

CLASS 11

# CBSE

## PHYSICS

- ▶ Specially designed eBook for complete CBSE syllabus
- ▶ CBSE preparation strategy & direction, speedy revision
- ▶ Chapter-wise important Problem-Solving
- ▶ Theory, Formulas & Diagrams to crack CBSE
- ▶ Updated New Pattern Objective questions
- ▶ Detailed high quality video lectures by experienced faculties
- ▶ CBSE full preparation for Class XI & XII



**misostudy**  
connect smart learning

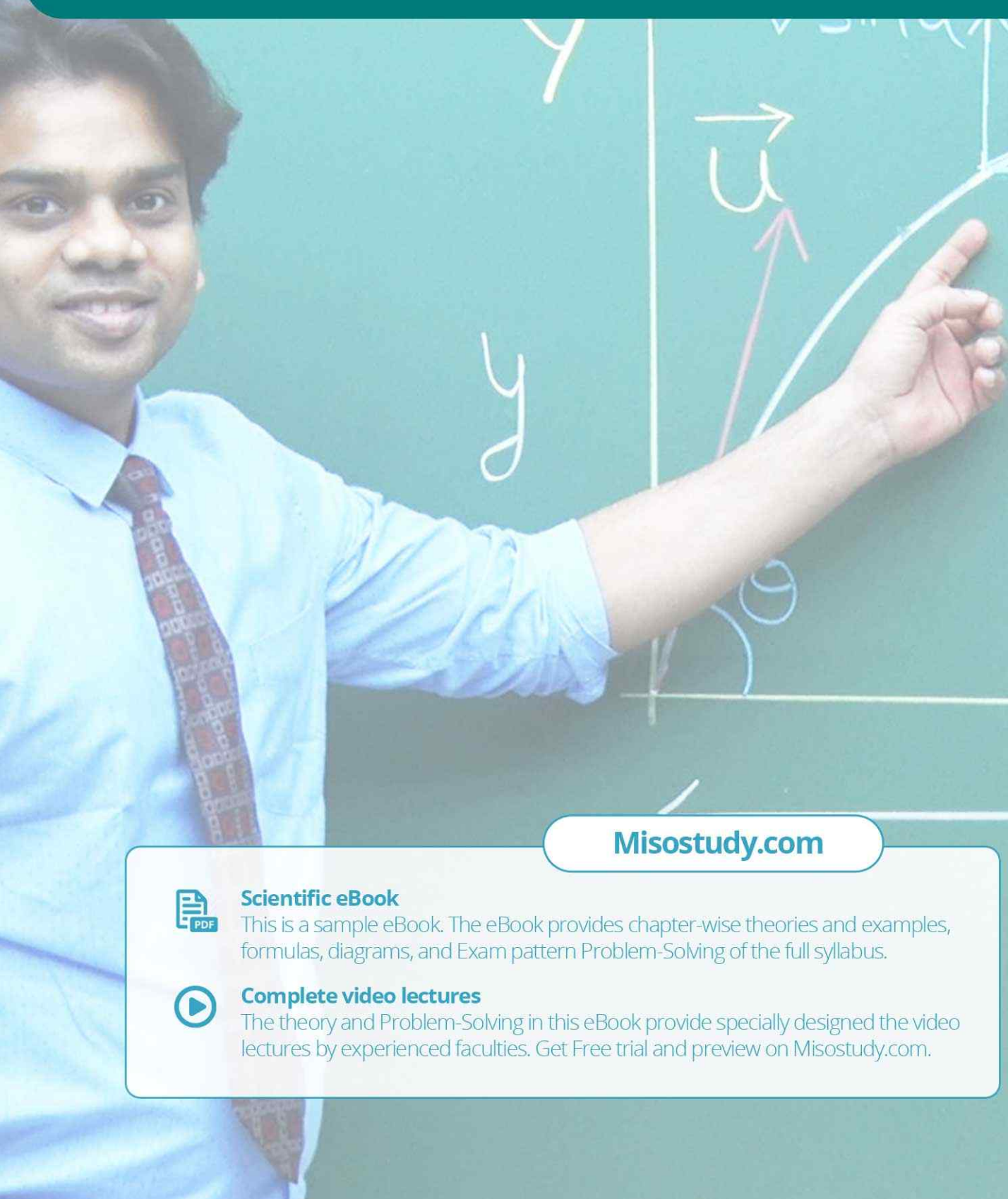
**JEE·NEET·AIIMS·CBSE·FOUNDATION**  
[www.misostudy.com](http://www.misostudy.com)

☎ 8929803804 (MON-FRI: 9am-6pm) [support@misostudy.com](mailto:support@misostudy.com)

MISO STUDY INDIA PVT. LTD.  
2ND FLOOR 65-A, OMPRO TOWER, KALU SARAI, NEW DELHI, DELHI 110016

# Class 11 | Physics

## 01 Units and Measurement



Misostudy.com



### Scientific eBook

This is a sample eBook. The eBook provides chapter-wise theories and examples, formulas, diagrams, and Exam pattern Problem-Solving of the full syllabus.



### Complete video lectures

The theory and Problem-Solving in this eBook provide specially designed the video lectures by experienced faculties. Get Free trial and preview on Misostudy.com.

## 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 } Defining properties/characters/features  
CONSCIOUSNESS }

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 exhibits 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 occurring 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 occurring 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.



## 01 Units and Measurement

- 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 occurring 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**

<b>Characterization</b>	-	Identification of character
<b>Identification</b>	-	Identification of living organisms
<b>Nomenclature</b>	-	Nomenclature of living organisms
<b>Classification</b>	-	Classification of living organisms in groups

## 05. Systematics


- The term “**Systematics**” was proposed by **Linnaeus**. The word systematics is derived from the Latin word “**systema**” which means systematic arrangement of organisms.
- 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.
- **Beta 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, carotenoids, 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.
- **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.
- **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 hierarchy 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 comprises 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<sup>th</sup> edition).
  - ❖ This 10<sup>th</sup> 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.	<i>Solanum tuberosum</i> (Potato)		<i>Mangifera indica</i> (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 origin.
- ❖ 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)
- ❖ Scientific 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 Botanical 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 & museums . 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 different

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 represents 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 character.

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 modern taxonomy, species is considered to be dynamic.

4. Classical taxonomy does not study evolution and inter-relationships of species. Modern Taxonomy studies primitiveness, advancement and inter-relationships of species.

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 of biodiversity.

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 performed 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

## 01 Units and Measurement

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 genus 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.



CLASS 11

# CBSE

# CHEMISTRY

- ▶ Specially designed eBook for complete CBSE syllabus
- ▶ CBSE preparation strategy & direction, speedy revision
- ▶ Chapter-wise important Problem-Solving
- ▶ Theory, Formulas & Diagrams to crack CBSE
- ▶ Updated New Pattern Objective questions
- ▶ Detailed high quality video lectures by experienced faculties
- ▶ CBSE full preparation for Class XI & XII



**misostudy**  
connect smart learning

**JEE·NEET·AIIMS·CBSE·FOUNDATION**  
[www.misostudy.com](http://www.misostudy.com)

☎ 8929803804 (MON-FRI: 9am-6pm) [support@misostudy.com](mailto:support@misostudy.com)

MISO STUDY INDIA PVT. LTD.  
2ND FLOOR 65-A, OMPRO TOWER, KALU SARAI, NEW DELHI, DELHI 110016

# Class 11 | Chemistry

## 02 Structure of Atom



Misostudy.com



### Scientific eBook

This is a sample eBook. The eBook provides chapter-wise theories and examples, formulas, diagrams, and Exam pattern Problem-Solving of the full syllabus.



### Complete video lectures

The theory and Problem-Solving in this eBook provide specially designed the video lectures by experienced faculties. Get Free trial and preview on Misostudy.com.



## 01. Introduction

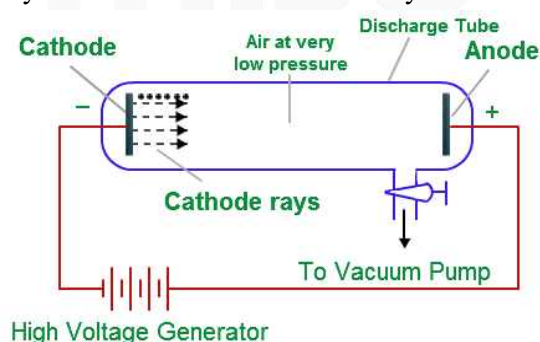
**John Dalton 1808**, believed that matter is made up of extremely minute indivisible particles, called atom which takes part in chemical reactions. These particles can neither be created nor be destroyed. However, modern researches have conclusively proved that atom is no longer an indivisible particle. Modern structure of atom is based on Rutherford's scattering experiment, quantization of energy and wave mechanical model.

### Composition of Atom

The works of J.J. Thomson and Ernst Rutherford actually laid the foundation of the modern picture of the atom. It is now verified that the atom consists of several sub-atomic particles like electron, proton, neutron, positron, neutrino, meson etc. Out of these particles the electron, proton and the neutron are called fundamental subatomic particles.

## 02. ELECTRON ( ${}_{-1}e^0$ , $e$ )

Electron was discovered by J.J. Thomson (1897) and it is a negatively charged particle. Cathode rays were discovered by William Crooke & J.J. Thomson using a cylindrical hard glass tube fitted with two metallic electrodes. This tube was known as discharge tube. They passed electricity (10,000V) through a discharge tube at very low pressure. Blue rays emerged from the cathode. These rays were termed as Cathode rays.



### Properties of Cathode rays

- (i) Cathode rays travel in straight line.
- (ii) Cathode rays produce mechanical effect, as they can rotate the wheel placed in their path.
- (iii) Cathode rays consist of negatively charged particles known as electron.

## 02 Structure of Atom

- (iv) Cathode rays travel with high speed.
- (v) Cathode rays can cause fluorescence.
- (vi) Cathode rays heat the object on which they fall due to transfer of kinetic energy to the object.
- (vii) When cathode rays fall on heavy metals, X-rays are produced.
- (viii) Cathode rays possess ionizing power i.e., they ionize the gas through which they pass.
- (ix) The cathode rays produce scintillation on the photographic plates.
- (x) They can penetrate through thin metallic sheets.
- (xi) The nature of these rays does not

### 03. Thomson's Model of Atom [1904]

- Thomson was the first to propose a detailed model of the atom.
- Thomson proposed that an atom consists of a uniform sphere of positive charge in which the electrons are distributed more or less uniformly.
- This model of atom is known as "Plum-Pudding model" or "Raisin Pudding Model" or "Water Melon Model".

#### Drawbacks:

- An important drawback of this model is that the mass of the atoms is considered to be evenly spread over that atom.
- It is a static model. It does not reflect the movement of electron.
- It could not explain the stability of an atom.

### 04. Rutherford's Scattering Experiment

#### Rutherford observed that

- (i) Most of the  $\alpha$ -particles (nearly 99.9%) went straight without suffering any deflection.
- (ii) A few of them got deflected through small angles.
- (iii) A very few (about one in 20,000) did not pass through the foil at all but suffered large deflections (more than  $90^\circ$ ) or even came back in the direction from which they have come i.e. a deflection of  $180^\circ$ .

#### Following conclusions were drawn from the above observations-

- (i) Since most of the  $\alpha$ -particle went straight through the metal foil undeflected, it means that there must be very large empty space within the atom.
- (ii) Since few of the  $\alpha$ -particles were deflected from their original paths through moderate angles; it was concluded that whole of the +ve charge is concentrated and the space occupied by this positive charge is very small in the atom.
  - When  $\alpha$ -particles come closer to this point, they suffer a force of repulsion and deviate from their paths.
  - The positively charged heavy mass which occupies only a small volume in an atom is called nucleus. It is supposed to be present at the centre of the atom.



- (iii) A very few of the  $\alpha$ -particles suffered strong deflections or even returned on their path indicating that the nucleus is rigid and  $\alpha$ -particles recoil due to direct collision with the heavy positively charged mass.

#### Drawbacks of rutherford model-

- (i) This theory could not explain stability of atom. According to Maxwell electron loose its energy continuously in the form of electromagnetic radiations. As a result of this, the e- should loose energy at every turn and move close and closer to the nucleus following a spiral path. The unlimited result will be that it will fall into the nucleus, thereby making the atom unstable.
- (ii) If the electrons loose energy continuously, the observed spectrum should be continuous but the actual observed spectrum consists of well defined lines of definite frequencies. Hence the loss of energy by electron is not continuous in an atom.

#### 05. Distance of closest approach :

When the  $\alpha$ -particles approaches the nucleus to made a head-on collision with a the nucleus, the  $\alpha$ -particle approaches the nucleus until coulombic potential energy of repulsion,  $k \frac{Z_1 Z_2 e^2}{r}$ ,

becomes equal to its initial K.E.,  $\frac{1}{2} m.v^2$ .

$$\text{Thus } \frac{1}{2} mv^2 = k \frac{Z_1 Z_2 e^2}{r}$$

$$\text{Hence, the distance of closest approach, } r = \frac{k z_1 z_2 e^2}{\left(\frac{1}{2}mv^2\right)}$$

The nucleus must be further smaller than the distance of closest approach.

#### 06. Moseley Experiment (Discovery of Atomic Number)

Moseley (1912-1913), investigated the X-rays spectra of 38 different elements, starting from aluminium and ending in gold. He measured the frequency of principal lines of a particular series (the  $\alpha$ -lines in the K series) of the spectra. It was observed that the frequency of a particular spectral line gradually increased with the increase of atomic mass of the element. But, it was soon realised that the frequency of the particular spectral line was more precisely related with the serial number of the element in the periodic table which he termed as atomic number (Z). He presented the following relationship:

$$\sqrt{\nu} = a(Z-b)$$

where,  $\nu$ =frequency of X-rays,  $Z$ =atomic number, 'a' and 'b' are constants. When the values of square root of the frequency were plotted against atomic number of the elements producing X-rays, a straight line was obtained.

## 07. Some Atomic Terms

**Atomic number** = Number of unit positive charge on nucleus = Number of protons in nucleus  
= Number of electrons in neutral atom.

Two different elements can never have identical atomic number.

**Mass number(A)** = Number of protons + Number of neutrons or Atomic number (Z)

Hence Number of neutrons =  $A - Z$ .

The atom of an element X having mass number (A) and atomic number (Z) may be represented by a symbol,

**Isotopes** : Atoms of an element with the same atomic number but different mass number.

eg.  ${}_1\text{H}^1$                        ${}_1\text{H}^2$                        ${}_1\text{H}^3$   
Protonium                      deuterium                      Tritium

**Isodiapheres** : The elements which have same value of  $(n - p)$  is called Isodiapheres.

eg.  ${}_7\text{N}^{14}$                        ${}_8\text{O}^{16}$   
Values of  $(n - p)$                       0                      0

**Isotone** : Elements which contain same no. of neutron is called **Isotone**.

eg.  ${}_{14}\text{Si}^{30}$                        ${}_{15}\text{P}^{31}$                        ${}_{16}\text{S}^{32}$   
number of neutrons                      16                      16                      16

**Isobar** : The two different atoms which have same mass number but different atomic number is called Isobar.

eg.  ${}_{18}\text{Ar}^{40}$                        ${}_{19}\text{K}^{40}$                        ${}_{20}\text{Ca}^{40}$

**Isoelectronic** : Ion or atom or molecule which have the same mass number of electron is called Isoelectronic species.

eg.  ${}_{17}\text{Cl}^-$                        ${}_{18}\text{Ar}$                        ${}_{19}\text{K}^+$                        ${}_{19}\text{Ca}^{+2}$   
No. of electrons                      18                      18                      18                      18

## 08. Bohr's Atomic Model

This model was based on the quantum theory of radiation and the classical law of physics. It gave new idea of atomic structure in order to explain the stability of the atom and emission of sharp spectral lines.

