

2 CHAPTER

BIODIVERSITY



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2.1 BIODIVERSITY**LONG ANSWER QUESTIONS**

Q.2 Discuss the concept of biodiversity and its significance in maintaining the health of ecosystems.(K.B)
Ans: BIODIVERSITY

Definition:

Biodiversity means the **variety of organisms** in a particular area.

Measuring the Biodiversity:

Biologists have different ways of measuring biodiversity, but many focus on the number of different kinds of organisms and the **variation** within each kind.

Significance of Biodiversity:

Biodiversity provides many essential **services** for humans and the planet. Here are some key benefits of biodiversity:

1. Ecosystem Stability

Biodiversity helps to maintain the **balance** of ecosystems. It plays important role in biogeochemical cycles such as **carbon cycle**, and **nitrogen cycle**.

2. Climate Regulation

Plants and **algae** absorb carbon dioxide. It helps to keep the climate balanced.

3. Natural Resources

Biodiversity provides a vast **array of resources**, from food and medicine to building materials and fuel.

4. Economic Benefits

Biodiversity supports numerous **industries**, including agriculture, tourism, and pharmaceuticals.

2.2 CLASSIFICATION**LONG ANSWER QUESTIONS**

Q.1 Explain the importance of classification in biology and how it helps us to understand the relationships between different organisms? (K.B)

Ans: CLASSIFICATION

Definition:

Classification is a method by which biologists divide organisms into **groups** and **subgroups** on the basis of similarities found in them.

Aims and Principles of Classification:

The main aims of classification are;

- To determine **similarities** and **differences** among organisms so that they can be studied easily.
- To find the **evolutionary relationships** among organisms.

Basis of Classification:

- Biologists classify organisms into groups and subgroups on the basis of similar **physical characteristics**.
- In recent times, they also take help from **genetics**. They find the genetic similarities and differences among organisms.
- Then they use this information to know similarities and differences in their structures and functions.

Advantages of Classification:

- Classification allows biologists to group similar organisms together, making it easier to **identify** and **understand** their characteristics, relationships, and **evolutionary history**.
- It helps us understand the vast diversity of living organisms on Earth.
- Classification provides a **framework** for studying and comparing different species.
- It explains the **inter-relationship** amongst various organisms.

- It helps in the identification of new species and in understanding their evolutionary relationships.
- Classification provides a **common language** for biologists around the world, enabling effective communication in the study of organisms.
- Overall, classification is **crucial** for our understanding of the natural world and for the **conservation** and **management** of biological diversity.

SHORT ANSWER QUESTIONS

Q.1 Define biodiversity.

(K.B)

Ans:

BIODIVERSITY**Definition:**

Biodiversity means the **variety of organisms** in a particular area.

Measuring the Biodiversity:

Biologists have different ways of measuring biodiversity, but many focus on the number of different kinds of organisms and the **variation** within each kind.

Q.2 What is the importance of biodiversity?

(K.B)

Ans:

IMPORTANCE OF BIODIVERSITY

Biodiversity provides many essential services for humans and the planet. Here are some key benefits of biodiversity:

1. Ecosystem Stability

Biodiversity helps maintain the balance of ecosystems by contributing to the **biogeochemical cycle** such as **water cycle**, **carbon cycle**, and **nitrogen cycle**.

2. Climate Regulation

Plants and algae absorb carbon dioxide, helping to **regulate the climate**.

3. Natural Resources

Biodiversity provides a **vast array of resources**, from food and medicine to building materials and fuel.

4. Economic Benefits

Biodiversity supports numerous **industries**, including agriculture, tourism, and pharmaceuticals.

Q.3 Explain the term classification. Also write the aims of classification.

(K.B)

Ans:

CLASSIFICATION**Definition:**

Classification is a method by which biologists divide organisms into **groups** and **subgroups** on the basis of similarities found in them.

Aims of Classification:

The main aims of classification are;

- a. To determine similarities and differences among organisms so that they can be studied easily.
- b. To find the **evolutionary relationships** among organisms.

Q.4 Why classification of living organisms is so important?

(U.B)

Ans:

IMPORTANCE OF CLASSIFICATION**Advantages of Classification:**

- Classification allows biologists to group similar organisms together, making it easier to identify and understand their **characteristics**, relationships, and **evolutionary history**.
- It helps us understand the vast diversity of living organisms on Earth.
- Classification provides a **framework** for studying and comparing different species.
- It explains the **inter-relationship** amongst various organisms.
- It helps in the identification of new species and in understanding their **evolutionary relationships**.

MULTIPLE CHOICE QUESTIONS

- Biodiversity means ____ of organisms in a particular area.** (K.B)
(A) Variety (B) Similarity
(C) Differences (D) Closeness
- Biodiversity has ecological and ____ importance.** (K.B)
(A) Economical (B) Environmental
(C) Medicinal (D) All of these
- How many kinds of organisms have been studied and classified by the biologists?** (K.B)
(A) 2 million (B) 2 billion
(C) 5 million (D) 10 billion
- Which of the following is the character of life?** (K.B)
(A) Movement (B) Respiration
(C) Reproduction (D) All of these
- The grouping of organisms is called:** (K.B)
(A) Taxonomy (B) Systematics
(C) Classification (D) Categorization
- The "International Biodiversity Day" is celebrated on:** (K.B)
(A) 22nd April (B) 20th May
(C) 22nd May (D) 1st September
- Biodiversity is important for:** (U.B)
(A) Ecosystem stability (B) Natural resources
(C) Economy of a country (D) All of these

2.3 TAXONOMIC RANKS**LONG ANSWER QUESTIONS**

- Q.1 Describe the Linnaean system of taxonomic hierarchy in detail, outlining the seven major taxonomic ranks and their relationships?** (K.B)

Ans:

TAXONOMIC HEIRARCHY**Taxonomic Ranks:**

The groups into which organisms are classified are known as **taxonomic ranks** or **taxa** (singular "taxon").

Linnaean System of Taxonomic Ranks:

- The Swedish botanist **Carl Linnaeus** devised the **Linnaean system of taxonomic ranks** in 1735.
- In this system, Linnaeus suggested **seven** taxonomic ranks i.e., kingdom, phylum (division), class, order, family, genus and species.
- In 1977, the rank of **domain** was added to this system.

Major Taxonomic Ranks:

The taxonomic ranks are defined as below:

1. Domain

The **highest** taxonomic rank is domain. All organisms are divided into **three domains**: Bacteria, Archaea, and Eukarya.

2. Kingdom

Domain is further divided into **kingdoms**. For example, the domain **Eukarya** is divided into four kingdoms i.e., Animalia, Plantae, Fungi, Protista.

3. Phylum (Division: for plants and fungi)

Each kingdom is subdivided into related phyla or divisions.

4. Class

Each phylum/division is divided into related classes.

5. Order

Each class is further divided into related orders.

6. Family

Each order is broken down into related families.

7. Genus

Each family is divided into related genera (singular genus).

8. Species

It is the most specific level of classification. A species consists of similar organisms that can interbreed and produce fertile offspring.

Q.2 Write down the taxonomic hierarchy of fruit-fly, human and pea. (K.B)

Ans:

TAXONOMIC HIERARCHY

Taxonomic Ranks	Fruit fly	Human	Pea
Domain	Eukarya	Eukarya	Eukarya
Kingdom	Animalia	Animalia	Plantae
Phylum or Division	Arthropoda	Chordata	Magnoliophyta
Class	Insecta	Mammalia	Magnoliopsida
Order	Diptera	Primates	Fabales
Family	Drosophilidae	Hominidae	Fabaceae
Genus	<i>Drosophila</i>	<i>Homo</i>	<i>Pisum</i>
Species	<i>Drosophila melanogaster</i>	<i>Homo sapiens</i>	<i>Pisum sativum</i>

SHORT ANSWER QUESTIONS

Q.1 What do you know about taxonomic ranks? (K.B)

Ans:

TAXONOMIC RANKS**Definition:**

The groups into which organisms are classified are known as **taxonomic ranks** or **taxa** (singular "taxon").

Taxonomic Ranks:

There are eight main taxonomic ranks

- Domain
- Kingdom
- Phylum or division
- Class
- Order
- Family
- Genus
- Species

Q.2 Explain the Linnaean system of taxonomic classification. (K.B)

Ans:

LINNAEAN SYSTEM OF CLASSIFICATION**Explanation:**

- The Swedish botanist **Carl Linnaeus** devised the **Linnaean system of taxonomic ranks** in 1735.
- In this system, Linnaeus suggested **seven** taxonomic ranks i.e., kingdom, phylum (division), class, order, family, genus and species.
- In 1977, the rank of **domain** was added to this system.

Q.3 Define species. (K.B)

Ans:

SPECIES**Definition:**

It is the most specific level of classification. A species consists of similar organisms that can interbreed and produce **fertile offspring**.

Examples:

- *Homo sapiens*
- *Oryza sativa*
- *Pisum sativum*

Q.4 Write the taxonomic classification of humans.

(K.B)

Ans: CLASSIFICATION OF HUMANS

Humans (*Homo sapiens*) are classified as:

- Domain – Eukarya
- Kingdom – Animalia
- Phylum – Chordata
- Class – Mammalia
- Order – Primate
- Family – Hominidae
- Genus – *Homo*
- Species – *Homo sapiens*

Q.5 Write the taxonomic classification of pea.

(K.B)

Ans: CLASSIFICATION OF PEA

Pea (*Pisum sativum*) is classified as:

- Domain – Eukarya
- Kingdom – Plantae
- Division – Magnoliophyta
- Class – Magnoliopsida
- Order – Fabales
- Family – Fabaceae
- Genus – *Pisum*
- Species – *Pisum sativum*

MULTIPLE CHOICE QUESTIONS

- 1. Carl Linnaeus was a:** (K.B)
 (A) German chemist (B) Swedish Naturalist
 (C) Swedish botanist (D) Geneticist
- 2. Carl Linnaeus introduced “Linnaean system of taxonomic ranks” in:** (K.B)
 (A) 1905 (B) 1977
 (C) 1735 (D) 1854
- 3. An order is further classified into:** (K.B)
 (A) Families (B) Species
 (C) Kingdoms (D) Genera
- 4. A genus is further classified into:** (K.B)
 (A) Families (B) Species
 (C) Kingdoms (D) Genera
- 5. How many main taxonomic ranks are there?** (K.B)
 (A) Two (B) Three
 (C) Four (D) Eight
- 6. *Homo sapiens* belongs to class:** (K.B)
 (A) Hominidae (B) Mammalia
 (C) Chordata (D) Magnoliopsida
- 7. *Homo sapiens* belongs to phylum:** (K.B)
 (A) Hominidae (B) Mammalia
 (C) Chordata (D) Magnoliopsida

8. *Pisum sativum* belongs to domain: (K.B)
 (A) Archaea (B) Plantae
 (C) Eukarya (D) Fabales
9. Pea belongs to Family: (K.B)
 (A) *Pisum* (B) Plantae
 (C) Fabaceae (D) Fabales
10. The largest taxon is: (K.B)
 (A) Domain (B) Kingdom
 (C) Species (D) Phylum
11. Fruit fly belongs to class: (K.B)
 (A) Insecta (B) Mammalia
 (C) Fabales (D) *sativum*

2.4 HISTORY OF CLASSIFICATION

LONG ANSWER QUESTIONS

- Q.1 Trace down the history of classification systems. (K.B)

Ans: HISTORY OF CLASSIFICATION

The history of the classification system can be traced back to ancient times.

