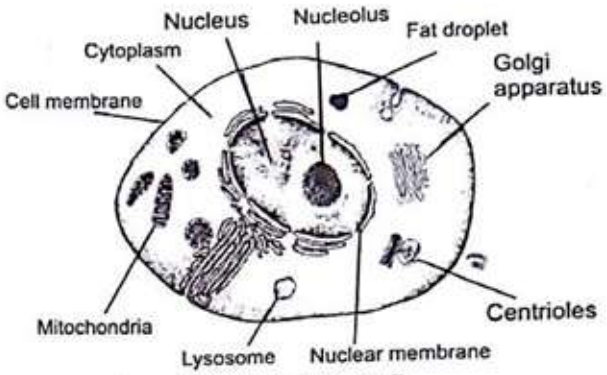
- **Robert Hooke** in 1665 discovered the cell.
- Cell theory was given by **Schleiden** and **Schwann**.
- **Mathias Jacob Schleiden** (1838), German botanist said that all plants are composed of different kinds of cells which in turn forms plant tissues.
- **Theodor Schwann** (1839) said that all animals and plants are made up of cells
- Prokaryotic and eukaryotic cells are the two different types of cells. A prokaryotic cell is simpler lacking a nucleus, *e.g.*, bacteria, mycoplasma, etc. A eukaryotic cell is complex with a membrane bound nucleus, *e.g.*, plant and animals cells.
- Smallest cell is Mycoplasma or Pleuro Pneumonia Like Organism (PPLO). Largest cells is ostrich's egg and the longest cell is nerve cell. The smallest human cell is the red blood cell.
- According to Virchow 'new cells arise from pre-existing cells.'
- Electron microscope was invented by Knoll and Ruska.
- First compound microscope was invented by **Jansen** and **Jansen**.
- Vital stains are used for staining living cells, *e.g.*, Janus green for mitochondira.

Differences between Prokaryotic and Eukaryotic Cell

Prokaryotic Cell	Eukaryotic Cell
Simplest and primitive in nature.	Developed and comparatively complex in nature.
Nucleus is absent.	Nucleus is present.
Membrane bound cell organelles are absent.	Membrane bound cell organelles are present.
Single naked chromosome present.	Many chromosomes are present.
Cell division is direct.	Cell division by mitosis or meiosis.

Differences between Plant and Animal Cell

Plant Cell	Animal Cell
It has cell wall.	Cell wall is usually absent.
Plastids are found.	Plastids are usually absent.
Centrioles are found in some algae and fungi.	Centrioles are found in all cells.
A big vacuole is present.	Vacuole is absent or very small in size.



Structure of the Cell

Composition of Cell

- Water 70%
- Protein 10%
- Nucleic acid 5%
- Carbohydrates 3%
- Lipid 2%

Some Discoveries About Cell

Name of Scientist	Year	Discovery
Fontana	1781	Nucleolus
Robert Brown	1831	Nucleus
Purkinje	1839	Named protoplasm to contents of cell
W Fleming	1877	Observed mitotic cell division
W Fleming	1879	Splitting of chromosomes and named the term chromatin
Walther Flemming	1879	Cell division
Kolliker	1880	Mitochondria
Benedern and Boveri	1887	The chromosome number is constant in a species
Camillo Golgi	1891	Golgi body
C Benda	1897	Named mitochondria
WS Sutton	1902	Significance of reductional division
F Meves	1904	Mitochondria in plant cell
JB Farmer and Moore	1905	Named meiosis
FA Johanssen	1909	Chiasma formation
TH Morgan	1933	Role of chromosomes in heredity

Detailed Study of Cell Organelles

Cell Organelles	Nature/Composition	Functions	Present/Absent	
			Animal Cell	Plant Cell
Cell membrane	Double layer of lipid molecules with proteins molecules, differentially permeable.	Gives shape to cell, maintains distinct composition of the cell.	P	P
Cell wall	Freely permeable, made up of fibrous polysaccharide (cellulose).	Gives strength and rigidity to the cell.	A	P
Cytoplasm	Consists of aqueous ground substance, having starch, glycogen, etc.	Provides medium for suspension of materials and cell organelles.	P	P
Vacuoles	Fluid filled spaces without any definite shape and size. Larger in plant cell.	Stores water, minerals, salts, food pigments, wastes, etc.	P	P
Nucleus	Oval-shaped, double membrane with pores, have genetic material.	Controls the metabolic activities, regulates cell division, synthesizes and stores proteins.	P	P
Endoplasmic Reticulum (ER)	Membranous network of fluid filled lumen, with or without ribosomes, absent in RBCs.	Forms supporting skeletal frame work of cell.	P	P

