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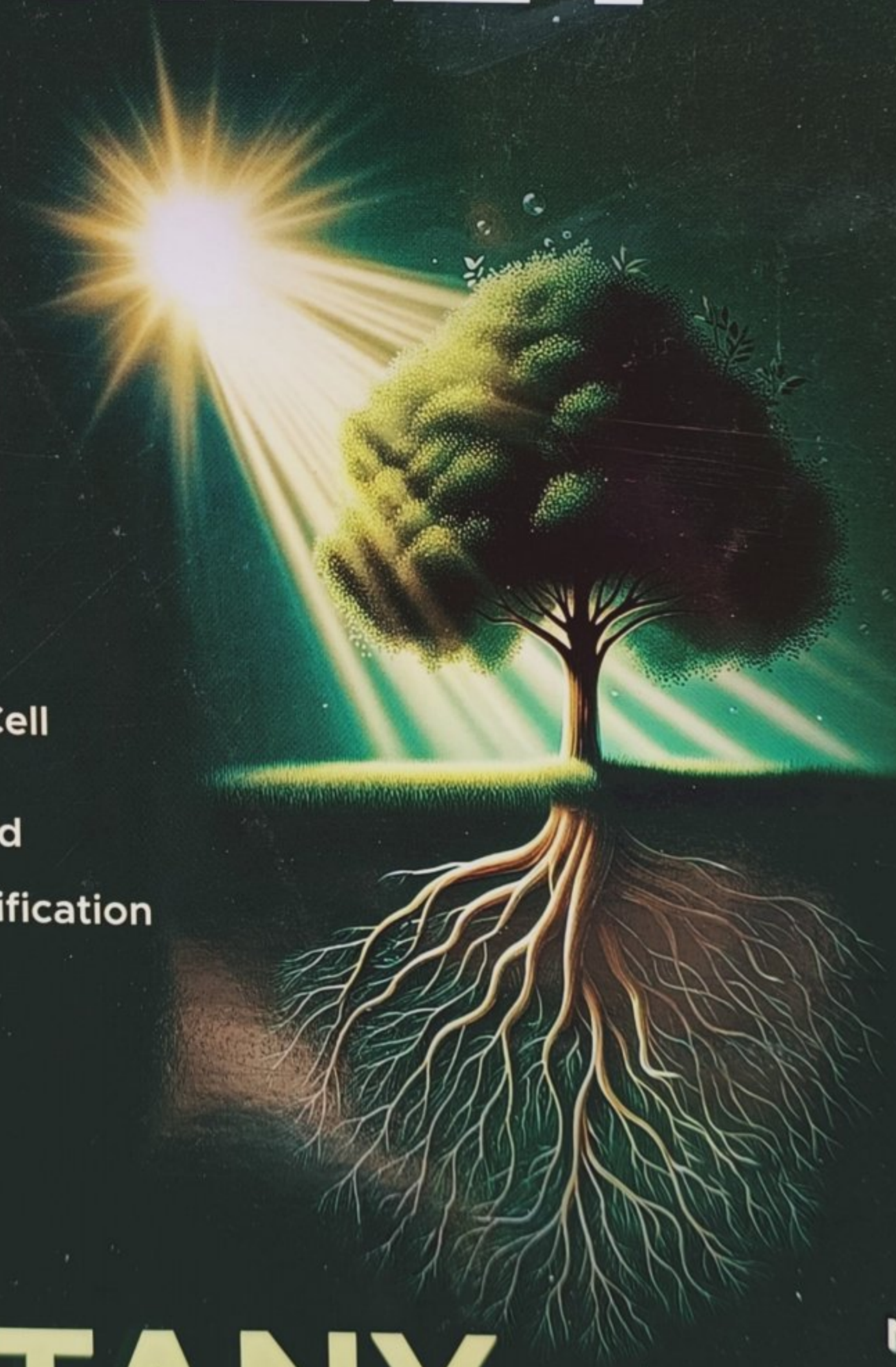

Class - XI

- Cell: The Unit of Life
- Cell Cycle and Cell Division
- The Living World
- Biological Classification

BOTANY

Module 1

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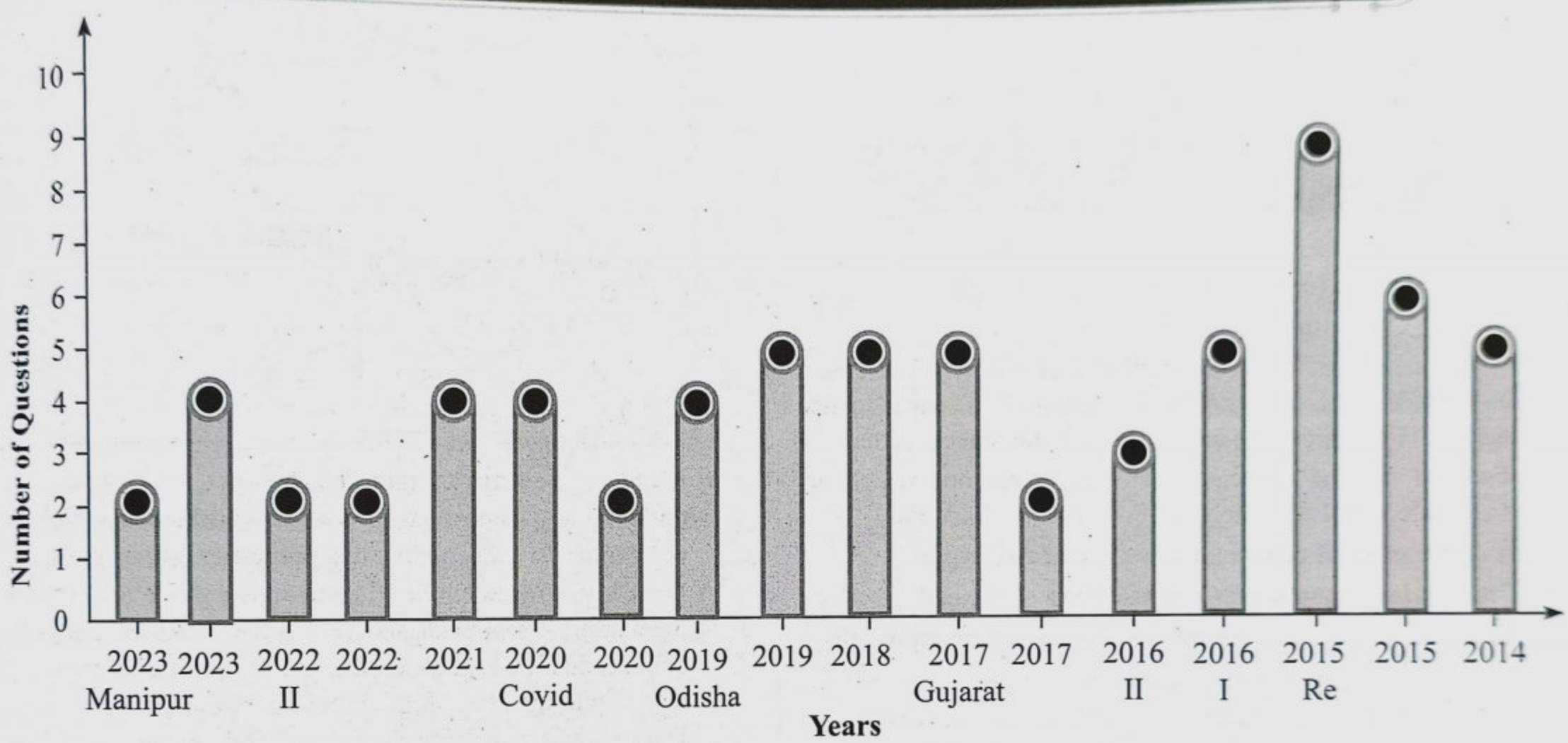
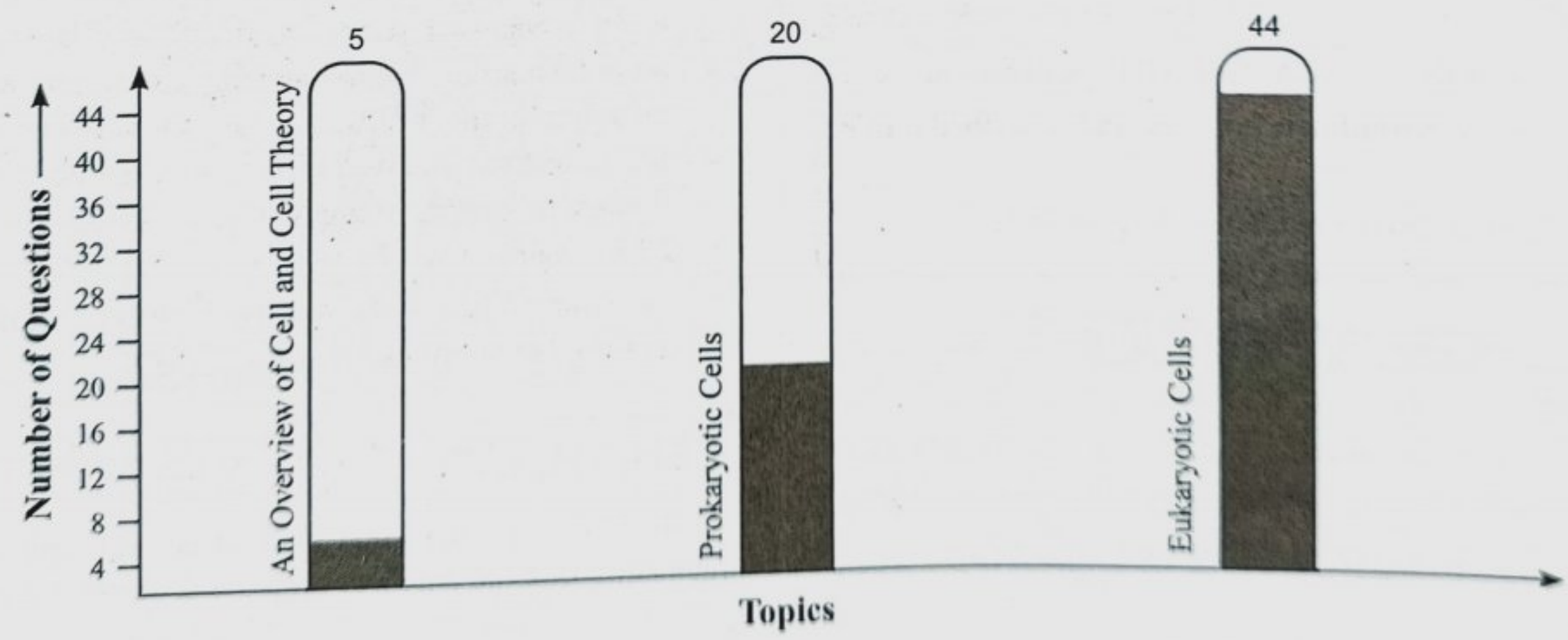
CHAPTER 1

Cell: The Unit of Life

Year Wise Number of Questions Analysis (2023-2014)



Topicwise Number of Questions Analysis (2023-2014)



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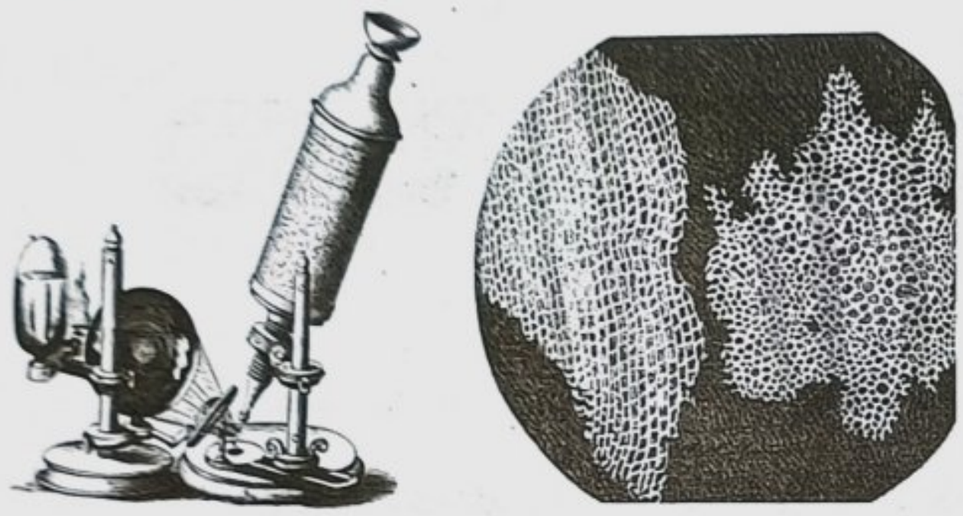
WHAT IS A CELL?

- Cell is the fundamental **structural and functional unit** of all living organisms., i.e., all organisms are composed of cells.

Discovery of the Cell

Cells were first observed by **1***..... in 1665 using a simple microscope. When he observed thin slices of cork, he saw a network of chambers in a honey comb structure. He named these structures as **cellula**. Robert Hooke's observation was published in his book *Micrographia*.



(*a*) (*b*)

Fig. 1: (*a*) Robert Hooke's microscope
(*b*) Honeycomb Structure of Cork

Anton Von Leeuwenhoek was another scientist who observed live cells after Robert Hooke but with improved lenses in his microscope. His microscope could magnify the objects better.

He observed moving objects under the microscope which he called animalcules. These included Protozoa and bacteria.

Based on number of cell, organisms are of two types:

1. **Unicellular organisms:** Composed of a single cell
2. **2**..... **organisms:** Composed of many cells

- Unicellular organisms are capable of:
  (*i*) Independent existence
  (*ii*) Performing the essential functions of life
- A single cell is a small & complex structure, so the complete and clear view of all its components is revealed after the invention of **electron microscopes.**

Key Note

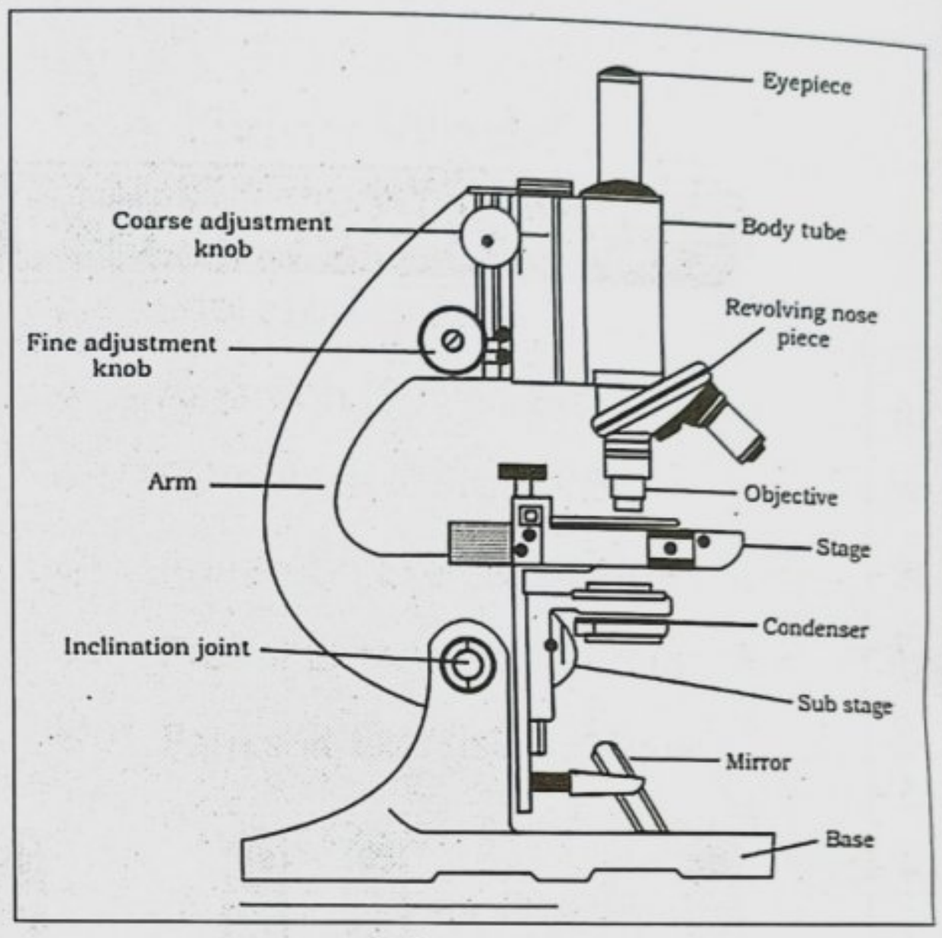
- **Robert Hooke** first observed dead cell in plant cork in 1665.
- **Anton Von Leeuwenhoek** first saw and described a live cell in 1674.
- **Robert Brown** discovered the nucleus in 1831.

EXTENDED LEARNING

Microscopy

Biological studies and explorations cannot be imagined without a microscope as it enables us to see something which is beyond the scope of our eyes.

The use of first microscope dates back to **1665** when the British Physicist **Robert Hooke** designed a simple microscope using combination of magnifying lenses and observed the slices of cork, and coined the term *Cellulae* or cell to that honeycomb like structure. You are aware that **Matthias Jacob Schleiden** and **Theodor Schwann** proposed cell theory in **1838** on the basis of observation of cells in plants and animals. Since, then with development of technology, microscopy has undergone improvement.



- **Light microscopy**: Light microscopes, also known as optical microscopes, have been the workhorses of biology for centuries. Leveraging the properties of visible light, these instruments employ lenses and illumination systems to magnify specimens and reveal their cellular and sub-cellular details. Light microscopes have been instrumental in deciphering the complexities of biological organisms, from studying the morphology of cells to observing live processes in real-time.
- **An electron microscopy**: Electron microscopy is a highly sophisticated technique in which the object to be studied is bombarded with electron beam which is approximately 1,00,000 time shorter in wavelength than visible light. The electron beam in an electron microscope magnifies the image with the help of electromagnetic lenses. The wavelength of electrons is thousands of times shorter than visible light, hence electron microscopes would be able to resolve objects that are thousands of times smaller. Resolution is the ability to distinguish two objects from each other.

  How due to use of electron beam, electron microscope are not used to study live material.

CELL THEORY

A cell is the fundamental and structural unit of all living organisms. It is the smallest biological, structural and functional

1* *"NCERT Focused Fill-ins" is an exercise with blanks in textbook passages that students fill in to test their NCERT-based knowledge and grasp over NCERT Textbook.*

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unit of all plants and animals. Therefore, cells are the 'Building Blocks of Life' or the 'Basic units of Life'. Organisms made up of a single cell are '3 _____' whereas organisms made up of many cells are 'multicellular'. Cells perform many different functions within a living organism such as digestion, respiration, reproduction, etc.

For example, within the human body, a lot of cells give rise to a tissue → multiple tissues make up an organ → many organs create an 4 _____ → several organs' systems functioning together make up the human body.

Formulation of Cell Theory

- Cell theory was formulated by a **German botanist** Matthias Schleiden in 1838 and a **British zoologist**, Theodore Schwann in 1839.
- **Matthias Schleiden** examined a large number of plants and observed that all plants are composed of different kinds of cells which form the tissues of the plant.
- **Theodore Schwann** studied different types of **animal cells** and reported that cells had a thin outer layer which is today known as the '5 _____'.
- Based on his studies on **plant tissues**, he concluded that the presence of **cell wall is a unique** character of the plant cells.
- On this basis, he proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.
- **Rudolf Virchow**: Cell theory did not explain the mechanism of formation of new cells. So, Rudolf Virchow (1855) first explained that cells divide and new cells are formed from 6 _____ cells (*Omnis cellula-e cellula*). He modified the cell theory to give it a final shape.

Features of cell theory

- All livings organisms are composed of cells and products of cells.
- All cells arise from pre-existing cells.

Need to Know

- Viruses represent a connecting link between living and non-living things. They are exception to cell theory because they do not grow or reproduce by themselves. This makes them non-living. However, when a virus enters a living cell of an organism, it obtains energy from the host cell and starts reproducing
- Anything less than a complete structure of a cell does not ensure independent living.

AN OVERVIEW OF CELL

- Onion cell is a typical plant cell which has a distinct cell wall as its outer boundary and just within it, is the cell membrane whereas the human cheek cell have an outer membrane as the delimiting structure of the cell **(cell wall is absent in animal cells)**.
- Dense membrane bound structure is found inside each cell which is called as **nucleus** which itself contains chromosomes which in turn contain the genetic material, DNA.
- Cells that have membrane bound nuclei are called eukaryotic whereas cells that lack a membrane bound nucleus are prokaryotic. In both prokaryotic and eukaryotic cells, a semi-fluid matrix called cytoplasm occupies the volume of the cell.

Key Note

- **Cytoplasm** is a semi-fluid matrix which occupies the volume of the cell. It is the **main arena** of cellular activities in both the plant and animal cells.
- Various chemical reactions occur inside the cytoplasm keep the cell in the **'living state'**.

Types of Cells According to Size & Shape

- Cells differ greatly in size, shape and activities. They may be disc-like, polygonal, columnar, cuboid, thread-like, or even irregular. The shape of the cell may vary with the function they perform.

Table 1: Some important cells and their features with their dimensions

Cell type	Feature/Size/Shape
Mycoplasma	Smallest cell; 7 _____ µm in length
Bacteria	3-5 µm
Ostrich egg	Largest isolated single cell
8 _____	7.0 µm in diameter
Nerve cells (neurons)	Longest cells in humans

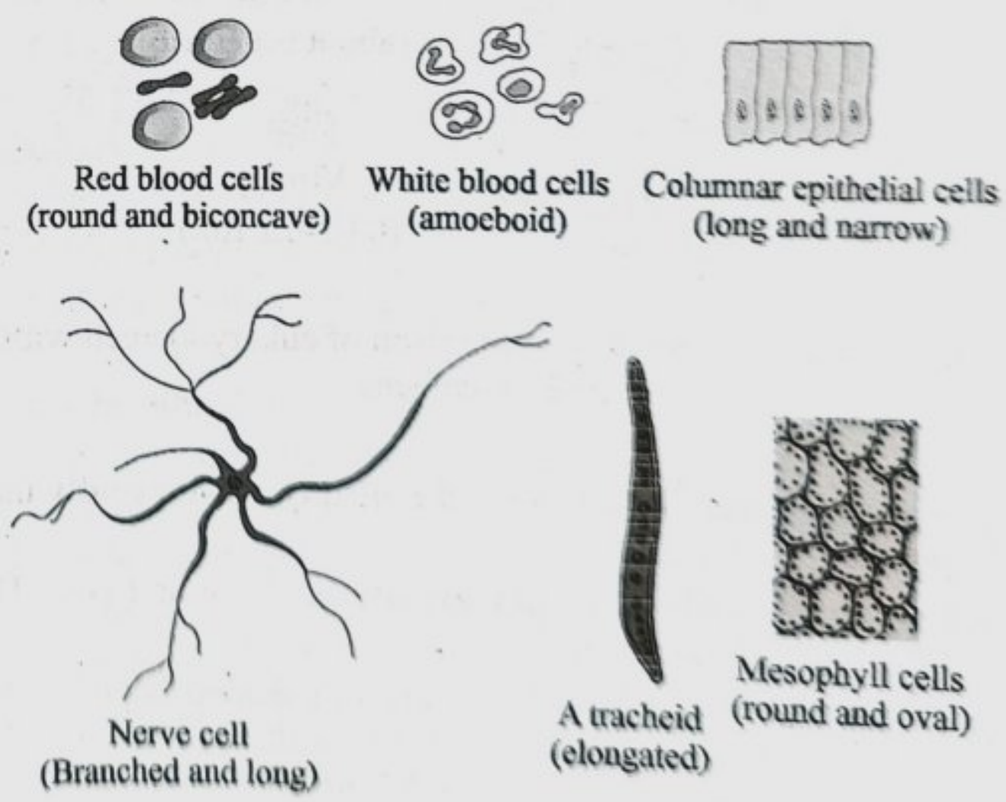

Fig. 2: Diagram showing different shapes of the cells

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Concept Application

Fill in the Blanks:

1. First person who saw and described a living cell is_____.
2. Unicellular organisms are capable of _____ and _____.
3. The smallest cell is of _____and its size is _____.
4. "*Omnis cellula-e-cellula*" which means new cells arises from pre-existing cells was given by scientist_____.

True and False:

5. Cell theory was given by Matthias Schleiden (British Botanist) and Theodore Schwann (German Zoologist).

TYPES OF CELLS

According to the Nuclear Organisation

On the basis of nuclear organisation, cells are classified mainly into two types:

- Prokaryotic cell
- Eukaryotic cell

Prokaryotic Cell

- These cells are represented by bacteria, blue-green algae Mycoplasma or PPLO (Pleuro Pneumonia Like Organisms).

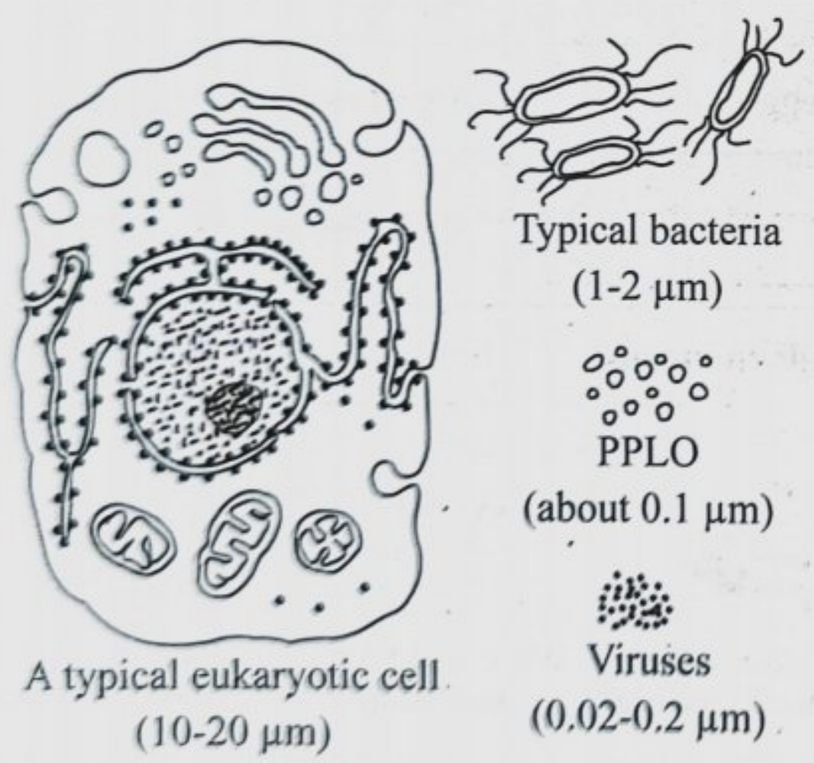

Fig. 3: Diagram showing comparison of eukaryotic cell with other organisms

- They are generally smaller and **multiply more rapidly** than the **9**_____ cells.
- Prokaryotic cells may **vary greatly** in shape and size. The **four basic shapes** of bacteria are as follows:
  - **Bacillus (rod-like):** These are rod-shaped bacteria that occur singly or in groups of two or three joined together to form a long chain. Example: *Bacillus coagulans.*
  - **Coccus (spherical):** These bacteria are spherical or oval in shape. Example: *Streptococcus pyogenes.*
  - **Vibrio (10**_____**):** These are comma-shaped bacteria. Example: *Vibrio cholerae.*
  - **Spirillum (spiral):** These are spiral-shaped bacteria. Example: *Spirillum minus.*

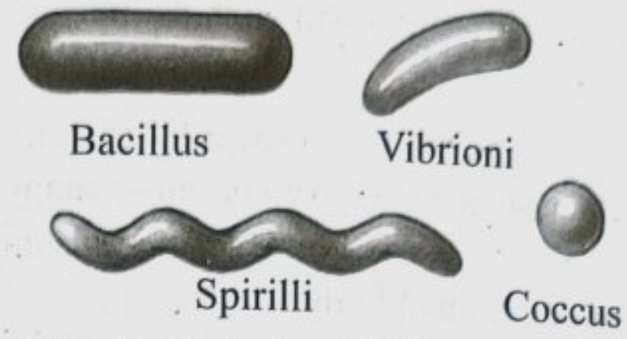

Fig. 4: Bacteria of different shapes.

Structure of Prokaryotic Cell

- The organisation of the prokaryotic cell is fundamentally similar even though prokaryotes exhibit a wide variety of shapes and functions.
- All prokaryotes are surrounded by plasma/cell membrane which is itself surrounded by a cell wall. **11**_____ **is an exception** where the cell wall is absent.
- The fluid matrix filling the cell is called cytoplasm.
- There is no well-defined nucleus.
- The genetic material is basically **12**_____, i.e., not enveloped by a nuclear membrane.
- In addition to the genomic DNA (the single chromosome/circular DNA), many bacteria have small circular DNA outside the genomic DNA. These smaller DNA are called **13**_____
- The plasmid DNA confers certain unique **phenotypic** characters to such bacteria. One such character is resistance to **antibiotics.**

3D Model

Scan this QR code to understand the ultra structure of Prokaryotic cell through 3D model. To learn more download the Physics Wallah App.

Key Note

- Plasmid DNA is used to monitor bacteria transformation with foreign DNA
- Nuclear envelope and membrane bound cell organelles are absent in prokaryotic cells.
- Ribosome is the only cell organelle found in prokaryotes.

Cell Envelope and its Modifications

- Most prokaryotic cells, particularly the bacterial cells, have a chemically complex **cell envelope** which consists of a tightly bound **three layered** structure, i.e., the **outermost** **14**_____ followed by the middle **cell wall** and then the innermost **plasma membrane.**
- They act together as a single **protective unit** but each layer of the envelope performs distinct function as well.

Gram Staining

Gram stain or **Gram staining**, also called **Gram's method**, is a method of staining used to distinguish and classify bacterial species.

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On the basis of the differences in the composition of cell hall and the manner in which bacteria respond to the staining procedure developed by Danish bacteriologist **Hans Christian Gram** in **1884**, they can be classified into two groups:

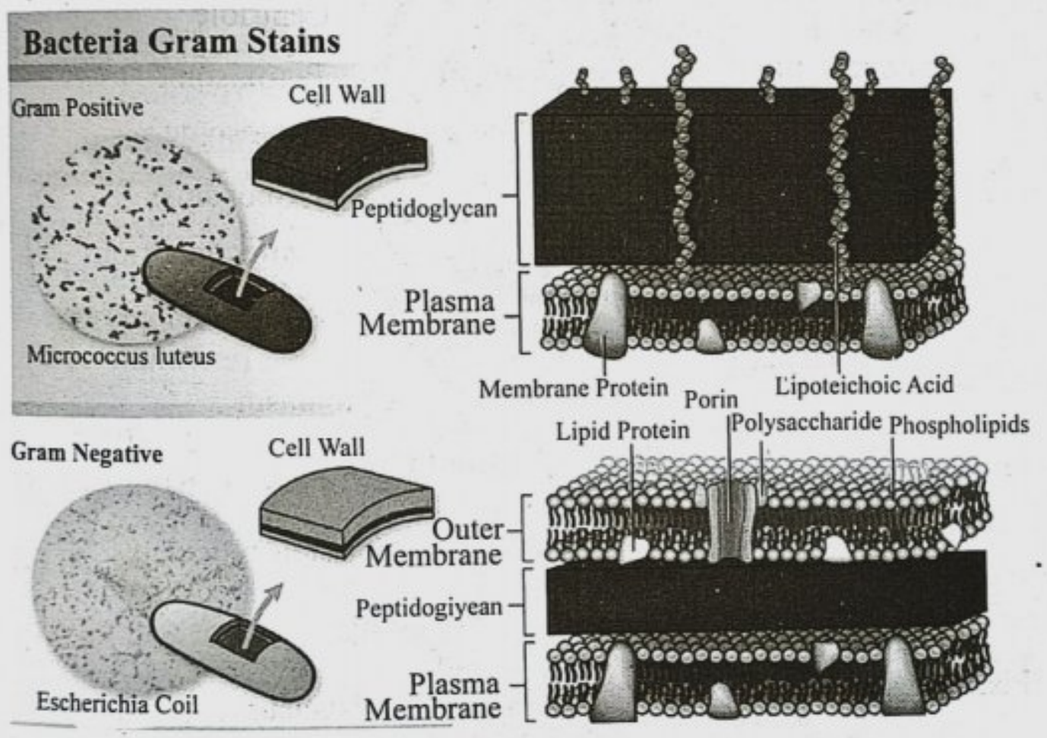
1. Gram-positive bacteria

Gram-positive bacteria retain the color of the **15**..... stain in the Gram stain. Such bacteria include *Staphylococci, Streptococci, Pneumococci*. Also, some others are the bacterium which causes diphtheria and anthrax. Gram-positive bacteria show the visible violet color upon the application of mordant means **iodine and ethanol**. Gram-positive bacteria constitute a cell wall consisting of a thick layer of peptidoglycan. It forms a rigid structure. Its cell walls additionally have **teichoic acids** and **phosphate**.

2. Gram-negative bacteria

Gram-negative bacteria do not retain the crystal violet stain and further, it takes the color of the red counterstain in Gram's method of staining. This is the major characteristic of bacteria that have a cell wall composed of a thin layer of peptidoglycan and an outer layer rich in lipids.

The gram-negative bacteria are stained by a counterstain such as safranin, also these are de-stained with the alcohol wash. Therefore, under a microscope, these are noticeably pink in color.



Glycocalyx

- Glycocalyx differs in composition and thickness among different bacteria. It could be a loose sheath called the **slime layer** in some, while in others it may be thick and tough, called the **16**.....

Cell Wall

- It determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting or collapsing.
- Cell wall is thicker, made of single layer of **17**..... in Gram positive bacteria.
- In gram negative bacteria cell wall is double layered made of thin outer membrane of lipid and inner wall of peptidoglycan.

Plasma Membrane

- It is selectively-permeable in nature and interacts with the outside world. This membrane is structurally similar to that of the eukaryotes.

Mesosome

- A special membranous structure is the **mesosome** which is formed by the extensions (or infoldings) of plasma membrane into the cell. These are **characteristic feature** of prokaryotes.
- These extensions are in the form of **vesicles, tubules** and **lamellae**.
- Help in cell wall formation, DNA replication and distribution to daughter cells.
- Also help in respiration, secretion processes, to increase the surface area of the plasma membrane and enzymatic content.

Key Note

- **Chromatophores** are pigment containing membranous extensions of plasma membrane into the cytoplasm in some prokaryotes like **cyanobacteria**.

Cytoplasm

- The part of cell which is present enclosed within and the cell membrane is cytoplasm. The term Cytoplasm was given by-Strasburger.
- Liquid matrix of cytoplasm contains water, proteins and other biomolecules.

Nucleoid

- The nucleoid is an irregularly shaped region within the cell of a prokaryote that contains all or most of the genetic material. In contrast to the nucleus of a eukaryotic cell, it is not surrounded by a nuclear membrane. The genome of prokaryotic organisms generally is a circular, double-stranded piece of DNA, without histone proteins.

DNA

- Deoxyribonucleic acid more commonly known as DNA is the molecule that carries genetic information for the development and functioning of an organism. It is located within the nucleus of a cell. DNA is present in both eukaryotes and prokaryotes.
- Prokaryotic DNA is present freely in the central portion of the cytoplasm as a closed circular structure.
- Eukaryotic DNA is present within the nucleus and is organised in chromosomes.

Motility

- Bacterial cells may be **motile** (have flagella which is thin filamentous extension of cell wall) or **non-motile**.
- Bacteria show a range in the number and arrangement of flagella.
- **Flagellum:** It is composed of three parts-**filament** (longest portion that extends from cell surface to the outside) **hook** and **basal body**.

Other Surface Structure

- **Pili:** These are **elongated tubular structure** made of a special protein.
- **Fimbriae:** They are **small bristle like fibres** sprouting out of the cell. In some bacteria, they are known to help **attach/anchorage** the bacteria to rocks in streams and also to the host tissues.

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Key Note

- **Pili** and **Fimbriae** do not play a role in motility.
- Besides Flagella, Pili and Fimbriae are also surface structures of the bacteria but do not play a role in motility.

Ribosomes

- Prokaryotic ribosomes are about 15 nm by 20 nm in size and are **18**_____ in nature (made up of 50S and 30S subunits).
- In prokaryotes, ribosomes are **associated with the plasma membrane** of the cell.
- Several ribosomes may attach to a single mRNA and form a chain called **polyribosomes** or **polysome**. The ribosomes of a polysome translate the mRNA into proteins.

Key Note

- Ribosome are the site of **protein synthesis.**
- Polyribosome are present only in prokaryotic cells.

Inclusion Bodies

- They store the reserve material in prokaryotic cells inside the cytoplasm.
- These are not membrane bound and lie freely in the cytoplasm, may consist of **phosphate granules,** **19**_____ **granules** and **glycogen granules**.
- **Gas vacuoles** are found in blue-green and **20**_____ and green photosynthetic bacteria.

Concept Application

Fill in the Blanks:

6. _____ is a special membranous structure, mainly associated with respiration, secretion process and replication in prokaryotic cells.
7. _____ is a pigment containing membranous extensions of plasma membrane in cyanobacteria.
8. Plasmids are small _____ outside the genomic DNA.
9. _____, _____ and _____ are surface structures found in Bacteria.
10. Cell envelope consists of outermost _____ followed by _____ and _____.

True and False:

11. Several ribosomes may attach to single mRNA to form a chain called polyribosomes.
12. Membrane bound inclusion bodies are present in prokaryotes.
13. Ribosomes are non-membrane bound organelles found only in prokaryotic cells.

EUKARYOTIC CELLS

- The eukaryotes include all protists, fungi, plants and animals.
- Membrane bound organelles are present in eukaryotes which leads to **extensive compartmentalisation of cytoplasm.**
- Eukaryotic cells possess an organised nucleus with a nuclear envelope. In addition, eukaryotic cells have a variety of complex locomotory and cytoskeletal structures. Their genetic material is organised into chromosomes.

Table 2: Difference between animal cell and plant cell

Animal Cell	Plant Cell
Cell walls absent	Possess cellulosic cell walls.
Plastids absent	Plastids present.
Large central vacuole is not present	Large central vacuole present, due to which nucleus is not central.
Have centrioles and centrosomes	Do not have centrioles.
Reserve food is glycogen	Reserve food is starch.

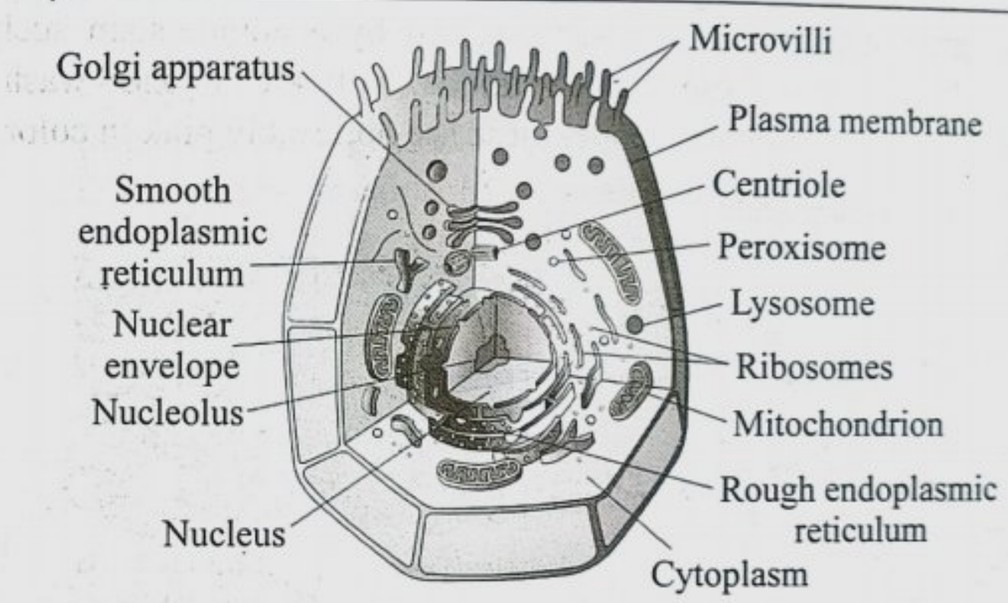

Fig. 5: Animal Cell

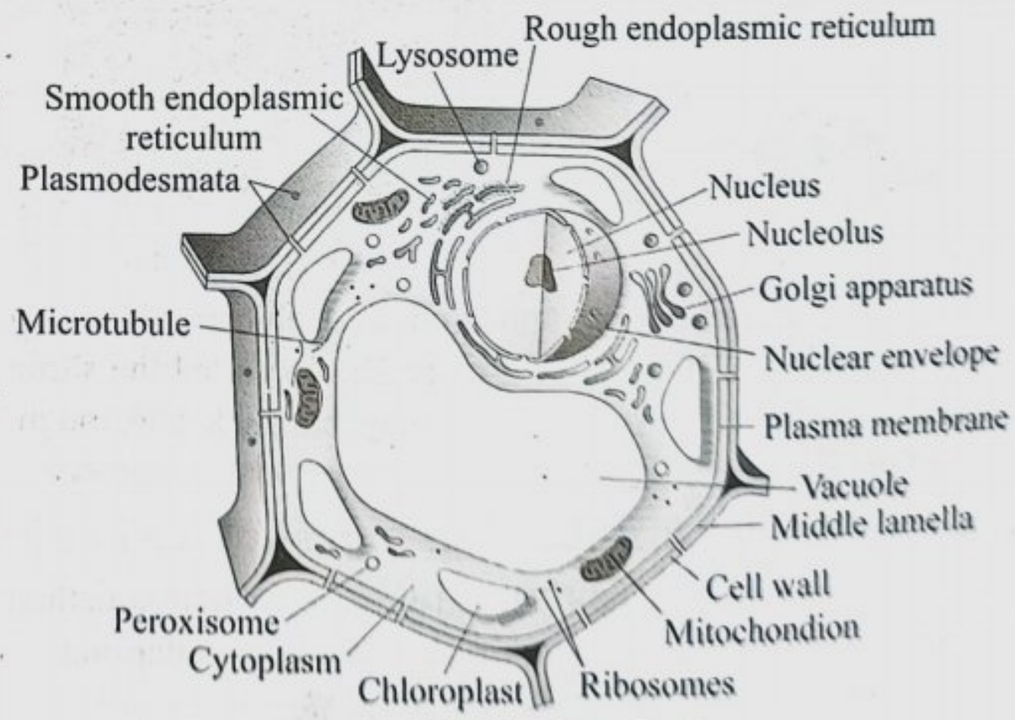

Fig. 6: Plant Cell

3D Model

Scan this QR code to understand the ultra structure of Eukaryotic cell (plant cell) through 3D model. To learn more download the Physics Wallah App.

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Plasma Membrane

- The detailed structure of the membrane was studied only after the advent of the **electron microscope** in the 1950s. Meanwhile, chemical studies on the cell membrane, especially in human **red blood cells** (RBCs), enabled the scientists to deduce the possible structure of plasma membrane.
- The cell membrane is mainly composed of **lipids** and **proteins**.
  - Major lipids found in cell membrane are phospholipids (most abundant) that are arranged in a **bilayer**.
  - Lipids are arranged within the membrane with the polar head towards the **21**_____ sides and the hydrophobic tails towards the **22**_____ part.
  - This ensures that the nonpolar tail of saturated hydrocarbons is protected from the aqueous environment.
- Depending on the ease of extraction, membrane proteins can be classified as **integral** and **peripheral**.
- Peripheral proteins lie on the surface of membrane while the integral proteins are partially or totally buried in the membrane.

Key Note

- Plasma membrane in addition to phospholipids also contain cholesterol.
- Later, biochemical investigation clearly reveal that the cell membranes also possess protein and carbohydrate
- The ratio of protein and lipid varies considerably in different cell types.
- In human beings, the membrane of the erythrocyte has approximately **52%** protein and **40%** lipids.

Fluid Mosaic Model of Plasma Membrane

- This model was proposed by **23**_____ **and** **24**_____ **in 1972** which is widely accepted. This describes the structure of all cellular membranes including the membranes of nucleus mitochondria, plastids and vacuole etc.
- It described membrane structure as **proteins as ice bergs** in a **sea of lipids.**
- According to this model, **the quasi-fluid** nature of lipid enables lateral movement of proteins within the overall bilayer. This ability to move within the membrane is measured as its **fluidity**.

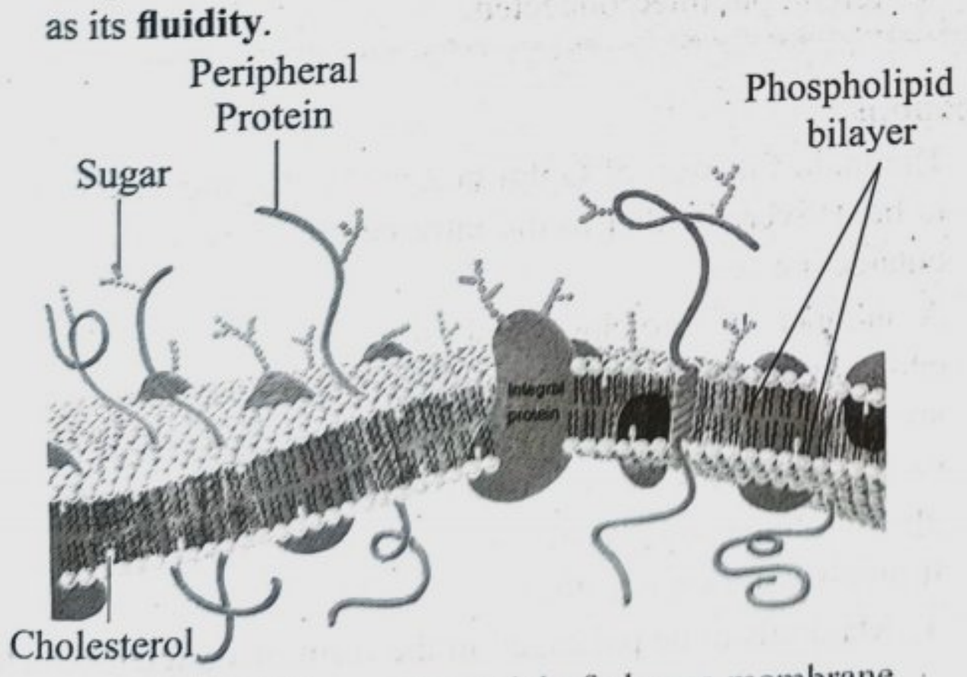

Fig. 7: Fluid mosaic model of plasma membrane

The fluid nature of the membrane is important for:

- Cell growth
- Formation of intercellular junctions
- Secretion
- Endocytosis
- Cell division

Transport of Molecules Across Cell Membrane

- It is one of the most important functions of plasma membrane.
- The membrane is **selectively permeable** to some molecules present on either side of it.
- Many molecules can move briefly across the membrane without any requirement of energy and this is called the **25**_____ **transport**.
- Neutral solutes may move across the membrane by the process of **simple diffusion** along the concentration gradient, i.e., from higher concentration to the lower concentration.
- Water may also move across this membrane from higher to lower concentration. Movement of water by diffusion is called **osmosis**.
- As the polar molecules cannot pass through the nonpolar lipid bilayer, they require a carrier protein of the membrane to facilitate their transport across the membrane.
- A few ions or molecules are transported across the membrane against their concentration gradient, i.e., from lower to the higher concentration. Such a transport is an energy dependent process, in which **26**_____ is utilised and is called **27**_____ **transport,** e.g., Na^+/K^+ Pump.

Key Note

- All biological membranes including the plasma membrane and internal membranes of eukaryotic cells (i.e., membranes bounding endoplasmic reticulum or ER, nucleus, mitochondria, chloroplast, Golgi apparatus, lysosomes, peroxisomes, etc.) are similar in structure (i.e., fluid-mosaic) and selective permeability but slightly differing in other functions.

Cell Wall

- It is a **non-living rigid** structure that forms an outer covering for the plasma membrane of fungi and plants cells.
- The cell wall of a young plant cell, the **primary wall** is capable of growth, which gradually diminishes as the cell matures and the **secondary wall** is formed on the inner (towards membrane) side of the cell.
- The secondary cell wall consists primarily of cellulose, along with other polysaccharides, lignin, and **28**_____.

Middle Lamella

- It is a layer composed mainly of **29**_____ which holds or **glues** the different neighbouring cells together.

Functions of Cell Wall

- Gives a particular size & shape to cell.
- Protects the cell from mechanical damage and infection.
- Helps in cell-to-cell interaction.
- Provides barrier to undesirable macromolecules.

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Key Note

- Cell wall in **plants** is made up of cellulose, hemicellulose, pectins and proteins whereas in **algae** it is made of cellulose, galactans, mannans and minerals like calcium carbonate.
- Cell wall of fungi is made up of chitin.
- **Cell wall** and **middle lamellae** may be traversed by **plasmodesmata** which connect the cytoplasm of neighbouring cells.

Endomembrane System

- All membranous organelles are quite different in terms of structure and function but many of them are considered together as endomembrane system as their functions are **coordinated**.
- Endomembrane system includes **Endoplasmic Reticulum (ER), Golgi Complex, Lysosomes** and **Vacuoles**.
- Mitochondria, chloroplast and **30**..... are not considered as the parts of endomembrane system as their functions are not coordinated with the above described organelles.

Endoplasmic Reticulum

- A network or reticulum of tiny tubular structures scattered in the cytoplasm.
- ER divides the intracellular space into two distinct compartments, i.e., **luminal** (inside ER) and **extra luminal** (cytoplasm) compartments.

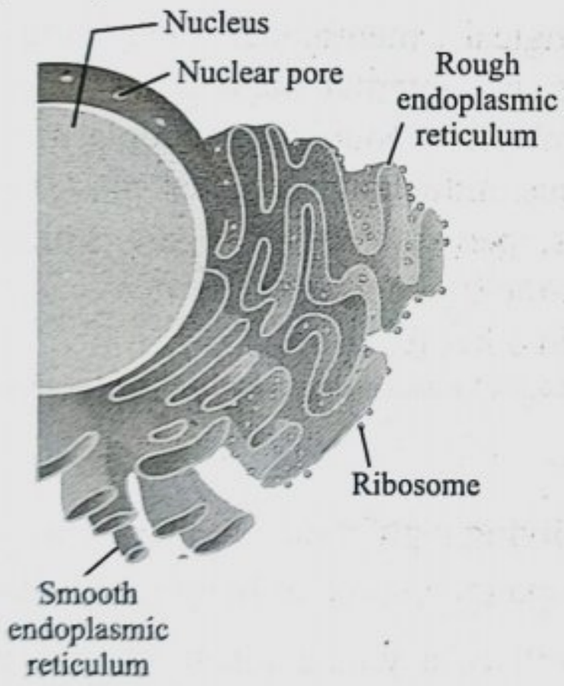

Fig. 8: Endoplasmic reticulum

Types of Endoplasmic Reticulum

- **SER** (Smooth Endoplasmic reticulum)-Ribosomes are absent.
- **RER** (Rough Endoplasmic Reticulum)-Ribosomes are found on the outer surface of ER.
- RER are extensive and continuous with the outer membrane of the **31**.....

Key Note

- SER is the major site for synthesis of **lipids** and **steroid hormones (in animals).** RER is frequently observed in the cells actively involved in **protein** synthesis and secretion.

Golgi Apparatus

- It was discovered by Camillo Golgi (1898) as densely stained reticular structures near the nucleus, hence named Golgi bodies.
- The functional unit of Golgi apparatus is **cisternae**. The group of these cisternae is called **32**..... in plant cells.
- It consists of many flat, disc-shaped sacs or cisternae of 0.5μm to 1.0μm in diameter.
- These are stacked parallel to each other.
- Varied number of cisternae are present in a Golgi complex.
- They are concentrically arranged near the nucleus forming two different faces:
  - **(a) Forming face/*cis* face:** The curved convex structure directed towards nucleus or ER.
  - **(b) Maturing face/*trans* face:** The concave surface directed towards plasma membrane.

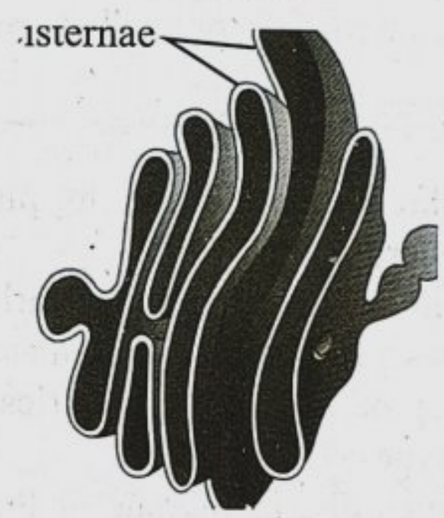

Fig. 9: Golgi Apparatus

3D Model

Scan this QR code to understand the structutre of Golgi Apparatus through 3D model. To learn more download the Physics Wallah App.

Key Note

- The *cis* and the *trans* faces of the Golgi are entirely different, but interconnected.

Functions

- The main function of Golgi body is packaging of materials, to be delivered either to the intra-cellular targets or secreted outside the cell.
- A number of proteins synthesised by ribosomes on the endoplasmic reticulum are modified in the cisternae of the golgi apparatus before they are released from its **33**..... face.
- Golgi apparatus is the important site of formation of glycoproteins and glycolipids.
- It involves following steps:
  - Materials to be packaged in the form of vesicles from the ER fuse with the *cis* face of the golgi apparatus and move towards the maturing face.
  - This explains, why the golgi apparatus remains in close association with the endoplasmic reticulum.

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Lysosomes

- They are **membrane bound** vesicular structures formed by the process of **packaging** in the golgi apparatus.
- Lysosomal vesicles are rich in all types of **hydrolytic** enzymes which are optimally active in 34 _____ pH.
- These enzymes are responsible for digesting carbohydrates, proteins, lipids and nucleic acids.

Functions

- Digestion of large extracellular particles.
- Digestion of intracellular substances.
- Autolysis.

Need to Know

Some lysosomal enzymes

- Lipases-Breakdown lipids
- Proteases-Breakdown proteins
- Amylases-Breakdown carbohydrates
- Nucleases-Breakdown nucleic acids

Vacuoles

- These are the membrane-bound space found in the cytoplasm that contains water, sap, excretory product and other materials not useful for the cell.
- Plant cell vacuole is larger than animal cell vacuole.

Key Note

- **Tonoplast** is the single membrane surrounding the vacuole. 90 percent of the volume in the plant cells is occupied by the vacuoles.

- Tonoplast (vacuolar membrane) facilitates the **transport** of a number of **ions** and other materials **against concentration** gradients into the vacuole, hence their concentration is significantly higher in the vacuole than in the cytoplasm.

Key Note

- **Contractile vacuole** in *Amoeba* is meant for osmoregulation and excretion.
- **Food vacuoles** are found in protists which is formed by engulfing the food particles.

Concept Application

Fill in the Blanks:

14. Eukaryotic ribosomes are _____ while the prokaryotic ribosomes are _____.
15. In human beings, the membrane of erythrocytes has approximately _____ percent of protein and _____ percent of lipids.
16. Algal cell wall is made up of cellulose, galactans _____ and _____.
17. _____ is a layer of cell wall chiefly made up of calcium pectate.
18. _____ cell organelle is specialized for the synthesis of lipids and steroids.
19. _____ first observed densely stained reticular structures near the nucleus.
20. Golgi apparatus is an important site of formation of _____ and _____.
21. Contractile vacuole helps in _____ and _____.

True and False:

22. Plant cells have centriole which is absent in almost all animal cells.
23. Lysosome is an organelle containing hydrolytic enzymes.
24. Membrane of plant vacuole is called tonoplast.

Mitochondria

- Mitochondria is known as **power house of cell**.
- Mitochondria (sing. mitochondrion), unless specifically stained, are **not easily visible** under the microscope.
- Depending on the physiological activity of the cells the number of mitochondria per cell varies.
- Mitochondria shows considerable degree of variability in terms of shape and sizes. Typically it is **sausage-shaped** or cylindrical having a diameter of 0.2 - 1.0μm (average 0.5μm) and length 1.0 - 4.1μm.
- Mitochondria is bound by a double membrane.
- The outer membrane and the inner membrane divide its lumen distinctly into two aqueous compartments, i.e., the outer compartment and the inner compartment.

Outer Membrane

- Forms the continuous limiting boundary of the organelle.

Inner Membrane

- Forms a number of infoldings called **cristae** towards the matrix.
- The cristae 35 _____ the surface area and provide abundant space for metabolism.

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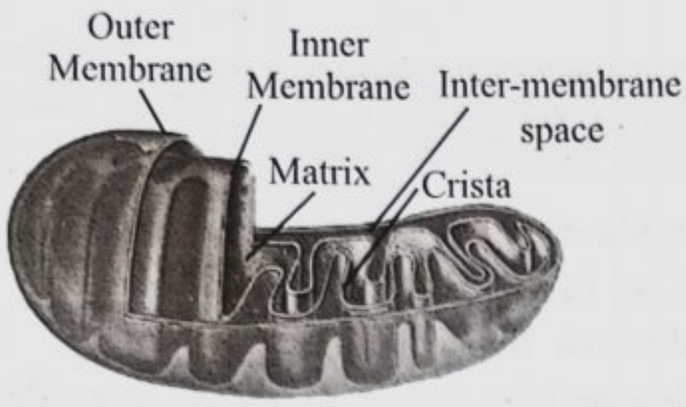

Fig. 10: Structure of mitochondrion

Key Note

- **Outer** and **inner membrane** of mitochondria have their own specific enzymes associated with the mitochondria function.
- Mitochondria divide by fission.

Matrix

- The inner compartment is filled with a dense **homogeneous** substance called the matrix.
- The matrix also possesses single **36**..... DNA molecule, a few **RNA** molecules, ribosomes **(70S)** and the components required for the synthesis of proteins.

Functions of Mitochondria

- Mitochodria are the site for **37**..... **respiration** because they contain all enzymes required for it.
- They produce cellular energy in the form of ATP (Adenosine triphosphate).

Plastids

- Plastids are found in all plant cells and in euglenoids.
- **Easily observed** under the microscope as they are large.
- Have some specific **pigments**, thus imparting specific colours to the plants.
- On the basis of colour plastids are classified as follows:

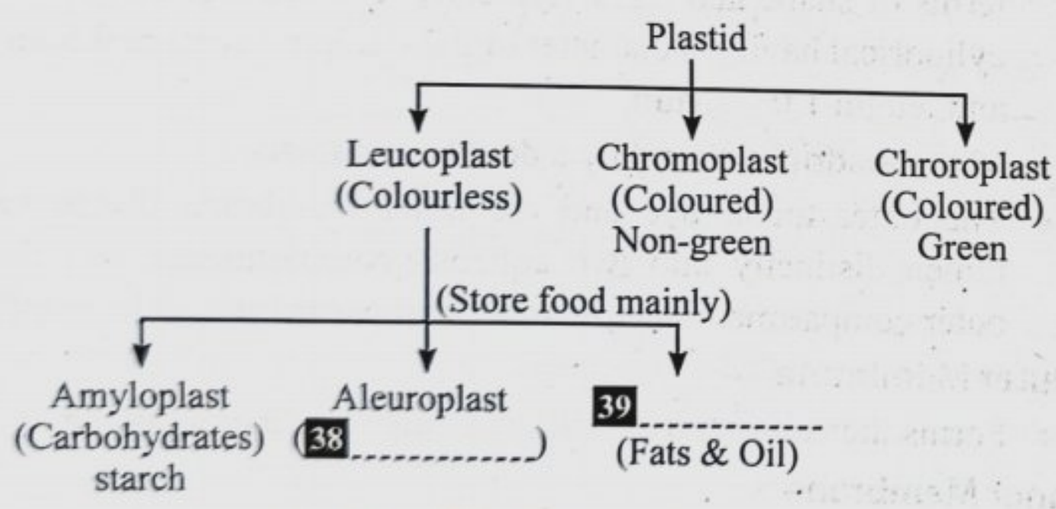

Fig. 11: Classification of plastids

- Chloroplasts contain **chlorophyll** and carotenoid pigments which are responsible for trapping light energy essential for photosynthesis.

Chromoplast

- **Coloured plastids** with red, orange and yellow carotenoids. It is found in plant parts like **fruits** and **flower**.
- These plastids contains **fat soluble** carotenoid pigments like carotene, xanthophylls etc.

Chloroplast

- Due to the presence of chlorophyll, leaves and other parts of plants exhibits **green** colour.
- These are found in the **mesophyll** cells of the leaves.
- These are lens-shaped, oval, spherical, discoid or even ribbon-like.
- They are variable in length (5-10 μm) and width (2-4 μm).
- Their number varies from 1 per cell of *Chlamydomonas*, a green alga to 20-40 per cell in mesophyll.

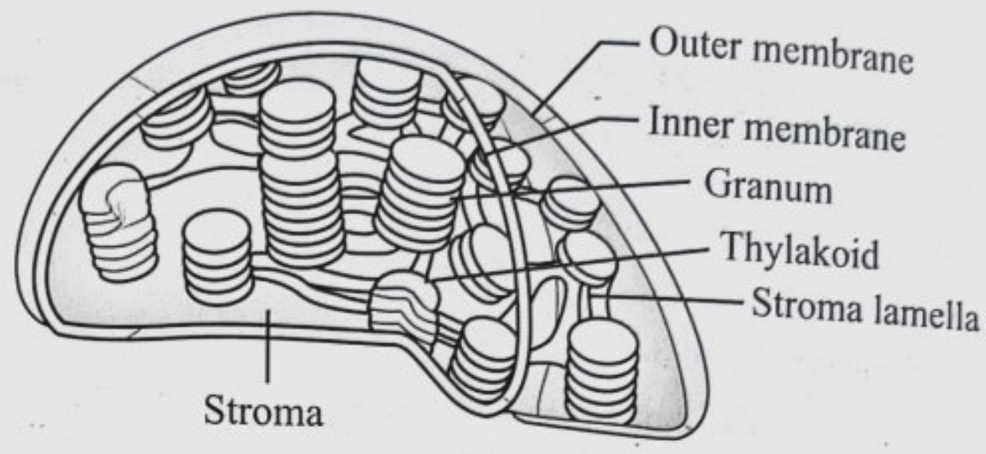

Fig. 12: Sectional view of chloroplast

- It is a **double membrane** bound organelle with an outer membrane (permeable) and an inner membrane (less permeable).
- The space limited by the inner membrane of the chloroplast is called the **stroma**.
- **Thylakoids** are flattened membranous sacs found in the stroma.
- Thylakoids are arranged in stacks like the piles of coins (one above other) called **40**..... or intergranal thylakoids.
- Also, there are flat membranous tubules called the **stroma lamellae** that connect the thylakoids of the different grana.
- The membrane of the thylakoids encloses a space called a **lumen.**
- The stroma of the chloroplast contains **enzymes** required for the synthesis of carbohydrates and proteins. It also contains ribosomes **(70S)** and small double stranded circular **DNA** molecules.
- Chlorophyll pigments are present in the **41**.....

Need to Know

- Both chloroplast and mitochondria have their own DNA, RNA and ribosomes (proteins synthetic machinery). They are semiautonomous in nature as they can make their own copies and synthesize most of the proteins.

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EXTENDED LEARNING

Endosymbiotic Theory

Scientists believe that 4 billion years ago the primitive cells had the following modes nutrition:

- Invagination of food particles
- Photosynthesis
- Absorb free-floating particle in their surrounding

The theory states that a free-living bacterium was engulfed by another cell as a food particle.

This engulfed cell ended up staying inside and formed a distinct compartment inside the host cell.

The host cell became dependent on the engulfed cells for energy because it was an aerobic cell and gradually evolved into the powerhouse of the cell. Today we know it as mitochondria.

The process of one organism taking up permanent residence inside another and eventually evolving into a single lineage is known as endosymbiosis.

