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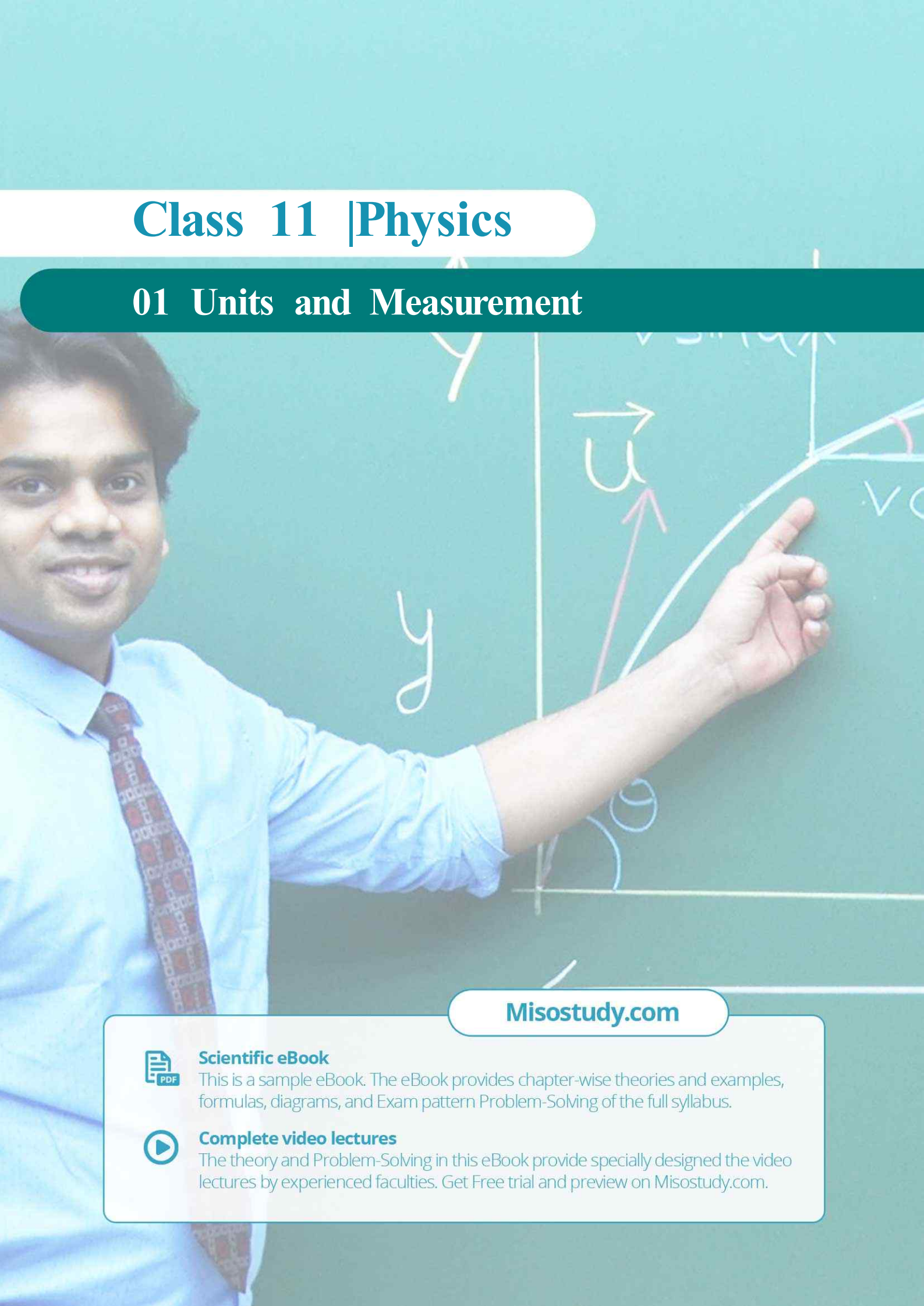
Class 11 |Physics