Cell Organelles	Nature/Composition	Functions	Present/Absent	
			Animal Cell	Plant Cell
Mitochondria	Bounded by a double membrane, found in cytoplasm.	Cellular respiration or oxidation of food, ATP is stored in it so called as power house of cell.	P	P
Ribosomes	Dense and spherical particle, found either attached to endoplasmic reticulum or freely in cytoplasm.	Play a vital role in protein synthesis.	P	P
Lysosomes	Tiny spherical bag-like structure found in cytoplasm with hydrolytic enzymes.	Helps in intracellular digestion, digest worn out organelles, also called suicidal bags.	P	P
Chloroplasts	Sac-like double walled with protein matrix.	Sites of photosynthesis, gives colour to organ also called as kitchen of cell.	A	P
Centriole	Hollow and cylindrical structures made up of microtubules.	Helps in cell division in animal cell.	P	A
Golgi bodies	Consist of tubules and vesicles.	Secretes hormones, enzymes, involved in synthesis of cell wall, plasma membrane, etc.	P	P
Microtubules	Tubulin protein	Spindle formation	P	P

- The **minimum number** of chromosomes are present in *Haplopappus gracilis* (a plant) — 4 and *Ophryortocha puerilis* (a polychaete) —2.
- The **maximum number** of chromosomes are present in *Ophioglossum reticulatum* (Adder's tongue ferm) —1262 and *Aulocantha* (a protist) —1600.

Structure of Cell Wall

Middle Lamella	Composed of calcium pectate (Chief component) and magnesium pectate.
Primary wall	Composed of cellulose, hemicellulose and lignin. Rigidity of cell wall is due to Lignin.
Secondary cell wall	Composed of cellulose and hemicelluloses.
Tertiary cell wall	Present in tracheids of gymnosperms.

Cell membrane or Plasma Lemma

Composition

- Protein-52%
- Lipid-40%
- Carbohydrate—5-10%
- The most popular theory 'fluid mosaic model' of membrane structure was given by **Singer** and **Nicolson**. It states that integral and peripheral proteins are found in cell membrane.
- **Pinocytosis (Cell drinking)** In this process cells ingest extracellular or fluid.
- **Phagocytosis (Cell eating)** Engulfing and digestion of extracellular solid food by cell.
- Cytoplasm term given by **Strasbvrger.**
- **Mitochondria, chloroplast, nucleus** Double membrane structure.
- **Lysosome, Golgi body, endoplasmic reticulum** Single membrane structure.
- Centrosome, Flagella, **ribosome** Non-membranous structure.

Nucleus

- Most of eukaryotic cells are uninucleate.
- *Paramecium* is binucleate.
- Nucleus is made up of following parts :
  (a) Nuclear membrane
  (b) Nucleoplasm
  (c) Nucleolus
  (d) Chromatin–Nucleic acid + proten (histone and non-histone chromosome – term given by **Waldeyer** (1888).
- Chromosome of eukaryotic cell — composed of DNA + histone protein + some amount of RNA. Normally each cell contains 23 pairs of chromosomes in **humans.**

Chromosome Number in Some Organisms

Organism	Chromosome Number in Each Body Cell
Round worm	2
Mosquito	6
Garden pea	14
Onion	16
Maize	20
Rice	26
Frog	24
Sunflower	34
Mouse	40
Rat	42
Human beings	46
Potato	48
Dog	64
Pigeon	80
Gold fish	100
Amoeba	250
Drosophila	8

- Nucleic acid, the genetic material was discovered by Fredrich Meischer.
- The term nucleic acid was given by Altman.