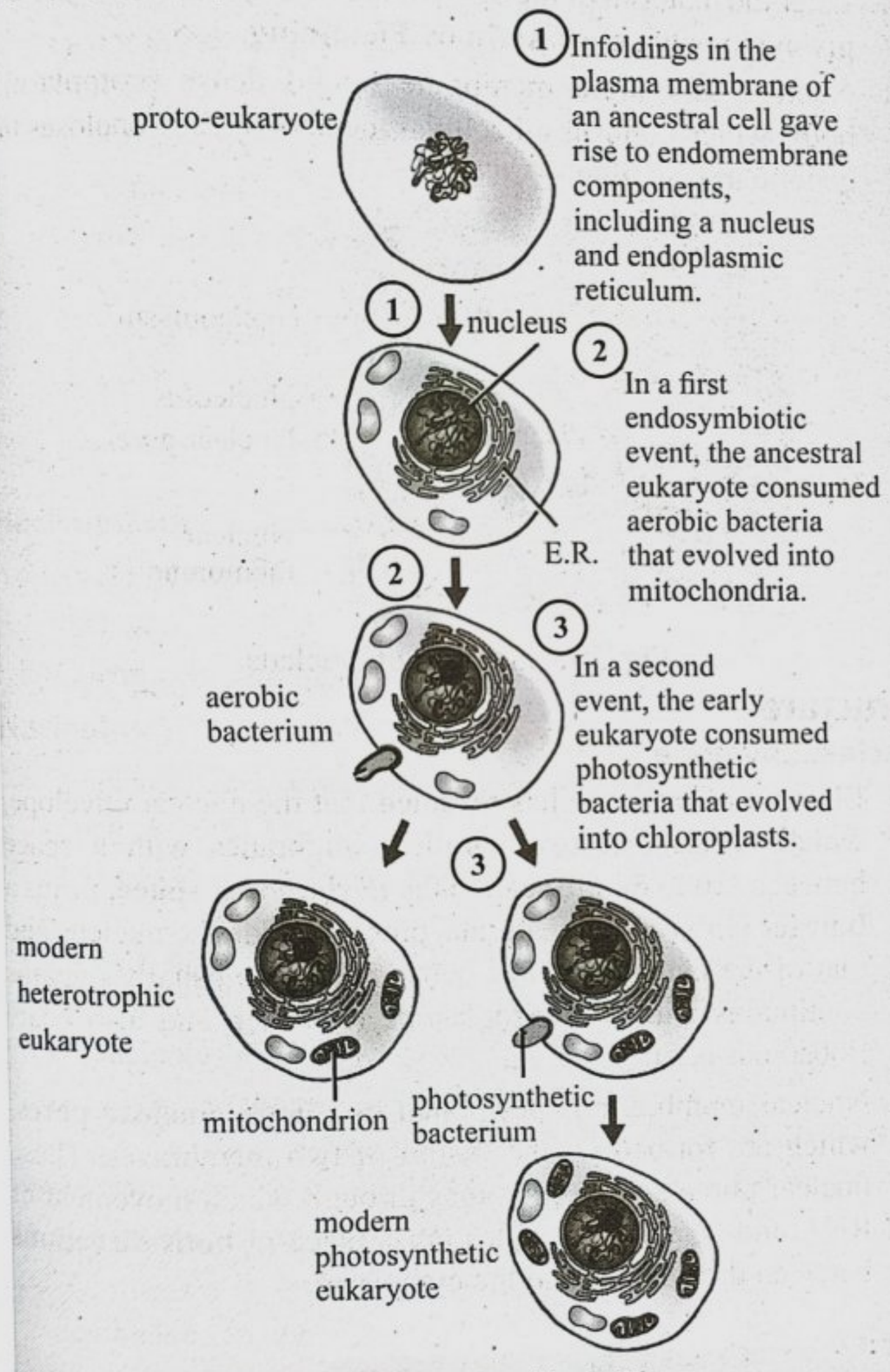

Fig. 13: The Endosymbiotic Theory

Ribosomes

- These are dense granular structures first observed under the electron microscope by **George Palade** in 1953.
- They are not surrounded by any membrane.

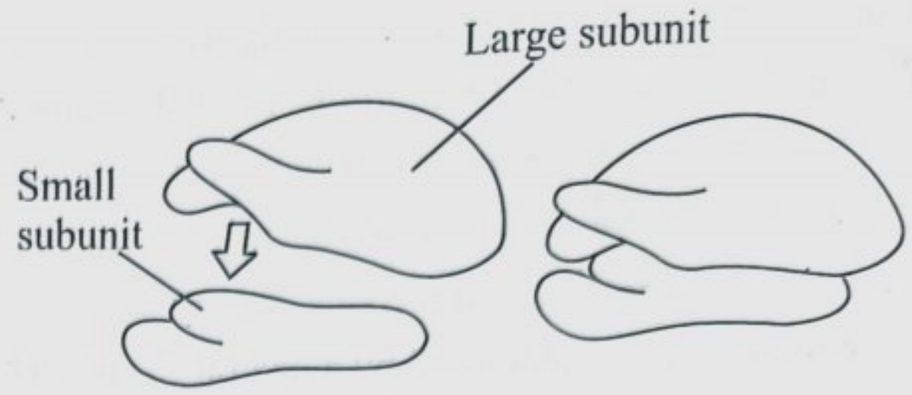

Fig. 14: Ribosome

Ribosome is mainly of two types:

1. **Prokaryotic Ribosome:** These are 70S ribosomes composed of two subunits: 50S (larger) and 30S (smaller).
2. **Eukaryotic ribosomes:** These are 80S ribosomes composed of two subunits 42_____ (larger) and 43_____ (smaller).

Key Note

- Ribosomes are composed of ribonucleic acid (RNA) and proteins.
- In 70S and 80S ribosomes 'S' is svedberg's unit which stands for the sedimentation coefficient.
- It is indirectly a measure of density and size.

Cytoskeleton

- An elaborate network of filamentous proteinaceous structures present in the cytoplasm is collectively referred to as the cytoskeleton.
- It includes microtubules, microfilaments and intermediate filaments.

Function

- Mechanical support
- Motility
- Maintenance of shape of the cell

Cilia and Flagella

- Cilia (sing: cilium) and flagella (sing: flagellum) are hair-like outgrowths of the cell membrane.
- Cilia are small **oars** like structure causing the movement of either the cell or the surrounding fluid material.
- Flagella are comparatively longer and responsible for cell movement.

Key Note

- Flagella in prokaryotes are structurally different from that of the eukaryotes.

- Cilia and flagella both are covered with plasma membrane.
- 44_____ is the core of cilium and flagellum that possesses a number of microtubules running parallel to the long axis.

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- It usually contains nine doublets of radially arranged peripheral microtubules, and a pair of centrally located microtubules. This type of arrangement of axonemal microtubules is referred to as the **45**..... array.
- The central microtubule are connected by bridge. These microtubules are also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublets by a **radial spoke**. Thus, there are **46**..... radial spokes.
- Linkers are the structures that interconnect the peripheral doublets.

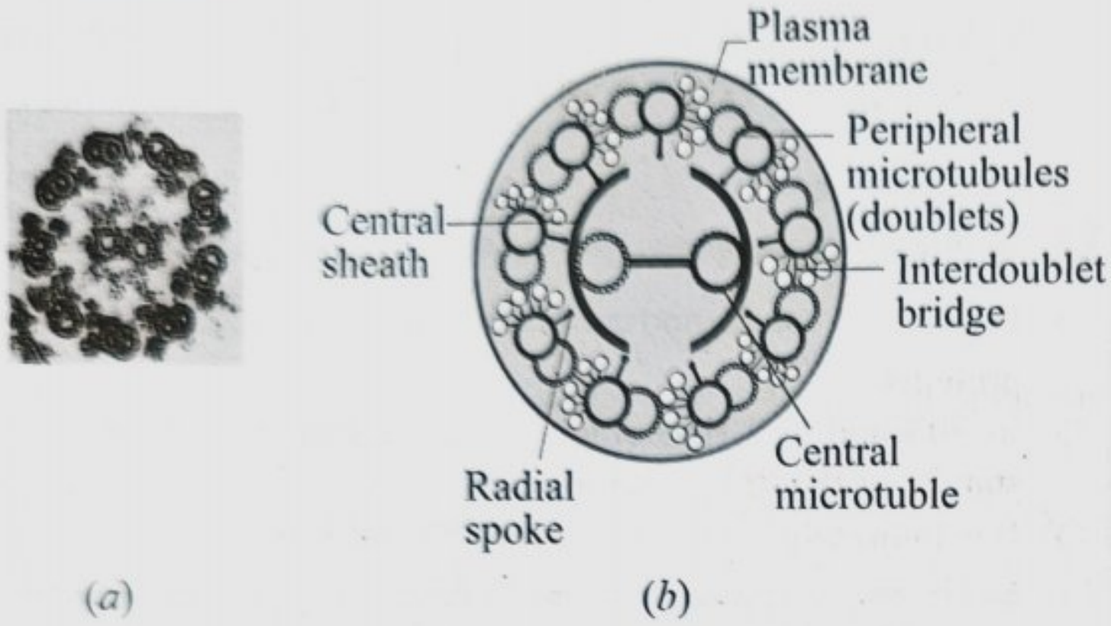

Fig. 15: Section of cilia/flagella showing different parts : (*a*) Electron micrograph (*b*) Diagrammatic representation of internal structure

Key Note

- **Basal bodies** are centriole like structure by which cilium and flagellum emerges out.

Centrosome and Centrioles

- Centrosome is an organelle that contains two cylindrical structures called **centrioles** that lie **perpendicular** to each other.
- Centrioles are surrounded by amorphous pericentriolar materials.
- Each centrioles has **cartwheel**-like organisation.
- Centriole is made up to 9 evenly spaced peripheral fibrils of **47**..... protein. Each of the peripheral fibril is a triplet (**9 + 0 arrangement**).
- Adjacent triplets in centrioles are also linked.
- The central part of the proximal region of the centriole is called **hub** (proteinaceous in nature).
- Hub is connected with tubules of the peripheral triplets by radial **spokes** made of protein.

Function

- In animal cells, centroiles play important role in initiation of cell division by forming **spindle fibres** that give rise to spindle apparatus.
- Form the basal body of cilia and flagella.

Concept Application

Fill in the Blanks:

25. A typical mitochondrion has a structure like _____.
26. Matrix of mitochondria has _____type of ribosomes.
27. _____ is a type of plastid that is involved in storage of proteins.
28. Centrioles have _____ arrangement.
29. In Cilia and flagella, no. of peripheral doublets in axoneme is_____.

True and False:

30. Outer mitochondrial membrane forms a number of infoldings called cristae.
31. Microtubules are made up of tubulin protein.

Nucleus

- The nucleus was discovered by **Robert Brown** in 1831.
- Later the material of the nucleus stained by the basic dyes was given the name **chromatin** by **Flemming**.
- Nucleus is double membrane bound dense protoplasmic body, which controls all cellular metabolism and encloses the genetic information of cell.

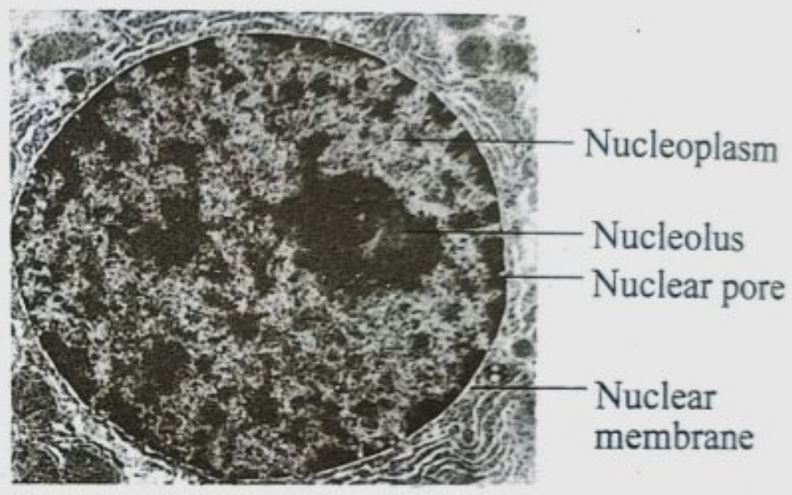

Fig. 16: Structure of Nucleus

Structure

Nuclear Envelope

- Electron microscopy has revealed that the nuclear envelope, which consists of two parallel membranes with a space between **(10 to 50 nm)** called the **perinuclear space**, forms a **barrier** between the materials present inside the nucleus and that of the cytoplasm. The outer membrane usually remains continuous with the endoplasmic reticulum and also bears ribosomes on it.
- Nuclear membrane is perforated by minute **nuclear pores**, which are formed by the **fusion** of two membranes. These nuclear pores are the **passages** through which movement of RNA and protein molecules takes place in **both directions** between the nucleus and the cytoplasm.

Need to Know

- Generally eukaryotic cell contain at least one nucleus but nucleus is absent in sieve tube cells of phloem and RBCs of many mammals.

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Train Your Brain

1. Can you recollect names of organisms that have more than one nucleus per cell?

Sol. Binucleate-*Paramecium*

Multinucleate-Slime moulds

2. Some mature cells even lack nucleus, e.g., erythrocytes of many mammals and sieve tube cells of vascular plants. Would you consider these cells as living?

Sol. Sieve tube cells of vascular plants and RBC of mammals have nuclei in their early stage but lose their nuclei at maturity. These cells lose nuclei as an adaptation and they can no longer divide and their lifespan is limited. For e.g., RBC accommodate hemoglobin in them that serves as a vehicle for the transport of O_2 and CO_2 in the blood. Since they do not divide, they get destroyed within 120 days of their life cycle. Likewise, sieve tube cells get differentiated for the translocation of food. Since they are closely associated with the companion cells through the plasmodesmata therefore, their activities are controlled by companion cells. Hence, they remain living. Although both RBC and sieve tube cells lack nuclei, but they are considered as living cells.

Nucleoplasm

- Nucleoplasm or nuclear matrix is a ground substance of nucleus.
- **Chromatin** and **nucleolus** are embedded in nucleoplasm.

Nucleolus

- Nucleolus is a **membraneless** spherical structure present in nucleoplasm. The content of nucleolus is continuous with the rest of the nucleoplasm.

Key Note

- Nucleolus is a site of active **ribosomal RNA** synthesis.
- Larger and more numerous nucleoli are present in cells actively carrying out protein synthesis.

Chromatin

- Chromatin is intranuclear, long, thread-like fine fibre. It is embedded in nucleoplasm.
- It is highly extended and elaborate **nucleoprotein** found in **48**_____ nucleus (nucleus of a cell when it is not dividing).
- **Composition:** Chromatin = DNA + histone (basic proteins) + RNA + non-histone proteins.
- Chromatin fibres contain genetic information.

Chromosomes

- Chromosomes are **dense** structure that can be best studied at **49**_____ stage of cell cycle.
- During cell division chromatin gets condensed to form chromosomes.
- Every chromosome (visible only in dividing cells) essentially has a primary constriction or the **centromere** on the sides of which disc shaped structures called **kinetochores** are present.

Fig. 17: Chromosome with kinetochore

Need to Know

- A single human cell has approximately **two metre** long thread of DNA distributed among its **46** (**23** pairs) chromosomes.

- Centromere holds two chromatids of a chromosome. Based on the position of the centromere, the chromosomes can be classified into four types:
  - **Metacentric chromosome:** Centromere at middle which forms two equal arms of the chromosome.
  - **Sub-metacentric chromosome:** Centromere slightly away from the middle of the chromosome resulting into one shorter arm and one longer arm.
  - **Acrocentric chromosome:** Centromere is situated close to its end forming one extremely **50**_____ and one very long arm.
  - **Telocentric chromosome:** Terminal centromere.

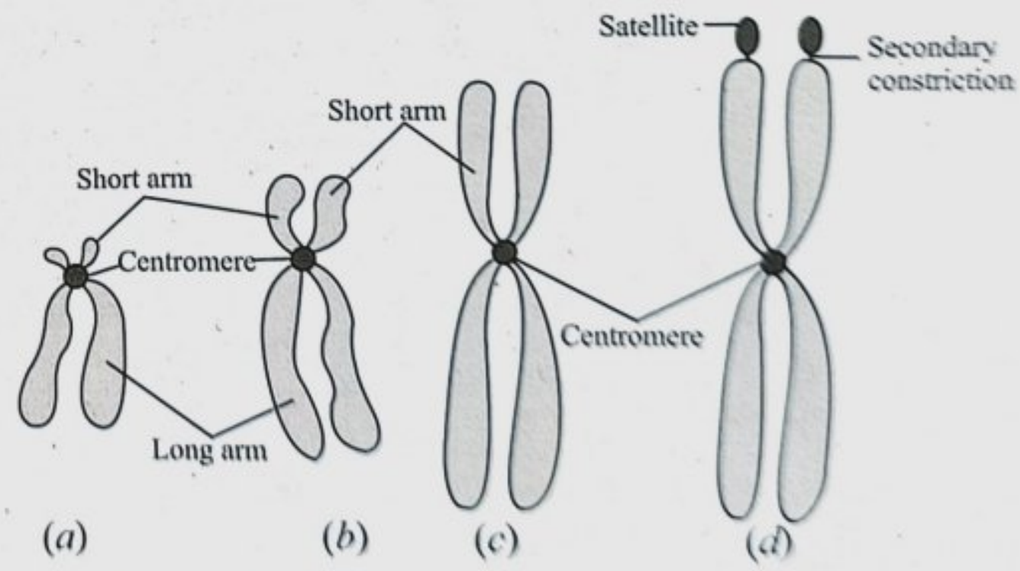

Fig. 18: Types of chromosomes based on the position of centromere (*a*) Telocentric (*b*) Acrocentric (*c*) Sub-metacentric (*d*) Metacentric

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Key Note

- Some chromosomes have non-staining secondary constriction at a constant location which gives the appearance of a small fragment called the **satellite**.

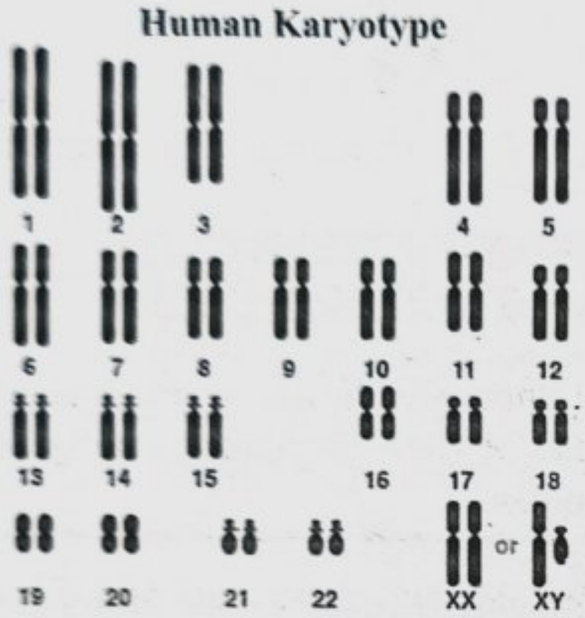
EXTENDED LEARNING

Karyotype chromosomes: A karyotype is an individual's complete set of chromosomes.

The term also refers to a laboratory-produced image of a person's chromosomes isolated from an individual cell and arranged in numerical order.

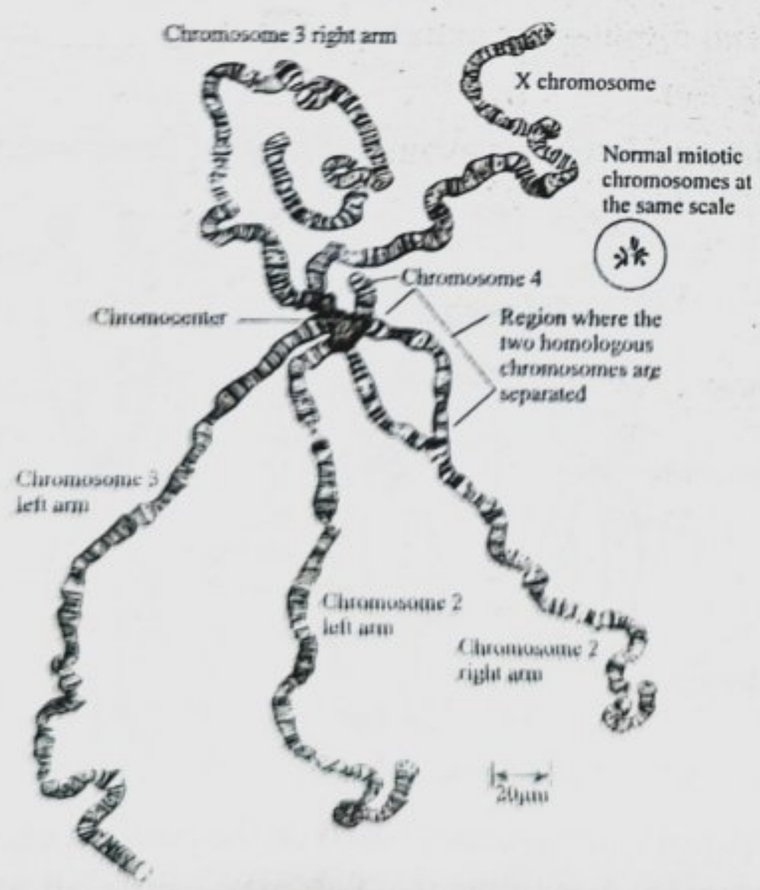
A karyotype may be used to look for abnormalities in chromosome number or structure.

Human Karyotype

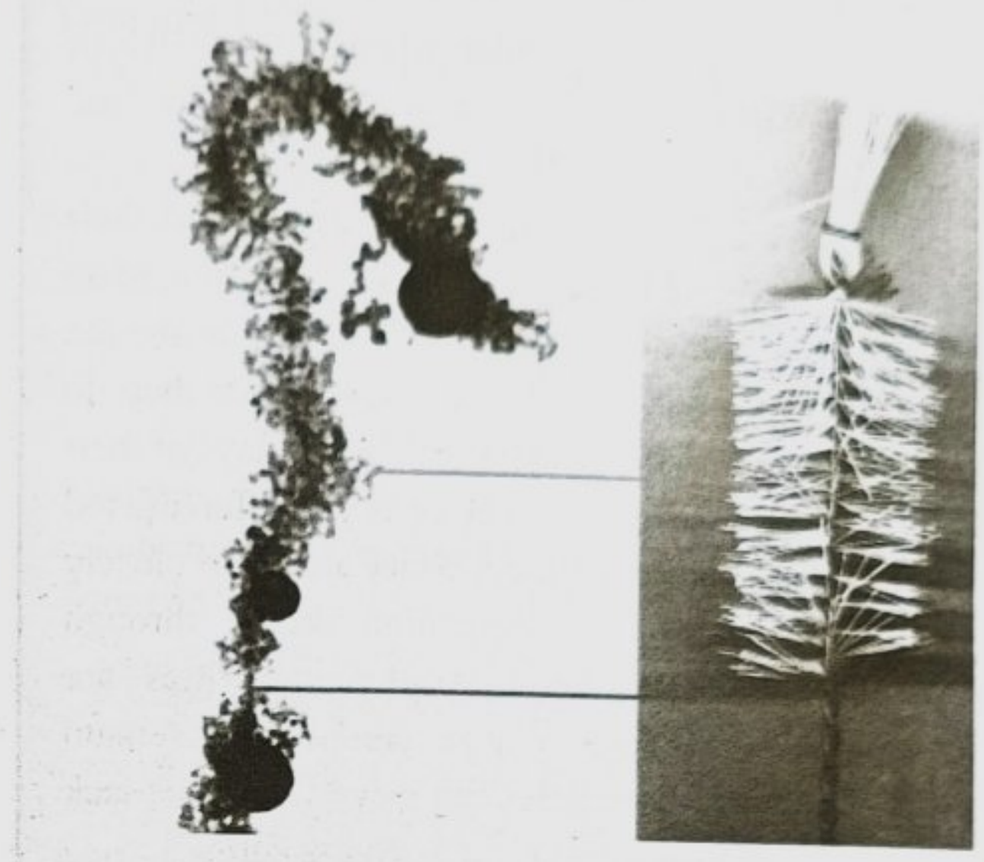


Polytene chromosomes: These are giant chromosomes but relatively smaller than lampbrush chromosomes, found in the larvae of certain dipterans.

Such banded chromosomes occur in the larval salivary glands, midgut epithelium, and rectum and malpighian tubules of various genera (*Drosophila*, *Sciara*).



- **Lampbrush chromosomes**: These are the largest known chromosomes found in the yolk rich oocytic nuclei of certain vertebrates such as fishes, amphibians, reptiles and birds. They can be seen with naked eye and are characterized by fine lateral loops, arising from the chromomeres, during first prophase (diplotene) of meiosis. These loops give it a brush-like appearance; that is why these are called lampbrush chromosomes first discovered by **Flemming** in **1882** and were described in **shark oocytes by Ruckert (1892)**.



Microbodies

- Microbodies are **single membrane** bound small spherical structures. *e.g.*, Perosixomes, Glyoxisome etc.
- Present in both plant and animal cells.
- They contain various enzymes.

Concept Application

Fill in the Blanks:

32. Term chromatin was given by _____.

33. A single human cell has approximately _____ long thread of DNA distributed among its _____ chromosomes.

34. Chromatin is stained with a _____ dye.

35. Metacentric chromosome has _____ centromere forming _____ arms of the chromosome.

36. In _____ Chromosome, centromere is present at the terminal end.

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Difference Between Prokaryotic Cell vs. Eukaryotic Cell

	Prokaryotes	Eukaryotes
Type of Cell	Always unicellular	Unicellular and multi-cellular
Cell size	Ranges in size from 0.2 μm – 2.0 μm in diameter	Size ranges from 10 μm – 100 μm in diameter
Cell wall	Usually present; chemically complex in nature	When present, chemically simple in nature
Nucleus	Absent. Instead, they have a nucleoid region in the cell	Present
Ribosomes	Present smaller in size and spherical in shape	Present comparatively larger in size and linear in shape
DNA arrangement	Circular	Linear
Mitochondria	Absent	Present
Cytoplasm	Present, but cell organelles absent	Present, cell organelles present
Endoplasmic reticulum	Absent	Present
Plasmids	Present	Very rarely found in eukaryotes
Ribosome	Small ribosomes	Large ribosomes
Lysosome	Lysosomes and centrosomes are absent	Lysosomes and centrosomes are present
Cell division	Through binary fission	Through mitosis
Flagella	The flagella are smaller in size and not covered by plasma membrane	The flagella are larger in size and covered by plasma membrane
Reproduction	Asexual	Both asexual and sexual
Example	Bacteria and Archaea	Plant and Animal cell

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SHORT NOTES

Cell

- Cell is the fundamental structural and functional unit of all living organisms.
- **Anton Von Leeuwenhoek** first saw and described a live cell.

Cell Theory

- Cell theory was given by two scientists **Schleiden** and **Schwann.**
- It states that all plants or animals are composed of cells and their products.
- **Rudolf Virchow** explained that new cells arise from pre-existing cells (*Omnis cellula-e cellula*) and finally modified the cell theory as:
  - (*i*) All living organisms are composed of cells and products of cells.
  - (*ii*) All cells arise from pre-existing cells.

An Overview of Cell

- Cells differ greatly in size, shape and activities for example, **Mycoplasma** is smallest cell (0.3μm), Egg of an ostrich is the largest isolated single cell.
- **Cytoplasm** is main arena of cellular activities in both plant and animal cells.

Prokaryotic Cells

- Lack membrane bound nucleus and cell organelles.
- Represented by bacteria, blue-green algae, mycoplasma and PPLO (0.1μm).
- In addition to genomic DNA, many bacteria have small circular DNA outside the genomic DNA called **plasmids**.
- All prokaryotes have a cell wall surrounding the cell membrane (except mycoplasma).
- Most prokaryotic cells have cell envelope which is tightly bound three layered structure i.e., the outermost **glycocalyx** followed by the **cell wall** and then the **plasma membrane.**
- **Mesosomes are** extensions of plasma membrane into the cell. It helps in cell wall formation, DNA replication, distribution of daughter cells, respiration, secretion process and increase the surface area of plasma membrane.
- In cyanobacteria, chromatophores contain pigments.
- Prokaryotic cells have surface structures - **Flagella, pili** and **fimbriae**. Pill and Fimbriae are also surface structures of the bacteria but do not play a role in motility.
- Bacteria may be motile or non-motile. If motile they have flagella, composed of three parts: **Filament** (longest portion), **hook** and **basal body**.
- Bacteria, on the basis of the staining, can be **Gram positive** or **Gram negative.**
- Ribosomes are non-membrane bound organelles.
- Ribosomes are 70S, has subunits 50S and 30S. Several ribosomes may attach to a single mRNA and form a chain called **polyribosome** or **polysome**.
- **Reserve material** is stored in the form of inclusion bodies in prokaryotic cytoplasm. Eg. phosphate granules, cyanophycean granules and glycogen granules.
- **Gas vacuoles** are found in blue-green, purple and green photosynthetic bacteria.

Eukaryotic Cells

- The eukaryotes include all the protists, plants, animals and fungi.
- Besides the nucleus, eukaryotic cells have other membrane bound structure called **organelles** like **ER, Golgi complex** etc.
- Cell membrane is mainly composed of proteins and lipids (**mainly phospholipids**).
- Membrane proteins can be **integral** or **peripheral**.
- Most accepted model for structure of cell membrane is **fluid mosaic model** given by **Singer and Nicolson** (1972).
- Membrane is **selectively permeable.**
- The **quasi-fluid** nature of lipid enables **lateral** movement of proteins within the overall bilayer. This ability to move within the membrane is measured as its fluidity.
- The fluid nature of membrane is important for cell growth, formation of intercellular junctions, secretion, endocytosis, cell division etc.
- Cell wall is a non-living rigid structure forms an outer covering of the plasma membrane in fungi and plants.
- **Primary wall:** Cell wall of a young plant cell is capable of growth which gradually diminishes as the cell matures.
- **Secondary wall:** As cell matures, it is formed on inner side (towards membrane) of the cell.
- **Middle lamella:** It is a layer mainly composed of calcium pectate that holds the different neighbouring cells together.
- **Cell wall of Algae:** Cellulose, galactans, mannans and calcium carbonate.
- **Cell wall of plants:** Cellulose, hemicellulose, pectin and proteins.
- Endomembrane system is made up of ER, GC, lysosomes and vacuole.
- **RER** (Rough endoplasmic reticulum) is involved in protein synthesis and **SER** (Smooth endoplasmic reticulum) is involved in lipid synthesis.
- **Golgi apparatus** has cisternae that perform processing, packaging and transporting the materials for secretions.
- **Lysosomes** contain hydrolytic enzymes

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- **Vacuole** is a single membrane (called **tonoplast**) bound organelle found in the cytoplasm containing water, sap, excretory product and other material not useful for the cell and thus occupy 90% of volume of plant cell.
- Plant cells have large central vacuole.
- Ribosomes are non-membrane bound organelles (80S - cytoplasm and 70S - Mitochondria and chloroplast), involved in protein synthesis.
- Mitochondria is the site of aerobic respiration and produce cellular energy in the form of **ATP**, hence called 'power house of the cell'.
- Each mitochondria is a **double membrane** bound structure
- It contain single circular DNA molecule, a few RNA molecules, ribosomes (70S) and the components required for the synthesis of proteins.
- Plastids are found in all plant cells and in euglenoids.
- **Chloroplast** contain chlorophyll and carotenoid pigments.
- **Leucoplast** are colourless plastids.
- **Amyloplasts** store carbohydrates e.g. Potato, **Elaioplasts** store oils and
- fats whereas the **aleuroplast** store proteins.
- **Chloroplast** are double membrane bound structure
- The stroma of chloroplast contains small, double stranded circular DNA molecules and ribosomes (70 S).
- Cytoskeleton is an elaborate network of filamentous proteinaceous structures present in the cytoplasm. It involves in many functions such as mechanical support, motility and maintenance of the shape of the cell.
- Cilia and Flagella are hair-like outgrowths of the cell membrane.
- The central core in cilia and flagella is **axoneme** having **9 + 2** array of microtubules.
- Both cilium and flagellum arise from centriole like structure called **basal bodies**.
- Centrosome is an organelle usually containing two cylindrical structures called **centrioles**, having 9 + 0 array of microtubules.
- Centrioles form the basal body of cilia or flagella, and spindle fibres that give rise to spindle apparatus during cell division in animal cells.
- Nucleus was discovered by **Robert Brown** and given the name **chromatin** by **Flemming**.
- **Interphase nucleus** has chromatin, nuclear matrix and nucleolus. Nucleus has the membranes and the space between two membranes is perinuclear space.
- The nuclear matrix or the nucleoplasm contains nucleolus and chromatin.
- **Chromatin** contains DNA, some basic histones, some non-histones and some RNA.
- Every chromosome has **primary constriction** called centromere on the sides of which disc-shaped structures called **kinetochores** are present.
- Micro bodies are membrane bound minute vesicles which contain enzymes and are present in both plant and animal cells.

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1. Which of the following pairs is **correctly** matched?

(1) Microtubules – Structural components of cilia

(2) Centrioles – Store hydrolytic enzymes

(3) Amyloplasts – Store oil protein and starch in plants

(4) Passive transport - Na^+/K^+ Pump

Sol. Hydrolytic enzymes are stored in lysosomes. Amyloplasts are responsible for the storage of starch. Na^+/K^+ pump involves active transport.

Therefore, option (1) is the correct answer.

2. Select the **incorrectly** matched pair;

(1)	Inclusion bodies	-	Stores reserve materials in prokaryotes
(2)	Fimbriae	-	Helps bacteria in attachment
(3)	Secondary wall	-	Formed towards membrane
(4)	Quasi-fluid nature of lipids	-	Flip-flop movement of proteins

Sol. The Quasi-fluid nature of lipid enables lateral movement of proteins within the overall lipid bilayer.

Therefore, option (4) is the correct answer.

3. Select the **incorrectly** matched pair;

(1) Camillo Golgi-Golgi bodies

(2) Robert Brown-Nucleus

(3) Flemming-Chromatin

(4) George Palade-Mitochondria

Sol. Ribosomes were discovered by George Palade.

Therefore, option (4) is the correct answer.

4. Choose the option containing the set of structures which are **not** surrounded by any membrane.

(1) Ribosome and mitochondria

(2) Mitochondria and chloroplast

(3) Ribosome and nucleolus

(4) Nucleolus and chloroplast

Sol. Ribosomes and nucleous are non-membrane bound structures whereas mitochondria and chloroplast are bound by double membrane.

Therefore, option (3) is the correct answer.

5. The function of polysome in prokaryotic cell is to:

(1) translate m-RNA into protein.

(2) store reserve food materials.

(3) synthesize pigments.

(4) help in buoyancy.

Sol. Polysome form when several ribosomes are attached to a single m-RNA molecule. It helps in translation of mRNA into a functional protein.

Therefore, option (1) is the correct answer.

6. Read the following statements

I. Membrane proteins can be classified as integral and peripheral on the basis of their location in membrane bilayer.

II. The plasma membrane is selectively permeable to some molecules present on either side of it.

III. The centrioles form the basal body of cilia or flagella, and spindle fibers that give rise to spindle apparatus during cell division in animal cells.

IV. The centrioles in a centrosome lie perpendicular to each other in which each has an organization like the cartwheel.

How many of the above statements are **incorrect**?

(1) One (2) Three

(3) Four (4) Five

Sol. Classification of membrane proteins as integral and peripheral is based on their ease of extraction.

Therefore, option (1) is the correct answer.

7. Read the following statements carefully and choose the option containing **correct** statements.

I. Materials to be packaged in the form of vesicles from the ER fuse with the *cis* face of the Golgi apparatus and move towards the maturing face.

II. Proteins synthesized by endoplasmic reticulum are modified in the cisternae of Golgi apparatus before they are released from its *trans* face.

III. Mitochondria possess a single circular ds DNA molecule, a few RNA molecules, ribosomes (70S) and the components required for the synthesis of proteins.

IV. 'S' (Svedberg's Unit) stands for the sedimentation coefficient; it is indirectly a measure of density and size.

V. Golgi apparatus consist of many flat, disc-shaped sacs or cisternae. These are stacked parallel to each other.

(1) I and IV (2) II and IV

(3) I and III (4) All statements are correct

Sol. All statements are correct.

Therefore, option (4) is the correct answer.

8. Enzymes like lipases, proteases and carbohydrases are found in

(1) Lysosome (2) Golgi bodies

(3) ER (4) Mitochondrion

Sol. Hydrolytic enzymes such as lipases, proteases, and carbohydrases are abundant in lysosomal vesicles.

Therefore, option (1) is the correct answer.

9. What is a tonoplast?

(1) Outer membrane of mitochondria

(2) Inner membrane of chloroplast

(3) Membrane of the vacuole of plant cells

(4) Cell membrane of a plant cell

Sol. The vacuole in a plant cell is separated from the rest of the cell by a single membrane called the tonoplast.

Therefore, option (3) is the correct answer.

10. A cell organelle in prokaryotes is concerned with storage of reserve food materials, e.g., cyanophycean granules, etc. It

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is a non-membrane bound cell organelle. Identify it among the following

(1) Gas vacuoles (2) Mesosomes
(3) Plasmids (4) Inclusion bodies

Sol. Inclusion bodies are non-membrane bound cell organelles that store reserve food materials such as cyanophycean granules.

Therefore, option (4) is the correct answer.

11. What is associated with the name of Schleiden and Schwann?

(1) protoplasm as the physical basis of life
(2) cell theory
(3) theory of cell lineage
(4) nucleus functions as control centre of cell.

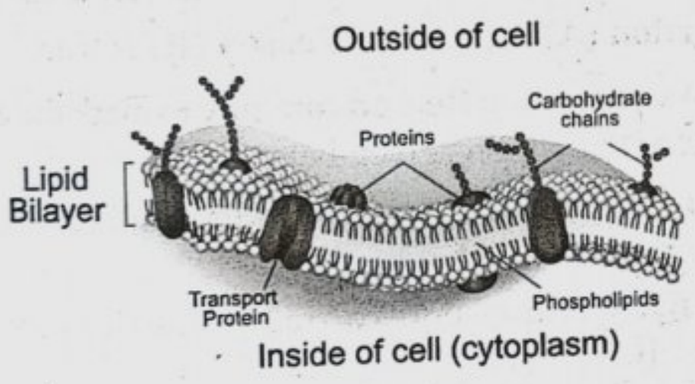
Sol. Names of Schleiden and Schwann were associated with cell theory in 1839. The concept that "All living organisms are composed of cell" is known as cell theory.

Therefore, option (2) is the correct answer.

12. Which of the following statements is **not true** regarding plasma membrane?

(1) It is present in both plant and animal cells.
(2) Lipid is present as a bilayer in it.
(3) Proteins are present in integrated as well as loosely associated with the lipid bilayer.
(4) Carbohydrate is never found in it.

Sol. Plasma membrane is present in both prokaryotic and eukaryotic cells. Also, it is present in both plant as well as animal cells. Plasma membrane is made up of a bilayer of phospholipid.



Types of proteins present

Peripheral proteins are loosely associated and usually lie on the surface of the plasma membrane while the integral proteins are partially or totally buried in the membrane.

Presence of carbohydrates

In a plasma membrane, carbohydrates are associated with lipids and proteins to form glycolipids and glycoproteins respectively. These have an important role in signalling pathways and also act as cell surface markers.

Therefore, option (4) is the correct answer.

13. Plasma membrane consists of:

(1) phospholipids embedded in a protein bilayer
(2) proteins embedded in a phospholipid bilayer
(3) proteins embedded in a polymer of glucose molecules
(4) proteins embedded in a carbohydrate bilayer.

Sol. Plasma membrane consists of lipids (20-79%), proteins (20-70%), carbohydrates (1-5%) and water (20%). Lipid molecules possess both hydrophobic and hydrophilic ends and are thus arranged in the form of lipid bilayer. Most common lipid of the bilayer is phospholipid. Protein molecules occur at places both inside (intrinsic proteins) and on the outer side (extrinsic proteins) of the phospholipid bilayer.

Therefore, option (2) is the correct answer.

14. Which of the following are **not** hydrolytic enzyme?

(1) Lipase (2) Proteases
(3) Carbohydrases (4) Ligases

Sol. Ligases are not hydrolytic enzymes. Hydrolytic enzymes are housed in membrane-enclosed compartments called lysosomes, which are utilized to safely break down macromolecules inside cells. They comprise roughly 40 different kinds of hydrolytic enzymes, including lipases, phospholipases, glycosidases, phosphatases, sulphatases, proteases, and nucleases, carbohydrases

Therefore, option (4) is the correct answer.

15. The high-resolution power of electron microscope is due to:

(1) electromagnetic lenses
(2) very low wavelength of electron beam
(3) low wavelength of light source used
(4) high numerical aperture of glass lenses used.

Sol. Microscopes are used for studying cellular structures. They are used to magnify small objects. In electron microscopes, a high energy beam of electrons is focused through electromagnetic lenses. It can magnify very small details with high resolving power. The increased resolution results from the shorter wavelength of the electron beam.

Therefore, option (2) is the correct answer.

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SCHOOL LEVEL PROBLEMS

SINGLE CORRECT TYPE QUESTIONS

1. Typical plant cell outer covering consists of:
   (1) cell wall externally
   (2) plasma membrane externally
   (3) cell wall internally
   (4) cell wall externally, plasma membrane internally

2. In some bacteria, the outermost layer is a loose sheath layer called as:
   (1) Slime layer (2) Capsule
   (3) Cell membrane (4) Glycocalyx

3. Match the following and select the **correct** answer:

A.	Centriole	I.	Infoldings in mitochondria
B.	Chlorophyll	II.	Thylakoids
C.	Cristae	III.	Nucleic acids
D.	Ribosomes	IV.	Basal body cilia or flagella

   (1) A : IV, B : II, C : I, D : III
   (2) A : I, B : II, C : IV, D : III
   (3) A : I, B : III, C : II, D : IV
   (4) A : IV, B : III, C : I, D : II

4. From the given options which one is **not** the function of cell wall?
   (1) Interaction with outside world
   (2) Provide structural support and shape
   (3) Prevent from bursting and collapsing
   (4) Exchange of nutrition through active transport

5. Which plastid is **not** included as a chromoplast?
   (1) Chloroplast (2) Carotene
   (3) Xanthophylls (4) Anthocyanin

6. The lipids have their polar heads facing.....in plasma membrane.
   (1) outer side (2) inner side
   (3) in the middle (4) stable facing nowhere

7. The leucoplast which stores protein is known as-
   (1) Aleuroplasts
   (2) Chloroplasts
   (3) Amyloplasts
   (4) Elaioplasts

8. Who mentioned that the presence of a cell wall is a unique character of the plant cell?
   (1) Schwann (2) Virchow
   (3) Schleiden (4) Robert Brown

9. From the given membrane proteins which one is partially or totally buried in cell membrane?
   (1) Integral proteins (2) Peripheral proteins
   (3) Both (1) and (2) (4) Glycoproteins

10. Select the **correct** option from List-I and List-II:

	List-I		List-II
A.	Microfilaments	I.	Glycocalyx
B.	Microtubules	II.	Actin
C.	Flagella	III.	Tubulin
D.	Outermost layer of bacteria	IV.	Flagellin

   (1) (A – II) (B – III) (C – IV) (D – I)
   (2) (A – II) (B – II) (C – IV) (D – I)
   (3) (A – II) (B – III) (C – I) (D – III)
   (4) (A – IV) (B – I) (C – III) (D – II)

ASSERTION AND REASON TYPE QUESTIONS

1. Read the **Assertion** and **Reason** carefully to mark the **correct** option out of the options given below:

   Assertion (A): In the membrane, lipid bilayer, lipid are arranged with polar head towards outer side and the hydrophobic tail towards the inner part.

   Reason (R): This ensures that the nonpolar tail of saturated hydrocarbon is protected from aqueous environment

   (1) Both the **Assertion (A)** and the **Reason (R)** are true and the **Reason (R)** is a correct explanation of the **Assertion (A)**.
   (2) Both the **Assertion (A)** and **Reason (R)** are true but the **Reason (R)** is not a correct explanation of the **Assertion (A)**.
   (3) **Assertion (A)** is true but the **Reason (R)** is false.
   (4) **Assertion (A)** is false but **Reason (R)** is true.

2. Read the **Assertion** and **Reason** carefully to mark the **correct** option out of the options given below:

   Assertion (A): The transport occurs in membrane through the carrier proteins.

   Reason (R): The transport carried by carrier proteins is always passive.

   (1) Both the **Assertion (A)** and the **Reason (R)** are true and the **Reason (R)** is a correct explanation of the **Assertion (A)**.
   (2) Both the **Assertion (A)** and **Reason (R)** are true but the **Reason (R)** is not a correct explanation of the **Assertion (A)**.
   (3) **Assertion (A)** is true but the **Reason (R)** is false.
   (4) **Assertion (A)** is false but **Reason (R))** is true.

3. **Assertion (A):** Fluid behaviour characteristics shown by cell membrane.

   Reason (R): A membrane is a mosaic or composite of diverse lipids and proteins.

   (1) Both **Assertion (A)** and **Reason (R)** are true and **Reason (R)** is the correct explanation of **Assertion (A)**.
   (2) Both **Assertion (A)** and **Reason (R)** are true but **Reason (R))** is not the correct explanation of **Assertion (A)**.
   (3) **Assertion (A)** is true but **Reason (R)** is false.
   (4) **Assertion (A)** is false but **Reason (R)** is true.

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4. In the following questions, a statement of **Assertion** is followed by a statement of reason.

Assertion (A): The cell theory given by Schleiden and Schwann modified by Rudolf Virchow.

Reason (R): Cell theory says that all cells arise from pre-existing cells.

(1) Both **Assertion (A)** and **Reason (R)** are true and **Reason (R))** is the correct explanation of **Assertion (A)**.

(2) Both **Assertion (A)** and **Reason (R)** are true but **Reason (R)** is not the correct explanation of **Assertion (A)**.

(3) **Assertion (A)** is true but **Reason (R)** is false.

(4) **Assertion (A)** is false but **Reason (R)** is true.

5. In the following questions, a statement of **Assertion** is followed by a statement of reason, choose the **correct** one-

Assertion (A): Centrosomes and centrioles both are related to each other.

Reason (R): Centrosome usually contains two cylindrical structures called centrioles.

(1) Both **Assertion (A)** and **Reason (R)** are true and **Reason (R)** is the correct explanation of **Assertion (A)**.

(2) Both **Assertion (A)** and **Reason (R)** are true but **Reason (R)** is not the correct explanation of **Assertion (A)**.

(3) **Assertion (A)** is true but **Reason (R)** is false.

(4) **Assertion (A)** is false but **Reason (R)** is true.

VERY SHORT ANSWER TYPE QUESTIONS

1. Which organelle is involved in the formation of lysosomes?
2. What is microscope?
3. What is a nucleoid?
4. What is the outermost layer found in the plant cell?
5. Which organelle is involved in the formation of lysosomes?
6. Cell wall is made up of which component?
7. Plasma membrane is made up of which two components?
8. What is the name of the power house of the cell?
9. What is the other name of cell membrane?
10. What is the name of thread-like structure present in nucleoplasm?

SHORT ANSWER TYPE QUESTIONS

1. What is the function of cell wall?
2. Name the parts of the nucleus and state its function.
3. Name the following which-

   Controls the function of a cell.

   Selectively allows things to get in and out of the cell.

   Transfer characters from parents to offspring.
4. What structural and functional attributes must a cell have to be called a living cell?
5. What are plasmids? Describe their role in bacteria?

LONG ANSWER TYPE QUESTIONS

1. Describe the structure and functions of the organelles stated below:

   (*a*) nucleus

   (*b*) mitochondria

   (*c*) plastid
2. Who proposed cell theory? Also, give its postulates.
3. How are chromatin, chromatid and chromosomes related to each other?
4. What is active transport? Differentiate between active and passive transport.
5. Why are the Golgi bodies found in large numbers in the cells which secrete digestive enzymes?

CASE STUDY BASED QUESTIONS

Case-I:

Read the following and answer any five questions:

In 1838, Matthias Schleiden, a German botanist, examined a large number of plants and observed that all plants are composed of different kinds of cells which form the tissues of the plant. At about the same time, Theodore Schwann (1839), a British Zoologist, studied different types of animal cells and reported that cells had a thin outer layer which is today known as the 'plasma membrane'. He also concluded, based on his studies on plant tissues, that the presence of cell wall is a unique character of the plant cells. On the basis of this, Schwann proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.

Schleiden and Schwann together formulated the cell theory. This theory however, did not explain as to how new cells were formed. Rudolf Virchow (1855) first explained that cells divided and new cells are formed from pre-existing cells (Omnis cellula-e cellula). He modified the hypothesis of Schleiden and Schwann to give the cell theory a final shape. Cell theory as understood today is: (i) all living organisms are composed of cells and products of cells. (ii) All cells arise from pre-existing cells.

1. Identify the **incorrect** statement

   Statement-I: Theodore Schwann reported the presence of cell membrane

   Statement-II: Rudolf Virchow gives the cell theory a final shape.

   Statement-III: New cells arise from pre-existing cells.

   Statement-IV: Living organisms are composed of cells and products of cells.

   (1) Statement-I and Statement-III are incorrect

   (2) Statement-II and Statement-III are incorrect

   (3) Statement-IV is incorrect

   (4) All statements are correct

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2. _____ proposed the theory, which states that the bodies of animals and plants are composed of cells and products of cells.

(1) Antony Von Leeuwenhoek

(2) Matthias Schleiden (1838)

(3) Rudolf Virchow (1855)

(4) Theodore Schwann (1839)

3. Give the name of scientist who stated that the animal cell had a thin outer layer.

4. Who was the first to explain that new cells arise from pre-existing cells and gave final shape to cell theory?

5. What is mean by "*Omnis cellula-e cellula*"?

6. Explain cell theory and give its postulates.

Case-II:

Read the following passage and answer the given questions:

Studies showed that the cell membrane is mainly composed of lipids and proteins. The major lipids are phospholipids that are arranged in a bilayer. Also, the lipids are arranged within the membrane with the polar head towards the outer sides and the hydrophobic tails towards the inner part. This ensures that the nonpolar tail of saturated hydrocarbons is protected from the aqueous environment. In addition to phospholipids membrane also contains cholesterol.

The ratio of protein and lipid varies considerably in different cell types. In human beings, the membrane of the erythrocyte has approximately 52 per cent protein and 40 per cent lipids.

Depending on the ease of extraction, membrane proteins can be classified as integral and peripheral. Peripheral proteins lie on the surface of membrane while the integral proteins are partially or totally buried in the membrane.

One of the most important functions of the plasma membrane is the transport of the molecules across it. The membrane is selectively permeable to some molecules present on either side of it. Many molecules can move briefly across the membrane without any requirement of energy and this is called the passive transport. Neutral solutes may move across the membrane by the process of simple diffusion along the concentration gradient, i.e., from higher concentration to the lower. Water may also move across this membrane from higher to lower concentration. Movement of water by diffusion is called osmosis. As the polar molecules cannot pass through the nonpolar lipid bilayer, they require a carrier protein of the membrane to facilitate their transport across the membrane. A few ions or molecules are transported across the membrane against their concentration gradient, i.e., from lower to the higher concentration. Such a transport is an energy dependent process, in which ATP is utilised and is called active transport, e.g., Na+/K+ Pump.

1. _____ is the major constituent of the cell membrane.

(1) Phospholipids (2) Lipoproteins

(3) Proteins (4) Carbohydrates

2. The lipids arranged within membrane in such way, that the polar head of lipids towards the _____ sides and the hydrophobic tails towards the _____ side.

(1) inner, outer (2) outer, inner

(3) outer, outer (4) inner, inner

3. In cell membrane, the tail of phospholipid is _____.

(1) Polar and hydrophilic

(2) Non-polar and hydrophilic

(3) Polar and hydrophobic

(4) Non-polar and hydrophobic

4. Define simple diffusion.

5. Give the classification of membrane protein.

6. What is the ratio of protein and lipid present in cell membrane of erythrocyte?

PRARAMBH EXERCISE-1 (TOPICWISE)

AN OVERVIEW OF CELL AND CELL THEORY

1. Plant cell differs from animal cell in the:

(1) presence of vacuoles.

(2) presence of cell wall and chloroplast.

(3) absence of cell wall.

(4) absence of chloroplast.

2. Cell was discovered by:

(1) Swanson (2) Leeuwenhoek

(3) Robert Hooke (4) Robert Brown

3. Cells having membrane bound nucleus are known as:

(1) Prokaryotic cell (2) Eukaryotic cell

(3) Mesophyll cell (4) Both (1) and (2)

4. Which of the following cell has a diameter of 7 micrometre?

(1) Erythrocyte (2) Monocyte

(3) Neuron (4) Blood platelets

5. Theodore Schwann named the outer layer of the cell which is today known as

(1) Tonoplast (2) Cell membrane

(3) Basement membrane (4) Biological membrane

6. *Omnis cellula-e cellula* is a generalisation given by:

(1) Lamarck (2) Dutrochet

(3) Leeuwenhoek (4) Virchow

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7. The main arena of cellular activities in plant and animal cells is:
(1) Cell membrane (2) Mitochondria
(3) Cytoplasm (4) Ribosome

8. Which of the following is present in both prokaryotes and eukaryotes?
(1) Golgi complex (2) Mitochondria
(3) Chloroplast (4) Plasma membrane

9. Who proposed the theory that states the cells arise only from the pre-existing cells?
(1) Mohl (2) Virchow
(3) Haeckel (4) Brown

10. Cell theory states that:
(1) all cells arise from pre-existing cells.
(2) all living organisms are composed of cells and products of cells.
(3) all cells are living.
(4) both (1) and (2).

11. Which of the following is the largest isolated single cell?
(1) Nerve cell (2) Mycoplasma
(3) Ostrich egg (4) RBCs

12. The simplest way to distinguish a prokaryotic from a eukaryotic cell is to check for:
(1) a plasma membrane (2) a nucleus
(3) DNA (4) proteins

13. All plants are composed of different kind of cells. This statement belongs to:
(1) Lamarck (2) Von Helmont
(3) Hugo de Vries (4) Schleiden

14. The shape of human red blood cell is:
(1) round and biconcave. (2) flat and thread like.
(3) irregular. (4) round and oval.

PROKARYOTIC CELLS

15. Cell envelope of prokaryotes consists of:
(1) Glycocalyx (2) Cell wall
(3) Cell membrane (4) All of these

16. The genetic material of prokaryotic cells is called:
(1) Nucleus (2) Nucleolus
(3) Nucleoid (4) Centrosome

17. Polysomes have two components. One is ribosome while another is:
(1) ER (2) mRNA
(3) Golgi bodies (4) Mitochondria

18. Which of the following is **NOT** a function of mesosomes?
(1) Respiration
(2) DNA replication
(3) Increases enzymatic content
(4) Reproduction

19. Larger subunit of prokaryotic ribosome is:
(1) 30 S (2) 40 S (3) 50 S (4) 60 S

20. Which of the following structures is **NOT** found in a prokaryotic cell?
(1) Nuclear envelope (2) Ribosome
(3) Mesosome (4) Plasma membrane

21. Gas vacuoles are found in:
(1) Blue-green photosynthetic bacteria
(2) Purple and green photosynthetic bacteria
(3) Both (1) and (2)
(4) All bacteria

22. Prokaryotic cell does not have:
(1) Nucleolus
(2) Membrane bound organelles
(3) Centrioles
(4) All of these

23. Several ribosomes may attach to a single mRNA and form a chain called:
(1) Polysome (2) Polyribosome
(3) Phagosome (4) Both (1) and (2)

24. In prokaryotes, chromatophores are:
(1) specialised granules responsible for food storage within the cells.
(2) structures responsible for organizing the shape of the organism.
(3) inclusion bodies lying free inside the cells for carrying out various metabolic activities.
(4) membranous extension into the cytoplasm which contain pigments.

25. The genetic material in prokaryotes is:
(1) basically naked.
(2) associated with acidic proteins.
(3) enveloped by a nuclear membrane.
(4) plasmid.

26. In a prokaryotic cell,
A. Enveloped genetic material is present
B. Ribosomes are absent
C. An organised nucleus is absent.
The **correct** option is
(1) Only A (2) Only B
(3) Only C (4) All of these

27. **Correct** sequence of layers of bacterial cell envelope is:
(1) Cell membrane → Glycocalyx → Cell wall
(2) Glycocalyx → Cell wall → Cell membrane
(3) Cell wall → Glycocalyx → Cell membrane
(4) Glycocalyx → Cell membrane → Cell wall

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28. The longest portion of the bacterial flagellum that extends from the cell surface to the outside is called:
(1) Filament (2) Hook
(3) Basal body (4) Shaft

29. Which layer of the cell envelope determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting or collapsing?
(1) Cell wall (2) Cell membrane
(3) Glycocalyx (4) Capsule

30. Prokaryotic ribosomes are:
(1) 50 S (2) 60 S (3) 70 S (4) 80 S

31. Mesosomes are the infolding of cell membrane. They,
(1) help in cell wall formation, DNA replication and respiration.
(2) increases the surface area of plasma membrane.
(3) are present in both prokaryotic and eukaryotic cells.
(4) both (1) and (2).

32. Many bacteria have small circular DNA outside the genomic DNA. These smaller DNA are called:
(1) Phasmids (2) Plastids
(3) Plasmids (4) Prophage

33. The best way to identify a cell as either plant cell or animal cell is to determine whether:
(1) it came from a single-celled or multicellular organism.
(2) it has a cell wall.
(3) it has a plasma membrane.
(4) it has cytosol.

34. Which of the following is seen only in prokaryotic cell?
(1) Lysosome (2) Ribosome
(3) Mesosome (4) ER

35. Bacteria show a range in the number of arrangement of flagella. Bacterial flagellum is composed of
(1) Two parts – pili and fimbriae
(2) Three parts – filament, hook and basement membrane
(3) Three parts – filament, shaft and basal body
(4) Three parts – filament, hook and basal body

36. Which of the following structures would you expect to find in a bacterium?
(1) Nucleus (2) Plasma membrane
(3) Golgi apparatus (4) Lysosome

37. The term "Glycocalyx" is used for:
(1) a layer surrounding the cell wall of bacteria.
(2) a layer present between cell wall and plasma membrane of bacteria.
(3) cell wall of bacteria.
(4) bacterial cell genetically engineered to possess N-glycosylated proteins.

38. A capsule in bacteria is related to
(1) Glycocalyx (2) Cell wall
(3) Plasma membrane (4) None of these

39. Select one which is **not true** for ribosome
(1) Made up of two sub-units
(2) Form polysome
(3) May attach to mRNA
(4) Have no role in protein synthesis

EUKARYOTIC CELLS

40. A plant cell has:
(1) a large central vacuole and rigid cell wall.
(2) a centriole for cell division.
(3) a centrosome inactive in non-dividing cells.
(4) absence of cell membrane.

41. How many of the following cell organelles are found only in animal cells and not in plant cell?
A - Cell wall B - Centriole
C - Chloroplast D - Mitochondria
E - 80S ribosomes
(1) 1 (2) 2 (3) 3 (4) 4

42. Cell membranes posses lipid, protein and carbohydrate. The ratio of protein and lipid varies considerably in different cell types. In human beings, the membrane of the RBCs has approximately
(1) 40 percent lipids and 52 percent carbohydrates
(2) 40 percent protein and 52 percent lipids
(3) 40 percent lipids and 52 percent proteins
(4) 40 percent protein and 52 percent carbohydrates

43. Which of the following limits the movement of molecules when carrier-mediated facilitated diffusion is involved?
(1) ATP
(2) Availability of carrier molecules
(3) Na^+/K^+ pump
(4) Both (1) and (2)

44. The fluid nature of the membrane is important from the point of view of functions like:
(1) cell division and cell growth
(2) endocytosis and secretion
(3) formation of intercellular junctions
(4) All of these

45. Which of the following is **not a** characteristic of the fluid mosaic model for biological membranes?
(1) Fluidity
(2) Integral proteins are absent
(3) Lateral movement of proteins
(4) Lipids are present as bilayer

46. What is true regarding fluid mosaic model?
(1) Phospholipid monolayer is present over protein layer
(2) Phospholipid bilayer is present over protein layer
(3) Protein embedded in phospholipid bilayer
(4) Phospholipid layer is sandwiched between two protein layers

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47. Depending on the ease of extraction, membrane proteins can be classified as:
(1) saturated and unsaturated.
(2) hydrophilic and hydrophobic.
(3) integral and peripheral.
(4) acidic, basic and neutral.

48. Which of the following macromolecules are found in the plasma membrane?
(1) Lipids only
(2) Lipids and proteins
(3) Lipids, proteins and carbohydrates
(4) Proteins and carbohydrates

49. Molecules which are transported across the membrane against their concentration gradient, i.e., from the lower to higher concentration. Such a transport is called
(1) Active transport, e.g., diffusion
(2) Passive transport, e.g., diffusion
(3) Active transport, e.g., Na^+/K^+ pump
(4) Osmosis, a type of simple diffusion

50. Which of the following is present in both prokaryotic and plant cells?
(1) Lysosome (2) Chloroplast
(3) Cell wall (4) Mitochondrion

51. A structure that connect the cytoplasm of neighbouring cells, and another which holds or glues the different neighbouring cell together. These are:
(1) cell wall and middle lamella, respectively
(2) plasmodesmata and middle lamella, respectively
(3) middle lamella and desmosomes, respectively
(4) middle lamella and plasmodesmata, respectively

52. The cell wall of a young plant cell, the primary wall is capable of growth, which gradually diminishes as the cell matures and the secondary wall is formed on the:
(1) inner (towards middle lamella) side of the cell.
(2) outer (towards middle lamella) side of the cell.
(3) inner (towards membrane) side of the cell.
(4) outer (towards membrane) side of the cell.

53. Which of the following layer is present nearest to plasma membrane in plant cell?
(1) Tonoplast (2) Middle lamella
(3) Primary wall (4) Secondary wall

54. The cell are held together by a Ca-pectate layer called:
(1) Primary cell wall (2) Secondary cell wall
(3) Middle lamella (4) Tertiary cell wall

55. The most abundant substance of middle lamella is:
(1) Suberin (2) Cutin
(3) Lignin (4) Pectin

56. In most of the plants, cell wall is made up of:
(1) Cellulose (2) Hemicellulose
(3) Pectins and proteins (4) All of these

57. Function(s) of the cell wall is/are:
(1) Provide shape of the cell and protects the cell from the mechanical damage and infection
(2) Helps in cell-to-cell interaction
(3) Provides barrier to undesirable macromolecules
(4) All of these

58. Energy releasing reaction in a cell occurs in:
(1) Cell wall (2) Ribosomes
(3) Mitochondria (4) Golgi bodies

59. Foldings of inner mitochondrial membrane are called
(1) Cristae (2) F_0 - F_1 structures
(3) Thylakoids (4) Grana

60. Organelles which are regarded as 'power house' of the cell is:
(1) Chloroplast (2) Ribosomes
(3) Endoplasmic reticulum (4) Mitochondria

61. Both chloroplasts and mitochondria:
(1) have more than one membranes.
(2) have 70S ribosomes.
(3) are found only in eukaryotic cells.
(4) All of these.

62. Cristae are found in:
(1) surface of grana.
(2) surface of plasma membrane.
(3) wall of mitochondria.
(4) nuclear membrane.