### Postulates

- The atom has a central massive core nucleus where all the protons and neutrons are present. The size of the nucleus is very small.
- The electron in an atom revolve around the nucleus in certain discrete orbits. Such orbits are known as stable orbits or non – radiating or stationary orbits.
- An electron can move only in those permissive orbits in which the angular momentum ( $mvr$ ) of the electron is an integral multiple of  $h/2\pi$  Thus,

$$mvr = n \frac{h}{2\pi}$$

Where,  $m$  = mass of the electron,  $r$  = radius of the electronic orbit,  $v$  = velocity of the electron in its orbit.

- (iv) The angular momentum can be  $\frac{h}{2\pi}$ ,  $\frac{2h}{2\pi}$ ,  $\frac{3h}{2\pi}$ , .....  $\frac{nh}{2\pi}$ . This principal is known as quantization of angular momentum. In the above equation 'n' is positive integer which has been called as principal quantum number. It can have the values  $n=1,2,3,\dots$  (from the nucleus). Various energy levels are designed as  $K(n=1)$ ,  $L(n=2)$ ,  $M(n=3),\dots$ etc. Since the electron present in these orbits is associated with some energy, these orbits are called energy levels.
- (v) The emission or absorption of radiation by the atom takes place when an electron jumps from one stationary orbit to another.

### 09. Calculation of the radius of the Bohr's orbit :

Suppose that an electron having mass 'm' and charge 'e' revolving around the nucleus of charge 'Ze' (Z is atomic number & e is charge) with a tangential/linear velocity of 'v'. Further consider that 'r' is the radius of the orbit in which electron is revolving. According to Coulomb's law, the electrostatic force of attraction (F) between the moving electron and nucleus is -

$$F = \frac{KZe^2}{r^2}$$

Where :  $K = \text{constant} = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$

and the centripetal force  $F = \frac{mv^2}{r}$

Hence  $\frac{mv^2}{r} = \frac{KZe^2}{r^2}$  or,  $v^2 = \frac{KZe^2}{mr} \dots(1)$

From the postulate of Bohr,  $mvr = \frac{nh}{2\pi}$  or,  $v^2 = \frac{n^2h^2}{4\pi^2m^2r^2} \dots(2)$

From equation (1) and (2) :

$$\therefore r = \frac{n^2h^2}{4\pi^2mKZe^2}$$

On putting the value of e, h, m,

$$r = 0.529 \times \frac{n^2}{Z} \text{ \AA}$$

### 10. Calculation of velocity of an electron in Bohr's orbit

Velocity of the revolving electron in  $n^{\text{th}}$  orbit is given by

$$mvr = \frac{nh}{2\pi} \quad v = \frac{nh}{2\pi mr}$$

Putting the value of r in above equation

$$\text{then } v = \frac{nh \times 4\pi^2 mZe^2}{2\pi mn^2 h^2}, \quad v = \frac{2\pi Ze^2}{nh}$$

on putting the values of  $e$  and  $h$ ,

$$v = 2.188 \times 10^6 \times \frac{Z}{n} \text{ m/sec}$$

### 11. Calculation of energy of an electron :

The total energy of an electron revolving in a particular orbit is -

$$\text{T. E.} = \text{K. E.} + \text{P. E.}$$

$$\text{The K.E. of an electron} = \frac{1}{2}mv^2$$

$$\text{and the P.E. of an electron} = -\frac{KZe^2}{r}$$

$$\text{Hence, T.E.} = \frac{1}{2}mv^2 - \frac{KZe^2}{r} \quad \dots(3)$$

$$\text{But } \frac{mv^2}{r} = \frac{KZe^2}{r^2} \quad \text{or } mv^2 = \frac{KZe^2}{r}$$

Substituting the value of  $mv^2$  in the equation (3)

$$\text{T.E.} = \frac{KZe^2}{2r} - \frac{KZe^2}{r} = -\frac{KZe^2}{2r}$$

$$\text{So, T.E.} = -\frac{KZe^2}{2r}$$

Substituting the value of 'r' in the equation of T.E. .

$$E = -\frac{kZe^2}{2} \times \frac{4\pi^2 Ze^2 mk}{n^2 h^2} = -\frac{2\pi^2 Z^2 e^4 mk^2}{n^2 h^2}$$

Thus, the total energy of an electron in  $n^{\text{th}}$  orbit is given by

$$\begin{aligned} E_n &= \frac{2\pi^2 Z^2 e^4 mk^2}{n^2 h^2} \\ &= -13.6 \times \frac{Z^2}{n^2} \text{ eV/atom} \\ &= -21.8 \times 10^{-19} \times \frac{Z^2}{n^2} \text{ J/atom} \\ &= -313.6 \times \frac{Z^2}{n^2} \text{ Kcal/mole} \end{aligned}$$

### 12. Relation between P. E., K. E. & T. E. :

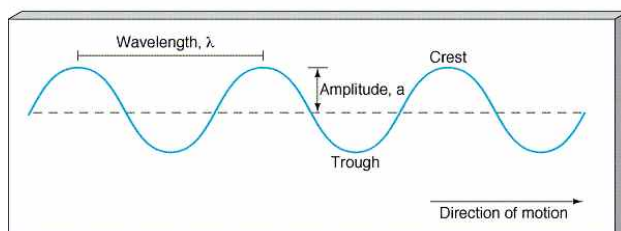
$$\text{P.E.} = -\frac{kZe^2}{r}, \quad \text{K.E.} = \frac{1}{2} \frac{kZe^2}{r}, \quad \text{T.E.} = -\frac{1}{2} \frac{kZe^2}{r},$$

$$T.E. = \frac{P.E.}{2} = -K.E.$$

### 13. Details About Waves

A wave motion is a means of transferring energy from one point to another point without any actual transportation of matter between these points. When we throw a piece of stone on the surface of water in a pond, we observe circles of ever increasing radius, till they strike the wall of the pond.

### 14. Some important terms related with wave motion.



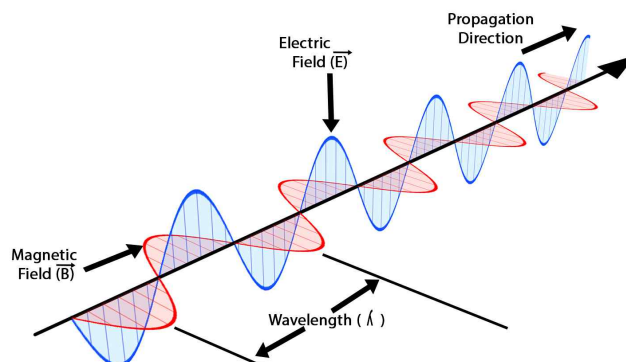
- (i) **Wave length ( $\lambda$ ):** The distance between two adjacent crest or trough of the wave (or the distance between two similar neighbouring points)
- (ii) **Time period (T):** Time for one complete oscillation of wave is called the period (T). Time taken by the wave to travel a distance equal to one wavelength. If C is the speed of wave, then  $C = \frac{\lambda}{T}$ .
- (iii) **Frequency (v):** Number of oscillations per unit time is called frequency.  $v = \frac{C}{\lambda}$
- (iv) **Wave number ( $\bar{v}$ ):** Number of wavelength per unit length.  $(\bar{v}) = \frac{1}{\lambda}$
- (v) **Amplitude (A):** It is the height of crest or depth of a trough of a wave.

### 15. Characteristics of electromagnetic radiations:

- (i) All electromagnetic waves move or travel with the same speed equal to that of light.
- (ii) They do not require any medium to propagate.
- (iii) These consist of electric and magnetic field that oscillate in the direction perpendicular to each other and to the direction in which the wave propagates (as shown in above diagram)

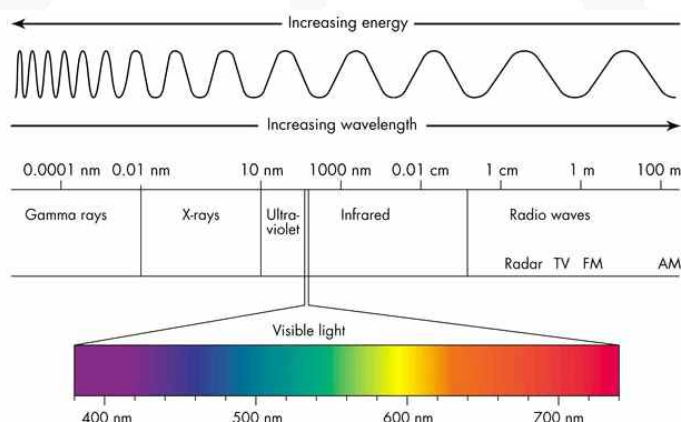


## Electromagnetic Wave



## 16. Electromagnetic Spectrum

Arrangement of various types of electromagnetic radiations in order of their increasing (or decreasing) wavelengths or frequencies is known as electromagnetic spectrum.



## 17. Planck's Quantum Theory

According to this theory atoms or molecules could emit or absorb energy only in discrete quantities (small packets) and not in any arbitrary amount. Planck gave the name quantum to the smallest quantity of energy that can be emitted in the form of E.M. radiation.

The energy of a photon is proportional to its frequency and is given by

$$E = h\nu \text{ where } h = 6.626 \times 10^{-34} \text{ J sec}$$

A body can emit or absorb energy only in terms of the integral multiples of quantum, i.e.

$$E = n \cdot h\nu, \text{ where } n = 1, 2, 3, \dots$$

i.e. a body can emit or absorb energy as  $h\nu$ ,  $2h\nu$  .... but it can not emit or absorb energy in fractional values of  $h\nu$  such as  $1.5 h\nu$ ,  $2.5 h\nu$ .

Einstein supported the planck's theory and explained the photoelectric effect considering that electromagnetic radiations also propagate in the form of photon. Energy of each photon

depends on frequency of light  $\left(E = h\nu = \frac{hc}{\lambda}\right)$ .

Since wave character of light explains the interference and diffraction phenomenon while the particle character explains, black body radiations and photoelectric effect, the light was considered to have wave as well as particle character [Dual character of light.]

- (i) Wave nature : diffraction, interference, polarisation.
- (ii) Particle nature : photoelectric effect.

## 18. Hydrogen Spectrum

Hydrogen spectrum is an example of line or atomic emission spectrum. When an electric discharge is passed through hydrogen gas at low pressure, a bluish light is emitted. All these lines of H-spectrum have Lyman, Balmer, Paschen, Barckett, Pfund and Humphrey series. These spectral series were named by the name of scientist discovered them. To evaluate wavelength of various H-lines Rydberg introduced the following expression,

$$\frac{1}{\lambda} = \frac{1}{\lambda} = \frac{\nu}{c} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

Where R is constant known as Rydberg's constant its value is  $109, 67800 \text{ m}^{-1}$

Although H-atom consists only one electron yet it's spectra consist of many spectral lines because electrons in different hydrogen atoms absorb different amount of energies and are excited to different energy levels. Since life time of electrons in these excited states is very small, they return to some lower energy level or even to the ground state in one or more jumps.

Maximum number of lines produced when an electron jumps from  $n$ th level to ground level =  $\frac{n(n-1)}{2}$ .

## 19. Lyman Series

- (a) It is a first series of spectral series of H.
- (b) It's value of  $n_1 = 1$  and  $n_2 = 2,3,4$ , where ' $n_1$ ' is ground state and ' $n_2$ ' is called excited state of electron present in H-atom.
- (c) If the electron goes to  $n_1 = 1$  from  $n_2 = 2$  — first Lyman series  
If the electron goes to  $n_1 = 1$  from  $n_2 = 3$  — Second Lyman series  
If the electron goes to  $n_1 = 1$  from  $n_2 = 4$  — third Lyman series ----- so on.

(d)  $\frac{1}{\lambda} = R_H \left[ \frac{1}{1^2} - \frac{1}{n_2^2} \right]$  where  $n_2 > 1$  always.

(e) For marginal line of limiting line  $n_2 = \infty$ . Hence the wavelength of marginal line =  $\frac{n_1^2}{R_H}$   
for all series. So, for Lyman series it is  $\frac{1}{R_H}$ .

## 20. Balmer Series :

- (i) It is second series of H-spectral series.
- (ii) It was found out in 1892 in visible region by **Balmer**.
- (iii) Balmer series was found out before all series because it was found in visible region.
- (iv) It's value of  $n_1 = 2$  and  $n_2 = 3, 4, 5, \dots$
- (v) If the electron goes to  $n_1 = 2$  from  $n_2 = 3$  — first Balmer series  
If the electron goes to  $n_1 = 2$  from  $n_2 = 4$  — Second Balmer series  
If the electron goes to  $n_1 = 2$  from  $n_2 = 5$  — third Balmer series ----- so on.

(vi) The wavelength of marginal line of Balmer series =  $\frac{n_1^2}{R_H} = \frac{2^2}{R_H} = \frac{4}{R_H}$ .

(vii)  $\frac{1}{\lambda} = R_H \left[ \frac{1}{2^2} - \frac{1}{n_2^2} \right]$  where  $n_2 > 2$  always.

## 21. Paschen Series :

- (i) It is the third series of H – spectrum.
- (ii) It was found out in infra red region by **Paschen**.
- (iii) It's value of  $n_1 = 3$  and  $n_2 = 4, 5, 6, \dots$
- (iv) If the electron goes to  $n_1 = 3$  from  $n_2 = 4$  — first Paschen series  
If the electron goes to  $n_1 = 3$  from  $n_2 = 5$  — Second Paschen series  
If the electron goes to  $n_1 = 3$  from  $n_2 = 6$  — third Paschen series ----- so on.

(v) The wavelength of marginal line of Paschen series =  $\frac{n_1^2}{R_H} = \frac{3^2}{R_H} = \frac{9}{R_H}$ .

(vi)  $\frac{1}{\lambda} = R_H \left[ \frac{1}{3^2} - \frac{1}{n_2^2} \right]$  where  $n_2 > 3$  always.

## 22. Brackett Series :

- (i) It is fourth series of H – spectrum.
- (ii) It was found out in infra red region by **Brackett**.
- (iii) It's value of  $n_1 = 4$  and  $n_2 = 5, 6, 7, \dots$

- (iv) If the electron goes to  $n_1 = 4$  from  $n_2 = 5$  — first Brackett series  
 If the electron goes to  $n_1 = 4$  from  $n_2 = 6$  — Second Brackett series  
 If the electron goes to  $n_1 = 4$  from  $n_2 = 7$  — third Brackett series ----- so on.
- (v) The wavelength of marginal line of Brackett series =  $\frac{n_1^2}{R_H} = \frac{4^2}{R_H} = \frac{16}{R_H}$ .
- (vi)  $\frac{1}{\lambda} = R_H \left[ \frac{1}{4^2} - \frac{1}{n_2^2} \right]$  where  $n_2 > 4$  always.

### 23. Pfund Series :

- (i) It is fifth series of H – spectrum.  
 (ii) It was found out in infra red region by Pfund.  
 (iii) It's value of  $n_1 = 5$  and  $n_2 = 6, 7, 8$  .....
- (iv) If the electron goes to  $n_1 = 5$  from  $n_2 = 6$  — first Pfund series  
 If the electron goes to  $n_1 = 5$  from  $n_2 = 7$  — Second Pfund series  
 If the electron goes to  $n_1 = 5$  from  $n_2 = 8$  — third Pfund series ----- so on.
- (v) The wavelength of marginal line of Pfund series =  $\frac{n_1^2}{R_H} = \frac{5^2}{R_H} = \frac{25}{R_H}$ .
- (vi)  $\frac{1}{\lambda} = R_H \left[ \frac{1}{5^2} - \frac{1}{n_2^2} \right]$  where  $n_2 > 5$  always.