01 Units and Measurement



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01. Introduction

- Biology; Bios = life, Logos = Study, means study of life is biology.
- **"Biology** is the science of life forms and living processes"
- **Systematic** and **monumental** description of life forms made human to make a detailed system of identification, nomenclature and classification of organisms i.e. **Taxonomy.**
- Hence the study of identification, nomenclature and identification is called taxonomy.
- All the organisms have been evolved by a very long and complex process of **evolution**, so they all are related to each other by sharing of some **common genetic material** but up to varying degrees. This sharing may be less or more among different cases..
- When human came to know this fact then he humbled and led to cultural movements for conservation of **biodiversity.**
- Sharing of common characters was also proved when human studied the similarities among living organisms both **horizontally** and **vertically.**
- The living world is full of amazing diversity of living organisms.
- The diversity of habitats of organisms is also very vast and amazing.
- This diversity makes us deeply reflect on "What indeed is life" ? This question actually asks to solve two problems.
  - **(i)** First is a technical → What living is as opposed to the non living means **Living v/s Non living.**
  - **(ii)** Second is a philosophical one → what the **purpose of life** is?
    As scientists we will try to solve the first question, because the second question is more related to philosophy rather science.

02. Characters of Living Organism

Following are the main characters of "living"-

GROWTH, REPRODUCTION } Not the defining properties/characters/features

METABOLISM, CELLULAR ORGANISATION, CONSCIOUSNESS } Defining properties/characters/features

The character which has no exception is called as **defining property** of life.

Growth

- Increase in mass or overall size of a tissue or organism or its parts is called growth.
- Increase in mass and increase in number of individuals are twin characters of growth.
- Growth is an irreversible permanent increase in size of an organ or its parts or even of an individual cell.
- Growth is of two types :
  - **(a) Intrinsic growth :-** This growth is from inside of the body of living organisms.
  - **(b) Extrinsic growth :-** This growth is from outside i.e. accumulation of material on any body surface Non living exhibts this type of growth.
- Growth is of two types :
  - **(a) Indeterminate growth = Unlimited growth** → Growth which occurs continuously throughout their life span is indeterminate growth or unlimited growth. It occurs in plants and not in animals.
  - **(b) Determinate growth = Limited growth** → Growth which occurs only up to a certain age is determinate growth or Limited growth. It occurs in animals. However, cell division occurs in certain tissues to replace lost cells.
- In majority of higher plants and animals, growth and reproduction are mutually **exclusive events.**
- Because both living and nonliving exhibit growth so it can not be taken as defining property.
- Growth from inside (intrinsic growth) can be taken as **defining property.**

Reproduction

Reproduction is one of the fundamental characteristics of living organisms. It can be defined as the production of new individuals of same kind by the grown up individuals. It is characteristic exhibited by living organisms which can produce new young ones of their own kind. There are two modes of reproduction — **asexual** and **sexual.**

- In lower organisms like yeasts and Hydra, budding takes place in which new individuals are produced by the formation of an outgrowth known as 'bud'.
- Fragmentation is another mode of asexual reproduction, as in this, body of an organism (parent body) breaks up into two or more parts (known as fragments) each of which grows into a new individual. It is also quite common in filamentous algae, fungus, bryophytes (at protonema stage which occurs during life cycle in mosses).
- Planaria (flat worms) exhibit an extraordinary ability to regenerate its lost body parts completely (which is known as true regeneration).

Metabolism :

- The sum total all the chemical reactions occuring in our body is metabolism.
- All living organisms, both unicellular and multicellular exhibit metabolism.
- No non-living object shows metabolism.
- In this way metabolism is a defining character of living organisms because it has no exceptions.
- Now we have known most of the chemical or metabolic reactions occuring in our body so we can demonstrate many of them in a cell free medium or in a test tube in lab..
- The isolated metabolic reaction outside the body of an organism, performed in a test tube (in-vitro) is neither living nor nonliving.
- These isolated reaction can be regarded as living things, but they are definitely living reactions because they are similar to the reactions performing in our body.

- Here we should not forget the fact that metabolism is the total sum of all the chemical reactions performing in our body, it is not the sum of few or more living reactions.
- All organisms are made of small or big chemicals perform thousands of reactions and form some other chemicals also in the bodies of living organisms.

Consciousness

- Most obvious and technically complicated feature of all living organism. All living organisms are able to detect changes, i.e., sense their surroundings and can also respond to them. This is known as sensitivity which is defined as the ability to detect changes in the environment and to give response towards it accordingly. Any change that can be detected by an organism is called stimulus. This can be physical (like intensity, duration, direction of light, sound, change in temperature, duration of day length, i.e., photoperiod, etc.), chemical (like acids, pollutants, etc.) or biological (like other organisms).