63. Which of the following colorless plastids are involved in storage of fat?
(1) Aleuroplast (2) Amyloplasts
(3) Elaioplast (4) Oleosomes

64. Stacks of membranous flattened discs in chloroplasts are termed as:
(1) Cisternae (2) Thylakoids
(3) Grana (4) Cristae

65. Which of the following stores carbohydrates?
(1) Aleuroplast (2) Amyloplast
(3) Leucoplast (4) Elaioplast

66. The number of chloroplast varies form 1 per cell in ___**A**___ to _____**B**_____ per cell in the mesophyll.
(1) A—*Chlorella*, B—15 to 20
(2) B—*Chlamydomonas*, B—20 to 40
(3) A—*Chlamydomonas*, B—15 to 20
(4) A—*Chlamydomonas*, B—10 to 40

67. Which of following **is not** common in chloroplasts & mitochondria?
(1) Both are present in animal cells
(2) Both contain their own genetic material
(3) Both are present in eukaryotic cells
(4) Both are present in plant cells

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68. The membrane of the thylakoids encloses a space called:
(1) Lumen (2) Stroma
(3) Matrix (4) Grana

69. The bright colours of ripen fruits are due to:
(1) Leucoplasts (2) Chloroplasts
(3) Amyloplasts (4) Chromoplasts

70. A number of organised flattened membranous sacs found inside a plastid is
(1) Thylakoid (2) Stroma
(3) Cristae (4) Oxysome

71. Cell organelle that store proteins is
(1) Elaioplast (2) Aleuroplast
(3) Amyloplast (4) Leucoplast

72. Which is **NOT** a plastid?
(1) Chloroplast (2) Mitoplast
(3) Chromoplast (4) Leucoplast

73. Which of the following plastids are helpful in starch storage?
(1) Chromoplast (2) Leucoplasts
(3) Chloroplast (4) Lycopene

74. Based on the type of pigments, plastids can be classified into
(1) Amyloplasts, elaioplasts and aleuroplasts
(2) Chlorophyll, carotenoid and xanthophyll
(3) Chloroplasts, chromoplasts and leucoplasts
(4) All of these.

75. Majority of the chloroplasts of the green plants are found in the
(1) Mesophyll cells (2) Bundle sheath cells
(3) Cortical cells (4) Epidermal cells

76. Which of the following substances are stored in aleuroplast?
(1) Starch (2) Oil and Lipids
(3) Proteins (4) Water and Oil

77. Which face of Golgi complex is associated with ER?
(1) Forming face, i.e., *Trans*-face
(2) Maturing face, i.e., *Trans*-face
(3) Both forming and maturing face
(4) Forming face or *Cis*-face

78. Rough E.R. mainly responsible for
(1) Protein synthesis (2) Cell wall formation
(3) Lipid synthesis (4) Cholesterol synthesis

79. An interconnected membranous network of the cell composed of vesicles, flattened sacs and tubules is
(1) Mitochondria (2) Endoplasmic reticulum
(3) Lysosomes (4) Nucleus

80. Which structures are responsible for synthesis of lipid like-steroidal hormones in animal cells?
(1) Smooth ER (2) Smooth and rough ER
(3) Sphaerosomes (4) Golgi bodies

81. From the given options choose the two organelles that look most alike structurally
(1) Nucleus and vesicle
(2) ER and mitochondrion
(3) Golgi apparatus and smooth ER
(4) Vacuole and cytoskeleton

82. Golgi apparatus:
(1) modifies and packages proteins.
(2) is important for osmoregulation and excretion.
(3) is found in prokaryotes.
(4) is site for rapid ATP synthesis.

83. Which is a part of endomembrane system of eukaryotic cells?
(1) Mitochondria (2) Peroxisomes
(3) Chloroplasts (4) Golgi bodies

84. Golgi body is associated with:
(1) packaging of material.
(2) protein synthesis.
(3) secretion of different substance.
(4) both (1) and (3).

85. Hydrolytic enzymes are abundantly found in which cell organelles?
(1) Ribosome (2) Lysosome
(3) Oxysome (4) Endoplasmic reticulum

86. What would happen if lysosomes get ruptured inside the cells in which they are present?
(1) Cells will swell (2) Cells will shrink
(3) Cells will die (4) Nothing would happen

87. Lysosomes contain:
(1) carboxylating enzymes (2) respiratory enzymes
(3) oxidising enzymes (4) hydrolytic enzymes

88. Cell organelle connected with intracellular digestion of macromolecules is
(1) Lysosome (2) Peroxisome
(3) Polysome (4) Glyoxisome

89. 70S type of ribosome is found in:
(1) Prokaryotic cells
(2) Prokaryotic cells, chloroplasts and mitochondria
(3) Mitochondria
(4) Nucleus, mitochondria

90. In 70S and 80S ribosomes, 'S' stands for:
(1) sedimentation coefficient and called svedberg unit.
(2) sedimentation rate and called svedberg unit.
(3) svedberg coefficient and called sedimentation unit.
(4) svedberg unit and called sedimentation rate.

91. Sedimentation coefficient(s) indirectly is a measure of:
(1) density (2) size
(3) volume (4) both (1) and (2)

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92. Plastid differs from mitochondria on the basis of one of the following features. Mark the right answer'
(1) Presence of two layers of membrane
(2) Presence of ribosome
(3) Presence of thylakoids
(4) Presence of DNA

93. Which of the following is **NOT** a membrane bound organelle?
(1) Lysosome (2) Ribosome
(3) Chloroplast (4) Mitochondria

94. Centrioles and centrosomes are present in cells of
(1) Bacteria (2) Cyanobacteria
(3) Green plants (4) Animals

95. Each centriole has a cartwheel organisation having a whorl of 9 peripheral fibrils, can be represented with
(1) 9 singlet + 0 central
(2) 9 doublet + 0 central
(3) 9 triplet + 2 central singlet
(4) 9 triplet + 0 central

96. Organelle important in spindle formation during nuclear division is:
(1) Centriole (2) Golgi body
(3) Chloroplast (4) Mitochondrion

97. The central proteinaceous part of proximal region of the centriole is called:
(1) Radial spoke (2) Hub
(3) Central sheath (4) Axoneme

98. The principal protein found in centrioles is:
(1) Tubulin (2) Nexin
(3) Basal body (4) Pilin

99. Cilium and flagellum emerge from centriole-like structure called:
(1) Centrosome (2) Kinetochore
(3) Basal body (4) Centromere

100. Membrane covering the vacuole is termed as:
(1) Cell wall
(2) Plasmalemma
(3) Cell membrane
(4) Tonoplast

101. Membrane bound minute vesicles that contain various enzymes are present in both plant and animal cells called
(1) Chloroplasts (2) Centrosome
(3) Microbodies (4) Mesosomes

102. Microtubules are responsible for:
(1) holding membrane proteins
(2) controlling cleavage and cyclosis
(3) conversion of fat to carbohydrate
(4) formation of cilia and flagella

103. Which of the following provides mechanical support and shape to the cell?
(1) Golgi complex (2) Centrioles
(3) Ribosomes (4) Cytoskeleton

104. Which of the following pairs lack the unit membrane?
(1) Nucleus & E.R.
(2) Mitochondria & chloroplast
(3) Ribosome & nucleolus
(4) Golgi body & lysosome

105. Which of the following organelles is directly connected to the outer membrane of the nucleus in a eukaryotic cell?
(1) Mitochondrion (2) Lysosome
(3) Golgi apparatus (4) Endoplasmic reticulum

106. Extra chromosomal DNA occurs in
(1) Mitochondria (2) Ribosomes
(3) Nucleus (4) Chromosomes

107. A chromosome having terminal centromere is called
(1) Telocentric (2) Acrocentic
(3) Metacentric (4) Sub-metacentric

108. Chromosome having centromere in its middle is:
(1) Acrocentric (2) Telocentric
(3) Metacentric (4) Sub-metacentric

109. DNA occurs in:
(1) Mitochondria, Plastids and Chromosomes
(2) Chromosomes, Mitochondria and Ribosomes
(3) Chromosomes, Mitochondria and Cell membrane
(4) Chromosomes, Ribosomes and Cytoplasm

110. Within nucleus, DNA is organised along with proteins into material called:
(1) Nuclear lamina (2) Chromosome
(3) Chromatid (4) Chromatin

111. Which structure is present in chromosomes?
(1) Nucleus (2) Centromere
(3) Centrosome (4) Golgi body

112. rRNA is synthesised in:
(1) E.R. (2) Nucleus
(3) Nucleolus (4) Cytoplasm

113. The function of nucleous is the synthesis of:
(1) DNA (2) m-RNA
(3) r-RNA (4) t-RNA

114. Which of the following is/are the nucleoprotein structure(s)?
(1) Chromatin (2) DNA
(3) Centromere (4) All of these

115. In which type of chromosome, one arm is very long and one arm is very short?
(1) Acrocentric (2) Metacentric
(3) Sub-metacentric (4) Telocentric

116. Where in a eukaryotic cell can DNA be found?
(1) Nucleus (2) Mitochondrion
(3) Chloroplast (4) All of these

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117. Which of the following organelles are double membrane-bound?

(1) Nucleus (2) Chloroplast
(3) Mitochondria (4) All of these

118. Satellite means:

(1) terminal part of the chromosome beyond secondary constriction.
(2) terminal part of the chromosome beyond primary constriction.
(3) terminal part of chromosome beyond tertiary constriction.
(4) none of these

119. Who proposed the fluid mosaic model of plasma membrane?

(1) Camillo Golgi
(2) Schleiden and Schwann
(3) Singer and Nicolson
(4) Robert Brown

120. In terms of shape and size of mitochondria, considerable degree of variability is observed. The number of mitochondria per cell is variable depending on the

(1) Morphology of the cells
(2) Biochemical activity of the cells
(3) Physiological activity of the cells
(4) All of these

PRABAL EXERCISE-2 (LEARNING PLUS)

1. Different cells have different sizes. Arrange the following cells in an ascending order of their size. Choose the **correct** option among the followings.

I. Mycoplasma II. Ostrich eggs
III. Human RBC IV. Bacteria

(1) I, IV, III, II (2) I, II, III, IV
(3) II, I, III, IV (4) III, II, I, IV

2. Which of the following features is common to prokaryotes and many eukaryotes?

(1) Chromatin material present
(2) Cell wall present
(3) Nuclear membrane present
(4) Membrane bound sub-cellular organelles present

3. Reserve material in prokaryotic cells are stored in the cytoplasm in the form of

(1) Pyrenoid
(2) Paramylum bodies
(3) Inclusion bodies which are bounded by single membrane
(4) Inclusion bodies which are not bounded by any membrane system

4. How many of the given cell organelles are found only in prokaryotic cells?

[Vacuoles, Mesosomes, Ribosomes, Chloroplast, Cell wall, Mitochondria]

(1) 1 (2) 2 (3) 3 (4) 4

5. Bacterial cells have a chemically complex cell envolope. The cell envelope consists of a tightly bound three layer structure, i.e., the

(1) Outermost cell wall followed by the plasma membrane and then the glycocalyx
(2) Outermost glycocalyx followed by plasma membrane and the cell wall
(3) Outermost cell wall followed by the glycocalyx and then the plasma membrane
(4) Outermost glycocalyx followed by the cell wall and then the plasma membrane

6. A common characteristic feature of plant sieve tube cells and most of mammalian erythrocytes is

(1) Absence of mitochondria
(2) Presence of cell wall
(3) Presence of haemoglobin
(4) Absence of nucleus

7. Which of the following is **NOT** true for a eukaryotic cell?

(1) ER is the important site of formation glycoproteins and glycolipids
(2) It has 80S type of ribosome present in the cytoplasm
(3) Mitochondria contain circular DNA
(4) Membrane bound organelles are present

8. Which of the following statement is **NOT** true for plasma membrane?

(1) It is present in both plant and animal cell
(2) Lipid is present as a bilayer in it
(3) Proteins are present integrated as well as loosely associated with the lipid bilayer
(4) Carbohydrate is never found in it

9. Phospholipid molecules of cell membrane possess

(1) Polar head and polar tail
(2) Non-polar head and non-polar tail
(3) Polar head and non-polar tail
(4) Non-polar head and polar tail

10. A student placed two cells in the same solution in two different containers. The observation was given in the table.

Container	Observation
1.	Cell burst
2.	Cell does not change its shape

Which structure maintains the shape of the cell present in container 2 and provides the most significant difference between the two cells?

(1) Nucleus
(2) Cell wall
(3) Chloroplast
(4) Cell membrane

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11. If living cells similar to those found on earth, were found on another planet where there was no oxygen. Which cell organelle would most probably be absent?
(1) Cell membrane (2) Ribosome
(3) Mitochondria (4) Chromosomes

12. Which of the following features are **true** regarding ribosomes?
A. Non-membrane bound structure
B. Involved in protein synthesis
C. Found in the cytoplasm and RER
D. Absent in plastids and mitochondria
The correct option is
(1) Only A (2) A and B
(3) A, B and C (4) All of these

13. A cell organelle '*X*' is divided into two types on the basis of a cell organelle '*Y*', that helps in the protein synthesis. Identify '*X*' and '*Y*' respectively.
(1) Golgi complex and ribosome
(2) SER and mitochondria
(3) ER and ribosome
(4) Lysosome and ER

14. How many of the following properties are related to lysosomes?
[Membrane bound vesicular structure, hydrolases, basic pH, formed in the RER, capable of digesting nucleic acids]
(1) Two (2) Three
(3) Four (4) Five

15. If A - 70S ribosomes, B - 80S ribosomes, C - single circular DNA, D - RNA molecules, E - double helical linear DNA, F - thylakoids and G - stroma lamellae, which of the following set is found is mitochondria?
(1) B, D, E, F (2) D, E, F, G
(3) A, D, E (4) A, C, D

16. Read the following statements carefully and find out whether they are **true or false.**
I. Lysosomes are reservoirs of hydrolytic enzymes.
II. Chromatin contains DNA and Histones.
III. Animal cells differ from plant cells in possessing a large central vacuole.
IV. Nucleolus is not a membrane bound structure.
(1) I-T, II-F, III-T, IV-T (2) I-T, II-T, III-T, IV-T
(3) I-T, II-T, III-F, IV-T (4) I-F, II-T, III-T, IV-T

17. Given below are some characters of a cell organelle. Identify the organelle which shows all the characters described above
I. It is a membrane bound space found in the cytoplasm.
II. It is bound by a single membrane called tonoplast.
III. It contains water, sap, excretory products and other materials not useful to the cell.
IV. It has higher concentration of ions than the cytoplasm.
(1) Golgi apparatus
(2) Lysosome
(3) Endoplasmic reticulum
(4) Vacuole

18. **Fill in the blanks**
I. In plant cells, the vacuoles can occupy up to ___A___ of the volume of the cell.
II. In plants, the tonoplast facilitates the transport of a number of ions and other materials ___B___ in concentration gradient into the vacuole, hence their concentration is significantly ___C___ in the vacuole than in the cytoplasm.
III. In *Amoeba*, the ___D___ vacuole is important for excretion.
IV. In many cells, as in protists ___E___ vacuoles are formed by engulfing the food particles.
(1) A-70%, B-along, C-higher, D-food, E-contractile
(2) A-70 to 90%, B-against, C-higher, D-contractile, E-food
(3) A-90%, B-against, C-lower, D-contractile, E-inclusion
(4) A-90%, B-against, C-higher, D-contractile, E-food

19. Axonemal arrangement of microtubules is
(1) 6 peripheral doublets and one central pair of microtubule
(2) 6 peripheral doublets and one central microtubule
(3) 9 peripheral doublets and one central pair of microtubules
(4) 9 peripheral pairs of doublets and one central microtubule

20. **Fill in the blanks**
I. Centrioles are ___A___ structures that lie ___B___ to each other.
II. Centrioles have an organisation like ___C___.
III. Centrioles are made up of nine evenly spaced peripheral fibrils of ___D___ protein.
IV. Each peripheral fibril of centriole is ___E___.
V. Central part of the proximal region of the centriole is called ___F___ which is proteinaceous.
(1) A-spherical, B-parallel, C-cartwheel, D-flagellin, E-doublet, F-bridge.
(2) A-cylindrical, B-perpendicular, C-cartwheel, D-tubulin, E-triplet, F-hub.
(3) A-cylindrical, B-perpendicular, C-cartwheel, D-tubulin, E-doublet, F-hub.
(4) A-spherical, B-perpendicular, C-cartwheel, D-tubulin, E-triplet, F-hub.

21. You are asked to examine a cell using a powerful light microscope. The image you see has a clearly defined nucleus and mitochondria. It also has a large central vacuole and chloroplasts. From what group of organisms did this cell most likely come?
(1) Bacteria (2) Protists
(3) Animal (4) Plants

22. According to fluid mosaic model (proposed by Singer & Nicolson), plasma membrane is composed of
(1) Cellulose, hemicellulose
(2) Phospholipid and integrated protein
(3) Phospholipid, integral protein and peripheral protein
(4) Phospholipid and hemicellulose

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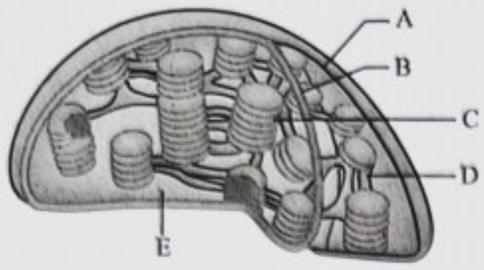
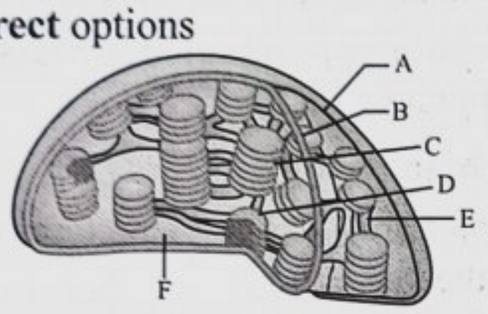
23. Consider the following five statements **(A to E)** w.r.t chloroplast shown below. Select the **correct** option stating which ones are True **(T)** and which ones are False **(F)**



A. It is relatively less permeable than B
B. The space limited by B is called stroma
C. It is arranged in stacks like the piles of coins
D. It is flat membranous tubules that connects the C of the different thylakoids.
E. It contains enzymes for synthesis of carbohydrates and proteins

	A	B	C	D	E
(1)	F	T	T	T	T
(2)	F	T	T	F	T
(3)	T	F	T	T	T
(4)	T	F	F	T	T

24. Identify **correct** options



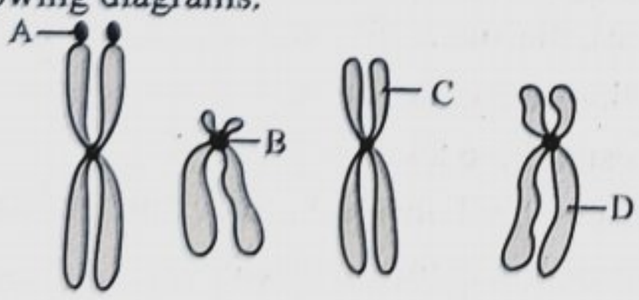
(1) A = Outer membrane, C = Granum, F = Stroma
(2) B = Inner membrane, C = Stroma, F = Stroma lamellae
(3) A = Outer membrane, D = Thylakoid, E = Stroma
(4) B = Inner membrane, C = Thylakoid, F = Stroma lamellae

25. Chloroplast does **NOT** contain
A. Double membraned envelope
B. Grana and Stroma
C. Matrix and Cristae
D. Circular DNA and 70S ribosomes
(1) A and D (2) A and C
(3) C only (4) B and D

26. Name the labeled part '**A**' in given diagram of endoplasmic reticulum.

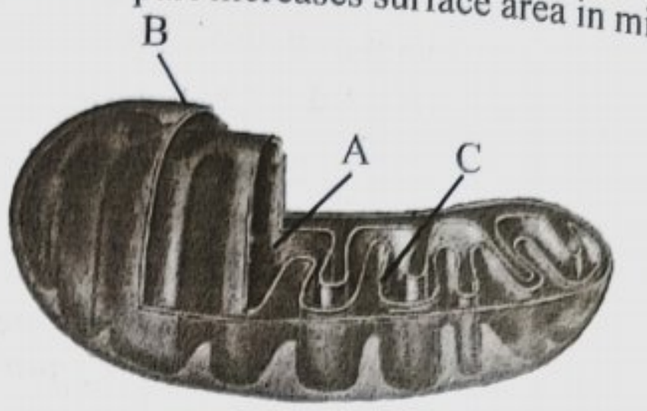
(1) Mesosomes
(2) Smooth Endoplasmic Reticulum
(3) Nuclear pore
(4) Ribosomes

27. Find out the **correct** option on the basis of following diagrams.



(1) A Satellite, B-Secondary constriction C- Short arm, D- Long arm
(2) A - A satellite, B - Centromere, C- Short arm, D- Long arm
(3) A - Secondary constriction, B - Satellite C - Long arm, D - Short arm
(4) A - NOR, B- secondary constriction C - Short arm, D - Long arm

28. Which labeled part increases surface area in mitochondria?

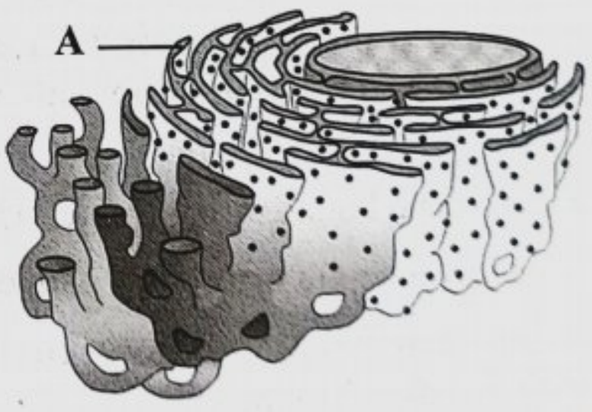


(1) A (2) B
(3) C (4) Both (1) and (3)

29. Read the following statements carefully and mark them as **true** (T) or **false** (F).
A. The content of nucleolus is continuous with the rest of the nucleoplasm.
B. In the chromoplast, water soluble carotenoid pigments like carotene and xanthophyll are present.
C. Basal body of bacterial flagellum has 9 + 2 arrangement of microtubules.
(1) T, F, F
(2) F, T, T
(3) T, F, T
(4) T, T, F

30. Which one of the following match of cellular parts is **correctly** described?
(1) Centrioles – Sites for active RNA synthesis
(2) Ribosomes – Those on chloroplasts larger (80S) while those in the cytoplasm are smaller (70S)
(3) Lysosomes – Optimally active at a pH of about 8.5
(4) Thylakoids – Flattened membranous sacs forming the grana of chloroplasts.

31. Identify the following organelle with its function, which labelled as **A**?



(1) Golgi apparatus, formation of glycolipids
(2) Rough endoplasmic reticulum, protein synthesis
(3) Rough endoplasmic reticulum, formation of glycoproteins
(4) Golgi apparatus, protein synthesis

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PARIKSHIT EXERCISE-3 (MULTICONCEPT)

MATCH THE COLUMN MCQs

1. Match the lists and select the **correct** option:

	List-I		List-II
A.	Lysosomes	P.	Protein synthesis
B.	Ribosomes	Q.	Hydrolytic activity
C.	Smooth endoplasmic reticulum	R.	Synthesis of steroid hormones
D.	Centriole	S.	Glycolytic activity
E.	Chromosomes	T.	Genetic information
		U.	Formation of spindle apparatus

(1) A-(Q); B-(P); C-(R); D-(U); E-(T)
(2) A-(U); B-(R); C-(S); D-(T); E-(P)
(3) A-(P); B-(S); C-(R); D-(U); E-(P)
(4) A-(S); B-(R); C-(P); D-(Q); E-(T)

2. Match the lists and select the **correct** option:

	List-I		List-II
A.	*Omnis cellula-e cellula*	P.	Singer and Nicolson
B.	Fluid mosaic model	Q.	Robert Brown
C.	Ribosomes	R.	Rudolf Virchow
D.	Nucleus	S.	George Palade

(1) A-(P); B-(R); C-(Q); D-(S)
(2) A-(P); B-(R); C-(S); D-(Q)
(3) A-(R); B-(P); C-(Q); D-(S)
(4) A-(R); B-(P); C-(S); D-(Q)

3. Match the lists and select the **correct** option:

	List-I		List-II
A.	Golgi apparatus	P.	Actively involved in protein synthesis and secretion
B.	Smooth Endoplasmic reticulum	Q.	Divides by fission
C.	Rough Endoplasmic reticulum	R.	Formation of glycoproteins and glycolipids
D.	Mitochondria	S.	Major site for synthesis of lipid

(1) A-(Q); B-(S); C-(P); D-(R)
(2) A-(R); B-(S); C-(P); D-(Q)
(3) A-(R); B-(S); C-(Q); D-(P)
(4) A-(P); B-(S); C-(Q); D-(R)

4. Match the lists and select the **correct** option:

	List-I		List-II
A.	Cristae	P.	Golgi apparatus
B.	Cisternae	Q.	Cilia
C.	Flattened membranous structures	R.	Mitochondria
D.	Axoneme	S.	Thylakoid

(1) A-(S); B-(P); C-(Q); D-(R)
(2) A-(Q); B-(R); C-(S); D-(P)
(3) A-(R); B-(P); C-(S); D-(Q)
(4) A-(Q); B-(S); C-(R); D-(P)

5. Match the lists and select the **correct** option:

	List-I		List-II
A.	Amyloplasts	P.	Store proteins
B.	Chromoplasts	Q.	Store oils and fats
C.	Aleuroplasts	R.	Store carbohydrates
D.	Elaioplasts	S.	Carotenoid pigments

(1) A-(S); B-(R); C-(P); D-(Q)
(2) A-(Q); B-(R); C-(S); D-(P)
(3) A-(R); B-(S); C-(P); D-(Q)
(4) A-(S); B-(Q); C-(P); D-(R)

6. Match the lists and select the **correct** option

	List-I		List-II
A.	Centrioles	P.	9+2 arrangement
B.	Cilia and Flagella	Q.	9+0 arrangement
		R.	Cellular movement
		S.	Cartwheel structure

(1) A-(P,Q); B-(R,S) (2) A-(Q,S); B-(P,R)
(3) A-(P,R); B-(Q,S) (4) A-(P,S); B-(Q,R)

7. Match the lists and select the **correct** option:

	List-I		List-II
A.	Double membrane	P.	Vacuole
B.	Single membrane	Q.	Mitochondria
C.	Non- membranous	R.	Mesosomes
D.	Extensions of plasma membrane	S.	Ribosome

(1) A-(Q); B-(P); C-(S); D-(R)
(2) A-(R); B-(S); C-(Q); D-(P)
(3) A-(S); B-(R); C-(P); D-(Q)
(4) A-(R); B-(P); C-(S); D-(Q)

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8. Match the lists and select the **correct** option:

	List-I		List-II
A.	Centriole	P.	Primary constriction of chromosome
B.	Endoplasmic reticulum	Q.	Maintain shape and provide mechanical support to the cell
C.	Cytoskeleton	R.	Basal body of cilia and flagella
D.	Centromere	S.	Protein and lipid synthesis

(1) A-(P); B-(R); C-(S); D-(Q)
(2) A-(R); B-(P); C-(S); D-(Q)
(3) A-(P); B-(R); C-(Q); D-(S)
(4) A-(R); B-(S); C-(Q); D-(P)

CORRECT-INCORRECT PAIR MCQs

9. Study the following table.

	Cell organelle	Function
I.	Ribosomes	Protein synthesis
II.	Golgi complex	DNA synthesis
III.	Inclusion bodies	Food storage
IV.	Nucleus	ATP synthesis

Which two show the **correct** combination?
(1) I and II (2) II and III
(3) III and IV (4) I and III

10. Choose the **incorrect** match
(1) Nucleus — RNA
(2) Lysosome — Protein synthesis
(3) Mitochondria — Cellular respiration
(4) Cytoskeleton — Microtubules

11. Which one is not **correctly** matched?
(1) Golgi apparatus-Breaking of complex macromolecules
(2) Endoplasmic reticulum-Protein synthesis
(3) Mitochondria-ATP formation
(4) Chloroplasts-Photosynthesis

12. Choose the **incorrectly** matched pair.
(1) Primary wall - Diminishes as the cell matures
(2) Forming face of Golgi complex - *Cis* face
(3) Contractile vacuole - Osmoregulation
(4) Eukaryotic ribosome – 80 S only

13. Choose the **incorrectly** matched pair.
(1) Chromatin - Flemming
(2) *Cis* - Maturing face of Golgi complex
(3) Metacentric chromosome - Centromere in the middle
(4) Cartwheel structure of centriole - Due to presence of radial spokes and peripheral fibrils

14. Choose the **incorrectly** matched pair.
(1) Bacteria - 3-5 μm
(2) Svedberg's unit - Direct measure of density and size
(3) Acrocentric chromosome - Centromere is situated close to the end of the chromosome.
(4) Lysosome - Hydrolytic activity

15. Choose the **correctly** matched pair.
(1) Human red blood cells - 5 μm in diameter
(2) Hub - Cilia
(3) Centrioles – Found only in animal cells
(4) Microbodies - Present exclusively in animal cells

16. Choose the **correctly** matched pair.
(1) Membrane of the erythrocyte has - 40% protein
(2) Telocentric chromosome – Centromere slightly away from the center
(3) Centriole - 9+0 arrangement
(4) Grana - Flattened membranous sacs

17. Choose the **incorrectly** matched pair.
(1) Cytoskeleton - Maintain the shape of cell
(2) Endoplasmic Reticulum (ER) - Involved in protein synthesis and secretion
(3) 70 S - Found in prokaryotic cell only
(4) Contractile vacuole - Helps in excretion

18. Select the **correctly** matched pair;
(1) Membrane of erythrocyte - 40 percent protein and 52 percent lipids
(2) Nucleolus - Contains nucleoplasm and chromatin
(3) Thylakoid - Flattened membranous sacs present in stroma.
(4) Elaioplasts - Starch containing plastids

STATEMENT BASED QUESTIONS

19. **Incorrect** statement is
(1) The shape of the cell may vary with the function they perform.
(2) The plasma membrane is the main arena of cellular activities in both plant and animal cells.
(3) Ribosomes are non-membrane bound organelles found in all cells.
(4) Animal cells contain cylindrical structure called centriole which helps in cell division.

20. **Correct** statement is
(1) Unicellular organisms are capable of independent existence
(2) Unicellular organisms are capable of performing essential functions of life
(3) Anything less than a complete structure of a cell does not ensure independent existence
(4) All of these

21. **Incorrect** statement is/are
A. All cells arise from pre-existing cells.
B. Various chemical reactions occur in cytoplasm to keep the cell in the living state.

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C. Plant cell have centrioles which are absent in almost all animal cells.

D. Lipid membrane of human erythrocytes has 52 percent protein and 40 percent lipids.

(1) A, C and D (2) C only
(3) B and D (4) B only

22. Select **correct** set of statements from given below.

A. The cytoplasm is the main arena of cellular activities in plants and animals.

B. Cell envelope in bacteria is tightly linked 5 - layered structure.

C. The endomembrane system does not include organelles like mitochondria and peroxisomes.

D. Convex face of golgi bodies is maturing face.

(1) A & D (2) A & C
(3) A, C, D (4) All are correct

23. **Incorrect** statement is

(1) All eukaryotic cells are not identical.
(2) Plant cells possess cell walls, plastids and a large central vacuole, which are absent in animal cell.
(3) Animal cells have centrioles and golgi bodies which are absent in almost all plant cells.
(4) Eukaryotic genetic material is organised into chromosomes.

24. Read the following statements and find out the **incorrect** statement.

(1) Prokaryotes are generally smaller and multiply more rapidly than the eukaryotic cells.
(2) Glycocalyx could be a loose sheath called slime layer in some, while in others it is called the capsule.
(3) The plasma membrane is impermeable in nature.
(4) Chromatophores are the membranous extensions into the cytoplasm of cyanobacteria which contain pigments.

25. Which of the following statement(s) of a bacterial cell is/are **correct**?

(i) Mesosome is formed by the extensions of plasma membrane into the cell.
(ii) The pili are elongated tubular structures made up of a protein.
(iii) Flagellum is composed of filament, hook and basal body.
(iv) Ribosomes are about 30 nm by 50 nm in size.

(1) (i), (ii) and (iii) (2) (iii) and (iv)
(3) (ii) and (iv) (4) None of the above

26. Consider the following statements

A. In prokaryotic cell, outgrowth of plasma membrane into cell is called polysome.

B. SER is major site for glycoprotein synthesis.

C. Contractile vacuole in Amoeba is important for osmoregulation.

D. Mitochondria, chloroplasts and inclusion bodies are not part of endomembrane system.

Which of the above statements are **correct**?

(1) C and D (2) B and C
(3) A and B (4) A and D

27. Read the statements given below with regard to the functions performed by Golgi apparatus?

(i) Transport and chemically modify the materials contained within it.
(ii) Performs the function of packaging materials.
(iii) Important site of formation of glycoproteins and glycolipids.

Which of the following is the **correct** answer?

(1) (i) is wrong but (ii) and (iii) are correct
(2) (ii) is wrong but (i) and (iii) are correct
(3) (ii) and (iii) are wrong but (i) is correct
(4) All are correct

28. Which of the following statements is **correct** regarding vacuole?

(1) It is membrane-bound and contains storage proteins and lipids.
(2) It is membrane-bound and contains water and excretory substances.
(3) It lacks membrane and contains air.
(4) It lacks membrane and contains water and excretory substances.

Directions: In the questions from 29 to 38 two statements are given as **Statement-I** and **Statement-II.**

Mark the correct choice as:

(1) Both **Statement-I** and **Statement-II** are correct
(2) Both **Statement-I** and **Statement-II** are incorrect
(3) **Statement-I** is correct and **Statement-II** is incorrect
(4) **Statement-I** is incorrect and **Statement-II** is correct

29. **Statement-I:** Golgi apparatus is the important site for the synthesis of steroid hormones.

Statement-II: Endomembrane system does not include mitochondria and chloroplast.

30. **Statement-I:** In plants, the cell wall consists of cellulose, hemicellulose, pectins and proteins.

Statement-II: The middle lamella acts as glue between primary wall and secondary wall.

31. **Statement-I:** Axoneme, has nine triplets of radially arranged peripheral microtubules, and a pair of centrally located microtubules called hub.

Statement-II: Cytoskeleton in a cell are involved in many functions such as mechanical support, motility, and maintenance of the shape of the cell.

32. **Statement-I:** Concave *trans* is the forming face and convex *cis* is the maturing face in Golgi apparatus.

Statement-II: The hypothesis which tell us the bodies of animals and plants are composed of cells and products of cells was given by Rudolf Virchow.

33. **Statement-I:** Nuclear pores are the passages through which bidirectional movement occurs between nucleus and cytoplasm.

Statement-II: Cell theory explains how new cells were formed from pre-existing cells.

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34. **Statement-I:** Bacteria that take up the gram stain are Gram positive and the others that do not are called Gram negative.

Statement-II: Capsule is the membranous structure in bacteria formed by the extensions of plasma membrane into the cell.

35. **Statement-I:** Centromere holds two chromatids of a chromosome.

Statement-II: In acrocentric chromosomes, the centromere is situated close to its end forming one extremely short and one very long arm.

36. **Statement-I:** Animal cells contain centriole which give rise to spindle apparatus during cell division.

Statement-II: Centrioles in a centrosome lie perpendicular to each other.

37. **Statement-I:** A specialized differentiated form of cell membrane called mesosome is the characteristic of prokaryotes.

Statement-II: Cilia and Flagella are outgrowth of cell membranes.

38. **Statement-I:** Contractile vacuole is important for osmoregulation and excretion in *Amoeba*.

Statement-II: The golgi apparatus principally performs the function of packaging materials, to be delivered outside the cell.

Directions: In the following questions, a statement of **Assertion** is followed by a statement of **Reason.**

Mark the correct choice as:

(1) If both **Assertion (A)** and **Reason (R)** are True and the **Reason (R)** is a correct explanation of the **Assertion (A).**

(2) If both **Assertion (A)** and **Reason (R)** are True but Reason (R) is not a correct explanation of the **Assertion (A).**

(3) If **Assertion (A)** is True but the **Reason (R)** is False.

(4) If **Assertion (A)** is False but the **Reason (R)** is True.

39. **Assertion (A):** Concentration of certain ions and other molecules is significantly higher in the vacuole than in the cytoplasm.

Reason (R): Tonoplast facilitates the transport of a number of ions and other materials against concentration gradients into the vacuole.

40. **Assertion (A):** The ability of protein to move within the membrane is measured as its fluidity.

Reason (R): Fluid nature of lipid allows protein to move between lipid bilayer of membrane.

41. **Assertion (A):** Nucleolus is a site for active ribosomal RNA synthesis.

Reason (R): Larger and more numerous nucleoli are present in cells actively carrying out lipid synthesis.

42. **Assertion (A):** Anything less than a complete structure of a cell can ensure independent living.

Reason (R): Unicellular organisms are capable of independent existence and performing essential functions of life.

43. **Assertion (A):** The mesosomes are formed by the extensions of plasma membrane into the cell.

Reason (R): Mesosomes help in cell wall formation, DNA replication and distribution of genetic material into daughter cells.

44. **Assertion (A):** Inclusion bodies are not bound by any membranous system and do not lie free in the cytoplasm.

Reason (R): Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies.

45. **Assertion (A):** Hub is the central part of the proximal region of the centriole.

Reason (R): Hub is connected with tubules of the peripheral triplets by radial spokes made of protein.

46. **Assertion (A):** A single human cell has two metre long thread of DNA.

Reason (R): The two metre long thread of DNA in a cell is distributed among 46 pairs of chromosomes.

47. **Assertion (A):** Mitochondria are called 'power house' of the cell.

Reason (R): Mitochondria produce cellular energy in the form of ATP.

48. **Assertion (A):** The golgi apparatus remains in close association with the endoplasmic reticulum.

Reason (R): Proteins synthesised by ribosomes on the endoplasmic reticulum are modified in the cisternae of the golgi apparatus.

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. Movement and accumulation of ions across a membrane against their concentration gradient can be explained by **(2023)**

(1) Facilitated Diffusion (2) Passive Transport
(3) Active Transport (4) Osmosis

2. How many different proteins does the ribosome consist of? **(2023)**

(1) 60 (2) 40
(3) 20 (4) 80

3. Which of the following are **NOT** considered as the part of endomembrane system? **(2023)**

A. Mitochondria B. Endoplasmic reticulum
C. Chloroplasts D. Golgi complex
E. Peroxisomes

Choose the most appropriate answer from the options given below:

(1) A, C and E only (2) A and D only
(3) A, D and E only (4) B and D only

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4. Which of the following functions is carried out by cytoskeleton in a cell? **(2023)**
(1) Protein synthesis (2) Motility
(3) Transportation (4) Nuclear division

5. Given below are two statements: **(2023 manipur)**
Statement-I: In bacteria, the mesosomes are formed by the extensions of plasma membrane.
Statement-II: The mesosomes, in bacteria, help in DNA replication and cell wall formation.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) **Statement-I** is correct but **Statement-II** is incorrect.
(2) **Statement-I** is incorrect but **Statement-II** is correct.
(3) Both **Statement-I** and **Statement-II** are correct.
(4) Both **Statement-I** and **Statement-II** are incorrect.

6. Which of the following statements are **correct** with respect of Golgi apparatus? **(2023 manipur)**
A. It is the important site of formation of glycoprotein and glycolipids.
B. It produces cellular energy in the form of ATP.
C. It modifies the protein synthesized by ribosomes on ER.
D. It facilitates the transport of ions.
E. It provides mechanical support.
Choose the most appropriate answer from the options given below:
(1) B and C only (2) A and C only
(3) A and D only (4) D and E only

7. Match the List-I with List-II. **(2022)**

	List-I		List-II
A.	Metacentric chromosome	I.	Centromere situated close to the end forming one extremely short and one very long arms
B.	Acrocentric chromosome	II.	Centromere at the terminal end
C.	Submetacentric	III.	Centromere in the middle forming two equal arms of chromosomes
D.	Telocentric chromosome	IV.	Centromere slightly away from the middle forming one shorter arm and one longer arm

Choose the **correct** answer from the options given below:
(1) (A)-(I); (B)-(II); (C)-(III); (D)-(IV)
(2) (A)-(III); (B)-(I); (C)-(IV); (D)-(II)
(3) (A)-(I); (B)-(III); (C)-(II); (D)-(IV)
(4) (A)-(II); (B)-(III); (C)-(IV); (D)-(I)

8. Which of the following statements with respect to Endoplasmic Reticulum is **incorrect**? **(2022)**
(1) SER are the sites for lipid synthesis
(2) RER has ribosomes attached to ER
(3) SER is devoid of ribosomes
(4) In prokaryotes only RER are present

9. Which type of substance would face difficulty to pass through the cell membrane? **2022 (Phase 2)**
(1) Substance with hydrophobic moiety
(2) Substance with hydrophilic moiety
(3) All substance irrespective of hydrophobic and hydrophilic moiety
(4) Substance soluble in lipids

10. If the pH in lysosomes is increased to alkaline, what will be the outcome? **2022 (Phase 2)**
(1) Hydrolytic enzymes will function more efficiently
(2) Hydrolytic enzymes will become inactive
(3) Lysosomal enzymes will be released into the cytoplasm
(4) Lysosomal enzymes will be more active

11. Which of the following is an **incorrect** statement? **(2021)**
(1) Microbodies are present both in plant and animal cells.
(2) The perinuclear space forms a barrier between the materials present inside the nucleus and that of the cytoplasm.
(3) Nuclear pores act as passages for proteins and RNA molecules in both directions between nucleus and cytoplasm.
(4) Mature sieve tube elements possess a conspicuous nucleus and usual cytoplasmic organelles.

12. Match the List-I with List-II. **(2021)**

	List-I		List-II
A.	Cristae	I.	Primary constriction in chromosome
B.	Thylakoids	II.	Disc-shaped sacs in Golgi apparatus
C.	Centromere	III.	Infoldings in mitochondria
D.	Cisternae	IV.	Flattened membranous sacs in stroma of plastids

Choose the **correct** answer from the options given below.
(1) (A)-(I); (B)-(IV); (C)-(III); (D)-(II)
(2) (A)-(III); (B)-(IV); (C)-(I); (D)-(II)
(3) (A)-(II); (B)-(III); (C)-(IV); (D)-(I)
(4) (A)-(IV); (B)-(III); (C)-(II); (D)-(I)

13. When the centromere is situated in the middle of two equal arms of chromosomes, the chromosome is referred as: **(2021)**
(1) Telocentric (2) Sub-metacentric
(3) Acrocentric (4) Metacentric

14. The organelles that are included in the endomembrane system are: **(2021)**
(1) Endoplasmic reticulum, Golgi complex, Lysosomes and Vacuoles.
(2) Golgi complex, Mitochondria, Ribosomes and Lysosomes.
(3) Golgi complex, Endoplasmic reticulum, Mitochondria and Lysosomes.
(4) Endoplasmic reticulum, Mitochondria, Ribosomes and Lysosomes.

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15. Which of the following statements about inclusion bodies is **incorrect**? **(2020)**

(1) These are involved in ingestion of food particles.
(2) They lie free in the cytoplasm
(3) These represent reserve material in cytoplasm
(4) They are not bound by any membrane

16. Which is the important site of formation of glycoproteins and glycolipids in eukaryotic cells? **(2020)**

(1) Peroxisomes (2) Golgi bodies
(3) Polysomes (4) Endoplasmic reticulum

17. The biosynthesis of ribosomal RNA occurs in: **(2020 Covid)**

(1) Golgi apparatus (2) Microbodies
(3) Nucleolus (4) Ribosomes

18. Inclusion bodies of blue-green, purple and green photosynthetic bacteria are: **(2020 Covid)**

(1) Gas vacuoles (2) Centrioles
(3) Microtubules (4) Contractile vacuoles

19. Match the following Lists and select the **correct** option; **(2020 Covid)**

	List-I		List-II
A.	Smooth Endoplasmic Reticulum	I.	Protein synthesis
B.	Rough endoplasmic reticulum	II.	Lipid synthesis
C.	Golgi complex	III.	Glycosylation
D.	Centriole	IV.	Spindle formation

	(A)	(B)	(C)	(D)
(1)	(III)	(I)	(II)	(IV)
(2)	(IV)	(II)	(I)	(III)
(3)	(I)	(II)	(III)	(IV)
(4)	(II)	(I)	(III)	(IV)

20. The size of Pleuropneumonia - like Organism (PPLO) is: **(2020 Covid)**

(1) 1 - 2 μm (2) 10 - 20 μm
(3) 0.1 μm (4) 0.02 μm

21. Which of the following pair of organelles does not contain DNA? **(2019)**

(1) Mitochondria and Lysosomes
(2) Chloroplast and Vacuoles
(3) Lysosomes and Vacuoles
(4) Nuclear envelope and Mitochondria

22. The shorter and longer arms of a sub-metacentric chromosome are referred to as **(2019)**

(1) s-arm and l-arm respectively
(2) p-arm and q-arm respectively
(3) q-arm and p-arm respectively
(4) m-arm and n-arm respectively

23. Which of the following statements is not **correct**? **(2019)**

(1) Lysosomes have numerous hydrolytic enzymes.
(2) The hydrolytic enzymes of lysosomes are active under acidic pH.
(3) Lysosomes are membrane bound structures.
(4) Lysosomes are formed by the process of packaging in the endoplasmic reticulum.

24. The concept of "*Omnis cellula-e cellula*" regarding cell division was first proposed by **(2019)**

(1) Rudolf Virchow (2) Theodor Schwann
(3) Schleiden (4) Aristotle

25. Which of the following statements regarding mitochondria is **incorrect**? **(2019)**

(1) Outer membrane is permeable to monomers of carbohydrates, fats and proteins.
(2) Enzymes of electron transport are embedded in outer membrane.
(3) Inner membrane is convoluted with infoldings.
(4) Mitochondrial matrix contains single circular DNA molecule and ribosomes.

26. Which of the following cell organelles is present in the highest number in secretory cells? **(2019 odisha)**

(1) Mitochondria (2) Golgi complex
(3) Endoplasmic reticulum (4) Lysosomes

27. Non-membranous nucleoplasmic structures in nucleus are the site for active synthesis of **(2019 odisha)**

(1) protein synthesis (2) mRNA
(3) rRNA (3) tRNA

28. Which of the following nucleic acids is present in an organism having 70 S ribosomes only? **(2019 odisha)**

(1) Single stranded DNA with protein coat
(2) Double stranded circular naked DNA
(3) Double stranded DNA enclosed in nuclear membrane
(4) Double stranded circular DNA with histone proteins

29. Match the List-I with List-II. **(2019 odisha)**

	List-I		List-II
A.	Golgi apparatus	P.	Synthesis of protein
B.	Lysosomes products	Q.	Trap waste and excretory
C.	Vacuoles	R.	Formation of glycoproteins and glycolipids
D.	Ribosomes	S.	Digesting biomolecules

Choose the **right** match from options given below:

(1) A-R, B-S, C-Q, D-P (2) A-S, B-R, C-P, D-Q
(3) A-R, B-Q, C-S, D-P (4) A-P, B-Q, C-S, D-R

30. Which of the following is **true** for nucleolus? **(2018)**

(1) Larger nucleoli are present in dividing cells.
(2) It is a membrane-bound structure.
(3) It takes part in spindle formation.
(4) It is a site for active ribosomal RNA synthesis

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Answer Key

CONCEPT APPLICATION

1. Anton Von Leeuwenhoek
2. Independent existence and perform essential functions of life
3. Mycoplasma and 0.3 micrometer
4. Rudolf Virchow
5. False
6. Mesosome
7. Chromatophore
8. Circular DNA
9. Flagella, pili, fimbriae
10. Glycocalyx, cell wall, cell membrane
11. True
12. False
13. False
14. 80S, 70S
15. 52, 40
16. Mannans, calcium carbonate
17. Middle lamella
18. SER [Smooth endoplasmic reticulum]
19. Camillo Golgi
20. Glycoproteins, glycolipids
21. Osmoregulation and excretion
22. False
23. True
24. True
25. Sausage-shaped
26. 70S
27. Aleuroplast
28. 9 + 0
29. 9
30. False
31. True
32. Flemming
33. 2 m, 46 (23 Pairs)
34. Basic
35. Middle, two equal
36. Telocentric

NCERT FOCUSED FILL-INS

1. Robert Hooke
2. Multicellular
3. Unicellular
4. Organ system
5. Plasma membrane
6. Pre-existing
7. 0.3
8. Human red blood cell (erythrocyte)
9. Eukaryotic
10. Comma shaped
11. Mycoplasma
12. Naked
13. Plasmids
14. Glycocalyx
15. Crystal violet
16. Capsule
17. Peptidoglycan
18. 70S
19. Cyanophycean
20. Purple
21. Outer
22. Inner
23. Singer
24. Nicolson
25. Passive
26. ATP
27. Active
28. Suberin
29. Calcium pectate
30. Peroxisomes
31. Nucleus
32. Dictyosome
33. Trans
34. Acidic
35. Increase
36. Circular
37. Aerobic
38. Proteins
39. Elaioplast
40. Grana
41. Thylakoids
42. 60S
43. 40S
44. Axoneme
45. 9+2
46. 9
47. Tubulin
48. Interphase
49. Metaphase
50. Short

SCHOOL LEVEL PROBLEMS

Single Correct Type Questions

1. (4) 2. (1) 3. (1) 4. (4) 5. (1) 6. (1) 7. (1) 8. (1) 9. (1) 10. (1)

Assertion and Reason Type Questions

1. (1) 2. (3) 3. (1) 4. (2) 5. (1)

Case Study Based Questions

Case-I

1. (4) 2. (4)

Case-II

1. (1) 2. (2) 3. (4)

PRARAMBH EXERCISE-1 (TOPICWISE)

1. (2) 2. (3) 3. (2) 4. (1) 5. (2) 6. (4) 7. (3) 8. (4) 9. (2) 10. (4)
11. (3) 12. (2) 13. (4) 14. (1) 15. (4) 16. (3) 17. (2) 18. (4) 19. (3) 20. (1)
21. (3) 22. (4) 23. (4) 24. (4) 25. (1) 26. (3) 27. (2) 28. (1) 29. (1) 30. (3)

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31. (4)	32. (3)	33. (2)	34. (3)	35. (4)	36. (2)	37. (1)	38. (1)	39. (4)	40. (1)
41. (1)	42. (3)	43. (2)	44. (4)	45. (2)	46. (3)	47. (3)	48. (3)	49. (3)	50. (3)
51. (2)	52. (3)	53. (4)	54. (3)	55. (4)	56. (4)	57. (4)	58. (3)	59. (1)	60. (4)
61. (4)	62. (3)	63. (3)	64. (3)	65. (2)	66. (2)	67. (1)	68. (1)	69. (4)	70. (1)
71. (2)	72. (2)	73. (2)	74. (3)	75. (1)	76. (3)	77. (4)	78. (1)	79. (2)	80. (1)
81. (3)	82. (1)	83. (4)	84. (4)	85. (2)	86. (3)	87. (4)	88. (1)	89. (2)	90. (1)
91. (4)	92. (3)	93. (2)	94. (4)	95. (4)	96. (1)	97. (2)	98. (1)	99. (3)	100. (4)
101. (3)	102. (4)	103. (4)	104. (3)	105. (4)	106. (1)	107. (1)	108. (3)	109. (1)	110. (4)
111. (2)	112. (3)	113. (3)	114. (1)	115. (1)	116. (4)	117. (4)	118. (1)	119. (3)	120. (3)

PRABAL EXERCISE-2 (LEARNING PLUS)

1. (1)	2. (2)	3. (4)	4. (1)	5. (4)	6. (4)	7. (1)	8. (4)	9. (3)	10. (2)
11. (3)	12. (3)	13. (3)	14. (2)	15. (4)	16. (3)	17. (4)	18. (4)	19. (3)	20. (2)
21. (4)	22. (3)	23. (2)	24. (1)	25. (3)	26. (3)	27. (2)	28. (3)	29. (1)	30. (4)
31. (2)									

PARIKSHIT EXERCISE-3 (MULTICONCEPT)

1. (1)	2. (4)	3. (2)	4. (3)	5. (3)	6. (2)	7. (1)	8. (4)	9. (4)	10. (2)
11. (1)	12. (4)	13. (2)	14. (2)	15. (3)	16. (3)	17. (3)	18. (3)	19. (2)	20. (4)
21. (2)	22. (2)	23. (3)	24. (3)	25. (1)	26. (1)	27. (4)	28. (2)	29. (4)	30. (3)
31. (4)	32. (2)	33. (3)	34. (3)	35. (1)	36. (1)	37. (1)	38. (3)	39. (1)	40. (3)
41. (3)	42. (4)	43. (2)	44. (4)	45. (2)	46. (3)	47. (1)	48. (1)		

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. (3)	2. (4)	3. (1)	4. (2)	5. (3)	6. (2)	7. (2)	8. (4)	9. (2)	10. (2)
11. (4)	12. (2)	13. (4)	14. (1)	15. (1)	16. (2)	17. (3)	18. (1)	19. (4)	20. (3)
21. (3)	22. (2)	23. (4)	24. (1)	25. (2)	26. (2)	27. (3)	28. (2)	29. (1)	30. (4)

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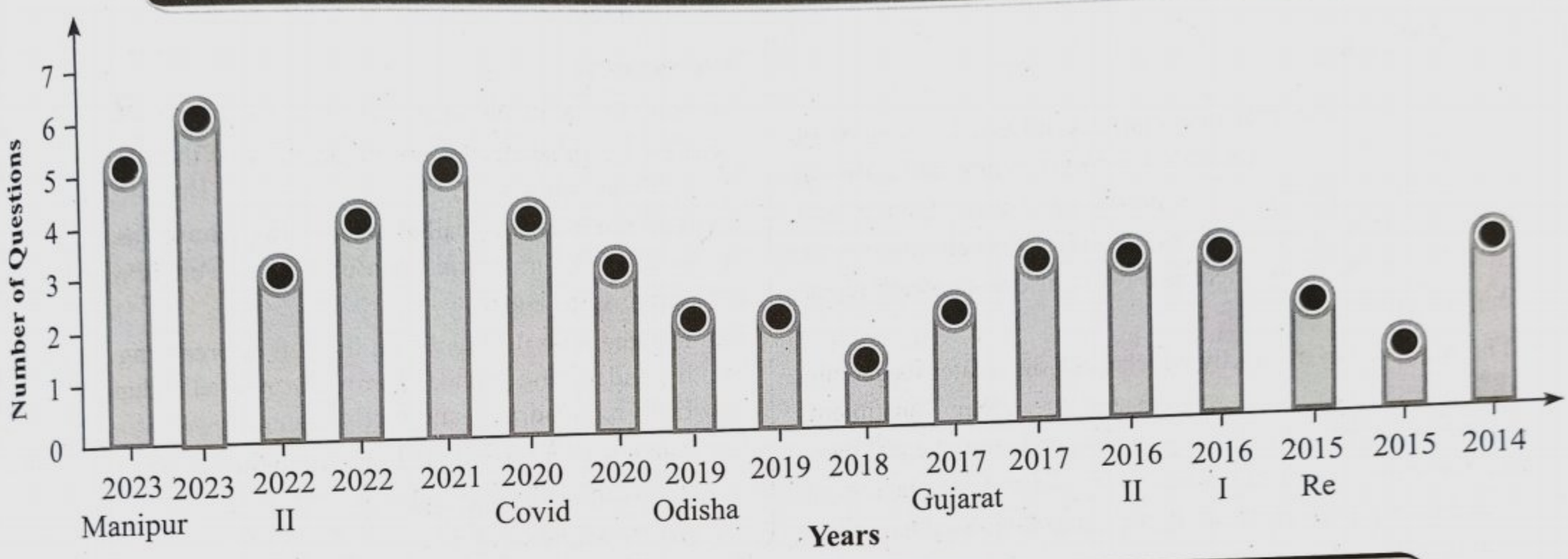
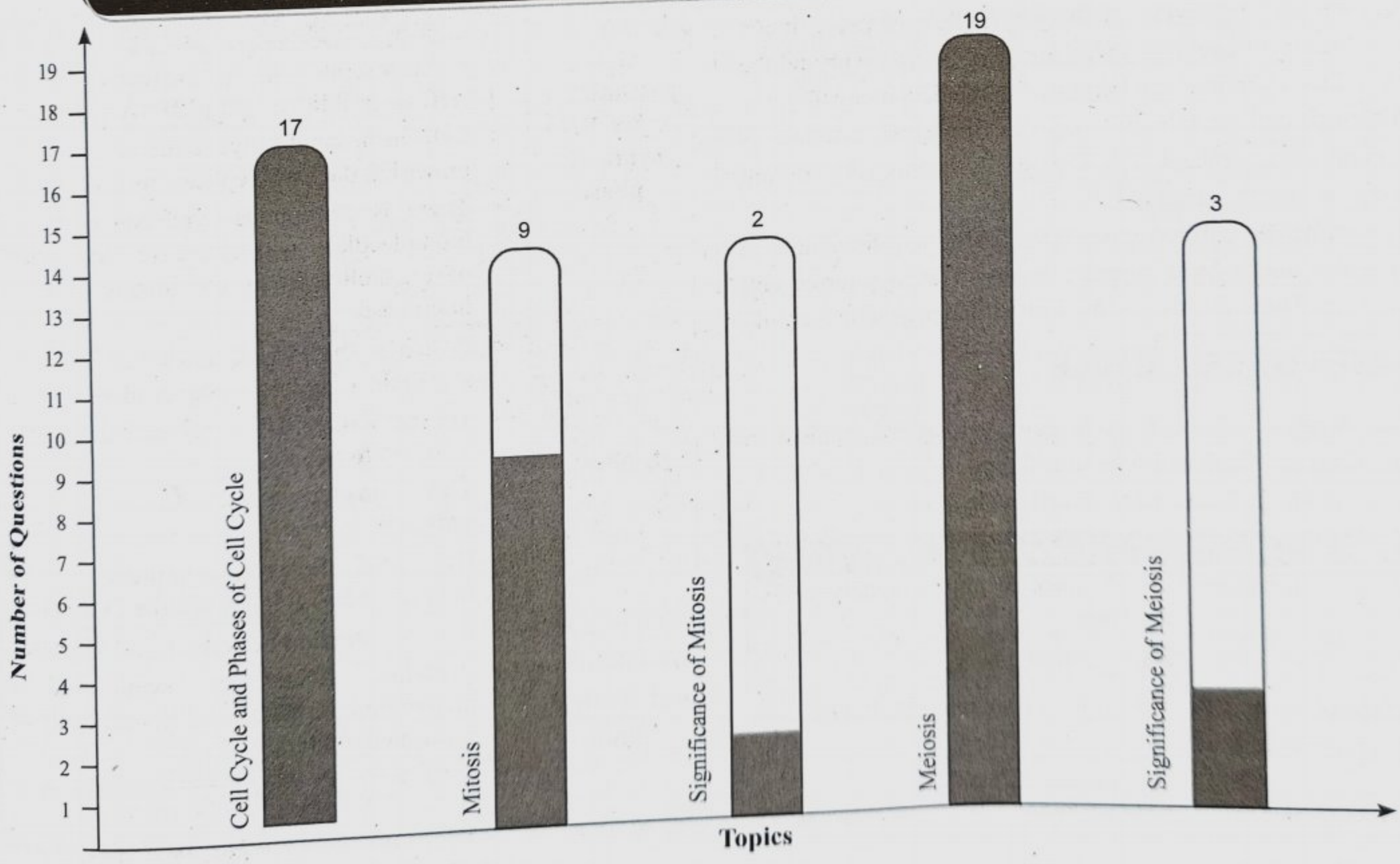
CHAPTER 2

Cell Cycle and Cell Division

Year Wise Number of Questions Analysis (2023-2014)



Topicwise Number of Questions Analysis (2023-2014)



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INTRODUCTION

- All sexually reproducing organisms, start their lives from a single celled zygote which undergoes division and differentiation to form the whole organism.
- **Cell division** is a very important process by which a mature cell divides and forms two or 4 daughter cells.
- The cell which undergoes division is called the **mother cell or parent cell**. The newly formed cells are known as **daughter cells**.
- Cell division is a **biological process** in all living organisms.
- Growth and reproduction are characteristics of cells, indeed of all living organisms.

CELL CYCLE

- Now we all know that new cells are formed by division of previous cells *(Omnis cellula e cellula)*. A new cell grows in size, there is increase in cytoplasm, number of organelle and duplication of genetic material. Finally, this cell divides into two new cells. Thus, there is a cycle of events which repeat themselves.
- The sequence of events by which a cell duplicates its genome (**1***.....), synthesizes the other constituents of the cell (since the cell is going to divide into 2 equal parts, all the cell constituents must be duplicated for their equal distribution) and eventually divides into two daughter cells is termed **cell cycle**.
- During the division of a cell, DNA replication and cell growth take place in a **coordinated way** to ensure correct division and formation of progeny cells containing intact genomes (replication so that there must be **no error** and the same intact genome will be passed to the daughter cells).
- Although cell growth (in terms of cytoplasmic increase) is a continuous process, DNA synthesis occurs only during **S-phase** specific stage in the cell cycle.
- The replicated chromosomes (DNA) are then distributed to daughter nuclei by a complex series of events during cell division. These events are themselves under genetic control.

PHASES OF CELL CYCLE

- The duration of a cell cycle can vary from organism to organism and from cell type to cell type.

Table 1: Cells and their cell cycle durations

Type of Cell	Duration of Cell Cycle
Human cells in culture	Divide once in approximately every 24 hours
Yeast	**2**..... minutes

- A typical eukaryotic cell cycle is illustrated by human cells in culture as follows:

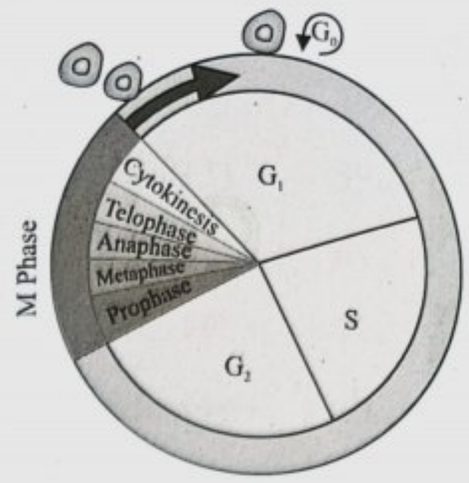

Fig. 1: A diagrammatic view of cell cycle indicating formation of two cells from one cell

- The cell cycle is divided into **two basic phases:**
  1. Interphase; 2. M-phase

1. Interphase

- Represents the phase between two successive **3**..... phases.
- The interphase lasts more than 95% of the duration of cell cycle in humans.
- The interphase is called the **resting phase** (as no division process occurs in this phase) but the cell is metabolically active at this stage.
- It is the time during which the cell is preparing for division by undergoing both cell growth, organelle duplication and DNA replication in an orderly manner.
- The interphase is divided into three further phases:
  - (*i*) **Gap-1 phase** (G_1 phase)
  - (*ii*) **Synthesis** (S-phase)
  - (*iii*) **Gap-2 phase** (G_2 phase)

Table 2: Events occurring in Interphase

Phase	Events Occurred
G_1 or **post-mitotic** or **pre-DNA synthetic phase**	❖ It corresponds to the **interval between mitosis and initiation of DNA replication.** ❖ Cells are metabolically active and continuously grows but **does not** replicate its DNA. ❖ There is continuous synthesis of various biomolecules and increase in number of organelles. It is the longest phase of interphase.
S-phase	❖ It marks the period during which DNA synthesis or replication takes place. ❖ The amount of DNA per cell doubles i.e. from **2C to 4C**. ❖ There is **no increase in the 4**..... **number**. ❖ DNA replication begins in the nucleus and the centriole duplicates in the cytoplasm.
G_2 phase **pre-mitotic** or **post-synthetic phase**	❖ It is the **duration** between S and M phase ❖ **Proteins, RNA** are synthesized in preparation for **5**..... while cell growth continues.

1* *"NCERT Focused Fill-ins" is an exercise with blanks in textbook passages that students fill in to test their NCERT-based knowledge and grasp over NCERT Textbook.*

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Key Note

G_0 / Quiescent Stage

- Some cells in plants, such as parenchyma cells and non-meristematic cells, as well as in adult animals, like heart cells and neurons, do not divide, while others only divide occasionally in response to injury or cell death. For instance, the lining of the stomach is replaced twice a week due to the damage caused by highly acidic HCl.
- These cells that do not divide further **exit G_1** phase to enter an inactive stage called G_0 (cells remain **metabolically active** in this stage but can no longer proliferate unless called on to do so, depending upon the requirement of the organism).