### 24. Calculation of Rydberg Constant from bohr's atomic model

Suppose that an electron transit from first energy level to second energy level. Then, the change of energy. is given by

$$\Delta E = E_{n_2} - E_{n_1}$$

$$\text{or, } = \left[ \frac{-2\pi^2 m Z^2 e^4 k^2}{n_2^2 h^2} \right] - \left[ \frac{-2\pi^2 m Z^2 e^4 k^2}{n_1^2 h^2} \right] \quad \text{or, } \frac{hc}{\lambda} = \frac{-2\pi^2 m Z^2 e^4 k^2}{h^2} \times \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\text{or, } \frac{1}{\lambda} = \frac{2\pi^2 m Z^2 e^4 k^2}{ch^3} \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] = R_H \cdot Z^2 \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\text{or, } R_H = \frac{2\pi^2 m e^4 k^2}{ch^3} \quad \text{Rydberg constant}$$

### 25. Particle and Wave Nature of Electron

In 1924, de Broglie proposed that an electron, like light, behaves both as material particle and as a wave. This proposal gave a new theory, known as wave mechanical theory of matter. According to this theory, the electrons, protons and even atoms, when in motion, possess wave properties.



de Broglie derived an expression for calculating the wavelength of the wave associated with the electron. According to Planck's equation

$$E = h\nu = h \cdot \frac{c}{\lambda} \quad \dots(1)$$

The energy of a photon on the basis of Einstein's mass-energy relationship is

$$E = mc^2 \quad \dots(2)$$

Where,  $c$  is the velocity of the electron.

From (1) and (2) equation

$$h \times \frac{c}{\lambda} = mc^2$$

$$\lambda = \frac{h}{mc} = \frac{h}{p} \quad \dots(3)$$

Momentum of the moving electron is inversely proportional to its wavelength.

Let kinetic energy of the particle of mass ' $m$ ' is  $E$ .

$$E = \frac{1}{2}mv^2$$

$$2Em = m^2v^2$$

$$\sqrt{2Em} = mv = p \text{ (momentum)}$$

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2Em}} \quad \dots(4)$$

Let a charged particle, with charge  $q$  be accelerated with a potential of  $V$ ; then the kinetic energy may be given as :  $E=qV$

$$\frac{1}{2}mv^2 = qV$$

$$m^2v^2 = 2qVm$$

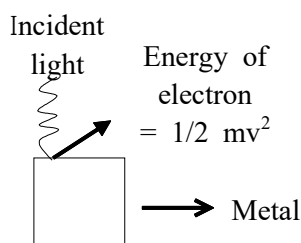
$$mv = \sqrt{2qVm}$$

$$\lambda = \frac{h}{\sqrt{2qVm}} \quad \dots(5)$$

and,

## 26. Photoelectric Effect

Emission of electrons from a metal surface when exposed to light radiations of appropriate wavelength is called photoelectric effect. The emitted electrons are called photoelectrons.



Work function or threshold energy may be defined as the minimum amount of energy required to eject electrons from a metal surface. According to Einstein,

Maximum kinetic energy of the ejected electron = absorbed energy – work function

$$\frac{1}{2} m v_{\max}^2 = h\nu - h\nu_0 = hc \left[ \frac{1}{\lambda} - \frac{1}{\lambda_0} \right]$$

where,  $\nu_0$  and  $\lambda_0$  are threshold frequency and threshold wavelength respectively.

### Stopping Potential

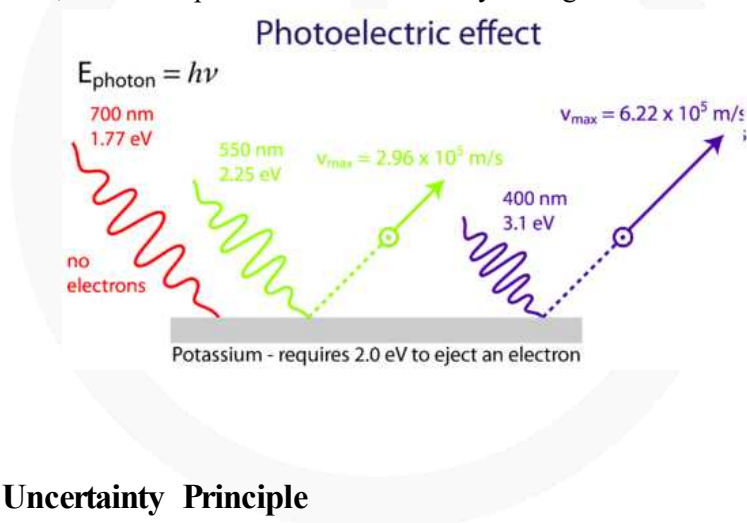
The minimum potential at which the photoelectric current becomes zero is called stopping potential.

If  $V_0$  is the stopping potential, then

$$eV_0 = h(\nu - \nu_0) \text{ or } V_0 = \frac{h(\nu - \nu_0)}{e} = \frac{\text{K.E.}_{\max}}{e}$$

### Some facts of Photoelectric Effect

- There is no time lag between incidence of light and emission of photoelectrons.
- For emission of photoelectrons, the frequency of incident light must be equal to or greater than the threshold frequency.
- Rate of emission of photoelectrons from a metal surface is directly proportional to the intensity of incident light.
- The maximum kinetic energy of photoelectrons depends on the frequency of incident radiation; but, it is independent of the intensity of light used.



## 27. Heisenberg's Uncertainty Principle

According to this principle it is impossible to measure simultaneously the exact position and exact momentum of a body as small as an electron. If uncertainty of measurement of position is  $\Delta x$  and uncertainty of measurement of momentum is  $\Delta p$  or  $m\Delta v$ , then according to Heisenberg,

$$\Delta x \cdot \Delta p \geq \frac{h}{4\pi} \quad \text{or} \quad \Delta x \cdot m\Delta v \geq \frac{h}{4\pi}$$

where  $h$  is Planck's constant

Like de Broglie equation, this principle has significance only for microscopic particles.

## 28. Wave Mechanical Model of Atom

The atomic model which is based on the particle and wave nature of the electron is known as wave mechanical model of the atom. This was developed by Erwin Schrodinger in 1926. This model describes the electron as a three-dimensional wave in the electronic field of positively charged nucleus.

### Significance of $\Psi$ :

The wave function may be regarded as the amplitude function expressed in terms of coordinates  $x$ ,  $y$  and  $z$ . The wave function may have positive or negative values depending upon the values of coordinates

### Significance of $\Psi^2$ :

$\Psi^2$  is a probability factor. It describes the probability of finding an electron within a small space. The space in which there is maximum probability of finding an electron is termed as orbital.

## 29. Quantum Numbers

Quantum numbers are to specify and display to complete information about size, shape and orientation of the orbital. These are principal, azimuthal and magnetic quantum number, which follows directly from solution of Schrodinger wave equation.

## 30. Principal Quantum Number ( $n$ ) :

- (i) It was proposed by Bohr and denoted by 'n'.
- (ii) It determines the average distance between electron and nucleus, means it is denoted the size of atom.
- (iii) It determines the energy of the electron in an orbit where electron is present.
- (iv) The maximum number of an electron in an orbit represented by this quantum number as  $2n^2$ .

## 31. Azimuthal Quantum Number of Angular Quantum Number ( $l$ ) -

- (i) It was proposed by Sommerfeld and denoted by 'l'.
- (ii) It determines the number of subshells or sublevels to which the electron belongs.
- (iii) It tells about the shape of subshells.
- (iv) It also expresses the energies of subshells  $s < p < d < f$  (Increasing energy).
- (v) The value of  $l$  is integral values upto  $(n-1)$ , starting from zero where 'n' is the number of principle shell.

(vi)

Value of $l$	0	1	2	3
Name of subshell	s	p	d	f
Shape of orbital	spherical	Dumbbell	Clover leaf (Except $d_{z^2}$ doughnut)	Complex

(vii) It represents the orbital angular momentum, which is equal to  $\frac{h}{2\pi} \sqrt{l(l+1)}$ .(viii) The number of electrons in subshell =  $2(2l+1)$ .

(ix) For a given value of 'n' the total value of 'l' is always equal to the value of 'n'.

**32. Magnetic Quantum Number (m) :**

- It gives the number of permitted orientations of subshells.
- The value of m varies from  $-l$  to  $+l$  through zero.
- Degenerate orbitals – Orbitals having the same energy are known as degenerate orbitals.  
e.g. for p subshell  $P_x$ ,  $P_y$  and  $P_z$  are degenerate orbitals.
- The number of degenerate orbitals of s subshell = 0.

**33. Spin quantum number (s) :**

- The value of 's' is  $+\frac{1}{2}$  or  $-\frac{1}{2}$ , which is signified as the spin or rotation or direction of electron on its axis during the movement.
- The spin may be clockwise or anticlockwise.
- It represents the value of spin angular momentum is equal to  $\frac{h}{2\pi} \sqrt{s(s+1)}$ .
- Maximum spin of an atom =  $\frac{1}{2} \times$  number of unpaired electrons.

**34. Shape and size of orbitals**

An orbital is the region of space around the nucleus within which the probability of finding an electron of given energy is maximum (90-95%). The shape of this region (electron cloud) gives the shape of the orbital. It is basically determined by the azimuthal quantum number  $l$ , while the orientation of orbital depends on the magnetic quantum number (m).



## 02 Structure of Atom

### 35. s-orbital ( $l = 0$ ):

These orbitals are spherical and symmetrical about the nucleus. The probability of finding the electron is maximum near the nucleus and keeps on decreasing as the distance from the nucleus increases. There is vacant space between two successive s-orbitals known as radial node. But there is no radial node for 1s orbital since it is starting from the nucleus.

### 36. p-orbital ( $l = 1$ ):

The probability of finding the p-electron is maximum in two lobes on the opposite sides of the nucleus. This gives rise to dumb-bell shape for the p-orbital  $l = 1$ . Hence,  $m = -1, 0, +1$ . Thus, p-orbital have three different orientations. These are designated as  $p_x, p_y$  &  $p_z$  depending upon whether the density of electron is maximum along the x y and z axis respectively.

### 37. d-orbital ( $l = 2$ ):

For d-orbitals,  $l = 2$ . Hence  $m = -2, -1, 0, +1, +2$ . Thus there are 5d orbitals. They have relatively complex geometry. Out of the five orbitals, the three ( $d_{xy}, d_{yz}, d_{zx}$ ) project in between the axis and the other two  $d_{z^2}$  and  $d_{x^2-y^2}$  lie along the axis.

### 38. Spherical nodes :

The spherical surface where probability of finding the electron is zero, is called spherical nodes.

No. of spherical nodes in any orbital =  $n-l-1$

### 39. Nodal Plane :

This is a plane passing through the nucleus where the probability of finding the electron is zero.

Number of nodal plane in a orbital =  $l$

Orbital	Nodal plane
$p_x$	yz
$p_y$	xz
$p_z$	xy
$d_{xy}$	yz,zx
$d_{yz}$	xy,xz
$d_{zx}$	xy,yz

### 40. Electronic Configuration

The distribution of electrons in different orbitals of atom is known as electronic configuration of the atoms. Filling up of orbitals in the ground state of atom is governed by the following rules:

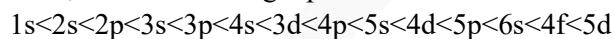
### 41. Aufbau Principle

According to this principle, “In the ground state, the atomic orbitals are filled in order of increasing energies i.e. in the ground state the electrons first occupy the lowest energy orbitals available”.

Lower the value of  $n+l$ , lower is the energy of the orbital and such an orbital will be filled up first.

When two orbitals have same value of  $(n+l)$  the orbital having lower value of “ $n$ ” has lower energy and such an orbital will be filled up first.

Thus, order of filling up of orbitals is as follows:



### 42. Pauli’s Exclusion Principle

According to this principle, “No two electrons in an atom can have same set of all the four quantum numbers  $n$ ,  $l$ ,  $m$  and  $s$ .”

According to this principle an orbital can accommodate at the most two electrons with spins opposite to each other. It means that an orbital can have 0, 1, or 2 electron. If an orbital has two electrons they must be of opposite spin.

### 43. Hund’s Rule of Maximum Multiplicity

According to this rule “Electron filling will not take place in orbitals of same energy until all the available orbitals of a given subshell contain one electron each with parallel spin”.

### 44. Extra stability If half filled and completely filled orbitals

#### Symmetry of orbitals

If the shift of an electron from one orbital to another orbital differing slightly in energy results in the symmetrical electronic configuration. It becomes more stable. For example  $p^3$ ,  $d^5$ ,  $f^7$  configurations are more stable than their near once.

#### Exchange energy

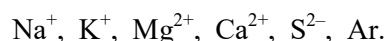
In case of half filled and completely filled orbitals, the exchange energy is maximum and is greater than the loss of energy due to the transfer of electron from a higher to a lower sublevel e.g. from 4s to 3d orbitals in case of Cu and Cr.

## CBSE Exam Pattern Exercise

### Subjective Questions (1)

#### (Q. No. 1 to 2) One Mark

1. Which of the following are isoelectronic species, i.e., those having the same number of electrons?



2. A certain particle carries  $2.5 \times 10^{-16}$  C of static electric charge. Calculate the number of electrons present in it.

#### (Q. No. 3 to 4) Two Marks

3. An element with mass number 81 contains 31.7% more neutrons as compared to protons. Assign the atomic symbol.
4. If the diameter of a carbon atom is 0.15 nm, calculate the number of carbon atoms which can be placed side by side in a straight line across the length of scale of length 20 cm long.

#### (Q. No. 5 to 6) Three Marks

5. How much energy is required to ionise a hydrogen atom if the electron occupies  $n = 5$  orbit? Compare your answer with the ionisation energy of hydrogen atom (energy required to remove the electron from  $n = 1$  orbit).
6. The quantum numbers of four electrons are given below. Arrange them in order of increasing energies. List if any of these combination (s) has/have the same energy:
- $n = 4, l = 2, m_l = -2, m_s = -1/2$
  - $n = 3, l = 2, m_l = -1, m_s = +1/2$
  - $n = 4, l = 1, m_l = 0, m_s = +1/2$
  - $n = 3, l = 2, m_l = -2, m_s = -1/2$

#### (Q. No. 7) Four Marks

7. If the position of the electron is measured within an accuracy of  $\pm 0.002$  nm, calculate the uncertainty in the momentum of the electron. Suppose the momentum of the electron is  $h/(4\pi \times 0.05)$  nm, is there any problem in defining this value?

#### (Q. No. 8 to 10) Five Marks

8. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition,  $n = 4$  to  $n = 2$  of  $\text{He}^+$  spectrum?
9. The work function for caesium atom is 1.9 eV. Calculate (a) the threshold wavelength and (b) the threshold frequency of the radiation. If the caesium element is irradiated with a wavelength

500 nm, calculate the kinetic energy and the velocity of the ejected photoelectron.

10.

- (i) Calculate the total number of electrons present in one mole of methane.
- (ii) Find (a) the total number and (b) the total mass of neutrons in 7 mg of  $^{14}\text{C}$  (Assume that the mass of neutron =  $1.675 \times 10^{-27}$  kg)
- (iii) Find (a) the total number and (b) the total mass of protons in 34 mg of  $\text{NH}_3$  at S.T.P.  
(Assume the mass of proton =  $1.6726 \times 10^{-27}$  kg)

Will the answer change if temperature and pressure are changed?







# Answer & Solution

Q1

No. of electron are:  $\text{Na}^+ = 11-1 = 10$ ,  $\text{K}^+ = 19-1 = 18$ ,  $\text{Mg}^{2+} = 12 - 2 = 10$ ,  
 $\text{Ca}^{2+} = 20-2 = 18$ ,  $\text{S}^{2-} = 16+2 = 18$ ,  $\text{Ar} = 18$ .

Hence, isoelectronic species are  $\text{N}^{3+}$  and  $\text{Mg}^{2+}$ ;  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{S}^{2-}$  and Ar.