- The nucleic acid are of two types — DNA and RNA
- Nucleic acid molecule is a long chain polymer.
- It is composed of monomeric units, calles nucleotides.

Nucleotide — Nucleoside + phosphate
Nucleoside — Nitrogenous base + pentose sugar
Nitrogenous base are of two types.
Pruine – Adenine guanine.
Pyrimidine – Cytosine, thymine and uracil.
Adenine, cuanine, cytosine and thymine are present in DNA.
Adenine, cuanine, cytosine and uracil are found in RNA.

- Adenine and thymine bonded by double (A = T) and cytosine and guanine by triple hydrogen bond (C ≡ G).
- Pentose sugar – Ribose in RNA and deoxyribose in DNA

1953 Watson and Crick propose double helical model of DNA (Deoxyribonucleic acid).
Function of DNA Transfer of genetic material from one generation to other.
Ribonucleic Acid (RNA) Three types of RNA:

(a) Messenger RNA (*m*RNA)
(b) Transfer RNA (*t*RNA)
(c) Ribosomal RNA (*r*RNA)

Function

Helps in the formation of protein (Protein synthesis).

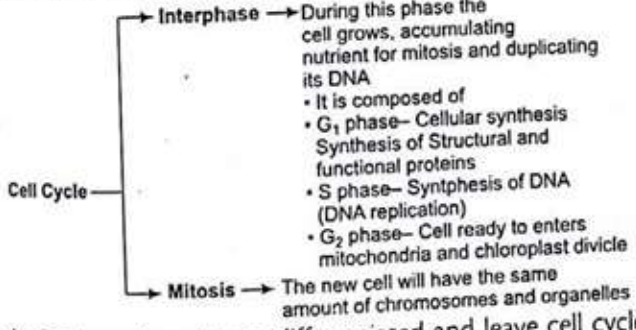
- **Geneticode** The sequence of nitrogen bases (nucleotides) in *m*RNA molecule encoding the information for protein synthesis.
- **Codon** The sequence of nitro genous bases (nucleotides) in *m*RNA which codes for a single amino acid.
- **Triplet** A codon is a triplet as it is formed of three bases.
- **Gene** A distinct sequence of nucleotides forming part of a chromosome.
- Artificial gene syntheisis was demonstrated by **Dr. Har Gobind Khorana**.

Differences between DNA and RNA

DNA	RNA
It usually occurs inside nucleus and in some cell organelles like mitochondria and chloroplast.	Very little RNA occurs inside nucleus. Most of it is found in the cytoplasm.
DNA is the genetic material.	RNA is not the genetic material except in certain viruses, *e.g.*, HIV, reovirus.
It is double stranded with the exception of some viruses like polyoma virus.	RNA is single stranded with the exception of some viruses, *e.g.*, double stranded in T_2, T_4, T_6 bacteriophage, etc.
DNA shows regular helical coiling.	There is no regular coiling except in parts of RNA.
It contains deoxyribose sugar.	It contains ribose sugar.
Nitrogen base thymine occurs in DNA along with three other adenine, cytosine and guanine.	Thymine is replaced by uracil in RNA. The other three are adenine, cytosine and guanine.
It replicates to form new DNA molecules.	It cannot replicate itself except in RNA-RNA viruses.
DNA controls heredity, evolution, metabolism, structure and differentiation.	RNA controls only protein synthesis.

Cell Cycle

A cyclic process involving cell growth and cell division.



- In Gophase the cells are differentiated and leave cell cycle.
- The four phase of mitosis are

(a) **Prophase** Chromosome deviation in chromatids start. Nuclear membrane and nucleolus disappear.
(b) **Metaphase** Chromosomes line up in the middle and spindles from centriole connect to each chromatid (half of chromosome).
(c) **Anaphase** Chromatids are pulled apart to separate poles and the membrane begins to pinch off in the middle.
(d) **Telophase** Complete division of cytoplasm (Cytokinesis) and two cells are formed.

- Two daughter cells are formed by mitosis having same/equal number of chromosomes.

Meiosis

A type of cell division that results in four daughter cells each with half the chromosome number of the parent cell.

In the process of meiosis, there are two stages.