EXTENDED LEARNING

Control of Cell Cycle

- The cell cycle is controlled through check points which involve some enzymes and proteins. A check point is a critical control point where **stop** and **go** signal regulate the cell cycle. There are three major check points at G_1, G_2 and M.
  - The G_1 check point at **G_1/S transition**.
  - The G_2 check point at **G_2/M transition.**
  - The Spindle checkpoint from **Metaphase to Anaphase transition.**
- The check point ensure the completion of a phase, then only cell moves to next phase. Cyclin protein, CDK enzyme and ATP are involved in this activity.
- Loss of control of cell cycle can cause cancer

Train Your Brain

1. How do plants and animals continue to grow all their lives? Do all cells in a plant divide all the time? Do you think all cells continue to divide in all plants and animals? Can you tell the name and the location of tissues having cells that divide all their life in higher plants? Do animals have similar meristematic tissues?

Sol. Plants and animals continue to grow by the virtue of cell division.

In case of plants, the cell division occur only at some limited locations which are termed as meristem zones. They can be root or shoot apical meristems that increases the length (primary growth) of a typical plant or it can be lateral meristems that increases the girth (secondary growth) of a plant.

Animals have stem cells, that give rise to all the cells in a particular niche. For example, HSC (Hematopoietic Stem Cells) give rise to all blood cells like erythrocyte, leucocyte, thrombocyte, etc.

In animals, the growth is seen up to a particular stage of life after which only certain cells divide to replace lost cells, like epithelial lining of gut or blood cells having limited life span.

2. You have studied mitosis in onion root tip cells. It has 16 chromosomes in each cell. Can you tell how many chromosomes will the cell have at G_1 phase, after S phase, and after M phase? Also, what will be the DNA content of the cells at G_1, after S and at G_2, if the content after M phase is 2C?

Sol. If a typical diploid cell of onion has 16 chromosomes, the number of chromosomes during different phases will be:

G_1 Phase	16 Chromosomes
S Phase	16 Chromosomes (as DNA content duplicate but chromosome number remains the same)
M Phase	16 Chromosomes (as mitosis is an equational division so daughter cells will have same number of chromosomes.

And, if DNA content after M-phase is 2C, the DNA content for G_1, S and G_2 phase will be:

G_1 Phase	2C
S Phase	4C (as DNA content is duplicated during replication in S-phase)
G_2 Phase	4C (as DNA content will remain same to the point when division occurs)

Concept Application

True and False:

1. Cycles of growth and division allow a single cell to form a structure consisting of millions of cells.
2. Cell division, DNA replication, and cell growth have to take place in a coordinated way to ensure correct division and formation of progeny cells containing intact genomes.
3. The replicated chromosomes (DNA) are distributed to daughter nuclei by a simple series of events during cell division.
4. Interphase represents the phase between two successive M phases.
5. Cell prepares for division by undergoing both cell growth and DNA replication in random manner.

Fill in the Blanks:

6. The interphase is called the_____but the cell is metabolically _____in this stage.
7. The amount of DNA per cell doubles in _____ phase.
8. Interphase in humans lasts _____of the duration of cell cycle.

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2. M Phase (Mitotic phase/actual cell division)

- This is the **most dramatic** period of the cell cycle where virtually all componentss of the cell are reorganized.
- In the 24 hour average duration of cell cycle of a human cell, cell division proper lasts for only about an hour (less than **5%** duration).
- Components of a cell already duplicated in interphase are now distributed to the daughter cells in M-phase.

MITOSIS

- Mitosis is called as **equational** division (no change in number of chromosomes in parent cell and daughter cell).
- Cell division is a progressive process and very **clear-cut lines cannot be drawn** between various stages but there are some changes occurring in cells, due to which it is divided into 2 major processes:
  - **A. Karyokinesis:** M-Phase starts with the nuclear division, corresponding to the separation of daughter chromosomes.
  - **B. Cytokinesis**: M-Phase usually ends with division of cytoplasm.

A. Karyokinesis

Mitosis has been divided into **four stages** of nuclear division (Karyokinesis) for convenience: namely prophase, metaphase, anaphase and telophase (Table 3).

Table 3: Events occuring during M-Phase.

Phase	Events
Prophase **Early prophase** **Late prophase**	❖ Follows the S and G_2 phases of interphase (**first step of karyokinesis**) ❖ In the S and G_2 phases, the new DNA molecules formed are not distinct but **intertwined.** ❖ Prophase is marked by the initiation of **condensation** of chromosomal material. ❖ The chromosomal material becomes untangled during the process of chromatin condensation. ❖ The centrosome begins to move towards opposite poles of the cell. ❖ The completion of prophase can thus be marked by the following **characteristic events**: (*a*) Chromosomal material condenses to form **compact mitotic chromosomes**. Chromosomes are seen to be composed of two chromatids attached together at the centromere (called primary constriction). (*b*) Centrosomes which have undergone duplication during interphase **begin to move** towards the **6**_____ poles of the cell. [Centrosomes are absent in plant cells] (*c*) Each centrosome radiates out microtubules called **asters**. The two asters together with spindle fibres form mitotic apparatus. In plant cells spindle formation is caused by cytoplasmic proteins. (*d*) At the end of prophase, cell when viewed under the microscope, **do not show golgi complexes** (GC), **endoplasmic reticulum** (ER), **nucleolus and the nuclear envelope.**
Metaphase **Transition to metaphase** **Metaphase**	❖ **Second phase** of mitosis is marked by complete disintegration of the nuclear envelope, hence the **chromosomes** are **spread** through the cytoplasm of the cell (since no boundary is there to hold the chromosomes) ❖ By this stage, condensation of chromosomes is completed and they can be observed clearly under the microscope (this stage is the best stage to study the morphology of chromosomes). ❖ Metaphase chromosome is made up of **two sister chromatids**, which are held together by the centromere. ❖ There is a **proteinaceous small disc** at the surface of centromere called **7**_____ Kinetochores serve as the sites of attachment of spindle fibres (formed by the spindle fibres) to the chromosomes that are moved into position at the centre of the cell. ❖ **Metaphasic plate formation:** Metaphase is characterised by all the chromosomes coming to lie at the **equator** (called **congression or metakinesis**) with one chromatid of each chromosome connected by its kinetochore to spindle fibres from one pole and its sister chromatid connected by its kinetochore to spindle fibres from the opposite pole. [There are 2 kinetchore on each Metaphasic chromosome]

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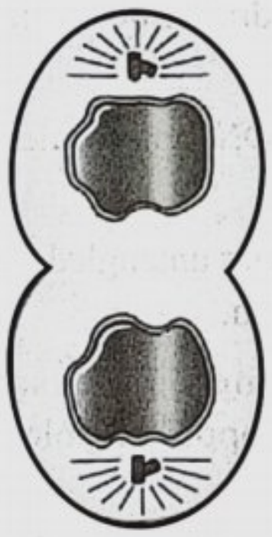
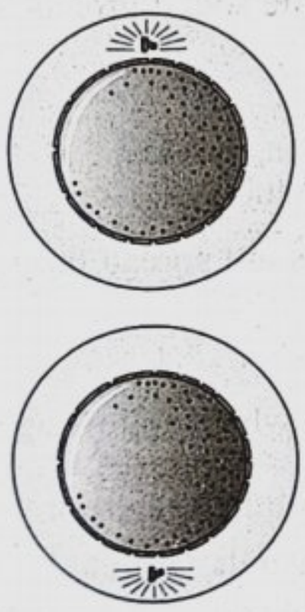
Phase	Events
	❖ The **key features** of metaphase are: (*a*) Spindle fibres attach to kinetochores of chromosomes (*b*) Chromosomes are moved to spindle equator and get aligned along **8**..... through spindle fibres to both poles.
Anaphase **Anaphase**	❖ At the beginning of anaphase, the chromosomes arranged at the metaphasic plate is **split** (so doubles in number) simultaneously and the two daughter chromatids (now referred to as chromosomes of the future daughter nuclei) begin their **migration** towards the two **opposite poles** due to contraction of **9**..... ❖ As each chromosome moves away from the equatorial plate, the **centromere** of each chromosome is towards the pole and hence at the leading edge, with the arms of the chromosome **trailing behind**. ❖ Anaphase stage is **characterised by:** (*a*) Centromere split and chromatids separate (*b*) Chromatids move to opposite poles.
Telophase  **Telophase**	❖ Final stage of karyokinesis. ❖ The chromosomes that have reached their respective poles **decondense** and **lose their individuality.** ❖ The individual chromosomes can no longer be seen and each set of chromatin material tends to collect at each of the two poles ❖ Mitotic **spindle disappears** ❖ This stage shows the following **key events:** (*a*) Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements (*b*) Nuclear envelope develops around the chromosome clusters at each pole forming 2 daughter nuclei. (*c*) Nucleolus, **10**..... and ER reform
Cytokinesis  **Interphase**	❖ 2 daughter cells are formed after cytokinesis (division of cytoplasm)

B. Cytokinesis

❖ Cell division is completed after the division of parent cell into 2 daughter cells by cytokinesis which takes place after karyokinesis.

❖ **Furrow formation:** In an **animal** cell, this is achieved by furrow formation in the plasma membrane. The furrow gradually deepens (from periphery to centre i.e. **centripetal**) and ultimately joins in the centre dividing the cell cytoplasm into two parts.

❖ **Phragmoplast/cell plate formation:** Plant cells are enclosed by a relatively inextensible cell wall, so they undergo cytokinesis in a different manner. The wall formation starts in the centre of the cell and grows outward (i.e., **centrifugal**) to meet the existing lateral walls. The formation of the new cell wall begins with the formation of a simple precursor called

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the cell-plate that represents the **11**..... between the walls of two adjacent cells.

- At the time of cytoplasmic division, **organelles** like mitochondria and plastids get **distributed** between the two daughter cells.
- In some organisms, karyokinesis is not followed by cytokinesis as a result of which multinucleate condition arises leading to the formation of multinucleate structure called **syncytium** (e.g., liquid endosperm in **12**.....).

Significance of Mitosis

- **Cell growth:** The **growth** of multicellular organisms is due to mitosis (from single celled zygote to an adult).
  - Cell growth results in **disturbing the ratio between** the **nucleus** and the **cytoplasm**. It, therefore, becomes essential for the cell to divide to restore the **13**..... ratio.
  - Low nucleo-cytoplasmic ratio stimulates cell division in a cell.
  - Mitotic divisions in the **14**..... tissues-the apical and the lateral cambium, result in a continuous growth of plants throughout their life. It also occurs in parts of a plant such as **leaves, fruits,** etc.,
- **Cell/Tissue repair:** Lost cells in case of injury and trauma can be replaced by mitosis.
  - The cells of the upper layer of the epidermis, cells of the **lining of the gut** (twice a week), and blood cells (e.g., **RBC** has a life span of 120 days) are being constantly replaced.
- **Reproduction:** For simpler organisms (**unicellular eukaryotic** organisms), mitosis serves as a mode of **reproduction.**

Key Note

- Mitosis is usually restricted to **diploid cells only**.
- In animals, mitotic cell division is only seen in the diploid somatic cells, diploid germ cells. However, there are few exceptions to this where haploid cell divide by mitosis eg. **Male Honey Bee.**
- Against this, the plants can show mitotic divisions in both diploid and haploid (meiosis in sporophyte produces haploid spores in case of bryophytes after which, the spores divide by mitotic divisions to form the gametophyte) cells.
- In some lower plants (algae and fungi) haploid cells also divide by mitosis.
- The diploid germ cells undergo meiosis to form gametes (haploid).

EXTENDED LEARNING

Mitotic Inhibitors

- There are some molecules/drugs that inhibit mitosis, they are known as **mitotic inhibitors.**
- Some of the inhibitors interfere with microtubule association and spindle formation e.g. Colchicine, while others inhibit cytokinesis e.g. Cytochalasin B.

Amitosis

This process is also called direct division. This is not the regular method of cell division. This does not include differentiation of chromosomes and spindle formation and occurs by simple splitting of the nucleus into two. It has been observed in Chara (algae). Binary fission in bacteria is also an example of amitosis.

Concept Application

True and False:

9. M phase is the most dramatic period of the cell cycle.
10. Very clear-cut lines cannot be drawn between various stages of mitosis.
11. In the S and G_2 phases the new DNA molecules formed are not distinct & not intertwined.
12. The chromosomal material becomes untangled during the process of chromatin condensation.
13. During prophase chromosome condensation & movement of centrioles to the opposite poles occurs simultaneously.
14. Cell-plate represents the middle lamella between the walls of two adjacent plant cells.
15. In some lower plants and in some social insects haploid cells also divide by mitosis.

Fill in the Blanks:

16. Each centrosome radiates out microtubules called _____.
17. During _____ chromosomes are spread through the cytoplasm of the cell.

Answer in one word:

18. Name the stage of cell cycle at which following events occurs:
    (*i*) Chromosomes are moved to spindle equator.
    (*ii*) Centromere splits and chromatids separate.
    (*iii*) Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.

MEIOSIS

- The production of offsprings by sexual reproduction includes the fusion of two gametes, each with a complete haploid set of chromosomes.
- In meiosis, the chromosome number **reduces by half (reductional division)** which results in the production of **15**..... **daughter cells.**

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- Meiosis ensures the production of haploid phase in the life cycle of sexually reproducing organisms whereas fertilisation restores the diploid phase (2 gametes fuse to form diploid zygote).
- Meiosis plays a vital role during **gametogenesis** in plants and animals.
- The **key features of meiosis** are as follows:
  - Meiosis involves two sequential cycles of **nuclear** and **cell division** called **meiosis-I** and **meiosis-II** but only a single cycle **of DNA replication** (only during meiosis-I).
  - Meiosis-I is initiated after the parental chromosomes have replicated to produce identical sister chromatids at the S phase.
  - Meiosis involves pairing of homologous chromosomes and **16**..... between them.
  - **17**..... **haploid cells** are formed at the end of meiosis-II.
  - There four haploid cells are genetically dissimilar.
- Meiotic events can be grouped under the following phases:

Table 4: Different phases of Meiotic Cell Cycle

Meiosis-I	Meiosis-II
Prophase-I	Prophase-II
Metaphase-I	Metaphase-II
Anaphase-I	Anaphase-II
Telophase-I	Telophase-II

Meiosis-I

Key Note

- **Meiosis-I** is called **reductional** division (chromosome number is reduced to half) and **meiosis-II** is called **equational** division which is just like mitosis.

1. Prophase-I

- It is typically **longer** and more complex as compared to prophase of mitosis.
- It is further divided into five phases based on **chromosomal behaviour** i.e., Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.

Table 5: Different phases of Prophase-I

Phase of Prophase-I	Events
(a) **Leptotene**	❖ The **compaction** of **chromosomes** continues throughout Leptotene and chromosomes become gradually **visible** under the light microscope.
(b) **Zygotene**	❖ Chromosomes start pairing together (this side by side association is called **synapsis**). ❖ Such parental chromosomes are called **homologous chromosomes** [homologous pair]. ❖ Electron micrographs of this stage indicate that chromosome synapsis is accompanied by the formation of complex structure called **18**..... which provides stability. ❖ The complex formed by a pair of synapsed homologous chromosomes is called a **bivalent** or a **tetrad**.
(c) **Pachytene**	❖ Pachytene phase is quite longer as compared to leptotene and zygotene. ❖ During this stage, 4 chromatids of each bivalent chromosome now become distinct and clearly **appear as tetrads**. ❖ This stage is characterized by the appearance of **recombination nodules**, the sites at which **crossing over** occurs between **non-sister chromatids** of the two homologous chromosomes. ❖ Crossing over is the exchange of genetic material between two homologous chromosomes. ❖ Crossing over is an **enzyme-mediated** process and the **enzyme** involved is called **recombinase**. ❖ Crossing over leads to recombination of genetic material on the two chromosomes by **breakage** and **rejoining** of DNA fragments. ❖ Recombination between homologous chromosomes is completed by the end of pachytene, leaving the chromosomes linked at the sites of crossing over.
(d) **Diplotene**	❖ The beginning of diplotene is recognized by the **dissolution** of the **synaptonemal complex** and the tendency of the recombined homologous chromosomes of the bivalents to separate from each other **except at the sites of 19**..... ❖ These **20**.....**-shaped** structures that are the point of attachment of homologous chromosomes after dissolution of the synaptonemal complex are called **21**..... (become visible in this phase). ❖ In **22**..... of some vertebrates, **23**..... **can last for months or years.**
(e) **Diakinesis**	❖ The final stage of meiotic prophase-I. ❖ **Terminalisation of chiasmata** occurs where chiasmata is **shifted** toward chromosomal ends and **slipped off.** ❖ During this phase the chromosomes are **fully condensed** and the **meiotic spindle is assembled** to prepare the homologous chromosomes for separation. ❖ By the end of diakinesis, the **nucleolus disappears** and the **nuclear envelope** also **breaks down.** ❖ **Diakinesis represents transition to metaphase.**

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Mnemonic

○ Stages of prophase-I of meiosis-I

Lata Zee Paani De Do

Lata = Leptotene, Zee = Zygotene, Paani = Pachytene,

De = Diplotene, Do = Diakinesis

2. Metaphase-I

- The bivalent chromosomes in the cytoplasm gets align on the equatorial plate.
- The microtubules from the opposite poles of the spindle attach to the pair of homologous chromosomes.
- Double metaphasic plate is formed.

3. Anaphase-I

- The homologous chromosomes **separate**, while **24**..... remain associated at their centromeres.
- Now the chromosomes are **monovalent** with 2 chromatids (after separation).

4. Telophase-I

- The **nuclear membrane and nucleolus reappear**; spindle disappears.
- Cytokinesis follows and this is called as **25**..... **of cells** (2 cells are formed with half the number of chromosomes as each daughter cell will have one chromosome out of the homologous pair).
- Although in many cases the chromosomes do undergo some dispersion, they **do not** reach the extremely extended state of the interphase nucleus.

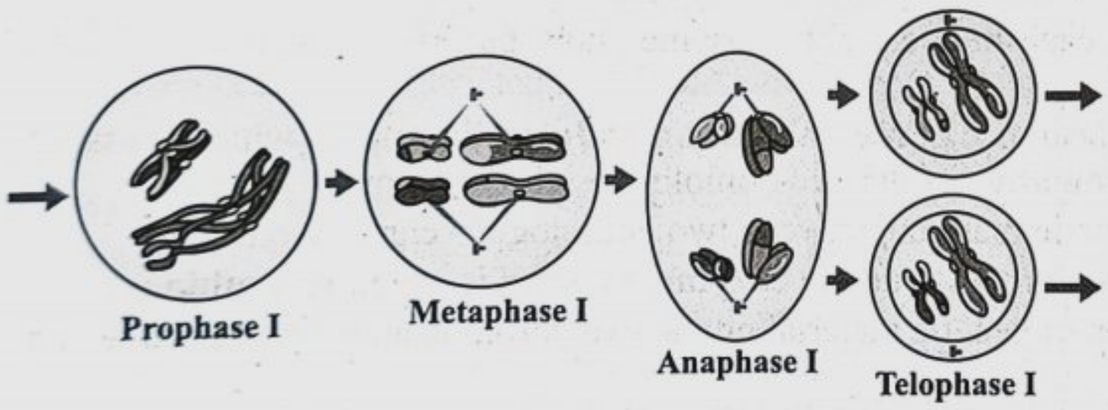


Fig. 2: Stages of Meiosis-I

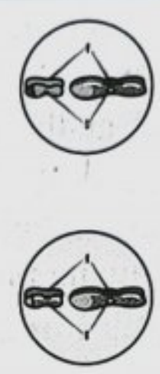
Interkinesis

- The stage between the two meiotic divisions is called **interkinesis** and is generally **26**.....
- There is **centriole** duplication or **RNA/protein** synthesis but **no DNA replication**.
- Interkinesis is followed by prophase-II, a much simpler prophase than prophase-I as there are no sub-stages in prophase-II.

Meiosis-II

- Meiosis-II is initiated immediately after cytokinesis, usually before the chromosomes have fully elongated.
- In contrast to meiosis-I, meiosis-II resembles a normal **27**.....

Table 6: Stages of Meiosis-II

Prophase-II	❖ The **nuclear membrane and nucleolus disappear** by the end of prophase-II. ❖ The chromosomes again become **compact**.
 **Metaphase-II**	❖ At this stage, the chromosomes align at the **equator** and the microtubules from opposite poles of the spindle get attached to the kinetochores of sister chromatids.
Anaphase-II	❖ It begins with the simultaneous **splitting** of the **28**..... of each chromosome (which was holding the sister chromatids together), allowing them to move toward opposite poles of the cell by shortening of microtubules attached to **29**.....
Telophase-II	❖ Meiosis ends with telophase II, in which the two groups of chromosomes once again get enclosed by a nuclear envelope. ❖ Cytokinesis follows resulting in the formation of tetrad of cells i.e., **30**..... **haploid** daughter cells.

Significance of Meiosis

- Meiosis is the mechanism by which conservation of specific chromosome number of each species is achieved across generations in sexually reproducing organisms, even though the process, per se, paradoxically, results in reduction of chromosome number by half.
- It also **increases the genetic variability** in the population of organisms from one generation to the next.
- Variations are very important for the process of **31**.....
- **Meiosis** always occurs in **32**..... cells to produce 4 haploid daughter cells.

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EXTENDED LEARNING

Types of Meiosis

- Based on mother and daughter cell meiosis is of **three types**
  - **Gametic meiosis-** It occurs in diploid cells to produce haploid gametes.
  - **Zygotic meiosis-** In haploid organisms such as Algae and Fungi, meiosis occurs in Zygote to produce haploid cells that develop into young haploid organism.
  - **Sporic meiosis-** In plants such as Bryophytes, diploid cells of capsule of sporophyte divide by meiosis to produce haploid spores which germinate to produce haploid gametophyte.

Non disjunction

Non disjunction of chromosomes means that a pair of homologous chromosomes has failed to get separated at Anaphase I of meiosis, so that both chromosomes of the pair pass to same daughter cell. As a result one cell will have trisomy $(2n+1)$ after fertilization another will have monosomy $(2n-1)$.

Concept Application

True and False:

19. Meiosis ensures the production of haploid phase in the life cycle of sexually reproducing organisms whereas fertilisation restores the diploid phase.
20. Meiosis during gametogenesis in plants and animals leads to the formation of haploid gametes.
21. Meiosis II is initiated after the parental chromosomes have replicated.
22. Prophase of the first meiotic division is typically longer and more complex when compared to prophase of mitosis.
23. During leptotene stage the chromosomes become gradually visible under the light microscope.
24. The first two stages of prophase I are relatively short-lived compared to the next stage that is pachytene.
25. Meiosis leads to conservation of specific chromosome number in each species across generations in sexually reproducing organisms.
26. During metaphase I, the bivalents arrange on the equatorial plate.

Fill in the Blanks:

27. Electron micrographs of zygotene indicate that chromosome synapsis is accompanied by the formation of complex structure called_____.

Answer in one word:

28. Name the stage of cell cycle at which the following events occur:
    - (*i*) Meiotic spindle is assembled to prepare the homologous chromosomes for separation.
    - (*ii*) The microtubules from the opposite poles of the spindle attach to the kinetochore of homologous chromosomes..
    - (*iii*) Dissolution of the synaptonemal complex.
    - (*iv*) Chromosomes do undergo some dispersion but do not reach the extremely extended state of the interphase nucleus.
    - (*v*) The stage between the two meiotic divisions which is generally short lived.

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- All sexually reproducing organisms start their life from a single cell called zygote. This zygote divides to make complete body of an organism, by cell division.

Cell Cycle

- The sequence of events by which a cell duplicates its genome, synthesizes the other constituents of the cell and eventually divides into two daughter cells is termed cell cycle. Although cell growth (in terms of cytoplasmic increase) is a continuous process, DNA synthesis occurs only during one specific stage in the cell cycle. The replicated chromosomes (DNA) are then distributed to daughter nuclei.
- Duration of cell cycle is different in different organisms. For examples, a typical human cell in culture takes 24hrs to divide and a yeast cell divides in about 90 minutes.
- The cell cycle is divided into Interphase and M-Phase (Mitosis phase).

Interphase	- Lasts for more than **95%** time of cell cycle called the resting phase, is the time during which the cell is preparing for division by undergoing both cell growth and DNA replication in an orderly manner. + **G_1 Phase:** Cell grows but DNA doesn't replicate. + **S-phase:** DNA replication occur; amount of DNA doubles but no. of chromosome remains same. + **G_2 Phase:** Proteins are synthesized in preparation for mitosis while cell growth continues. - **G_0/Quiescent Phase:** Some cells that do not divide further exit G_1 phase to enter an inactive stage called G_0 where the cells remain metabolically active but no longer proliferate unless called on to do so.
M-phase	- Most **dramatic** period of the cell cycle. - **Karyokinesis**/Nuclear division + **Prophase:** Chromosomal material condenses to form compact mitotic chromosomes; Centrosome begins to move towards opposite poles; centrosome radiates out microtubules called asters; golgi complexes, endoplasmic reticulum, nucleolus and the nuclear envelope disappears. + **Metaphase:** Spindle fibres attach to kinetochores of chromosomes; metaphasic plate is formed. + **Anaphase:** Centromeres split and chromatids separate; Chromatids move to opposite poles. + **Telophase:** Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements; Nuclear envelope develops around the chromosome clusters at each pole forming two daughter nuclei; Nucleolus, golgi complex and ER reform. - **Cytokinesis/cell division:** Cell plate is formed in case of plants and cell furrow in case of animals.

- **Meiosis:** It is called reductional division where chromosome number reduces to half; it involves two sequential cycles of nuclear and cell divisions called meiosis-I and meiosis-II but only a single cycle of DNA replication.

Meiosis-I	- **Prophase-I:** Longer and complex; divided into 5 subphases. + **Leptotene:** Chromosomes become gradually visible under the light microscope; compaction of chromosomes continues throughout. + **Zygotene:** Chromosomes start pairing together and this process of association is called synapsis; synaptonemal complex formed. + **Pachytene:** Characterised by the appearance of recombination nodules; tetrad is clearly visible; crossing over and recombination occurs. + **Diplotene:** Dissolution of the synaptonemal complex; chiasmata remain. + **Diakinesis:** Terminalisation of chiasmata, N.M. & nucleous dissapear. - **Metaphase-I:** Two metaphasic plates formed. - **Anaphase-I:** Homologous chromosomes separate, while sister chromatids remain associated at their centromeres. - **Telophase-I:** Nuclear membrane and nucleolus reappear, cytokinesis follows and this is called as dyad of cells; interkinesis is followed by meiosis-I.
Meiosis-II	- Similar to Mitosis (equational division).

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AARAMBH (SOLVED EXAMPLES)

1. Which of the following phases of the cell cycle is characterised by the replication of DNA?
   (1) G_1 phase (2) S phase
   (3) M phase (4) G_2 Phase

Sol. DNA and centriole duplication takes place during a specific phase of cell cycle only i.e., S-phase. Since, the DNA synthesis occur in this phase, the phase itself is named as synthesis phase.
Therefore, option (2) is the correct answer.

2. Which is the longest phase of cell cycle?
   (1) Interphase (2) M-Phase
   (3) Interkinesis (4) S-Phase

Sol. The cell spends most of its time in Interphase where continuous cell growth (in terms of cytoplasm increment) occur. Normal growth activities and DNA duplication also takes place.
Therefore, option (1) is the correct answer.

3. During which stage of meiosis, the crossing over occurs?
   (1) Prophase-I
   (2) Metaphase-II
   (3) Anaphase-I
   (4) Prophase-II

Sol. Crossing over or recombination occur during pachytene phase of Prophase-I of meiosis-I.
Therefore, option (1) is the correct answer.

4. Meiosis results in the production of:
   (1) Aneuploid cell
   (2) Polyploid cell
   (3) Haploid cell
   (4) Diploid cell

Sol. Meiosis occur in diploid cells and since it is reductional division, it will result in formation of 4 haploid cells.
Therefore, option (3) is the correct answer.

5. Two equatorial plates are formed during which phase of cell cycle
   (1) Metaphase-II
   (2) Metaphase-I
   (3) M-phase
   (4) Metaphase of Mitosis

Sol. In Metaphase-I, two metaphasic or equatorial plates are formed. Only one plate is formed at equator during metaphase of mitosis and Metaphase-II of Meiosis.
Therefore, option (2) is the correct answer.

6. Which of the following cells in an adult animal do not appear to exhibit division?
   (1) Bone marrow cells
   (2) Cells of lining of gut
   (3) Heart cells
   (4) All the above

Sol. In an adult animal, heart cells do not appear to divide.
Therefore, option (3) is the correct answer.

7. In G_1-phase of cell division,
   (1) RNA and proteins are synthesised for cell growth
   (2) DNA and proteins are synthesised
   (3) Formation of RNA and DNA continues for spindle formation and cell growth
   (4) Cell undergoes duplication

Sol. The G_1 phase is the time between mitosis and the start of DNA replication. Enzymes, proteins, RNA, nucleotides, and other molecules are synthesised at this stage.
Therefore, option (1) is the correct answer.

8. G_2 phase is not associated with
   (1) synthesis of proteins
   (2) synthesis of tubulin proteins for spindle fibres
   (3) DNA synthesis
   (4) none of these.

Sol. DNA synthesis or replication takes place during S-phase of interphase.
Therefore, option (3) is the correct answer.

9. Which of the following proteinaceous components of the cell cytoplasm help in the initiation of the assembly of mitotic spindle?
   (1) Microtubules (2) Microbodies
   (3) Centromeres (4) Kinetochores

Sol. Microtubules, which are proteinaceous components of the cytoplasm, aid in the commencement of mitotic spindle construction.
Therefore, option (1) is the correct answer.

10. Which of the events listed below is not observed during mitosis?
   (1) Chromatin condensation
   (2) Movement of centrioles to opposite poles
   (3) Appearance of chromosomes with two chromatids joined together at the centromere
   (4) Crossing over

Sol. Crossing over is a hallmark aspect of meiotic cell division and is the event of genetic exchange between homologous pairs of chromosomes. It doesn't happen during mitosis.
Therefore, option (4) is the correct answer.

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11. What is the requirement of equational division in meiosis?

(1) Crossing over

(2) Segregation of replicated chromosomes

(3) Equal distribution of haploid chromosomes

(4) Both (1) and (3)

Sol. Equational division in meiosis ensures separation of the two identical sister chromatids, which make up a replicated chromosome, into two separate daughter cells.

Therefore, option (2) is the correct answer.

12. The complex formed by pair of synapsed homologous chromosome is known as

(1) Bivalent

(2) Axoneme

(3) Kinetochore

(4) Equatorial plate

Sol. Bivalent is formed during the zygotene stage of meiosis I. Bivalent is formed due to the pairing of homologous chromosomes.

Therefore, option (1) is the correct answer.

13. During gamete formation, the enzyme recombinase participates during

(1) Metaphase-I (2) Anaphase-II

(3) Prophase-I (4) Prophase-II

Sol. Recombinase enzyme is responsible for crossing over in pachytene stage of prophase-I

Therefore, option (3) is the correct answer.

14. During meiosis-I pairing of chromosomes start at

(1) Pachytene (2) Zygotene

(3) Diplotene (4) leptotene

Sol. Pairing of homologous chromosomes start at the zygotene stage of meiosis-I.

Therefore, option (2) is the correct answer.

15. How many bivalents will form in the zygotene stage, if the number of chromosomes is 30 at G_1 stage?

(1) 30 (2) 15

(3) 45 (4) 60

Sol. If the number of chromosomes is 30 at the G1 stage, that means there are 30/2 = 15 pairs of homologous chromosomes. In zygotene, each pair of homologous chromosomes forms one bivalent. So, there will be 15 bivalents that form during the zygotene stage in this case.

Therefore, option (2) is the correct answer.

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SCHOOL LEVEL PROBLEMS

SINGLE CORRECT TYPE QUESTIONS

1. Which of these is **correct** regarding anaphase-I?
   (1) Sister chromatids remain attached at the centromeres.
   (2) Bivalent is unequally separated.
   (3) Homologous chromosomes remain together
   (4) It takes place before diakinesis
2. The centriole undergoes duplication during:
   (1) Prophase (2) Metaphase
   (3) G_2 phase (4) S-phase
3. Tetrad is made up of:
   (1) four homologous chromosomes with four chromatids
   (2) four non-homologous chromosomes
   (3) four non-homologous chromatids
   (4) two homologous chromosomes, each with two chromatids
4. A plant cell has 12 chromosomes before mitosis. How many chromosomes would it have in each of daughter cells after mitosis?
   (1) 24 (2) 12
   (3) 8 (4) 6
5. Chiasmata occurs in -
   (1) Leptotene (2) Pachytene
   (3) Zygotene (4) Diplotene
6. Bivalent is formed during-
   (1) Pachytene. (2) Diplotene.
   (3) Zygotene. (4) Diakinesis
7. During Cytokinesis, cell plate represent-
   (1) primary lamella
   (2) secondary lamella
   (3) middle lamella
   (4) both (1) & (3)
8. Which of the following shows equational division
   (1) Meiosis-I (2) Meiosis-II
   (3) Mitosis (4) 2 and 3 both
9. Which of the following statements is **correct?**
   (1) Mitosis only occurs in haploid cell
   (2) Meiosis only occurs in haploid cell
   (3) Meiosis always occurs in diploid cell
   (4) All of these
10. Which of the following stages represents the last stage of prophase-I?
   (1) Diplotene (2) Diakinesis
   (3) Zygotene (4) Pachytene

ASSERTION AND REASON TYPE QUESTIONS

1. **Assertion (A) :** Cells that do not divide further exit G_1 phase to enter inactive stage G_0.
   Reason (R) : Cell in G_0 stage are metabolically active but no longer proliferate unless called on to do so.
   (1) Both **Assertion (A)** and **Reason (R)** are true and **Reason (R)** is correct explanation of **Assertion (A)**
   (2) Both **Assertion (A)** and **Reason (R)** are true but **Reason (R)** is not correct explanation of **Assertion (A)**
   (3) **Assertion (A)** is true but **Reason (R)** is false
   (4) **Assertion (A)** is false but **Reason (R)** is true
2. **Assertion (A) :** Crossing over takes place in meiosis.
   Reason (R): Crossing over take place between sister chromatids of homologous chromosome.
   (1) Both **Assertion (A)** and **Reason (R)** are true and **Reason (R)** is correct explanation of **Assertion (A)**
   (2) Both **Assertion (A)** and **Reason (R)** are true but **Reason (R)** is not correct explanation of **Assertion (A)**
   (3) **Assertion (A)** is true but **Reason (R)** is false
   (4) **Assertion (A)** is false but **Reason (R)** is true
3. **Assertion (A):** Sister chromatids are not separated during anaphase-I.
   Reason (R) : Meiosis maintains genetic similarity of somatic cells.
   (1) Both **Assertion (A)** and **Reason (R)** are true and **Reason (R)** is correct explanation of **Assertion (A)**
   (2) Both **Assertion (A)** and **Reason (R)** are true but **Reason (R)** is not correct explanation of **Assertion (A)**
   (3) **Assertion (A)** is true but **Reason (R)** is false
   (4) **Assertion (A)** is false but **Reason (R)** is true

VERY SHORT ANSWER TYPE QUESTIONS

1. In which phase it is decided that a cell is going to divide or not?
2. Which phase is responsible for duplication of the genetic material of cell?
3. Which is the best stage to study the morphology of chromosomes?
4. Which is the best stage to study the shape of chromosomes?
5. The two daughter cells formed after mitosis are genetically similar. Why?
6. What do you understand by syncytium? Explain with example.
7. Name the stage of Meiosis at which synaptonemal complex is formed.

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8. Name the stage of Meiosis at which crossing over takes place.
9. What is the main difference between the Anaphase-I and Anaphase-II?
10. What do you understand by interkinesis?

SHORT ANSWER TYPE QUESTIONS

1. Why "S" phase of cell cycle is known as synthesis phase?
2. The cells in G_0 phase are not dividing but are not dead. Justify.
2. Why "interphase" is also known as resting phase?
3. Differentiate between cytokinesis of plant cell and animal cell.
4. What is the significance of "crossing over" during meiosis?

LONG ANSWER TYPE QUESTIONS

1. Explain all stages of Prophase-I.
2. Draw and explain the Cell Cycle.
3. What is the significance of mitosis?

CASE STUDY BASED QUESTIONS

Case-I:

The meristematic cells in plants remain in cell cycle and continuously produce new cells. Some of these cells exit the cell cycle and gets differentiate to form parenchyma of mesophyll cells of leaf and start performing photosynthesis.

Read the above text and answer the following questions.

1. The differentiated cells belong which phase of cell cycle.
   (1) G_1 Phase (2) S Phase
   (3) G_0 Phase (4) G_2 Phase
2. Mark the **incorrect** statement.
   (1) The cells in G_0 phase are non dividing
   (2) The cells in G_0 phase are dead
   (3) These cells are metabolically active
   (4) These cells can come back to cell cycle

Case-II:

In a laboratory experiment a teacher is demonstrating the microscopic slides to study mitosis in onion root tip cells. All chromosomes are arranged at equatorial plate of the cell. There are 16 chromosomes in each cell.

Read the above text and answer the following questions.

1. How many chromosomes will the cell have at G1 phase, after S phase, and after M phase respectively?
   (1) 16, 16 and 16 (2) 16, 16 and 8
   (3) 16, 32 and 16 (4) 8, 16, 8
2. What will be the DNA content of the cells at G_1, after S and at G_2, if the content after M phase is 2C?
   (1) 2C, 4C and 2C (2) 2C, 4C and 4C
   (3) 2C, 2C and 4C (4) 4C, 4C and 4C
3. What is the name of the stage at which the cell is being observed?
   (1) Metaphase-I (2) Metaphase
   (3) Anaphase-I (4) Metaphase-II

PRARAMBH EXERCISE-1 (TOPICWISE)

CELL CYCLE AND PHASE OF CELL CYCLE

1. The sequence of events in which a cell duplicates its genome, synthesises the other constituents of the cell and eventually divides into two daughter cells is called;
   (1) Cell division (2) Cell cycle
   (3) Karyokinesis (4) Cytokinesis
2. A typical eukaryotic cell cycle is illustrated by;
   (1) Yeast (2) Bacteria
   (3) Human cells in culture (4) Both (1) and (3)
3. In the 24 hour average duration of cell cycle of a human cell, cell division proper lasts for about;
   (1) 23 hours (2) An hour
   (3) Half an hour (4) 90 minutes
4. Of the total duration of cell cycle, the interphase lasts for more than;
   (1) 95% (2) 5%
   (3) 90% (4) 80%
5. Cell division is;
   (1) a process that does not involve co-ordination of various cellular elements.
   (2) a process that can occur at any time.
   (3) a highly co-ordinated process.
   (4) never precise.
6. Astral rays arise from;
   (1) Centriole (2) Nucleus
   (3) Chromatid (4) Centromere
7. Most of the organelle duplication occurs during;
   (1) M-phase
   (2) Interphase
   (3) Interkinesis
   (4) Cytokinesis
8. Which among the following is **correct**?
   (1) DNA content becomes double during G_1-phase
   (2) Duration of interphase is short as compared to M-phase

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(3) G_2-phase follows mitotic phase
(4) DNA-replication occurs in S-phase

9. Which of the following does not occur during cell division?
(1) DNA replication
(2) Cell growth
(3) Increase in cytoplasm of daughter cell
(4) Division of cell organelles

10. How many times does DNA replicate?
(1) Twice in each cell cycle
(2) Only once in each cell cycle
(3) Once in mitotic cell cycle, once in meiotic-I (reductional division) and once in meiotic-II (equational division)
(4) None of these

11. Which phase corresponds to the interval between mitosis and initiation of DNA replication?
(1) Gap 1/G_1 phase
(2) Gap 2/G_2 phase
(3) Synthesis/S phase
(4) M phase

12. G_1, S and G_2 are stages of;
(1) Interphase (2) Prophase
(3) Metaphase (4) Anaphase

13. "Post-mitotic phase" of the cell in which active synthesis of RNA and proteins takes place is;
(1) S-phase (2) Amitotic phase
(3) G_2-phase (4) G_1-phase

14. If the initial amount of DNA is denoted as 2C then the amount of DNA after S-phase will be:
(1) 4C (2) 6C (3) C (4) 2C

15. A cell is bound to divide, if it has entered;
(1) G_2 - phase (2) G_1 - phase
(3) Prophase (4) S -phase

16. Mature nerve cells cannot undergo cell division. These cells are probably considered in;
(1) G_2 - phase (2) S - phase
(3) Mitosis (4) G_0 - phase

17. During cell cycle, RNA and protein synthesis takes place in;
(1) G_1 phase (2) Metaphase
(3) M - phase (4) Cytokinesis

18. Interphase is also known as _____ stage and it takes about _____% time of cell cycle:
(1) Dividing, 95% (2) Dividing, 80%
(3) Resting, 95% (4) Resting, 80%

19. Decision of G_0- phase occurs;
(1) in G_1- phase.
(2) in G_2- phase.
(3) at the end of S-phase.
(4) towards the end of cytokinesis.

20. G_2 phase is also called:
(1) Post-mitotic gap phase (2) Synthetic phase
(3) Pre-mitotic gap phase (4) Interkinesis

21. Which pair of body cells lack cell division?
(1) Skin epithelial cells and nephrons
(2) Nephrons and endothelial cells
(3) Gut lining cell and neurons
(4) Neurons and heart cells

22. The stage between two M-phases is;
(1) G_1-phase (2) S-phase
(3) G_2-phase (4) Interphase

23. G_1 stage of interphase of cell cycle shows:
(1) active synthesis of DNA.
(2) active synthesis of RNA.
(3) active synthesis of protein.
(4) both (2) and (3)

24. Cells which are not dividing are likely to be at;
(1) G_1 phase (2) G_2 phase
(3) G_0 phase (4) S-phase

25. Select the **correct** statement about G_1 phase.
(1) Cell is metabolically inactive
(2) DNA in the cell does not replicate
(3) It is not a phase of synthesis of macromolecules
(4) Cell stops growing

26. Choose the event of cell cycle which shows the importance of synapsis and the formation of chiasmata.
(1) An increase in the variation of progeny occurs
(2) Reciprocal exchange of chromosomal sections occurs
(3) The DNA on homologous chromosomes mix
(4) All of the above

27. The stages through which a cell passes from one division to the next is called;
(1) Cell division (2) Cell cycle
(3) Karyokinesis (4) Cytokinesis

M PHASE

28. Nucleolus, Golgi apparatus, ER reform in;
(1) Anaphase (2) Prophase
(3) Telophase (4) Metaphase

29. Chromosomes are least condensed during;
(1) Telophase (2) Metaphase
(3) Interphase (4) Anaphase

30. End of prophase is marked by:
(1) complete disintegration of plasma membrane.
(2) disappearance of ER, GB, nucleolus and nuclear envelope.
(3) initiation of condensation of chromosomal material.
(4) chromosomes align at the equatorial plate.

31. The completion of prophase can be marked by:
(1) chromosomal material condenses to form compact mitotic chromosomes.
(2) initiation of condensation of chromosomal material.
(3) initiation of the assembly of mitotic spindle.
(4) both (1) and (3)

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32. The centriole begins to move towards opposite poles of the cell in;
(1) Prophase (2) Metaphase
(3) Anaphase (4) Telophase

33. By which stage, condensation of chromosomes is completed?
(1) Prophase (2) Metaphase
(3) Anaphase (4) Telophase

34. In mitosis, the chromosomal elongation starts, nucleolus and the nuclear membrane reappear. This essential step happens in;
(1) Telophase (2) Interphase
(3) Metaphase (4) S phase

35. The plane of alignment of the chromosomes at metaphase is referred to as the;
(1) Cell furrow formation (2) Chromosome alignment
(3) Metaphase plate (4) All of these

36. In which stage of cell division chromosomes are most condensed?
(1) Prophase (2) Metaphase
(3) Anaphase (4) Telophase

37. In mitosis, centromere splits during;
(1) Prophase (2) Metaphase
(3) Anaphase (4) Telophase

38. How many generations of mitotic divisions are needed for a single cell to make 256 cells?
(1) 8 (2) 16
(3) 32 (4) 64

39. Chromosome exhibit high level of coiling at which phase of karyokinesis?
(1) Prophase
(2) Metaphase
(3) Telophase
(4) Interphase

40. Karyokinesis differs from cytokinesis as it involves division of:
(1) Cell (2) Both nucleus and cytoplasm
(3) Nucleus (4) Cytoplasm

41. Centromere is required for;
(1) movement of chromosomes towards poles
(2) cytoplasmic cleavage
(3) crossing over
(4) transcription

42. 'X' is a phase of mitosis, in which the chromatin condenses into discrete chromosomes. During 'X' phase, nuclear envelope breaks down and spindles forms at opposite ends of the cell. Identify 'X'.
(1) Interphase
(2) Anaphase
(3) Telophase
(4) Prophase

43. Reason of chromosomal movement in Anaphase is;
(1) Astral rays
(2) Centrioles
(3) Kinetochore
(4) Kinetochore and spindle fibres

44. Starting of metaphase is marked by;
(1) Complete disintegration of nuclear envelope
(2) Disappearance of ER, GB, nucleolus and nuclear envelope
(3) Initiation of condensation of chromosomal material
(4) Alignment of chromosomes at the equatorial plate

45. Mitosis is characterised by;
(1) Reduction division
(2) Equational division
(3) Both (1) and (2)
(4) Pairing of homologous chromosomes

46. During mitosis, after the separation of centromeres, the chromatids move towards the opposite poles of the spindle. Name the term used for these chromatids.
(1) Daughter chromosomes (2) Kinetochores
(3) Half spindles (4) Centrosomes

47. In which stage of mitosis, the structure of chromosomes can be observed?
(1) Prophase (2) Metaphase
(3) Anaphase (4) Telophase

48. In telophase of mitosis, the mitotic spindle breaks down and nuclear membranes form. This is essentially the opposite of what happens in;
(1) Prophase (2) Interphase
(3) Metaphase (4) S phase

SIGNIFICANCE OF MITOSIS

49. What is the significance of mitosis?
(1) Growth (2) Repair
(3) Replacement (4) All of these.

50. A very significant contribution of mitosis is cell repair. Repairing takes place in our body in;
(1) blood cells
(2) upper layer of epidermis
(3) cells of the lining of the gut
(4) all of these.

51. The growth of multicellular organisms is due to
(1) Meiosis I (2) Mitosis
(3) Meiosis II (4) Both (1) and (3)

52. What type of cell division occurs in the cells of the upper layer of the epidermis, cells of the lining of the gut, and blood cells?
(1) Mitosis (2) Meiosis I
(3) Meiosis II (4) Both (2) and (3)

53. Significance of mitosis involves;
(1) the growth of multicellular organism.
(2) cell repair.
(3) production of diploid daughter cells with identical genetic complement.
(4) all of these.

54. Mitosis results in the production of;
(1) genetically identical daughter cells.
(2) two diploid daughter cells.
(3) genetically different daughter cells.
(4) Both (1) and (2)

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MEIOSIS

55. When synapsis is complete all along the chromosomes, the cell is said to have entered a stage called;
(1) Diakinesis (2) Pachytene
(3) Diplotene (4) Zygotene

56. Prophase-I is subdivided into five phases based on;
(1) Chromosomal movement
(2) Chromosomal alignment
(3) Chromosomal behaviour
(4) Chromosomal structure

57. The chiasmata is _____ structure.
(1) C-shaped (2) X-shaped
(3) Y-shaped (4) U-shaped

58. Tetrad is made up of;
(1) four homologous chromosomes with four chromatids.
(2) four non-homologous chromosomes.
(3) four non-homologous chromatids.
(4) two homologous chromosomes, each with two chromatids.

59. Electron micrographs of which stage indicate that chromosome synapsis is accompanied by the formation of complex structure called synaptonemal complex?
(1) Zygotene (2) Pachytene
(3) Diplotene (4) Diakinesis

60. What precedes reformation of nuclear envelope in M-phase?
(1) Formation of contraction ring and transcription from chromosomes
(2) Transcription of chromosomes and reassembly of nuclear lamina
(3) Formation of phragmoplast and contraction ring
(4) Decondensation of chromosomes and appearance of nuclear lamina

61. If one cell has twice as much DNA as another similar cell, it may be;
(1) Respiring (2) Secreting
(3) Dividing (4) Moving

62. The four daughter cells produced at the end of meiosis are;
(1) Genetically similar (2) Genetically dissimilar
(3) Polynucleate (4) Anucleate

63. Non-sister chromatids of homologous chromosome exchange segments during;
(1) Leptotene (2) Diplotene
(3) Zygotene (4) Pachytene

64. Which is unique to mitosis and does not occur in meiosis with identical genetic complement?
(1) Homologous chromosomes cross over
(2) Homologous chromosomes pair and form bivalent
(3) The final products are two daughter cells
(4) Chromatids are separated during anaphase

65. Microtubules from opposite poles of spindle get attached to kinetochores of sister chromatids during;
(1) Anaphase II (2) Prophase II
(3) Metaphase II (4) Metaphase I

66. In meiosis, synapsis occurs during;
(1) S-phase (2) Interphase
(3) Leptotene (4) Prophase I

67. Meiosis involves;
(1) two nuclear divisions and one chromosomal division.
(2) one nuclear division and one chromosomal division.
(3) one nuclear division and two chromosomal divisions.
(4) two nuclear divisions and two chromosomal divisions.

68. In which stage, synaptonemal complex dissolves?
(1) Zygotene (2) Pachytene
(3) Diplotene (4) Diakinesis

69. At what stage does the number of chromosomes become half?
(1) Prophase-I (2) Metaphase-I
(3) Anaphase-I (4) Telophase-I

70. Poleward movement of dyads occurs during
(1) Anaphase (2) Anaphase-I
(3) Anaphase-II (4) Telophase

71. In which stage, the chromosomes clearly appear under the light microscope?
(1) Zygotene (2) Leptotene
(3) Pachytene (4) Prophase-II

72. When are chromatids/chromosomes of tetrad clearly visible in meiosis?
(1) Zygotene (2) Diplotene
(3) Pachytene (4) Diakinesis

73. Which of the following cellular structures always disappears during mitosis and meiosis?
(1) Plastid and nuclear membrane
(2) Nucleolus and nuclear membrane
(3) Endoplasmic reticulum and mitochondria
(4) Endoplasmic reticulum and plasma membrane

74. Second division of meiosis is
(1) Reductional division (2) Multiplied division
(3) Equational division (4) None of these.

75. Gap between meiosis-I and meiosis-II is called;
(1) Interphase (2) Interkinesis
(3) Diakinesis (4) Metakinesis

76. Slipping of chiasmata towards the ends of bivalet is called;
(1) Terminalisation (2) Diakinesis
(3) Interkinesis (4) None of these.

77. After meiosis-I, the two chromatids of a chromosome are;
(1) Genetically similar
(2) Genetically different
(3) There occurs only one chromatid in each chromosome
(4) None of the above

78. Among the following which one is generally the longest phase in prophase of meiosis?
(1) Leptotene (2) Zygotene
(3) Pachytene (4) Diplotene

79. During pachytene stage of meiosis, the chromosomes appear;
(1) single stranded
(2) four stranded (chromatids)
(3) six stranded
(4) eight stranded

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80. During the first metaphase of meiosis, the centromeres;
(1) undergo division
(2) do not divide
(3) divide but do not separate
(4) none of these.

81. Which of the following does **NOT** occur in Anaphase-I?
(1) Segregation of homologous chromosomes
(2) Contraction in spindle
(3) Poleward movement of chromosomes
(4) Division of centromere

82. The homologous chromosomes separate, while sister chromatid remain associated at their centromeres at;
(1) Metaphase-I of meiosis (2) Anaphase-I of meiosis
(3) Metaphase of mitosis (4) Anaphase of mitosis

83. A bivalent of meiosis-I consists of;
(1) four chromatids and two centromeres
(2) two chromatids and one centromere
(3) two chromatids and two centromeres
(4) four chromatids and four centromeres

84. During Anaphase-I of meiosis:
(1) homologous chromosomes separate
(2) non-homologous chromosomes separate
(3) sister chromatids separate
(4) non-sister chromatids undergo crossing over

85. At what phase of meiosis are there two cells, each with sister chromatids aligned at the spindle equator?
(1) Anaphase-II (2) Metaphase-II
(3) Metaphase-I (4) Anaphase-I

86. Meiosis occurs in organisms during:
(1) sexual reproduction (2) vegetative reproduction
(3) both (1) and (2) (4) none of these.

87. Which of the event(s) restore the normal number of chromosomes in life cycle of a sexually reproducing diploid organism?
(1) Mitosis and Meiosis (2) Meiosis and fertilisation
(3) Fertilisation and mitosis (4) Only meiosis

SIGNIFICANCE OF MEIOSIS

88. Meiotic cell division is also termed as reduction division because of;
(1) involvement of gametes
(2) doubling of chromosomes
(3) elimination of chromosomes
(4) number of chromosomes become halved

89. Which one ensures maintenance of chromosome number generation after generation in sexually reproducing organisms?
(1) Mitosis (2) Meiosis
(3) Parthenogenesis (4) Metamorphosis

90. Genetic recombination is due to
(1) Meiosis (2) Mitosis
(3) Fertilisation (4) None of these

91. Meiosis is evolutionary significant because it results in
(1) genetically similar daughters
(2) four daughter cells
(3) eggs and sperms
(4) recombinations

92. Meiosis in diploid organisms results in:
(1) production of gametes
(2) reduction in the number of chromosomes
(3) introduction of variation
(4) all of these

PRABAL EXERCISE-2 (LEARNING PLUS)

1. How many chromosomes will the cell have at G_1, after S and after M-phase respectively if it has 14 chromosomes?
(1) 7, 14, 14 (2) 14, 14, 14
(3) 14, 14, 7 (4) 7, 7, 7

2. The M phase starts with the nuclear division, corresponding to the separation of daughter chromosomes called ...**A**... and usually ends with division of cytoplasm, called ...**B**...
(1) A-Cytokinesis, B-Karyokinesis
(2) A-Interkinesis, B-Cytokinesis
(3) A-Karyokinesis, B-Cytokinesis
(4) A-Interkinesis, B-Karyokinesis

3. Read the following statements and find out the **incorrect** statement.
(1) In an animal cell, cytokinesis is achieved by the appearance of a furrow in the plasma membrane.
(2) In an animal cell, furrow formation starts in the centre of cell and grows outward to meet the existing lateral walls.
(3) Cell plate represents the middle lamella between the walls of two adjacent plant cells.
(4) During cytokinesis, organelles like mitochondria and plastids get distributed between the two daughter cells.

4. In some organisms, such as certain fungi and algae, cells undergo mitosis repeatedly without subsequently undergoing cytokinesis. What would result from this?
(1) A decrease in chromosome number
(2) Inability to duplicate DNA
(3) Division of the organism into many cells, most lacking nuclei
(4) Large cells containing many nuclei

5. If you are provided with root-tips of onion in your class and are asked to count the choromosomes, which of the following stages can you most conveniently look into?
(1) Telophase (2) Anaphase
(3) Prophase (4) Metaphase

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6. The two chromatids of a mitotic metaphase chromosome shows
(1) replicated chromosomes to be separated at anaphase
(2) homologous chromosomes of a haploid set
(3) non-homologous chromosomes joined at the centromere
(4) maternal and paternal chromosomes joined at the centromere

7. Which of the following is **true** for the mitotic spindle?
(1) It is composed of actin and myosin microfilaments.
(2) It is composed of kinetochores at the metaphase plate.
(3) It is composed of microtubules, which help in separating the chromosomes to opposite poles of he cell.
(4) None of these.

8. During which stages (or prophase-I substages) of meiosis, do you expect to find the bivalents formation and DNA replication respectively?
(1) Pachytene and interphase (between two meiotic divisions)
(2) Pachytene and interphase (just prior to prophase-I)
(3) Leptotene and S phase (of interphase just prior to prophase-I)
(4) Zygotene and S phase (of interphase prior to prophase I)

9. Identify the **wrong** statement about meiosis:
(1) Pairing of homologous chromosomes occurs
(2) Four haploid cells are formed
(3) At the end of meiosis, the number of chromosomes are reduced to half
(4) Two cycles of DNA replication occur

10. If the number of bivalents are 8 in metaphase-I, what shall be the number of chromosomes in daughter cells after meiosis-I and meiosis-II respectively?
(1) 8 and 4 (2) 4 and 4
(3) 8 and 8 (4) 16 and 8

11. A cell divides every one minute. At this rate of division it can fill a 100 mL of beaker in one hour. How much time does it take to fill a 50 mL beaker?
(1) 30 minutes (2) 60 minutes
(3) 59 minutes (4) 32 minutes

12. How many of the following events, belong to S-phase of cell cycle?
A. Doubling of amount of DNA per cell
B. Initiation of DNA replication
C. Division of centrioles
D. Synthesis of proteins for cell division
(1) None (2) One
(3) Two (4) Three

13. A human bone marrow cell, in prophase of mitosis, contains 46 chromosomes. How many chromatids does it contain altogether?
(1) 46
(2) 92
(3) 23
(4) 23 or 46, depending when during prophase you look

14. The absence of centrioles from higher plant cells means that during somatic cell nuclear division, there is:
(1) no apparent organisation of mitotic spindles.
(2) no equatorial arrangement of chromosomes at metaphase.
(3) no new cell wall laid down at telophase.
(4) no spindle formed.

15. 'X' ensures the production of 'Y' phase in the life cycle of sexually reproducing organisms whereas fertilization restores the 'Z' phase. Identify **X, Y** and **Z**.
(1) **X**- Mitosis, **Y** - haploid, **Z** - haploid
(2) **X**- Mitosis, **Y** - diploid, **Z** - diploid
(3) **X**- Meiosis, **Y** - haploid, **Z** - diploid
(4) **X**- Meiosis, **Y** - diploid, **Z** - diploid

16. Which statement is **true** for mitosis?
(1) Daughter cells exhibit division of labour, i.e., perform different functions
(2) Daughter cells are exactly similar in all respect
(3) Daughter cells have half the number of chromosomes as compared to mother cell
(4) Daughter cells have differences in genetic characters

17. Which one of the following statements that contrasts mitosis and meiosis is **correct**?
(1) Cell divides by cytokinesis only in mitosis
(2) DNA is replicated before the start of meiosis only
(3) Spindles consisting of microtubule form only in mitosis
(4) Exchange of genetic material occurs only in meiosis

18. Which one of the following options contain the **correct** order of meiotic events?
(1) Separation of sister chromatids, recombination, formation of the synaptonemal complex, separation of homologous chromosomes
(2) Separation of homologous chromosomes, formation of the synaptonemal complex, recombination, separation of sister chromatids
(3) Formation of synaptonemal complex, recombination, separation of sister chromatids, separation of homologous chromosomes
(4) Formation of the synaptonemal complex, recombination, separation of homologous chromosomes, separation of sister chromatids.

19. If a grasshopper cell contained 200 units of DNA during G_2. What would be the quantity of DNA in one of the 4 grasshopper cells at the end of telophase II of meiosis?
(1) 50 units
(2) 100 units
(3) Between 50 and 100 units
(4) 200 units

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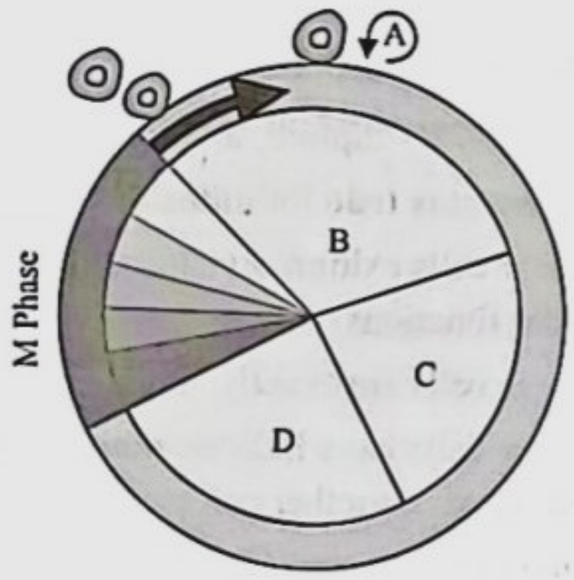
20. A zoologist examined an intestine cell from a crayfish and counted 200 chromosomes, each consists of 2 chromatids, at metaphase of mitosis. What would he expect to see in each of the four cells at telophase II of meiosis if he looked in the crayfish ovary?

(1) 50 chromosomes, each consisting of 2 chromatids
(2) 50 chromosomes, each consisting of 1 chromatid
(3) 100 chromosomes, each consisting of 2 chromatids
(4) 100 chromosomes, each consisting of 1 chromatid

21. Identify **A, B, C** and **D** in diagram depicting cell cycle correctly.



	A	B	C	D
(1)	G_0	G_1	S	G_2
(2)	G_0	G_1	G_2	S
(3)	S	G_1	G_0	G_2
(4)	G_2	S	G_1	G_0

22. **A, B** and **C** are three stages in the meiosis-I as given in diagrams:

A B C

The **correct** sequence of events is

(1) A → C → B
(2) A → B → C
(3) C → A → B
(4) C → B → A

23. X, Y and Z are three stages of cell division in meiosis. Choose the option with their **correct** identification:

X Y Z

	X	Y	Z
(1)	Metaphase-II	Anaphase-II	Prophase-II
(2)	Prophase-II	Anaphase-I	Prophase-I
(3)	Metaphase-I	Anaphase-I	Anaphase-II
(4)	Prophase-II	Anaphase-II	Prophase-I

24. Recognise the figure and find out the **correct** matching.

(A) (B) (C)

(1) A—Early prophase, B—late prophase, C—transition to metaphase
(2) B—Early prophase, C—late prophase, A—transition to metaphase
(3) C—Early prophase, A—late prophase, B—transition to metaphase
(4) B—Early prophase, A—late prophase, C—transition to metaphase

25. During which stage of mitosis and meiosis respectively, does the centromere of each chromosome split?

(1) Metaphase, Metaphase-II
(2) Prophase, Telophase-II
(3) Telophase, Anaphase-I
(4) Anaphase, Anaphase-II

26. Doubling the number of chromosomes can be achieved by disrupting mitotic cell division soon after

(1) Anaphase
(2) Metaphase
(3) Telophase
(4) Prophase

27. During mitosis, ER and nucleolus begin to disappear at

(1) Late prophase
(2) Early metaphase
(3) Late metaphase
(4) Early prophase

28. Mitotic spindle is mainly consists of which protein?

(1) Actin (2) Tubulin
(3) Myosin (4) Myoglobin

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29. At what stage of the cell cycle are histone proteins synthesized in a eukaryotic cell?

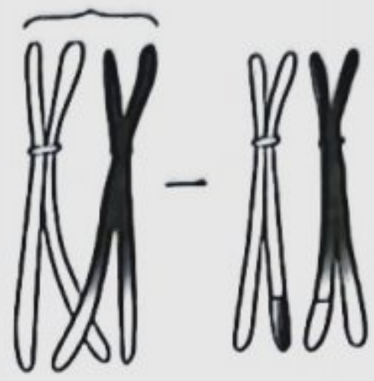
(1) During G_2 phase of prophase

(2) During S phase

(3) During entire prophase

(4) During telophase

30. Given below is the representation of a certain event at a particular stage of a type of cell division. What is this stage?