Aristotle:

The Greek philosopher Aristotle (384-322 BC) was the first who classified organisms into two groups i.e., plants and animals.

Ibn Rushd:

In 1172, Ibn Rushd (Averroes) translated Aristotle's book "*de Anima (On the Soul)*" into Arabic.

Abu Usman Umer Al- Jahiz:

- The Arab scholar Abu Usman Umer Al- Jahiz (781-869 AD) described the characteristics of **350 species of animals**.
- He wrote a lot about the **life of ants**.

Andrea Caesalpinia:

The Italian botanist Andrea Caesalpinia (1519-1603 AD) divided plants into **fifteen groups** and called them **genera**.

Tournefort:

The French botanist Tournefort (1656-1708 AD) introduced the taxa of **class** and **species**.

Carl Linnaeus:

The Swedish biologist Carl Linnaeus (1707-1778 AD) created a **taxonomic hierarchy** of organisms with six taxa i.e., Kingdom, Class, Order, Family, Genus, and Species.

- Q.2 Write a note on two kingdom classification system. (K.B)

Ans: TWO KINGDOM CLASSIFICATION SYSTEM

Introduction:

It was the earliest classification system in which all organisms were classified into two kingdoms i.e., **Plantae** and **Animalia**.

Kingdom Plantae:

- The organisms that can prepare their own food (**autotrophs**) were classified in the kingdom plantae.
- According to this system, **prokaryotes** (bacteria, archaea) and fungi were members of kingdom plantae.

Kingdom Animalia:

The organisms that cannot make their own food (**heterotrophs**) were classified in kingdom animalia.

Objections:

- Some taxonomists found this system **unworkable** because many unicellular organisms like **Euglena** have both **plant-like** (presence of chlorophyll) and **animal-like** (heterotrophic mode of nutrition in darkness and lack of cell wall) characteristics.
- So, a separate kingdom was proposed for such organisms.
- This system also did not clear the difference between prokaryotes (bacteria and archaea) and eukaryotes.

Q.3 Write a note on three kingdom classification system.

(K.B)

Ans:

THREE KINGDOM CLASSIFICATION SYSTEM**Introduction:**

In 1866, the German zoologist **Ernst Haeckel** proposed a third kingdom i.e., Protista for Euglena-like organisms.

Kingdom Protista:

He also included **prokaryotes** (bacteria and archaea) in the **kingdom Protista**.

Objections:

- In this system, **fungi** were still included in the kingdom Plantae.
- Some taxonomists **disagreed** about the position of fungi in kingdom Plantae.
- Fungi resemble plants in many ways but are heterotrophs which get their food by absorption.
- They do not have cellulose in their cell walls but possess **chitin**.

Q.4 Write a note on five kingdom classification system.

(K.B)

Ans:

FIVE KINGDOM CLASSIFICATION SYSTEM**Work of E-Chatton:**

In 1937, French biologist **E-Chatton** suggested the terms, "**Procariotique**" to describe bacteria and "**Eucariotique**" to describe protista, fungi, animal and plant cells.

Five Kingdom System:

In 1969, American ecologist **Robert Whittaker** introduced the five-kingdom classification system.

Basis of Five Kingdom System:

This system is based on:

- The levels of **cellular organization** i.e. prokaryotic (bacteria, archaea), unicellular eukaryotic (Protista) and multicellular eukaryotic (fungi, plants and animals)
- The **modes of nutrition** i.e. photosynthesis, absorption, and ingestion.

Five Kingdoms:

On this basis, organisms were classified into five kingdoms: Monera, Protista, Fungi, Plantae and Animalia.

Modifications in Five Kingdom System:

- In 1988, American biologists **Margulis and Schwartz** modified the five-kingdom classification of Whittaker.
- They considered **genetics** along with cellular organization and mode of nutrition in classification.
- They classified the organisms into the same five kingdoms as proposed by Whittaker.

Q.5 Explain the three-domain classification system.

(K.B)

Ans:

THREE DOMAIN CLASSIFICATION SYSTEM**Introduction:**

In 1977, American microbiologist **Carl Woese** (1928-2012 AD) added a level of classification (the domains) above the kingdoms present in the previously used five-kingdom system.

Three Domains:

He classified organisms into three domains i.e.,

- Archaea
- Bacteria
- Eukarya

Basis of Three Domain System:

- It was actually a division of the prokaryotes in two domains (**Archaea** and **Bacteria**).
- While all eukaryotes were placed in a single domain i.e., **Eukarya**.
- This classification is based on the differences between Archaea and Bacteria

(a) 2-Kingdom System

Kingdom Plantae	Kingdom Animalia
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(b) 3-Kingdom System

Kingdom Protista	Kingdom Plantae	Kingdom Animalia
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(c) 5-Kingdom System

Kingdom Monera	Kingdom Protista	Kingdom Plantae	Kingdom Fungi	Kingdom Animalia
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(d) 3-Domain System

<i>Archaea</i>	<i>Bacteria</i>	<i>Eukarya</i>			
Kingdom Archaeobacteria	Kingdom Eubacteria	Kingdom Protista	Kingdom Plantae	Kingdom Fungi	Kingdom Animalia

Figure: Different classification systems

SHORT ANSWER QUESTIONS

Q.1 Write about two kingdoms classification system.

(K.B)

Ans:

TWO-KINGDOMS SYSTEM**Introduction:**

It was the earliest classification system in which all organisms were classified into two kingdoms i.e., **Plantae** and **Animalia**.

Kingdom Plantae:

- The organisms that can prepare their own food (**autotrophs**) were classified in the kingdom plantae.
- According to this system, **prokaryotes** (bacteria, archaea) and fungi were members of kingdom plantae.

Kingdom Animalia:

The organisms that cannot make their own food (**heterotrophs**) were classified in kingdom animalia.

Q.2 Why third kingdom was needed after two-kingdom classification system?

(U.B)

Ans:

NEED OF THIRD KINGDOM**Objections in Two-kingdoms Classification System:**

- Some taxonomists found this system unworkable because many unicellular organisms like **Euglena** have both **plant-like** (presence of chlorophyll) and **animal-like** (heterotrophic mode of nutrition in darkness and lack of cell wall) characteristics.
- So, a separate kingdom was proposed for such organisms.
- This system also did not clear the difference between prokaryotes (bacteria and archaea) and eukaryotes.

Q.3 Write the work of Carolus Linnaeus and Ernst Hackel. (K.B)

Ans: WORK OF

Carl Linnaeus:

The Swedish biologist Carl Linnaeus (1707-1778 AD) created a **taxonomic hierarchy** of organisms with six taxa i.e., Kingdom, Class, Order, Family, Genus, and Species.

Ernst Hackel:

In 1866, the German zoologist Ernst Hackel proposed a third kingdom i.e., **Protista** for Euglena-like organisms.

Kingdom Protista:

He also included **prokaryotes** (bacteria and archaea) in the kingdom Protista.

Q.4 What were the objections of biologists in three-kingdoms classification system? (U.B)

Ans: OBJECTIONS OF THREE-KINGDOMS SYSTEM

Objections:

- In three-kingdoms system, **fungi** were still included in the kingdom Plantae.
- Some taxonomists **disagreed** about the position of fungi in kingdom Plantae.
- Fungi resemble plants in many ways but are heterotrophs which get their food by absorption.
- They do not have **cellulose** in their cell walls but **possess chitin**.

Q.5 What do you know about the five-kingdom classification system? (K.B)

Ans: FIVE-KINGDOMS SYSTEM

Introduction:

In 1969, American ecologist **Robert Whittaker** introduced the five-kingdom classification system.

Basis of Five Kingdom System:

This system is based on:

- The levels of **cellular organization** i.e. prokaryotic (bacteria, archaea), unicellular eukaryotic (Protista) and multicellular eukaryotic (fungi, plants and animals)
- The **modes of nutrition** i.e. photosynthesis, absorption, and ingestion.

Five Kingdoms:

The five kingdoms are:

- Monera
- Protista
- Fungi
- Plantae
- Animalia

Q.6 What do you mean by domain? (K.B)

Ans: DOMAIN

In biology, a **domain** means the largest of all groups in the classification of life. Domain is group of kingdoms or taxonomic category above the kingdom.

Q.7 What do you know about the work of Carl Woese? (K.B)

Ans: WORK OF CARL WOESE

In 1977, American microbiologist **Carl Woese** (1928-2012 AD) added a level of classification (the **domains**) above the kingdoms present in the previously used five-kingdom system.

Three Domains:

He classified organisms into three domains i.e.,

- Archaea
- Bacteria
- Eukarya

Q.8 Write the basis of classification of the three-domain system. (K.B)

Ans: BASIS OF CLASSIFICATION

Basis of Three Domain System:

- It was actually a division of the prokaryotes in **two domains** (Archaea and Bacteria).
- While all eukaryotes were placed in a single domain i.e., **Eukarya**.
- This classification is based on the differences between **Archaea** and **Bacteria**.