Meiosis-I

- **Prophase I** The longest phase of meiosis-I. It is composed of 5 sub-stages

(a) **Leptotene** Chromatin condense to form chromosome.
(b) **Zygotene** Pairing of homologous chromosomes called synapsis. Forms synaptonemal complex.

(iii) **Pachytene** Crossing over between non-sister chromatids.
(iv) **Diplotene** Chiasmata formation.
(v) **Diakinesis** Sliping of chiasmata called terminalization.

- **Metaphase-I** Lining of chromosomes in the middle. Formation of spindle apparatus
- **Anaphase-I** Separation of homologous chromosomes (disjunction) to form two cells with haploid number of the chromosomes.
- **Telophase-I** Two cells with *n* number of chromosomes.

Meiosis-II

It is very similar to mitosis.

- **Prophase-II** The shortening and thickening of the chromatids.
- **Metaphase-II** Lining of chromosomes in the middle.
- **Anaphase-II** Separation of chromosomes into chromatids.
- **Telophase-II** Uncoiling and lengthening of the chromosomes four daughter cells with haploid set of chromosomes.

Differences between Mitosis and Meiosis

Mitosis	Meiosis
Found is somatic cells.	Found in diploid reproductive cells.
Forms two identical cells	Forms four haploid cells.
Every chromosome behave independently.	Homologous chromosomes show pairing.
Chromosome number remains constant.	Chromosome number become half.
Crossing over does not occur.	Crossing over occurs.

Introduction

- It is the process of transfer of heredity character from one generation to next generation through genes.
- A **gene** is a molecular unit of heredity of a living organism.
- **GJ Mendel** is known as the **Father of Genetics**.

Term Genetics was first used by William Bateson in 1905.

Mendel's Laws

- The laws of inheritance were derived by **Gregor Johann Mendel** in 19th century, conducting hybridization experiments in garden pea (*Pisum sativum*).
- In 1900, his work was 're-discovered' by three European scientists, **Hugo de Vries, Carl Correns** and **Erich von Tschermak**.
- Crossing between pure organisms for two contrasting characters produce only one character in F_1 and called **dominant**.
- *Mirabilis jalapa* shows hybrid flowers in F_1, *i.e.*, uncomplete dominance (exception to dominance law).
- Mendel summarized his findings in two laws– the **Law of Segregation** and the **Law of Independent Assortment**.

Law of Segregation (The First Law)

- The two co-existing alleles of an individual for each trait segregate (separate) during gamete formation so that each gamete gets only one of the two alleles.
- Alleles again unite at random fertilization of gametes.

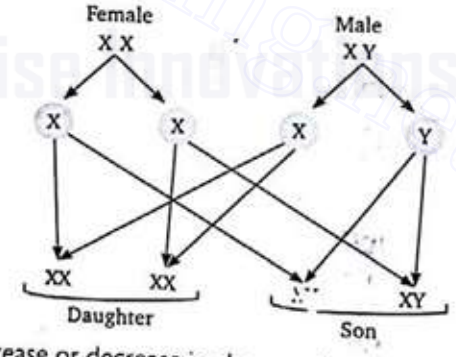
Law of Independent Assortment (The Second Law)

It is also known as Inheritance Law and states that alleles of different genes assort independently of one another during gamete formation.

- Back cross is performed between F_1 hydrid and one of its parent (homozygous dominant or recessive).
- Test cross is a cross between F_1 hybrid and recessive parent.

Sex Determination in Human

- In humans, each cell contains 46 chromosomes (44 autosome + 2 sex chromosome).
- In humans, male sex chromosme in XY, whereas female sex chromosome is XX.
- During gamete formation, in female all gametes contain only one type of chromosome, *i.e.*, X and in male half of the sperm contain X-chromosome, while half contain Y-chromosome.
- Thus, when a male gamets, *i.e.*, sperm carrying X-chromosome fertilize an ova, the zygote develop into female.
- When a sperm carrying Y-chromosome fertilize an ova, the zygote developes into a male.