Q2

Charges carried by one electron =  $1.6022 \times 10^{-19} \text{C}$

$\therefore$  Electrons present in particle carrying  $2.5 \times 10^{-16} \text{C}$  charges =  $\frac{2.5 \times 10^{-16}}{1.6022 \times 10^{-19}} = 1560$

Q3

Mass number = 81, i.e.,  $p + n = 81$

If protons =  $x$ , then neutrons =  $x + \frac{31.7}{100} \times x = 1.317x$

$\therefore x + 1.317x = 81$  or  $2.317x = 81$  or  $x = \frac{81}{2.317} = 35$

Thus, protons = 35, i.e., atomic no. = 35

Hence, the symbol is  $\frac{81}{35}\text{Br}$

Q4

Diameter of carbon atom = 0.15 nm =  $0.15 \times 10^{-9} \text{ m}$   $1.5 \times 10^{-10} \text{ m}$

Length along which atoms are to be placed = 20 cm  $20 \times 10^{-2} \text{ m} = 2 \times 10^{-1} \text{ m}$

$\therefore$  No. of C-atoms which can be placed along the line =  $\frac{2 \times 10^{-1}}{1.5 \times 10^{-10}} = 1.33 \times 10^9$

Q5

$$E_n = \frac{21.8 \times 10^{-9}}{n^2} \text{ J atom}^{-1}$$

For ionization from 5<sup>th</sup> orbit,  $n_1 = 5$ ,  $n_2 = \infty$

$$\therefore \Delta E = E_2 - E_1 = -21.8 \times 10^{-19} \left( \frac{1}{\frac{n}{2}} - \frac{1}{\frac{n}{1}} \right) = 21.8 \times 10^{-19} \left( \frac{1}{\frac{5}{2}} - \frac{1}{\frac{5}{1}} \right) = 21.8 \times 10^{-19}$$

## 02 Structure of Atom

$$\left(\frac{1}{5^2} - \frac{1}{\infty}\right) = 8.72 \times 10^{-20} \text{ J}$$

For ionization from 1<sup>st</sup> orbit,  $n_1 = 1$ ,  $n_2 = \infty$

$$\Delta E' = 21.8 \times 10^{-19} \left(\frac{1}{1^2} - \frac{1}{\infty}\right) = 21.8 \times 10^{-19} \text{ J}$$

$$\frac{\Delta E'}{\Delta E} = \frac{21.8 \times 10^{-19}}{8.72 \times 10^{-20}} = 25$$

Thus, the energy required to remove electron from 1<sup>st</sup> orbit is 25 times than that required to removed electron from 5<sup>th</sup> orbit.

Q6

The orbitals occupied by the electron are

- (i) 4 d
- (ii) 3 d
- (iii) 4 p
- (iv) 3 d
- (v) 3 p
- (vi) 4 p

Their energies will be in the order:

- (v) < (ii) = (iv) = < (vi) = (iii) < (i)

Q7

$$\Delta x = 0.002 \text{ nm} = 2 \times 10^{-3} \text{ nm} = 2 \times 10^{-12} \text{ m}$$

$$\Delta x \times \Delta p = \frac{h}{4\pi} \therefore \Delta p = \frac{h}{4\pi \Delta x} = \frac{6.626 \times 10^{-34} \text{ kg m}^2 \text{ s}^{-1}}{4 \times 3.14 \times (2 \times 10^{-12} \text{ m})} = 2.638 \times 10^{-23} \text{ kg m s}^{-1}$$

$$\text{Actual momentum} = \frac{h}{4\pi \times 0.05 \text{ nm}} = \frac{h}{4\pi \times 5 \times 10^{-11} \text{ m}} = \frac{6.626 \times 10^{-34} \text{ kg m}^2 \text{ s}^{-1}}{4 \times 3.14 \times 5 \times 10^{-11} \text{ m}}$$

$$= 1.055 \times 10^{-24} \text{ kg m s}^{-1}$$

It cannot be defined as the actual magnitude of the momentum is smaller than the uncertainty.

Q8

$$\text{For H-like particles in general } \bar{V} = \frac{2\pi^2 m Z^2 e^4}{ch^3} \left( \frac{1}{n_1} - \frac{1}{n_2} \right) = RZ^2 \left( \frac{1}{n_1} - \frac{1}{n_2} \right)$$

$\therefore$  For He<sup>+</sup> spectrum, for Balmer transition,  $n = 4$  to  $n = 2$ .

$$\bar{V} = \frac{1}{\lambda} = RZ^2 \left( \frac{1}{2^2} - \frac{1}{4^2} \right) = R \times 4 \times \frac{3}{16} = \frac{3R}{4}$$

$$\text{For hydrogen spectrum } \bar{V} = \frac{1}{\lambda} = R \left( \frac{1}{n_1} - \frac{1}{n_2} \right) = \frac{3}{4} R \text{ or } \frac{1}{n_1} - \frac{1}{n_2} = \frac{3}{4}$$

which can be so far  $n_1 = 1$  and  $n_2 = 2$ . i.e., the transition is from  $n = 2$  to  $n = 1$

Q9

- (i) Work function ( $W_0$ ) =  $h \nu_0$

$$\therefore \nu_0 = \frac{W_0}{h} = \frac{1.9 \times 1.602 \times 10^{-19} \text{ J}}{6.626 \times 10^{-34} \text{ J s}} = 4.59 \times 10^{14} \text{ s}^{-1} \quad (1 \text{ eV} = 1.602 \times 10^{-19} \text{ J})$$



## 02 Structure of Atom

$$(ii) \quad \therefore \lambda_0 = \frac{c}{v_0} = \frac{3.0 \times 10^8 \text{ ms}^{-1}}{6.59 \times 10^{14} \text{ s}^{-1}} = 6.54 \times 10^{-7} \text{ m} = 654 \times 10^{-9} \text{ m} = \mathbf{654 \text{ nm}}$$

$$(iii) \quad \text{K.E. of ejected electron} = h(v - v_0) = hc \left( \frac{1}{\lambda} - \frac{1}{\lambda_0} \right)$$

$$= (6.626 \times 10^{-34} \text{ J s}) (3.0 \times 10^8 \text{ m s}^{-1}) \left( \frac{1}{500 \times 10^{-9} \text{ m}} - \frac{1}{654 \times 10^{-9} \text{ m}} \right)$$

$$= \frac{6.626 \times 3.0 \times 10^{-26}}{10^{-9}} \left( \frac{154}{500 \times 654} \right) \text{ J} = \mathbf{9.36 \times 10^{-20} \text{ J}}$$

$$\text{K.E.} = \frac{1}{2} m v^2 = 9.36 \times 10^{-20} \text{ J or kg m}^2 \text{ s}^{-2}$$

$$\therefore \frac{1}{2} \times (9.11 \times 10^{-31} \text{ kg}) v^2 = 9.36 \times 10^{-20} \text{ kg m}^2 \text{ s}^{-2}$$

$$\text{or } v^2 = 2.055 \times 10^{11} \text{ m}^2 \text{ s}^{-2} = 20.55 \times 10^{10} \text{ m}^2 \text{ s}^{-2} \quad \text{or } v = \mathbf{4.53 \times 10^5 \text{ ms}^{-1}}.$$

Q10

(i) 1 molecule of  $\text{CH}_4$  contains electrons = 6+4=10

$\therefore$  1 mole, i.e.,  $6.022 \times 10^{23}$  molecules will contain electrons =  $\mathbf{6.022 \times 10^{23}}$

(ii)

(a) 1 g atom of  $^{14}\text{C}$  = 14 g =  $6.022 \times 10^{23}$  atoms =  $(6.022 \times 10^{23}) \times 8$  neutrons.)  
(as each  $^{14}\text{C}$  atom has 14-6=8 neutrons)

Thus, 14 g or 14000 mg have  $8 \times 6.022 \times 10^{23}$  neutrons

$$\therefore 7 \text{ mg will have neutron} = \frac{8 \times 6.022 \times 10^{23}}{14000} \times 7 = \mathbf{2.4088 \times 10^{21}}$$

(b) Mass of 1 neutrons =  $1.675 \times 10^{-27}$  kg

$$\therefore \text{Mass of } 2.4088 \times 10^{21} \text{ neutrons} = (2.4088 \times 10^{21}) (1.675 \times 10^{-27} \text{ kg}) = \mathbf{4.0347 \times 10^{-6} \text{ kg}}$$

(iii)

(a) 1 mol of  $\text{NH}_3$  = 17 g  $\text{NH}_3$  =  $6.022 \times 10^{23}$  molecules of  $\text{NH}_3$   
=  $(6.022 \times 10^{23}) \times (7+3)$  protons =  $6.022 \times 10^{24}$  protons

$$\therefore 34 \text{ mg, i.e., } 0.034 \text{ g } \text{NH}_3 = \frac{6.022 \times 10^{24}}{17} \times 0.034 = \mathbf{1.2044 \times 10^{22} \text{ protons.}}$$

(b) Mass of one proton =  $1.6726 \times 10^{-27}$  kg

$$\therefore \text{Mass of } 1.2044 \times 10^{22} \text{ protons} = (1.6726 \times 10^{-27}) \times (1.2044 \times 10^{22}) \text{ kg} = \mathbf{2.0145 \times 10^{-5} \text{ kg}}$$

There is no effect of temperature and pressure.

CLASS 11

# CBSE

# BIOLOGY

- ▶ Specially designed eBook for complete CBSE syllabus
- ▶ CBSE preparation strategy & direction, speedy revision
- ▶ Chapter-wise important Problem-Solving
- ▶ Theory, Formulas & Diagrams to crack CBSE
- ▶ Updated New Pattern Objective questions
- ▶ Detailed high quality video lectures by experienced faculties
- ▶ CBSE full preparation for Class XI & XII



**misostudy**  
connect smart learning

**JEE·NEET·AIIMS·CBSE·FOUNDATION**  
[www.misostudy.com](http://www.misostudy.com)

☎ 8929803804 (MON-FRI: 9am-6pm) [support@misostudy.com](mailto:support@misostudy.com)

MISO STUDY INDIA PVT. LTD.  
2ND FLOOR 65-A, OMPRO TOWER, KALU SARAI, NEW DELHI, DELHI 110016



# Class 11 | Biology

## 03 The Living Organism

has both unicellular

? When is a fungus

unicellular → Protista

Multi cellular → Penicillium

Misostudy.com



### Scientific eBook

This is a sample eBook. The eBook provides chapter-wise theories and examples, formulas, diagrams, and Exam pattern Problem-Solving of the full syllabus.



### Complete video lectures

The theory and Problem-Solving in this eBook provide specially designed the video lectures by experienced faculties. Get Free trial and preview on Misostudy.com.



## 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 } Not the defining properties/characters/features  
REPRODUCTION }

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

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 exhibits 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 occurring 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 occurring 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.

## 03 The Living Organism

- 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 occurring 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)


## 03 The Living Organism

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

<b>Characterization</b>	-	Identification of character
<b>Identification</b>	-	Identification of living organisms
<b>Nomenclature</b>	-	Nomenclature of living organisms
<b>Classification</b>	-	Classification of living organisms in groups

## 05. Systematics


- (i) The term “**Systematics**” was proposed 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.
- **Beta 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, carotenoids, 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.
- **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.
- **Adansonian system or Phenetic Classification or Numerical Classification.**
  - ❖ Proposed by “**Sokal 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 hierarchy 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 comprises 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<sup>th</sup> edition).
  - ❖ This 10<sup>th</sup> 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.	<i>Solanum tuberosum</i> (Potato)		<i>Mangifera indica</i> (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 origin.
- ❖ 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)
- ❖ Scientific 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 Botanical 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 & museums . 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 different

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 represents 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 character.

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 modern taxonomy, species is considered to be dynamic.

4. Classical taxonomy does not study evolution and inter-relationships of species. Modern Taxonomy studies primitiveness, advancement and inter-relationships of species.

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

## 03 The Living Organism

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 of biodiversity.

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 performed 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

## 03 The Living Organism

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 genus 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.

CLASS 12

# CBSE

## PHYSICS

- ▶ Specially designed eBook for complete CBSE syllabus
- ▶ CBSE preparation strategy & direction, speedy revision
- ▶ Chapter-wise important Problem-Solving
- ▶ Theory, Formulas & Diagrams to crack CBSE
- ▶ Updated New Pattern Objective questions
- ▶ Detailed high quality video lectures by experienced faculties
- ▶ CBSE full preparation for Class XI & XII



**misostudy**  
connect smart learning

**JEE·NEET·AIIMS·CBSE·FOUNDATION**  
[www.misostudy.com](http://www.misostudy.com)

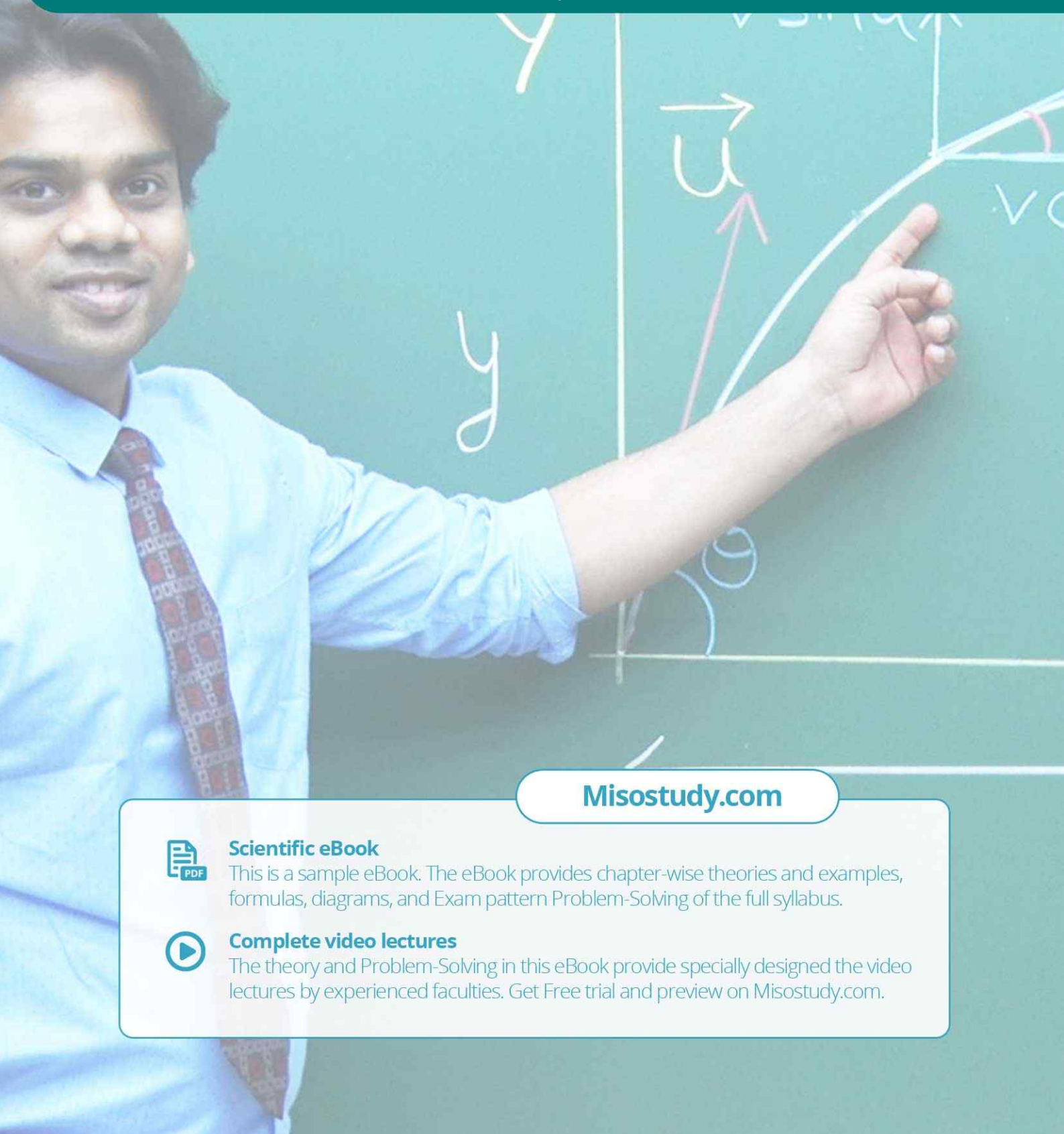
☎ 8929803804 (MON-FRI: 9am-6pm) [support@misostudy.com](mailto:support@misostudy.com)

MISO STUDY INDIA PVT. LTD.  
2ND FLOOR 65-A, OMPRO TOWER, KALU SARAI, NEW DELHI, DELHI 110016



# Class 12 | Physics

## 02 Communication System



Misostudy.com



### Scientific eBook

This is a sample eBook. The eBook provides chapter-wise theories and examples, formulas, diagrams, and Exam pattern Problem-Solving of the full syllabus.