03. Diversity In The Living World

- We consider vast areas like forest, desert, plateau etc. we find that number and kinds of living organisms increase many folds. These different kinds of plants, animals and other organisms are referred to as '**Biodiversity**' of this earth.
- **Biodiversity** is the number and various kinds of organisms found on earth. It stands for the variability found among living organisms inhabiting this world.
- **Biodiversity (Greek word bios = life; diversity = forms) or biological diversity** can be defined as the vast array of species of microorganisms, algae, fungi, plants, animals occuring on the earth either in the terrestrial or aquatic habitats and the ecological complexes of which they are a part.
- According to **IUCN** (International Union of Conservation of Nature and Natural resources), currently known and described species of all organisms are between **1.7-1.8 million**. These millions of plants, animals and other organisms in the world cannot be recognised, studied or described by an individual on its own.
- There is need to standardize the names of all living organisms after proper identification, in order to study such diverse life forms. Therefore, for better understanding of biodiversity scientists have established a definite system of principles, procedures and terms which identifies, categories and assigns specific name to each and every organism known to us. Such systems are acceptable to all biologists all over the world.
- The scientific need for simple, stable and internationally accepted systems for naming the living organisms of the world has generated, a process called **"Nomenclature"**. And, before assigning a specific name to an organism, one should determine or know its kind or features correctly, so that one can identify it in each every part of the world. This is known as **"Identification"**

04. Taxonomy

- This word was proposed by **A.P. De Candolle** in his book **"Theories elementaire de la botanique"** (Theory of elementary botany)

- **Taxonomy includes study of following 4 points**

Characterization	-	Identification of character
Identification	-	Identification of living organisms
Nomenclature	-	Nomenclature of living organisms
Classification	-	Classification of living organisms in groups

05. Systematics

(i) The term **"Systematics"** was pro posed by **Linnaeus**. The word systematics is derived from the latin word "systema" which means systematic arrangement of organisms.

(ii) **According to G. Simpson** : Systematics is the study of diversity of organisms and all their comparative and evolutionary relationship.

NOTE ☞ It includes description of external morphological characters of plants of living organisms.
eg. Morphological characters of Root, Stem, Leaves, Flowers.

06. New Systematics or Neosystematics or Biosystematics

- **Neo-systematics** – A new branch – Name given by **Julian Huxley (1940)**
- It includes description of all the characters **(external + internal)**
  e.g. Anatomical characters, Histological characters, Embryological characters, Identical characters
- It is used to know the **inter-relationship** between living organisms.

NOTE ☞ New systematics is mainly based on **evolutionary** as well as **genetic relationship** as compared to morphological characters.

07. Types of Taxonomy

- **Alpha taxonomy or classical taxonomy :** It is based on **external morphology** of plants.
- **Bete taxonomy or Explorative taxonomy :** Besides external **morphology** it also includes **internal** characters like embryological, cryological, anatomical characters etc.
- **Omega taxonomy or Encyclopaedic taxonomy :** Omega taxonomy have widest scope. It is based on **all the information** or data available about plants.
- **Chemotaxonomy :** The uses of chemical characters of plants in classification or in solving taxonomic problems is called chemotaxonomy or chemical taxonomy. It is based on the **chemical constituents** of plants. The fragrance and taste vary from species to species. The basic chemical compounds used in chemotaxonomy are **alkaloids, carotenoides, tannins,** polysaccharide, nucleic acids, fatty acids, amino acids, **aromatic compounds** etc.

- **Cytotaxonomy :** The use of cytological characters of plants in classification or in solving taxonomic problems is called cytotaxonomy. Cytological data have been used in many cases to find out the affinities among genera.
- **Karyotaxonomy :** Based on characters of **nucleus and chromosomes.** Pattern of **chromosomal bands** (dark bands and light bands) is most specific character.
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- **Adansonian system or Phenetic Classification or Numerical Classification.**
  - ❖ Proposed by **"Sokel** and **Sneath"**
  - ❖ In it plants are classified on the basis of number of similarities and dissimilarities.
  - ❖ In this, importance to any one character is not given, **all characters have same importance.**
    While in **natural** classification **floral characters** have importance than morphological characters.