(1) Prophase of mitosis
(2) Both prophase and metaphase of mitosis
(3) Prophase-I during meiosis
(4) Prophase-II during meiosis

PARIKSHIT EXERCISE-3 (MULTICONCEPT)

MATCH THE COLUMN MCQs

1. Match the **List-I** with **List-II** and select the **correct** option:

	List-I		List-II
A.	Doubling of DNA	P.	Anaphase
B.	Double the number of chromosomes	Q.	Cytokinesis
C.	Double the number of cells	R.	S-phase
D.	Doubling of cell organelles	S.	G_1–phase

(1) A-R; B-P; C-Q; D-S
(2) A-P; B-R; C-S; D-Q
(3) A-S; B-Q; C-P; D-R
(4) A-Q; B-S; C-R; D-P

2. Match the **List-I** with **List-II** and select the **correct** option:

	List-I		List-II
A.	Anaphase–I	P.	Two daughter cells
B.	Anaphase–II	Q.	Separation of two genomes
C.	Metaphase-II	R.	One metaphasic plate
D.	Telophase-II	S.	Separation of two chromatids
		T.	Four daughter nuclei

(1) A-Q; B-S; C-P; D-R
(2) A-R; B-R; C-S; D-T
(3) A-Q; B-S; C-R; D-T
(4) A-R; B-Q; C-T; D-P

3. Match the **List-I** with **List-II** and select the **correct** option:

	List-I		List-II
A.	Crossing over	P.	Diplotene
B.	Synapsis	Q.	Zygotene
C.	Weakening of synaptonemal force	R.	Leptotene
D.	Terminalisation	S.	Pachytene
		T.	Diakinesis

(1) A-S; B-Q; C-P; D-T (2) A-T; B-R; C-Q; D-P
(3) A-S; B-Q; C-T; D-R (4) A-R; B-Q; C-S; D-T

4. Match the **List-I** with **List-II** and select the **correct** option:

	List-I		List-II
A.	Attraction between homologous chromosomes	P.	Crossing over
B.	Exchange of genetic material between homologous chromosomes	Q.	Synapsis
C.	Repulsion between homologous chromosomes	R.	Segregation
D.	Separation of homologous chromosomes	S.	Diplotene

(1) A-Q; B-P; C-S; D-R (2) A-P; B-R; C-S; D-Q
(3) A-S; B-Q; C-P; D-R (4) A-Q; B-S; C-R; D-P

5. Match the **List-I** with **List-II** and select the **correct** option:

	List-I		List-II
A.	Metaphase	P.	X-shaped structure
B.	Diplotene	Q.	Exchange of part of chromatid
C.	Diakinesis	R.	Study the shape of chromosomes
D.	Crossing over	S.	Terminalisation of chiasmata
		T.	Examine the structure of the chromosomes

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(1) A-S; B-P; C-Q; D-R (2) A-T; B-P; C-S; D-Q
(3) A-Q; B-S; C-T; D-P (4) A-T; B-P; C-R; D-S

6. Match the following and choose the **correct** option.

	List-I		List-II
A.	G_1 phase	P.	Cells remain metabolically active but do not proliferate.
B.	G_2 phase	Q.	Centriole duplication occurs.
C.	S phase	R.	Cell size increases
D.	G_0 Phase	S.	Proteins required for spindle fiber formation are synthesized.

(1) A-R; B-S; C-Q; D-P
(2) A-S; B-P; C-R; D-Q
(3) A-Q; B-S; C-R; D-P
(4) A-P; B-S; C-R; D-Q

7. Match the following and choose the **correct** option:

	List-I		List-II
A.	Interphase	P.	Shortest phase of interphase
B.	G_2 phase	Q.	Most dramatic phase of cell cycle
C.	M phase	R.	Resting phase of cell cycle
D.	G_1 phase	S.	Longest phase of interphase

(1) A-R; B-S; C-P; D-Q
(2) A-P; B-S; C-R; D-Q
(3) A-R; B-P; C-Q; D-S
(4) A-S; B-R; C-P; D-Q

8. Match the following and choose the **correct** option:

	List-I		List-II
A.	DNA content [2C] Chromosome no. [2n]	P.	G_1 phase
B.	DNA content [4C] Chromosome no. [2n]	Q.	G_2 phase
		R.	Go phase
		S.	S phase

(1) A-P & Q; B-R & S (2) A-R & S; B-P & Q
(3) A-Q & S; B-P & R (4) A-P & R; B-Q & S

9. Match the following and choose the **correct** option:

	List-I		List-II
A.	Prophase	P.	Increase in chromosome number
B.	Metaphase	Q.	Formation of compact mitotic chromosomes.
C.	Anaphase	R.	Chromosomes lose their individuality
D.	Telophase	S.	Morphology of chromosome can be studied easily

(1) A-R; B-P; C-S; D-Q (2) A-Q; B-S; C-P; D-R
(3) A-R; B-P; C-Q; D-S (4) A-S; B-R; C-P; D-Q

10. Match the following and choose the **correct** option:

	List-I		List-II
A.	Cytokinesis	P.	Equatorial plate formation
B.	Metaphase	Q.	Marks the end of cell cycle
C.	Coenocytic	R.	Marks the initiation of mitotic phase
D.	Karyokinesis	S.	Nuclear division is not followed by cytoplasmic division

(1) A-R; B-S; C-P; D-Q
(2) A-P; B-S; C-R; D-Q
(3) A-Q; B-P; C-S; D-R
(4) A-P; B-S; C-P; D-Q

11. Match the following and choose the **correct** option:

	List-I		List-II
A.	Meiosis	P.	Incrases genetic variability
B.	Mitosis	Q.	Gametogenesis
		R.	Ensures growth in multicellular organisms
		S.	Restore nucleoplasmic ratio

(1) A-P & Q; B-R & S (2) A-R, Q & S B-P
(3) A-R, S & P B-Q (4) A-R & P B-Q & S

12. Match the following and choose the **correct** option:

	List-I		List-II
A.	Telophase-I	P.	Splitting of centromere
B.	Anaphase-I	Q.	Dyad of cells
C.	Telophase-II	R.	Separation of homologous chromosome
D.	Anaphase-II	S.	Tetrad of cells

(1) A-R; B-P; C-S; D-Q
(2) A-Q; B-R; C-S; D-P
(3) A-R; B-P; C-Q; D-S
(4) A-Q; B-R; C-P; D-S

13. Match the following and choose the **correct** option:

	List-I		List-II
A.	Prophase-I	P.	Spindle fibre attach to kinetochores of sister chromatids
B.	Prophase-II	Q.	Typically longer and more complex than mitotic prophase
C.	Metaphase-I	R.	Initiates after a short lived intermediate stage
D.	Metaphase-II	S.	Formation of double equatorial plate

(1) A-R; B-P; C-Q; D-S
(2) A-R; B-Q; C-P; D-S
(3) A-Q; B-R; C-S; D-P
(4) A-Q; B-R; C-P; D-S

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CORRECT-INCORRECT PAIR MCQs

14. Find the **mismatched** pair.
    (1) Interphase - represents the phase between two successive M phases.
    (2) Yeast cells - Divide in every 90 minutes.
    (3) Human cells in culture - Divide in every 120 minutes.
    (4) M Phase - Phase of cell cycle when the actual cell division occurs.

15. Find the **mismatched** pair.
    (1) G_1 phase - Cell prepares proteins required for DNA replication.
    (2) S phase - DNA content doubles, [2C] but chromosome no. remains unchanged, [2n].
    (3) G_0 phase - Cells exit G_1 phase and enter in this stage.
    (4) G_2 phase - Cell prepare proteins required for it's division thereby stopping the cellular growth.

16. Find the **incorrect** matching pair.
    (1) Longest phase of M Phase - Metaphase
    (2) Shortest phase of interphase - G_2 phase
    (3) M phase - Maintains nucleocytoplasmic ratio
    (4) Interphase - Preparatory phase

17. Find the **mismatched** pair.
    (1) Kinetochores - Serves as the site of attachment of spindle fibres to the chromosomes.
    (2) Meiosis-II - Reductional division.
    (3) Heart cells - In some cases, at the end of the resting phase, DNA content is 2C, and chromosome no. is 2n.
    (4) Meiosis I - Brings genetic variability.

18. Find the **mismatched** pair.
    (1) Mitosis - Responsible for growth of multicellular organisms.
    (2) Mitosis - Cell repair
    (3) Metaphase plate - Plane of alignment of chromosomes
    (4) Meiosis - Reduces chromosome number across generations.

19. Find the **mismatched** pair.
    (1) DNA replication – G_1 phase
    (2) Centriole duplication - S phase
    (3) Tubulin protein synthesis - G_2 phase
    (4) Organelle duplication - G_2 phase

20. Choose the **mismatched** pair.
    (1) Karyokinesis – Division of centromere
    (2) Cytokinesis – Division of cytoplasm
    (3) S-phase – DNA synthesis
    (4) Synapsis – Pairing of homologous chromosomes

21. Find the **mismatched** pair.
    (1) Pachytene - Appearance of recombination nodules.
    (2) Diplotene - Short lived stage found in oocytes of some vertebrates.
    (3) Zygotene - Synaptonemal complex.
    (4) Diakinesis - Terminalistaion of chiasmata.

22. Find the **mismatched** pair.
    (1) Diakinesis - Nucleolus and the nuclear envelope disappears.
    (2) Diplotene - Completion of recombination between homologous chromosome marks beginning of this phase.
    (3) Pachytene – Recombinase enzyme is present.
    (4) Zygotene - Chromosomes condensation starts.

23. Find the **incorrect** pair.
    (1) Splitting of centromere of each chromosome - Anaphase-I
    (2) Appearance of double equatorial plate - Metaphase-I
    (3) Two haploid nuclei in single cell - Telophase-II
    (4) Gap between meiosis and Meiosis-II - Interkinesis

STATEMENT BASED QUESTIONS

24. Read the following statements carefully and choose the **correct** option.
    (1) During the division of a cell, only DNA replication takes place.
    (2) Crossing over is the exchange of genetic material between two homologous chromosomes.
    (3) Cells of the lining of the gut, and blood cells are being constantly replaced by meiotic division.
    (4) Chromosomes starts moving to the opposite poles during Metaphase.

25. Read the given statements.
    (I) Cell growth is a continuous process in terms of cytoplasmic increase.
    (II) The interphase lasts more than 95% of the duration of the cell cycle.
    (III) Karyokinesis involves the following four stages: Prophase, Metaphase, Anaphase & Telophase.
    (IV) Among the several asters coming out of the centrosome, only the two asters together with spindle fibers form a mitotic apparatus.

    Select the options containing **correct** statement(s);
    (1) I & II (2) I, II & III
    (3) I, III & IV (4) I, II, III & IV

26. Read the following statements carefully and choose the **incorrect** option.
    (1) The complex formed by a pair of synapsed homologous chromosomes is called a chromonemata.
    (2) DNA synthesis occurs only during one specific stage in the cell cycle.
    (3) Cell division does not stop with the formation of the mature organism.
    (4) Bivalent chromosomes align on the double equatorial plate.

27. Read the given statements regarding cell division.
    (I) M Phase starts with the nuclear division, and usually ends with division of cytoplasm.
    (II) Two metaphasic plates are formed at equator in mitosis.
    (III) Once the chromatids reach the two poles, the chromosomal decondensation starts, this stage is called Anaphase.

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(IV) The division in animal cells starts from the center and ends towards the periphery.

(V) Meiosis ensures the production of haploid phase in the life cycle of sexually reproducing organisms whereas fertilization restores the diploid phase.

How many statement(s) are **incorrect**?

(1) I (2) II
(3) III (4) All are correct

28. Read the given statements regarding cell cycle.

(I) The interphase, though called the resting phase, remains metabolically active throughout its span.

(II) The endosperm in coconut is a perfect example of syncytium condition.

(III) In the S phase, the new DNA molecules formed are not distinct.

(IV) Plants and animal cells follow different mechanisms for cytokinesis after karyokinesis.

How many statements are **correct**?

(1) I (2) II
(3) III (4) IV

29. Read the following statements carefully and choose the **incorrect** option.

(1) The plants can show mitotic divisions in both haploid and diploid cells.
(2) Centriole duplication occurs inside the nucleus.
(3) Cell-plate represents the middle lamella in a plant cell.
(4) Diplotene is recognised by the appearance of chiasmata.

30. Read the following statements carefully and choose the **incorrect** option.

(1) After the S phase the DNA content increases along with the chromosome number.
(2) Cell growth usually disturbs the ratio between the nucleus and the cytoplasm.
(3) Meiosis I is initiated after the parental chromosomes have replicated to produce identical sister chromatids at S phase.
(4) During Anaphase, the centromere of each chromosome remains directed towards the pole.

31. Read the given statements regarding cell division.

(I) The chromosomes are aligned at equator in the form of metaphasic plate during metaphase of mitosis.

(II) During telophase of mitosis, the centromere splits and chromatids separates.

(III) A very significant contribution of mitosis is cell repair.

(IV) Meiosis involves two sequential cycles of nuclear and cell division but only a single cycle of DNA replication.

Select the options containing **correct** statements;

(1) I & II (2) I, II & III
(3) I, III & IV (4) All are correct

32. Identify **wrong** pair of statements from the following:

A. DNA replication takes place in S phase.
B. Doubling of chromosomes occur in S phase of interphase.
C. Nuclei formed after meiosis-I are haploid.
D. Terminalization of chiasmata occurs in Anaphase-I.

(1) B and D (2) C and D
(3) A and B (4) A and D

33. Pick out the **correct** statement:

(1) Mitosis takes place in the somatic cells and meiosis takes place in the germ cells.
(2) During mitosis, the DNA replicates once for one cell division and in meiosis, the DNA replicates twice for two cell divisions.
(3) Mitosis and meiosis both are seen in bacteria.
(4) Mitosis takes place in germ cell and meiosis takes place in the somatic cells.

34. Pick out the **correct** statement(s) and choose the correct option:

A. Synapsis of homologous chromosomes take place during prophase I of meiosis.
B. Division of centromeres takes place during anaphase I of meiosis.
C. Spindle fibres disappear in telophase of mitosis.
D. Nucleoli reappear at telophase I of meiosis.

(1) A only (2) C only
(3) A and B (4) A, C and D

35. **Correct** statement is/are

A. Nuclear membrane and nucleolus reappear in telophase-I.
B. During metaphase-I, the bivalents arrange on the equatorial plate.
C. Metaphase is marked by the alignment of chromosome at the equatorial plate.
D. During mitosis, chromosome number of the parent is conserved in the daughter cell.
E. Cell division does not stop with the formation of the mature organism but continues throughout its life cycle.

(1) A, C and E (2) B only
(3) C and D (4) All of these

36. **Incorrect** statement is:

(1) Diplotene can last for months or years.
(2) In interkinesis, chromosomes do not reach the extremely extended state of the interphase nucleus.
(3) Meiosis-II is the equational division in which the chromosome number of the parent is conserved in the daughter cell.
(4) Mitosis is usually restricted to the haploid cells only.

37. Choose the **correct** statements (with respect to cell division).

A. Cell duplicates its genome.
B. Cell synthesises the other constituents.
C. The events of cell division are under genetic control.
D. M-phase starts with increase in number of cell organelles and decondensation of chromosomes.

(1) A & D
(3) A, B &

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(3) A, B & D (4) A, B & C

Directions: In the questions from 38 to 47 two statements are given as **Statement-I** and **Statement-II.**

Mark the correct choice as:

(1) Both **Statement-I** and **Statement-II** are correct
(2) Both **Statement-I** and **Statement-II** are incorrect
(3) **Statement-I** is correct and **Statement-II** is incorrect
(4) **Statement-I** is incorrect and **Statement-II** is correct

38. **Statement-I:** By the end of diakinesis, the nucleolus and the nuclear envelope disappears.
Statement-II: Meiosis is the mechanism by which specific chromosome numbers are maintained across generations even though the process reduces chromosome number by half.

39. **Statement-I:** Variations induced by the process of meiosis can be lethal or harmful in the process of evolution.
Statement-II: Interphase is further subdivided into G_1, S and G_2 phase.

40. **Statement-I:** In animals, mitotic cell division is only seen in the diploid somatic cells without exception.
Statement-II: Mitosis has been divided into four stages of cellular division.

41. **Statement-I:** The interphase of a human cell lasts more than 95% of the duration of cell cycle.
Statement-II: In telophase, chromosomes reach their respective poles and thereby lose their individuality.

42. **Statement-I:** Telophase is marked by reappearance of nucleolus; cytokinesis follows and forms dyad of cells.
Statement-II: Only some plants can show mitotic divisions in both haploid and diploid cells.

43. **Statement-I:** During diakinesis, chromosomes are being condensed and the meiotic spindle starts assembling across the cell.
Statement-II: In an animal cell, cytoplasmic division is achieved by the appearance of a furrow in the plasma membrane.

44. **Statement-I:** Centrosome undergoes duplication during interphase.
Statement-II: In plant cells, wall formation starts at the cell wall which grows towards the centre.

45. **Statement-I:** Cell-plate between the walls of two adjacent cells is a characteristic feature of animal cells.
Statement-II: Meiosis involves pairing of homologous chromosomes and recombination between two sister chromatids of homologous chromosomes.

46. **Statement-I:** Karyokinesis is not followed by cytokinesis as a result of which a multinucleate condition arises leading to the formation of syncytium.
Statement-II: Cell growth disturbs the ratio between the nucleus and the cytoplasm.

47. **Statement-I:** Liquid endosperm in coconut is an example of syncytium condition.
Statement-II: Crossing over is an enzyme-mediated process and the enzyme involved is called transferase.

Directions: In the following questions, a statement of **Assertion** is followed by a statement of **Reason.**

Mark the correct choice as:

(1) Both **Assertion (A)** and **Reason (R)** are True and the **Reason (R)** is a correct explanation of the **Assertion (A).**
(2) Both **Assertion (A)** and **Reason (R)** are True but **Reason (R)** is not a correct explanation of the **Assertion (A).**
(3) **Assertion (A)** is True but the **Reason (R)** is False.
(4) **Assertion (A)** is False but the **Reason (R)** is True.

48. **Assertion (A):** Cell division is a very important process in all living organisms.
Reason (R): During the division of a cell, DNA replication and cell growth also take place.

49. **Assertion (A):** Prophase which is the first stage of karyokinesis is longest among all its stages.
Reason (R): Prophase is characterized by condensation of chromosomes only.

50. **Assertion (A):** At metaphase stage, the morphology of chromosomes is most easily studied.
Reason (R): Complete disintegration of the nuclear envelope and condensation of chromosomes is completed at the start of this stage.

51. **Assertion (A):** The condensed chromosomes are characterized by the appearance of two sister chromatids held together by a disc shaped proteinaceous structure called kinetochore.
Reason (R): Kinetochores serve as the sites of attachment of spindle fibres to the chromosomes.

52. **Assertion (A):** The cytoplasmic division of plant cells occurs from center to periphery that is centrifugally.
Reason (R): The formation of the new cell wall in plants begins with the formation of a simple precursor, called the cell-plate that represents the middle lamella.

53. **Assertion (A):** Meiosis increases the genetic variability in the population of organisms from one generation to the next.
Reason (R): Pachytene, a stage of Meiosis I is characterized by the appearance of recombination nodules, the sites at which crossing over occurs.

54. **Assertion (A):** M phase or Mitotic phase is also known as equational division.
Reason (R): Mitotic phase is known to conserve specific chromosome number across generations.

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PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. Among eukaryotes, replication of DNA takes place in; **(2023)**
   (1) S phase (2) G_1 phase
   (3) G_2 phase (4) M phase

2. Which of the following stages of meiosis involves division of centromere? **(2023)**
   (1) Metaphase-II (2) Anaphase-II
   (3) Telophase (4) Metaphase-I

3. The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis? **(2023)**
   (1) Pachytene (2) Diplotene
   (3) Diakinesis (4) Zygotene

4. Match **List-I** with **List-II.** **(2023)**

	List-I		List-II
A.	M Phase	I.	Proteins are synthesized
B.	G_2 Phase	II.	Inactive phase
C.	Quiescent stage	III.	Interval between mitosis and initiation of DNA replication
D.	G_1 phase	IV.	Equational division

   Choose the correct answer from the options given below;
   (1) A-IV, B-II, C-I, D-III (2) A-IV, B-I, C-II, D-III
   (3) A-II, B-IV, C-I, D-III (4) A-III, B-II, C-IV, D-I

5. Select the **correct** statements. **(2023)**
   A. Tetrad formation is seen during Leptotene.
   B. During Anaphase, the centromeres split and chromatids separate.
   C. Terminalization takes place during Pachytene.
   D. Nucleolus, Golgi complex and ER are reformed during Telophase.
   E. Crossing over takes place between sister chromatids of homologous chromosome.
   Choose the **correct** answer from the options given below:
   (1) B and D only (2) A, C and E only
   (3) B and E only (4) A and C only

6. Given below are two statements: **(2023)**
   Statement-I: During G_0 phase of cell cycle, the cell is metabolically inactive.
   Statement-II: The centrosome undergoes duplication during S phase of interphase.
   In the light of the above statements, choose the most appropriate answer from the options given below:
   (1) Both **Statement-I** and **Statement-II** are incorrect.
   (2) **Statement-I** is correct but **Statement-II** is incorrect.
   (3) **Statement-I** is incorrect but **Statement-II** is correct.
   (4) Both **Statement-I** and **Statement-II** are correct.

7. Doubling of the number of chromosomes can be achieved by disrupting mitotic cell division soon after; **(2023 manipur)**
   (1) Anaphase (2) Telophase
   (3) Prophase (4) Metaphase

8. The dissolution of synaptonemal complex during; **(2023 manipur)**
   (1) Pachytene (2) Diplotene
   (3) Diakinesis (4) Leptotene

9. During which stages of mitosis and meiosis, respectively does the centromere of each chromosome split? **(2023 manipur)**
   (1) Metaphase, Metaphase-II
   (2) Prophase, Telophase-I
   (3) Telophase, Anaphase-I
   (4) Anaphase, Anaphase-II

10. Select **correct** sequence of substages of Prophase of Meiotic division. **(2023 manipur)**
   A. Zygotene B. Pachytene
   C. Diakinesis D. Leptotene
   E. Diplotene
   Choose the **correct** answer from the options give below;
   (1) D, B, A, E, C (2) A, B, D, E, C
   (3) D, A, B, E, C (4) A, D, B, C, E

11. Which one of the following is the quiescent stage of cell cycle? **(2023 manipur)**
   (1) M (2) G_2
   (3) G_1 (4) Go

12. Which one of the following never occurs during mitotic cell division? **(2022)**
   (1) Coiling and condensation of the chromatids
   (2) Spindle fibres attach to kinetochores of chromosomes
   (3) Movement of centrioles towards opposite poles
   (4) Pairing of homologous chromosomes

13. The appearance of recombination nodules on homologous chromosomes during meiosis characterises : **(2022)**
   (1) Terminalisation
   (2) Synaptonemal complex
   (3) Bivalent
   (4) Sites at which crossing over occurs

14. Regarding Meiosis, which of the statements is **incorrect?** **(2022)**
   (1) Four haploid cells are formed at the end of Meiosis-II
   (2) There are two stages in Meiosis, Meiosis-I and II
   (3) DNA replication occurs in S phase of Meiosis-II
   (4) Pairing of homologous chromosomes and recombination occurs in Meiosis-I

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15. Select the **incorrect** statement with reference to mitosis; **(2022)**
(1) Splitting of centromere occurs at anaphase.
(2) All the chromosomes lie at the equator at metaphase.
(3) Spindle fibres attach to centromere of chromosomes.
(4) Chromosomes decondense at telophase.

16. Which stage of meiosis can last for months or years in the oocytes of some verterbrates? **(2022 phase 2)**
(1) Leptotene (2) Pachytene
(3) Diplotene (4) Diakinesis

17. In meiosis, crossing over and exchange of genetic material between homologous chromosomes are catalysed by the enzyme. **(2022 phase 2)**
(1) Phosphorylase (2) Recombinase
(3) Transferase (4) Polymerase

18. Identify the **correct** sequence of events during Prophase I of meiosis; **(2022 phase 2)**
(a) Synapsis of homologous chromosomes
(b) Chromosomes become gradually visible under microscope
(c) Crossing over between non-sister chromatids of homologous chromosomes
(d) Terminalisation of chiasmata
(e) Dissolution of synaptonemal complex
Choose the **correct** answer from the options given below :
(1) (a), (b), (c), (d), (e) (2) (b), (c), (d), (e), (a)
(3) (b), (a), (c), (e), (d) (4) (a), (c), (d), (e), (b)

19. Which of the following stages of meiosis involves division of centromere? **(2021)**
(1) Metaphase-II (2) Anaphase-II
(3) Telophase-II (4) Metaphase-I

20. Match **List-I** with **List-II** **(2021)**

	List-I		List-II
A.	S phase	(i)	Proteins are synthesised
B.	G_2 phase	(ii)	Inactive phase
C.	Quiescent stage	(iii)	Interval between mitosis and initiation of DNA replication
D.	G_1 phase	(iv)	DNA replication

Choose the **correct** answer from the options given below.
(1) A-(iv); B-(ii); C-(iii); D-(i)
(2) A-(iv); B-(i); C-(ii); D-(iii)
(3) A-(ii); B-(iv); C-(iii); D-(i)
(4) A-(iii); B-(ii); C-(i); D-(iv)

21. The fruit fly has 8 chromosomes (2n) in each cell. During interphase of mitosis if the number of chromosomes at G_1 phase is 8, what would be the number of chromosomes after S phase? **(2021)**
(1) 16 (2) 4 (3) 32 (4) 8

22. Which stage of meiotic prophase shows terminalisation of chiasmata as its distinctive feature? **(2021)**
(1) Zygotene (2) Diakinesis
(3) Pachytene (4) Leptotene

23. The centriole undergoes duplication during: **(2021)**
(1) Prophase (2) Metaphase
(3) G_2 phase (4) S-phase

24. Match the following with respect to meiosis: **(2020)**

	Lists-I		List-II
A.	Zygotene	I.	Terminalization
B.	Pachytene	II.	Chiasmata
C.	Diplotene	III.	Crossing over
D.	Diakinesis	IV.	Synapsis

Select the correct option from the following:

	A	(B)	(C)	(D)
(1)	(IV)	(III)	(II)	(I)
(2)	(I)	(II)	(IV)	(III)
(3)	(II)	(IV)	(III)	(I)
(4)	(III)	(IV)	(I)	(II)

25. Some dividing cells exit the cell cycle and enter vegetative inactive stage. This is called quiescent stage (G_0). This process occurs at the end of; **(2020)**
(1) G_1 phase (2) S phase
(3) G_2 phase (4) M phase

26. In a mitotic cycle, the correct sequence of phases is; **(2020 Covid)**
(1) G_1, S, G_2, M (2) M, G_1, G_2, S
(3) G_1, G_2, S, M (4) S, G_1, G_2, M

27. Attachment of spindle fibers to kinetochores of chromosomes becomes evident in; **(2020 Covid)**
(1) Telophase (2) Prophase
(3) Metaphase (4) Anaphase

28. Match the following events that occur in their respective phases of cell cycle and select the correct option: **(2020 Covid)**

	List-I		List-II
A.	G_1 phase	(I)	Cell grows and organelle duplication
B.	S phase	(II)	DNA replication and chromosome duplication
C.	G_2 phase	(III)	Cytoplasmic growth
D.	Metaphase in M-phase	(IV)	Alignment of chromosomes

	(A)	(B)	(C)	(D)
(1)	(III)	(IV)	(I)	(II)
(2)	(IV)	(I)	(II)	(III)
(3)	(I)	(II)	(III)	(IV)
(4)	(II)	(III)	(IV)	(I)

29. Identify the **correct** statement with regard to G_1 phase (Gap 1) of interphase. **(2020)**
(1) Reorganisation of all cell components takes place.
(2) Cell is metabolically active, grows but does not replicate its DNA.
(3) Nuclear division takes place.
(4) DNA synthesis or replication takes place.

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30. Dissolution of the synaptonemal complex occurs during; (2020)
(1) Zygotene (2) Diplotene
(2) Leptotene (4) Pachytene

31. During Meiosis-I, in which stage synapsis takes place? (2020 Covid)
(1) Zygotene (2) Diplotene
(3) Leptotene (4) Pachytene

32. The correct sequence of phases of cell cycle is: (2019)
(1) $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$ (2) $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$
(3) $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$ (4) $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

33. Cell in G_0 phase (2019)
(1) Exit the cell cycle
(2) Enter the cell cycle
(3) Suspend the cell cycle
(4) Terminate the cell cycle

34. After meiosis-I, the resultant daughter cells have (2019 odisha)
(1) same amount of DNA as in the parent cell in S
(2) twice the amount of DNA in comparison to haploid
(3) same amount of DNA in comparison to haploid gamete
(4) four times the amount of DNA in comparison to haploid gamete

35. Crossing over takes place between which chromatids and in which stage of the cell cycle? (2019 odisha)
(1) Non-sister chromatids of non-homologous chromosomes at Zygotene stage of prophase-I.
(2) Non-sister chromatids of homologous chromosomes at Pachytene stage of prophase-I.
(3) Non-sister chromatids of homologous chromosomes at Zygotene stage of prophase-I.
(4) Non-sister chromatids of non-homologous chromosomes at Pachytene stage of prophase-I.

36. The stage during which separation of the paired homologous chromosomes begins is; (2018)
(1) Pachytene (2) Diplotene
(3) Diakinesis (4) Zygotene

37. Anaphase promoting complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cells. If APC is defective in a human cell, which of the following is expected to occur? (2017-Delhi)
(1) Chromosomes will not condense
(2) Chromosomes will be fragmented
(3) Chromosomes will not segregate
(4) Recombination of chromosome arms will occur

38. Which of the following options gives the correct sequence of events during mitosis? (2017-Delhi)
(1) Condensation → Nuclear membrane disassembly → Crossing over → Segregation → Telophase
(2) Condensation → Nuclear membrane disassembly → Arrangement at equator → Centromere division → Segregation → Telophase
(3) Condensation → Crossing over → Nuclear membrane disassembly → Segregation → Telophase
(4) Condensation → Arrangement at equator → Centromere division → Segregation → Telophase

39. DNA replication in bacteria occurs: (2017-Delhi)
(1) During S-phase (2) Within nucleolus
(3) Prior to fission (4) Just before transcription

40. Which of the following statements is correct with respect to cell cycle? (2017-Gujarat)
(1) DNA content of cell remains constant during entire cell cycle
(2) A cell in G_1 phase has double the amount of DNA than a cell in G_2 phase
(3) Each chromosome has two chromatids in G_1 phase
(4) Nerve cells in adult human are in G_0 state

Answer Key

CONCEPT APPLICATION

1. True 2. True 3. False 4. True 5. False
6. Resting phase, active 7. S 8. more than 95% 9. True 10. True
11. False 12. True 13. True 14. True 15. True
16. Asters 17. Metaphase 18. (*i*) Metaphase, (*ii*) Anaphase (*iii*) Telophase 19. True
20. True 21. False 22. True 23. True 24. True
25. True 26. True 27. Synaptonemal complex
28. (*i*) Diakinesis, (*ii*) Metaphase I, (*iii*) Diplotene, (*iv*) Telophase I, (*v*) Interkinesis

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NCERT FOCUSED FILL-INS

1. Replication
2. 90
3. M
4. Chromosome
5. Mitosis
6. Opposite
7. Kinetochore
8. Metaphasic plate
9. Spindle fibres
10. Golgi complex
11. Middle lamella
12. Coconut
13. Nucleo-cytoplasmic
14. Meristematic
15. Haploid
16. Recombination
17. Four
18. Synaptonemal complex
19. Crossovers
20. X
21. Chiasmata
22. Oocytes
23. Diplotene
24. Sister chromatids
25. Dyad
26. Short-lived
27. Mitosis
28. Centromere
29. Kinetochores
30. Four
31. Evolution
32. Diploid

SCHOOL LEVEL PROBLEMS

Single Correct Type Questions

1. (1) 2. (4) 3. (4) 4. (2) 5. (4) 6. (3) 7. (3) 8. (4) 9. (3) 10. (2)

Assertion and Reason Type Questions

1. (1) 2. (3) 3. (3)

Case Study Based Questions

Case-I: 1. (3) 2. (2)

Case-II: 1. (1) 2. (2) 3. (2)

PRARAMBH EXERCISE-1 (TOPICWISE)

1. (2)	2. (3)	3. (2)	4. (1)	5. (3)	6. (1)	7. (2)	8. (4)	9. (3)	10. (2)
11. (1)	12. (1)	13. (4)	14. (1)	15. (4)	16. (4)	17. (1)	18. (3)	19. (1)	20. (3)
21. (4)	22. (4)	23. (4)	24. (3)	25. (2)	26. (4)	27. (2)	28. (3)	29. (3)	30. (2)
31. (4)	32. (1)	33. (2)	34. (1)	35. (3)	36. (2)	37. (3)	38. (1)	39. (2)	40. (3)
41. (1)	42. (4)	43. (4)	44. (1)	45. (2)	46. (1)	47. (2)	48. (1)	49. (4)	50. (4)
51. (2)	52. (1)	53. (4)	54. (4)	55. (2)	56. (3)	57. (2)	58. (4)	59. (1)	60. (4)
61. (3)	62. (2)	63. (4)	64. (3)	65. (3)	66. (4)	67. (1)	68. (3)	69. (3)	70. (2)
71. (2)	72. (3)	73. (2)	74. (3)	75. (2)	76. (1)	77. (2)	78. (3)	79. (2)	80. (2)
81. (4)	82. (2)	83. (1)	84. (1)	85. (2)	86. (1)	87. (2)	88. (4)	89. (2)	90. (1)
91. (4)	92. (4)								

PRABAL EXERCISE-2 (LEARNING PLUS)

1. (2)	2. (3)	3. (2)	4. (4)	5. (4)	6. (1)	7. (3)	8. (4)	9. (4)	10. (3)
11. (3)	12. (4)	13. (2)	14. (1)	15. (3)	16. (2)	17. (4)	18. (4)	19. (1)	20. (4)
21. (1)	22. (3)	23. (2)	24. (1)	25. (4)	26. (2)	27. (1)	28. (2)	29. (2)	30. (3)

PARIKSHIT EXERCISE-3 (MULTICONCEPT)

1. (1)	2. (3)	3. (1)	4. (1)	5. (2)	6. (1)	7. (3)	8. (4)	9. (2)	10. (3)
11. (1)	12. (2)	13. (3)	14. (3)	15. (4)	16. (1)	17. (2)	18. (4)	19. (1)	20. (1)
21. (2)	22. (4)	23. (1)	24. (2)	25. (2)	26. (1)	27. (3)	28. (4)	29. (2)	30. (1)
31. (3)	32. (1)	33. (1)	34. (4)	35. (4)	36. (4)	37. (4)	38. (1)	39. (4)	40. (2)
41. (1)	42. (3)	43. (4)	44. (3)	45. (2)	46. (1)	47. (3)	48. (2)	49. (3)	50. (1)
51. (4)	52. (2)	53. (2)	54. (3)						

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

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

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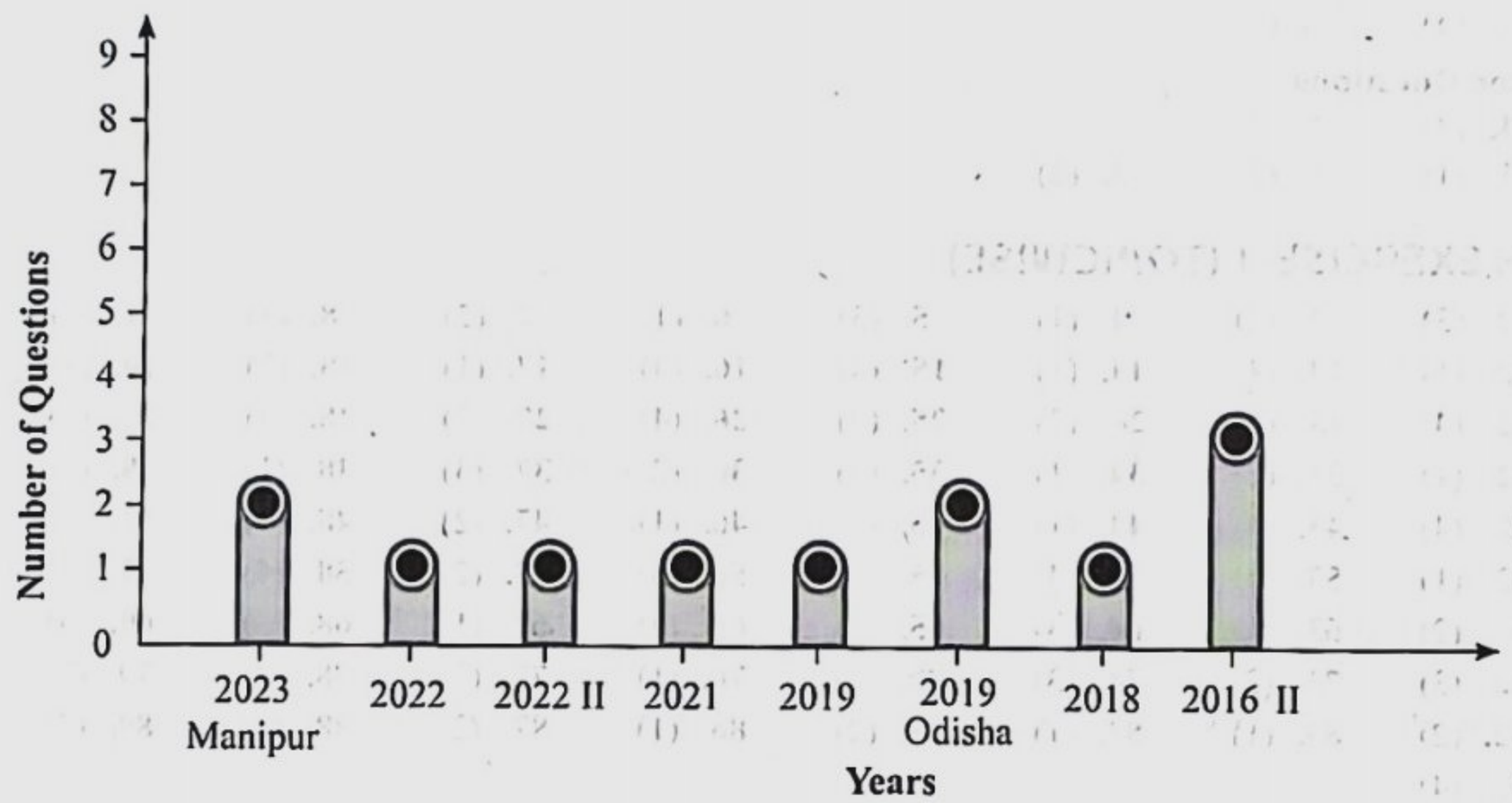
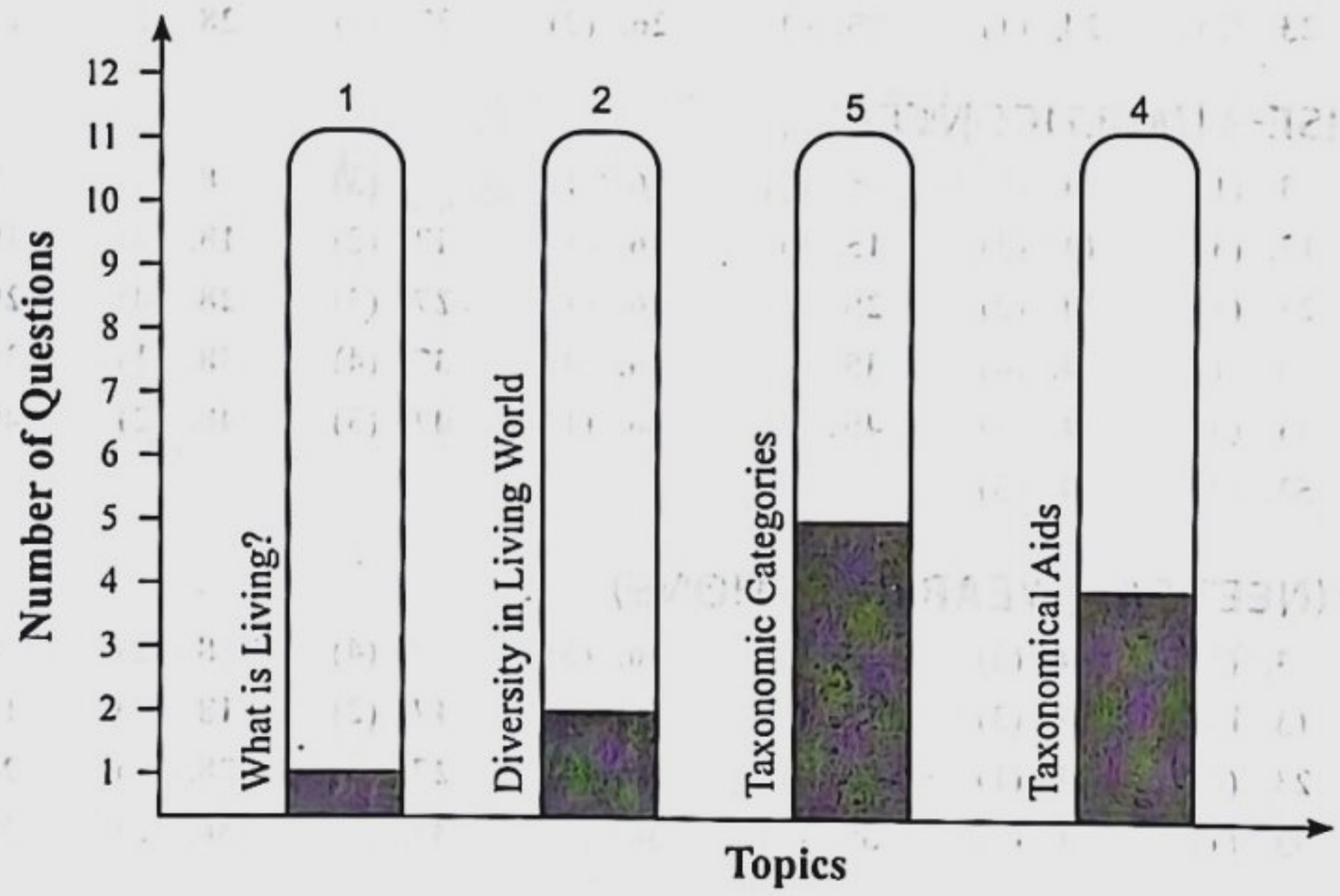
CHAPTER 3

The Living World

Year Wise Number of Questions Analysis (2023-2014)



Topicwise Number of Questions Analysis (2023-2014)



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INTRODUCTION

- The living world is a complex network of interconnected organisms that engage in metabolism, reproduction, and response to environmental cues. We are aware of how intricately connected everything in the living world is. The diversity of living forms on earth gives it a wonderful environment to live and thrive. The abundance of diversity suggests the presence of numerous species with unique characteristics. The fact that an organism is either a living thing or a non-living entity is its most striking characteristic. As a result, in order to distinguish between a living item and a non-living one, we first need to define what a "living being" actually is.

WHAT IS 'LIVING'?

- Any life form that exhibits or possesses the qualities of life or being alive is referred to as a living thing. The basic traits include having an organized structure, requiring energy, reacting to stimuli and changing their surroundings, and having the ability to reproduce, grow, move, metabolize, and die.
- The living beings live in different types of habitats like forests, mountains, deserts, oceans, freshwater bodies, hot springs, polar regions, etc.
- There are certain distinctive characteristics exhibited by living organisms which distinguish them from non-living.

Unique Characteristics of Living Organisms

- The most distinctive features exhibited by living organisms include:

Growth

- All living organisms have the capacity to grow.
- In plants, 1*..... occurs continuously throughout their life span. In animals, this growth is seen only up to a certain age. However, cell division occurs in certain tissues to replace lost cells throughout life.
- Growth of an individual organism has **two** characteristics **(twin characters):**
  - Increase in 2.....
  - Increase in number of individuals
- In majority of higher animals and plants, growth and reproduction are **mutually exclusive events.** One must remember that increase in 3..... is considered as growth.
- Unicellular organisms grow by cell division. One can easily observe this in *in vitro* cultures by simply counting the number of cells under the microscope.
- Non-living objects also grow by accumulation of material on the surface. E.g., mountains, boulders and 4..... Growth, therefore, **cannot** be taken as a 5..... property of living organisms.
- A dead organism does not grow.

Key Note

- In living organisms, the growth is internal but in non-living organisms, the growth is external.

Reproduction

- Reproduction is a characteristic of living organisms.
- No non-living object is capable of reproducing or replicating by itself.
- In multicellular organisms, reproduction refers to the **production of progeny** possessing features more or less similar to those of parents.
- Organisms reproduce by both sexual and asexual means. For example, fungi multiply and spread easily due to the millions of asexual spores they produce.

Key Note

- In majority of higher animals and plants, growth and reproduction are mutually exclusive events.

- The lower organisms like yeast and 6....., reproduce by budding. In *Planaria* (flat worms), the mode of reproduction is **true regeneration**, i.e., a fragmented organism regenerates the lost part of its body and becomes a new organism.
- The fungi, the filamentous algae, the protonema of mosses, all easily multiply by fragmentation.
- In unicellular organisms such as bacteria, unicellular algae or *Amoeba*, reproduction is 7..... with growth, i.e., increase in number of cells.

Key Note

- Many organisms such as mules, sterile worker bees, infertile human couples, etc., do not reproduce. Hence, reproduction also **cannot** be an all-inclusive defining characteristic of living organisms.

Metabolism and Cellular Organisation

- All living organisms are made up of chemicals. These chemicals, small and big, belonging to various classes, sizes, functions, etc., are constantly being made and changed into some other biomolecules. These conversions are **chemical reactions or metabolic reactions.**

1* *"NCERT Focused Fill-ins" is an exercise with blanks in textbook passages that students fill in to test their NCERT-based knowledge and grasp over NCERT Textbook.*

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- The sum total of all the **8**..... reactions occurring in our body is called **metabolism**.
- It is of two types anabolism and catabolism. Anabolism is otherwise called constructive metabolism e.g., Photosynthesis, nutrition, synthesis of starch from glucose, synthesis of lipids from fatty acids and alcohols, synthesis of proteins from amino acids.
- Catabolism is otherwise called destructive metabolism. It is mainly concerned with the breakdown of the organic nutrients into simple substances e.g., respiration involves oxidative breakdown of glucose to release energy.
- No non-living object exhibits metabolism.
- An isolated metabolic reaction outside the body of an organism, performed in a test tube is neither living nor non-living. Hence, **9**..... is a **defining feature** of all living organisms **without exception**, isolated metabolic reactions *in vitro* are not living things but surely living reactions. Hence, cellular organisation of the body is the **defining feature of life forms**.

Conciousness

- The most obvious and technically complicated feature of all living organisms is the ability to sense their surroundings or environment and respond to these environmental stimuli which could be physical, chemical or biological.
- All organisms, from the prokaryotes to the most complex eukaryotes can sense and respond to environmental cues. Plants respond to external factors like light, water, temperature, other organisms, pollutants, etc.
- Photoperiod affects reproduction in seasonal breeders, both plants and animals. All organisms handle chemicals entering their bodies.
- All organisms therefore are **'aware'** of their surroundings.

Key Note

- Human being is the only organism who is aware of himself, i.e., has **self-consciousness**. Consciousness therefore becomes the **defining property** of living organisms.

key Note

- "Living organisms are self-replicating, evolving and self-regulating interactive systems capable of responding to external stimuli."
- All living organisms – present, past and future, are linked to one another by the sharing of the common genetic material, but to varying degrees.

Need to Know

- Patients lying in coma in hospitals virtually supported by machines which replace heart and lungs. The patient is otherwise brain-dead. The patient has no self-consciousness. Such patients who never come back to normal life are considered neither living or non-living.
- Exclusive characteristics are specific to certain types of organisms and are not universally shared, while inclusive characteristics are fundamental traits found in all living organisms. These characteristics play a vital role in defining and distinguishing living organisms from non-living entities

Concept Application

True and False:

1. Increase in mass and increase in number of individuals are twin characteristics of growth.
2. In animals, growth by cell division occurs continuously throughout their life span.
3. In majority of higher animals and plants, growth and reproduction are mutually exclusive events.
4. In non-living objects, growth is from inside.
5. Fungi multiply by asexual spores and yeast and *Hydra* by budding.
6. In multicellular organisms, reproduction is synonymous with growth.
7. Reproduction cannot be an all-inclusive defining characteristic of living organisms.
8. The most obvious and technically complicated feature of all living organisms is this ability to sense their surroundings or environment and respond to these environmental stimuli.
9. Consciousness is not the defining property of living organisms.

Fill in the Blanks:

10. The sum total of all the chemical reactions occurring in our body is _____.
11. _____ and _____ are the defining features of living organisms.

DIVERSIT

- Biodiversity
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Taxonomy

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DIVERSITY IN THE LIVING WORLD

- Biodiversity refers to the number and types of different organisms present on earth.
- The number of species that are known and described range between **1.7 - 1.8 million.** This refers to the **10**..... present on earth.
- There are millions of plants and animals in the world which have different local names.
- To avoid confusion, there is a need to standardise the naming of living organisms so that a particular organism is known by the same name all over the world. This process is called **11**.....
- Nomenclature or naming is only possible when the organism is described correctly and we know to what organism the name is attached to. This is **12**.....

Common Names

In biology, a vernacular name of a taxon or organism (also known as a common name, English name, colloquial name, trivial name, trivial epithet, country name, popular name, or farmer's name) is a name that is based on the normal language of everyday life.

Disadvantages of Common Names

- Since vernacular names often have a local distribution, a single species may have several vernacular names or a single vernacular name often applies to various species due to language differences.
- Because of ignorance of relevant biological facts among the lay public, a single species may be called by several vernacular names, because individuals in the species differ in appearance depending on their maturity, gender, or can vary in appearance as a morphological response to their natural surroundings.
- Many species, generally lacking economic importance, do not have a vernacular name.

Scientific Names

- These are the names given to the organisms by biologists based on universally accepted principles and criteria.
- The scientific names ensure that each organism has only one name. Description of any organism should enable the people (in any part of the world) to arrive at the same name.
- They also ensure that such a name has not been used for any other known organism.
- To accomplish this, certain international codes have been established. These codes are
  - **ICBN**-International Code for Botanical Nomenclature
  - **ICZN**-International Code of Zoological Nomenclature

Taxonomy

- Since it is nearly impossible to study all the living organisms, it is necessary to devise some means to make this possible, the solution is classification. Classification is the process by which anything is grouped into convenient categories based on some easily observable characters.
- For example, we easily recognise groups such as plants or animals or dogs, cats or insects. The moment we use any of these terms, we associate certain characters with the organism in that group. What image do you see when you think of a dog? Obviously, each one of us will see 'dogs' and not 'cats'.
- Similarly, suppose we were to say 'mammals', you would, of course, think of animals with external ears and body hair.
- Likewise, in plants, if we try to talk of 'Wheat', the picture in each of our minds will be of wheat plants, not of rice or any other plant.
- Hence, all these - 'Dogs', 'Cats', 'Mammals', 'Wheat', 'Rice', 'Plants', 'Animals', etc., are convenient categories we use to study organisms. The scientific term for these categories is **13**.....
- **Taxa** are the hierarchical divisions of a species from Kingdom to subspecies.
- Taxa can indicate categories at very different levels. 'Plants' – also form a taxa. 'Wheat' is also a taxa. Similarly, 'animals', 'mammals', 'dogs' are all taxa – but you know that a dog is a mammal and mammals are animals. Therefore, 'animals', 'mammals' and 'dogs' represent taxa at different levels.
- Based on characteristics, all living organisms can be classified into different taxa. This process of classification is **14**.....
- External and internal structure, along with the structure of cell, development process and ecological information of organisms are essential and form the basis of modern taxonomic studies.
- Hence, **15**....., identification, classification and nomenclature are the processes that are basic to taxonomy.

Taxonomy Includes

- **Characterisation:** It is based on the understanding of characters of organisms like their external and internal structure (morphology and anatomy), the structure of the cell (cytology), developmental process (embryology) and ecological information (ecology).
- **Identification:** It is the **correct description of organism** to determine the exact place or position in taxonomic arrangement of taxonomy.
- **Classification:** It is the **placing** of an organism or a group of organisms into convenient categories based on easily observable characteristics.
- **Nomenclature:** The **naming of living organisms** such that a particular organism is known by the same name all over the world is called nomenclature.

Systematics

- It is the study of different kinds of organisms, their diversities and relationships among them.
- The word 'systematics' is derived from the Latin word 'Systema' which means systematic arrangement of organisms.
- Linnaeus used *Systema Naturae* as the title of his publication.
- Systematics takes into account **16**..... relationships between organisms.
- The scope of systematics was later enlarged to include identification, nomenclature and classification.

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Binomial Nomenclature

- Binomial nomenclature was proposed by Carolus Linnaeus.
- In binomial nomenclature, each scientific name has two components-
  - **Generic name (genus)**
  - **Specific epithet (species)**
- Example, *Mangifera indica* Linn. Here *Mangifera* is the genus name and *indica* represents the species. Linn. indicates that this species was first described by Linnaeus.

Universal Rules of Nomenclature

- Biological names are generally in Latin and written in italics. They are Latinised or derived from Latin irrespective of their origin.
- The first word in a biological name represents the genus while the second component denotes the specific epithet.
- Both the words in a biological name, when handwritten, are separately underlined, or printed in italics to indicate their **17**..... origin.
- The first word denoting the genus starts with a capital letter while the specific epithet starts with a small letter. It can be illustrated with the example of *Mangifera indica*.
- The name of the **18**..... is written in an **abbreviated form** after the species epithet (at the end of the biological name).

Advantages of Binomial Nomenclature

- The biological name are same all over the world.
- They are definite and accepted universally.
- All newly discovered plants and animals can be named, classified and described easily.

Concept Application

True and False:

12. There is a need to standardise the naming of living organisms such that a particular organism is known by the same name all over the world because different places always have different living organisms.
13. The scientific names of plants are given according to the rules given by ICZN.
14. Binomial nomenclature was proposed by Carolus Linnaeus.
15. Biological names are generally in Greek and written in italics.
16. The first word in a biological name represents the genus while the second component denotes the specific epithet.
17. Characterization, identification, classification and nomenclature are the processes that are basic to taxonomy.
18. The word systematics is derived from the Latin word 'systema' which takes into account evolutionary relationships between organisms.

Fill in the Blanks:

19. The number and types of organisms present on earth is called _____.
20. Nomenclature or naming is only possible when the organism is described correctly and we know to what organism the name is attached to. This is _____.
21. The scientific term for the categories in which the living organisms have been classified is _____.

TAXONOMIC CATEGORIES

Introduction

- Classification is not a single step process but involves hierarchy of steps in which each step represents a **19**..... or category. Since the category is a part of overall taxonomic arrangement, it is called the taxonomic category.
- The system of organising organisms in a definite sequence of various taxonomic categories in a descending order is called **taxonomic hierarchy**. It was first proposed by Carolus Linnaeus.
- Each category, referred to as a unit of classification, represents a rank and is commonly termed as **taxon**. (pl: Taxa)
- Taxonomic categories and hierarchy can be illustrated by an example. Insects represent a group of organisms sharing common features like **20**..... pairs of jointed legs. It means insects are recognisable concrete objects which can be classified, and thus were given a rank or category.
- Each rank or taxon, in fact, represents a unit of classification. These taxonomic groups/categories are **distinct biological entities and not merely** **21**..... aggregates.
- The basic requirement for classification of organisms in different categories is the knowledge of characters of an individual or group of organisms.
- There are seven main taxonomic categories. They are called **obligate categories**, i.e., they are strictly used at the time of any organism's classification.

The Seven Main Taxonomic Categories are:

1. Species

- Taxonomic studies consider a group of individual organisms with fundamental **22**..... as a species.
- Two species can be distinguished on the basis of distinct morphological differences.
- *Mangifera indica*, *Solanum tuberosum* (potato) and *Panthera leo* (lion). All the three names, *indica*, *tuberosum* and *leo*, represent the specific epithets, while the first words *Mangifera*, *Solanum* and *Panthera* are genera and represents another higher level of taxon or category. Each genus may have one or more than one specific epithets representing different organisms, but having morphological similarities.

Key Note

- It is the lowest taxon
  classification. So the ba

- Each genus may have on
  representing different or
  similarities, e.g., *Panther*
  tigris and *Solanum* inclu
  and *melongena*.
- Human beings belong to
  in the genus *Homo*. Th
  being, is written as *Hom*

2. Genus

- Genus comprises a grou
  characters in common in
- Genera are aggregates o
- E.g., potato and brinjal
  belong to the genus *Sola*
- Lion (*Panthera leo*), Le
  with several common f
  Panthera. This genus di
  which includes cats.

3. Family

- Family has a group of r
  of similarities as compa

Key Note

- Families are character
  and reproductive featu

- For example among pl
  Petunia and *Datura* are p
- Among animals, genu
  leopard is put along w
  Felidae. Cats and dogs
  Felidae and **26**.....

4. Order

- Generally, order and o
  identified based on the
- Being a higher cate
  27..... whi
- The similar character
  different genera includ
- Plant families like **28**
  are included in the or
  floral characters.
- The animal order, Ca
  (cat family) and Canid

5. Class

- It includes related ord

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Key Note

- It is the lowest taxon or category in the biological classification. So the basic unit of taxonomy is species.

- Each genus may have one or more than one specific epithets representing different organisms, but having morphological similarities, e.g., *Panthera* has another specific epithet called *tigris* and *Solanum* includes species like 23..... and *melongena*.
- Human beings belong to the species *sapiens* which is grouped in the genus *Homo*. The scientific name thus, for human being, is written as *Homo sapiens*.

2. Genus

- Genus comprises a group of **related species** which has more characters in common in comparison to species of other genera.
- Genera are **aggregates of closely related species.**
- E.g., potato and brinjal are two different species but both belong to the genus *Solanum*.
- Lion (*Panthera leo*), Leopard (*P. pardus*) and Tiger (*P. tigris*) with several common features, are all species of the genus *Panthera*. This genus differs from another genus 24..... which includes cats.

3. Family

- Family has a group of **related genera** with still less number of similarities as compared to genus and species.

Key Note

- Families are characterised on the basis of both vegetative and reproductive features of plant species.

- For example among plants, three different genera *Solanum*, *Petunia* and *Datura* are placed in the family 25.....
- Among animals, genus *Panthera*, comprising lion, tiger, leopard is put along with genus, *Felis* (cats) in the family Felidae. Cats and dogs are places in the two different families Felidae and 26..... respectively.

4. Order

- Generally, order and other higher taxonomic categories are identified based on the aggregates of characters.
- Being a higher category, order is the **assemblage of** 27..... which exhibit a few similar characters.
- The similar characters are less in number as compared to different genera included in a family.
- Plant families like 28....., Solanaceae are included in the order Polymoniales mainly based on the floral characters.
- The animal order, Carnivora, includes families like Felidae (cat family) and Canidae (dog family).

5. Class

- It includes related orders having common characters.
- E.g., Order Primata (comprising monkey, gorilla and gibbon) is placed in class Mammalia along with order 29..... (includes tiger, cat and dog).

6. Phylum

- Classes having same features in common constitute the next higher category called phylum.
- Phylum Chordata includes classes like fishes, amphibians, reptiles, birds and mammals with the common features.
  - Presence of notochord
  - Presence of dorsal hollow neural system.

Key Note

- In case of plants, classes with few similar characters are assigned to a higher category called division.

7. Kingdom

- All organisms whether plants or animals belonging to various phyla are assigned to the highest category called Kingdom.
- Kingdom Animalia comprises all animals belonging to various phylums.
- Kingdom Plantae, is distinct and comprises all plants from various divisions.
- The taxonomic categories from species to kingdom have been shown in ascending order starting with species in **Figure 1.** These are broad categories. However, taxonomists have also developed sub-categories in this hierarchy to facilitate more sound and scientific placement of various taxa.

Kingdom
↑
Phylum or Division
↑
Class
↑
Order
↑
Family
↑
Genus
↑
Species

Fig. 1. Taxonomic categories showing hierarchial arrangement in ascending order

Key Note

- As we go higher from species to kingdom, the number of common characteristics goes on decreasing.
- Lower the taxa, more are the characteristics that the members within the taxon share.
- Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level. Hence, the problem of classification becomes more complex.

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Table 1: Indicates the taxonomic categories to which some common organisms like housefly, man, mango and wheat belong.

Common Name	Biological Name	Genus	Family	Order	Class	Phylum/Division
Man	*Homo sapiens*	*Homo*	Hominidae	Primata	Mammalia	Chordata
Housefly	*Musca domestica*	*Musca*	Muscidae	30.....	Insecta	Arthropoda
Mango	*Mangifera indica*	*Mangifera*	Anacardiaceae	Sapindales	Dicotyledonae	Angiospermae
Wheat	*Triticum aestivum*	*Triticum*	Poaceae	Poales	Monocotyledonae	Angiospermae

Concept Application

True and False:

22. The taxonomic groups/categories are distinct biological entities and not merely morphological aggregates.
23. The basic requirement for classification of organisms in different categories is the knowledge of characters of an individual or group of organisms.
24. Genus *Solanum* includes species like *nigrum* and *melongena*.
25. Generally, order and other higher taxonomic categories are identified based on the aggregates of characters.
26. In case of plants, classes with a few similar characters are assigned to a higher category called Phylum.
27. As we go higher from species to kingdom, the number of common characteristics goes on increasing.

Fill in the Blanks:

28. One should be able to distinguish one species from the other closely related species based on the distinct _____ differences.
29. A group of related species which has more characters in common in comparison to species of other genera is called _____.
30. *Solanum*, *Petunia* and *Datura* are placed in the family _____.
31. Mango belongs to class _____ and family _____.

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Characteristic Feature of Living Organisms

- **Growth, reproduction, metabolism,** and **the ability to sense their environment** are thought to be the distinguishing characteristics of living things.

Growth

- Increase in mass and number of individuals are twin characteristics of growth and can be exhibited by both living (intrinsic growth) as well as non-living things (extrinsic growth). Therefore, growth cannot be considered a defining characteristic of living things.
- Growth in plant is localised & indefinite (throughout life).
- Growth in animal is diffused and definite (up to a limit).

Reproduction

- It is not a characteristic feature of organisms, like mules, sterile worker bees etc., are unable to reproduce. Therefore, reproduction is also not a defining property of living things.

Metabolism and Cellular Organisation

- Metabolism → Catabolism + Anabolism. Metabolism is the some of all catabolic and anabolic reactions in our body.
- Metabolic reaction occur inside the cell, it means cellular organization is strictly required for metabolism to define the feature.
- No non-living thing exhibits metabolism, though metabolic reactions can be demonstrated *in - vitro*.
- These isolated metabolic reactions are not living entities but definitely living reactions.
- Therefore, metabolism and cellular organization is a characteristic and defining feature of all living organisms.

Consciousness

- The state of being aware of what is around you and able to sense environment.
- From prokaryotes to the most complex eukaryotes, all organisms can sense environmental stimuli and react to them.
- Therefore, consciousness becomes the defining feature of living things.

Diversity in the Living World

- Basis of modern taxonomic studies; external & internal structure, ecological information, cell structure and development process.
- Biologists have developed a set of rules and principles for the identification, classification, nomenclature, and characterization of the vast diversity of organisms. This field of study is referred to as **taxonomy**.
- **Identification:** Correct description of organism.
- **Nomenclature:** Scientific naming → Binomial nomenclature.
- **Classification:** Give a particular position of an organism in a particular taxa.
- **ICBN** → International Code for Botanical Nomenclature.
- **ICZN** → International Code for Zoological Nomenclature.
- Binomial nomenclature was given by **Carolus Linnaeus**. It contains name with two components: **Generic name** and **Specific epithet**.
- **Systematics:** This branch of study focussed on determining the evolutionary relationships between organisms.