### Complete video lectures

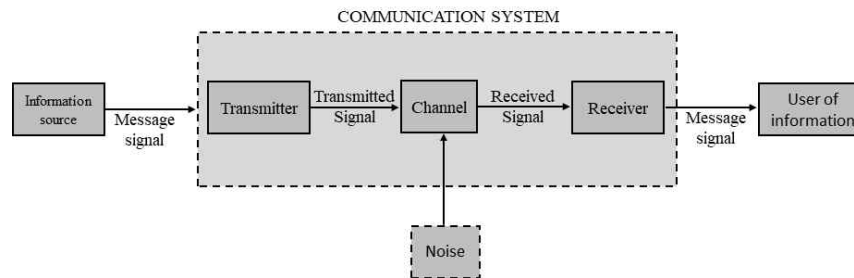
The theory and Problem-Solving in this eBook provide specially designed the video lectures by experienced faculties. Get Free trial and preview on Misostudy.com.

## 01. Introduction

The act of transmission and reception of information is known as communication.

## 02. Elements of a Communication System

Every communication system has three essential elements, transmitter, medium and receiver.



There are two basic modes of communication: point-to-point and broadcast.

## 03 Basic Terminology of Communication Systems

- (i) **Transducer** : Device that converts one form of energy into another.
- (ii) **Signal**: Information converted in electrical form and suitable for transmission. Signals can be either *analog* or *digital*.
- (iii) **Noise**: The unwanted signals that tend to disturb the transmission and processing of message signals
- (iv) **Transmitter**: Processes the incoming message signal so as to make it suitable for transmission through a channel and subsequent reception
- (v) **Receiver**: Extracts the desired message signals from the received signals at the channel output.
- (vi) **Attenuation**: It is the loss of strength a signal while propagating through a medium.
- (vii) **Amplification**: The process of increasing the amplitude of a signal using an electronic circuit called the amplifier.
- (viii) **Range** : Largest distance between a source and a destination up to which the signal is received with sufficient strength
- (ix) **Bandwidth**: Frequency range over which an equipment operates or the portion of the spectrum occupied by the signal.

- (x) **Modulation:** Original low frequency message/information signal cannot be transmitted to long distances because of obvious reasons. Therefore, at the transmitter, information contained in the low frequency message signal is superimposed on a high frequency wave, which acts as a carrier of the information
- (xi) **Demodulation:** The process of extraction of information from the carrier wave at the receiver
- (xii) **Repeater:** A combination of receiver and a transmitter. Communication satellite is essentially a repeater station ins space.

**NOTE** ☞ Undesirable effects in the course of signal transmission are

- (i) **Attenuation** : decrease in signal strength due to energy loss.
- (ii) **Distortion** : waveform perturbation
- (iii) **Interference** : contamination by extraneous signals.
- (iv) **Noise** : due to random electrical signal

### 03. Types of Transmission Media

Broadly, transmission media have been divided into two types

- (i) **Guided transmission medium:** That communication medium of channel which is used in point to point communication between a single transmitter and receiver.
- (ii) **Unguided transmission medium:** communication medium which is used, where there is no point to point contact between the transmitter and receiver.

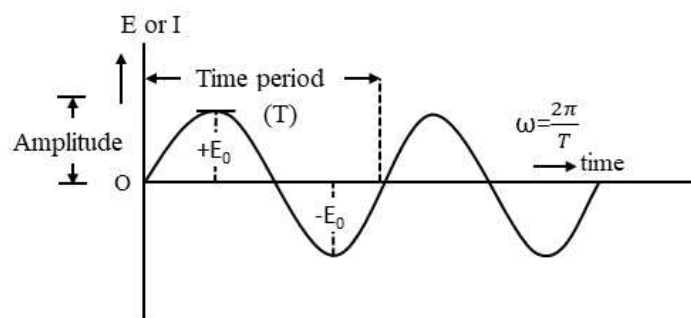
**Characteristics and quality of transmission medium depends upon**

- (i) Nature of transmission medium
- (ii) Nature of signal

The electrical signals are of two types:

- (i) **Analog signals:** An analog signal is that in which current or voltage value varies continuously with time

$$E = E_0 \sin(\omega t + \phi)$$



**Examples of Analog signals** are speech, music, sound produced by a vibrating tuning fork.

- (ii) **Digital signals:** A digital signal is discontinuous function of time, in contrast to an analog signal, wherein current or voltage value varies continuously with time.

**Examples of Digital signals** are (i) letters printed in a book (ii) listing of any data (iii) output of a digital computer (iv) electronic transmission of document at a distant place via telephone

#### 04. Propagation of Electromagnetic Waves

An antenna at the transmitter in communication using radio waves, radiates the electromagnetic waves which travel through space and reach the receiving antenna at the other end.

#### 05. Ground Wave

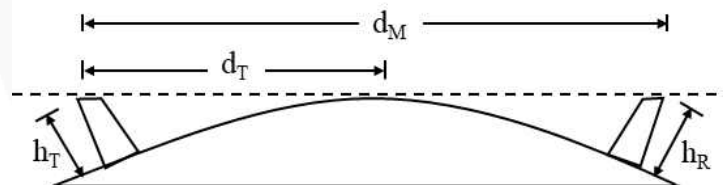
The antennas should have a size comparable to wavelength of signal. At longer wavelengths the antennas have large physical size and they are located on or very near to the ground.

#### 06. Sky Waves

Long distance communication can be achieved by ionospheric reflection of radio waves back towards the earth. The phenomenon of bending of em waves so that they are diverted towards the earth is similar to total internal reflection.

#### 07. Space wave

A space wave travels in a straight line from transmitting antenna to the receiving antenna. Space waves are used for line-of-sight (LOS) communication as well as satellite communication.



Where  $R$  is the radius of the earth

$$d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

where  $h_R$  is the height of receiving antenna.

#### 08. Determination of range

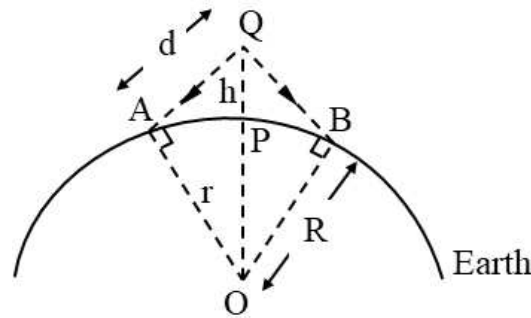
The range is determined by the height of transmitting antenna. The range  $AP$  or  $PB$  can be easily calculated by geometrical consideration. Suppose height of the tower is  $h$  and the radius of earth is  $r$  ( that is  $OA = OB = OP = r$ ). in the right-angled triangle  $OQA$ , we have

$$OQ^2 = QA^2 + OA^2$$

$$\therefore QA \approx AP = d$$

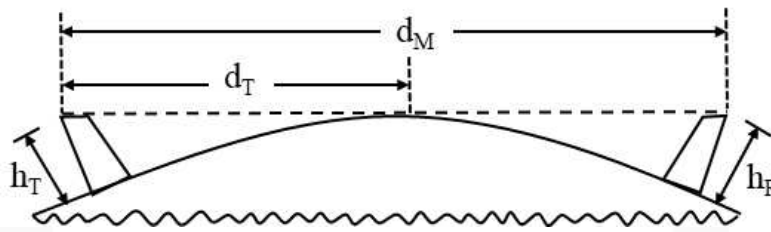
Therefore

$$\begin{aligned}(R+h)^2 &= R^2 + d^2 \\ R^2 + h^2 + 2Rh &= R^2 + d^2 \\ \therefore R^2 &\gg h^2 \\ \therefore d^2 &= 2Rh \\ d &= \sqrt{2Rh}\end{aligned}$$



For a height of 500 m,  $d = 80$  km

Hence maximum line-of-sight distance between two antennas will be calculated as follows



$$d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

Where  $d_M$ : Maximum line-of-sight distance between two antennas

$d_T$ : Radio horizon of transmitting antenna

$h_T$ : Height of transmitting antenna

$h_R$ : Height of receiving antennas

## 09. Modulation And its Necessity

**Size of the antenna or aerial :** An antenna or aerial is needed, both for transmission and reception. Each antenna should have a size comparable to the wavelength of the signals, (at least  $\lambda/4$  in size) so that time variation of the signal is properly sensed by the antenna.

**Effective power radiated by antenna :** Theoretical studies reveal that power  $P$  radiated from a linear.

antenna of length  $l$  is proportional  $(l/\lambda)^2$ , i.e.,  $P \propto \left(\frac{l}{\lambda}\right)^2$

**Modulation is the phenomenon of superimposing the low audio frequency baseband message or information signals (called the modulation signals) on a high frequency wave (called, the carrier wave). The resultant wave is called the modulated wave, which is transmitted.**



## 10. Amplitude Modulation

The amplitude modulation is produced by varying the amplitude of the carrier waves in accordance with the amplitude of the modulating wave (audio signal). Let the instantaneous values of the voltage of the carrier waves and the modulating signal be represented by

$$e_c = E_c \sin \omega_c t \quad \dots(i)$$

and  $e_m = E_m \sin \omega_m t \quad \dots(ii)$

respectively. Here,  $\omega_c = 2\pi f_c$  and  $\omega_m = 2\pi f_m$  are the angular frequencies of the carrier waves and the modulating signal respectively.

The instantaneous voltage of the modulated signal is given by

$$e = (E_c + E_m \sin \omega_m t) \sin \omega_c t$$

or  $e = E_c \left( 1 + \frac{E_m}{E_c} \sin \omega_m t \right) \sin \omega_c t \quad \dots(iii)$

In amplitude modulation, the degree of modulation is defined by a term called **modulation index**, which is given by

$$m_a = \frac{E_m}{E_c} \quad \dots(iv)$$

The modulation index is also called **modulation factor** or **depth of modulation**.

Therefore, the equation (iii) becomes

$$e = E_c (1 + m_a \sin \omega_m t) \sin \omega_c t$$

or  $e = (E_c + m_a E_c \sin \omega_m t) \sin \omega_c t \quad \dots(v)$

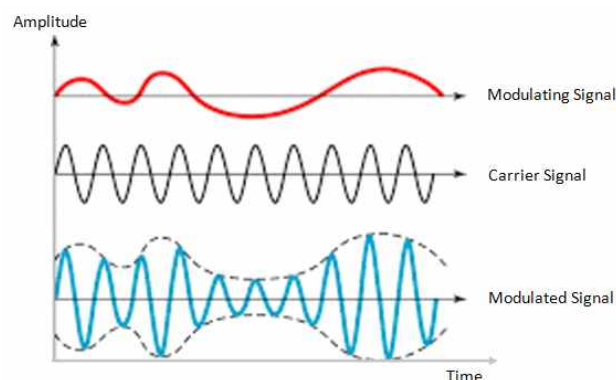
or  $e = E \sin \omega_c t,$

where  $E = E_c + m_a E_c \sin \omega_m t \quad \dots(vi)$

represents the amplitude of the modulated signal. It follows that the amplitude of the modulated signal varies with time in accordance with the amplitude of the modulating signal, Fig. gives the sketch of amplitude modulated signal with time. The amplitude of the modulated signal varies between  $E_{\min} (= E_c - E_m)$  and  $E_{\max} (= E_c + E_m)$ . It can be easily proved that

$$m_a = \frac{E_{\max} - E_{\min}}{E_{\max} + E_{\min}} \quad \dots(vii)$$

It follows that the expression for instantaneous value of the voltage of the modulated signal consists of three terms. The first term represents a wave form of carrier frequency  $\omega_c$  and the second term of frequency  $\omega_c - \omega_m$  (slightly less than  $\omega_c$ ), known as **lower sideband**. The third term represents a wave form of frequency  $\omega_c + \omega_m$  (slightly greater than  $\omega_c$ ), called the **upper sideband**.



**Bandwidth :**

The modulated signal lies in the frequency range from  $\omega_c - \omega_m$  to  $\omega_c + \omega_m$  i.e.  $2\omega_m$ . It is called the bandwidth of the modulated signal.

Thus,

$$\text{band width} = 2 \times \text{frequency of modulating signal}$$

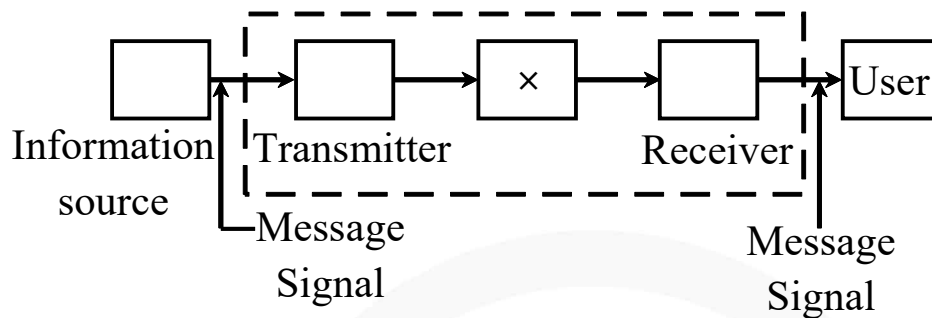


## CBSE Exam Pattern Exercise

### Subjective Questions (1)

#### (Q 1 to 3) One Mark

1. The figure given below shows the block diagram of a generalised communication system. Identify the element labelled X and write its function.



2. Why are broadcast frequencies (carrier waves) sufficiently spaced in amplitude modulated wave?
3. How does the effective power radiated from a linear antenna depend on the wavelength of the signal to be transmitted?

#### (Q 4 to 7) Two Marks

4. Mention the function of any two of the following used in communication system.
- Transducer
  - Repeater
  - Transmitter
  - Bandpass filter
5. A message signal of frequency 10 kHz and peak voltage 10 V is used to modulate a carrier of frequency 1 MHz and peak voltage 20 V.  
Determine
- the modulation index
  - the side bands produced.
- 6.
- What is line of sight communication?
  - Why is it not possible to use sky wave propagation of transmission of TV signals?
7. Define the term modulation. Draw a block diagram of a simple modulator for obtaining AM signal.

#### (Q 8 to 10) Three Marks

- 8.
- How is amplitude modulation achieved?
  - The frequencies of two side bands in an AM wave are 640 kHz and 660 kHz, respectively. Find the frequencies of carrier and modulating signal. What is the bandwidth required for amplitude modulation?
9. Optical communication system having an operating wavelength  $\lambda$  (in meters) can use only  $x\%$  of its source frequency as its channel bandwidth. The system is to be used for transmitting TV signals requiring a bandwidth of  $F$  hertz. How many channels can this system transmit simultaneously? Assuming all other factors to remain constant, show graphically the dependence of the number of channels that can be transmitted simultaneously on the operating wavelength of the system.
10. A signal is to be transmitted along a cable system of total length 125 km. The cable has an attenuation of  $7 \text{ dB km}^{-1}$ . Amplifiers, each having a gain of 43 dB, are placed at 6 km intervals along the cable
- State what is meant by the attenuation of a signal.
  - Calculate (i) the total attenuation caused by the transmission of the signal along the cable, (ii) the total signal gain as a result of amplification by all of the amplifiers along the cable.
  - The input signal has a power of 450 mW. Use your answers in (b) to calculate the output power of the signal as it leaves the cable system.



## Answer & Solution

Q1.

Labelled element X represents the channel. Its function is to transmit information from one place to another.

Q2.

To avoid mixing up of signal from different transmitters the broadcast frequencies are sufficiently spaced in amplitude modulated wave.

This can be done by modulating the signals on high frequency carrier waves, e.g. frequency band for satellite communication is 5.925-6.425 GHz.

Q3

The power radiated by a linear antenna of length  $L$  is proportional to  $(L/\lambda)^2$ , where  $\lambda$  is the signal wavelength. Since for efficient transmission, the signal should be transmitted with high power, the signal should be of small wavelength or high frequency.