MULTIPLE CHOICE QUESTIONS

- The first concept of classification was given by: (K.B)**
(A) Al Jahiz (B) Robert Whittaker
(C) Aristotle (D) Carl Linnaeus
- Andrea Caesalpinia divided plants into how many genera? (K.B)**
(A) 10 (B) 15
(C) 20 (D) 03
- The book “De Anima” was written by: (K.B)**
(A) Ibn Rushd (B) Robert Whittaker
(C) Aristotle (D) Carl Linnaeus
- The taxon of class was introduced by: (K.B)**
(A) Ibn Rushd (B) Aristotle
(C) Tournefort (D) Carl Linnaeus
- The organisms that lack nucleus in their cells are called: (K.B)**
(A) Prokaryotes (B) Eukaryotes
(C) Perkaryotes (D) All of these
- Who introduced the five-kingdom classification system? (K.B)**
(A) Robert Whittaker (B) Ernst Haeckel
(C) Robert Hook (D) Carolus Linnaeus
- Who proposed a third kingdom? (K.B)**
(A) Ernst Hackel (B) Robert Whittaker
(C) Aristotle (D) Socrates
- The organisms that can prepare their own food are: (U.B)**
(A) Heterotrophs (B) Autotrophs
(C) Humans (D) Decomposers
- The plant like characteristic of Euglena is: (K.B)**
(A) Having chlorophyll (B) Absence of nucleus
(C) Lack of cell wall (D) Presence of cell wall
- Ernst Hackel classified fungi in kingdom: (U.B)**
(A) Animalia (B) Plantae
(C) Protista (D) Fungi
- Who modified the classification system of Robert Whittaker? (K.B)**
(A) E-Chatton (B) Margulis and Schwartz
(C) Carl Linnaeus (D) Ernst Hackel
- Who proposed the three-domain classification system? (K.B)**
(A) Newton (B) Carl Watson
(C) Carl Woese (D) Carl Smith
- Domain is a group of: (K.B)**
(A) Kingdoms (B) Phylums
(C) Classes (D) Families
- Carl Woese was a: (K.B)**
(A) Microbiologist (B) Naturalist
(C) Taxonomist (D) Botanist

15. Carl Woese classified all eukaryotes in domain: (K.B)
 (A) Archaea (B) Protista
 (C) Eukarya (D) Bacteria

2.5 DOMAINS OF LIVING ORGANISMS

LONG ANSWER QUESTIONS

- Q.1 Compare and contrast the domains Archaea and Eubacteria, focusing on their key characteristics. (K.B)

Ans: DOMAIN ARCHAEA AND EUBACTERIA

Basis of Domains System:

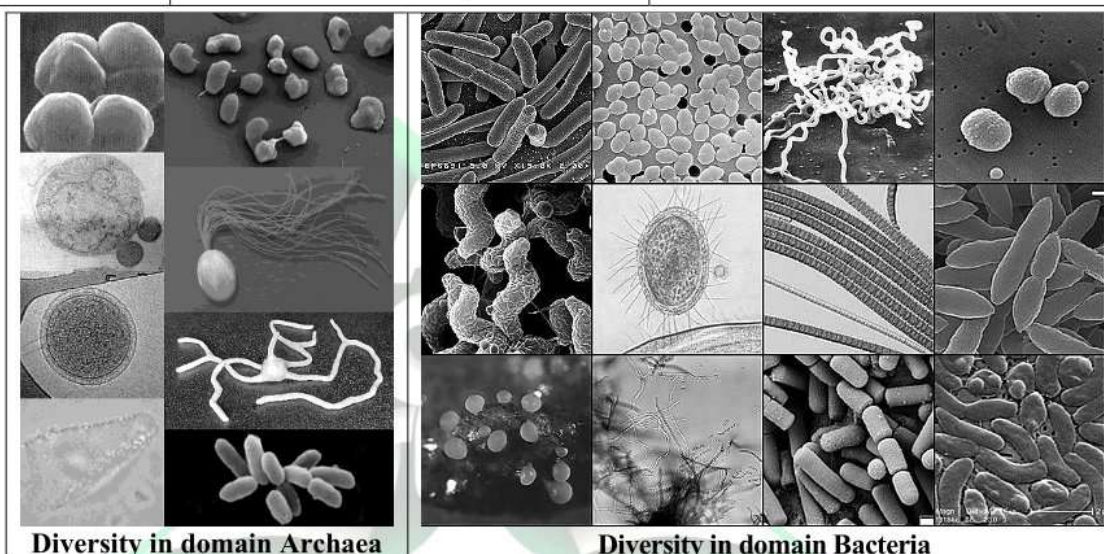
Classification into three domains is based on:

- Difference in the **sequence of nucleotides** in the **rRNA** (ribosomal Ribonucleic acid) of the cell.
- The **cell membrane lipid structure** and its **sensitivity to antibiotics**.

COMPARISON

Features	Domain Archaea	Domain Bacteria/Eubacteria
Nature	These are the most primitive organisms on Earth.	They are the true bacteria.
Type of Cell	They are prokaryotes.	They are prokaryotes.
Cellular Organization	They are unicellular.	They are unicellular. Many live solitary although some form chains, clusters, or colonies of cells.
Cell Wall	Their cell wall does not contain peptidoglycan .	They have cell wall made of peptidoglycan.
Habitat	• Their cell membrane contains unique lipids which enable them to live in extreme environments e.g., hot springs, salt lakes, deep-sea hydrothermal vents, and acidic or alkaline waters. • However, they also exist in more common environments like soil and oceans.	Bacteria are found everywhere including soil, water, air, and living organisms.
rRNA	Their rRNA (ribosomal RNA) is more closely related to eukaryotes than to bacteria.	They contain rRNA that is unique to bacteria.
Source of Energy	• Some archaea obtain energy from inorganic compounds such as sulphur or ammonia. • Other groups perform photosynthesis but do not produce oxygen.	• Most are heterotrophic. • Some perform photosynthesis because they have chlorophyll.
Kingdom	The domain Archaea contains kingdom Archaeobacteria (ancient bacteria).	The domain bacteria contain kingdom Eubacteria.

Roles in Environment	Archaea do not typically cause diseases and primarily play essential roles in nutrient recycling.	Some bacteria cause diseases and many plays essential roles in nutrient recycling.
Examples	Major archaeobacteria include: • Methanogens (produce methane as byproduct) • Halophiles (found in extremely salty environments) • Thermophiles (found in hot springs) • Acidophiles (found in extremely acidic environments)	Major groups in this kingdom are: • Bacteria • Cyanobacteria.



Q.2 Describe the diagnostic characteristics of the four kingdoms within domain Eukarya. (K.B)
 Ans: DOMAIN EUKARYA

Domain Eukarya contains four kingdoms, which are as follows:

1. Kingdom Protista

- Kingdom Protista includes eukaryote which are **unicellular** or **colonial** or **filamentous** or simple multicellular.
- Simple multicellular means that they do not have **multicellular sex organs**.

Pathogenicity:

Certain protists are parasitic and cause diseases e.g.,

- *Plasmodium* causes malaria
- *Entamoeba histolytica* causes amoebic dysentery
- *Trypanosoma* causes sleeping sickness

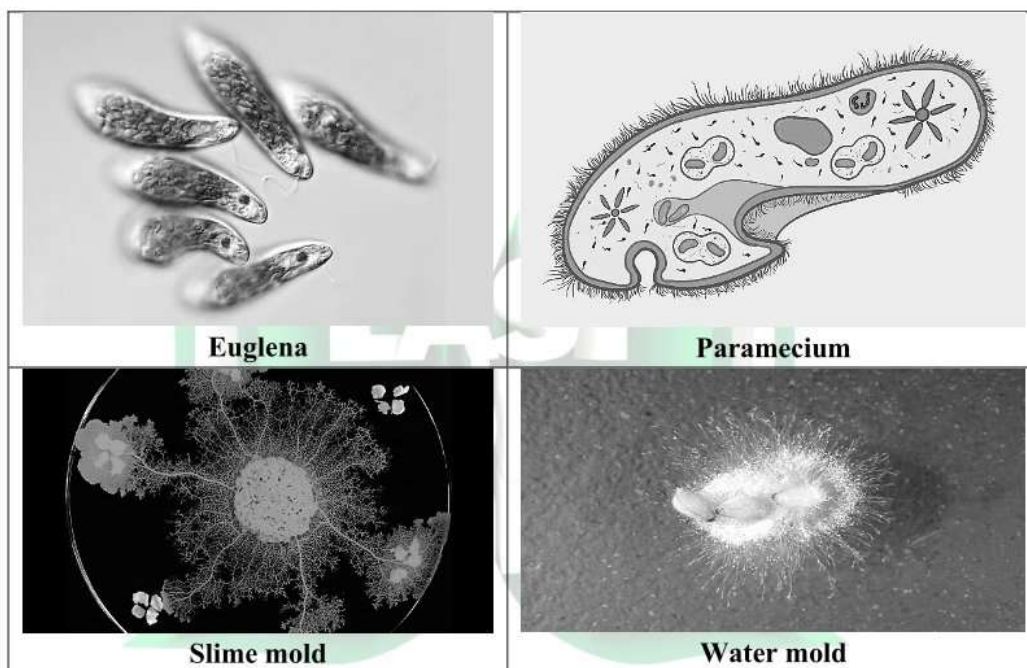
Types of Protists:

There are three types of protists.

a) Plant-like Protists

- Plant-like protists have cell walls made of **cellulose**.

- They have chlorophyll in chloroplasts and are autotrophs.
 - They are called **algae** (e.g., *Euglena*, diatoms).
- b) **Animal-like Protists**
- Animal-like protists are **heterotrophs** and ingest food.
 - They have no cell wall.
 - They are called **protozoans** (e.g., *Amoeba*, *Paramecium*).
- c) **Fungus-like Protists**
- Fungus-like protists produce **hyphae-like** structure.
 - They are **saprophytic**.
 - Examples include **slime molds** and **water molds**.



2. Kingdom Fungi

- This kingdom consists of fungi which are **eukaryotic heterotrophic** organisms.
- They are **unicellular** or **multicellular**.
- Their cells are covered by cell wall made of **chitin** (a polysaccharide).
- Fungi get **nutrients** in a unique way.
- They do not ingest food like animals and some protists. They **absorb food** from surroundings.

Importance:

- Some fungi are used in the production of **bread, cheese** and **beer**.
- Others have medicinal properties, such as **penicillin**, an antibiotic derived from the fungus *Penicillium*.

Examples:

Examples are **mushrooms, rusts, smuts** and **molds**.



Smut fungi on leaf



Toadstool



Bracket fungi



Sweet Tooth Fungi

3. Kingdom Plantae

- It includes plants which are **eukaryotic, multicellular** organisms.
- Their cell wall is made up of **cellulose**.
- They are autotrophic and prepare food through photosynthesis.
- All plants develop from **embryos**.

Examples:

Mosses, ferns, conifers and flowering plants.



Moss



Fern



Conifer



Flowering plant

4. Kingdom Animalia

- This kingdom of eukaryotes includes animals which are **eukaryotic, multicellular** and **heterotrophic**.
- They develop from embryos.
- They ingest food and digest it within their bodies.

Examples:

Frog, Lion, Human, etc.

Q.3 Summarize the distinguishing characteristics of the six kingdoms of life.