08. Significance of Taxonomy

- Most significant feature is **identification** of living organism.
- With the help of taxonomy **diversity** of living being can be studied easily.
- Maximum diversity of living beings are found in **tropical rain forests.** These forest have heavy rain fall through out the year. In **India** maximum tropical rain forest are found in **Andaman & Nicobar** and in all **eastern states** (Assam, Meghalaya, West Bengal etc.)
- At present, 300 lakh **(30 million)** type of living organism are found on our earth.
- 17 lakh **(1.7 million)** type of living organism have been **discovered till now.**
- Out of them **12 lakh** types are **animal** and **5 lakh** types are **plants.**

09. Taxonomic Category

Classification is not a single step process but involves heirarchy of steps in which each step represent a rank or category.

- **Species :**
  Taxonomic studies consider a group of individual organism with fundamental similarities as a species. One should be able to distinguish one species from the other closely related species based on the distinct morphological difference.
- **Genus :**
  Genus comperises a group of related species which has more characters in common in comparison to species of other genera.
- **Family :**
  Family has a group of related genera with still less number of similarities as compared to genus and species. Families are characterized on the basis of both vegetative and reproductive feature of plant species.
  For example :Three different genera **Solanum, Petunia** and **Datura** are included in family solanaceae.
- **Order :**
  Order being a higher category is the assemblage of families which exhibit a few similar character.
  For example : Plant families like **convolvulaceae, Solanaceae** are included in the order **polymoniales mainly based on the floral characters.**
- **Class :**
  Class includes organism of related orders having less similarities than orders.
- **Division :**
  Division includes all organisms belonging to different classes having a few common characters. There 7 main taxonomic categories. They are obligate or essential or broad categories i.e. they are strictly used at the time of any plant classification. There are some extra or sub categories, like sub division, sub order, sub family, etc. They are used only when they are needed.

Biggest group →	├ Kingdom
	├ Division/Phylum
	├ Class
	├ Order - Cohort
	├ Family
	├ Genus
	├ Species

- ❖ The classification of any plant or animal is written in **descending** or ascending order.
- ❖ Hierarchy – **Descending** or ascending arrangement of taxonomic categories is known as hierarchy.
- ❖ **Species :** Smallest taxonomic category → It is basic unit of classification.

10. Nomenclature

- **Polynomical system :**
  - ❖ According to this system name of any plant consists of many words.
  - ❖ For eg. Caryophyllum → Caryophyllum saxatilis folis gramineus umbellatis corymbis
  - ❖ Based of morphology mainly

- **Trinomical system :**
  - ❖ Proposed by **Lamarck.**
  - ❖ According to this system name of any plant or species is composed of three names-
    - **Generic name**
    - **Specific epithet**
    - **Subspecific name (Name of variety)**
  - ❖ When members of any species have large variations then trinomial system is used.
  - ❖ On the basis of dissimilarities this species is classified into sub species. eg.
    Brassica oleracea var. botrytis (Cauliflower)
    Brassica oleracea var. capitata (Cabbage)
    Brassica oleracea var. caulorapa (Knol-Khol)

- **Binomial system :**
  - ❖ Binomial system was first proposed by **Gaspard Bauhin** in his book -**"Pinax Theatre Botanica"**
  - ❖ **Carolus Linnaeus :** Linnaeus used this nomenclature system for the first time on large scale and proposed scientific name of all the plants and animals.
  - ❖ **Linnaeus** is the **founder** of binomial system.
  - ❖ Linnaeus proposed scientific name of plants in his book **"Species Plantarum"**
  - ❖ It was published on **1 May, 1753.** So this was the initiation of binomial system for plants.
  - ❖ So any name proposed (for plants) before this date is **not** accepted today.
  - ❖ **Linnaeus** proposed scientific name of animals in his book **"Systema Naturae"** (10^{th} edition).
  - ❖ This 10^{th} edition of **Systema Naturae** was first published on **1 August, 1758.**
  - ❖ So initiation of binomial system **for animals** is believed to be started on **1 August, 1758.**