Q4

(i) **Transducer :**

Any device which converts one converts pressure, temperature, etc. into varying electrical signals I.e. transducer converts physical signals into electrical signals.

(ii) **Repeater :**

It picks up the signals from the transmitter, amplifies it and transmit it to the receiver. Thus, repeater comprises up of receiver, transmitter and amplifier. Its function is to extend the range of communication.

(iii) **Transmitter :**

It comprises of message signal source, modulator and transmitting antenna. Transmitter make signals compatible for communication channel *via* modulator and antenna.

(iv) **Bandpass filter :**

A device which passes the signals with certain frequency range only.

Q5



- (i) Modulation index,  $\frac{E_m}{E_c} = \frac{10}{20} = 0.5$
- (ii) Side band frequencies =  $f_c \pm f_m$   
 $f_m = 10 \text{ kHz} \Rightarrow f_c = 1 \text{ MHz} = 1000 \text{ kHz}$   
 $\therefore$  Side band frequencies =  $1000 \pm 10$   
 $= 1010 \text{ kHz}, 990 \text{ kHz}$

Q6

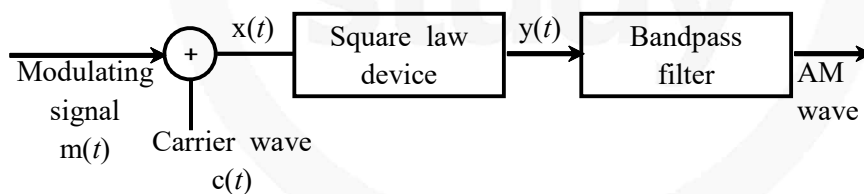
- (i) Line of Sight (LOS) is a type of propagation that can transmit & receive data only where transmit & receive stations are in view of each other without any sort of obstacle between them.

**Ex** – FM radio, Microwave & Satellite Transmission.

- (ii) The frequency of waves used for transmission of TV signals are of range 100 MHz-220 MHz. But ionosphere may be able to reflect waves back on earth of frequency up to 30 MHz. Therefore, ionosphere is unable to reflect TV waves (space waves) back on the earth.

Q7

Modulation is the process in which low frequency message signal is superimposed on high frequency carrier wave so that they can be transmitted over long distance. The block diagram for a simple modulator for obtaining AM signal is shown as below :



Q8

- (i) For amplitude modulation, message signal is used to modulate amplitude of a high frequency wave in input transistor of CE amplifier.

The output voltage is carrier signal varying in amplitude in accordance with biasing modulating voltage.

- (ii) Given, USB frequency = 660 kHz  
 and LSB frequency = 640 kHz  
 As USB =  $f_c + f_m = 660 \text{ kHz}$   
 and LSB =  $f_c - f_m = 640 \text{ kHz}$   
 $\therefore 2f_c = 660 + 640 = 1300$   
 So, carrier frequency  
 $f_c = 650 \text{ kHz}$   
 and  $2f_m = 20 \text{ kHz}$

$$\begin{aligned} \text{Bandwidth of frequencies required} \\ = \text{USB} - \text{LSB} = 660 - 640 = 20 \text{ kHz} \end{aligned}$$

Q9

Here, the wavelength of signal =  $\lambda$

$$\text{Therefore, frequency of the signal, } v = \frac{c}{\lambda}$$

Since  $x$  % of the source frequency can be used as the bandwidth,

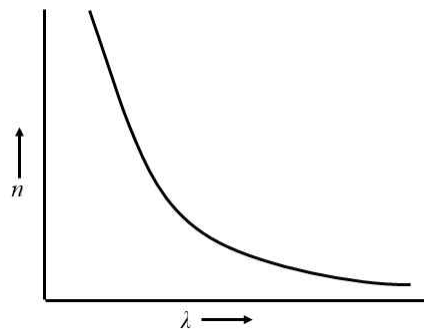
$$\text{available bandwidth} = \frac{v \times x}{100} = \frac{cx}{\lambda \times 100}$$

The bandwidth of the TV signal to be transmitted =  $F$

Therefore, number of channels, the system can transmit,

$$\begin{aligned} n &= \frac{\text{available bandwidth}}{\text{bandwidth of TV signal}} \\ &= \frac{cx/\lambda \times 100}{F} = \frac{cx}{100\lambda F} \end{aligned}$$

As  $n \propto 1/\lambda$ , the dependence of number of channels on the operating wavelength of the system will be as shown in Fig. below.



Q10

(a) The loss of power in a signal, as it travels, is called attenuation.

(b) (i) Here, attenuation =  $7 \text{ dB km}^{-1}$   
length of the cable =  $125 \text{ km}$   
Hence, total attenuation in the cable  
 $= 7 \times 125 = 875 \text{ dB}$

(ii) Since amplifiers are placed at  $6 \text{ km}$  intervals along the cable of length  $125 \text{ km}$ , it follows that in total  $20$  amplifiers will have to be placed.  
Gain of each amplifier =  $43 \text{ dB}$   
Therefore, total signal gain =  $20 \times 43 = 860 \text{ dB}$

(c) Here, power of the input signal,  
 $P_1 = 450 \text{ mW} = 450 \times 10^{-3} \text{ W}$   
The overall gain =  $860 - 875 = 15 \text{ dB}$   
If  $P_2$  is the output power, then

$$\text{gain (or loss) in signal power} = 10 \log \frac{P_2}{P_1}$$

$$\text{or } -15 = 10 \log \frac{P_2}{450 \times 10^{-3}} \text{ or } \log \frac{P_2}{450 \times 10^{-3}} = -1.5$$

$$\text{or } \frac{P_2}{450 \times 10^{-3}} = 0.0316.$$

$$\text{or } P_2 = 0.0316 \times 450 \times 10^{-3} = 14 \times 10^{-3} = \mathbf{14 \text{ mW}}$$



misostudy

## CBSE Exam Pattern Exercise

### Objective Questions (2)

- Which process is used in optical fibres
  - T.I.R
  - Scattering
  - Reflection
  - Dispersion
- An antenna behaves as a resonant circuit only when its length
  - equal  $\frac{\lambda}{4}$
  - equal  $\frac{\lambda}{2}$
  - equal  $\frac{\lambda}{2}$  or its integral multiple
  - equal to  $3\lambda$
- In modulation process, radio frequency wave is termed as
  - modulating wave
  - modulated wave
  - carrier wave
  - modified wave
- A payload that is invariably found on all communication satellites is
  - optical telescope
  - camera
  - transponder
  - spectrometer
- Attenuation in optical fibre is mainly due to
  - Scattering
  - Dispersion
  - Absorption and scattering
  - Reflection



# Answer & Solution

1. (a)  
T.I.R
2. (c)  
equal  $\frac{\lambda}{2}$  or its integral multiple
3. (c)  
carrier wave
4. (c)  
transponder
5. (c)  
Absorption and scattering

miso  
study



CLASS 12

# CBSE CHEMISTRY

- ▶ Specially designed eBook for complete CBSE syllabus
- ▶ CBSE preparation strategy & direction, speedy revision
- ▶ Chapter-wise important Problem-Solving
- ▶ Theory, Formulas & Diagrams to crack CBSE
- ▶ Updated New Pattern Objective questions
- ▶ Detailed high quality video lectures by experienced faculties
- ▶ CBSE full preparation for Class XI & XII



**misostudy**  
connect smart learning

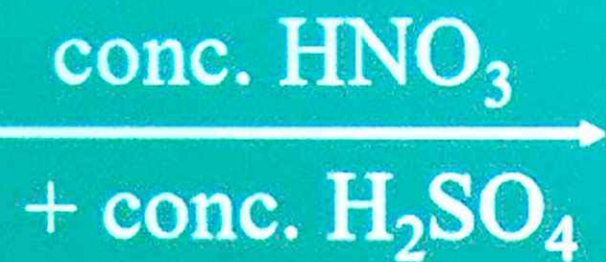
**JEE·NEET·AIIMS·CBSE·FOUNDATION**  
[www.misostudy.com](http://www.misostudy.com)

☎ 8929803804 (MON-FRI: 9am-6pm) [support@misostudy.com](mailto:support@misostudy.com)

MISO STUDY INDIA PVT. LTD.  
2ND FLOOR 65-A, OMPRO TOWER, KALU SARAI, NEW DELHI, DELHI 110016

# Class 12 | Chemistry

## 02 Solution



*p*-Nitro

Misostudy.com



### Scientific eBook

This is a sample eBook. The eBook provides chapter-wise theories and examples, formulas, diagrams, and Exam pattern Problem-Solving of the full syllabus.



### Complete video lectures

The theory and Problem-Solving in this eBook provide specially designed the video lectures by experienced faculties. Get Free trial and preview on Misostudy.com.

Misostudy  
Learning

www.misostudy.com

8929 803 804, support@



## 01. Introduction

When two or more chemically non-reacting substances are mixed and form homogeneous mixture it is called solution.

## 02. Types of Solution

	Solvent	Solute	Examples
1.	Gas	Gas	Mixture of gases, eg. air
2.	Gas	Liquid	Water vapour in air, mist. $\text{CHCl}_3(l) + \text{N}_2(g)$
3.	Gas	Solid	Smoke, camphor (s) + $\text{N}_2(g)$
4.	Liquid	Gas	$\text{CO}_2$ gas dissolve in water (aerated drink), soda water.
5.	Liquid	Liquid	Mixture of miscible liquids e.g. alcohol in water.
6.	Liquid	Solid	Salt in water, sugar in water.
7.	Solid	Gas	hydrogen over palladium.
8.	Solid	Liquid	Mercury in zinc, mercury in gold i.e. all amalgams.
9.	Solid	Solid	Alloys e.g. copper in gold. zinc in copper.

## 03. Mass Percentage

It may be defined as the number of parts of mass of solute per hundred parts by mass of solution.

$$\% \text{ by mass } \left( \frac{w}{W} \right) = \frac{\text{Wt. of solute}}{\text{Wt. of solution}} \times 100$$

[X % by mass means 100 gm solution contains X gm solute; (100–X) gm solvent]

## 04. Mass-Volume Percentage (W/V %) :

It may be defined as the mass of solute present in 100 cm<sup>3</sup> of solution. For example, If 100 cm<sup>3</sup> of solution contains 5 g of sodium hydroxide, then the mass-volume percentage will be 5% NaOH solution.

$$\% \left( \frac{w}{V} \right) = \frac{\text{wt. of solute (in gm)}}{\text{volume of solution (in mL)}} \times 100$$

[X%  $\left( \frac{w}{V} \right)$  means 100 ml solution contains X gm solute]

### 05. Volume Percent

It can be represented as % v/v or % volume and used to prepare such solutions in which both components are in liquids state. It is the number of parts of by volume of solute per hundred parts by volume of solution

Therefore,

$$\% \left( \frac{v}{V} \right) = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100$$

### 06. Parts Per Million (ppm)

This method is used for expressing the concentration of very dilute solutions such as hardness of water, air pollution etc.

$$\text{ppm of substance} = \frac{\text{Mass of solute} \times 10^6}{\text{Mass of solution}} = \frac{\text{Volume of solute} \times 10^6}{\text{Volume of solution}}$$

### 07. Mole Fraction:

The ratio of the number of moles of one component to the total number of all the components present in the solution, is called the mole fraction of that component.

Mole fraction of solute  $X_A$  is given by 
$$X_A = \frac{n_A}{n_A + n_B} = \frac{n_A}{\sum n}$$

Mole fraction of solvent  $X_B$  is given by 
$$X_B = \frac{n_B}{n_A + n_B} = \frac{n_B}{\sum n}$$

where  $n_A$  is moles of solute A and  $n_B$  is moles of solvent B.

For binary solution of A & B  $X_A + X_B = 1$

### 08. Molarity (Molar Concentration) :

It is defined as the number of moles of the solute dissolved in per litre of the solution, i.e.,

$$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution (in l)}} = \frac{w_A}{m_A \times V} = \frac{c(\text{gm/l})}{m_A} = \frac{\% \frac{W}{W} \times d \times 10}{m_A}$$

where let  $w_A$  g of the solute of molecular mass  $m_A$  be dissolved in  $V$  litre of solution,  $d$  = density of solution in g/mL.

### 09. Molarity of Dilute Solution :

$$\begin{array}{ccc} \text{Before dilution} & & \text{After dilution} \\ M_1V_1 & = & M_2V_2 \end{array}$$

#### Molarity of mixing :

Let there be three samples of solution (containing same solvent and solute) with their molarity  $M_1$ ,  $M_2$ ,  $M_3$  and volumes  $V_1$ ,  $V_2$ ,  $V_3$  respectively. These solutions are mixed; molarity of mixed solution may be given as:

$$M_1V_1 + M_2V_2 + M_3V_3 = M_R (V_1 + V_2 + V_3)$$

where,  $M_R$  = Resultant molarity

$V_1 + V_2 + V_3$  = Resultant volume after mixing

### 10. Some Important Point :

[Note : Molarity is dependent on volume, therefore, it depends on temperature.]

1 M	Molar solution, i.e., molarity is 1
0.5 M or M/2	Semimolar
0.1 M or M/10	Decimolar
0.01 M or M/100	Centimolar
0.001 M or M/1000	Millimolar

### 11. Molality (m) :

The number of moles or gram-mole of solute dissolve in 1000 gram of the solvent is called molality of the solution.

$$\text{Molality of a solution} = \frac{\text{Number of moles of solute}}{\text{Amount of solvent in kg.}} = \frac{\text{Number of moles of solute} \times 1000}{\text{Amount of solvent in grams.}}$$

### 12. Normality (N) :



The number of equivalents or gram equivalents of solute dissolved in one litre of the solution is known as normality (N) of the solution.

$$\text{Normality (N)} = \frac{\text{Number of gram equivalents of solute}}{\text{volume of solution in litre}} = \frac{\text{weight of solute in gram}}{\text{equivalent weight} \times \text{volume of sol}}$$

$$= \frac{\text{strength of solution in gram/litre}}{\text{Equivalent weight of solute}}$$

Equivalent weight of a substance is that weight which reacts with or displaces one gram of hydrogen, 8 grams of oxygen or 35.5 grams of chlorine.

### 13. Solubility of Gases

Gases dissolve in liquids in solids. For example, soda-water contains carbon dioxide dissolved in water under high pressure. Oxygen is sufficiently soluble in water to allow survival of aquatic life in lakes, rivers and oceans.

The solubility of a gas in a liquid is determined by several factors. In addition to the nature of the gas and the liquid, solubility of the gas depends on the temperature and pressure of the system. The solubility of a gas in a liquid is governed by Henry's Law which states that the solubility of a gas in a liquid is directly proportional to the pressure of the gas.

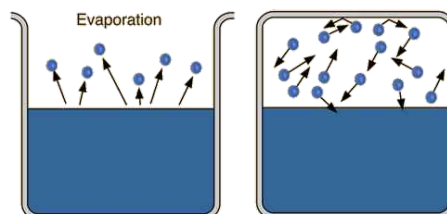
*Mole fraction of the gas in a solution is proportional to the partial pressure of the gas. Or, partial pressure of the gas in solution =  $K_H \times$  mole fraction of the gas in solution. Here  $K_H$  is Henry's law constant.*

### 14. Vapour Pressure :

#### The Evaporation of a Liquid in a Closed Container

When a liquid is taken in a closed vessel at constant temperature, then there are two process which takes place.

- (i) **evaporation**
- (ii) **condensation**



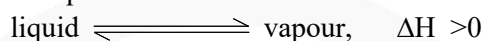
In the constant evaporation from the surface particles continue to break away from the surface of the liquid.

As the gaseous particles bounce around, some of them will hit the surface of the liquid again, and will be trapped there. This is called condensation. The rate of condensation increases with time, but rate of evaporation remain constant. There will rapidly be an equilibrium set up in which the number of particles leaving the surface is exactly balanced by the number rejoining it.

This pressure at equilibrium is called the saturated vapour pressure (also known as saturation vapour pressure).