(A.B)

Ans:

SIX KINGDOMS OF LIFE

The major characteristics of six kingdoms of life are summarized in the table below:

Domain	Bacteria	Archaea	Eukarya			
Kingdom	Eubacteria	Archaeobacteria	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Nuclear Envelope	Absent	Absent	Present	Present	Present	Present
Cell Wall	Peptidoglycan	Various chemicals	Present in some (various types)	Chitin	Cellulose and other polysaccharides	Absent
Mode of Nutrition	Autotroph or heterotroph	Autotroph or heterotroph	Autotroph or heterotroph or combination	Absorptive heterotroph	Autotroph	Ingestive heterotroph
Multi-cellularity	Absent in all	Absent in all	Absent in most	Present in most	Present in all	Present in all

SHORT ANSWER QUESTIONS

Q.1 What are the basis of three domain system of classification?

(K.B)

Ans:

DOMAIN SYSTEM

Basis of Domains System:

Classification into three domains is based on:

- Difference in the **sequence of nucleotides** in the rRNA (ribosomal Ribonucleic acid) of the cell.
- The **cell membrane lipid structure** and its **sensitivity to antibiotics**.

Q.2 Write down few differences of domain Archaea and Bacteria.

(K.B)

Ans:

DIFFERENCES

Features	Domain Archaea	Domain Bacteria
Type of Cell	They are prokaryotes.	They are prokaryotes.
Cellular Organization	They are unicellular.	They are unicellular. Many live solitary although some form chains, clusters, or colonies of cells.
Cell Wall	Their cell wall does not contain peptidoglycan.	They have cell wall made of peptidoglycan.
rRNA	Their rRNA (ribosomal RNA) is more closely related to eukaryotes than to bacteria.	They contain rRNA that is unique to bacteria.
Source of Energy	• Some archaea obtain energy from inorganic compounds such as sulphur or ammonia. • Other groups perform photosynthesis but do not produce oxygen.	• Most are heterotrophic. • Some perform photosynthesis because they have chlorophyll.

Q.3 What do you know about kingdom fungi? (K.B)

Ans: KINGDOM FUNGI

Characteristics:

- This kingdom consists of fungi which are **eukaryotic heterotrophic** organisms.
- They are unicellular or multicellular.
- Their cells are covered by cell wall made of **chitin** (a polysaccharide).
- Fungi get nutrients in a unique way.
- They do not ingest food like animals and some protists. They absorb food from surroundings.

Importance:

- Some fungi are used in the production of bread, cheese and beer.
- Others have medicinal properties, such as **penicillin**, an antibiotic derived from the fungus *Penicillium*.

Examples:

Examples are **mushrooms, rusts, smuts and molds**.

Q.4 Explain different types of protists. (K.B)

Ans: KINGDOM PROTISTA

Types of Protists:

There are three types of protists.

a) **Plant-like Protists**

- Plant-like protists have cell walls made of **cellulose**.
- They have **chlorophyll** in chloroplasts and are autotrophs.
- They are called **algae** (e.g., *Euglena*, diatoms).

b) **Animal-like Protists**

- Animal-like protists are **heterotrophs** and **ingest** food.
- They have no cell wall.
- They are called **protozoans** (e.g., *Amoeba*, *Paramecium*).

c) **Fungus-like Protists**

- Fungus-like protists produce **hyphae-like** structure.
- They are **saprophytic**.
- Examples include **slime molds** and **water molds**.

Q.5 Differentiate between kingdom plantae and animalia. (K.B)

Ans: DIFFERENTIATION

Kingdom Plantae	Kingdom Animalia
Type of Cell	
The members of kingdom plantae are eukaryotic multicellular.	The members of kingdom animalia are eukaryotic multicellular.
Cell Wall Composition	
Cell wall is made up of cellulose.	Animals lack cell wall and chlorophyll.
Mode of Nutrition	
They are autotrophic and prepare food through photosynthesis.	They ingest food and digest it within their bodies (ingestive heterotrophs).
Reproduction	
All plants develop from embryos.	They develop from embryos.
Examples	
• Moss • Mustard	• Insects • Starfish

- Rose
- Conifers

- Frogs
- Man

Q.6 Define methanogens.

(K.B)

Ans:

METHANOGENS

Definition:

The microorganisms that produce **methane** as their metabolic byproduct are called methanogens. They belong to domain archaea.

Example:

- *Methanopyrus kandleri*
- *Methanococcus*

Q.7 Define halophiles.

(K.B)

Ans:

HALOPHILES

Definition:

The microorganisms that live in **high salt concentrations** are called halophiles. They belong to domain archaea.

Example:

- *Halobacterium*
- *Halococcus*

MULTIPLE CHOICE QUESTIONS

- The most primitive organisms on Earth are:** (K.B)
(A) Archaea (B) Eukarya
(C) Bacteria (D) Viruses
- The cell wall of bacteria contains:** (K.B)
(A) Chitin (B) Lignin
(C) Peptidoglycan (D) Cellulose
- Eukarya have _____ cells.** (K.B)
(A) Eukaryotic (B) Non-classified
(C) Prokaryotic (D) Colonial-type
- Halophiles belong to domain:** (K.B)
(A) Bacteria (B) Eukarya
(C) Protista (D) Archaea
- Euglena belongs to kingdom:** (K.B)
(A) Protista (B) Plantae
(C) Fungi (D) Animalia
- Fungi-like protists are:** (K.B)
(A) Amoeba (B) Euglena
(C) Slime molds (D) Mushroom
- Microorganisms that live in salt water are:** (K.B)
(A) Thermoacidophiles (B) Halophytes
(C) Thermophiles (D) Methanogens
- Microorganisms that produce methane as their metabolic byproduct are:** (K.B)
(A) Thermoacidophiles (B) Halophytes
(C) Thermophiles (D) Methanogens
- Fungal mode of nutrition is:** (K.B)
(A) Autotrophic (B) Ingestive
(C) Saprotrophic (D) Both B and C
- The microorganisms that live in high temperature are:** (K.B)
(A) Thermoacidophiles (B) Halophytes
(C) Thermophiles (D) Methanogens

11. These are found in acidic environments: (K.B)
 (A) Thermophiles (B) Halophiles
 (C) Acidophiles (D) Both A and C
12. The unicellular organisms that can exist in chains, clusters or colonies of cells: (U.B)
 (A) Algae (B) Bacteria
 (C) Archaea (D) Fungi
13. The parasitic protists are: (K.B)
 (A) Rusts and smuts (B) *Trypanosoma*
 (C) *Penicillium* (D) All of these
14. Fungi are also known as: (K.B)
 (A) Decomposers (B) Absorptive heterotrophs
 (C) Saprotrophs (D) All of these
15. Plantae are eukaryotic: (K.B)
 (A) Unicellular (B) Multicellular
 (C) Colonial (D) Decomposers
16. It is a methanogen. (K.B)
 (A) *Acidianus* (B) *Methanococcus*
 (C) *Sulfolobus* (D) *Halococcus*
17. Example of autotrophic cellulose containing organism is: (A.B)
 (A) Fungi (B) Cyanobacteria
 (C) Moss (D) Amoeba
18. It is an example of algae: (K.B)
 (A) *Penicillium* (B) *Euglena*
 (C) Water mold (D) *Amoeba*
19. Fungus cell wall is made up of: (K.B)
 (A) Cellulose (B) Pectin
 (C) Chitin (D) Peptidoglycan
20. A eukaryotic organism with polysaccharide-based cell wall belongs to kingdom: (U.B)
 (A) Animalia (B) Plantae
 (C) Fungi (D) Eubacteria

2.6 STATUS OF VIRUS IN CLASSIFICATION

LONG ANSWER QUESTIONS

- Q.1 Discuss the challenges of classifying viruses within the traditional three domains of life. (K.B)
 Ans: VIRUSES

Definition:

Viruses are **ultramicroscopic creatures** that are at the **borderline** of living and non-living.

Non-Living Characteristics:

- They are **acellular** i.e., they are not made of cells and do not have organelles.
- They cannot run any **metabolism** and depend upon the host cell (including plants, animals, and bacteria) to replicate and synthesize their proteins.

Living Characteristics:

- A virus consists of **nucleic acid** (DNA or RNA) surrounded by a **protein coat**.
- It **reproduces** inside the host cell.

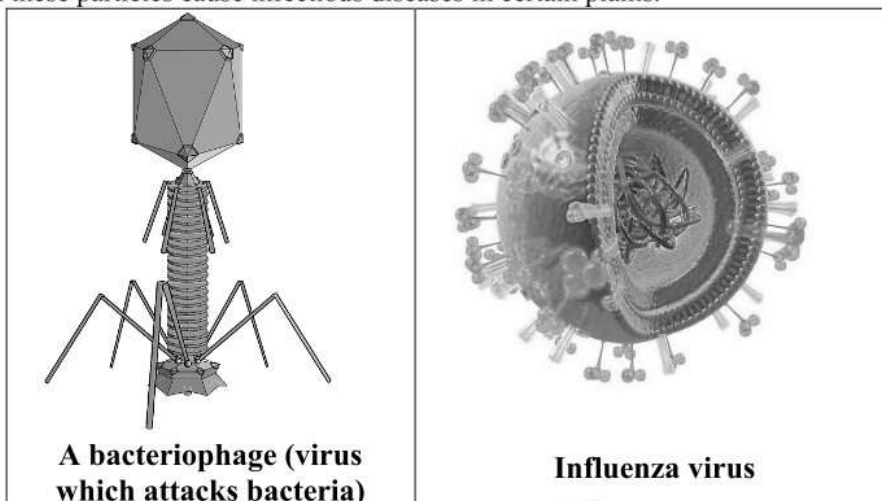
Classification:

Because they **lack** any of the characteristics of the three domains of life, viruses are not included in those categories.

Prions and Viroids:

- **Prions** and **viroids** are also acellular particles and are also not included in classification system.

- Prions are composed of protein only and Viroids are composed of circular RNA only.
- Both these particles cause infectious diseases in certain plants.



Q.2 Write a note on coronavirus.

(K.B)

Ans:

CORONAVIRUS

Introduction:

Coronavirus is a **virus**, identified in late 2019 in **Wuhan**, China, it caused a pandemic of respiratory illness, called **COVID-19**.

Mode of Spread:

- The virus primarily spreads through **respiratory droplets** when an infected person coughs, sneezes, talks, or breathes.
- It can also spread by **touching** surfaces contaminated with the virus.

Symptoms:

- Common symptoms of this disease include **fever**, **cough**, shortness of breath, fatigue, body aches, loss of taste or smell, sore throat, and headache.
- In some cases, it can lead to severe respiratory problems, especially in older adults and people with underlying health conditions.