Taxonomic Categories

- To form a taxonomic category, the basic requirement is the knowledge of characters of an organism or group of organisms.
- Taxonomic categories include, kingdom, phylum or division (for plants), class, order, family, genus and species.
- All categories together constitute the taxonomic hierarchy.
- Each category referred to as a unit of classification, infact, represent a rank and as commonly called as **taxon**.
  - **Species:** Group of individual with fundamental similarities e.g., *nigrum*, *tigris*.
  - **Genus:** Group of closely related species e.g., *Mangifera*.
  - **Family:** Group of related genus e.g., Solanaceae.
  - **Order:** Assemblage of families which exhibit a few similar characteristics e.g., Order Polymoniales includes families like Convolvulaceae and Solanaceae.
  - **Class:** Group of related orders e.g., Dicotyledonae, Mammalia.
  - **Phylum/Division:** Related plant classes come in a division but in case of animals, related classes become a part of phylum e.g., Chordata.
  - **Kingdom:** Group of similar phyla or divisions e.g., Animalia and Plantae.

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AARAMBH (SOLVED EXAMPLES)

1. Mark the **correct** statement w.r.t characteristics of living organisms.
   (1) Only animals perform the visible types of movements
   (2) Growth always occurs from outside
   (3) The metabolic reactions can be demonstrated *in vitro*
   (4) Reproduction is a characteristic feature of all living organisms

Sol. Metabolism is defining feature of all living organisms as metabolic reactions *in-vitro* are not living things but surely living reactions.

Therefore, option (3) is the correct answer.

2. Taxonomic studies of organisms need:
   (1) correct classification and identification.
   (2) nomenclature and characterization.
   (3) habitat information and vegetation.
   (4) physiological and anatomical information

Sol. Taxonomic studies of various species of plants, animals and other organisms require correct classification and identification. It is essential for knowing our bio-resources and their diversity.

Therefore, option (1) is the correct answer.

3. Families Felidae and Canidae are placed under common order:
   (1) Primata (2) Diptera
   (3) Carnivora (4) Poales

Sol. Order Carnivora includes families like Felidae and Canidae.

Therefore, option (3) is the correct answer.

4. Among the following, select the **correct** statements.
   A. In majority of higher plants and animals, growth and reproduction are mutually exclusive events.
   B. In non-living objects growth is by accumulation of material on the surface.
   C. An isolated metabolic reaction outside the body of an organism, preformed in an test tube is neither living nor non-living.
   D. All organisms, from the prokaryotes to the most complex eukaryotes can sense and respond to environmental cues.
   (1) B, C and D (2) A, B and C
   (3) A, D and C (4) All of these

Sol. Growth and reproduction are mutually exclusive phenomena in the majority of higher plants and animals.Growth in non-living objects occurs as a result of material deposition on the surface. A metabolic reaction done in a test tube outside of an organism's body is neither living nor non-living. Environmental signals can be sensed and responded by all species, from prokaryotes to the most complex eukaryotes.

Therefore, option (4) is the correct answer.

5. Select the option with **wrong** statements.
   A. Lower the taxon, more are the characteristics that the members within the taxon share.
   B. Order is the assemblage of genera which exhibit a few similar characters.
   C. Cat and dog are included in the same family Felidae.
   D. Binomial nomenclature was introduced by Carolus Linnaeus.
   (1) A, B and C (2) B, C and D
   (3) A and D (4) B and C

Sol. An order is a group of families that share a few characteristics. Cats and dogs are included in two different families-Felidae and Canidae, respectively.

Therefore, option (4) is the correct answer.

SINGLE CO
1. Which of
   (1) All li
   (2) Prop amo
   (3) Livi regu exte
   (4) All char
2. Cell divi in anima
   (1) (R)-
   (2) (R)-
   (3) (R)-
   (4) (R)
3. In Binor name re
   (1) Ger
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4. In nome
   (1) Ge
   (2) Ge
   (3) Bo
   (4) Bo
5. Given b incorre
   A. Me an
   B. Ar me
   C. Fa
   D. M me
   E. Th re
   (1) A
   (3) B
6. Match

A.	
B.	
C.	
D.	

(1) (
(2) (
(3) (
(4) (

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SCHOOL LEVEL PROBLEMS

SINGLE CORRECT TYPE QUESTIONS

1. Which of the following options is **incorrect**?
   (1) All living phenomena are due to underlying interactions.
   (2) Properties of tissues arise as a result of interactions among the constituent cells.
   (3) Living organisms are self-replicating, evolving, and self-regulating interactive systems capable of responding to external stimuli.
   (4) All members of kingdom Animalia possess a specific characteristic called self-consciousness.

2. Cell division occurs _____(R)____ in plants and ___(J)___ in animals.
   (1) (R)- continuously; (J)-only up to a certain age
   (2) (R)-only up to a certain age;(J)- continuously
   (3) (R)- continuously; (J)-never
   (4) (R) -once; (J)-twice

3. In Binomial nomenclature in animals, what does the second name represent?
   (1) Genus. (2) Species.
   (3) Sub-genus. (4) Sub-species.

4. In nomenclature, which statement is **correct**?
   (1) Genus is written after the species.
   (2) Genus and species are always of the same name.
   (3) Both in genus and species, the first letter is capitalized.
   (4) Both genus and species are printed in italics.

5. Given below are statements about classification, identify the **incorrect** statements
   A. Members of a family are less similar than members of an included genus.
   B. An order has more members than the number of members in an included genus.
   C. Families have more members than phyla.
   D. Members of a family share a common ancestor in the more distant past than members of an included genus.
   E. The number of species in a taxon depends on their relative degree of similarity.
   (1) A and C (2) Only C
   (3) B and E (4) C and D

6. Match **List-I** with **List-II** and select the **correct** option.

	List-I		List-II
A.	*Homo sapiens*	P.	Primata
B.	*Mangifera indica*	Q.	Poales
C.	*Musca domestica*	R.	Sapindales
D.	*Triticum aestivum*	S.	Diptera

   (1) (A)-(P); (B)-(R); (C)-(Q); (D)-(S)
   (2) (A)-(R); (B)-(Q); (C)-(S); (D)-(P)
   (3) (A)-(P); (B)-(R); (C)-(S); (D)-(Q)
   (4) (A)-(P); (B)-(S); (C)-(R); (D)-(Q)

7. In the taxonomic categories of man and housefly, what is the equivalent rank of Carnivora, respectively?
   (1) *Homo* and *Musca*. (2) Hominidae and Muscidae.
   (3) Mammalia and Insecta. (4) Primata and Diptera.

ASSERTION AND REASON TYPE QUESTIONS

1. **Assertion (A):** Taxonomic studies of various species of plants and animals are useful in agriculture and forestry.
   Reason (R): Taxonomic studies would require correct classification and identification of living organisms.
   (1) Both **Assertion (A)** and **Reason (R)** are correct and the **Reason (R)** is the correct explanation of **Assertion (A)**.
   (2) Both **Assertion (A)** and **Reason (R)** are correct But **Reason (R)** is not the correct explanation of the **Assertion (A)**.
   (3) The **Assertion (A)** is correct and **Reason (R)** is incorrect.
   (4) Both **Assertion (A)** and **Reason (R)** are incorrect.

2. **Assertion (A):** A dead organism does not grow and respond to stimuli.
   Reason (R): Non-living things are capable of self-replicating by itself but do not reproduce.
   (1) Both **Assertion (A)** and **Reason (R)** are correct and the **Reason (R)** is the correct explanation of **Assertion (A)**.
   (2) Both **Assertion (A)** and **Reason (R)** are correct But **Reason (R)** is not the correct explanation of the **Assertion (A)**.
   (3) The **Assertion (A)** is correct and **Reason (R)** is incorrect.
   (4) Both **Assertion (A)** and **Reason (R)** are incorrect.

3. **Assertion (A):** To replace lost cells, animal tissues will undergo cell division.
   Reason (R): Growth can be considered as defining property of living organisms.
   (1) Both **Assertion (A)** and **Reason (R)** are correct and the **Reason (R)** is the correct explanation of **Assertion (A)**.
   (2) Both **Assertion (A)** and **Reason (R)** are correct But **Reason (R)** is not the correct explanation of the **Assertion (A)**.
   (3) The **Assertion (A)** is correct and **Reason (R)** is incorrect.
   (4) Both **Assertion (A)** and **Reason (R)** are incorrect.

4. **Assertion (A):** Both anabolism and catabolism together considered as metabolism.
   Reason (R): Catabolism is otherwise called constructive metabolism.
   (1) Both **Assertion (A)** and **Reason (R)** are correct and the **Reason (R)** is the correct explanation of **Assertion (A)**.
   (2) Both **Assertion (A)** and **Reason (R)** are correct But **Reason (R)** is not the correct explanation of the **Assertion (A)**.
   (3) The **Assertion (A)** is correct and **Reason (R)** is incorrect.
   (4) Both **Assertion (A)** and **Reason (R)** are incorrect.

5. **Assertion (A):** Each different kind of plants, animals or organism that you see, represents a species.
   Reason (R): The number of species that are known and described range between 1.7-1.8 billion.

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(1) Both Assertion (A) and Reason (R) are correct and the Reason (R) is the correct explanation of Assertion (A).
(2) Both Assertion (A) and Reason (R) are correct But Reason (R) is not the correct explanation of the Assertion (A).
(3) The Assertion (A) is correct and Reason (R) is incorrect.
(4) Both Assertion (A) and Reason (R) are incorrect.

VERY SHORT ANSWER TYPE QUESTIONS

1. Name the three fields of systematics.
2. Who introduced the binomial system of nomenclature?
3. Write the correct order of sequence of taxonomic categories.
4. Give the unit of classification.
5. Name the highest categories of classification.
6. Define species.
7. What is systematics?
8. Mango belongs to which class in taxonomic categories?
9. Man belongs to which order in taxonomic categories?
10. What are two components of scientific name?

SHORT ANSWER TYPE QUESTIONS

1. What are the advantages of giving scientific names to organisms?
2. Why are living organisms classified?
3. Mention universal rules of nomenclature.
4. Why growth and reproduction cannot be taken as defining property of all living?

LONG ANSWER TYPE QUESTIONS

1. Define and explain the significance of the following taxonomic categories:
   (*i*) Phylum, (*ii*) Class, (*iii*) Family, (*iv*) Order, & (*v*) Genus.
2. Define the term kingdom and illustrate all taxonomic categories of organisms mentioned below:
   (*i*) Man, (*ii*) Housefly,
   (*iii*) Mango, (*iv*) Wheat.

CASE STUDY BASED QUESTIONS

Case-I:

Taxonomical studies have proven invaluable in fields such as agriculture, forestry, industry, and our broader comprehension of biological resources and their diversity.

Fundamental to taxonomy are the processes of identifying, naming, and classifying organisms. These foundational principles are universally upheld under international codes. Utilizing both shared resemblances and distinct differences, every organism is assigned a precise scientific or biological name, typically composed of two words following the binomial system of nomenclature. This process assigns each organism its place within the system of classification.

Within taxonomy, there exists a hierarchy of categories or ranks, commonly known as taxonomic categories or taxa. These categories collectively form a taxonomic hierarchy that organizes life into kingdoms, phyla or divisions (in the case of plants), classes, orders, families, genera, and species. Of note, the lowest category in this hierarchy, found in both the plant and animal kingdoms, is "species."

1. What is the primary purpose of taxonomy in the study of living organisms?
   (1) To explore the diversity of non-living objects
   (2) To understand the chemical composition of organisms
   (3) To identify, naming, and classify organisms
   (4) To examine the geological history of Earth
2. Why is taxonomy referred to as a hierarchical process?
   (1) It involves complex mathematical calculations
   (2) It organizes organisms into a strict numerical order
   (3) It assigns ranks or categories to organisms, with each step representing a level of the hierarchy
   (4) It categorizes organisms based on size, color, and habitat
3. Which term is commonly used to describe a rank or category within the taxonomic hierarchy?
   (1) Kingdom (2) Taxon (3) Genus (4) Species
4. In the binomial system of nomenclature, each organism is given a scientific name comprising _____ words.
5. The lowest category in the taxonomic hierarchy, found in both plant and animal kingdoms, is the _____.

Case-II:

Carl Linnaeus is credited with introducing the binomial nomenclature for plants and animals in his work *"Species Plantarum" in 1753.* Binomial nomenclature is a biological naming system where the name consists of two terms. The first term represents the genus, and the second term represents the species of the organism. For example, in the name *Mangifera indica* Linn, *Mangifera* is the genus, and indica is the species, with Linn. indicating that Linnaeus first described this species. This system is crucial for the scientific identification, nomenclature, and classification of organisms within the field of biology.

1. Who introduced the binomial nomenclature for plants and animals?
   (1) Charles Darwin (2) Gregor Mendel
   (3) Carl Linnaeus (4) Louis Pasteur
2. In the name Mangifera indica Linn., what does "Linn." indicate?
   (1) Location of the organism
   (2) Habitat
   (3) Linnaeus as the describer
   (4) Latin origin of the species
3. What does the term "binomial" in binomial nomenclature signify?
   (1) A name with two components
   (2) A complex scientific term
   (3) A hybrid organism
   (4) A plant species
4. Which field of biology involves the identification, nomenclature, and classification of organisms?
   (1) Genetics (2) Ecology
   (3) Taxonomy (4) Physiology
5. What is the purpose of binomial nomenclature in biology?
   (1) Assigning common names
   (2) Providing scientific names
   (3) Naming based on appearance
   (4) Creating hybrid species

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PRARAMBH EXERCISE-1 (TOPICWISE)

WHAT IS LIVING?

1. Among the following which can be a common feature exhibited by both living and non-living?
   (1) Growth (2) Reproduction
   (3) Metabolism (4) Cellular organisation
2. Among the following, increase in body mass can be taken as criterion for growth:
   (1) in living organisms (2) in non-living objects
   (3) both (1) and (2) (4) none of these
3. How many (in number) of the following properties are the defining characteristics of living organisms?
   Growth, reproduction, metabolism, consciousness
   (1) 2 (2) 3 (3) 4 (4) 1
4. Self-consciousness is the property of;
   (1) all living organisms (2) prokaryotes only
   (3) eukaryotes only (4) human being only
5. Twin characteristics of growth are:
   (1) increase in length
   (2) increase in width
   (3) increase in mass and number
   (4) both (1) and (2)
6. Growth and reproduction are mutually exclusive events in:
   (1) lower plants (2) higher animals and plants
   (3) lower animals (4) unicellular organisms
7. Non-living objects also grow if we take increase in body mass as a criterion for growth. In mountains, boulders and sand mounds growth is from:
   (1) outside (2) inside
   (3) both (1) and (2) (4) none of these
8. The sum total of chemical reactions occurring in our body is called:
   (1) Metabolism (2) Homeostasis
   (3) Anabolism (4) Catabolism
9. Growth, development and functioning of living body is due to:
   (1) Order (2) Homeostasis
   (3) Metabolism (4) Adaptation
10. Which of the following is a defining characteristic of living organisms?
    (1) Growth (2) Ability to make sound
    (3) Reproduction (4) Response to external stimuli
11. Choose an appropriate option to complete the given statement. In plants, growth takes place by ____ throughout their life span.
    (1) Cell dedifferentiation (2) Cell differentiation
    (3) Cell multiplication (4) None of these
12. All living organisms are linked to one another because:
    (1) they show common genetic material but to varying degree
    (2) they have common genetic material of the same type
    (3) all have common cellular organisation
    (4) all of these
13. The main purpose of classification of organisms is to:
    (1) locate plants and animals
    (2) establish relationships amongst organisms
    (3) study evolution
    (4) both (2) & (3)

DIVERSITY IN LIVING WORLD

14. ICBN stands for:
    (1) International code for Botanical Nomenclature
    (2) International code for Binomial Nomenclature
    (3) International code for Botanical Naming
    (4) International code for Binomial Naming
15. In *Mangifera indica*, *indica* indicates:
    (1) name of the genus
    (2) name of the species
    (3) specific epithet
    (4) both (2) and (3)
16. ICZN codes for:
    (1) International code of Zoological Nomenclature
    (2) International code of Zoological Naming
    (3) International coding of Zoological Nomenclature
    (4) Inbreeding code of Zoological Nomenclature
17. The process of giving names to living organisms is called:
    (1) Nomenclature (2) Identification
    (3) Classification (4) Characterization
18. In binomial nomenclature, the name of an organism consists of:
    (1) a scientific and a common name
    (2) name of genus and species
    (3) a name given by two scientists
    (4) one name is latin, other is common
19. In relation to the biological or scientific names, which is **wrong**?
    (1) Scientific names are generally in Latin and printed in Italics
    (2) Scientific names ensure that one organism has only one name
    (3) Scientific names are used all over the world
    (4) One scientific name can be used for two related species

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20. Scientific names of animals are based on principles and criteria agreed by:
(1) IUCN (2) ICZN
(3) ICBN (4) ICVN

21. Biological names, when handwritten, should necessary be:
(1) underlined (2) bold
(3) in capital letter (4) italics

22. The word systematics is derived from:
(1) Greek word systema (2) Roman word systema
(3) Latin word systema (4) English word systema

23. An important criterion for modern day classification is:
(1) resemblances in morphology
(2) anatomical and physiological traits
(3) breeding habits
(4) presence or absence of notochord

24. Given below is the botanical name of mango. Mark the option in which the name is correctly written:
(1) Magnifera Indica (2) Mangifera indica
(3) *Mangifera Indica* (4) *Mangifera indica*

25. In taxonomy the first step is:
(1) Identification (2) Nomenclature
(3) Classification (4) Characterisation

26. Human beings were since long, not only interested in knowing more about different kinds of organisms and their diversities, but also the relationship among them. This branch of study is referred to as:
(1) Classification (2) Systematics
(3) Taxonomy (4) All of these

27. Which of the following are the basic processes of taxonomy?
(1) Characterisation and classification
(2) Identification and nomenclature
(3) Both (1) and (2)
(4) None of these

28. Nomenclature or naming is only possible when the organism is described correctly and we know to what organism the name is attached to. This is known as:
(1) Taxonomy (2) Classification
(3) Identification (4) Binomial system

29. There is a need to standardise the naming of living organisms such that a particular organism is known by the same name all over the world. This process is called:
(1) Systematics (2) Nomenclature
(3) Cytotaxonomy (4) Taxonomy

30. In a scientific name, the name of the author is printed in:
(1) capital letters (2) bold
(3) italics (4) abbreviated form

31. Which is not the component of taxonomy?
(1) Identification (2) Responsiveness
(3) Nomenclature (4) Classification

32. Which of the following ensures that each organism has only one name all over the world?
(1) Scientific name (2) Local name
(3) Trivial name (4) All of these

33. Which naming system is practised by biologists all over the world?
(1) Binomial system (2) Trivial system
(3) Artificial system (4) All of these

34. The word 'systematics' refers to:
(1) study of diversity of different kinds of organisms and relationships among them
(2) identification and classification of organisms
(3) identification and nomenclature of organisms
(4) nomenclature and classification of organisms

35. Carolus Linnaeus is famous for:
(1) coining the term 'systematics'
(2) introducing binomial nomenclature
(3) giving all natural system of classification
(4) all of these.

36. The process by which anything grouped into convenient categories based on some easily observable characters is called:
(1) Systematics (2) New Systematics
(3) Nomenclature (4) Classification

37. Few rules are written below regarding binomial nomenclature. Identify the **wrong** one:
(1) Biological names are latinized and printed in italics
(2) Generic and specific name starts with capital letter
(3) Generic and specific name when hand written are underlined
(4) All are correct

38. Specific epithet is:
(1) first word in the scientific name of a species
(2) second name in the scientific name of a species
(3) both (1) and (2)
(4) none of these

39. Which of the following has **correct** specific epithet?
(1) *Indica mangifera* (2) *Leo Panthera*
(3) *Canis familiaris* (4) *Ascaris*

TAXONOMIC CATEGORIES

40. Which of the following taxa has least number of similar characters?
(1) Order (2) Family
(3) Division (4) Class

41. In which of the following taxa, other three are included within itself?
(1) Phylum (2) Order
(3) Class (4) Family

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42. The unit of classification is:
(1) Taxon (2) Rank
(3) Category (4) All of these.

43. The connecting link between kingdom and class in plant hierarchy, is:
(1) Division (2) Order
(3) Family (4) Class

44. Which is essential and is the prime source of taxonomic studies of plants and animals?
(1) Identification
(2) Nomenclature
(3) Classification
(4) Collection of actual specimens

45. Identify the **correct** sequence of taxonomic categories in ascending order.
(1) Species-Order-Kingdom-Phylum
(2) Species-Family-Genus-Class
(3) Genus-Species-Order-Phylum
(4) Species-Genus-Order-Phylum

46. Mark the **odd** one in the following:
(1) Family (2) Class
(3) Taxon (4) Phylum

47. Which of the following is included in the seven basic categories of the taxonomical hierarchy?
(1) Tribe (2) Variety
(3) Family (4) Series

48. Fishes, amphibians, reptiles, birds and mammals constitute in the same category, called:
(1) Division (2) Phylum
(3) Order (4) Class

49. Each different kind of plant, animal or organism that you see, represents a:
(1) Species (2) Genus
(3) Population (4) Family

50. The smallest unit of classification is:
(1) Family (2) Order
(3) Genus (4) Species

51. Reproduction can occur within members of a:
(1) Species (2) Genus
(3) Order (4) Family

52. Linnaeus put similar species into a larger group called the:
(1) Species (2) Family
(3) Kingdom (4) Genus

53. Genus *Solanum* includes:
A. Potato B. Brinjal
C. *Datura* D. Tulip
(1) A and C (2) A and B
(3) A and D (4) All of these

54. In a taxonomic hierarchy, genus is interpolated between
(1) Kingdom and class (2) Phylum and order
(3) Order and species (4) Family and species

55. The taxonomic category below the level of family is
(1) Class (2) Order
(3) Phylum (4) Genus

56. In taxonomical hierarchy, the category below the level of order is
(1) Class (2) Species
(3) Phylum (4) Family

57. Family and Order of *Triticum aestivum* (wheat) are
(1) Poaceae, Monocotyledonae
(2) Poaceae, Poales
(3) Poales, Monocotyledonae
(4) None of these.

58. The closest category of family is:
(1) Phylum (2) Class
(3) Division (4) Order

59. The families, Convolvulaceae and Solanaceae are included in the order Polymoniales mainly on the basis of:
(1) Vegetative characters (2) Morphological characters
(3) Floral characters (4) Both (1) and (2)

60. Family of man (*Homo sapiens*) is:
(1) Hominidae (2) Muscidae
(3) Primata (4) Felidae

61. The word ending with - *aceae* indicates:
(1) Genera (2) Family
(3) Order (4) Class

62. If two plants belong to the same division but in different orders, they may belong to the same:
(1) Genus (2) Family
(3) Class (4) Species

63. Order Polymoniales include:
(1) Convolvulaceae (2) Solanaceae
(3) Both (1) and (2) (4) None of these

64. Poales is the order of:
(1) Mango (2) Wheat
(3) Housefly (4) Humans

65. The order generally ends with the suffix:
(1) -ales (2) -aceae
(3) -eae (4) None of these

66. Which of the following categories possess least number of related characters?
(1) Order (2) Phylum
(3) Class (4) Species

67. In case of plants, classes with a few similar characters are assigned to a higher category called:
(1) Phylum (2) Division
(3) Order (4) Kingdom

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68. The taxomomic unit 'Phylum' in the classification of animals is equivalent to which hierarchical level in classification of plants:
(1) Order (2) Division
(3) Class (4) Family

69. As we go from species to kingdom in a taxonomic hierarchy, the number of common characteristics:
(1) will decrease
(2) will increase
(3) remain same
(4) may increase or decrease

70. Genus represents:
(1) an individual plant or animal
(2) a collection of plants or animals
(3) group of closely related species of plants or animals
(4) a group of plants in a given area

71. Two animals belong to the same kingdom but different classes. They may belong to the same:
(1) Phylum (2) Order
(3) Division (4) Family

72. Which of the following 'suffixes' used for units of classification in animals indicates a taxonomic category of 'family'?
(1) —ales (2) —onae
(3) —aceae (4) —ae

73. Taxonomic hierarchy refers to:
(1) step-wise arrangement of all categories for classification of plants and animals
(2) a group of senior taxonomists who decide the nomenclature of plants and animals
(3) a list of botanists or zoologists who have worked on taxonomy of a species or group
(4) classification of a species based on fossil record

PRABAL EXERCISE-2 (LEARNING PLUS)

1. The practical purpose of classification of living organisms is to:
(1) explain the origin of living organisms
(2) trace the evolution of living organisms
(3) name the living organisms
(4) facilitate identification of unknown organisms

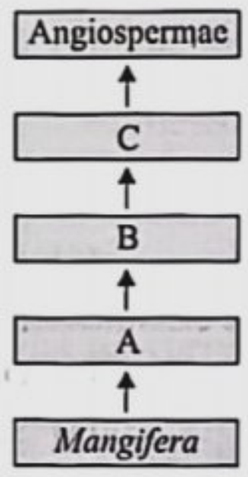
2. The disadvantage of using common names for species is that:
(1) the name may change
(2) one name does not apply universally
(3) one species may have several common names and one common name may be applied to two species
(4) all of these.

3. Need for a proper system of classification arises because:
(1) the organisms of the past cannot be studied without it.
(2) classification help in knowing the relationship among the different group of organisms.
(3) it is not possible to study every organism.
(4) all of these.

4. The scientific name of banyan is written as *Ficus benghalensis* L. which of the following is a **correct** statement regarding this?
(1) Letter L signifies Latin language.
(2) The name should be reverse with *benghalensis* preceding *Ficus*
(3) Letter L signifies taxonomist Linnaeus
(4) *Benghalensis* is generic name

5. Family - order - class of *Musca domestica* (Housefly) are respectively:
(1) Muscidae - Insecta - Hymenoptera
(2) Muscidae - Diptera - Mandibulata
(3) Hymenoptera - Insecta - Mandibuleta
(4) Muscidae - Diptera - Insecta

6. Recognise the following flow diagram and find the correct options according to taxonomic hierarchy.



(1) 'A' is comparable to Muscidae while 'B' is at the same level as that of Primata.
(2) 'C' includes all the Angiosperms having two cotyledons in their seeds.
(3) For wheat 'A' is Poaceae, 'B' is Poales and 'C' is Monocotyledonae.
(4) All of these.

7. Which one of the following is applicable to both plants and animals?
(1) Herpetology (2) Saurology
(3) Taxonomy (4) Ichthyology

8. Which
taxonom
(1) Pot
(2) Mo
(3) *Sol*
(4) *Ma*
tub

9. Which o
(1) Ge
Poa
(2) Ge
Cla
(3) Ge
Cla
(4) Ge
Cla

10. Match

A.	
B.	
C.	
D.	

(1) A-
(2) A-
(3) A-
(4) A-

11. Fill in
Kingd
(1) (a
(3) (a

12. The c
discov
(1) F
a
(2) F
c
(3) F
a
(4) F
a

13. Fill i
A.
B.
C.
D.

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8. Which of the following shows the **correct** example of taxonomic category - Genus?
   (1) Potato, tomato and brinjal belong to *Solanum*.
   (2) Monkey, gorilla and gibbon are placed in Mammalia.
   (3) *Solanum*, *Petunia*, and *Datura* are placed in Solanaceae.
   (4) *Mangifera* and *Panthera* belong to same genus *tuberosum*.

9. Which of the following combinations is **correct** for wheat ?
   (1) Genus : *Triticum*, Family : Anacardiaceae, Order : Poales, Class : Monocotyledonae
   (2) Genus : *Triticum*, Family : Poaceae, Order : Poales, Class : Dicotyledonae
   (3) Genus : *Triticum*, Family : Poaceae, Order : Sapindales, Class : Monocotyledonae
   (4) Genus : *Triticum*, Family : Poaceae, Order : Poales, Class : Monocotyledonae

10. Match **List-I** with **List-II** and select the **correct** option.

	List-I		List-II
A.	*Homo sapiens*	P.	Poaceae
B.	*Mangifera indica*	Q.	Anacardiaceae
C.	*Musca domestica*	R.	Hominidae
D.	*Triticum aestivum*	S.	Muscidae

   (1) A-(P); B-(R); C-(Q); D-(S)
   (2) A-(R); B-(Q); C-(S); D-(P)
   (3) A-(P); B-(Q); C-(S); D-(R)
   (4) A-(P); B-(S); C-(Q); D-(R)

11. Fill in the blanks (*a*) and (*b*) using the **correct** option.
   Kingdom → Phylum→ (*a*) → Order→ (*b*)
   (1) (*a*)-Genus; (*b*)-Species (2) (*a*)-Family; (*b*)-Class
   (3) (*a*)-Class; (*b*)-Family (4) (*a*) - Species; (*b*)-Division

12. The **correct** sequence of taxonomic study of a newly discovered organism is:
   (1) First classification then identification, nomenclature and characterisation.
   (2) First identification then classification and then characterisation and nomenclature.
   (3) First nomenclature then characterisation, identification and classification.
   (4) First characterisation then identification and nomenclature and then classification.

13. Fill in the blanks by choosing the **correct** option
   A. Each _____ may have one or more than one specific epithets representing different organisms.
   B. Taxonomic studies consider a group of individual organisms with fundamental similarities as a _____.
   C. In case of plants, classes with a few similar characters are assigned to a higher category called _____.
   D. _____ being a higher category, is the assemblage of families which exhibit a few similar characters.

	A	B	C	D
(1)	Species	Order	Phylum	Division
(2)	Genus	Species	Division	Order
(3)	Class	Genus	Species	Phylum
(4)	Species	Genus	Division	Tribe

14. Which one of the following statements given below is **NOT** included in universal rules of nomenclature?
   (1) Generic names and specific epithet should be in Latin words.
   (2) Generic name is immediately followed by name of taxonomists who described it first.
   (3) Generic name must begin with capital letter.
   (4) All letters of the specific name must be small.

15. Biosystematics aims at:
   (1) The classification of organisms based on their evolutionary history and establishing their phylogeny studies.
   (2) Identification and arrangement of organisms on the basis of their cytological characteristics.
   (3) The classification of organisms based on broad morphological characters.
   (4) Delimiting various taxa of organisms and establishing their relationships.

16. Which of the following statements about classification is **NOT** true?
   A. Members of a family are less similar than members of an included genus.
   B. An order has more members than the number of members in an included genus.
   C. Families have more members than phyla.
   D. Members of a family share a common ancestor in the more distant past than members of an included genus.
   E. The number of species in a taxon depends on their relative degree of similarity.
   (1) Only C (2) Only D
   (3) Only E (4) None of these

17. Select the **wrong** statement.
   (1) The number of species that are known and described range between 1.7-1.8 million.
   (2) The scientific names ensure that each organism has only one name.
   (3) The first word in a biological name represents the specific epithet while the second component denotes the genus.
   (4) Biological names are generally in Latin and written in italics.

18. Read the statements given below and identify the **incorrect** statement.
   (1) Scientific names are used all over the world.
   (2) Scientific names indicate relationship between species.
   (3) Scientific names favour multiple naming for the same kind of an organism.
   (4) Scientific names are often descriptive and tell us some important character of an organism.

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19. Select the **mismatched** pair.
(1) Order Primata - Gibbon, monkey, gorilla
(2) Order Carnivora - Tiger, cat, dog
(3) Order Polymoniales - Solanaceae and Liliaceae families
(4) Order Carnivora - Felidae and Canidae families

20. In referring to an organism in writing, such as in a newspaper, textbook or lab report, which of these rules should be followed?
A. Underline or italicize genus
B. Underline or italicize species
C. First letter of species should be uppercase
D. First letter of genus should be uppercase
(1) All except C (2) All except D
(3) All except A (4) All except B

21. Mark the **incorrect** statement with respect to metabolism.
(1) Microbes exhibit the metabolism.
(2) It is the property of all living forms.
(3) The metabolic reactions can be demonstrated in vitro.
(4) It is not a defining feature of life forms.

22. Which of the following is **incorrect** for reproduction?
(1) Unicellular organisms reproduce by cell-division.
(2) Reproduction is a characteristic of all living organisms.
(3) In unicellular organisms, reproduction and growth are linked together.
(4) Non-living objects are incapable of reproducing.

23. Identify the generic name from the given scientific names.
Naja naja, Larix larix, Bufo bufo
(1) *Naja, Larix, Bufo* (2) *Naja, larix, Bufo*
(3) *naja, Larix, bufo* (4) *naja, larix, bufo*

24. *Solanum* includes species
(1) *nigrum* (2) *melongena*
(3) *tuberosum* (4) All of these

25. What forms the basis of modern taxonomic studies?
(1) Structure of cell (2) Ecology
(3) Development process (4) All of these

PARIKSHIT EXERCISE-3 (MULTICONCEPT)

MATCH THE COLUMN MCQs

1. Match the following and choose the **correct** option.

	List-I		List-II
A.	Family	P.	*tuberosum*
B.	Kingdom	Q.	Polymoniales
C.	Order	R.	*Solanum*
D.	Species	S.	Plantae
E.	Genus	T.	Solanaceae

(1) A-(S); B-(R); C-(T); D-(Q); E-(P)
(2) A-(T); B-(S); C-(Q); D-(P); E-(R)
(3) A-(S); B-(T); C-(Q); D-(P); E-(R)
(4) A-(T); B-(R); C-(Q); D-(P); E-(S)

2. Match the following and choose the **correct** option.

	List-I		List-II
A.	Species	P.	A group of similar individuals
B.	Family	Q.	Includes related orders
C.	Division	R.	A group of related genera
D.	Class	S.	Occur below kingdom and above class

(1) A-(R); B-(P); C-(S); D-(Q)
(2) A-(Q); B-(P); C-(S); D-(R)
(3) A-(R); B-(P); C-(Q); D-(S)
(4) A-(P); B-(R); C-(S); D-(Q)

3. Match the following and choose the **correct** option.

	List-I		List-II
A.	Aggregate of closely related species	P.	Class
B.	Aggregate of closely related genera	Q.	Division
C.	Aggregate of closely related order	R.	Family
D.	Aggregate of closely related classes of plants	S.	Genus

(1) A-(R); B-(P); C-(S); D-(Q)
(2) A-(S); B-(Q); C-(R); D-(P)
(3) A-(R); B-(S); C-(Q); D-(P)
(4) A-(S); B-(R); C-(P); D-(Q)

4. Match the following and choose the **correct** option.

	List-I		List-II
A.	*Panthera pardus*	P.	Housefly
B.	*Manglfera indica*	Q.	Man
C.	*Musca domestica*	R.	Leopard
D.	*Homo sapiens*	S.	Mango

(1) A-(R); B-(S); C-(P); D-(Q)
(2) A-(S); B-(P); C-(R); D-(Q)
(3) A-(R); B-(P); C-(Q); D-(S)
(4) A-(S); B-(R); C-(P); D-(Q)

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5. Match the following and choose the correct option.

	List-I		List-II
A.	Cats	P.	Poaceae
B.	*Datura*	Q.	Anacardiaceae
C.	Wheat	R.	Solanaceae
D.	Mango	S.	Felidae

(1) A-(R); B-(P); C-(S); D-(Q)
(2) A-(S); B-(P); C-(R); D-(Q)
(3) A-(S); B-(P); C-(Q); D-(R)
(4) A-(S); B-(R); C-(P); D-(Q)

6. Match the following and choose the **correct** option.

	List-I		List-II
A.	Canidae	P.	Polymoniales
B.	Anacardiaceae	Q.	Diptera
C.	Convolvulaceae	R.	Carnivora
D.	Muscidae	S.	Sapindales

(1) A-(R); B-(P); C-(S); D-(Q)
(2) A-(S); B-(Q); C-(R); D-(P)
(3) A-(R); B-(S); C-(P); D-(Q)
(4) A-(S); B-(R); C-(P); D-(Q)

CORRECT-INCORRECT PAIR MCQs

7. Select the **correct** match:

	Taxonomic category	Examples
(1)	Class	Sapindales, Insecta
(2)	Order	Primata, Diptera
(3)	Genus	*Musca*, Poales
(4)	Family	*Triticum*, Muscidae

8. Find the **mis - match** pair.
(1) Order Primata - monkey, gibbon, gorilla
(2) Order Carnivora - tiger, cat, dog
(3) Phylum Chordata - housefly, lizard, human
(4) Order Polymoniales - potato, brinjal, *Petunia*

9. Find the **mis - match** pair.
(1) Systematics - Deals with evolutionary relationships between organisms.
(2) Systema Naturae - Aristotle
(3) Binomial nomenclature - Carolus Linnaeus
(4) Aggregation or assemblage of classes of animals - Phylum

10. Find the **mis - match** pair.
(1) Class - Assemblage of families with similar characteristics
(2) Phylum - Assemblage of Classes
(3) Species - A group of individual organisms with fundamental similarities.
(4) Genus - A group of related species which has more characters in common

STATEMENT BASED QUESTIONS

11. Read the following statements carefully and choose the **correct** option.
(1) In plants,growth by cell division occurs continuously only in meristematic cells and that too for a specified period of time.
(2) Living organisms are self-replicating, evolving and self-regulating interactive systems but are not capable of responding to external stimuli.
(3) Nomenclature standardizes the naming of living organisms such that a particular organism is known by the same name all over the world.
(4) Classification is a single step process.

12. Select the option containing **correct** statements:
I. In the majority of higher animals and plants, growth and reproduction are mutually exclusive events.
II. All organisms, except prokaryotes can sense and respond to environmental cues.
III. Classification is the process by which anything is grouped into convenient categories based on some easily observable characters.
IV. The word systematics is derived from the Greek word 'systema' which means systematic arrangement of organisms.
(1) Only I (2) Only II
(3) I and III (4) I and IV

13. Read the following statements carefully and choose the **incorrect** option.
(1) Based on characteristics, all living organisms can be classified into different taxa. This process is called identification.
(2) Properties of tissues are not present in the constituent cells but arise as a result of interactions among the constituent cells.
(3) *Solanum*, *Petunia* and *Datura* are placed in the family Solanaceae.
(4) Problem of classification becomes more complex as we go higher in the category

14. Read the following statements carefully and choose the **incorrect** option.
(1) Reproduction is not an all-inclusive defining characteristic of living organisms.
(2) Biodiversity can also be defined as the number and types of organisms present in the region under consideration only.
(3) The specific epithet starts with a small letter while the genus starts with a capital letter.
(4) The earliest classifications were based on the 'uses' of various organisms.

15. Read the following statements and select the option with **correct** ones.
A. Increase in mass and increase in number of individuals are twin characteristics of growth
B. Metabolic reactions can be demonstrated outside the body in cell-free system

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C. 'Feel or response to stimuli' is a defining property of living organisms

(1) A and B (2) B and C
(3) A and C (4) All of these

16. Read the following statements.

A. Isolated-metabolic reactions *in-vitro* are living things.
B. Reproduction is synonymous with growth in *Amoeba*.
C. Reproduction is an all inclusive defining characteristic of living organisms.
D. Extrinsic growth cannot be taken as defining property of living organisms.

How many of the above statement (s) is/are **NOT** true?

(1) One (2) Two
(3) Three (4) Four

17. Read the following statements and identify the option with **correct** statements:

A. Biodiversity refers to the number and types of organisms present on earth.
B. The local names would vary from place to place, even within a country.
C. International Code for Botanical Nomenclature (ICBN) provides scientific names for plants.
D. Nomenclature or naming is only possible when the organism is described correctly.

(1) A and B only (2) A, B and C only
(3) A, D and C only (4) All of these

18. Which of the following statements is **NOT** correct?

(1) Biodiversity is occurrence of variety of life forms differing in morphology, anatomy, habitats and habits.
(2) The word systematics is derived from the Latin word 'systema' which means systematic arrangement of organisms.
(3) Taxonomy is the branch of biology that deals with principles and procedures of identification and nomenclature of organisms.
(4) Biodiversity is the study of aquatic life forms on the basis of morphological features only.

19. Consider the following statements and select the option that mentions the **correct** set of statements.

A. The most obvious and technically complicated feature of living organisms is consciousness.
B. Growth and reproduction are mutually exclusive events for higher plants.
C. Generally, families and orders are identified on the basis of aggregates of vegetative characters only.

(1) B and C (2) A and C
(3) A and B (4) A, B and C

20. Which of the following taxonomic categories is being described by the given statements (i-ii)?

(*i*) It is the basic unit of classification.
(*ii*) It is defined as the group of individuals which resemble in their morphological and reproductive characters and interbreed among themselves and produce fertile offspring.

(1) Species (2) Genus
(3) Order (4) Family

21. Select the **incorrect** statement with respect to the taxon, 'genus':

(1) It is a group or assemblage of related species.
(2) A genus may have one or more than one number of species.
(3) Lion, Tiger, Leopard are closely related species which have been placed in the genus *Panthera* and are respectively named as *Panthera leo*, *P. tigris* and *P. pardus*.
(4) *Solanum*, *Musca*, *Triticum* and *sapiens* are the examples of genera.

22. **Incorrect** statement is.

(1) Naming is only possible when the organism is described correctly.
(2) Scientific names of plants are based on the principles and criteria provided in ICBN.
(3) Description of any organism should enable the people (in any part of the world) to arrive at the same name.
(4) Category denotes rank, and these categories or ranks are merely morphological aggregates.

Directions: In the questions from 23 to 27 two statements are given as **Statement-I** and **Statement-II.**

Mark the correct choice as:

(1) Both **Statement-I** and **Statement-II** are correct
(2) Both **Statement-I** and **Statement-II** are incorrect
(3) **Statement-I** is correct and **Statement-II** is incorrect
(4) **Statement-I** is incorrect and **Statement-II** is correct

23. **Statement-I:** Unlike multicellular organisms, unicellular organisms grow by fusion of cells.

Statement-II: The problem of classification becomes more complex as we go lower while studying taxonomic categories.

24. **Statement-I:** Each genus may have one or more than one specific epithets representing different organisms with no common features.

Statement-II: Cell division occurs in certain tissues to add cells in existing cells.

25. **Statement-I:** Intrinsic growth is a characteristic of living things and extrinsic growth is a characteristic of non - living things.

Statement-II: Lower the taxa, more are the characteristics that the members within the taxon share.

26. **Statement-I:** External and internal structure, structure of the cell, development process and ecological information of organisms form the basis of modern taxonomic studies.

Statement-II: The scope of systematics include identification, nomenclature and classification.

27. **Statement-I:** To form a category, the basic requirement is the knowledge of characters of an individual or group of organisms.

Statement-II: The taxonomic groups are distinct biological entities and not merely morphological aggregates.

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Directions: In the following questions, a statement of **Assertion** is followed by a statement of **Reason.**
Mark the correct choice as:

(1) If both **Assertion (A)** and **Reason (R)** are True and the **Reason (R)** is a correct explanation of the **Assertion (A).**

(2) If both **Assertion (A)** and **Reason (R)** are True but **Reason (R)** is not a correct explanation of the **Assertion (A).**

(3) If **Assertion (A)** is True but the **Reason (R)** is False.

(4) If **Assertion (A)** is False but the **Reason (R)** is True.

28. **Assertion (A):** Growth, cannot be taken as a defining property of living organisms.

Reason (R): Growth can also be seen in non-living things.

29. **Assertion (A):** Lower the taxa, greater is the difficulty of determining the relationship to other taxa at the same level.

Reason (R): As we go higher from species to kingdom, the number of common characteristics goes on decreasing.

30. **Assertion (A):** Metabolism is not a defining feature of all living organisms.

Reason (R): Metabolic reactions can be demonstrated outside the body in cell-free systems.

31. **Assertion (A):** Biological names are derived from Latin or Latinised irrespective of their origin.

Reason (R): Latin is a well accepted language worldwide because it is considered as a scientific language.

32. **Assertion (A):** Unicellular organisms grow by cell division.

Reason (R): Cell division occurs in certain tissues to replace lost cells.

33. **Assertion (A):** Reproduction is synonymous with growth in unicellular organisms.

Reason (R): *Amoeba* reproduce *via* binary fission therefore, a single parent cell produces two daughter cells resulting in increase in its population.

34. **Assertion (A):** Systematics is the study of organisms, their diversities but not the relationships among them.
Reason (B): The word systematics is derived from the Latin word 'systema'.

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. **'X'** and **'Y'** are the components of Binomial nomenclature. This naming system was proposed by **'Z'**: **(2023 Manipur)**
   (1) X-Specific epithet, Y - Generic name, Z - Carolus Linnaeus
   (2) X - Generic name, Y - Specific epithet, Z - R.H. Whittaker
   (3) X - Generic name, Y - Specific epithet, Z - Carolus Linnaeus
   (4) X-Specific epithet, Y - Generic name, Z - R.H. Whittaker

2. House fly belongs to family. **(2023 Manipur)**
   (1) Calliphoridae
   (2) Muscidae
   (3) Cyprinidae
   (4) Hominidae

3. In the taxonomic categories which hierarchical arrangement in ascending order is **correct** in case of animals? **(2022)**
   (1) Kingdom, Order, Phylum, Class, Family, Genus, Species
   (2) Kingdom, Phylum, Class, Order, Family, Genus, Species
   (3) Kingdom, Class, Phylum, Family, Order, Genus, Species
   (4) Kingdom, Order, Class, Phylum, Family, Genus, Species

4. Which one of the following belongs to the family Muscidae? **(2021)**
   (1) Grasshopper (2) Cockroach
   (3) Housefly (4) Fire fly

5. Select the **correctly** written scientific name of Mango which was first described by Carolus Linnaeus. **(2019)**
   (1) *Mangifera indica* Car. Linn.
   (2) *Mangifera indica* Linn.
   (3) *Mangifera indica*
   (4) Mangifera Indica

6. Which of the following is against the rules of ICBN? **(2019 odisha)**
   (1) Hand written scientific names should be underlined.
   (2) Every species should have a generic name and a specific epithet.
   (3) Scientific names are in Latin and should be italized.
   (4) Generic and specific names should be written starting with small letters.

7. Study the four statements **(A–D)** given below and select the two **correct** ones out of them: **(2016-II)**
   A. Definition of biological species was given by Ernst Mayr.
   B. Photoperiod does not affect reproduction in plants.
   C. Binomial nomenclature system was given by R.H. Whittaker.
   D. In unicellular organisms, reproduction is synonymous with growth.

   The **two correct** statements are-
   (1) A and D (2) A and B
   (3) B and C (4) C and D

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8. Match **Column-I** with **Column-II** for housefly classification and select the **correct** option using the codes given below. **(2016-II)**

	Column-I		Column-II
A.	Family	p.	Diptera
B.	Order	q.	Arthropoda
C.	Class	r.	Muscidae
D.	Phylum	s.	Insecta

(1) A-(S); B-(R); C-(Q); D-(P)
(2) A-(S); B-(Q); C-(P); D-(R)
(3) A-(R); B-(P); C-(S); D-(Q)
(4) A-(R); B-(Q); C-(S); D-(P)

PYQ's (DELETED SYLLABUS)

1. Which of the following are **true** about the taxonomical aid 'key'? **(2022 Phase 2)**
   (A) Keys are based on the similarities and dissimilarities.
   (B) Key is analytical in nature.
   (C) Keys are based on the contrasting characters in pair called couplet.
   (D) Same key can be used for all taxonomic categories.
   (E) Each statement in the key is called Lead.
   Choose the **most appropriate** answer from the options given below:
   (1) (A), (B) and (C) only
   (2) (B), (C) and (D) only
   (3) (A), (B), (C) and (E) only
   (4) (A), (C), (D) and (E) only

2. The contrasting characteristics generally in a pair used for identification of animals in Taxonomic Key are referred to as: **(2019 odisha)**
   (1) lead (2) couplet
   (3) doublet (4) alternate

3. Match the items given in **Column-I** with those in **Column-II** and select the **correct** option given below: **(2018)**

	Column-I		Column-II
A.	Herbarium	P.	It is a place having a collection of preserved plants and animals.
B.	Key	Q.	A list that enumerates methodically all the species found in an area with brief description aiding identification.
C.	Museum	R.	Is a place where dried and pressed plant specimens mounted on sheets are kept.
D.	Catalog	S.	A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.

   (1) A-(Q), B-(S), C-(R), D-(P)
   (2) A-(R), B-(S), C-(P), D-(Q)
   (3) A-(P), B-(Q), C-(R), D-(S)
   (4) A-(P), B-(S), C-(R), D-(Q)

4. The label of a herbarium sheet does **NOT** carry information on: **(2016-II)**
   (1) date of collection (2) name of collector
   (3) local names (4) height of the plant

Answer Key

CONCEPT APPLICATION

1. True 2. False 3. True 4. False 5. True
6. False 7. True 8. True 9. False 10. Metabolism
11. Metabolism and Consciouness 12. False 13. False 14. True
15. False 16. True 17. True 18. True 19. Biodiversity
20. Identification 21. Taxa 22. True 23. True 24. True
25. True 26. False 27. False 28. Morphological 29. Genus
30. Solanaceae 31. Dicotyledonae, Anacardiaceae

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NCERT FOCUSED FILL-INS

1. Growth
2. Body mass
3. Body mass
4. Sand mounds
5. Defining
6. *Hydra*
7. Synonymous
8. Chemical
9. Metabolism
10. Biodiversity
11. Nomenclature
12. Identification
13. Taxa
14. Taxonomy
15. Characterisation
16. Evolutionary
17. Latin
18. Author
19. Rank
20. Three
21. Morphological
22. Similarities
23. *nigrum*
24. *Felis*
25. Solanaceae
26. Canidae
27. Families
28. *Convolvulaceae*
29. Carnivora
30. Diptera

SCHOOL LEVEL PROBLEMS

Single Correct Type Questions

1. (4) 2. (1) 3. (2) 4. (4) 5. (2) 6. (3) 7. (4)

Assertion and Reason Type Questions

1. (2) 2. (3) 3. (3) 4. (3) 5. (3)

Case Study Based Questions

Case-I: 1. (3) 2. (3) 3. (2) 4. Two 5. Species

Case-II: 1. (3) 2. (3) 3. (1) 4. (3) 5. (2)

PRARAMBH EXERCISE-1 (TOPICWISE)

1. (1)	2. (3)	3. (1)	4. (4)	5. (3)	6. (2)	7. (1)	8. (1)	9. (3)	10. (4)
11. (3)	12. (1)	13. (4)	14. (1)	15. (4)	16. (1)	17. (1)	18. (2)	19. (4)	20. (2)
21. (1)	22. (3)	23. (2)	24. (4)	25. (1)	26. (2)	27. (3)	28. (3)	29. (2)	30. (4)
31. (2)	32. (1)	33. (1)	34. (1)	35. (2)	36. (4)	37. (2)	38. (2)	39. (3)	40. (3)
41. (1)	42. (4)	43. (1)	44. (4)	45. (4)	46. (3)	47. (3)	48. (2)	49. (1)	50. (4)
51. (1)	52. (4)	53. (2)	54. (4)	55. (4)	56. (4)	57. (2)	58. (4)	59. (3)	60. (1)
61. (2)	62. (3)	63. (3)	64. (2)	65. (1)	66. (2)	67. (2)	68. (2)	69. (1)	70. (3)
71. (1)	72. (4)	73. (1)							

PRABAL EXERCISE-2 (LEARNING PLUS)

1. (4)	2. (4)	3. (4)	4. (3)	5. (4)	6. (4)	7. (3)	8. (1)	9. (4)	10. (2)
11. (3)	12. (4)	13. (2)	14. (2)	15. (1)	16. (1)	17. (3)	18. (3)	19. (3)	20. (1)
21. (4)	22. (2)	23. (1)	24. (4)	25. (4)					

PARIKSHIT EXERCISE-3 (MULTICONCEPT)

1. (2)	2. (4)	3. (4)	4. (1)	5. (4)	6. (3)	7. (2)	8. (3)	9. (2)	10. (1)
11. (3)	12. (3)	13. (1)	14. (2)	15. (4)	16. (2)	17. (4)	18. (4)	19. (3)	20. (1)
21. (4)	22. (4)	23. (2)	24. (2)	25. (1)	26. (1)	27. (1)	28. (1)	29. (4)	30. (4)
31. (3)	32. (2)	33. (1)	34. (4)						

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. (3) 2. (2) 3. (2) 4. (3) 5. (2) 6. (4) 7. (1) 8. (3)

PYQ'S (Deleted Syllabus)

1. (3) 2. (2) 3. (2) 4. (4)

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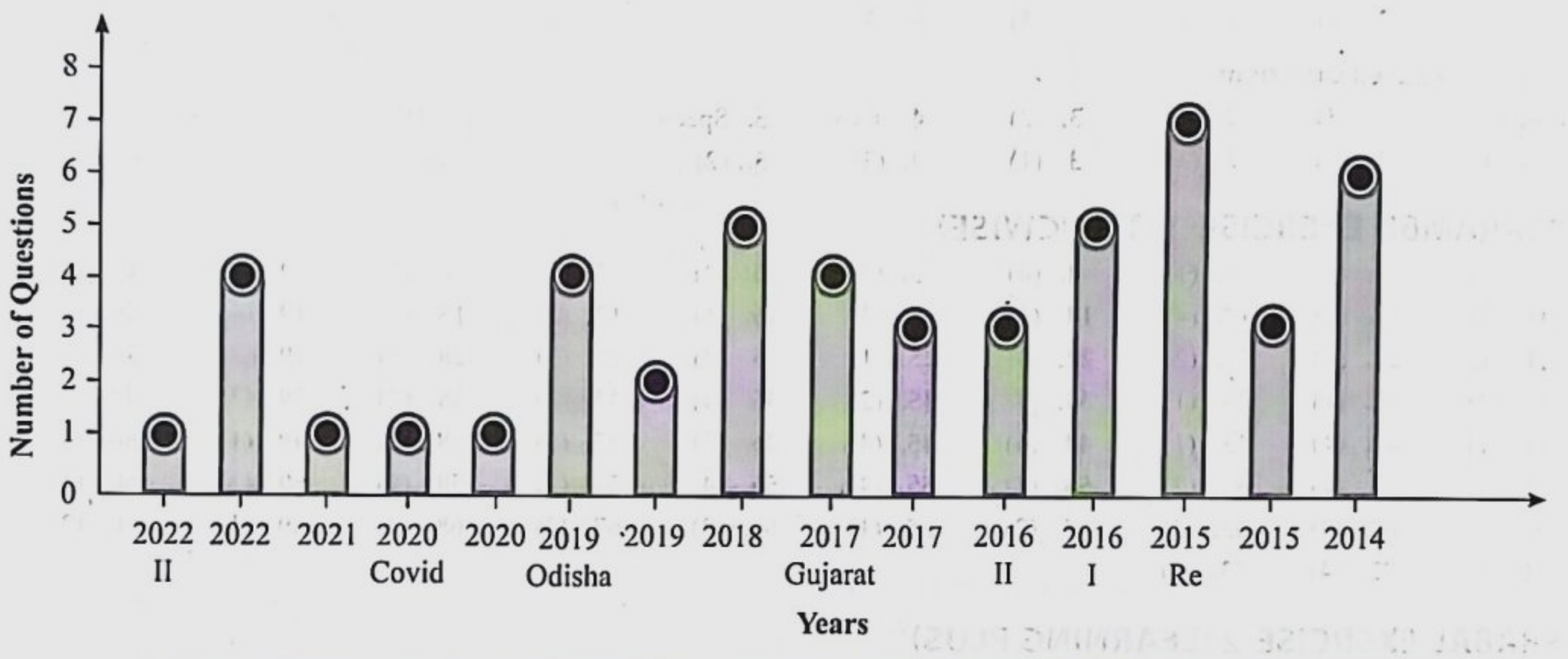
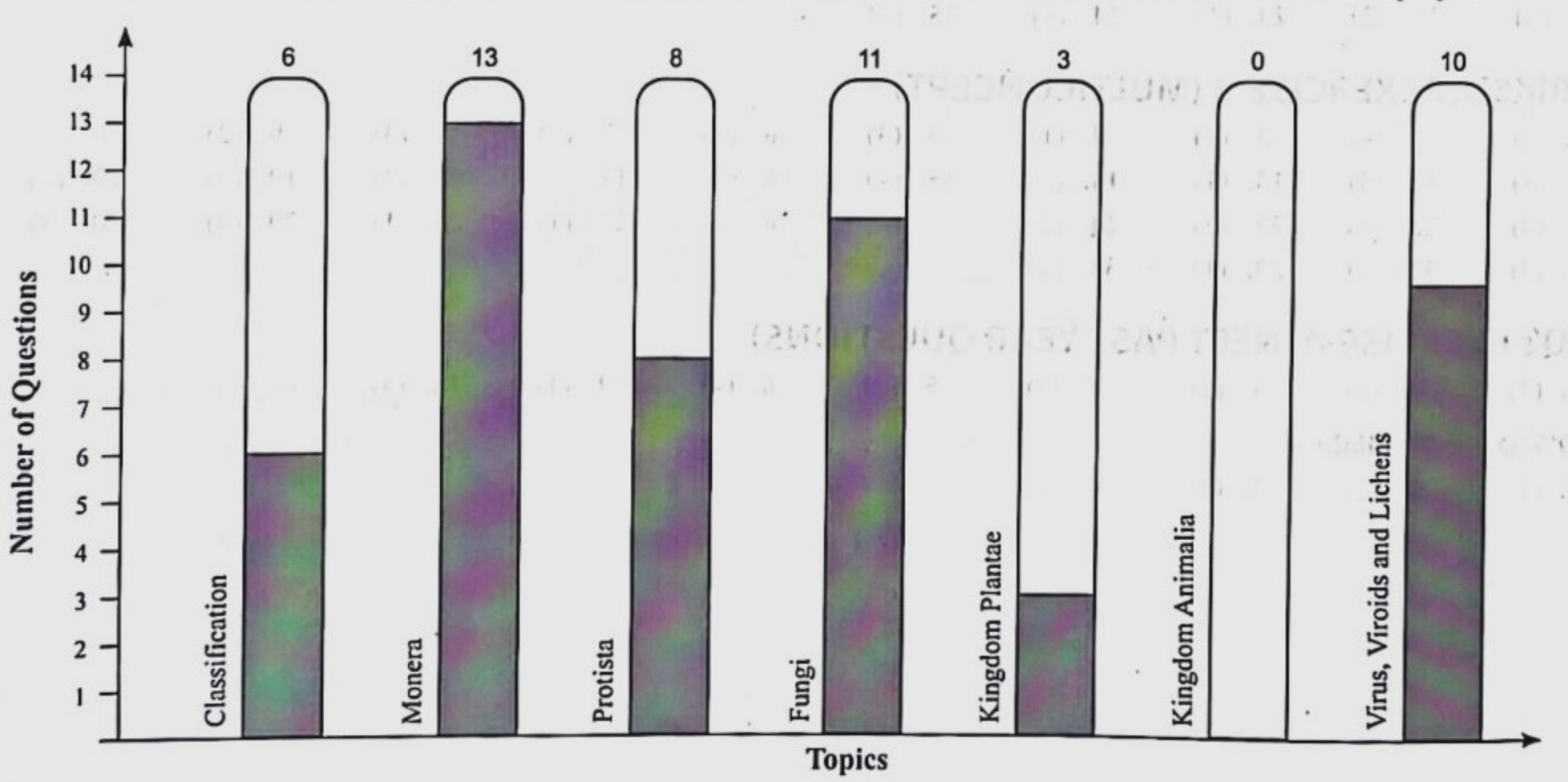
CHAPTER 4

Biological Classification

Year Wise Number of Questions Analysis (2023-2014)



Topicwise Number of Questions Analysis (2022-2013)



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INTRODUCTION

- Identification of differences among organisms and placing them into groups that reflect their most significant features and relationship is called **biological classification.**
- Biological classification was **first proposed** by **Aristotle** who used simple morphological characteristics to classify plants into trees, shrubs and herbs. He also classified animals into **two** groups, those which had 1*.....and those that did not.

Key Note

- The purpose of biological classification is to organise the vast number of known plants into categories that could be studied easily.

System of Classification	Name of Kingdoms	Taxonomist
2 kingdom	Plantae ans Animalia	Carolous Linnaeus
3 Kingdom	Plantae, Protista and Animalia	Ernst Haeekel
4 Kingdom	Plantae, Protista, Monera and Animalia	Copeland
5 Kingdom	Plantae, Protista, Monera Fungi and Animalia	Whittaker
6 Kingdom	Plantae, Protista, Monera Fungi Archaebacteria and Animalia	Carl Woese

KINGDOM CLASSIFICATION OF LIVING ORGANISMS

1. Two Kingdom Classification System

- **Linnaeus** introduced **two** kingdom classification. He classified all organisms into **two** kingdoms – **Kingdom plantae and kingdom animalia.**
- Kingdom Plantae involves autotrophic, fixed organisms while kingdom Animalia includes motile, heterotrophic organisms.

Limitations of Two-Kingdom System:

(*i*) Unicellular and multicellular forms have been placed in both the kingdoms though they have different organisation.

(*ii*) Bacteria and cyanobacteria are included under plants but they are prokaryotes.

(*iii*) Lichens are also included in plants but they are symbiotic organisms.

(*iv*) Fungi are included under plantae but they are non-photosynthetic and heterotrophic.

(*v*) Didn't distinguish between prokaryotes and eukaryotes.

2. Five Kingdom Classification System

- It was proposed by **R.H. Whittaker (1969).**

The Five Kingdoms Defined by him were:

(*i*) Monera (*ii*) Protista
(*iii*) Fungi (*iv*) Plantae
(*v*) Animalia

The Main Criteria for Classification Used by him Include:

(*i*) Cell structure (*ii*) Thallus organisation
(*iii*) 2..... (*iv*) Reproduction
(*v*) Phylogenetic relationships

Key Points of Five Kingdom Classification

- Earlier classification systems included bacteria, blue green algae, fungi, mosses, ferns, gymnosperms and the angiosperms under 'Plants'.
- The character that unified this whole kingdom was that all the organisms included had a 3..... in their cells.
- This placed together groups which widely differed in other characteristics.
- It brought together the prokaryotic bacteria and the blue green algae (cyanobacteria) with other groups which were eukaryotic.
- It also grouped together the unicellular organisms and the multicellular ones, say, for example, *Chlamydomonas* and *Spirogyra* were placed together under algae.
- The classification did not differentiate between the heterotrophic group – fungi, and the autotrophic green plants, though they also showed a characteristic difference in their walls composition – the fungi had **chitin** in their walls while the green plants had a **cellulosic** cell wall. When such characteristics were considered, the fungi were placed in a separate kingdom – Kingdom Fungi.
- All prokaryotic organisms were grouped together under Kingdom Monera and the unicellular eukaryotic organisms were placed in 4.....
- Kingdom Protista has brought together *Chlamydomonas*, *Chlorella* (earlier placed in Algae within Plants and both having cell walls) with 5..... and *Amoeba* (which were earlier placed in the animal kingdom which lack cell wall).

Merits of Five Kingdom Classification:

(*i*) It exhibits phylogenetic relationship between diverse groups of organisms.

(*ii*) Prokaryotes are classified in a separate kingdom according to their genetic, cellular, reproductive and physiological differences.

(*iii*) Fungi were grouped under a separate kingdom and protozoa was excluded from kingdom animalia.

1* *"NCERT Focused Fill-ins" is an exercise with blanks in textbook passages that students fill in to test their NCERT-based knowledge and grasp over NCERT Textbook*

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Demerits of Five Kingdom Classification:

(*i*) Monera and Protista include diverse life forms because both include photosynthetic and heterotrophic organisms and also have cells with and without cell wall.

(*ii*) Viruses and viroids have not been given proper place in this classification system.

(following topic to be printed in blue)

3. The Three-Domain System

- Proposed by **Carl Woese.**
- It divides the Kingdom Monera into two domains, leaving the remaining eukaryotic kingdoms in the third domain and thereby a **6**..... kingdom classification.

Table 1: Characteristics of the five kingdoms

Characters	Five Kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulosic (Polysaccharide + amino acid)	Present in some	Present with **7**.....	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multicellular/ loose tissue	Tissue/organ	Tissue/organ/organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic) and heterotrophic	Heterotrophic (saprophytic/parasitic)	Autotrophic (photosynthetic)	Heterotrophic (holozoic/sapropytic etc.)

Concept Application

True and False:

1. The main criteria for classification used by Whittaker include cell structure, body organisation, mode of nutrition, reproduction and phylogenetic relationships.
2. Earlier classification systems included bacteria, blue green algae, fungi, mosses, ferns, gymnosperms and the angiosperms under 'Plants'. The character that unified this whole kingdom was that all the organisms were autotrophic.
3. The fungal and plant cell wall are made up of chitin and cellulose, respectively.