### 15. Effect of Temperature on Vapour Pressure

When the space above the liquid is saturated with vapour particles, you have this equilibrium occurring on the surface of the liquid :



The forward change (liquid to vapour) is endothermic. It needs heat to convert the liquid into the vapour. According to Le Chatelier, increasing the temperature of a system in a dynamic equilibrium favours the endothermic change. That means increasing the temperature increase the amount of vapour present, and so increases the saturated vapour pressure.

### 16. Raoult's Law for Volatile Solute :

For a two component solution A (volatile) and B (volatile) the vapour pressure of solution is given by.

Vapour pressure of solution = Vapour pressure of solvent in solution + Vapour pressure of solute

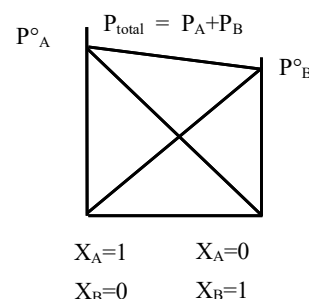
According to Raoult's Law partial. pressure of a component is equal to its mole fraction in solution multiplied with partial pressure in pure state

$$\text{Thus } P_A = P_A^\circ X_A$$

$P_A^\circ$  = vapour pressure in pure state of A

$X_A$  = Mole fraction of A in solution

$P_A$  = Partial pressure of A in solution



$$\text{Total vapour pressure of solution } P = P_A^\circ X_A + P_B^\circ X_B$$

## 17. Types of Solutions :

- (a) **Ideal Solution** : An ideal solution may be defined as the one which obeys Raoult's law over all concentration ranges at a given temperature. The total vapour pressure of an ideal solution containing liquids A and B is given by the following equation.

$$P = P_A + P_B = P_A^0 X_A + P_B^0 X_B$$

<i>Example</i>	benzene + toluene	chlorobenzene + bromobenzene
	ethyl bromide + ethyl iodide	n-butyl chloride + n-butyl bromide
	ethyl alcohol + methyl alcohol	

- (b) **Non-ideal solutions** : Solutions which do not over Raoult's law over all concentration ranges at constant temperature are called non-ideal solutions.

## 18. Distinction Between Ideal & Non Ideal Solutions

S.No.	Ideal Solution	Non Ideal Solution
1.	They obey Raoult's Law	They do not obey Raoult's Law
2.	$\Delta H_{\text{mixing}} = 0 \Rightarrow$ no heat is absorbed or released during dissolution	$\Delta H_{\text{mixing}} \neq 0 \Rightarrow$ no heat is absorbed or released during dissolution
3.	$\Delta V_{\text{mixing}} = 0 \Rightarrow$ the total volume of the solution is equal to the sum of the volume of the pure liquids mixed to form the solution	$\Delta V_{\text{mixing}} \neq 0 \Rightarrow$ the total volume of the solution is not equal to the sum of the volume of the pure liquids mixed to form the solution
4.	In ideal solution $P_A = P_A^0 X_A$	In non ideal solution $P_A \neq P_A^0 X_A$
5.	Components of ideal solution can be separated in pure form by fractional distillation	Components of non ideal solution can not be separated in pure form by fractional distillation

## 19. Types of Non - Ideal Solutions

- (I) Non ideal solutions showing positive deviation.  
(II) Non ideal solutions showing negative deviation.

## 20. Non Ideal Solutions Showing Positive Deviation

Condition for forming non-ideal solution showing positive deviation from Raoult's law. Two liquids A and B on mixing form this type of solution when

- A—B attractive force should be weaker than A—A and B—B attractive forces.
- 'A' and 'B' have different shape, size and character.
- 'A' and 'B' escape easily showing higher vapour pressure than the expected value.

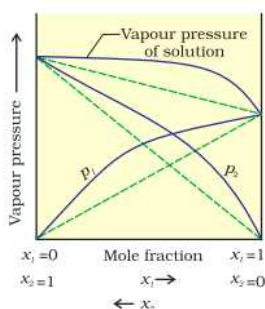
**Example**

acetone + ethanol  
water + ethanol  
acetone + benzene

acetone + CS<sub>2</sub>  
CCl<sub>4</sub> + toluene  
CCl<sub>4</sub> + CH<sub>3</sub>OH

water + methanol  
CCl<sub>4</sub> + CHCl<sub>3</sub>  
cyclohexane + ethanol

## 21. Graphical Representation of Vapour Pressure of Non-Ideal Solution Showing Positive Deviation



## 22. Non Ideal Solutions Showing Negative Deviation.

**Condition for forming non-ideal solution showing negative deviation from Raoult's law.**

Two liquids A and B on mixing form this type of solution when

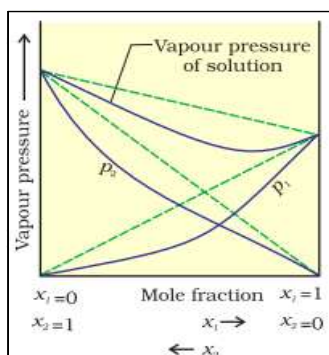
- A—B attractive force should be greater than A—A and B—B attractive forces.
- 'A' and 'B' have different shape, size and character.
- Escaping tendency of both components 'A' and 'B' is lowered showing lower vapour pressure than expected ideally.

**Example**

acetone + aniline;  
chloroform + diethyl ether,  
chloroform + benzene  
water + HCl

CH<sub>3</sub>OH + CH<sub>3</sub>COOH;  
acetic acid + pyridine;  
H<sub>2</sub>O + HNO<sub>3</sub>;

## 23. Graphical Representation of Vapour of non-ideal Solution Showing Negative Deviation



## 24. Distinction Between Non Ideal Solutions Showing Positive Deviation & Negative Deviation

S.NO.	Showing positive deviation	Showing negative deviation
1.	$\Delta H_{\text{mix}} > 0$ . (endothermic dissolution i.e. heat is absorbed)	$\Delta H_{\text{mix}} < 0$ . (Exothermic dissolution i.e. heat is evolved)
2.	$\Delta V_{\text{mix}} > 0$ . (Volume is increased after dissolution)	$\Delta V_{\text{mix}} < 0$ . (Volume is decreased after dissolution)
3.	$p_A > p_A^0 X_A$ ; $p_B > p_B^0 X_B$ , $\therefore p_A + p_B > p_A^0 X_A + p_B^0 X_B$	$p_A < p_A^0 X_A$ ; $p_B < p_B^0 X_B$ , $\therefore p_A + p_B < p_A^0 X_A + p_B^0 X_B$

## 25. Colligative Properties

The properties of dilute solutions containing nonvolatile solute, which depends upon relative number of solute and solvent particles but do not depend upon their nature are called colligative properties.

Some of the colligative properties are

- (i) Relative lowering of vapour pressure
- (ii) Elevation in boiling point
- (iii) Depression in freezing point and
- (iv) Osmotic pressure.

## 26. Factor that Affect the Colligative Property

The number of solute particles in solution. To be more accurate, the colligative property depends upon the fraction of solute and solvent particles in solution.

- (1) Nature of the solvent
- (2) Independent of the nature of the solute
- (3) Extent of association and dissociation of solute particles in solution.



## 27. Relative Lowering of Vapour Pressure

As shown earlier the mathematical expression for relative lowering of vapour pressure is as follows

$$\frac{\Delta P}{P_A^{\circ}} = X_B = \text{mole fraction of solute}$$

$\Delta P = P_A^{\circ} - P_A = \text{lowering of vapour pressure}$

$P_A = \text{vapour pressure of pure solvent}$

Molecular mass of non-volatile substance can be determined from relative lowering of vapour pressure

$$\frac{P_A^{\circ} - P}{P_A^{\circ}} = \frac{W_B/M_B}{W_A/M_A + W_B/M_B}$$

For dilute solution  $W_B/M_B < W_A/M_A$  and hence  $W_B/M_B$  may be neglected in the denominator. So

$$\frac{P_A^{\circ} - P_A}{P_A^{\circ}} = \frac{W_B/M_B}{W_A/M_A} = \frac{W_B}{W_A} \times \frac{M_A}{M_B} \text{ or } M_B = \frac{W_B/M_A}{W_A} \left( \frac{P_A^{\circ}}{P_A^{\circ} - P_A} \right)$$

## 28. Elevation in Boiling Point

The boiling points elevates when a non-volatile solute is added to a volatile solvent. Which occurs due to lowering of vapour pressure. The boiling point of a liquid may be defined as the temperature at which its vapour pressure becomes equal to atmospheric pressure.

So when a non-volatile solute is added to a volatile solvent results lowering of vapour pressure and consequent elevation of boiling point. where

$$\Delta T_b = T_b - T_b^{\circ}$$

$\Delta T_b = \text{elevation in B.P.}$

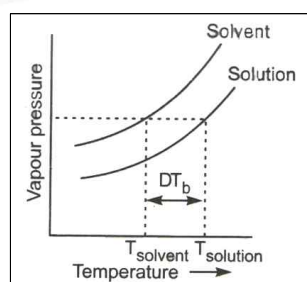
$\Delta P = \text{lowering of V.P.}$

$X_B = \text{mole fraction of solute}$

$K = \text{elevation constant}$

$T_b^{\circ} = \text{boiling point of solvent}$

$T_b = \text{boiling point of solution}$



It is found that elevation of boiling point is directly proportional to the number of moles of the solute in given amount of the solvent(m).

$$\Delta T_b \propto m$$

$$\Delta T_b \propto K_b m$$

Where 'm' is the molality of solution.

Where  $K_b$  is ebullioscopic or boiling point elevation constant. When molality of the solution is equal to one. Then

$$\Delta T_b = K_b$$

**Determination of  $K_b$  of solvent:**

$$K_b = \frac{RT_b^2}{1000L_v}$$

where R is molar gas constant,  $T_b$  is the boiling point of the solvent on Kelvin scale and  $L_v$  the latent heat of vaporization of solvent in calories per gram.

$$\text{For water} \quad K_b = \frac{2 \times (373)^2}{1000 \times 540} = 0.515 \text{ K}\cdot\text{kg/mol}$$

## 29. Depression in Freezing Point

The freezing point of a pure liquid is fixed. If a non-volatile solute is dissolved in a liquid the freezing point of the solution is lowered. The freezing point is that temperature at which the solvent has the same vapour pressure in two phases liquid solution and solid solvent. Since the solvent vapour pressure in solution is depressed. Its vapour pressure will become equal to that of the solid solvent at a lower temperature.

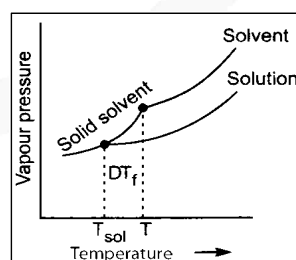
$$\Delta T_f = T_f^0 - T_f$$

It is found that depression in freezing point is directly proportional to the number of moles of the solute in given amount of the solvent(m).

Hence  $\Delta T_f \propto m$

$$\Delta T_f \propto K_f m$$

Where m = molarity of the solution.



$K_f$  = molal depression constant

When molarity (m) of the solution is one. then

$$\Delta T_f = K_f$$

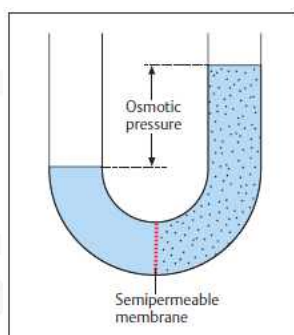
Hence molal depression constant or molal cryoscopic constant may be defined as “the depression in freezing point when one mole of non-volatile solute is dissolved per kilogram (1000 gm) of solvent” and molal depression constant is defined as “the depression in freezing point when one mole of non-volatile solute is dissolved per litre (1000 ml) of solvent.” The molecular mass of the non-volatile solute may be calculated by the use of following mathematical equation

$$M_B = \frac{K_f \times W_B \times 1000}{W_A \times \Delta T_f}$$

Where  $W_A$  = mass of solvent,  $W_B$  = mass of solute,  
 $M_A$  = Molar mass of solvent,  $M_B$  = Molar mass of solute.

### 30. Osmotic Pressure

- (i) **Osmosis** : Spontaneous flow of solvent molecules through a semipermeable membrane from a pure solvent to the solution (or from a dilute solution to a concentrated solution) is termed as osmosis.



- (ii) **Osmotic Pressure** :

When a solution is separated from the pure solvent with the help of a semipermeable membrane. There occurs the flow of solvent molecules from the pure solvent to the solution side. The flow of solvent molecules from a region of higher concentration of solvent to the region of lower concentration of solvent is termed as the phenomenon of osmosis. This also happens when two solution of different concentrations are separated by a semipermeable membrane.

The excess pressure that must be applied to the solution side to prevent the passage of solvent into it through a semipermeable membrane.

- (iii) **Theory of Dilute Solutions** :

The osmotic pressure of dilute solution was the same as the solute would have exerted if it were a gas at the same temperature as of the solution and occupied a volume equal to that of the solution. This generalization is known as Van't Hoff theory of dilute solutions. The osmotic pressure is a colligative property. So the osmotic pressure is related to the number of moles of the solute by the following relation

$$\pi V = nRT$$

$$\pi = \frac{n}{V} RT \quad (\because \frac{n}{V} = C)$$

$$\pi = CRT$$

Here C = concentration of solution in moles per litre;

R = solution constant;

T = temperature in Kelvin degree;

n = number of moles of solute; and

V = volume of solution.

This equation is called Van't Hoff's equation.

### 31. Type of Solution :

(i) **Isotonic solution :**

The two solutions having equal osmotic pressure are termed as isotonic solution.

(ii) **Hypertonic solution :**

A solution having higher osmotic pressure than some other solution is said to be called hypertonic solution.

(iii) **Hypotonic solution :**

A solution having a lower osmotic pressure relative to some other solution is called hypotonic solution.

#### Semipermeable membrane :

A membrane which allows the passage of solvent molecules but not that of solute. When a solution is separated from the solvent by it is known as semipermeable membrane.

Some example of it are as follows

(a) Copper ferrocyanide  $\text{Cu}_2[\text{Fe}(\text{CN})_6]$

(b) Calcium phosphate membrane and

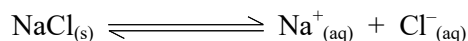
(c) Phenol saturated with water.

#### Reverse Osmosis :

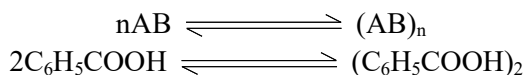
If a pressure greater than the osmotic pressure is applied on the concentrated solution, the solvent starts to flow concentrated solution to dilute solution (or pure solvent). This is reverse osmosis. One of its chief uses is desalination of sea water to get pure drinking water.

### 32. Abnormal Molecular Masses

Vapour pressure lowering, boiling point elevation, freezing point depression and osmotic pressure are colligative properties which depend upon the fraction of solute and solvent particles in solution and not upon the chemical nature of the solute. If solute molecules dissociates in solution, there are more particles in solution and therefore, lowering of vapour pressure shows an increased effect.



If the solute molecules associates in solution, there are less particles in solution, and therefore lowering of vapour pressure shows a decreased effect.



### 33. Vant Hoff Factor


In 1886, Van't Hoff, Jacobs Henricus (Dutch chemist, 1859,-1911) introduced a factor 'i' known as Van't Hoff factor to express the extent to association or dissociation of a solute in solution. It can be calculated as:

$$\begin{aligned} i &= \frac{\text{number of solute particles actually present in solution}}{\text{number of solute particles dissolved}} \\ &= \frac{\text{Observed colligative property}}{\text{normal colligative property}} = \frac{\text{observed molality}}{\text{normal molality}} = \frac{\text{normal molecular weight of solute}}{\text{observed molecular weight of solute}} \end{aligned}$$

The Van't Hoff factor for a solute can be calculated by the following modified equations:

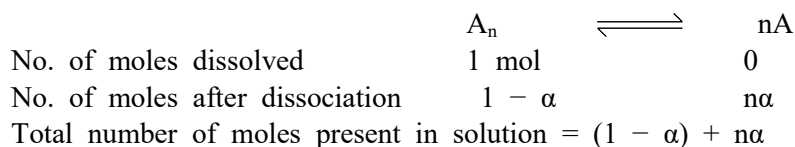
$$\begin{aligned} \text{(i)} \quad \frac{P_A^\circ - P_A}{P_A^\circ} &= iX_B & \text{(iii)} \quad \Delta T_b &= iK_b m \\ \text{(ii)} \quad \Delta T_f &= iK_f m & \text{(iv)} \quad \pi &= iCRT \end{aligned}$$

where C is molarity of the solution.