11. ICBN

- **Main rules of ICBN :**
  - ❖ According to binomial system name of any species consists of two components or words.
    - Generic name Name of genus
    - Specific epithet

e.g. ***Solanum tuberosum*** (Potato) ***Mangifera indica*** (Mango)

↓ ↓ ↓ ↓

Generic name Specific epithet Generic name Specific epithet

- ❖ In plant nomenclature (ICBN) tautonyms are not valid i.e. generic name and specific epithet should not be same in plants.
  eg. *Mangifera mangifera*
  But tautonyms are valid in animal nomenclature (ICZN-International Code of Zoological Nomenclature)
  eg. *Naja naja* (Indian cobra), *Rattus rattus* (Rat)
- ❖ First letter of generic name should be in capital letter and first letter of specific epithet should be in small letter.
  eg. *Mangifera indica*
- ❖ But if specific epithet is based on the name of any person, its first letter should be in capital letter.
  eg. *Isoetes pantii*
- ❖ When written with free hand or typed, then generic name and specific epithet should be separately underlined.
  But during printing name should be in italics to indicate their latin orgin.
- ❖ Name of scientist (who proposed nomenclature) should be written in short after the specific epithet.
  eg. *Mangifera indica* Linn.
- ❖ Name of scientist should be neither underlined nor in italics, but written in Roman letters (simple alphabets)
- ❖ Sciectific names should be derived from Latin (usually) or Greek languages because they are dead languages.
- ❖ Type specimen (Herbarium Sheet) of newly discovered plant should be placed in herbarium (Dry garden).

12. Classification

According to **"A.P. de Candolle",** Classification is of two types

(i) Empirical Classification **(ii) Rational Classification**

- **Empirical Classification :**
  - ❖ In this type, the actual nature or character of plants is not considered.
  - ❖ Plants are classified on the basis of their alphabetical order.
  - ❖ In this way plants are classified into 26 groups.

- **Rational Classification**
  In this classification, plants are classified on the basis of their actual character or nature i.e. by viewing the characters.

13. Taxonomical Aids

- Accurate classification and identification of organisms is required which needs field studies and intensive laboratory work. This is done after collection of actual specimens of plants and animal species which is the primary source of all taxonomic studies.
- Hence, these taxonomical studies help in
  Fundamental study of different living organisms.
  Also aid in their systematic study.
  Information gathered is stored with specimens for future studies.

Herbarium

- It is defined as "store house of collected plant specimens that are dried, pressed and preserved on sheets". Further, these sheets are arranged in the sequence of a universally accepted system of classification.
- Such herbaria serve as quick source of reference in taxonomical studies. It also provides information about the local flora as well as flora of distant areas. This information is also useful in locating wild varieties and relatives of economically important plants.
  List of some Herbaria of the world :
  (i) Royal Botanical Gardens, Kew (England)
  (ii) Central National Herbarium, Calcutta

14. Botanical Gardens

Botanical garden is an institution located in an enclosed piece of land which grows numerous kinds of plants obtained from different places for botanical studies. Each plant is first identified and then labelled indicating its botanical/scientific name and its family.

List of some Botanical Gardens

(i) Royal Botanical Garden, Kew (England)
(ii) National Botanica Garden, Lucknow
(iii) Indian Botanical Garden, Howrah
(iv) Lloyd Botanical Garden, Darjeeling

15. Museum

- Museum is a place used for storing, preservation and exhibition of both plants and animals. All educational institutes and universities maintain museums in their Botany and Zoology departments.
- A commonly used preservative solutions is "Formalin". Plants and animals specimen may also be preserved as dry specimens. For instances, insects are collected, killed and pinned before preserving them in special insect boxes while larger animals like reptiles, birds and mammals are usually stuffed and then preserved.
- National Museum of Natural History (NMNH) in Delhi is important from natural science point of view.

16. Zoological Parks

- Zoological parks commonly known as zoos are the places where live wild animals are kept in protected environment which is made similar to their natural habitats as much as possible. Here, they are provided with protection and care by human beings.
- These parks serve as ideal means to study and learn different food habits and behaviour of variety of animals. So, students should visit nearby zoos for knowledge and entertainment both.
- National Zoological Park (Delhi) is one of the finest zoos of Asia.