Prevention:

- Wearing a **mask** over nose and mouth can help prevent the spread of disease.
- Washing hands frequently with soap for at least 20 seconds or use **hand sanitizer** with at least 60% alcohol can also prevent the spread of disease.

Vaccination:

- **Vaccination** plays a crucial role in protecting from COVID-19.
- Vaccines help immune system recognize and fight the virus, reducing the severity of the disease.

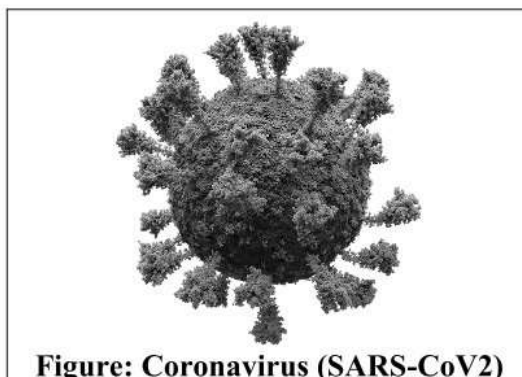


Figure: Coronavirus (SARS-CoV2)

SHORT ANSWER QUESTIONS

Q.1 What do you know about viruses?

(K.B)

Ans:

VIRUSES**Definition:**

Viruses are **ultramicroscopic creatures** that are at the borderline of living and non-living.

OR

Viruses are acellular infectious entities that can be visible only under an electron microscope.

Classification:

Viruses are at the **borderline** of living and non-living. So, they are not included in any domain and kingdom under modern classification.

Examples:

- Dengue virus
- Influenza virus
- SARS-COV2

Q.2 Write the non-living characteristics of viruses.

(U.B)

Ans:

NON-LIVING CHARACTERISTICS OF VIRUSES

The non-living characteristics of viruses are:

1. They are **acellular** i.e. they are not made of cells and do not have organelles.
2. They cannot run any metabolism.
3. They depend upon the **host cell** (including plants, animals, and bacteria) to replicate and synthesize their proteins.

Q.3 Differentiate between prions and viroids.

(K.B)

Ans:

DIFFERENTIATION

The basic difference between prions and viroids are:

PRIONS	VIROIDS
COMPOSITION	
Prions are composed of proteins only.	Viroids are composed of circular RNA only.
REPRODUCTION	
They replicate by inducing misfolding of normal proteins.	They replicate using host cell machinery but do not encode any proteins.
DISEASE	
They cause diseases in sheep and man.	They cause disease in plants, like potato, apple, etc.
TREATMENT	
There is no cure of diseases caused by prions. Because they are extremely resistant to sterilization.	The diseases caused by viroids can be treated using traditional anti-viroid methods.

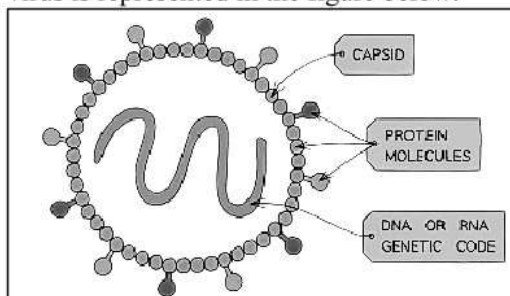
Q.4 Draw a general structure of virus.

(U.B)

Ans:

STRUCTURE OF VIRUS

A general structure of virus is represented in the figure below.



Q.5 What is coronavirus disease (COVID-19)? Write down its symptoms. (K.B)

Ans: COVID-19

Introduction:

Coronavirus is a **virus**, identified in late 2019 in **Wuhan**, China, it caused a pandemic of respiratory illness, called **COVID-19**.

Symptoms:

- Common symptoms of this disease include fever, cough, shortness of breath, fatigue, body aches, loss of taste or smell, sore throat, and headache.
- In some cases, it can lead to severe respiratory problems, especially in older adults and people with underlying health conditions.

Q.6 How coronavirus spreads? (K.B)

Ans: CORONAVIRUS

Mode of Spread:

- The virus primarily spreads through respiratory droplets when an infected person coughs, sneezes, talks, or breathes.
- It can also spread by touching surfaces contaminated with the virus.

MULTIPLE CHOICE QUESTIONS

- Viruses belong to kingdom: (K.B)**
(A) Monera (B) Protista
(C) Fungi (D) None
- Which organisms are composed of only proteins? (K.B)**
(A) Prions (B) Viroids
(C) Fungi (D) Algae
- Which of these are acellular particles? (K.B)**
(A) Virus (B) Human
(C) Fungi (D) Bacteria
- The organisms that are composed of circular RNA only? (K.B)**
(A) Virus (B) Viroids
(C) Protists (D) Prions
- Viruses are considered as living because they can? (U.B)**
(A) Exist on Earth (B) Reproduce
(C) Infect organisms (D) Crystallized
- Coronavirus causes the disease: (K.B)**
(A) COVID-19 (B) SARS-Cov2
(C) AIDS (D) Both A and B
- SARS-Cov2 (Coronavirus) was first identified in: (K.B)**
(A) India (B) China
(C) Pakistan (D) America

2.7 BINOMIAL NOMENCLATURE

LONG ANSWER QUESTIONS

Q.1 Explain binomial nomenclature in details. OR Explain the rules and guidelines for suggesting scientific names to organisms. (K.B)

Ans: BINOMIAL NOMENCLATURE

Introduction:

The great Swedish naturalist **Carolus Linnaeus** was the founder of the scientific naming system of organisms.

Definition:

The system of scientific naming of organisms is termed as binomial nomenclature. According to this system:

- The scientific name of an organism consists of two parts.
- The first part is the name of the **genus** to which the organism belongs.
- The second part is the name of the **species**.

Issues in Traditional Naming Methods:

1. Different Names

- Various regions have different names for the same organism.
- The common name of onion in Urdu is '**Piyaz**' but in different regions of Pakistan it is also known as '**ganda**' or '**bassal**' or '**vassal**'.
- In other countries it has other sets of names.

2. Same Names

- In some cases, several different organisms are called by the same **common name**.
- The name '**blue bell**' is used for dozens of plants with bell shaped flowers.
- Similarly, '**black bird**' is used for crow as well as for raven.

3. Common Names

- Common names have no scientific basis.
- A **fish** is a vertebrate animal with a backbone, fins and gills.
- But several common names of '**silver fish**', '**cray fish**', '**jelly fish**', and '**star fish**' do not fit to the true definition of fish.

Significance of Binomial Nomenclature:

- In binomial nomenclature, two organisms cannot have the same name.
- The words of scientific name are taken from **Latin language** (spoken by no country) so that no country is favoured.
- The scientific name of an organism is the same anywhere in the world.
- This system provides a standard way of communication, whether the language of a particular biologist is Chinese, Arabic, Spanish, or English.

Rules of Binomial Nomenclature:

The scientific naming of an organism is done in accordance with some international rules. Some important rules of binomial nomenclature are:

1. For scientific naming, words are taken from Latin language.
2. Every scientific name has two parts. The **genus** name always comes first followed by the **species** name.
3. Every scientific name should have to be **unique** because the same name cannot be used for naming two different organisms.
4. The first part of the name i.e. **genus name** should begin with a **capital letter**. The second part of the name i.e. **species name** should begin with **small letter**.
5. At the time of printing of a scientific name, it should be typed in **Italics**.
6. When a scientific name would be **hand written**, two parts of it should be separately **underlined**.

Examples:

Common Name	Scientific Name
Onion	<i>Allium cepa</i>
Potato	<i>Solanum tuberosum</i>
Tomato	<i>Solanum esculentum</i>
Honeybee	<i>Apis cerana</i>
Tiger	<i>Panthera tigris</i>
Human being	<i>Homo sapiens</i>

SHORT ANSWER QUESTIONS

Q.1 What is binomial nomenclature? (U.B)

Ans: **BINOMIAL NOMENCLATURE**

Introduction:

The great Swedish naturalist **Carolus Linnaeus** was the founder of the scientific naming system of organisms.

Definition:

The system of scientific naming of organisms is termed as **binomial nomenclature**. According to this system:

- The scientific name of an organism consists of two parts.
- The first part is the name of the **genus** to which the organism belongs.
- The second part is the name of the **species**.

Q.2 What are the rules of writing biological names according to binomial nomenclature? (K.B)

Ans: **RULES OF BINOMIAL NOMENCLATURE**

Rules:

The scientific naming of an organism is done in accordance with some international rules. Some important rules of binomial nomenclature are:

- For scientific naming, words are taken from **Latin language**.
- Every scientific name has two parts. The genus name always comes first followed by the species name.
- Every scientific name should have to be unique because the same name cannot be used for naming two different organisms.
- The first part of the name i.e. **genus name** should begin with a capital letter. The second part of the name i.e. **species name** should begin with small letter.
- At the time of printing of a scientific name, it should be typed in **Italics**.
- When a scientific name would be hand written, two parts of it should be separately underlined.

Q.3 Why was binomial nomenclature needed? (K.B)

Ans: **NEED OF BINOMIAL NOMENCLATURE**

Issues in Traditional Naming Methods:

1. Different Names

- Various regions have different names for the same organism.
- The common name of onion in Urdu is '**Piyaz**' but in different regions of Pakistan it is also known as '**ganda**' or '**bassal**' or '**vassal**'.
- In other countries it has other sets of names.

2. Same Names

- In some cases, several different organisms are called by the same common name.
- The name '**blue bell**' is used for dozens of plants with bell shaped flowers.
- Similarly, '**black bird**' is used for crow as well as for raven.

So, there was a need for a universal language such as Latin. Because a scientific name has the advantage of standing for a single kind of animal, plant or microorganism all over the world.

Q.4 How Binomial nomenclature resolves the issue of traditional naming systems? (U.B)

Ans: **Significance of Binomial Nomenclature:**

- In binomial nomenclature, two organisms cannot have the same name.
- The words of scientific name are taken from **Latin language** (spoken by no country) so that no country is favoured.
- The scientific name of an organism is the same anywhere in the world.
- This system provides a standard way of communication, whether the **language** of a particular biologist is Chinese, Arabic, Spanish, or English.