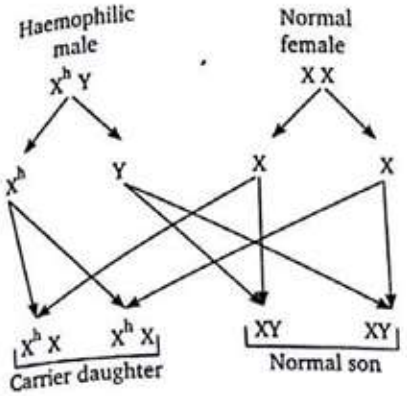


- Any increase or decrease in the number of sex chromosomes or autosomes causes genetic disorder.

Some Hereditary Diseases

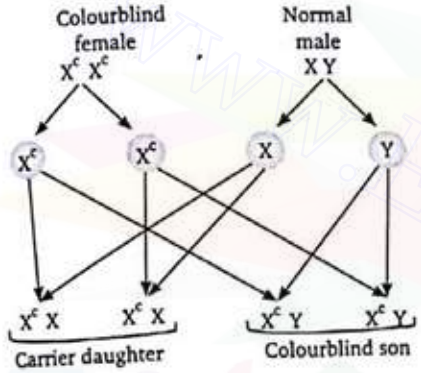
Haemophilia A

- It is the most common X-linked genetic disorder associated with serious bleeding.
- It is caused by a reduction in the amount or activity of coagulation factor VIII.



Colour Blindness

- It is an X-linked genetic disease.
- It is the inability to perceive differences between some of the colours that others can distinguish.



Cri-du-chat Syndrome

- It is a rare genetic disorder due to a missing part of chromosome 5. It is characterized by having a cat-like cry of affected children.

Sickle-Cell Anaemia

- It is a genetic blood disorder characterized by an abnormal, sickle-shape red blood cells.
- It caused by a mutation in the 11 autosomal chromosome.

Down's Syndrome/Trisomy-21

- It is a chromosomal disorder caused by the presence of all or part of an extra 21st chromosome.
- It is associated with impairment of cognitive ability and physical growth and a particular set of facial characteristics.
- In this syndrome the person became mangolism.

Klinefelter's Syndrome

- It is a condition in which human males have an extra X sex chromosome (44 + XXY). Effects are development of small testicles and reduced fertility.

Duchenne Muscular Dystrophy

- It is an X-linked disease associated with muscular dystrophy (mutations in the dystrophin gene).
- It is characterized by rapid progression of muscle degeneration, eventually leading to loss in ambulation, respiratory failure and death.

Turner's Syndrome

- It is a condition in which human female has only one sex chromosome (XO).
- Effect are rudimentary ovaries and lack of secondary sexual character.

Patau Syndrome/Trisomy-13

- A syndrome in which a patient has an additional autosomal chromosome 13 due to a non-disjunction of chromosomes during meiosis.
- Its effects are mental retardation, cut mark in the lip.

Number of Chromosomes in Different Organisms

Animal/Plant	Chromosomes
Rabbit	44
Frog	26
Horse	64
Dog	78
Wheat	42
Cat	38
Mosquito	6

Blood Group System

- The ABO blood group system is widely credited to have been discovered by the Austrian scientist **Karl Landsteiner.**
- The ABO blood group is due to the presence or absence of the antigen A or B. Now there are four types of blood groups according to the presence or absence of the antigens.
- The H antigen is an essential precursor to the ABO blood group antigens.
- As far as transfusion compatibility is concerned, it is not strictly as simple as matching A, B and O groups.
- The rhesus factor Rh factor must also be considered. Together, the rhesus factor and ABO grouping are the two most important compatibility factors to consider.
- An individual may be Rh^+ or Rh. In simpler terms, if an individual is blood type A and positive for the rhesus factor, then he or she is deemed 'A^+'.

Points to be Remember

- Bacterial cell wall is composed of **peptidoglycan** or **murein**.
- Bacterial cell wall contains D-amino acids.
- Fungal cell wall is composed of chitin.
- Chromoplasts are yellow, orange and red coloured.
- Leucoplasts are colourless plastids.
- **Golgi bodies** are absent in bacteria, blue-green algae, mature sperm and RBCs. Type AB^+ is the universal recipient: Although those with AB blood type may be referred to as universal recipients, in actuality, type AB^+ blood is that of the universal recipient, whereas type AB^- is not. This is an important distinction to make.
- Because A^-, A^+, B^-, B^+, AB^-, AB^+, O^- and O^+ individuals can all receive blood from donors of type O^- blood, an individual with type O^- blood is deemed universal donor. In similar manner, O^+ is not the universal donor blood type.