Fill in the Blanks:

4. _____ was the earliest to attempt a more scientific basis for classification.
5. The three domain system has _____ kingdoms.
6. Five kingdom classification of living organisms is given by in year _____

KINGDOM MONERA

- **All prokaryotic** organisms were grouped together under Kingdom Monera.
- Bacteria are the **sole members** of the Kingdom Monera. They are the most abundant micro-organisms.

General Characteristics

- **Cell wall** is made up of **peptidoglycan** except **8**..... and absent in mycoplasma.
- **Genetic material** is **naked DNA** known as **nucleoid.** Histones, nuclear envelope, nucleoplasm, nucleolus and chromatin are absent.
- All membrane bound organelles are absent.
- Contains 70S type of ribosomes.
- Since mitochondria are absent, therefore respiratory enzymes are associated with plasma membrane (mesosome).
- **Nutrition** is autotrophic (chemosynthetic and photosynthetic) and heterotrophic (saprophytic/parasitic).
- **Reproduction** takes place by asexual methods only. However, there is transfer of genetic material in some cases (Conjugation or Transduction) but **true sexual** reproduction is absent.

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Key Note

- Though the bacterial structure is very simple, they are very complex in behaviour.
- Compared to many other organisms, bacteria as a group show the most extensive metabolic diversity.

Habitat

- They show cosmopolitan distribution.
- They are found everywhere, i.e., in air, water, soil and in plants and animals.
- They also live in extreme habitats such as hot springs, deserts, snow and deep oceans where very few other life forms can survive.
- Many of them live in or on the other organisms as parasites.

Types of Bacteria

On the Basis of Their Shape:

(*i*) **Coccus (pl: Cocci)** – Spherical shaped
(*ii*) **Bacillus (pl: Bacilli)** – **9**.....
(*iii*) **Spirillum (pl: Spirilla)** – Spiral shaped bacteria
(*iv*) **Vibrium (pl: vibrio)** – Comma shaped

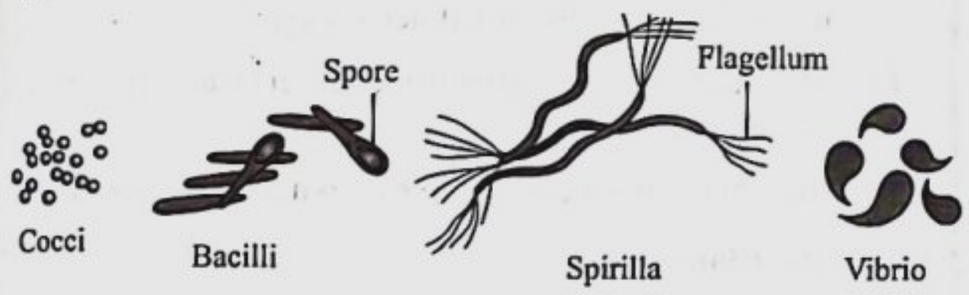

Fig. 1 : Bacteria of different shapes

Nutrition in Bacteria

(*i*) **Autotrophs:** These bacteria use light or chemical energy for their own food synthesis. On the basis of source of energy autotrophs are of following two types:

(A) Photosynthetic autotrophs
+ They use light energy for food synthesis.
e.g., Green sulfur bacteria

(B) Chemosynthetic autotrophs
+ They use chemical energy instead of light energy for food synthesis.
+ Chemical energy is obtained from oxidation of inorganic or organic compounds.
e.g., *Nitrosomonas*

(*ii*) **Heterotrophs:**
+ Most of the bacteria are **heterotrophic** i.e., they can not manufacture their own food.
+ They receive their own food from dead organic matter **(saprophytic)** or living organism **(parasitic)**.
e.g., *Salmonella*

Archaebacteria

- **Most primitive form** of life.
- These bacteria are special since they live in most extreme environmental conditions such as extreme salty areas (**10**.....), hot springs **(thermoacidophiles)** and mashy areas **(methonogens)**.
- Archaebacteria differ from other bacteria in having a different **11**..... **structure** and this feature is responsible for their survival in extreme conditions.
- Methanogens are present in the gut of several **ruminant** animals such as cows and buffaloes and thus are responsible for the production of methane **(biogas)** from the dung of these animals.

Eubacteria

- There are thousands of different eubacteria or 'true bacteria'.
- They are characterised by the presence of a rigid cell wall, and if motile, a flagellum.

Cyanobacteria

- The cyanobacteria (also referred to as blue-green algae) have chlorophyll *a* similar to **12**..... and are **photosynthetic autotrophs.**
- The cyanobacteria are unicellular, colonial or filamentous, fresh water/marine or terrestrial algae. The colonies are generally surrounded by **gelatinous sheath.**
- They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called **heterocysts**, e.g., *Nostoc* and **13**.....
- **Chemosynthetic autotrophic** bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. **Heterotrophic bacteria are most abundant in nature.**

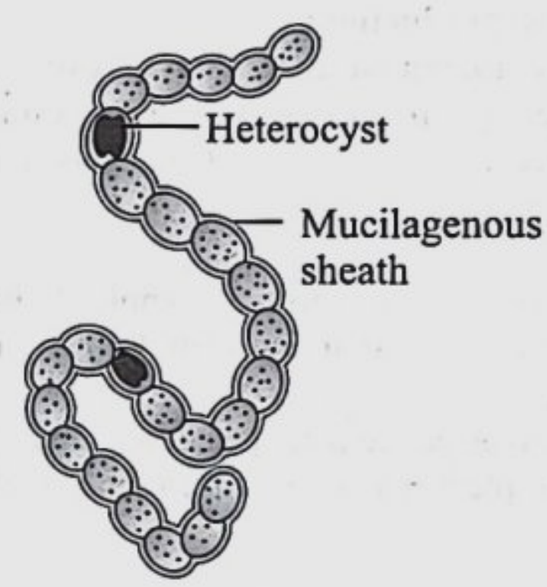

Fig. 2: A filamentous blue-green algae – *Nostoc*

Key Note

- Cyanobacteria perform oxygenic photosynthesis, they are the first organism to produce O_2 on earth.
- Heterocysts are special cells of cyanobacteria. They are thick walled, pale yellow coloured cells. They lack photosynthetic pigments but contain a pink colour pigment called **leghaemoglobin.**
- Heterocysts are anaerobic cells, fix atmospheric N_2 with the help of enzyme **Nitrogenase.**
- Heterocysts obtain nutrition from neighbouring cells.

Economic Importance of Bacteria

- The chemosynthetic autotrophic play a great role in recycling nutrients like nitrogen, phosphorous, iron and sulphur.
- The majority of **heterotrophic bacteria** are important decomposers.
- They are helpful in making **curd** from milk, production of **antibiotics, fixing nitrogen** in legume roots, etc.

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- Some are pathogens causing damage to human beings, crops, farm animals and pets. Cholera, typhoid, tetanus, citrus canker are well known diseases caused by different bacteria.

Reproduction

Bacteria perform reproduction by the following methods:

(*i*) **By Binary Fission:**

It takes place during favourable conditions.

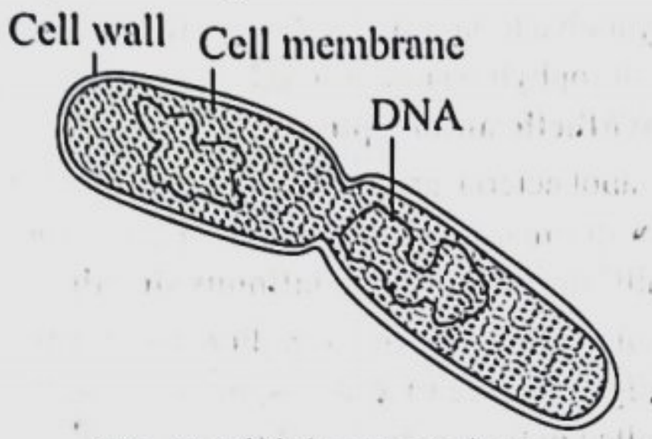

Fig. 3: Dividing Bacterium

(*ii*) **By spore:**

- It takes place in adverse conditions. The spore is thick walled, highly resistant and surrounded by protective layers.

(*iii*) **Sexual Reproduction:**

- They also reproduce by a sort of sexual reproduction by adopting a **primitive type** of DNA transfer from one bacterium to the other (Conjugation, transformation and transduction).

Mycoplasma

- Mycoplasma are organisms that completely **lack a cell wall.**
- They are the **smallest living cells known** and can survive without [14]_____.
- Many mycoplasma are pathogenic in animals and plants. *e.g.*, Bovine pleuropnenomia in cattles and Witche's broom in plants.

Train Your Brain

Example 1. The chemosynthetic bacteria are autotrophic or heterotrophic?

Sol. Autotrophs

Example 2. State the uses of heterotrophic bacteria and archaebacteria which are economically important.

Sol. Heterotrophic Bacteria

- They maintain the fertility of the soil by nitrogen fixation, ammonification and nitrification. *e.g.*, *Rhizobium*
- The milk products such as cheese, curd are obtained by bacteria.

Archaebacteria

- Biogas is produced by methanogens from animal dung.

Example 3. Why are cyanobacteria used in agricultural fields for crop improvement?

Sol. Cyanobacteria have the ability to fix atmospheric nitrogen and make it available to the plants. This improves the crop yield. That is why cyanobacteria are used in agricultural fields Eg *Nostoc, Anabaena.*

Concept Application

True and False:

7. Bacteria are the sole members of the Kingdom Monera.
8. Bacteria are grouped under four categories based on their mode of nutrition.
9. The vast majority of bacteria are autotrophs.
10. Archaebacteria differ from other bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions.
11. Archaebacteria are characterised by the presence of a rigid cell wall, and if motile, a flagellum.
12. Cyanobacteria (also referred to as blue-green algae) have chlorophyll a similar to green plants.
13. Cyanobacteria often form blooms in polluted water bodies and some of these can fix atmospheric nitrogen in specialised cells called heterocysts.
14. Majority of heterotrophic bacteria are important decomposers.
15. Bacteria reproduce mainly by sexual reproduction.

Fill in the Blanks:

16. _____ are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.
17. _____ are the smallest living cells known and can survive without oxygen.

KINGDOM PROTISTA

General Characters

- All the organisms included in Protista are **unicellular eukaryotes.**
- The **boundaries** of this kingdom are **not well defined.**
- They bear well-defined nucleus and other membrane bound organelles.
- Members of Protista are **primarily aquatic.**
- This kingdom forms a link with the others dealing with plants, animals and [15]_____.
- Locomotion takes place by flagella or cilia.
- They reproduce asexually and sexually by a process involving cell fusion and zygote formation.

Protists are further classified into following groups:

1. Chrysophytes

- This group includes diatoms and golden algae (desmids).
- They are found in fresh water as well as in marine environments.

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- They are microscopic and **float passively** in water currents (plankton).
- Most of them are **photosynthetic.**
- The cell walls of diatoms are made up of **silica** embedded and thus the due to which cell walls are **16**.....
  The cell wall form two thin overlapping shells, which fit together as in a **soap box.**
- Diatoms are the **chief 'producers'** in the oceans.

Key Note

- Due to a transparent siliceous shell (silica deposited in cellulosic cell wall), the cell wall of diatoms is hard. It does not get destroyed after their death and deposited at the bottom of sea. This accumulation occurs over billions of years and is referred to as **diatomaceous earth** or **diatomite.**
- Being gritty this soil (**diatomaceous earth**) is used in polishing, filtration of oils and syrups.

2. Dinoflagellates

- Mostly marine and photosynthetic organisms.
- Dinoflagellates are yellow, green, brown, blue or red depending on the main **pigments** present in their cells.
- The cell wall has stiff **cellulose plates** on the outer surface.
- Most of the dinoflagellates have **two flagella** - one is **17**..... and other is **18**..... in a furrow between the wall plates.

Key Note

- Very often, red dinoflagellates undergo such rapid multiplication that they make the sea appear red (**red tides**). E.g., *Gonyaulax*.
- Toxins released by such large numbers may even kill other marine animals such as fishes.

Fig. 4: A dinoflagellate

3. Euglenoids

- They are unicellular protists found in **stagnant fresh** water habitats.
- Their **cell membrane is covered with pellicle** instead of cell wall. Pellicle is rich in **19**..... and it is elastic in nature, which makes their body flexible.
- They have **two flagella,** a short and a long one.
- Though they are **photosynthetic** in the presence of sunlight, when deprived of sunlight they behave like **heterotrophs** by predating on other smaller organisms.
- The pigments of euglenoids are identical to those present in higher plants. Example: *Euglena*

Fig. 5: *Euglena*

4. Slime Moulds

- Slime moulds are **saprophytic** protists.
- The body moves along decaying twigs and leaves engulfing organic material.
- Under **suitable** conditions, they form an aggregation called **plasmodium** which may grow and spread over several feet.
- During **unfavourable** conditions, the plasmodium differentiates and forms **20**..... bearing spores at their tips.
- The spores possess true walls and are dispersed by air currents.
- They are extremely resistant and survive for many years, even under adverse conditions.

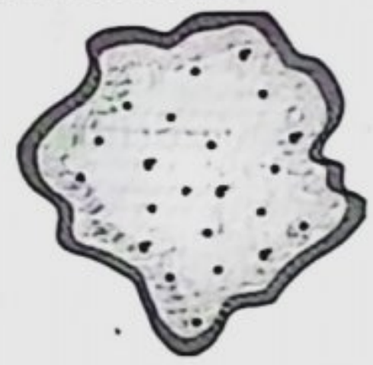

Fig. 6: Slime mould

5. Protozoans

- All protozoans are **heterotrophs** and live as predators or parasites. Some are symbiotic.
- They are animal like protista (lack cell wall) hence, they are believed to be **21**..... **relatives of animals.**
- There are four major groups of protozoans.

(*i*) Amoeboid Protozoans:

- Locomotory organ – Pseudopodia (one or two or many)
- Habit & Habitat – Fresh water, sea water (marine) or moist soil.
- Food capturing – Prey is captured by putting out pseudopoida (false feet).
- Marine forms have silica shells on their surface.

E.g., *Amoeba, Entamoeba* (act as parasite).

(*ii*) Flagellated Protozoan:

- Locomotory organ – Flagella.
- Habit and Habitat – Free living or parasitic, some are aquaitic.
- The parasitic forms such as **22**..... cause diseases sleeping sickness.

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(*iii*) **Ciliated Protozoan:**

- Locomotory organ – Thousands of Cilia.
- The co-ordinated movement of rows of cilia causes the water laden with food to be steered into the 23.....,, a cavity that opens to the outside of the cell surface.
- Habit and Habitat – Aquatic, free living, parasitic and commensal. E.g., *Paramoecium*.

Fig. 7: *Paramoecium*

(*iv*) **Sporozoans:**

- Locomomotory organ – absent.
- Habit and Habitat – They all are **parasite**, mostly intracellular parasite that have an infectious 24..... stage in their life cycle. Eg. *Plasmodium*

Train Your Brain

Example 4. What is the nature of the cell wall in diatoms?

Sol. The cell wall of diatoms forms two thin overlapping cells. It is made up of silica.

Example 5. Why are red tides caused and why are they harmful?

Sol. Dinoflagellates such as Gonyaulax have a rapid multiplication rate. They are dangerous because they emit chemicals that destroy aquatic animals.

Example 6. Which group comprises single-celled eukaryotes only.

Sol. Kingdom Protista comprises single-celled eukaryotes.

Example 7. Which organisms are the chief producers in oceans?

Sol. Diatoms are the chief producers in oceans.

Key Note

- Flagellated Protozoa cause vector borne diseases such as Kala azar (vector-**sand fly**) and sleeping sickness (vector-**Tse-tse fly**)
- The most notorious sporozoan is *Plasmodium* (vector-**Female** ***Anopheles*** mosquito) which causes malaria, a disease which has a staggering effect on human population.
- Ciliated Protozoan *Paramoecium* has two nuclei (macro-nuclei and micro-nuclei).

Concept Application

True and False:

18. The protistan cell body contains a well defined nucleus and other membrane-bound organelles.
19. Chrysophytes are found only in fresh water.
20. 'Diatomaceous earth' is created by the chief 'producers' in the oceans.
21. Most of the diatoms have two flagella; one lies longitudinally and the other transversely in a furrow between the wall plates.
22. Red dinoflagellates undergo such rapid multiplication that they make the sea appear red (red tides).
23. Euglenoids have a protein rich layer called pellicle which makes their body rigid.
24. Euglenoids can behave both as a plant as well as an animal.
25. Under suitable conditions, slime moulds form an aggregation called fruiting bodies.
26. The spores possess of slime moulds possess true walls.
27. All protozoans are autotrophs and live as predators or parasites.
28. Silica shells are present on the surface of amoeboid protozoans.
29. *Trypanosoma* possesses flagellum.
30. Malaria is caused by *Paramoecium*.

Fill in the Blanks:

31. In _____ the cell walls form two thin overlapping shells, which fit together as in a soap box.
32. _____ are saprophytic protists.

KINGDOM FUNGI

- The fungi constitute a unique kingdom of **heterotrophic** organisms.
- They show a **great diversity** in morphology and habitat.
- Fungi are cosmopolitan & 25..... allows them to grow on leather, wood, pickle and bread.
- They prefer to grow in **warm and humid places**. Some fungi live **parasitically** in plants, animals and human body.
- They lack chloroplast, so fungi are heterotrophs. Fungi obtain their food from dead organic matter or living organisms.

Structure

- With the exception of yeasts which are unicellular, fungi are filamentous.
- Their bodies consist of long, slender 26.....-like structures called **hyphae**. The network of hyphae is known **as mycelium.**
- Some hyphae are continuous tubes filled with multinucleated cytoplasm – these are called 27..... **hyphae.** Others have septae or cross walls in their hyphae.
- Cell wall is made up of **chitin and polysaccharides.**

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On the basis of nutrition, fungi are of three types:

(*i*) **Saprophytic:**

+ They obtain their own food from dead organic matter such as bread, rottening fruit, vegetable and dung.

(*ii*) **Parasitic:**

+ They obtain their own food from living organism such as plants, animals and human beings.

(*iii*) **Symbionts:**

+ Some fungi are found **symbiotically** associated with algae and form **lichens** or with the roots of higher plants to form **mycorrhiza.**

Reproduction in Fungi

- Reproduction takes place by **three** different methods;

(*i*) **Vegetative Reproduction:** By fragmentation, budding and fission.

(*ii*) **Asexual Reproduction:** Asexual reproduction takes place by the formation of different types of spores called **28**..... or **sporangiospores** or **zoospores.**

(*iii*) **Sexual Reproduction:**

+ Sexual reproduction takes place by oospores, **29**..... and basidiospores.
+ The various sexual spores are produced in distinct structures called **fruiting bodies.**
+ **The sexual cycle involves the following three steps:**

(*i*) Fusion of protoplasms between two motile or non-motile gametes called **plasmogamy.**

(*ii*) Fusion of two nuclei called **karyogamy.**

(*iii*) **Meiosis in zygote** resulting in haploid spores.

(*iv*) When a fungus reproduces sexually, two haploid hyphae of compatible mating types comes together and fulse.

Key Note

- In some fungi, the fusion of two haploid cells immediately results in diploid cells (2n).
- However, in other fungi **(ascomycetes and basidiomycetes),** an intervening dikaryotic stage (n + n, i.e., two nuclei per cell) occurs; such a condition is called a **dikaryon** and the phase is called **dikaryophase** of fungus.
- Later, the parental nuclei fuse and the cells become diploid.
- The fungi form fruiting bodies in which reduction division occurs, leading to formation of haploid spores.

Economic Importance

- The common **mushroom** you eat and toadstools are fungi.
- White spots seen on mustard leaves are due to a parasitic fungus.
- Some unicellular fungi, e.g., **yeast** are used to make **bread** and **beer.**
- *Neurospora* is used extensively in **30**..... and genetic work.
- Many members like morels and **31**..... are **edible** and are considered delicacies.
- Other fungi cause **diseases** in plants and animals; wheat rust-causing *Puccinia* is an important example.
- Some are the source of **antibiotics,** e.g., *Penicillium.*

Classification of Fungi

- Fungi are divided into following classes on the **basis** of the morphology of the **mycelium,** mode of **spore** formation and **fruiting bodies.**

1. Phycomycetes

- Found in **aquatic habitats** and on decaying wood in moist and damp places or as **obligate parasites** on plants.
- The mycelium is multinucleate **(coenocytic)** and aseptate.
- **Asexual reproduction** takes place by **zoospores** (motile) or by **aplanospores** (non-motile). These spores are endogenously produced in sporangium. A zygospore is formed by fusion of two gametes.
- These gametes are similar in morphology **(isogamous)** or dissimilar **(anisogamous or oogamous).**
- E.g., *Mucor*, *Rhizopus* (the bread mould) and **32**..... (the parasitic fungi on mustard).

Mnemonic

- Phycomycetes examples-"***Pheku-RAM***"

(***Pheku***-**Phycomycetes** ***RAM***-R = *Rhizopus;* A = *Albugo;* M = *Mucor*)

Fig. 8: *Mucor*

2. Ascomycetes (sac fungi)

- Commonly known as sac-fungi, the ascomycetes are mostly multicellular, e.g., *Penicillium*, or rarely unicellular, e.g., yeast (*Saccharomyces*).
- They are saprophytic, decomposers, parasitic or **coprophilous** (growing on dung).
- The mycelium is septate & branched.
- **Asexual reproduction** takes place by asexual spores **conidia** which are produced **33**..... on the special mycelium called **conidiophores.**
- **Sexual reproduction** occurs by Plasmogamy and delayed karyogamy. Ascospores (sexual spores) are produced **34**..... in sac like **asci** (singular ascus). These asci are arranged in different types of fruiting bodies called **ascocarps.**

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- Some examples are *Aspergillus*, *Claviceps* and *Neurospora*.
- Morels and truffels are edible Ascomycetes

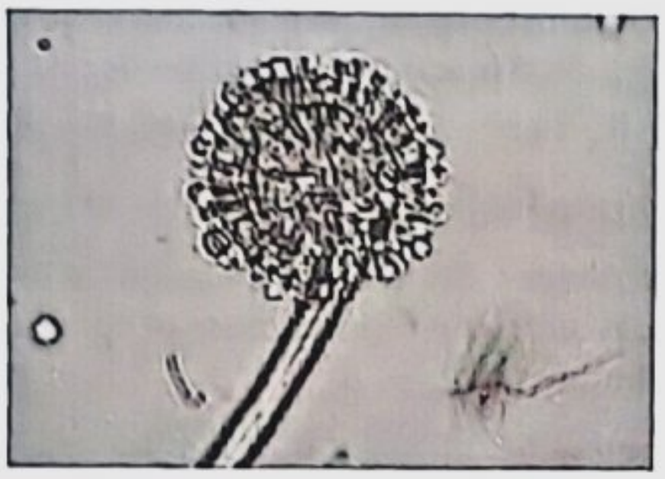

Fig. 9: *Aspergillus*

Key Note

- *Neurospora* has been used for biochemical and genetics work.
- Some Ascomycetes such as morels and truffels are edible they are considered delicacies hence have high market value
- The first antibiotic penicillin was obtained by *Penicillium* notatum

3. Basidiomycetes (club fungi)

- Commonly known forms of basidiomycetes are **mushrooms**, bracket fungi or puffballs.
- They grow in soil, on logs and tree stumps and in living plant bodies as parasites, e.g., rusts and smuts.
- Mycelium is **septate and branched**.
- The asexual spores are generally not found, but vegetative reproduction by **35**..... is common.
- The sex organs are absent, but plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotypes. The resultant structure is dikaryotic which ultimately gives rise to basidium.
- **First karyogamy and then meiosis take place in the basidium** producing four basidiospores. The basidiospores are exogenously produced on the basidium (pl.: basidia). The basidia are arranged in fruiting bodies called **36**.....
- Some common members are *Agaricus* (mushroom), *Ustilago* (smut) and *Puccinia* (rust fungus).

Fig. 10: *Agaricus*

4. Deuteromycetes (fungi imperfecti)

- Commonly known as **fungi imperfecti** because the sexual stage is either absent or not reported.
- When the sexual forms of these fungi were discovered they were moved into classes they rightly belong to. It is also possible that the asexual and vegetative stage have been given one name (and placed under deuteromycetes) and the sexual stage another (and placed under another class). Later when the linkages were established, the fungi were correctly identified and moved out of deuteromycetes. Once perfect (sexual) stages of members of deuteromycetes were discovered they were often moved to **37**..... and basidiomycetes.
- Mycelium is septate and branched.
- They **reproduce only by asexual spores** called **38**..... formed on conidiophores.
- Some members are **saprophytes** or parasites while a large number of them are **decomposers** of litter and help in **mineral cycling.**
- E.g., *Alternaria*, *Colletotrichum* and *Trichoderma*.

Mnemonic

- Deuteromycetes examples-"***CAT is imperfect***"

(***CAT-C*** = *Colletotrichum;* A = *Alternaria;*
T = *Trichoderma*)

imperfect = Deuteromycetes are *imperfect Fungi*

Train Your Brain

Example 8. Name the fungus that causes the rust of wheat?

Sol. *Puccinia* is the fungus that causes the rust of wheat.

Example 9. Why are some fungi grouped under "fungi imperfecti"?

Sol. Asexual reproduction is widespread in fungus. A portion of the mycelium is fragmented into minute pieces that grow into new mycelium, however sexual reproduction occurs in some fungus. Fungi imperfecti refers to a group of fungi that reproduces entirely by asexual spores rather than sexual spores.

Example 10. Name the fungus which causes disease in wheat (*i*) rust (*ii*) Smut.

Sol. (*i*) *Puccinia*, (*ii*) *Ustilago* are the fungus that causes disease in wheat.

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Concept Application

True and False:

33. The fungi constitute a unique kingdom of heterotrophic organisms.
34. White spots seen on mustard leaves are due to an autotrophic fungus.
35. Wheat rust is caused by *Penicillium*.
36. Yeasts are filamentous fungi.
37. The fungi can be saprophytic, parasitic or symbiotic.
38. Asexual reproduction in fungi takes place by fragmentation, fission and budding.
39. Dikaryophase is seen in members of ascomycetes and basidiomycetes.
40. The morphology of the mycelium, mode of spore formation and fruiting bodies form the basis for the division of kingdom fungi into various classes.
41. The mycelium of phycomycetes is septate and coenocytic.
42. In sac fungi, conidia are produced endogenously on the special mycelium called conidiophores.

Fill in the Blanks.

43. _____ is used extensively in biochemical and genetic work.
44. Members of _____ morels and truffles are edible and are considered delicacies.
45. _____causes smut and _____ is called rust fungus.
46. In *Agaricus*, karyogamy and meiosis take place in the basidium producing four _____.
47. A large number of imperfect fungi are _____ and help in mineral cycling.

KINGDOM PLANTAE

- Kingdom Plantae includes all **eukaryotic chlorophyll-containing** organisms commonly called plants.
- The plant cells have prominent chloroplasts and surrounded by a cell wall (mainly made of **cellulose**).
- Plantae includes algae, bryophytes, pteridophytes, gymnosperms and angiosperms.
- **Alternation of generation:** Life cycle of plants has two distinct phases – the diploid 39..... and the haploid 40..... – that alternate with each other.
  - The lengths of the haploid and diploid phases, and whether these phases are free– living or dependent on others, vary among different groups in plants.

Key Note

- A few members are partially heterotrophic such as the insectivorous plants or parasites. Bladderwort and Venus fly trap are examples of insectivorous plants and Cuscuta is a parasite.
- Alternation of generation: Life cycle of plants has two distinct phases – the diploid sporophytic and the haploid gametophytic – that alternate with each other. The lengths of the haploid and diploid phases, and whether these phases are free– living or dependent on others, vary among different groups in plants

EXTENDED LEARNING

Kingdom Animalia

- This kingdom is characterised by **heterotrophic eukaryotic** organisms that are **multicellular** and their cells lack cell walls.
- They directly or indirectly depend on plants for food.
- They digest their food in an internal cavity and store food reserves as glycogen or fat.
- Their **mode of nutrition is holozoic** – by ingestion of food.
- They follow a definite growth pattern and grow into adults that have a definite shape and size.
- Higher forms show elaborate sensory and neuromotor mechanism. Most of them are capable of locomotion.
- The sexual reproduction is by copulation of male and female followed by embryological development.

VIRUSES, VIROIDS AND LICHENS

In five kingdom classification of Whittaker there is no mention of lichens and some acellular organisms like viruses, viroids and prions.

VIRUS

- Viruses did not find a place in classification since they are not considered truly 'living', if we understand living as those organisms that have a cell structure.
- The viruses are non-cellular organisms that are characterised by having an inert 41..... structure outside the living cell. Once they infect a cell they take over the machinery of the host cell to replicate themselves, finally killing the host.
- Viruses are obligate parasites.
- **D.J. Ivanowsky (1892)** recognised certain microbes as casual organism of the mosaic disease of tobacco. These were found to be smaller than 42..... because they passed through bacteria-proof filters.

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Key Note

- The term 'virus' has been derived from Latin, which means poison or **venom or viscous fluid** (given by Dmitri **Ivanowsky**, 1892).
- Common cold of flu is caused by a virus.

- **M.W. Beijerinck (1898)** demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and called the fluid as **43**..... (infectious living fluid).
- **W.M. Stanley (1935)** showed that viruses could be crystallised and crystals consist largely of proteins. They are inert outside their specific host cell.
- In addition to proteins, viruses also contain genetic material, that could be either RNA or DNA. **No virus contain both DNA and RNA.**
- A virus is a nucleoprotein entity and it is infectious.
- The genetic material of different viruses is given below:
  - **Plant viruses:** Single stranded RNA
  - **Animal viruses:** Either single or double stranded RNA or **44**..... DNA.
  - **Bacterial viruses or bacteriophages:** (viruses that infect the bacteria): Double stranded DNA viruses.

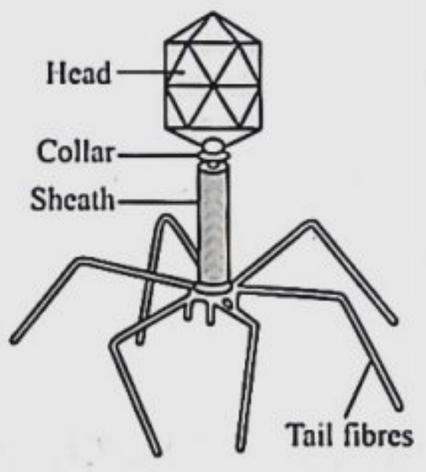

Fig. 11: Bacteriophage

- The protein coat called **capsid** made of small subunits called **45**....., protects the nucleic acid. These capsomeres are arranged in helical or polyhedral geometric forms.
- Viruses cause **diseases** like mumps, small pox, herpes and influenza. AIDS in humans is also caused by a virus.
- In plants, the symptoms can be mosaic formation, **46**..... rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

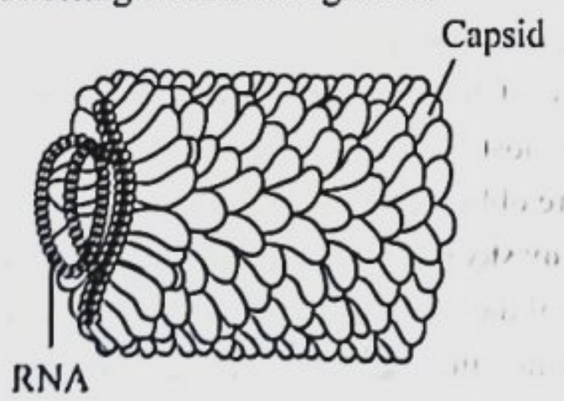

Fig. 12: Tobacco Mosaic Virus (TMV)

- **Viroids:**
  - Discovered by **T.O. Diener** in 1971.
  - An infectious agent that is smaller than viruses and caused **potato spindle tuber** disease.
  - It was found to be a **free RNA**; it lacked the protein coat that is found in viruses, hence the name viroid.
  - The RNA of the viroid is of **47**..... **molecular weight.**
- **Prions:**
  - They consist of **abnormally folded** **48**..... that cause certain infectious neurological diseases.
  - Similar in size to viruses.
  - The most notable diseases caused by prions are **bovine spongiform encephalopathy** (BSE) commonly called mad cow disease in cattle and its **49**..... variant **Cr–Jacob disease** (CJD) in humans.
- **Lichen:**
  - Lichens are symbiotic associations i.e. mutually useful associations, between algae and fungi.
  - The algal component is known as **phycobiont** and fungal component as **mycobiont**, which are autotrophic and heterotrophic, respectively.
  - Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
  - Lichens are very good **pollution indicators** as they do not grow in polluted areas.
  - *Cladonia* known as Reindeer moss is a lichen which provide food for reindeers in acrtic region.
- **Mycorrhiza:**
  - Symiotic association between fungi and roots of higher plants.
  - Plants provide nutrition and shelter to fungi and the fungi species help in nutrient solublisation and mobilisation from soil.

Train Your Brain

Example 11. How are viroids different from viruses?

Sol.

VIROIDS	VIRUSES
Viroids are smaller than viruses & lack protein coat.	Viruses are non-cellular organisms having a protein coat.
Genetic material is free RNA	Genetic material as RNA or DNA

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Example 12. What do you understand by 'phycobiont' and 'mycobiont'?

Sol. The algal component of the lichens is known as phycobiont, while the fungal component is known as mycobiont. Both the algae and the fungi live in symbiotic association with each other. The algae prepare food for the fungi and the fungi, in turn, provides shelter and absorbs nutrients from the soil.

Example 13. Who has discoverd viroids?

Sol. T.O. Diner.

Concept Application

True and False:

48. Bladderwort and Venus fly trap are examples of parasitic plants.
49. Life cycle of plants has two distinct phases – the diploid sporophytic and the haploid gametophytic – that alternate with each other.
50. Animal kingdom is characterised by heterotrophic eukaryotic organisms that are multicellular and their cells lack cell walls.
51. Viruses, viroids and prions are acellular organisms.
52. Ivanowsky demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants.
53. In general, viruses that infect plants have single stranded DNA.
54. The units of protein coat in viruses are arranged in helical or polyhedral geometric forms.
55. Diener discovered the infectious organisms which had a free DNA.
56. Mad cow disease in cattle is caused by an organism which has an abnormally folded protein.
57. In a lichen, algal component is known as phycobiont and fungal component as mycobiont, which are autotrophic and heterotrophic, respectively.

Fill in the Blanks:

58. Kingdom _____ includes all eukaryotic chlorophyll-containing organisms.
59. Holozoic nutrition is shown by members of kingdom _____.
60. _____ showed that viruses could be crystallised and crystals consist largely of proteins.

SHORT NOTES

Table 1: Characteristics of Five Kingdoms proposed by Whittaker (1969)

Characters	Five Kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Noncellulosic (Polysaccharide + amino acid)	Present in some	Present with chitin	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multicellular/ loose tissue	Tissue/organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (Chemosynthetic and photosynthetic) and Heterotrophic (sapro-phytic/ parasitic)	Autotrophic (Photosynthetic) and Hetero-trophic	Heterotrophic (Saprophytic/ Parasitic)	Autotrophic (Photosyn-thetic)	Heterotrophic (Holozoic/ Saprophytic etc.)

Kingdom Monera

- Has bacteria a sole member.
- Bacteria can have shapes like: Coccus (sphere cal). Bacillus (rod-shaped). Vibrio (comma shaped) and sprillum (spiral shaped)
- Bacteria found almost everywhere and can he Photosynthetic autotrophs, Chemosynthetic autotrophs or Heterotrophs.

Archaebacteria

- Halophiles (salt-loving)
- Thermoacidophiles (in hot springs)
- Methonogens (in marsh and in gut of ruminant animals produce methane gas.)

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Eubacteria

- Photosynthetic autotrophs like Cyanobacteria. some like *Anabaena* have specialised cells called heterocysts for nitrogen fixation.
- **Chemosynthetic autotrophs:** Oxidise various inorganic substances like nitrates/nitrites, ammonia and use released energy for their ATP production.
- **Heterotrophic bacteria:** decomposes, help in making curd, production of antibio tics, N_2 fixation, cause diseases like cholera, typhoid.

Mycoplasma: Completely lack cell wall. smallest living cells. Can survive without oxygen. Pathogenic in animals and plants.

Kingdom Prostita: (All single celled eukaryotes)

Forms a link between plants, animals and fungi.

(*i*) **Chrysophytes:** (Has diatoms and golden algae)

- Cell walls have silica and cell walls overlap to fit together like a soap box.
- Their accumulation forms 'Diatomaceous Earth'.
- Used in polishing, filtration of oils and syrups.

(*ii*) **Dinoflagellates:** Marine, photosynthetic, cell wall has cellulose. Two flagella "one longitudinal and other transversely in a furrow between wall plates.

(*iii*) **Euglenoids:** Have protein rich layer 'pellicle' which makes body flexible. Photsynthetic in presence of sunlight but become heterotrophs if they do not get sunlight.

(*iv*) **Slime Moulds:** Saprophytic protists form aggregates to form plasmodium grows on decaying twigs and leaves. Spores have true walls which are extremely resistant and survive form many years.

(*v*) **Protozonans:**

- **Amoeboid:** Catch prey using pseudopdia, e.g., Amoeba.
- **Flagellated:** More flagella. Cause disease like sleeping sickness e.g., *Trypanosoma.*
- **Ciliated:** Have cilia to move food into gullet and help in locomation. e.g., *Paramecium.*
- **Sprozonans:** Have infective spore like stage in life cycle, e.g., Plasmodium which causes

Kingdom Fungi

- Non chlorophyllous hyphae
- Network of hyphane called mycelium
- Cell wall of chitin and polysaccharides
- Grow in warm and humid places
- Saprophytic, parasitic, symbiotic (Lichen) *e.g.*, *Puccinia* (rust causing), *Penicillium.*

Table 2: Characteristics of Four Classes of fungi

Classes	Typical Examples	Sexual Reproduction	Asexual Reproduction	Hyphae
Phycomyeetes	Rhizopus, Mucor, Albugo	Zygospores	Zoopores (motile) Aplanospores (non-motile)	Aseptate and Coenocytic
Ascomyeetes (Sac fungi)	Penicillium (multicellualr), yeast (unicellualr), Aspergillus, Claviceps, Neurospora, morels and truffles (buffles)	Ascospores produced endogenously in sac like asci	Conidia produced on conidiophore	Branched and septate
Basidiomyeetes (Club fungi)	Mushrooms (Agaricus) smut (Ustilago), Rust (Puccinia) Bracket fungi or Puff balls.	Basidiospores produce exogenously on the basidium	Generally asexual spores are not found bu reproduce vegetatively by fragmentation	Branched and septate
Deuteromyeetes (Imperfect fungi)	Alternaria, Colletotrichum. Trichoderma	Sexual phase has not been observed	Conidia	Branched and Septate.

Classes of Fungi

(*i*) **Phycomycetes:**

- Grow on decaying wood
- Mycelium Aseptate
- spores produced endgogenously
- Asexual reproduction by Zoospores of Aplanospores e.g., ***Rhizopus, Albugo.***

(*ii*) **Ascomycetes:**

- Also known as 'sac fungi'
- Mycelium branched and septate
- Spores: Asexual spres are called conidia produced exogenously on the conidiophores.
- Sexual spores are called ascspores produced endog enously in ascus produced inside fruiting body called ascocarp. e.g., ***Aspergillus, Neurospora.***

(*iii*) **Basidiomycetes:**

- Mycelium septate.
- The asexual spores are generally not found but vegetative reproduction by fragmentation is common.
- The basidiospores are exogenously produced on the basidium (pl.:basidial).
- The basidia are arranged in fruiting bodies called basidiocarps.
- Some common members are *Agaricus* (mushroom), *Ustilago* (smut) and *Puccinia* (rust fungus).

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(iv) **Deuteromycetes:**

- Called as 'Fungi imperfecti' as sexual form(perfect stage) is not known for them.
- Once perfect (sexual) stages of members of dueteromycetes were discovered they were often moved to ascomycetes and basidiomycetes.
- The deuteromycetes reproduce only by asexual spores known as conidia.
- The mycelium is septate and branched.
- Some members are saprophytes or parasites while a large number of them are decomposers of litter and help in mineral cycling.
- Some examples are *Alternaria*, *Colletotrichum* and *Trichoderma*.

Viruses

- They did not find a place i classification. Take over the machinery of host cell on entering it but as such they have inert crystalline structure. So, difficult it call them living or **non-living.**
- Pasteur gave the term 'Virus' i.e., **poisonous fluid.**
- **D.J. Ivanowsky** found out that certain microbes cause
- **M.W. Beijerinek** called fluid as **'Contagium vivum fluidum'** as extracts of infected plants of tobacco could cause infection in healthy plants.
- **W.M. Stanely** showed viruses could be arystalli sed to form cry stals of protein which are inert outside their specific host.

Structure of Virus

- Its a nucleoprotein Covered by protein called **Capsid.** Capsid is made up of capsomeres arranged in helical or polygeometric forms.
- Have either DNA or RNA as genetic material which may be single or double stranded.
- Usually plant viruses have single stranded RNA
- Bacteriophages have double stranded DNA and animal virus have single or double stranded RNA or double stranded DNA.

Diseases caused: Mumps, Small pox, AIDA etc.

Viroids

- Infectious agent, free RNA (lack protein coat) of low molecular weight
- Causes **potato spindle tuber disease.**
- Discovered by **T.O. Diener.**

Prions

- They consist of **abnormally folded protein** without genetic material.
- They cause mad cow disease in cattle and **Cr–Jacob disease** (CJD) in humans.

Lichens

- Symbiotic association between algal component **(Phycobiont)** and fungal component **(mycobiont).** Algae provide food. Fungi provide shelter and absorb nutrients for alga.
- Good pollution indicators as they do not grow in polluted area.
- Mycorrhiza: Symbiotic association between fungi and roots of higher plants.

AARAMBH (SOLVED EXAMPLES)

1. In basidiomycetes, karyogamy and meiosis take place in;
   (1) Basidium (2) Basidiocarp
   (3) Basidiospore (4) Dikaryon

Sol. In basidiomycetes, karyogamy and meiosis takes place in basidium.
Therefore, option (1) is the correct answer.

2. All eukaryotic unicellular organisms belong to;
   (1) Monera (2) Protista
   (3) Fungi (4) Bacteria

Sol. Protista is a group of all unicellular eukaryotic organisms.
Therefore, option (2) is the correct answer.

3. The five kingdom classification was proposed by;
   (1) RH Whittaker (2) C Linnaeus
   (3) A Roxberg (4) Virchow

Sol. RH Whittaker (1969), an American taxonomist, in order to develop phylogenetic classification, divided organism into five kingdoms, i.e., Monera, Protista, Fungi, Plantae and Animalia.
Therefore, option (1) is the correct answer.

4. Organisms living in highly salty areas are called as;
   (1) Methanogens (2) Halophiles
   (3) Heliophytes (4) Thermoacidophiles

Sol. Halophiles are organisms that live in areas of high concentration of salts. The name halophiles is originated from the Greek word that means 'salt loving'.
Therefore, option (2) is the correct answer.

5. Kingdom monera comprises;
   (1) Plants of economic importance
   (2) All the plants studied in botany
   (3) Prokaryotic organisms
   (4) Plants of Thallophyta group

Sol. Prokaryotic organisms are present in Kingdom Monera.
Therefore, option (3) is the correct answer.

6. Association between mycobiont and phycobiont are found in:
   (1) Mycorrhiza (2) Root
   (3) Lichens (4) BGA

Sol. Lichens are dual organisms which has a permanent symbiotic association of fungus and an alga. The fungal partner is called mycobiont and the algal partner is called phycobiont.
Therefore, option (3) is the correct answer.

7. Mycorrhiza is correctly described as;
   (1) Parasitic association between roots and some fungi
   (2) Symbiotic relationship between fungi and roots of some higher plants
   (3) Symbiosis of algae and fungi
   (4) Relation of ants with the stem of some trees

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Sol. Mycorrhiza is an example of symbiotic relationship that established between fungi and roots of higher plants. In this relationship, fungi absorb water & nutrients for plants & itself get shelter & food from plants.

Therefore, option (2) is the correct answer.

8. Naked cytoplasm, multinucleated and saprophytic are the characteristics of;

(1) Monera (2) Protista
(3) Fungi (4) Slime mould

Sol. Slime moulds are saprophytic protists, moving along the dead leaves engulfing organic material. These are multinucleated and do not possess cell wall and have naked cytoplasm.

Therefore, option (4) is the correct answer.

9. What is common among *Agaricus*, rust and smut?

(1) All are parasites
(2) All are the members of basidiomycetes and bears basidiocarps
(3) All do not reproduce sexually
(4) Both (2) and (3)

Sol. *Agaricus*, rust and smut all are the members of basidiomycetes and bears basidiocarps.

Therefore, option (2) is the correct answer.

10. *Contagium vivum fluidum* was proposed by;

(1) DJ Ivanowsky
(2) MW Beijernck
(3) Stanley
(4) Robert Hook

Sol. M.W. Beijerinck proposed *contagium vivum fluidum* means contagious living fluid.

Therefore, option (2) is the correct answer.

11. Which one of the following is an incorrect statement regarding mycoplasma?

(1) They lack a cell wall
(2) They are the smallest living cells.
(3) They cannot survive without oxygen.
(4) They are pathogenic in plants and animals.

Sol. Mycoplasmas or mollicutes are the simplest and the smallest of the free living prokaryotes classified under Kingdom Monera. The size ranges from 0.1-0.15 um. A cell wall is absent. Plasma membrane forms the outer boundary of the cell. Mycoplasma can survive without O_2.

Therefore, option (3) is the correct answer.

12. Sexual reproduction in fungi occurs by all of the following except;

(1) oospores (2) ascopores
(3) zoospores (4) basidiospores.

Sol. Sexually produced spores (or meiospores) are produced after meiosis in some fungi, e.g., ascospores, basidiospores and oospores. Zoospores are motile spores produced asexually.

Therefore, option (3) is the correct answer.

13. Which one is an incorrectly matched pair?

(1) Phycomycetes – *Mucor, Albugo*
(2) Ascomycetes – *Penicillium, Aspergillus*
(3) Basidiomycetes – *Puccinia, Agaricus*
(4) Deuteromycetes – *Ustilago, Colletotrichum*

Sol. Deuteromycetes is an artificial class of fungi which has been created to include all those fungi in which sexual stage is either absent or not known. Ustilago is the member of Basidiomycetes.

Therefore, option (4) is the correct answer.

14. Which of the following contains insectivorous plants?

(1) Bladderwort and *Cuscuta*
(2) *Cuscuta* and *Solanum*
(3) Venus fly trap and bladderwort
(4) *Solanum* and Venus fly trap

Sol. Bladderwort and Venus fly trap are insectivorous plants. Cuscuta is a parasite. Solanum is a photosynthetic green plant.

Therefore, option (3) is the correct answer.

15. Which of the following is a mismatched pair of protozoan group and its example?

(1) Amoeboid protozoan – *Entamoeba histolytica*
(2) Flagellated protozoan – *Trypanosoma gambiense*
(3) Ciliated protozoan – *Paramecium caudatum*
(4) Sporozoan – *Gonyaulax spinifera*

Sol. *Gonyaulax spinifera* is a dinoflagellate.

Therefore, option (4) is the correct answer.

16. With respect to the fungal sexual cycle, choose the correct sequence of events.

(1) Karyogamy, plasmogamy and meiosis
(2) Meiosis, plasmogamy and karyogamy
(3) Plasmogamy, karyogamy and meiosis
(4) Meiosis, karyogamy and plasmogamy

Sol. In fungi, sexual reproduction involves the formation and union of two gametes or their nuclei. In fungi, fusion involves the union of cytoplasms as well as nuclei. The former is called plasmogamy while the latter is called karyogamy. In higher fungi, karyogamy is delayed and occurs just before meiosis.

Therefore, option (3) is the correct answer.

17. Contagium vivum fluidum was proposed by;

(1) D.J. Ivanowsky (2) M.W. Beijerinck
(3) Stanley (4) Robert Hooke.

Sol. M.W. Beijeirnek have a phrase "Contagium vivum fluidum" to describe a virus

Therefore, option (2) is the correct answer.

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SCHOOL LEVEL PROBLEMS

SINGLE CORRECT TYPE QUESTIONS

1. The imperfect fungi which are decomposers of litter and help in mineral cyclig belong to?
   (1) Deuteromycetes (2) Basidiomycetes
   (3) Phycomycetes (4) Ascomycetes
2. Cell wall is absent in:
   (1) *Nostoc* (2) *Aspergillus*
   (3) *Funaria* (4) Mycoplasma
3. Which of following is correct about viroids?
   (1) They have free RNA without protein coat.
   (2) They have DNA with protein coat.
   (3) They have free DNA without protein coat.
   (4) They have RNA with protein coat.
4. Which of the following statements is correct?
   (1) Lichens do not grow in polluted areas.
   (2) Algal component of lichens is called mycobiont
   (3) Fungal component of lichens is called phycobiont
   (4) Lichens are not good pollution indicators.
5. Select the **wrong** statement.
   (1) Cell wall is present in members of Fungi and Plantae
   (2) Mushrooms belong to Basidiomycetes.
   (3) Pseudopodia are locomotory and feeding structures in Sporozoans.
   (4) Mitochondria are the powerhouse of the cell in all kingdoms except monera.
6. *Contagium vivum fluidum* was proposed by;
   (1) DJ Ivanowsky (2) MW Beijernek
   (3) Stanley (4) Robert Hook
7. With respect to fungal sexual cycle, choose the correct sequence of events.
   (1) Karyogamy, Plasmogamy and Meiosis
   (2) Meiosis, Plasmogamy and Karyogamy
   (3) Plasmogamy, Karyogamy and Meiosis
   (4) Meiosis, Karyogamy and Plasmogamy
8. Members of Phycomycetes are found in;
   (*a*) Aquatic habitats
   (*b*) On decaying wood
   (*c*) Moist and damp places
   (*d*) As obligate parasites on plants
   Choose from the following options.
   (1) (*a*) and (*d*) (2) (*b*) and (*c*)
   (3) All of these (4) None of these
9. An interviening dikaryotic stage occurs in-;
   (1) Phycomycetes and Ascomycetes
   (2) Ascomycetes and Basidiomycetes
   (3) Basidiomycets and Phycomycetes
   (4) Phycomycetes and Ascomycetes
10. Fungus known by the name of 'Bread mould' is:
   (1) *Mucor* (2) *Albugo*
   (3) *Puccinia* (4) *Rhizopus*

ASSERTION AND REASON TYPE QUESTIONS

1. **Assertion (A):** Mycoplasma is pathogenic both to animals and plants
   Reason (R): These organisms lack cell wall and can survive without oxygen
   (1) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is the correct explanation of the a **Assertion (A).**
   (2) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is not the correct explanation of the **Assertion (A).**
   (3) **Assertion (A)** is true but **Reason (R)** is false.
   (4) Both the **Assertion (A)** and **Reason (R)** are false statement.
2. **Assertion (A):** Sporozoans may have silica shells on their surface.
   Reason (R): Shells of sporozoans help in protection from acidic environments of the host.
   (1) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is the correct explanation of the a **Assertion (A).**
   (2) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is not the correct explanation of the **Assertion (A).**
   (3) **Assertion (A)** is true but **Reason (R)** is false.
   (4) Both the **Assertion (A)** and **Reason (R)** are false statement.
3. **Assertion (A):** Viruses are smaller than bacteria.
   Reason (R): Viruses pass through bacteria-proof filters.
   Choices for **Assertions** and **Reasons:**
   (1) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is the correct explanation of the a **Assertion (A).**
   (2) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is not the correct explanation of the **Assertion (A).**
   (3) **Assertion (A)** is true but **Reason (R)** is false
   (4) Both the **Assertion (A)** and **Reason (R)** are false statement
4. **Assertion (A):** In basidiomycetes, basidiospores are produced endogenously in the basidium.
   Reason (R): In ascomycetes, ascospores are produced exogenously in ascus.
   (1) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is the correct explanation of the a **Assertion (A).**
   (2) Both the **Assertion (A)** and **Reason (R)** are true and the **Reason (R)** is not the correct explanation of the **Assertion (A).**
   (3) **Assertion (A)** is true but **Reason (R)** is false.
   (4) Both the **Assertion (A)** and **Reason (R)** are false statement.

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VERY SHORT ANSWER TYPE QUESTIONS

1. Who introduced the five kingdom classifiaction of organisms?
2. Which organisms are the chief producers in oceans?
3. Nostoc and Anabaena have specialised cells called heterocysts. What is the function of these cells?
4. Which kingdom consists of unicellular eukaryotes?
5. What do you mean by mycorrhiza?
6. Who has discovered viroids?
7. Which group of fungi is called sac fungi?
8. What is called fungal component of lichens?
9. What are bacteriophages?

SHORT ANSWER TYPE QUESTIONS

1. Whay are red tides caused and why are they harmful?
2. How are bacteria classified on the bassis of their shapes?
3. How are viroids different from viruses.
4. Write as shore note on Prions.

LONG ANSWER TYPE QUESTIONS

1. Desribe briefly the four major group of protozoa?
2. Describe briefly the different classes of fungi?

CASE STUDY BASED QUESTIONS

Case-I:

The fungi constitute a unique kingdom of heterotrophic organisms. They show a great diversity in morphology and habitat. Some unicellular fungi, e.g., yeast are used to make bread and beer. Other fungi cause diseases in plants and animals; wheat rust-causing Puccinia is an important example. Some are the source of antibiotics, e.g., Penicillium. Fungi are cosmopolitan and occur in air, water, soil and on animals and plants. With the exception of yeasts which are unicellular, fungi are filamentous. Their bodies consist of long, slender thread-like structures called hyphae. The network of hyphae is known as mycelium. Some hyphae are continuous tubes filled with multinucleated cytoplasm - these are called coenocytic hyphae. Others have septae or cross walls in their hyphae. The cell walls of fungi are composed of chitin and polysaccharides. Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called saprophytes. Those that depend on living plants and animals are called parasites. They can also live as symbionts - in association with algae as lichens and with roots of higher plants as mycorrhiza.

1. _____ Hyphae are withoup septa and filled with multinucleated cytoplasm.
   (1) Septate (2) Nucleated
   (3) Coenocytic (4) Both 1 and 3
2. _____ is the only single celled fungi organism.
   (1) *Penicullium* (2) Yeast
   (3) Mycrrhiza (4) Both 1and 2
3. What is saprophytic fungi?
4. Give reason – why fungi are referred as cosmopolitan organism?
5. Name the fungi which is responsible for rusting disease in wheat plant.

Case-II:

Bacteria are the sole members of the Kingdom Monera. They are the most abundant micro-organisms. Bacteria occur almost everywhere. They also live in extreme habitats such as hot springs, deserts, snow and deep oceans where very few other life forms can survive. Many of them live in or on other organisms as parasites. Though the bacterial structure is very simple, they are very complex in behaviour. Compared to many other organisms, bacteria as a group show the most extensive metabolic diversity. Some of the bacteria are autotrophic, i.e., they synthesise their own food from inorganic substrates. They may be photosynthetic autotrophic or chemosynthetic autotrophic. The vast majority of bacteria are heterotrophs, i.e., they depend on other organisms or on dead organic matter for food.

Archaebacteria

These bacteria are special since they live in some of the harshest habitats such as extreme salty areas(halophiles), hot sulphur springs (thermoacidophiles) and marshy areas (methanogens). Archaebacteria differ fromother bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions. Methanogens are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.

Eubacteria

There are thousands of different eubacteria or 'true bacteria. They are characterised by the presence of a rigid cell wall, and if motile, a flagellum. The cyanobacteria (also referred to as blue-green algae) have chlorophyll a similar to green plants and are photosynthetic autotrophs. The cyanobacteria are unicellular, colonial or filamentous, freshwater/marine or terrestrial algae. The colonies are generally surrounded by gelatinous sheath. They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called heterocysts, e.g., *Nostoc* and *Anabaena*. Chemosynthetic autotrophic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They play a great role in recycling nutrients like nitrogen. phosphorous, iron and sulphur.

Heterotrophic bacteria are most abundant in nature. The majority are important decomposers. Many of them have a significant impact on human affairs. They are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume roots, etc. Some are pathogens causing damage to human beings, crops, farm animals and pets. Cholera, typhoid, tetanus, citrus canker are well known diseases caused by different bacteria.

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1. _____ bacteria are responsible for formation of biogas from cow dung/organic waste
   (1) cyanobacteria (2) Halophiles
   (3) Thermoacidophiles (4) Methanogens
2. _____ are the bacteria that can grow and thrive in salty areas.
   (1) Methanogens (2) Halophobic
   (3) Halophiles (4) Thermoacidophiles
3. True bacteria are characterised by _____
   (1) Rigid cell wall
   (2) Flagellum present for locomotion
   (3) Both 1 and 2
   (4) None of these.
4. Name the eubacteria which is also referred as blue green algae.
5. What is heterocyst?
6. What are the thermoacidophiles?

PRARAMBH EXERCISE-1 (TOPICWISE)

CLASSIFICATION

1. Five kingdom classification was based on;
   (1) Cell structure (2) Thallus organisation
   (3) Mode of Nutrition (4) All of the above
2. How many criteria were used in five-Kingdom classification?
   (1) 2 (2) 4 (3) 5 (4) 3
3. Who was the earliest to attempt a scientific basis for classification?
   (1) R.H. Whittaker (2) Linnaeus
   (3) Aristotle (4) Bentham and Hooker
4. Which of the following is not mentioned in Whittaker's classification?
   (1) Virus (2) Viroids
   (3) Lichens (4) All of these
5. In the five kingdom system of classification, which single kingdom out of the following can include blue-green algae, nitrogen fixing bacteria and methanogenic archaebacteria?
   (1) Monera (2) Fungi
   (3) Plantae (4) Protista
6. The boundaries of Kingdom 'x' is not well-defined. Which of the following organisms belong to Kingdom 'x'?
   (1) *Amoeba* (2) *Anabaena*
   (3) Yeast (4) *Halobacterium*
7. Five kingdom classification includes;
   (1) Monera, Protista, Fungi, Plantae, Animalia
   (2) Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms
   (3) Virus, Prokaryota, Fungi, Plantae, Animalia
   (4) Monera, Protista, Animalia, Plantae, Algae
8. In Whittaker's system of classification, prokaryotes are placed in the kingdom;
   (1) Protista (2) Monera
   (3) Plantae (4) Animalia
9. Five kingdom system of classification suggested by R.H. Whittaker is not based on;
   (1) Complexity of body organisation
   (2) Presence or absence of locomotion
   (3) Mode of reproduction
   (4) Mode of nutrition
10. The two Kingdoms that are constant in all type of classification from Linnaeus to Whittaker are;
    (1) Plantae and Animalia
    (2) Monera and Protista
    (3) Protista and Fungi
    (4) Monera and Fungi
11. Three domains of life include how many kingdoms?
    (1) 3 (2) 4
    (3) 5 (4) 6
12. The unique character that unified the kingdom Plantae of Linnaeus was:
    (1) all organisms had green pigment.
    (2) all organisms were autotrophic.
    (3) all organisms had a well-developed nucleus.
    (4) all organisms had a cell wall in their cells.
13. Earliest scientific classification was given by Aristotle. Aristotle classified animals into;
    (1) prokaryota and eukaryota
    (2) those which had red blood and those that did not
    (3) protozoa and Metazoa
    (4) autotrophic and Heterotrophic
14. Linnaeus is related to;
    (1) Two-Kingdom classification
    (2) Binomial nomenclature
    (3) *Systema Naturae*
    (4) All of the above
15. Cellular level of body organisation is found in;
    (1) Monera (2) Protista
    (3) Fungi (4) Both (1) and (2)
16. In bacteria, the site for respiratory activity is found in;
    (1) Episome (2) Microsome
    (3) Ribosome (4) Cell membrane

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MONERA

17. Which pigment is present in cyanobacteria?
(1) Chlorophyll *a* (2) Chlorophyll *b*
(3) Chlorophyll *c* (4) Xanthophylls

18. Colonies of Eubacteria are surrounded by;
(1) Polysaccharide sheath (2) Gelatinous sheath
(3) Mucous sheath (4) None of these

19. Chlorophyll *a* is present in;
(1) Archaebacteria (2) Mycoplasma
(3) Cyanobacteria (4) All of these.

20. Bacteria reproduce by;
(1) fission
(2) asexual reproduction (spore formation)
(3) sexual reproduction (DNA transfer)
(4) all of these.

21. Which bacteria are most abundant in nature?
(1) Archaebacteria
(2) Photosynthetic autotrophic bacteria
(3) Chemosynthetic autotrophic bacteria
(4) Heterotrophic bacteria

22. Some of cyanobacteria can fix atmospheric nitrogen in specialised cells called heterocysts. Examples of such cyanobacteria are;
(1) *Nostoc* (2) *Gonyaulax*
(3) *Chlamydomonas* (4) Both (2) and (3)

23. The smallest living cells that completely lack cell wall are;
(1) Mycoplasma (2) Slime moulds
(3) Cyanobacteria (4) Diatoms

24. Rod-shaped bacterium is called;
(1) bacillus (2) coccus
(3) vibrium (4) spirillum

25. Which of the following bacteria is comma-shaped?
(1) *Salmonella typhi* (2) *Vibrio cholerae*
(3) *E. coli* (4) *Clostridium tetani*

26. Prokaryotes used in making curd and antibiotics are;
(1) Cyanobacteria
(2) Archaebacteria
(3) Chemosynthetic autotrophs
(4) Heterotrophic bacteria

27. In bacterial chromosomes, the genomic nucleic acid is;
(1) linear DNA molecule (2) circular DNA molecule
(3) circular RNA molecule (4) linear RNA molecule

28. The chief component of bacterial cell wall is:
(1) Cellulose and chitin
(2) Cellulose and pectin
(3) Amino acids and polysaccharides
(4) Cellulose and carbohydrates

29. Chemosynthetic bacteria obtain energy from;
(1) sunlight (2) UV rays
(3) organic substances (4) inorganic substances

30. Under unfavourable conditions, bacteria reproduce by;
(1) Fission (2) *Plasmodium*
(3) Fruiting bodies (4) Spore

31. Among the following, which is/are photosynthetic autotrophs?
(1) Archaebacteria (2) Fungi
(3) Cyanobacteria (4) All of the above

32. Which bacteria would function best in hot temperatures (45-60°C)?
(1) Methanogens
(2) Thermophiles
(3) Halophiles
(4) All would do equally well

33. A few organisms are known to grow and multiply at temperatures of 100–105°C. They belong to;
(1) thermophilic sulphur bacteria.
(2) hot spring blue-green algae.
(3) methanogenic archaebacteria.
(4) marine archaebacteria.

34. The bacteria forming blooms in polluted water bodies are nutritionally;
(1) photosynthetic autotrophs.
(2) chemosynthetic autotrophs.
(3) heterotrophs.
(4) saprophytic.

35. Most abundant microorganisms are;
(1) Fungi (2) Bacteria
(3) Virus (4) Cyanobacteria

36. Sole member of Kingdom Monera are;
(1) Bacteria (2) Fungi
(3) Blue green algae (4) Archaebacteria

37. *Nostoc* and *Anabaena* can fix atmospheric nitrogen in specialised cells known as;
(1) Conidiophores (2) Auxospores
(3) Hormogonia (4) Heterocysts

38. The conditions which would be favoured by thermoacidophiles are;
(1) hot and alkaline.
(2) snow and acidic.
(3) hot and sulphur spring.
(4) gut of cows.

39. Bacteria are found to be primitive organisms because they:
(1) Are small, microscopic which are not seen with naked eye.
(2) Cause serious diseases to human being, domesticated animals and crop plants.
(3) Produce endospores which are very resistant to adverse conditions.
(4) Posses incipient nucleus and lacks membrane bound organelles.