17. Key

- Key is an important taxonomic aid used for identification of plants and animals based on the **similarities** and **dissimilarities.** Actually, it is a set of alternate characters of different types arranged sequence wise in such a fashion that by selection and elimination one can quickly find out the name of the organism.
- The keys are based on the set of contrasting characters generally in a pair known as **"couplet".** Each character of the couplet or statement in the key is called as **"lead".**
- One has to choose correct option between two statements of characters of definite species so that the animal or plant is identified accurately. **Keys are generally analytical in nature.**

18. Flora, Manuals, Monographs and Catalogues

- These flora, manuals, monographs, etc. are recorded descriptions of plants, animals and other organisms. They provide correct identification and description of variety of living organisms.
  - ❖ **Flora :** It is a book containing information about plants found in a particular area. It gives the actual account of habitat and distribution of various plants of a given area. These provide the index to the plant species found in a particular area. For example, Flora of Delhi by J.K. Maheshwari.
  - ❖ **Manual :** It is a book containing complete listing and description of the plants growing in a particular area. They provide useful information for identification of names of various species found in an area.
  - ❖ **Monograph :** It contains information of any one taxon.
  - ❖ **Catalogue :** It include the alphabetical arrangement of species of a particular place describing their features.

CBSE Exam Pattern Exercise
Subjective Questions (1)

(Q1 to 3) One Mark

1. Write the correct order of sequence of taxonomical categories.

2. What do you mean by chemotaxonomy?

3. Define genus

(Q4 to 6) Two Marks

4. Elaborate about keys as one of taxonomical aids?

5. What is classical taxonomy and modern taxonomy?

6. What is meant by living ? Give any four defining features of all life forms.

(Q7 to 8) Three Marks

7. What are taxonomical aids? Give importance of herbaria & mueseums . How are botanical gardens and zoological parks useful in conserving biodiversity?

8. Metabolism is a defining feature of all living organisms without exception. Isolated metabolic reactions in vitro are not living things but surely living reactions. Comment

(Q9 to 10) Five Marks

9. ICBN has provided a code for classification of plants. Give hierarchy of units of classification botanists follow while classifying plants.

10. What is binomial system of nomenclature? Who proposed this system? Why is binomial nomenclature the most acceptable mode of naming organism?

Answer & Solution

Q1
Species→genus → family → order → class → Phylum → kingdom

Q2
Chemotaxonomy is based on the presence or absence of certain chemicals in cells or tissues.

Q3
Terms 'Genus was coined by Tournefort. Genera are the aggregates of closely related species. For example, Potato (*Solanum tuberosum*), tomato (Solanum lycopersicum) and brinjal (Solanum nigrum) are three diff

Q4
It is a taxonomical aid used for the identification of plants and animals. The keys are based on the paired contrasting characters called as couplet. It represent two alternate forms of a given character. Keys are generally of two types
(i) **Indented or yoked keys** It has a sequence of forms of different characters.
(ii) **Bracketed keys** It includes one pair of contrasting statements for a given characters.
Separate taxonomic keys are required for each taxonomic category such as family, genus and species for identification purposes.

Q5
1. Classical Taxonomy deals with morphospecies. Modern Taxonomy deals with biological species.
2. Classical Taxonomy has typological concept. Modern Taxonomy has a population or biosystematic concept.
3. In Classical taxonomy, species is considered to be static. In moder taxonomy, species is considered to be dynamic.
4. Classical taxonomy does not study evolution and inter-relationships of species. Modern Taxonomy studies premitiveness, advancement and inter-relationships of specoes.

Q6
The living organism exhibit distinctive characteristics, which are as follows (i) Growth All living organisms grow in size as well as in number. Plants show growth all through their life whereas animals up to a certain growth period after which growth ceases. (ii) Reproduction The process of

reproduction is essential for the continuity of life on earth. Every organism whether unicellular or multicellular gives rise to an individual of its own kind. Lower organisms usually reproduce asexually, e.g.. Hydra, fungi, yeast, etc. Sexual reproduction is found in advanced group of organisms, which involves two parents. In Amoeba growth and reproduction however is synonymous. (iii) Metabolism There are thousands of enzymatic ally controlled reactions occurring in all living cells. These are synthesizing (anabolic) and breaking down (catabolic) reactions. Hence, it is the most important characteristic of living organisms. (iv) Response to stimuli Consciousness and response to stimulus is the defining property of all living organisms. Plants respond to light, water temperature. Unicellular organisms also sense their environment and respond accordingly. (v) Cellular organization The cellular organization of the body is the defining feature of life forms. Cells work together in hierarchical manner group of cells make tissues, tissues make organs, organs make systems, systems when work in co-ordination form an individual. So, we can say living organisms are self replicating, evolving and capable of responding to external stimuli.