Exercise

1. Which of the following is represented by X in figure?

DNA ⟶ C G A T C G C T
mRNA ⟶ G C X A G C G A

(a) Adenine (b) Guanine
(c) Uracil (d) Thymine

2. Transfer of genetic information from one generation to the other is accomplished by
(a) DNA (b) messenger RNA
(c) transfer RNA (d) Both (b) and (c)

3. Rigidity of cell wall is due to
(a) chitin (b) lignin
(c) suberin (d) pectin

4. The nucleic acid in cell was discovered by
(a) E Strasburger (b) A Kossel
(c) F Miescher (d) Huxley

5. Gene was first isolated by
(a) CV Raman (b) JC Bose
(c) Hargobind Khurana (d) S Chandra Shekhar

6. The 'cell theory' for organisms was proposed by
(a) Purkinje and Von Mohl (b) Schleiden and Schwann
(c) Carolus Linnaeus (d) Felix Dujardin

7. The unit structure of which gene is made up of its
(a) RNA (b) DNA
(c) nucleotides (d) endoplasmic reticulum

8. The source of immediate energy for cellular activity, is
(a) FAD (b) RNA
(c) NAD (d) ATP

9. The fact that new cells arise from pre-existing cells was proposed by
(a) JE Purkinje (b) F Dujardin
(c) R Virchow (d) E Abbe

10. The correct model of DNA structure is proposed by
(a) Jacob and Monod (b) Watson and Crick
(c) Khurana (d) Baltimore and Temin

11. Dr. Hargobind Khurana is credited for the discovery of
(a) Synthesis of proteins
(b) Synthesis of genes
(c) Synthesis of nitrogenous bases
(d) None of the above

12. The scientist who is considered as the Father of Genetics?
(a) Lamarck (b) Charles Drawin
(c) Hugo de Vries (d) Gregor Johnn Mendel

13. The scientists who first recognized and named the nucleus was
(a) Robert Hooke (b) Robert Brown
(c) Theodore Schwann (d) Thomas Margan

14. In which one of the following types of cell division does crossing over of chromosomes takes place?
(a) Mitosis (b) Meiosis
(c) Amitosis (d) Cytokinesis

15. Chromosomes are
(a) present only in the nucleus of a cell
(b) the largest in number in human cells
(c) made up of DNA as a main component
(d) visible in all cells at every time

16. Which of the following is a physical basis of life?
(a) Mitochondria (b) Ribosome
(c) Protoplasm (d) Nucleus

17. Which of the following cell organelles functions as the power house of a living cell?
(a) Chloroplast (b) Mitochondria
(c) Ribosomes (d) Golgi apparatus

18. Enzyme responsible for DNA replication
(a) polymerase (b) proteolytic
(c) dehydrogenase (d) carboxylase

19. The sugar in RNA is
(a) ribose (b) deoxyribose
(c) sucrose (d) lactose

20. Genetic code is
(a) singlet (b) doublet
(c) triplet (d) None of these

21. Transcription is the formation of
(a) *m*RNA (b) *t*RNA
(c) *r*RNA (d) protein

22. Number of chromosomes in *Drosophila* is
(a) eight (b) ten
(c) twelve (d) fourteen

23. Chromosomes are best seen in
(a) telophase (b) anaphase
(c) metaphase (d) prophase

24. How many linkage groups are present in man?
(a) 46 (b) 23 (c) 48 (d) 10

25. A haemophilic man marries with a normal homozygous woman. What is the probability that their son will be haemophilic?
(a) 100% (b) 75%
(c) 50% (d) 0%

26. A pair of contrasting characters is called
(a) phenotype (b) genotype
(c) allele (d) None of these

27. A couple with blood types A and B may have children with of the blood types
(a) A and B (b) A, B and AB
(c) A, B, AB and O (d) AB only