MULTIPLE CHOICE QUESTIONS

- Who introduced the scientific naming system? (K.B)
(A) Isaac Newton (B) Albert Einstein
(C) Carolus Linnaeus (D) Robert Brown
- Scientific name of humans is: (A.B)
(A) H. sapiens (B) *Homo Sapiens*
(C) *Homo sapiens* (D) *Homo sapien*
- Oryza sativa* is the scientific name of: (K.B)
(A) Brinjal (B) Rice
(C) Potato (D) Onion
- Zea mays* is the scientific name of: (K.B)
(A) Potato (B) Onion
(C) Corn (D) Rice
- All cats belong to the genus: (K.B)
(A) *Homo* (B) *Felis*
(C) *Leo* (D) *Oryza*
- In binomial system, the second word represents: (K.B)
(A) Kingdom (B) Genus
(C) Species (D) Organism
- The species name starts with: (K.B)
(A) Capital letter (B) Small letter
(C) Letter B (D) Italics letter
- Example of universal language is: (K.B)
(A) French (B) Punjabi
(C) Pashto (D) Latin

TEXTBOOK EXERCISE

MULTIPLE CHOICE QUESTIONS

- Which of the following taxonomic ranks represents the broadest rank of classification?
(A) Species (B) Genus
(C) Kingdom (D) Domain
- Which characteristics is unique to organisms in the domain Archaea?
(A) Cell walls made of peptidoglycan (B) Presence of a nucleus
(C) Ability to live in extreme environments (D) Lack of ribosomes
- Which of these statements is NOT related to bacteria?
(A) Do not have a nucleus (B) Cell wall made of peptidoglycan
(C) Most are heterotrophic (D) Have chlorophyll in their chloroplast
- Which of these organisms belong to the domain Eukarya?
(A) *Escherichia coli* (B) Yeast
(C) Coronavirus (D) None of these
- Which of the following is a key characteristic that distinguishes eukaryotic cells from prokaryotic cells?
(A) Lack of a cell wall (B) Presence of a nucleus
(C) Absence of ribosomes (D) Smaller size
- Which kingdom includes organisms that are primarily unicellular, eukaryotic, and often heterotrophic?
(A) Archaea (B) Protista
(C) Fungi (D) Plantae
- Why are fungi classified as heterotrophs?
(A) Have chitin in cell wall (B) Absorb nutrients
(C) Reproduce by spores (D) Form symbiotic relationships with plants

8. **Why are viruses challenging to classify within traditional biological kingdoms?**
(A) They lack cellular structure and organelles
(B) They can perform photosynthesis
(C) They are larger than most bacteria
(D) They have a complex nervous system
9. **Which of the following is the correct way for writing the scientific name of humans?**
(A) *Homo sapiens* (B) Homo sapiens
(C) Homo Sapiens (D) homo sapiens
10. **Which information you can get if you know the scientific name of an organism?**
(A) Kingdom and phylum (B) Phylum and genus
(C) Genus and species (D) Class and species

SHORT ANSWER QUESTIONS

Q.1 **What is the term used to describe the variety of life on Earth?** (K.B)

Ans: **BIODIVERSITY**

The term used to describe the variety of life on Earth is “**Biodiversity**”.

Definition:

Biodiversity means the **variety of organisms** in a particular area.

Measuring the Biodiversity:

Biologists have different ways of measuring biodiversity, but many focus on the number of different kinds of organisms and the variation within each kind.

Q.2 **How is the biodiversity crucial for humans and for the planet Earth?** (K.B)

Ans: **IMPORTANCE OF BIODIVERSITY**

Biodiversity provides many essential services for humans and the planet. Here are some key benefits of biodiversity:

1. Ecosystem Stability

Biodiversity helps maintain the balance of ecosystems by contributing to the **biogeochemical cycle** such as water cycle, carbon cycle, and nitrogen cycle.

2. Climate Regulation

Plants and algae **absorb carbon dioxide**, helping to regulate the climate.

3. Natural Resources

Biodiversity provides a **vast array of resources**, from food and medicine to building materials and fuel.

4. Economic Benefits

Biodiversity supports numerous **industries**, including agriculture, tourism, and pharmaceuticals.

Q.3 **What are the seven taxonomic ranks used in the Linnaean system?** (K.B)

Ans: **TAXONOMIC RANKS**

The Swedish botanist Carl Linnaeus devised the **Linnaean system of taxonomic ranks** in 1735. In this system, Linnaeus suggested seven taxonomic ranks i.e.,

1. Kingdom
2. Phylum (division)
3. Class
4. Order
5. Family
6. Genus
7. Species

Q.4 Can you provide the taxonomic classification for lions and corn? (K.B)

Ans: TAXONOMIC CLASSIFICATION

Yes, the taxonomic classification of lion (*Panthera leo*) and Corn (*Zea mays*) are as follows:

Taxonomic Ranks	Lion	Corn
Kingdom	Animalia	Plantae
Phylum/Division	Chordata	Tracheophyta
Class	Mammalia	Liliopsida
Order	Carnivora	Poales
Family	Felidae	Poaceae
Genus	<i>Panthera</i>	<i>Zea</i>
Species	<i>Panthera leo</i>	<i>Zea mays</i>

Q.5 What are the basic differences between archaea and bacteria? (K.B)

Ans: DIFFERENCES

Some major differences between archaea and bacteria are given below:

Features	Domain Archaea	Domain Bacteria
Cellular Organization	They are unicellular.	They are unicellular. Many live solitary although some form chains, clusters, or colonies of cells.
Cell Wall	Their cell wall does not contain peptidoglycan.	They have cell wall made of peptidoglycan.
Habitat	Mostly found in extreme environments e.g., hot springs, salt lakes, deep-sea hydrothermal vents, and acidic or alkaline waters.	Bacteria are found everywhere including soil, water, air, and living organisms.
rRNA	Their rRNA is more closely related to eukaryotes than to bacteria.	They contain rRNA that is unique to bacteria.
Roles in Environment	Archaea do not typically cause diseases and primarily play essential roles in nutrient recycling.	Some bacteria cause diseases and many plays essential roles in nutrient recycling.

Q.6 What were the shortcomings of the three-kingdom classification system? (K.B)

Ans: THREE-KINGDOM SYSTEM

Objections:

- In three-kingdom system, **fungi** were still included in the kingdom Plantae.
- Some taxonomists **disagreed** about the position of fungi in kingdom Plantae.
- Fungi resemble plants in many ways but are heterotrophs which get their food by absorption.
- They do not have cellulose in their cell walls but possess **chitin**.

Q.7 Which kingdom includes organisms that are multicellular, heterotrophic, and lack cell walls? (U.B)

Ans: THREE-KINGDOM SYSTEM

The kingdom that includes organisms that are **multicellular, heterotrophic, and lack cell walls** is Kingdom Animalia.

Examples:

Mammals, birds, reptiles, amphibians, fish, etc.

Q.8 Enlist the distinguishing characteristics of fungi. (K.B)

Ans: CHARACTERISTICS OF FUNGI

Some important distinguishing characteristics of fungi are:

- This kingdom consists of fungi which are **eukaryotic heterotrophic** organisms.

- They are unicellular or multicellular.
- Their cells are covered by cell wall made of **chitin** (a polysaccharide).
- Fungi get nutrients in a unique way.
- They do not ingest food like animals and some protists. They absorb food from surroundings.

Q.9 List the three main domains that encompass all living organisms. (U.B)

Ans: **THREE DOMAINS OF LIFE**

According to American microbiologist **Carl Woese**, the three main domains that encompass all living things are:

- Archaea
- Bacteria
- Eukarya

Explanation:

The Domain Archaea contains **Archaeobacteria**, domain **Bacteria** is unique for prokaryotes, and domain **Eukarya** contains Protists, Fungi, Plants and Animals.

Q.10 Why cannot we classify viruses in any kingdom? (U.B)

Ans: **CLASSIFICATION OF VIRUSES**

Viruses are **acellular** i.e. they are not made of cells and do not have organelles. They cannot run any metabolism and depend upon the host cell (including plants, animals, and bacteria) to replicate and synthesize their proteins.

Classification:

Because they lack any of the characteristics of the three domains of life, viruses are not included in those categories.

Q.11 How does binomial nomenclature facilitate clear communication about organisms across different languages? (U.B)

Ans: **SIGNIFICANCE OF BINOMIAL NOMENCLATURE**

Binomial nomenclature facilitates clear communication about organisms across different languages because this system uses **Latin language** for giving scientific names.

- Latin language is not spoken by any country.
- So, this system provides a **standard way of communication**, whether the language of a particular biologist is Chinese, Arabic, Spanish, or English.
- Scientific name of an organism stands same all over the world.

EXTENSIVE ANSWER QUESTIONS

Q.1 Discuss the concept of biodiversity and its significance in maintaining the health of ecosystems.

See Q.no.1 of topic 2.1

Q.2 Explain the importance of classification in biology and how it helps us understand the relationships between different organisms.

See Q.no.1 of topic 2.2

Q.3 Describe the Linnaean system of taxonomic hierarchy in detail, outlining the seven major taxonomic ranks and their relationships.

See Q.no.1 of topic 2.3

Q.4 Compare and contrast the domains Archaea and Eubacteria, focusing on their key characteristics.

See Q.no.1 of topic 2.5

Q.5 Describe the diagnostic characteristics of the four kingdoms within the domain Eukarya.

See Q.no.2 of topic 2.5

Q.6 Discuss the challenges of classifying viruses within the traditional three domains of life.

See Q.no.1 of topic 2.6

- Q.7 Explain the rules and guidelines for suggesting scientific names to organisms.
Consult Q.no.1 of topic 2.7

INQUISITIVE ANSWER QUESTIONS

- Q.1 How might placing an organism in the incorrect taxonomic group affect conservation or scientific studies?

Ans: CLASSIFYING AN ORGANISM INCORRECTLY

Putting an organism in the **wrong** taxonomic group can cause several problems:

Conservation Issues:

If a species is put in the wrong group, it might not get the **protection** it needs. This can lead to the species becoming more **endangered** or even going **extinct**.

Wasted Resources:

Efforts and **money** might be spent on the wrong species, while the species that actually needs help might be ignored.

Ecosystem Confusion:

Every species has a role in its environment. If a species is **misclassified**, scientists might misunderstand how it fits into the ecosystem, which can lead to mistakes in **managing** the environment.

Wrong Research Results:

Scientific studies based on the wrong classification can give **incorrect results**, which can confuse our understanding of things like evolution and how different species are related.

Bad Policies:

Laws and **plans** to protect the environment might not work well if they are based on incorrect information about species.

- Q.2 Imagine you discover a new organism. What steps would you take to classify and name it according to the principles of binomial nomenclature?

Ans: DISCOVERING AN ORGANISM

If I discovered a new organism, I would follow these steps to classify and name it using binomial nomenclature:

1. **Study the Organism**

Observe Physical Features:

Look at the organism's structure, shape, size, and other physical **characteristics**.