Q7

The taxonomic aids are the aids which help in identification, classification and naming of a newly discovered organisms (plant or animal). It could be in the form of preserved document like herbaria or specimen kept at museums or scientific institutions. Other aids can be in the form of written document like monograph ,taxonomic keys, couplets, etc. A new organism found can be studied while comparing it with living plants and animals living in protected areas like Botanical gardens, Zoological parks, etc. Botanical gardens helps in conservation of plants by (i) Growing important local plant species and keeping record of them. (ii) Growing and maintaining rare and endangered species. (iii) Supplying seeds for different, aspects of botanical research. Whereas zoological parks also contribute in conserving biodiversity by (i) Providing natural environment and open space to animals, i.e., wild life species. (ii) Keeping them safe from their predators ensuring protection, food and shelter. (iii) Providing home to different native and exotic wild animals. (iv) Involving in the rescue of endangered species. (v) Facilitating breeding of animals and releasing them free. Thus, both botanical gardens and zoological parks play an important role in conservation ofbiodiversity.

Q8

All living organisms are made of chemicals which belong to various classes and have different sizes and functions. In the cells, these chemicals are constantly being made and changed into some other biomolecules. These conversions or chemical reactions taking place in the body are collectively known as metabolism. All plants, animals, fungi and microbes exhibit metabolism. Non-living objects do not exhibit metabolism. So we can say metabolism is a defining feature of all living organisms without exception.

Metabolic reactions can be demonstrated outside the body in a test-tube. A metabolic reaction preformed in a test-tube (in vitro) is neither living nor non-living but surely living reaction.

Q9

The study of taxonomy has led to the taxonomic categories – Kingdom, phylum, class, order, family, genus, and species. Now let us see how all the organisms are classified into the hierarchy.

Species

It is the lowest level of classification and shows the high level of similarities among the organisms. One species can be distinguished from other closely related species based on distinct differences in morphology. Let us look at an example; Plasmodium vivax and Plasmodium falciparum – Both are malaria-causing parasites but have different effects on a patient. Plasmodium is the name of the genus and

has a number of species which show distinct morphological characteristics.

Genus

This taxonomic group comprises several species which have similar characteristics but different from that of species from another genus. Considering the same example of Plasmodium, it is a genius with multiple species which are similar to each other and differs from the species of another genus.

Family

This category of taxonomy includes various genus which shares some resemblance among themselves. However, the number of similarities decrease compared to species and genus. For example, the genus of tiger, leopard, lion, i.e., Panthera and the genus of cats i.e., Felis are grouped together in the family Felidae.

Order

The classification which begins with the order has fewer comparisons as an effect, they are grouped based on aggregates of characteristics. A group of families showing somewhat few similarities forms an order. For example, the order of carnivores i.e., Carnivore includes families like Felidae and Canidae.

Class

A group of Orders which share a few similarities forms a Class. For example- Orders of primates and carnivores are grouped together in the Class of mammals.

Phylum

This is the next level of classification was along a number of Classes are clubbed up to form one Phylum. Example – aves, fishes, reptiles, mammals, and amphibians combined to form the phylum of or Chordata.

Kingdom

This is the highest level of classification. We have Kingdoms like Plantae, Animalia, Fungi, Protista, and Monera.

Q10

Binomial nomenclature, introduced by Carolus Linnaeus is the method of naming an organism with the genus name first and species name later.

Conventions followed while naming

*Name of the genus begins with a capital letter.
*Name of the species should begin with a small letter.
*Scientific name should be in Italics when printed.
*Genus name and the species name should be underlined separately while handwritten.

The advantages of scientific over common names are that they are accepted by speakers of all languages, that each name applies only to one species, and that each species has only one name.