28. Which one of the following ratio represents a test cross?
(a) 3 : 1 (b) 9 : 7
(c) 1 : 1 : 1 (d) 1 : 1: 1 : 1

29. Which type of division occurs in cleavage?
(a) Amitotic (b) Mitotic
(c) Meiotic (d) Both (b) and (c)

30. Which of the following is caused by a sex-linked recessive gene?
(a) Haemophilia
(b) Colour blindness
(c) Both (a) and (b)
(d) None of the above

31. Addition of one chromosome to a diploid set is
(a) trisomy (b) monosomy
(c) nullisomy (d) tetrasomy

32. DNA structure was discovered by
(a) Weismann (b) Wastson and Crick
(c) Sutton (d) Jacob

33. Which base replace thymine in RNA?
(a) Adenine (b) Guanine
(c) Uracil (d) Cytosine

34. Match the following lists.

List I (Cell organelle)	List II (Discoverer)
A. Nucleus	1. Christain de Duve
B. Ribosomes	2. Robert Brown
C. Lysosomes	3. E Haeckel
D. Plastids	4. George Palade

Codes

	A	B	C	D
(a)	4	1	2	3
(b)	2	3	1	4
(c)	4	3	2	1
(d)	2	4	1	3

Direction (Q. Nos. 35 to 37)
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

35. **Assertion (A)** Cell theory was proposed by Schleiden and Schwann.
Reason (R) Cell theory is an example of serendipity.

36. **Assertion (A)** Bacterial chromosome is highly folded.
Reason (R) The bacterial chromosome lack the histone proteins.

37. **Assertion (A)** Mitochondria is called the power house of the cell.
Reason (R) Mitochondria contains ATP.

38. Match list I with list II and select the correct answer using the code given below the lists. **(CDS 2010 II)**

List I (Sugar)	List II (Source)
A. Cellulose	1. Honey
B. Fructose	2. Sugarcane
C. Maltose	3. Cotton wool
D. Sucrose	4. Starch

Codes

	A	B	C	D
(a)	3	1	4	2
(b)	3	4	1	2
(c)	2	1	4	3
(d)	2	4	1	3

39. Cattle are capable of digesting cellulose present in the grass and/or fodder that they eat. This ability is attributed to the **(CDS 2010 II)**
(a) presence of cellulose degrading bacteria in the rumen
(b) production of cellulose by the cattle rumen
(c) acids present in the rumen
(d) prolonged retention of cellulose in the rumen

40. Why are pregnant women recommended substantial intake of green leafy vegetables in their diet, especially in the 1st trimester? **(CDS 2010 II)**
(a) They are a rich source of chlorophyll
(b) They are a rich source of lecithin
(c) They are a rich source of folic acid which is required for DNA synthesis
(d) They are a rich source of essential fatty acids required for cell anabolism

41. Which of the following statements correctly describe the properties of hormones? **(CDS 2010 II)**
I. They are steroids, proteins, peptides or amino acids derivatives.
II. They are not produced by body organs and are mostly taken as supplements.
III. They do not influence the working of those organs which have secreted them.
IV. They act as co-enzymes and help enzymes to perform their function.
Select the correct answer using the code given below
(a) I and IV (b) II, III and IV
(c) I and III (d) I, II, III and IV

42. Which one of the following types of cells has the ability to develop into any type of cell?
(a) Endodermal cells (b) Ectodermal cells
(c) Stem cell (d) Muscle cell

43. The smallest organelle in a cell is
(a) ribosome (b) peroxysome
(c) lysosome (d) spherosome

Answers

1. (c)	2. (a)	3. (b)	4. (c)	5. (c)	6. (b)	7. (b)	8. (d)	9. (c)	10. (b)
11. (b)	12. (d)	13. (b)	14. (b)	15. (c)	16. (c)	17. (b)	18. (a)	19. (a)	20. (c)
21. (a)	22. (a)	23. (c)	24. (b)	25. (d)	26. (c)	27. (c)	28. (d)	29. (b)	30. (c)
31. (a)	32. (b)	33. (c)	34. (d)	35. (c)	36. (b)	37. (b)	38. (a)	39. (a)	40. (c)
41. (a)	42. (c)	43. (a)							