Analyze Behavior:

Study how it **behaves**, such as how it moves, eats, and interacts with its environment.

Examine Genetics:

If possible, **analyze its DNA** to see how it relates to other known organisms.

2. **Determine Classification**

Compare with Known Species:

Compare the new organism to **existing species** to determine which group (kingdom, phylum, class, etc.) it fits into.

Identify Family and Genus:

Place the organism into an appropriate **genus** based on its similarities to other species.

3. **Choose a Species Name**

Follow Binomial Nomenclature Rules:

- **The name should have two parts:** the genus name (capitalized) and the species name (lowercase).
- Both parts are usually in from Latin language.
- It must be printed in italics or underlined when handwritten.
- Choose a descriptive or unique name that hasn't been used for another species.

4. **Publish the Discovery**

Describe the organism in detail, including its features, habitat, and how it differs from similar species. Then publish the data.

EXTRA CONCEPTUAL MCQs

11. Into which kingdom you place a multicellular land organism that performs photosynthesis:
 (A) Monera (B) Protista
 (C) Plantae (D) Animalia
12. Which kingdom is mismatched with the characteristics?
 (A) Fungi – usually saprotrophic (B) Animalia – rarely ingestive
 (C) Protista – various modes of nutrition (D) Plantae – photosynthetic
13. The kingdom to which the algae belong is:
 (A) Animalia (B) Protista
 (C) Plantae (D) Fungi
14. Scientific name has advantages of:
 (A) Same name applied to different organisms
 (B) Same organisms have different name in different areas
 (C) Has no scientific basis
 (D) Has scientific basis and is universally accepted
15. The organisms that feed on dead, decaying matter are called:
 (A) Saprotrophs (B) Autotrophs
 (C) Heterotrophs (D) Parasites
16. The common characteristic of viruses, prions and viroids is:
 (A) Respiration (B) Movement
 (C) Infectious nature (D) Excretion
17. Viruses are not included in any domain or classification as:
 (A) They are poorly understood (B) They are too large
 (C) They are of various colours (D) They are not considered as organism
18. Which option is correct regarding the mode of nutrition of following organisms?
- | | Animal | Prokaryote | Fungi | Plant |
|-----|---------------|---------------|-------------|----------------|
| (A) | Heterotrophic | Heterotrophic | Ingestive | Autotrophic |
| (B) | Ingestive | Absorptive | Autotrophic | Heterotrophic |
| (C) | Ingestive | Heterotrophic | Absorptive | Photosynthetic |
| (D) | Absorptive | Autotrophic | Ingestive | Autotrophic |
19. Colonial organization is the unique feature of kingdom:
 (A) Animalia (B) Protista
 (C) Fungi (D) Plantae
20. A related groups of genera consists of:
 (A) A phylum (B) A class
 (C) An order (D) A family
21. In which of the following the first letter is capitalized in binomial nomenclature?
 (A) Genus (B) Class
 (C) Species (D) Family
22. If humans and cats belong to the same class, they must belong to the same:
 (A) Phylum (B) Order
 (C) Family (D) Genus
23. Classification is based on:
 (A) External morphology (B) Internal morphology
 (C) Anatomy (D) All of these
24. Naming and classification of organisms is concerned in:
 (A) Taxonomy (B) Taxon
 (C) Taxonomic hierarchy (D) Systematics
25. Five-kingdom classification system of Whittaker was modified by:
 (A) Margulis (B) Schwartz

- (C) Ernst Hackel (D) Both A and B
26. According to Biologist, the protists are the ancestors of?
 (A) Plantae (B) Fungi
 (C) Animalia (D) All of these
27. Kingdom Protista includes:
 (A) Eukaryotic unicellular (B) Simple multicellular
 (C) Eukaryotic multicellular (D) Both A and B
28. Which one of the following are all parasites?
 (A) Monera (B) Fungi
 (C) Animalia (D) Viruses
29. Protozoans resemble to animals because _____ :
 (A) Lack cell wall (B) Lack of nucleus
 (C) Lack of chlorophyll (D) Both A and B
30. Core of virus is mainly made up of:
 (A) DNA (B) RNA
 (C) DNA or RNA (D) None of these
31. Kingdom Protista arose from which kingdom?
 (A) Monera (B) Animalia
 (C) Plantae (D) Fungi

STUDENT LEARNING OUTCOMES (SLOs)

SHORT ANSWER QUESTIONS

Q.1 What is the basis of classification of life into domains?

Ans:

CLASSIFICATION OF LIFE

Classification into three domains is based on

- Difference in the **sequence of nucleotides** in the rRNA (ribosomal Ribonucleic acid) of the cell.
- The cell's membrane lipid structure.
- Its **sensitivity to antibiotics**.

Q.2 Can you differentiate between?

Ans:

DIFFERENTIATION

a) Bacteria and Protists

BACTERIA	PROTISTS
TYPE OF CELL	
Bacteria are prokaryotic organisms.	Protists are eukaryotic organisms.
HABITAT	
They are found in virtually every habitat on Earth, from soil and water to the human body.	These are mostly aquatic. It is a diverse group of organisms.
CELL WALL COMPOSITION	
Bacterial cell wall is composed of peptidoglycan.	The composition of cell wall of protists varies, due to their diversity.

b) Fungi and Plants

FUNGI	PLANTS
TYPE OF CELL	
Fungi are multicellular eukaryotes.	Plants are multicellular eukaryotes.
MODE OF NUTRITION	
Fungi are saprotrophs (absorptive heterotrophic mode of nutrition).	Plants have autotrophic mode of nutrition.

CELL WALL COMPOSITION	
Their cell wall is made up of chitin.	Their cell wall is made up of cellulose.
c) Plants and Animals	
PLANTS	ANIMALS
TYPE OF CELL	
Plants are multicellular eukaryotes.	Animals are multicellular eukaryotes.
MODE OF NUTRITION	
They have autotrophic mode of nutrition.	They have ingestive heterotrophic mode of nutrition.
CELL WALL COMPOSITION	
They have cellulose-based cell wall and chlorophyll.	They do not have cell wall and chlorophyll.

Q.3 Answer the following with supportive reasons

Ans:

a) Which is the simplest domain?

- Among the three domains of life (i.e., Bacteria, Archaea, and Eukarya), **Bacteria** is often considered as the simplest domain.
- Bacteria are **prokaryotic** organisms, meaning they lack a membrane-bound nucleus and other membrane-bound organelles found in eukaryotic cells.

b) Which is the complex domain?

- **Eukarya** is generally considered as the most complex domain.
- Eukaryotic organisms, which belong to the domain Eukarya, possess complex cellular structures characterized by membrane-bound organelles, including a nucleus that houses the genetic material (DNA).

c) Are most bacteria harmful?

- Most bacteria are not harmful.
- In fact, the majority of bacteria are either harmless or even beneficial to humans and other organisms.

Example:

Lactobacillus acidophilus in human gut helps in digestion of lactose sugar in the milk.

d) Which domain/s can flourish or survive in most adverse conditions?

Archaea are known for their ability to survive in extreme environments such as

- High temperatures (**thermophiles**)
- High salinity (**halophiles**)
- Acidic or alkaline conditions (**acidophiles** or **alkaliphiles**)

Q.4 Compare the two-kingdom, three kingdom and five-kingdom system of classification.

Ans:

DIFFERENTIATION

Two-kingdoms system	Three-kingdoms system	Five-kingdoms system
HISTORY		
Aristotle classified living organisms into two main groups.	The German Scientist Ernst Haeckel proposed a third kingdom.	In 1967 Robert Whittaker introduced the five-kingdom.
KINGDOMS		
• Plantae • Animalia	• Protista • Plantae • Animalia	• Monera • Protista • Fungi • Plantae • Animalia

NEED OF THIS SYSTEM

The kingdom Plantae includes the autotrophs. Bacteria, fungi and algae were also included in the kingdom. So, a better system was needed.	It was proposed to accommodate Euglena-like organisms and to separate unicellular microscopic organisms from multicellular ones.	All objections of previous systems were resolved in this system.
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Q.5 Compare the three-domain system of classification.

Ans:

THREE DOMAIN SYSTEM

DOMAIN ARCHAEA	DOMAIN BACTERIA	DOMAIN EUKARYA
TYPE OF CELL		
They are prokaryotic cells.	They are prokaryotic cells.	They have eukaryotic cells.
CELL WALL COMPOSITION		
The cell wall of Archaea contains no peptidoglycan.	The cell walls of bacteria contain peptidoglycan.	Not all Eukarya have cells with a cell wall. Their cell wall contains no peptidoglycan
RIBOSOMAL RNA (rRNA)		
They have the rRNA (ribosomal RNA) that is not found in Bacteria and Eukarya	They contain rRNA that is unique to bacteria.	Eukarya contains rRNA that is unique to Eukarya.
ANTIBIOTIC SENSITIVITY		
Archaea are not sensitive to some antibiotics that affect bacteria but are sensitive to some antibiotics that affect the Eukarya.	Bacteria are sensitive to traditional antibacterial antibiotics but are resistant to most antibiotics that affect Eukarya.	Eukarya are resistant to traditional antibacterial antibiotics but are sensitive to most antibiotics that affect eukaryotic cells.
HABITAT		
Archaea often live in extreme environment. As their membrane can withstand higher temperature and stronger acid concentration.	They have diverse habitats.	They have diverse habitats.

Q.6 How does classification help scientists understand the evolutionary relationships between organisms? (U.B)

Ans:

EVOLUTIONARY RELATIONSHIP**Explanation:**

The classification reflects shared **ancestry**. Organisms with similar traits likely share a common evolutionary history.

For Example:

Pigeons and parrots indicate their shared origin from a common **bird ancestor**.

Importance of Classification:

Classification helps us construct **phylogenetic trees**, which depict the evolutionary history of species. These trees show how species are related through common ancestors.

Q.7 How can you explain that classification is vital for researchers? (U.B)

Ans:

EVOLUTIONARY RELATIONSHIP**Model Organisms:**

Classification is an essential tool for researchers to select model organisms that are representative of a larger group for experimental research.

This allows researchers to apply their findings from one organism to others.

Example:

Both mice and humans belong to the class Mammalia. This shared classification group enables researchers to select mice as model organisms in medical research, including drug testing.



Predictions:

They evaluate the safety and effectiveness of drugs by observing responses to their treatments in mice, which helps predict how these drugs might affect humans. This leads to the development of safer and more effective medications.

Q.8 How organisms are classified in kingdom Protista? (A.B)

Ans: **KINGDOM PROTISTA**

Protista is the only kingdom with no definite characteristics that can differentiate it from other kingdoms. It is often defined by exclusion in biological classification.