40. Which type of bacteria are responsible for production of biogas?
(1) Halophiles (2) Thermoacidophiles
(3) Methanogens (4) BGA

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41. The members of monera have cell wall made up of polysaccharide + amino acid. Which member of monera lack cell wall?
(1) Slime mould (2) Mycoplasma
(3) Both (1) and (2) (4) Archaebacteria

42. An organism having cytoplasm, DNA and RNA but no cell wall is;
(1) Cyanobacterium (2) Mycoplasma
(3) Bacterium (4) Virus

43. In which of the following heterocysts are seen?
(1) *Chara* (2) *Polysiphonia*
(3) *Spirogyra* (4) *Nostoc*

44. Genetic material without nuclear membrane is found in:
(1) Bacteria and Mycoplasma;
(2) Cyanobacteria and Bacteria
(3) Archaebacteria and Blue-green algae
(4) All of these.

45. N_2-fixing organisms and nitrifying organisms are placed in the kingdom:
(1) Plantae (2) Animalia
(3) Protista (4) Monera

46. The shape of the cocci bacteria is;
(1) rod-shaped (2) spherical
(3) comma shaped (4) spiral

47. Cyanobacteria are called blue green algae because;
(1) they do not produce gametes.
(2) they are not green.
(3) they have chlorophyll pigment.
(4) they are as small as bacteria.

PROTISTA

48. In which of the following kingdoms, both plant and animal like unicellular organisms are placed?
(1) Monera (2) Protista
(3) Fungi (4) Plantae

49. In which of the following kingdoms some members have cell wall and some are without cell wall?
(1) Fungi (2) Protista
(3) Plantae (4) Animalia

50. During unfavourable conditions, slime moulds:
(1) form fruiting bodies bearing spores at their tips
(2) form an aggregation called plasmodium
(3) form an aggregation called pseudoplasmodium
(4) Both (1) and (2) are correct

51. Diatomaceous earth is used for;
(1) Polishing (2) Filtration of oils
(3) Filtration of syrups (4) All of these.

52. Chief 'producers' in the oceans are;
(1) Chrysophytes (2) Euglenoids
(3) Desmids (4) Diatoms

53. Two flagella are found in which protist(s)?
(1) *Amoeba* (2) *Gonyaulax*
(3) *Paramoecium* (4) All of the above

54. Most of them have two flagella; one lies longitudinally and the other transversely in a furrow between the wall plates. Here we are talking about;
(1) Euglenoids (2) *Paramoecium*
(3) *Gonyaulax* (4) Golden brown algae

55. Which of the following is not present in *Euglena*?
(1) Chloroplasts
(2) Flagella
(3) Cellulosic cell wall
(4) Proteinaceous pellicle

56. Red tides often cause massive fish kills and human illness in those eating shellfish. Which group of protists is responsible for red tides?
(1) Chlorophyta (2) Rhodophyta
(3) Phaeophyta (4) Dinoflagellates

57. Which one of the following is a characteristic feature of Chrysophytes?
(1) They are parasitic forms which cause disease in animals
(2) They have a protein rich layer called pellicle
(3) They include diatoms
(4) They are saprophytic protists

58. Which organisms has a cavity (gullet) that opens to the outside of the cell surface?
(1) *Entamoeba* (2) *Trypanosoma*
(3) *Paramoecium* (4) *Euglena*

59. Which organism have an infectious spore like stage in their life cycle?
(1) Amoeboid protozoans (2) Flagellated protozoans
(3) Ciliated protozoans (4) Sporozoans

60. All protozoans are;
(1) heterotrophs (2) autotrophs
(3) saprotrophs (4) parasites

61. Which are believed to be primitive relative of animals?
(1) Protozoans (2) Poriferans
(3) Euglenoids (4) Archaebacteria

62. Which organism behaves like plants in the presence of sunlight and absence of organic food, but in reverse condition behaves like animal?
(1) Archaebacteria (2) *Euglena*
(3) *Nostoc* (4) *Paramoecium*

63. Which of the following organisms were never included in protista?
(1) Bacteria (2) Red algae
(3) Slime moulds (4) Mosses

64. Diatom frustule/shell is made of;
(1) silica (2) lime
(3) magnesium carbonate (4) Any of these.

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65. Diatomaceous earth is used in polishing, filtration of oils and syrups due to its;
(1) slimy nature (2) gritty nature
(3) dusty nature (4) hard nature

66. Dinoflagellates are mostly;
(1) terrestrial (2) marine
(3) thermohaline (4) freshwater

67. Sea appear red due to the rapid multiplication of;
(1) *Gonyaulax* (red dinoflagellates)
(2) Desmids
(3) *Colletotrichum*
(4) Both (1) and (3)

68. Euglenoids have flexible body due to the presence of;
(1) chlorophyll (2) cell wall
(3) pellicle (4) cellulose

69. Which bears two unequal flagella?
(1) Euglenoids (2) Slime molds
(3) Diatoms (4) Dinoflagellates

70. When deprived of sunlight, euglenoids behave as;
(1) autotrophs.
(2) heterotrophs.
(3) chemosynthetic organisms.
(4) osmotrophs.

71. Cell walls of diatoms are indestructible because of the presence of;
(1) $CaCO_3$ (2) Silica
(3) Chitin (4) All of these.

72. Common feature of *Amoeba*, *Euglena*, *Paramoecium* and *Trypanosoma* is;
(1) Being eukaryotic (2) Holozoic nutrition
(3) Multiple fission (4) Contractile vacuole

73. The class of protozoa which includes all parasitic animals is;
(1) Amoeboids (2) Ciliates
(3) Flagellates (4) Sporozoans

74. Which kingdom forms a link with the plants, animals and fungi?
(1) Monera (2) Protista
(3) Lichen (4) Mycorrhiza

75. Protista contains;
(1) *Euglena*, Dinoflagellates and Yeast
(2) *Amoeba*, *Paramaecium*, *Hydra*
(3) *Euglena*, *Paramaecium*, *Mushroom*
(4) *Amoeba*, *Paramaecium* and *Dinoflagellates*

FUNGI

76. The members of which of the following are litter decomposers?
(1) Deuteromycetes
(2) Ascomycetes
(3) Basidiomycetes
(4) Phycomycetes

77. From which of the following most of the antibiotics are prepared?
(1) Fungi (2) Plants
(3) Methanogens (4) Archaebacteria

78. The edible ascomycetes fungus/fungi is/are
(1) Morels (2) *Agaricus*
(3) Truffels (4) Both (1) and (3)

79. A dikaryon is formed when:
(1) meiosis is arrested.
(2) the two haploid nuclei do not fuse immediately.
(3) cytoplasm does not fuse.
(4) None of the above.

80. Truffels are the member of class:
(1) Basidiomycetes (2) Ascomycetes
(3) Deuteromycetes (4) Phycomycetes

81. With respect to fungal sexual cycle, choose the correct sequence of events.
(1) Karyogamy, Plasmogamy and Meiosis
(2) Meiosis, Plasmogamy and Karyogamy
(3) Plasmogamy, Karyogamy and Meiosis
(4) Meiosis, Karyogamy and Plasmogamy

82. In fungi, sexual reproduction takes place by;
(1) Ascospores, basidiospores and zoospores
(2) Zoospores, sporangiospores and conidia
(3) Zoospores, oospores and basidiospores
(4) Oospores, ascospores and basidiospores

83. A fungus contains cells with two nuclei from different genomes. The nuclei do not fuse but divide independently and simultaneously as new cells are formed. It belongs to;
(1) Phycomycetes (2) Zygomycetes
(3) Deuteromycetes (4) Basidiomycetes

84. The cell wall of fungi is made up of;
(1) chitin (2) cellulose
(3) pectin (4) suberin

85. Morels and truffles groups of fungi are classified as:
(1) Phycomycetes (2) Deuteromycetes
(3) Basidiomycetes (4) Ascomycetes

86. Which is the basis of classification of kingdom fungi?
(1) Morphology of mycelium
(2) Mode of spore formation
(3) Fruiting bodies
(4) All of the above

87. Fungi prefer to grow in;
(1) warm and swampy places
(2) warm and salty places
(3) warm and humid places
(4) cold and moist places

88. Which fungus does not consist of a long, slender thread – like structure called hyphae?
(1) Yeast (2) Mushroom
(3) Toadstool (4) Puffball

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89. When fungi feed on dead organic matter, they are known as;
(1) dimorphic (2) parasites
(3) saprophytes (4) none of these

90. Plasmogamy is fusion of;
(1) two haploid cells including their nuclei
(2) two haploid cells without nuclear fusion
(3) sperm and egg
(4) sperm and two polar nuclei

91. Fungi can be parasites on;
A. Animals B. Human being
C. Plants
Choose the answer from the following options
(1) Only A (2) B and C
(3) A and B (4) All of these

92. Fungi are always;
(1) Autotrophs (2) Heterotrophs
(3) Saprophytes (4) Parasites

93. Some fungal hyphae are continuous tube filled with multinucleated cytoplasm. These are called;
(1) Syncytial hyphae (2) Dikaryon
(3) Mycelium (4) Coenocytic hyphae

94. Vegetative reproduction in fungi takes place by;
(1) fragmentation (2) budding
(3) fission (4) all of these.

95. Dikaryophase does not occur in;
(1) Ascomycetes (2) Phycomycetes
(3) Basidiomycetes (4) both (1) and (2)

96. Which of the following is a fungal disease?
(1) Citrus canker
(2) White spots on mustard
(3) Black rot of mustard
(4) Potato spindle tuber disease

97. In *Mucor*, asexual reproduction takes place by non-motile spores named as;
(1) Conidia (2) Zoospores
(3) Aplanospores (4) None of the above

98. Asexual spores are generally absent in
(1) *Ustilago* (2) *Trichoderma*
(3) *Neurospora* (4) Yeast

99. The deuteromycetous fungi member were often moved to ascomycetes and basidiomycetes after the identification of;
(1) sexual phase (2) vegetative phase
(3) asexual phase (4) none of the above

100. The deuteromycetes reproduce by;
(1) Aplanospores (2) Zoospores
(3) Ascospores (4) Conidia

101. Mushrooms, bracket fungi or puffballs are placed in;
(1) Ascomycetes (2) Basidiomycetes
(3) Deuteromycetes (4) Phycomycetes

102. The network of hyphae in fungi is known as;
(1) Mycelium (2) Rhizoids
(3) Flagella (4) Pseudomycelium

103. Members of phycomycetes are found in;
(*i*) Aquatic habitats
(*ii*) On decaying wood
(*iii*) Moist and damp places
(*iv*) As obligate parasites on plants
Choose from the following options.
(1) (*i*) and (*iii*) (2) (*i*) and (*iv*)
(3) (*ii*) and (*iii*) (4) All of the above

104. Slender and thread – like structure of fungi are called;
(1) Mycelium (2) Rhizoids
(3) Rhizomes (4) Hyphae

105. An association between roots of higher plants and fungi is called;
(1) Lichen (2) Fern
(3) Mycorrhiza (4) BGA

106. Fungi are filamentous with the exception of "X" which is unicellular. Identify X.
(1) Yeast (2) *Albugo*
(3) *Mucor* (4) Lichen

107. Fungi without sexual or perfect stages are classified as;
(1) Phycomycetes (2) Deuteromyectes
(3) Basidiomycetes (4) Ascomycetes

KINGDOM PLANTAE

108. Which of the following is irrelavent to the kingdom Plantae?
(1) *Spirogyra* (2) *Rhizopus*
(3) *Funaria* (4) *Cycas*

109. Considering two-kingdom classification system, the organisms that are included in kingdom Plantae are
(1) *Volvox*, *Amoeba* and *Paramecium*
(2) Cyanobacteria, algae and fungi
(3) *Amoeba*, bacteria and fungi
(4) Fungi, bacteria and algae

110. According to two-kingdom classification, the kingdom Plantae consists of
(1) Autotrophs (2) Heterotrophs
(3) Mesotrophs (4) Chemotrophs

111. Cell wall of kingdom Plantae organisms is made up of
(1) Chitin (2) Cellulose
(3) Polysaccharides (4) Lipids

KINGDOM ANIMALIA

112. The heterotrophic, eukaryotic, multicellular organisms without cell wall are included in the kingdom;
(1) Protista (2) Fungi
(3) Plantae (4) Animalia

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113. In animals, the stored food reserve is in the form of;
(1) Glycogen (2) Cellulose
(3) Fat (4) Both (1) and (3)

114. Kingdom Animalia is characterized by which type of organisms?
(1) Unicellular, prokaryotic and autotrophic
(2) Multicellular, eukaryotic and heterotrophic
(3) Multicellular, prokaryotic and saprophytic
(4) Unicellular, eukaryotic and heterotrophic

115. Which of the following is **true** for Kingdom Animalia?
(1) Cell wall is present in animal cell.
(2) Their mode of nutrition is holozoic.
(3) They do not follow a definite growth pattern.
(4) All of them are capable of locomotion.

116. The heterotrophic mode of nutrition is found in;
(1) Monera (2) Fungi
(3) Animalia (4) All of these

VIRUS, VIROIDS AND LICHENS

117. Who prepares food in lichens?
(1) Mycobiont (2) Fungi
(3) Phycobiont (4) All of these.

118. Arrangement of capsomeres is in the form of;
(1) helical (2) polyhedral
(3) either (1) or (2) (4) no definite form

119. Viruses are non-cellular organisms but replicate themselves once they infect the host cell. Which of the following kingdom do viruses belong to?
(1) Monera (2) Protista
(3) Fungi (4) None of these

120. Lichens are very good pollution indicator because they are sensitive to;
(1) Sulfur trioxide (2) Sulfur dioxide
(3) Carbon dioxide (4) Global warming

121. Potato Spindle Tuber disease is caused due to:
(1) Viroid (2) Virus
(3) Bacterium (4) Nematode

122. Viroids have;
(1) sngle stranded RNA not enclosed by protein coat
(2) single stranded DNA not enclosed by protein coat
(3) double stranded DNA enclosed by protein coat
(4) double stranded RNA enclosed by protein coat

123. HIV is classified as a retrovirus because its genetic information is carried in;
(1) DNA instead of RNA
(2) DNA
(3) RNA instead of DNA
(4) Protein coat

124. Which of the following facts differentiates the plant virus from other viruses?
(1) DNA is the genetic material
(2) Obligate parasites
(3) RNA is the genetic material
(4) Nucleo-protein nature

125. Viruses cause several diseases in plants and animals. In plants, the symptoms can be;
(1) mosaic formation, dwarfing and stunted growth
(2) leaf rolling and curling
(3) yellowing and vein clearing
(4) all of these.

126. Which of the following are called acellular organisms?
(1) Viruses and viroids (2) Viroids and lichens
(3) Lichens and viruses (4) Viruses, viroids and lichens

127. T.O. Diener discovered a/an;
(1) free infectious DNA (2) infectious protein
(3) bacteriophage (4) free infectious RNA

128. Who recognised certain microbes as causal organism of the mosaic disease?
(1) Ivanowsky (2) Pasteur
(3) Beijerinek (4) Stanley

129. Among the common cold (flu), mumps, small pox, herpes, influenza and AIDS, how many diseases are caused by viruses in humans?
(1) Three (2) Four (3) Five (4) Six

130. Which disease is caused by viroids?
(1) Leaf curling disease (2) Potato spindle tuber disease
(3) Dwarfing disease (4) All of these

131. Crystals of virus consist largely of;
(1) DNA (2) RNA (3) Protein (4) Histone

132. The virus which contains both DNA and RNA;
(1) TMV (2) Bacteriophage
(3) Rhinovirus (4) None of these

133. The protein coat of virus is made up of small subunits called;
(1) Nucleoprotein (2) Capsid
(3) DNA and RNA (4) Capsomere

134. The capsid of viruses protects the;
(1) Nucleoprotein (2) Capsomere
(3) Nucleic acid (4) Protein

135. Viruses are made up of;
(1) Nucleic acid (DNA or RNA)
(2) Nucleic acid (DNA and RNA)
(3) Protein + DNA + RNA
(4) Nucleic acid + Protein (Nucleoprotein)

136. In Five-Kingdom classification, lichens are placed in which Kingdom?
(1) Plantae (2) Protista
(3) Monera (4) None of these

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137. What is common in between bacteriophage and fungi?
(1) Cell membrane (2) Cell wall
(3) DNA (4) Organelles

138. In a bacteriophage, DNA is present in;
(1) Head (2) Tail
(3) Head and tail (4) In tail fibres only

139. The symbiotic association of fungi and algae is called;
(1) Lichen (2) Mycorrhiza
(3) Rhizome (4) Endomycorrhiza

140. A virus like naked pathogenic particle of single-stranded circular RNA filament without a protein covering is known as;
(1) Potato Spindle Tuber viriod
(2) Mumps virus
(3) Polyoma virus
(4) Tobacco mosaic virus

141. In plants, mosaic formation, leaf rolling and curling, yellowing of plant parts, vein clearing, dwarfing and stunted growth, necrosis, etc., are the symptoms of;
(1) Bacterial diseases (2) Mycoplasmal diseases
(3) Viral diseases (4) Fungal diseases

142. Which of the following cannot be grown on artificial culture medium?
(1) *Escherichia coli* (2) TMV
(3) *Aspergillus* (4) Yeast

PRABAL EXERCISE-2 (LEARNING PLUS)

1. As per Whittaker's classification, an organism possessing eukaryotic cells structure, multicellular organisation with a cell wall and nuclear membrane showing autotrophic nutrition can be placed under the kingdom;
(1) Monera (2) Protista
(3) Plantae (4) Fungi

2. A. Unicellular, colonial, filamentous, marine or terrestrial forms;
B. The colonies are surrounded by a gelatinous sheath
C. Some can fix atmospheric nitrogen in specialised cells called heterocysts
D. They often form blooms in water bodies
The above characters are seen in
(1) Archaebacteria (2) Cyanobacteria
(3) Chrysophytes (4) Dinoflagellates

3. The drawbacks or limitations of two-kingdom classification is / are;
(1) no distinction between eukaryotes and prokaryotes
(2) no distinction between unicellular and multicellular organisms
(3) photosynthetic and non-photosynthetic organisms are placed together
(4) all of these.

4. Which of the following statements concerning bacteria is not **true**?
(1) Most bacteria are pathogenic
(2) Bacteria live in diverse environments
(3) Bacteria are derived from Archaea
(4) Both (1) and (3)

5. Lichens are usually cited as an example of symbiosis where an algal and a fungal species live together for their mutual benefit. Which of the following will happen if algal and fungal partners are separated from each other?
(1) Both will die
(2) Both will survive and grow normally and independent from each other
(3) Algal component will survive while the fungal component will die
(4) Fungal component will survive while the algal partener will die

6. Which of the following environmental conditions are essential for optimum growth of *Mucor* on a piece of bread?
A. Temperature about 25°C
B. Temperature about 5°C
C. Relative humidity of about 5%
D. Relative humidity of about 95%
E. A shaded place
F. A brightly illuminated place
Choose the answer from the following options
(1) B, C and F only (2) A, C and E only
(3) A, D and E only (4) B, D and E only

7. In which of the following options, all the members do not belong to same class?
(1) Bread mould, *Mucor*, Parasitic fungi on Mustard
(2) *Claviceps*, *Neurospora*, *Aspergillus*, morels, truffles and puffballs.
(3) Rust, smut, mushrooms, bracket fungi
(4) *Colletotrichum*, *Alternaria* and *Trichoderma*

8. Which of the following combination of characters is **true** for slime moulds?
(1) Parasitic, plasmodium with true walls, spores dispersed by air currents
(2) Saprophytic, plasmodium without walls, spores dispersed by water
(3) Parasitic, plasmodium without wall, spores dispersed by water
(4) Saprophytic, plasmodium without walls, spores dispersed by air currents

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9. Capsid is
(1) Genetic material of virus
(2) Protein coat of virus
(3) Extra genetic material of bacterium
(4) House keeping genome of bacterium

10. T.O. Diener discovered a new infectious agent that was smaller than viruses and have the following characteristics.
1. It causes potato spindle tuber disease.
2. It has free RNA.
3. Molecular weight of RNA is low.
Identify the infections agent.
(1) Viruses (2) Viroids
(3) Virion (4) Mycoplasma

11. Most of the antibiotics have no effect on viruses because;
(1) they kill all bacteria which form host of virus.
(2) viruses are too small in size for antibiotics to act on them.
(3) viruses have no metabolism of their own.
(4) viruses produce a thick covering and endospores.

12. In an experiment, a microbiologist put equal number of each of the following organisms into a flask of sterile broth, consisting mostly of sugar and a few amino acids. He, then placed the flask in the dark. Which of the organism would be most likely to survive?
(1) Chemoheterotrophic bacteria
(2) Cyanobacteria
(3) Photoheterotrophs
(4) Photoautotrophs

13. Identify **true** statements about archaebacteria.
A. They can live in harsh habitats.
B. Cell walls do not contain peptidoglycan.
C. Cell membrane contains branched chain lipids.
D. Some of them are capable of producing biogas.
(1) A & B only (2) A, B & C only
(3) B & C only (4) All of these

14. Which of the following statements about *Mycoplasma* is **true**?
(1) They are smallest, disease causing thin walled organisms.
(2) They differ from viruses in being cellular in organization.
(3) Insensitive to several antibiotics as they have 70S ribosomes.
(4) They can survive without photosynthetic pigments and genetic material.

15. Read the given statements about lichens and select the **incorrect** ones:
A. They represent an example of true symbiosis
B. Algal partner obtains water and mineral salts from the fungus and the fungal partner obtains food prepared by the alga
C. These grow in polluted area
D. The mycobiont is usually an ascomycetes or a basidio -mycetes
E. The phycobiont is mostly a green alga or a cyano -bacterium
(1) A and B (2) C only
(3) A and D (4) A, E and D

16. A proteinaceous covering which is elastic enough to enable turning and flexing of the cell, yet rigid enough to prevent excessive alternation in shape is;
(1) Pellicle in *Euglena*
(2) Plasmalemma in *Peranema*
(3) Pellicle in *Amoeba*
(4) Plasma membrane in *Gonyaulax*

17. The given statements describe a group of organisms.
A. Instead of a cell wall, they have a protein rich pellicle making their body flexible
B. They have 2 flagella, a short and a long one
C. They show mixotrophic nutrition
D. They are connecting link between plants and animals
Which of the following groups is referred here?
(1) Dinoflagellates (2) Slime moulds
(3) Desmids and diatoms (4) Euglenoids

18. Read the following statements regarding slime moulds and select the **incorrect** ones.
A. They are saprophytic protists.
B. Under suitable conditions, they form an aggregation called Plasmodium.
C. The spores possess true walls.
D. The body moves along decaying twigs and leaves engulfing organic material.
E. The spores are dispersed by water currents.
(1) A and E (2) D and E
(3) C only (4) E only

19. Which of the following statements is not correct regarding the class Ascomycetes?
(1) Conidia are the asexual spores produced endogenously on conidiophores
(2) Ascospores are the sexual spores produced endogenously in asci
(3) *Aspergillus*, *Neurospora* and *Claviceps* are ascomycetes fungi
(4) Mycelium is generally branched and sepate

20. Which of the following statements is correct w.r.t the given diagram?

(1) 'A' is mucilaginous sheath and is also found in *Rivularia*
(2) 'A' is mucilaginous sheath and is also found in *Anabaena*

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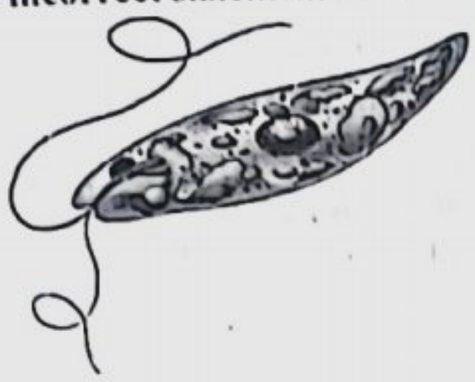
(3) 'A' is heterocyst and is found in methanogens
(4) 'A' is heterocyst and is found in *Anabaena*

21. Choose the **incorrect** statement about the given organism?.



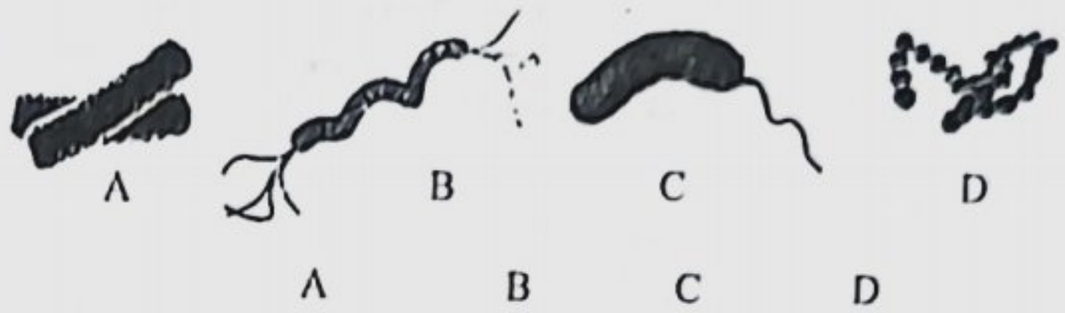
(1) Two, unequal flagella are found
(2) It dies, when deprived of sunlight
(3) Member of kingdom Protista
(4) Photosynthetic pigments are similar to those of higher plants

22. The given fungus belongs to which class?

(1) Ascomycetes (2) Phycomycetes
(3) Basidiomycetes (4) Deuteromycetes

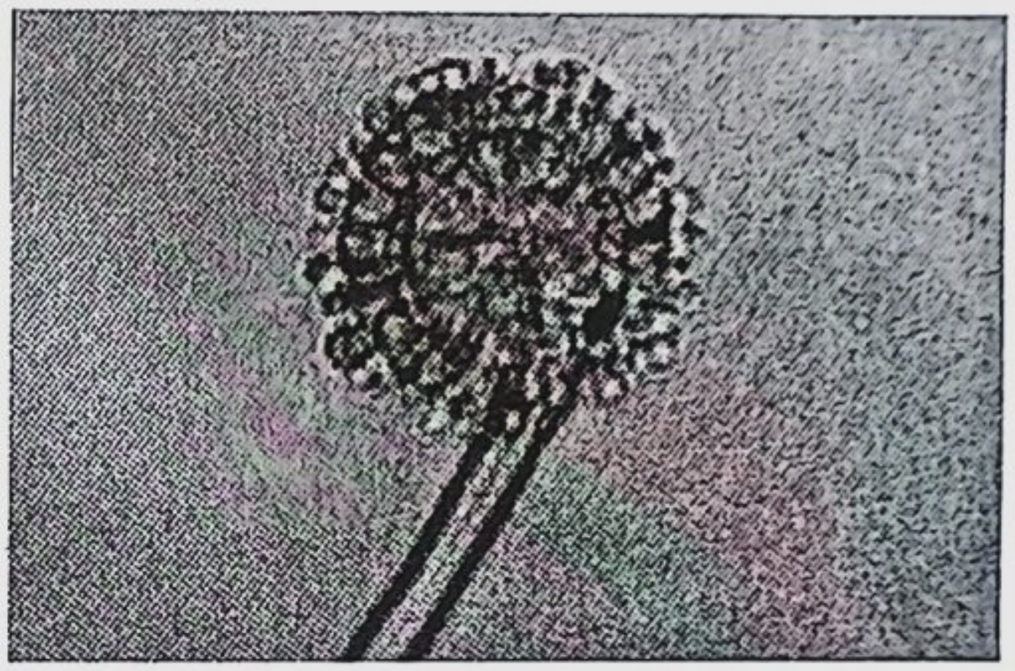
23. As per Whittaker's classification, an organism possessing eukaryotic cells structure, multicellular organisation with a cell wall and nuclear membrane showing autotrophic nutrition can be placed under the kingdom;
(1) Monera (2) Protista
(3) Plantae (4) Fungi

24. Bacteria are grouped under four categories according to their shape. Study the given figures and select the **correct** option regarding this.



	A	B	C	D
(1)	Cocci	Bacilli	Spirilla	Vibrio
(2)	Spirilla	Bacilli	Vibrio	Cocci
(3)	Bacilli	Spirilla	Vibrio	Cocci
(4)	Bacilli	Spirilla	Cocci	Vibrio

25. The given organism belongs to Class;
(1) Phycomycetes
(2) Basidiomycetes
(3) Ascomycetes
(4) Deuteromycetes.



PARIKSHIT EXERCISE-3 (MULTICONCEPT)

MATCH THE COLUMN MCQs

1. Match **List-I** with **List-II** and select the **correct** option.

	List-I (Kingdom)		List-II (Class)
A.	Plantae	P.	Archaebacteria
B.	Fungi	Q.	Euglenoids
C.	Protista	R.	Phycomycetes
D.	Monera	S.	Algae

(1) A-S; B-R; C-Q; D-P
(2) A-P; B-Q; C-R; D-S
(3) A-R; B-S; C-Q; D-P
(4) A-S; B-Q; C-R; D-P

2. Match the **List-I** with **List-II**, and choose the **correct** option

	List-I (Scientists)		List-II (Contribution)
A.	Ivanowsky	P.	*Contagium vivum fluidum*
B.	Pasteur	Q.	Crystallisation of viruses
C.	Beijerinck	R.	Discovery of viruses
D.	Stanley	S.	Term virus

(1) A-R; B-S; C-Q; D-P
(2) A-S; B-R; C-Q; D-P
(3) A-R; B-S; C-P; D-Q
(4) A-S; B-R; C-P; D-Q

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3. Match the columns and choose the **correct** option

	List-I		List-II
A.	Phycomycetes	P.	Fungi imperfecti
B.	Ascomycetes	Q.	Club fungi
C.	Basidiomycetes	R.	Algal fungi
D.	Deuteromycetes	S.	Sac fungi

(1) A-R; B-S; C-P; D-Q
(2) A-R; B-S; C-Q; D-P
(3) A-P; B-Q; C-R; D-S
(4) A-P; B-S; C-Q; D-R

4. Match the columns and find out the **correct** combination:

	List-I		List-II
A.	Viroid	P.	Nucleoprotein
B.	Virus	Q.	Infectious protein
C.	Prion	R.	Infectious nucleic acid
D.	Virion	S.	Infectious sub-viral particle

(1) A-S; B-P; C-Q; D-R
(2) A-Q; B-S; C-P; D-R
(3) A-R; B-P; C-Q; D-S
(4) A-S; B-Q; C-R; D-P

5. Match the following:

	List-I		List-II
A.	Ciliated protozoan	P.	*Entamoeba*
B.	Amoeboid protozoan	Q.	*Plasmodium*
C.	Sporozoan	R.	*Paramoecium*
D.	Flagellated protozoan	S.	*Trypanosoma*

(1) A-Q; B-R; C-S; D-P
(2) A-S; B-Q; C-R; D-P
(3) A-R; B-P; C-Q; D-S
(4) A-P; B-R; C-S; D-Q

6. Match the following:

	List-I		List-II
A.	*Trypanosoma*	P.	Mosaic formation and leaf curling
B.	Virus	Q.	Sleeping Sickness
C.	Viroids	R.	Tetanus and citrus canker
D.	Bacteria	S.	Potato spindle tuber disease

(1) A-R; B-P; C-S; D-Q (2) A-Q; B-P; C-S; D-R
(3) A-R; B-P; C-Q; D-S (4) A-Q; B-R; C-S; D-P

7. Match the following:

	List-I		List-II
A.	Puff Balls	P.	Kingdom Fungi
B.	Bladderwort	Q.	Kingdom Monera
C.	*Nostoc* and *Anabaena*	R.	Kingdom Protista
D.	Golden Algae	S.	Kingdom Plantae

(1) A-R; B-P; C-S; D-Q
(2) A-S; B-P; C-Q; D-R
(3) A-R; B-P; C-Q; D-S
(4) A-P; B-S; C-Q; D-R

8. Match the following:

	List-I		List-II
A.	Mycoplasma	P.	Cr – Jakob disease
B.	Prions	Q.	biochemical and genetic work
C.	*Cuscuta*	R.	wall - less organisms
D.	*Neurospora*	S.	Parasitic plant

(1) A-S; B-R; C-P; D-Q
(2) A-P; B-Q; C-R; D-S
(3) A-R; B-P; C-S; D-Q
(4) A-P; B-R; C-S; D-Q

9. Match the following:

	List-I		List-II
A.	Euglenoids	P.	Photosynthetic
B.	Slime molds	Q.	Both photosynthetic and heterotrophic
C.	Protozoans	R.	Heterotrophs
D.	Desmids	S.	Saprophytic

(1) A-Q; B-S; C-R; D-P
(2) A-P; B-S; C-Q; D-R
(3) A-S; B-Q; C-R; D-P
(4) A-P; B-R; C-S; D-Q

10. Match the following:

	List-I		List-II
A.	Dinoflagellates	P.	Cell wall contain silica
B.	Slime molds	Q.	Proteinaceous cell wall
C.	Diatoms	R.	Lacks true cell wall
D.	Euglenoids	S.	Stiff cellulose plates present in cell wall

(1) A-R; B-P; C-S; D-Q
(2) A-S; B-P; C-Q; D-R
(3) A-R; B-P; C-Q; D-S
(4) A-S; B-R; C-P; D-Q

CORRECT-INCORRECT PAIR MCQs

11. Find the **mismatch** pair.
(1) Phycomycetes - *Albugo*
(2) Deuteromycetes - *Trichoderma*
(3) Ascomycetes - *Agaricus*
(4) Basidiomycetes - *Puccinia*

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12. Find the **mismatch** pair.
   (1) Genetic material of virus that infect plant - Double stranded RNA
   (2) Genetic material of virus that infect animals - Double stranded / Single stranded RNA
   (3) Genetic material of viroids - Single stranded RNA
   (4) Genetic material of virus that infect bacteria - Double stranded DNA

13. Find the **mismatch** pair.
   (1) Toadstool - Poisonous fungi
   (2) *Ustilago* - Smut causing fungi
   (3) Morels - Edible fungi
   (4) *Neurospora* - Pathogenic

14. Find the **mismatch** pair.
   (1) Golden Algae - Autotrophic
   (2) Euglenoids - Autotrophic
   (3) Dinoflagellates - Autotrophic
   (4) Protozoa - Heterotrophic

15. Find the **mismatch** pair.
   (1) Mycoplasma - Obligate Aerobe
   (2) Archaebacteria - Obligate Anaerobe
   (3) Cyanobacteria - Facultative aerobe
   (4) Virus - Obligate Parasite

16. Find the **mismatch** pair.
   (1) Phycomycetes - Endogenous Asexual and Sexual spore.
   (2) Deuteromycetes - Exogenous asexual spores but sexual spores are absent.
   (3) Ascomycetes - Exogenous asexual spores and Endogenous sexual spores.
   (4) Basidiomycetes - Exogenous Asexual and Sexual spores.

17. Find the **mismatch** pair.
   (1) *Paramoecium* - Gullet.
   (2) Flagellated protozoa - Infectious spore stage.
   (3) Slime moulds - Plasmodium.
   (4) Euglenoids - Pigments similar to higher plants.

18. Find the **mismatch** pair.
   (1) Bladderwort - Insectivorous plant
   (2) Lichens - Symbiotic relationship of a algae and fungi
   (3) Yeast - Unicellular eukaryote
   (4) Ascomycetes - Septate, unbranched and Coenocytic mycelium.

19. Find the **mismatch** pair.
   (1) Prions - consists of abnormally folded nucleoprotein
   (2) Slimemoulds - spore possess true walls
   (3) Pellicle - proteinaceous
   (4) Bacteria - produce spores in unfavorable conditions

20. Find the **mismatch** pair.
   (1) White spots on mustard leaves - *Albugo*
   (2) Coprophilous - Members of Ascomycetes
   (3) Wheat rust - *Puccinia*
   (4) Help in mineral cycling - Phycomycetes

STATEMENT BASED QUESTIONS

21. A. First attempt to use a more scientific approach for classification was done by Linneaus.
   B. The mode of nutrition in Kingdom Animalia is only through ingestion of food that is holozoic.
   C. Compared to other organisms, bacteria as a group show the most extensive metabolic diversity.
   D. Most abundant microorganisms are a part of Kingdom Protista.
   E. Presence of flagella in cyanobacteria helps in their movement in aquatic environments.

   How many statements are **incorrect**?
   (1) 1 (2) 2
   (3) 3 (4) 4

22. A. Dinoflagellates have two flagella; one lies longitudinally and the other transversely in a furrow between the wall plates.
   B. The fungi form fruiting bodies in which reduction division occurs, leading to formation of spores.
   C. Two Kingdom classification proposed by linnaeus was based on gross morphology.
   D. Eubacteria can also be considered as thermoacidophiles.

   How many statements are **correct**?
   (1) 1 (2) 3
   (3) 2 (4) 4

23. Read the following statements carefully and choose the **incorrect** one.
   (1) W.M. StanlWey, showed that viruses could be crystallized and crystals consist largely of proteins.
   (2) All the organisms present in Kingdom protista have a cell wall.
   (3) A virus is a nucleoprotein and the genetic material is infectious.
   (4) Excessive growth of *Nostoc* in polluted water bodies also known as water bloom.

24. Read the following statements carefully and choose the **incorrect** one.
   (1) *Methanococcus*, which is an Archaebacteria, is found in the gut of ruminant animals.
   (2) Deducing phylogenetic relationships among organisms present at various levels could also be used in classification systems.
   (3) The protein coat around the viral genome is called capsid made of small subunits called capsomeres, thereby performing the function of protection.
   (4) Mad cow disease in cattle and its analogous variant Cr–Jacob disease (CJD) in humans is caused by viroids.

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25. I. *Aspergillus*, *Rhizopus*, *Mucor* are a type of phycomycetes.

II. Basis of classification of Kingdom Fungi into various classes is; morphology of the mycelium, mode of spore formation and fruiting bodies.

III. Eubacteria differ from Archaebacteria in terms of the presence of a rigid cell wall structure and presence of flagella to help in movement.

IV. *Chlorella*, *Chlamydomonas* and *Paramoecium* were earlier placed in the Plantae Kingdom as they contain a cell wall.

Identify the pair of **incorrect** options;

(1) I & II (2) I & III
(3) II & III (4) I & IV

26. I. The newly evolved classification system is based on morphological, physiological, reproductive and phylogenetic similarities.

II. All members of Plantae kingdom are eukaryotic, chlorophyll-containing, autotrophic organisms.

III. Specialized cell structures to fix atmospheric nitrogen can be seen in some members of eubacteria.

IV. In Basidiomycetes, the sex organs are absent, but plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotypes.

Select the option containing **correct** statements;

(1) I & II (2) I, II & III
(3) I, III & IV (4) All are **correct**

27. A. Plants follow a definite growth pattern and have a definite shape and size.

B. Based on improving the understanding of characteristics and evolutionary relationships, criteria of classification can be changed anytime.

C. Cyanobacteria are photosynthetic autotrophs because they contain Chlorophyll similar to green plants.

D. A virus is a nucleoprotein and it's the protein coat causes infection in the host cell.

E. Most notable disease caused by prions is herpes.

How many options are **incorrect**?

(1) 1 (2) 3
(3) 4 (4) 2

28. Read the following statements carefully and choose the **incorrect** one.

(1) The recycling of several nutrients in soil like iron , sulfur etc. is done by chemosynthetic autotrophs.

(2) Lichen is a symbiotic association between phycobiont and mycobiont, which are autotrophic and heterotrophic in nature, respectively.

(3) Aristotle used simple morphological features to classify plants into herbs and shrubs.

(4) The mode of nutrition of Kingdom Animalia is holozoic.

29. Read the following statements carefully and choose the **correct** one.

(1) In the classification system proposed by Linneaus a large number of organisms had found their place in either category

(2) In Two Kingdom classification, the sole members of the plant kingdom were; Fungi, cyanobacteria, ferns, gymnosperms and angiosperms.

(3) The three-domain system has also been proposed that divides the Kingdom Monera into two domains, thereby giving 6 kingdom classification.

(4) Blue green algae are unicellular, can form filamentous or colonial structures and are strictly found in freshwater.

30. Identify the **correct** statements from the following.

A. All monerans show non-cellulosic cell walls.

B. All protistans show true nucleus.

C. All fungi are plants with cellulosic cell walls.

D. All protists are autotrophic and all monerans are heterotrophic.

(1) A & B (2) B & D
(3) B & C (4) A & D

31. Read the statements (A-D) and select the **incorrect** ones.

A. Though the bacterial cell structure is very simple, they are very complex in behaviour.

B. Chrysophytes include diatoms, desmids and dinoflagellates.

C. Slime moulds, during suitable conditions, forms fruiting bodies.

D. Lichen, in nature, had two different organisms within them.

(1) A & B (2) C & D
(3) A & D (4) B & C

32. Select **incorrect** statement regarding protists.

(1) They are connecting link between prokaryotes and other eukaryotes

(2) They have diversified type of nutrition

(3) Flagella & cilia have 9 + 0 arrangement of microtubules

(4) They may have both plant and animal like characters

33. What may be a 'photosynthetic protistian' to one biologist may be 'a plant' to another. Which of the following feature of slime mould shows linkage with plant?

(1) Presence of holozoic nutrition

(2) Presence of diverse sexual reproduction

(3) Slime moulds have cellulosic spore wall

(4) Formation of fruiting bodies

34. Read the following statements regarding methanogens and select the **correct** option:

A. They are included in the group Archaebacteria

B. They are responsible for the production of biogas in gobar gas plants

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C. They live in hot sulphur springs

D. They are strictly anaerobic

(1) Statements A and B are **correct**

(2) Statements A, B and D **correct**

(3) Statements B, C and D are **correct**

(4) All statements are **correct**

35. Select the **incorrect** statements from the following:

(1) In Phycomycetes, asexual spores are produced endogenously

(2) In Ascomycetes, asexual spores are produced exogenously

(3) In Ascomycetes, sexual spores are produced endogenously

(4) In Basidomycetes, asexual spores are produced exogenously

Directions: In the questions from 36 to 44 two statements are given as **Statement-I** and **Statement-II.**

Mark the **correct** choice as:

(1) Both the **Statement-I** and **Statement-II** are **correct.**

(2) Both the **Statement-I** and **Statement-II** are **incorrect.**

(3) **Statement-I** is **correct** & **Statement-II** is **incorrect.**

(4) **Statement-I** is **incorrect** & **Statement-II** is **correct.**

36. **Statement-I:** Dmitri Ivanowsky, demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and called the fluid as Contagium vivum fluidum.

Statement-II: In Two Kingdom classification, the members of the plant kingdom were; Fungi, bacteria, cyanobacteria, ferns, mosses, gymnosperms and angiosperms based on the common characteristic that they all show autotrophic mode of nutrition.

37. **Statement-I:** Deuteromycetes are decomposers of litter and help in mineral cycling.

Statement-II: When deprived of sunlight *Euglena* behaves like chemo - heterotroph.

38. **Statement-I:** Protozoans are believed to be primitive relatives of animals.

Statement-II: Colonies of *Nostoc* are generally surrounded by gelatinous sheath or mucilagenous sheath.

39. **Statement-I:** Eubacteria also known as true bacteria are obligate anaerobes.

Statement-II: Yeast is a multicellular eukaryotic organism.

40. **Statement-I:** Kingdom Protista forms a link with the others dealing with plants, animals and fungi.

Statement-II: Recycling of nutrients like nitrogen and phosphorus is done by photosynthesis autotrophs.

41. **Statement-I:** Protists reproduce sexually by a process involving cell fusion and zygote formation.

Statement-II: According to Dmitri Ivanowsky, viruses were found to be smaller than bacteria because they passed through bacteria-proof filters.

42. **Statement-I:** When a fungus reproduces sexually, two diploid hyphae of compatible mating types come together and fuse.

Statement-II: Bacterial species responsible for fixing atmospheric nitrogen in legumes are heterotrophs.

43. **Statement-I:** The sexual cycle of fungi involves the following three steps; fusion or protoplasm, fusion of nuclei and meiosis in zygotic cells.

Statement-II: During unfavorable conditions in slime moulds, the plasmodium differentiates and forms fruiting bodies bearing spores at their tips.

44. **Statement-I:** Viruses are inert outside their specific host cell.

Statement-II: Plantae kingdom include multicellular eukaryotic organisms such as *Chlorella* and *Chlamydomonas.*

Directions: In the following questions, a statement of **Assertion** is followed by a statement of **Reason.**

Mark the **correct** choice as:

(1) Both **Assertion (A)** and **Reason (R)** are true and Reason is the **correct** explanation of Assertion.

(2) Both **Assertion (A)** and **Reason (R)** are true but Reason is not the **correct** explanation of **Assertion (A).**

(3) **Assertion (A)** is true but **Reason (R)** is false.

(4) **Assertion (A)** is false but **Reason (R)** is true.

45. **Assertion (A):** Archaebacteria are able to survive in harsh habitats.

Reason (R): Archaebacteria survive in extreme conditions due to the presence of peptidoglycan in their cell wall.

46. **Assertion (A):** Bacteria are prokaryotic.

Reason (R): Bacteria do not possess true nucleus and membrane bound cell organelles.

47. **Assertion (A):** Methanogens are obligate anaerobes.

Reason (R): Halophiles are salt loving bacteria.

48. **Assertion (A):** Cyanobacteria are photosynthetic autotrophs.

Reason (R): Cyanobacteria have chlorophyll *a* and *b* similar to green plants.

49. **Assertion (A):** *Euglena* is studied as an animal as well as a plant.

Reason (R): *Euglena* is phototrophic but in the absence of sunlight, it becomes heterotrophic.

50. **Assertion (A):** Cell wall of chrysophytes are indestructible.

Reason (R): Cell walls of chrysophytes have layer of silica embedded in it.

51. **Assertion (A):** Kingdom-Protista forms a link between monerans and and the other organism like plants, animal and fungi.

Reason (R): Protist reproduce sexually by a process involving cell fusion and zygote formation.

52. **Assertion (A):** Ascomycetes are commonly known as sac fungi.

Reason (R): In Ascomycetes, ascospore (sexual spores) are produced endogenously in sac like asci.

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53. **Assertion (A):** Deuteromycetes is known as fungi imperfecti.
Reason (R): In Deuteromycetes, only the sexual phase is known.

54. **Assertion (A):** Morels and Truffles are edible fungi.
Reason (R): Their basidiocarps are edible.

55. **Assertion (A):** Symbiosis is shown by lichens.
Reason (R): In mycorrhiza, symbiosis is established between fungus and alga.

56. **Assertion (A):** Viruses are nucleoproteins and lack cell organelle, etc.
Reason (R): Viruses are neither living nor non living.

57. **Assertion (A):** TMV is a virus which causes mosaic disease.
Reason (R): TMV has RNA as genetic material.

58. **Assertion (A):** Classification done by R.H. Whittaker provided a separate kingdom for Fungi.
Reason (R): Fungi have a unique mode of nutrition and cell wall composition.

59. **Assertion (A):** Archaebacteria are special since they are found in some of the most harsh habitats.
Reason (R): The oldest/primitive organisms or the first life forms on earth is Archaebacteria, an integral part of kingdom monera.

60. **Assertion (A):** Deuteromycetes a class of fungi including *Trichoderma*, *Colletotrichum* is commonly known as Perfect fungi.
Reason (R): Deuteromycetes reproduce mainly via vegetative and asexual mode and its sexual form is unknown.

61. **Assertion (A):** In the five kingdom classification proposed by Whittaker, there is no mention of viruses, viroids and prions.
Reason (R): Viruses are not truly 'living', they are often considered as a connecting link between biotic and abiotic systems as it requires cellular machinery of the host to reproduce.

62. **Assertion (A):** Lichens are very good pollution indicators as they are unable to grow in polluted areas.
Reason (R): Lichens are symbiotic associations i.e. mutually useful associations, between algae and fungi.

63. **Assertion (A):** Euglenoids, a member of Kingdom Protista, lack a true cell wall instead of that they contain a protein rich layer called pellicle.
Reason (R): The presence of pellicle in euglenoids, ensures cell rigidity and enables them to withstand unfavorable or extreme conditions.

64. **Assertion (A):** Dikaryophase is a characteristic feature of ascomycetes and basidiomycetes.
Reason (R): In some fungi the fusion of two haploid cells immediately results in diploid cells.However, in other fungi an intervening dikaryotic stage i.e., two nuclei per cell occurs, such a condition is called a dikaryon and the phase is called dikaryophase of fungus.

65. **Assertion (A):** Diatoms are the chief 'producers' in the oceans.
Reason (R): After the death of Diatoms large amounts of cell wall deposits containing calcium are left behind and upon their accumulation over billions of years it is referred to as 'diatomaceous earth'. Being gritty this soil is used in polishing, filtration of oils and syrups.

66. **Assertion (A):** The RNA of the viroid has less molecular weight than that of the viral RNA.
Reason (R): T.O. Diener discovered a new infectious agent that was smaller than viruses whose genetic material was a free RNA molecule.

67. **Assertion (A):** Bacteria are the sole members of Kingdom Monera and are the most abundant microorganisms.
Reason (R): Bacteria can reproduce only through asexual means, like binary fission or endospore formation under unfavorable conditions.

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. Match **List-I** with **List-II.** **(2022)**

List-I	List-II
(A) *Puccinia*	(I) Parasitic fungus on mustard
(B) *Neurospora*	(II) Dead substrates
(C) *Saprophytes*	(III) Wheat rust
(D) *Albugo*	(IV) Biochemical and Genetic Work

Choose the **correct** answer from the option given below:
(1) A-III; B-II; C-IV; D-I (2) A-III; B-IV; C-II; D-I
(3) A-I; B-II; C-III; D-IV (4) A-IV; B-II; C-I; D-III

2. Given below are two statements:
Statement-I: Mycoplasma can pass through less than 1 micron filter size.
Statement-II: Mycoplasma are bacteria with cell wall.
In the light of the above statements, choose the most appropriate answer from the options given below **(2022)**
(1) Statement-I is incorrect but Statement-II are correct
(2) Both Statement-I and Statement-II are correct
(3) Both Statement-I and Statement-II are incorrect
(4) Statement-I is correct but Statement-II is incorrect

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3. Which of the following is a **correct** statement? **(2022)**
   (1) Mycoplasma have DNA, ribosome and cell wall.
   (2) Cyanobacteria are a group of autotrophic organisms classified under kingdom Monera
   (3) Bacteria are exclusively heterotrophic organisms
   (4) Slime moulds are saprophytic organisms classified under Kingdom Monera

4. Identify the asexual reproductive structure associated with *Penicillium:* **(2022)**
   (1) Gemmules (2) Buds
   (3) Zoospores (4) Conidia

5. Mad cow disease in cattle and Cr Jacob disease in humans are due to infection by: **(2022 phase -2)**
   (1) Prion (2) Bacterium
   (3) Virus (4) Viroid

6. Which of the following statements is **correct**? **(2021)**
   (1) Fusion of protoplasms between two motile or non-motile gametes is called plasmogamy.
   (2) Organisms that depend on living plants are called saprophytes.
   (3) Some of the organisms can fix atmospheric nitrogen in specialized cells called sheath cells.
   (4) Fusion of two cells is called Karyogamy.

7. Which of the following is **correct** about viroids? **(2020)**
   (1) They have free RNA without protein coat.
   (2) They have DNA with protein coat.
   (3) They have free DNA without protein coat.
   (4) They have RNA with protein coat.

8. Which of the following is **incorrect** about Cyanobacteria? **(2020 Covid)**
   (1) They lack heterocysts
   (2) They often form blooms in polluted water bodies
   (3) They have chlorophyll 'a' similar to green plants
   (4) They are photoautotrophs

9. Which of the following statements is **incorrect**? **(2019)**
   (1) Viroids lack a protein coat.
   (2) Viruses are obligate parasites.
   (3) Infective constituent in viruses is the protein coat.
   (4) Prions consist of abnormally folded proteins.

10. Which of the following statements is **incorrect**? **(2019)**
   (1) Morels and truffles are edible delicacies.
   (2) *Claviceps* is a source of many alkaloids and LSD.
   (3) Conidia are produced exogenously and ascospores endogenously.
   (4) Yeasts have filamentous bodies with long thread-like hyphae.

11. Mad cow disease in cattle is caused by an organism which has: **(2019 odisha)**
   (1) inert crystalline.
   (2) abnormally folded protein.
   (3) free RNA without protein coat.
   (4) free DNA without protein coat.

12. Which of the following statements is **correct**? not grow in polluted areas. **(2019 odisha)**
   (1) Lichens do not grow in polluted areas.
   (2) Algal component of lichens is called mycobiont
   (3) Fungal component of lichens is called phycobiont
   (4) Lichens are not good pollution indicators.

13. Match the organisms in **List-I** with habitats in **List-II.** **(2019 odisha)**

	List-I		List-II
A.	Halophiles	P.	Hot springs
B.	Thermoacidophiles	Q.	Aquatic environment
C.	Methanogens	R.	Guts of ruminants
D.	Cyanobacteria	S.	Salty areas

   Select the **correct** answer from the options given below:
   (1) A-S, B-P, C-R, D-Q (2) A-P, B-Q, C-R, D-S
   (3) A-R, B-S, C-P, D-P (4) A-Q. B-S, C-R, D-P

14. Which of the following statements about methanogens is not **correct**? **(2019 odisha)**
   (1) They can be used to produce biogas,
   (2) They are found in the rumen of cattle and their excreta.
   (3) They grow aerobically and breakdown cellulose-rich food.
   (4) They produce methane gas.

15. Select the **wrong** statement. **(2018)**
   (1) Cell wall is present in members of Fungi and Plantae
   (2) Mushrooms belong to Basidiomycetes
   (3) Pseudopodia are locomotory and feeding structures in Sporozoans
   (4) Mitochondria are the powerhouse of the cell in all kingdoms except Monera

16. After karyogamy followed by meiosis, spores are produced exogenously in; **(2018)**
   (1) *Neurospora* (2) *Alternaria*
   (3) *Agaricus* (4) *Saccharomyces*

17. Oxygen is not produced during photosynthesis by; **(2018)**
   (1) *Nostoc* (2) Green sulphur bacteria
   (3) *Cycas* (4) *Chara*

18. Which of the following organisms are known as chief producers in the oceans? **(2018)**
   (1) Dinoflagellates (2) Diatoms
   (3) Cyanobacteria (4) Euglenoids

19. Ciliates differ from all other protozoans in; **(2018)**
   (1) Using flagella for locomotion
   (2) Having a contractile vacuole for removing excess water
   (3) Using pseudopodia for capturing prey
   (4) Having two types of nuclei

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20. Which of the following are found in extreme saline conditions? **(2017-Delhi)**
(1) Archaebacteria (2) Eubacteria
(3) Cyanobacteria (4) Mycobacteria

21. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen? **(2017-Delhi)**
(1) *Bacillus* (2) *Pseudomonas*
(3) Mycoplasma (4) *Nostoc*

22. Viroids differ from viruses in having: **(2017-Delhi)**
(1) DNA molecules with protein coat
(2) DNA molecules without protein coat
(3) RNA molecules with protein coat
(4) RNA molecules without protein coat

23. An example of flagellate protozoan is: **(2017-Gujarat)**
(1) *Paramoecium* (2) *Trypanosoma*
(3) *Entamoeba* (4) *Plasmodium*

24. Which of the following is **not** true of organisms in the kingdom Monera? **(2017-Gujarat)**
(1) They originated at least 3.5 billion years ago
(2) They have prokaryotic cellular organisation
(3) They may be autotrophic or heterotrophic in nature
(4) They reproduce by mitosis

25. Select the sac fungus: **(2017-Gujarat)**
(1) *Albugo* (2) *Agaricus*
(3) *Neurospora* (4) *Mucor*

26. The protein coat around a virus is called: **(2017-Gujarat)**
(1) Capsule (2) Core
(3) Capsid (4) Trichome

27. Select the **wrong** statement: **(2016-II)**
(1) *Diatoms* are chief producers in the oceans
(2) *Diatoms* are microscopic and float passively in water
(3) The walls of diatoms are easily destructible
(4) 'Diatomaceous earth' is formed by the cell wall of diatoms.

28. Methanogens belong to: **(2016-II)**
(1) Dinoflagellates (2) Slime moulds
(3) Eubacteria (4) Archaebacteria

29. Which one of the following is **wrong** for fungi? **(2016-II)**
(1) They are heterotrophic
(2) They are both unicellular and multicellular
(3) They are eukaryotic
(4) All fungi possess a purely cellulosic cell wall

30. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the: **(2016-I)**
(1) Halophiles (2) Thermoacidophiles
(3) Methanogens (4) Eubacteria

31. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom: **(2016-I)**
(1) Animalia (2) Monera
(3) Protista (4) Fungi

32. Which one of the following statements is **wrong**? **(2016-I)**
(1) *Cyanobacteria* are also called blue-green algae
(2) Golden algae are also called desmids
(3) Eubacteria are also called false bacteria
(4) Phycomycetes are also called algal fungi

33. One of the major components of cell wall of most fungi is:
(1) Chitin (2) Peptidoglycan **(2016-I)**
(3) Cellulose (4) Hemicellulose

34. Which of the following statements is **wrong** for viroids?
(1) They lack a protein coat **(2016-I)**
(2) They are smaller than viruses
(3) They causes infections
(4) Their RNA is of high molecular weight

35. Which one of the following matches is **correct**? **(2015)**

(1)	*Mucor*	Reproduction by Conjugation	Ascomycetes
(2)	*Agaricus*	Parasitic fungus	Basidiomycetes
(3)	*Phytophthora*	Aseptate mycelium	Basidiomycetes
(4)	*Alternaria*	Sexual reproduction absent	Deuteromycetes

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Answer Key

CONCEPT APPLICATION

1. True
2. False
3. True
4. Aristotle
5. Six
6. 1969
7. True
8. False
9. False
10. True
11. False
12. True
13. True
14. True
15. False
16. Methanogens
17. Mycoplasma
18. True
19. False
20. True
21. False
22. True
23. False
24. True
25. False
26. True
27. False
28. True
29. True
30. False
31. Diatoms
32. Slime moulds
33. True
34. False
35. False
36. False
37. True
38. False
39. True
40. True
41. False
42. False
43. *Neurospora*
44. Ascomycetes
45. *Ustilago; Puccinia*
46. basidiospores
47. decomposers
48. False
49. True
50. True
51. True
52. False
53. False
54. True
55. False
56. True
57. True
58. Plantae
59. Animalia
60. Stanley

NCERT FOCUSED FILL-INS

1. Red blood
2. Mode of nutrition
3. Cell wall
4. Kingdom Protista
5. *Paramoecium*
6. Six
7. Chitin
8. Archaebacteria
9. Rod shaped
10. Halophiles
11. Cell wall
12. Green plants
13. *Anabaena*
14. Oxygen
15. Fungi
16. Indestructible
17. Transverse
18. Longitudinal
19. Protein
20. Fruiting bodies
21. Primitive
22. *Trypanosoma*
23. Gullet
24. Spore like
25. Moisture
26. Thread
27. Coenocytic
28. Conidia
29. Ascospores
30. Biochemical
31. Truffles
32. *Albugo*
33. Exogenously
34. Endogenously
35. Fragmentation
36. Basidiocarps
37. Ascomycetes
38. Conidia
39. Sporophytic
40. Gametophytic
41. Crystalline
42. Bacteria
43. *Contagium vivum fluidum*
44. Double stranded
45. Capsomeres
46. Leaf
47. Low
48. Protein
49. Analogous

SCHOOL LEVEL PROBLEMS

Single Correct Type Questions

1. (1) 2. (4) 3. (1) 4. (1) 5. (3) 6. (2) 7. (3) 8. (3) 9. (2) 10. (4)

Assertion and Reason Type Questions

1. (2) 2. (4) 3. (2) 4. (4)

Case Study Based Questions

Case-I

1. (1) 2. (2)

Case-II

1. (4) 2. (3) 3. (3)

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PRARAMBH EXERCISE-1 (TOPICWISE)

1. (4)	2. (3)	3. (3)	4. (4)	5. (1)	6. (1)	7. (1)	8. (2)	9. (2)	10. (1)
11. (4)	12. (4)	13. (2)	14. (4)	15. (4)	16. (4)	17. (1)	18. (2)	19. (3)	20. (4)
21. (4)	22. (1)	23. (1)	24. (1)	25. (2)	26. (4)	27. (2)	28. (3)	29. (4)	30. (4)
31. (3)	32. (2)	33. (1)	34. (1)	35. (2)	36. (1)	37. (4)	38. (3)	39. (4)	40. (3)
41. (2)	42. (2)	43. (4)	44. (4)	45. (4)	46. (2)	47. (3)	48. (2)	49. (2)	50. (1)
51. (4)	52. (4)	53. (2)	54. (3)	55. (3)	56. (4)	57. (3)	58. (3)	59. (4)	60. (1)
61. (1)	62. (2)	63. (4)	64. (1)	65. (2)	66. (2)	67. (1)	68. (3)	69. (1)	70. (2)
71. (2)	72. (1)	73. (4)	74. (2)	75. (4)	76. (1)	77. (1)	78. (4)	79. (2)	80. (2)
81. (3)	82. (4)	83. (4)	84. (1)	85. (4)	86. (4)	87. (3)	88. (1)	89. (3)	90. (2)
91. (4)	92. (2)	93. (4)	94. (4)	95. (2)	96. (2)	97. (3)	98. (1)	99. (1)	100. (4)
101. (2)	102. (1)	103. (4)	104. (4)	105. (3)	106. (1)	107. (2)	108. (2)	109. (4)	110. (1)
111. (2)	112. (4)	113. (4)	114. (2)	115. (2)	116. (4)	117. (3)	118. (3)	119. (4)	120. (2)
121. (1)	122. (1)	123. (3)	124. (3)	125. (4)	126. (1)	127. (4)	128. (1)	129. (4)	130. (2)
131. (3)	132. (4)	133. (4)	134. (3)	135. (4)	136. (4)	137. (3)	138. (1)	139. (1)	140. (1)
141. (3)	142. (2)								

PRABAL EXERCISE-2 (LEARNING PLUS)

1. (3)	2. (2)	3. (4)	4. (4)	5. (3)	6. (3)	7. (2)	8. (4)	9. (2)	10. (2)
11. (3)	12. (1)	13. (4)	14. (2)	15. (2)	16. (1)	17. (4)	18. (4)	19. (1)	20. (4)
21. (2)	22. (3)	23. (3)	24. (3)	25. (3)					

PARIKSHIT EXERCISE-3 (MULTICONCEPT)

1. (1)	2. (3)	3. (2)	4. (3)	5. (3)	6. (2)	7. (4)	8. (3)	9. (1)	10. (4)
11. (3)	12. (1)	13. (4)	14. (2)	15. (1)	16. (4)	17. (2)	18. (4)	19. (1)	20. (4)
21. (4)	22. (2)	23. (2)	24. (4)	25. (4)	26. (3)	27. (2)	28. (3)	29. (3)	30. (1)
31. (4)	32. (3)	33. (3)	34. (4)	35. (2)	36. (2)	37. (3)	38. (1)	39. (2)	40. (3)
41. (1)	42. (4)	43. (1)	44. (3)	45. (3)	46. (1)	47. (2)	48. (3)	49. (1)	50. (1)
51. (2)	52. (1)	53. (3)	54. (3)	55. (3)	56. (1)	57. (2)	58. (1)	59. (2)	60. (4)
61. (1)	62. (2)	63. (3)	64. (2)	65. (3)	66. (1)	67. (3)			

PYQ's EXERCISE-4 (NEET PAST YEAR QUESTIONS)

1. (2)	2. (4)	3. (2)	4. (4)	5. (1)	6. (1)	7. (1)	8. (1)	9. (3)	10. (4)
11. (2)	12. (1)	13. (1)	14. (3)	15. (3)	16. (3)	17. (2)	18. (2)	19. (4)	20. (1)
21. (3)	22. (4)	23. (2)	24. (4)	25. (3)	26. (3)	27. (3)	28. (4)	29. (4)	30. (3)
31. (3)	32. (3)	33. (1)	34. (4)	35. (4)					

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