Method of Classification:

The organisms that do not fit into the other kingdoms are included in the kingdom Protista.

Q.9 Why was it challenging for biologists to classify organisms like Euglena? (U.B)

Ans: **EUGLENA-LIKE ORGANISMS**

Characteristics of Euglena:

Euglena is a special organism that can make its own food using sunlight, just like plants, and can also absorb food from its surroundings when there is no light.

Difficulty in Classification:

Because of its unique features, scientists initially found it hard to classify Euglena.

Solution:

But now, it is placed in a third kingdom, Protista, which includes organisms that do not fit into kingdom Plantae and Animalia.

Q.10 Outline the classification of Oak? (K.B)

Ans: **CLASSIFICATION OF OAK**

Oak (*Quercus robur*) is classified as:

- Domain – Eukarya
- Kingdom – Plantae
- Division – Angiospermophyta
- Class – Dicotyledonae
- Order – Fagales
- Family – Fagaceae
- Genus – *Quercus*
- Species – *Quercus robur*

Q.11 How scientific names help to cope with the confusion created by local or common names? (U.B)

Ans: **IMPORTANCE OF BINOMIAL NOMENCLATURE**

Example of Robin:

- In Pakistan and other parts of Asia, the name "robin" often refers to a small, black and white bird commonly found in gardens and urban areas.
- However, in Europe, the name "robin" refers to an entirely different species, the European robin, a small bird with a distinctive orange-red breast.

Confusion in Common Names:

This variation can lead to confusion regarding discussions or research about these species across different regions.

Solution:

By giving each a scientific name Binomial nomenclature eliminates such confusion worldwide, as

- *Copsychus saularis* for Asian robin
- *Erithacus rubecula* for European robin

Q.12 Write the scientific names of red panda and mountain lion? (K.B)

Ans: **SCIENTIFIC NAMES**

Red Panda – *Ailurus fulgens*

Mountain Lion – *Puma concolor*

Q.13 What kind of parasites are viruses?

(K.B)

Ans:

VIRUSES

Definition:

Viruses are acellular structures that are obligate intracellular parasites which are inactive outside the host cell.

Replication of Viruses:

They depend on the host cell to replicate and metabolize. Once inside the host cell, they become active and take over the host's cellular machinery, such as cellular organelles and enzymes, to make new viruses.

Q.14 What are the basic challenges scientists face in classifying viruses?

(K.B)

Ans:

CHALLENGES IN CLASSIFYING VIRUSES

There are many challenges in classifying viruses in any of the five kingdoms or a separate one, because

Challenges:

- Viruses evolve quickly due to a high mutation rate, often resulting in the emergence of new strains or variants. This rapid evolution can make it challenging to maintain a stable classification system.
- Viruses infect a wide range of hosts, from bacteria and plants to animals and humans. The host range can be a factor in classification, but it can also complicate matters when a virus can infect multiple hosts.

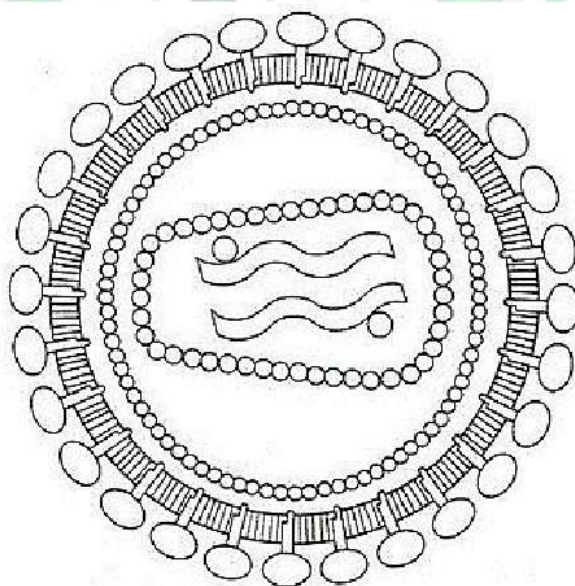
MULTIPLE CHOICE QUESTIONS

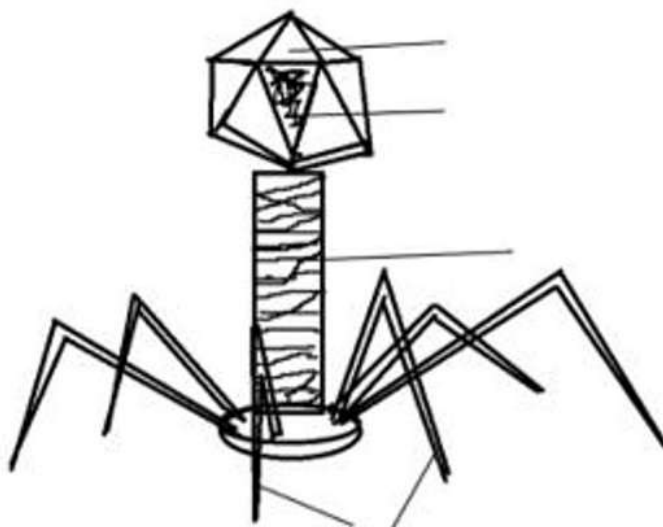
- Who is recognized as the “Father of modern taxonomy”?**
(A) Carolus Linnaeus (B) Aristotle
(C) Carl Woese (D) Gregor Mendel
- What does biodiversity refer to?**
(A) The variety of living organisms in an area (B) The quantity of water bodies in a region
(C) The speed at which species evolve (D) The number of cells in an organism
- Which is not one of the three broad domains of living organisms?**
(A) Bacteria (B) Archaea
(C) Fungi (D) Eukarya
- Which of the following is NOT a taxonomic rank?**
(A) Kingdom (B) Scientific name
(C) Phylum (D) Class
- Why is classifying viruses, so complicated?**
(A) They are too large to study
(B) They can reproduce without any host
(C) They are considered non-living outside the host
(D) They belong to the Eukarya kingdom
- Which of the following is NOT one of the six kingdoms of life as proposed in the modern classification system?**
(A) Animalia (B) Reptilia
(C) Plantae (D) Fungi
- Which of the following kingdoms contains their DNA float freely within the cell?**
(A) Plantae (B) Protista
(C) Fungi (D) Eubacteria
- The two-kingdom classification system divided organisms into which of the following?**
(A) Plantae and Animalia (B) Protista and Plantae
(C) Animalia and Fungi (D) Archaea and Bacteria
- Which kingdom included multicellular organisms that obtain nutrients through absorption?**
(A) Plantae (B) Protista
(C) Fungi (D) Animalia

10. Which classification system is considered the most comprehensive, as it considers both cellular organization and genetic differences?
(A) Two-Kingdom (B) Four-Kingdom
(C) Five-Kingdom (D) Six-Kingdom
11. Plant-like protist is:
(A) Slime mold (B) Amoeba
(C) Chlorella (D) Paramecium
12. C. Linnaeus published his naming system in his book:
(A) Systema Naturae (B) Binomia Namen
(C) Al Nabatat (D) Khalaq-al-Ansan
13. The terms "prokaryotic" and "eukaryotic" were introduced:
(A) Aristotle (B) E. Chatton
(C) Margulis (D) Robert Whittaker

ASSIGNMENT**LET'S DRAW AND LABEL****(A) Structure of Virus****Instructions:**

- Label as much components as you can
- Search the web for components



**(B) Binomial Nomenclature****Instructions:**

- Visit a park and collect pictures of some flowers
- Now using google lens or other apps, find their common and scientific names to fill the following table.

No.	Common Name	Biological Name
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Terms to Know

Andrea Caesalpino	He divided plants into fifteen groups and called them genera.
Animalia	These are multicellular heterotrophic eukaryotes.
Aristotle	The first person who classified the living organisms.
Archaea	A domain that consists of single-cell prokaryotic organisms.
Bacteria	Microscopic, single-celled organisms belonging to the domain Bacteria, exhibiting diverse metabolic capabilities and ecological roles.
Bacteria	A domain that are microscopic, single-celled organisms that exist in their millions, in every environment, both inside and outside other organisms.
Carolus Linnaeus	He grouped species according to similar physical characteristics.
Class	A group of related orders.
Classification	Grouping of organisms
Domain	Is a group of kingdoms or taxonomic category above the kingdom.
Eukarya	Is a domain or a large taxonomy group that is made up of organisms that contain a nucleus within their cells.
Eukaryotes	The organisms which have nucleus in their cells.
Fungi	Are eukaryotic organisms that are saprotrophic decomposers.
Genus	A group of related species.
Heterotrophs	The organisms that eat other things or organisms for food.
Kingdom	The largest taxon or rank.
Order	Group of related families.
Phylum	A group of related classes.
Plantae	Members of the kingdom Plantae are eukaryotic multicellular and autotrophic with chloroplasts containing chlorophyll.
Prions	Viral particles that are composed of proteins only.
Prokaryotes	The organisms that are composed of cells which do not have nucleus.
Species	A group of similar organisms capable of interbreeding.
Saprotrophs	The organisms that depend upon dead and decaying matter.
Taxa	The group into which organisms are classified.
Taxonomy	It is concerned with identification, naming and classification of organisms.
Viroid	Viral particles composed of circular RNA only.

ANSWER KEY**TOPIC 2.2**

1	A	2	D	3	A	4	D	5	C
6	C	7	D						

TOPIC 2.3

1	C	2	C	3	A	4	B	5	D
6	B	7	C	8	C	9	C	10	A
				11	A				

TOPIC 2.4

1	C	2	B	3	C	4	C	5	A
6	A	7	A	8	B	9	A	10	B
11	B	12	C	13	A	14	A	15	C

TOPIC 2.5

1	A	2	C	3	A	4	D	5	A
6	C	7	B	8	D	9	C	10	C
11	C	12	B	13	B	14	D	15	B
16	B	17	C	18	B	19	C	20	B

TOPIC 2.6

1	D	2	A	3	A	4	B	5	B
6	A	7	B						

TOPIC 2.7

1	C	2	C	3	B	4	C	5	B
6	C	7	B	8	D				

TEXTBOOK EXERCISE MCQs

1	D	2	C	3	D	4	B	5	B
6	B	7	B	8	A	9	A	10	C

EXTRA CONCEPTUAL MCQs

1	C	2	B	3	B	4	D	5	A
6	C	7	D	8	C	9	B	10	D
11	A	12	A	13	D	14	A	15	D
16	D	17	D	18	D	19	A	20	C
				21	A				

SLOs MCQs

1	A	2	A	3	C	4	B	5	C
6	B	7	D	8	A	9	C	10	D
		11	C	12	A	13	B		