**NOTE**  For non-electrolytes;  $i = 1$   
For electrolytes;  $i > 1$  (If solute particles undergo Dissociation in the solution)  
 $i < 1$  (If solute particles undergo Association in the solution)

### 34. Application of Van't Hoff Factor :

(a) Calculation of Degree of Dissociation of solute particles:





**(b) Calculation of Degree of Dissociation of solute particles:**

	$A_n$	$\rightleftharpoons$	$nA$
No. of moles dissolved	1 mol		0
No. of moles after dissociation	$1 - \alpha$		$n\alpha$
Total number of moles present in solution	$= (1 - \alpha) + n\alpha$		

$$\text{Van't Hoff factor, } i = \frac{\text{Moles of solute actually present in solution}}{\text{Moles of solute dissolved}}$$

$$= \frac{(1-\alpha)+n\alpha}{1} = 1+(n-1)\alpha \quad \text{or} \quad \alpha = \frac{i-1}{n-1}$$

**(c) Calculation of Degree of Association of solute particles:**

Let  $n$  moles of the solute,  $A$ , associate to form  $(A)_n$ . If  $\alpha$  is the degree of association.

	$nA$	$\rightleftharpoons$	$A_n$
No. of moles dissolved	1 mol		0
No. of moles after dissociation	$1 - \alpha$		$\alpha/n$
Total number of moles present in solution	$= (1 - \alpha) + \alpha/n$		

$$i = \left[ 1 - \alpha \left( 1 - \frac{1}{n} \right) \right] \quad \text{Hence } \alpha = \frac{i-1}{\frac{1}{n}-1} = (i-1) \times \frac{n}{1-n}$$

## CBSE Exam Pattern Exercise

### Subjective Questions (1)

#### (Q 1 to 2) One Mark

1. What role does the molecular interaction play in solution of alcohol and water?
2. Why do gases nearly always tend to be less soluble in liquid as the temperature is raised?

#### (Q 3 to 4) Two Marks

3. If the solubility product of CuS is  $6 \times 10^{-16}$ , calculate the maximum molarity of CuS in aqueous solution.
4. State Henry's law and mention some of its important applications.

#### (Q 5 to 6) Three Marks

5.
  - (a) Determine the amount of  $\text{CaCl}_2$  ( $i = 2.47$ ) dissolved in 2.5 litre of water such that its osmotic pressure is 0.75 atm at  $27^\circ\text{C}$ .
  - (b) Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water (i) phenol, (ii) toluene, (iii) formic acid, (iv) ethylene glycol, (v) chloroform, (vi) pentanol
6. Calculate the mass of a non-volatile solute (molar mass  $40 \text{ g mol}^{-1}$ ) which should be dissolved in 114g octane to reduce its vapour pressure to 80%.

#### (Q 7 to 8) Four Marks

7. 100 g of liquid A (molar mass  $140 \text{ g mol}^{-1}$ ) was dissolved in 1000 g of liquid B (molar mass  $180 \text{ g mol}^{-1}$ ). The vapour pressure of pure liquid B was found to be 500 torr. Calculate the vapour pressure of pure liquid A and its vapour pressure in the solution if the total vapour pressure of the solution is 475 torr.
8. The air is a mixture of a number of gases. The major components are oxygen and nitrogen with approximate proportion of 20% is to 79% by volume at 298 K. The water is in equilibrium with air at a pressure of 10 atm. At 298 K, if the Henry's law constants for oxygen and nitrogen are  $3.30 \times 10^7 \text{ mm}$  and  $6.51 \times 10^7 \text{ mm}$  respectively, calculate the composition of these gases in water.

#### (Q 9 to 10) Five Marks

9. Calculate the depression in the freezing point of water when 10 g of  $\text{CH}_3\text{CH}_2\text{CHClCOOH}$  is added to 250 g of water.  $K_a = 1.4 \times 10^{-3}$ ,  $K_f = 1.86 \text{ K kg mol}^{-1}$ .
10. 19.5g of  $\text{CH}_2\text{FCOOH}$  is dissolved in 500g of water. The depression in the freezing point observed is  $1.0^\circ\text{C}$ . Calculate the van't hof factor and dissociation constant of fluoroacetic acid.  $K_f$  for water is  $1.86 \text{ K kg mol}^{-1}$ .



# Answer & Solution

Q1

There is strong hydrogen bonding in alcohol molecules as well as water molecules. On mixing, the molecular interactions are weakened. Hence, their solution will show positive deviations from ideal behaviour. As a result, the solution will have higher vapour pressure and lower boiling point than that of water and alcohol.

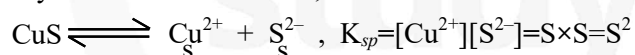
Q2

Dissolution of gas in liquid is an exothermic process ( $\text{Gas} + \text{Solvent} \rightleftharpoons \text{Solvent} + \text{Heat}$ ). As the temperature is increased, equilibrium shifts backward.

Q3

Maximum molarity of CuS in aqueous solution = Solubility of CuS in  $\text{mol L}^{-1}$

If S is the solubility of CuS in  $\text{mol L}^{-1}$ , then



$$\therefore S^2 = 6 \times 10^{-6} \text{ or } S = \sqrt{6 \times 10^{-6}} = 2.45 \times 10^{-3} \text{ mol L}^{-1}.$$

Q4

*The mass of a gas dissolved in a given volume of the liquid at constant temperature is directly proportional to the pressure of the gas present in equilibrium with the liquid.*

Mathematically,  $m \propto P$  or  $m = Kp$

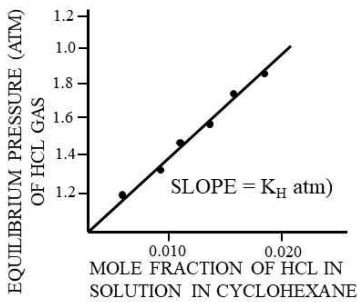
Or

*The solubility of a gas in a liquid at a particular temperature is directly proportional to the pressure of the gas in equilibrium with the liquid at that temperature.*

$$\text{From eqn (ii), } p_A = \frac{1}{K} x_A \text{ or } P_A = K_H x_A$$

The partial pressure of a gas in vapour phase ( $p$ ) is directly proportional to the mole fraction ( $x$ ) of the gas in the solution.

## 02 Solution



Plot of mole fraction in solution versus equilibrium pressure

### Application of Henry's law:

- (i) In the production of carbonated beverages.
- (ii) In the deep sea diving.  
bend or decompression sickness
- (iii) In the function of lungs.
- (iv) For climbers or people living at high altitudes.

Q5

$$\pi = i CRT = i \frac{n}{V} RT \quad \text{or} \quad n = \frac{\pi \times V}{i \times R \times T} = \frac{0.75 \text{ atm} \times 2.5 \text{ L}}{2.47 \times 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1} \times 300 \text{ K}} = 0.0308 \text{ mole}$$

Molar mass of  $\text{CaCl}_2 = 40 + 2 \times 35.5 = 111 \text{ g mol}^{-1} \therefore$  Amount dissolved =  $0.0308 \times 111 \text{ g} = 3.42 \text{ g}$

Q6

Reduction of vapour pressure to 80% means that if  $p^\circ = 100 \text{ mm}$ , then  $p_s = 80 \text{ mm}$ . Applying complete formula

$$\frac{p^\circ - p_s}{p^\circ} = \frac{n_2}{n_1 + n_2} = \frac{w_2 M_2}{w_1 / M_1 + w_2 / M_2}$$

$$\frac{100 - 80}{100} = \frac{w_2 / 40}{114 / 114 + w_2 / 40} \quad (\text{Mol. mass of octane } \text{C}_8\text{H}_{18} = 114 \text{ g mol}^{-1})$$

$$\text{or} \quad \frac{20}{100} = \frac{w_2 / 40}{1 + w_2 / 40} \quad \text{or} \quad \frac{1}{5} \left( 1 + \frac{w_2}{40} \right) = \frac{w_2}{40} \quad \text{or} \quad w_2 = 10 \text{ g}$$

Note that complete formula is required because concentration of solution is greater than 5%

Complete formula can also be applied in the form

$$\frac{p^\circ - p_s}{p_s} = \frac{w_2 / M_2}{w_1 / M_1} \quad \text{or} \quad \frac{100 - 80}{80} = \frac{w_2 / 40}{114 / 114} \quad \text{or} \quad \frac{1}{4} = \frac{w_2}{40} \quad \text{or} \quad w_2 = 10 \text{ g}$$

Alternatively, suppose mass of solute dissolved =  $w \text{ g}$

$$\text{Moles of solute} = \frac{w}{40} \text{ g}$$

$$\text{Moles of solvent (octane)} = \frac{114}{114} = 1 \text{ mole} \quad (\text{Mol. mass of } \text{C}_8\text{H}_{18} = 114 \text{ g mol}^{-1})$$

$$\therefore \text{Mole fraction of solvent} = \frac{1}{1 + w/40}$$

For a non-volatile solute,

Vapour pressure of solution = Mole fraction of solvent in the solution  $\times$  Vapour pressure of pure

## 02 Solution

solvent

$$P_s = x_i \times p^\circ$$

$$\therefore 80 = \frac{1}{1 + w/40} \times 100 \text{ or } 1 + \frac{w}{40} = \frac{100}{80} \text{ or } \frac{w}{40} = \frac{10}{8} - 1 = \frac{2}{8} = \frac{1}{4} \text{ or } w = 10\text{g}$$

Q7

$$\text{No of moles of liquid A (solute)} = \frac{100\text{g}}{140\text{g mol}^{-1}} = \frac{5}{7} \text{ mole}$$

$$\text{No. of moles of liquid B (solvent)} = \frac{1000\text{g}}{180\text{g mol}^{-1}} = \frac{50}{9} \text{ mole}$$

$$\therefore \text{Mole fraction of A in the solution } (x_A) = \frac{5/7}{5/7 + 50/9} = \frac{5/7}{395/63} = \frac{5}{7} \times \frac{63}{395} = \frac{45}{395} = 0.114$$

$$\therefore \text{Mole fraction of B in the solution } (x_B) = 1 - 0.114 = 0.886$$

Also, given  $P_B^\circ = 500 \text{ torr}$

Applying Raoult's law,  $P_A = x_A P_A^\circ = 0.114 \times P_A^\circ$

$$P_B = x_B P_B^\circ = 0.886 \times 500 = 443 \text{ torr}$$

$$P_{\text{Total}} = P_A + P_B$$

$$475 = 0.114 P_B^\circ + 443 \text{ or } P_A^\circ = \frac{475 - 443}{0.114} = 280.7 \text{ torr}$$

$$\text{Substituting this value in eqn. (i), we get } P_A = 0.114 \times 280.7 \text{ torr} = 32 \text{ torr.}$$

Q8

Total pressure of air in equilibrium with water = 10 atm

As air contains 20% oxygen and 79% nitrogen by volume,

$$\therefore \text{Partial pressure of oxygen } (p_{O_2}) = \frac{20}{100} \times 10 \text{ atm} = 2 \text{ atm} = 2 \times 760 \text{ mm} = 1520 \text{ mm}$$

$$\text{Partial pressure of nitrogen } (p_{N_2}) = \frac{79}{100} \times 10 \text{ atm} = 7.9 \text{ atm} = 7.9 \times 760 \text{ mm} = 6004 \text{ mm}$$

$$K_H(O_2) = 3.30 \times 10^7 \text{ mm}, K_H(N_2) = 6.51 \times 10^7 \text{ mm}$$

$$\text{Applying Henry's law, } P_{O_2} = K_H \times x_{O_2} \text{ or } x_{O_2} = \frac{P_{O_2}}{K_H} = \frac{1520 \text{ mm}}{3.30 \times 10^7 \text{ mm}} = 4.61 \times 10^{-5}$$

$$p_{N_2} = K_H \times x_{N_2} \text{ or } x_{N_2} = \frac{P_{N_2}}{K_H} = \frac{6004 \text{ mm}}{6.51 \times 10^7 \text{ mm}} = 9.22 \times 10^{-5}$$

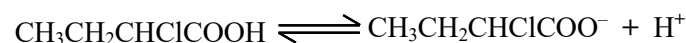
Q9

Molar mass of  $\text{CH}_3\text{CH}_2\text{CHClCOOH} = 15 + 14 + 13 + 35.5 + 45 = 122.5 \text{ g mol}^{-1}$

$$10 \text{ g of } \text{CH}_3\text{CH}_2\text{CHClCOOH} = \frac{10}{122.5} \text{ mole} = 8.16 \times 10^{-2} \text{ mole}$$

$$\therefore \text{Molality of the solution } (m) = \frac{8.16 \times 10^{-2} \text{ mole}}{250 \text{ g}} \times 1000 \text{ g kg}^{-1} = 0.3264$$

Of  $\alpha$  is the degree of dissociation of  $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ , then



Initial conc.	C	mol L <sup>-1</sup>	0	0
---------------	---	---------------------	---	---

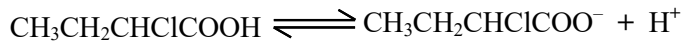


## 02 Solution

At eqm.  $C(1-\alpha)$   $C\alpha$   $C\alpha$

$$\therefore K_a = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} \approx C\alpha^2 \quad \text{or} \quad \alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{1.4 \times 10^{-3}}{0.3264}} = 0.065$$

To calculate van't Hoff factor:



Initial moles 1

Moles at eqm.  $1-\alpha$   $\alpha$   $\alpha$  Total =  $1+\alpha$

$$i = \frac{1+\alpha}{1} = 1+\alpha = 1+0.065 = 1.065 ; \Delta T_f = i K_f m = (1.065)(1.86)(0.3264) = \mathbf{0.65^\circ}$$

Q10

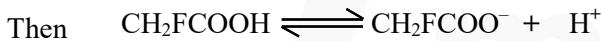
Hence,  $W_2=19.5\text{g}$ ,  $w_1=500\text{g}$ ,  $K_f=1.86\text{K kg mol}^{-1}$ ,  $(\Delta T_f)_{\text{obs}} = 1.0^\circ$

$$\therefore M_2 \text{ (observed)} = \frac{100K_f w_2}{w_1 \Delta T_f} = \frac{(1000\text{g kg}^{-1})(1.86\text{K kg mol}^{-1})(19.5\text{g})}{(500\text{g})(1.0\text{K})} = 72.54\text{g}$$

$M_2$  (calculated) for  $\text{CH}_2\text{FCOOH} = 14+19+45=78\text{g mol}^{-1}$

$$\text{van't Hoff factor } (i) = \frac{(M_2)_{\text{cal}}}{(M_2)_{\text{obs}}} = \frac{78}{72.54} = \mathbf{1.0753}$$

Calculation of dissociation constant. Suppose degree of dissociation at the given concentration is  $\alpha$ .



Initial  $C\text{ mol L}^{-1}$  0 0

At eqm.  $C(1-\alpha)$   $C\alpha$   $C\alpha$ , Total =  $C(1+\alpha)$

$$i = \frac{C(1+\alpha)}{C} = 1+\alpha \quad \text{or} \quad \alpha = i-1 = 1.0753-1 = 0.0753$$

$$K_a = \frac{[\text{CH}_2\text{FCOO}^-][\text{H}^+]}{[\text{CH}_2\text{FCOOH}]} = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{1-\alpha}$$

Taking volume of the solution as 500 mL,

$$C = \frac{19.5}{78} \times \frac{1}{500} \times 1000 = 0.5\text{M} \quad \therefore K_a = \frac{C\alpha^2}{1-\alpha} = \frac{(0.5)(0.0753)^2}{1-0.0753} = \mathbf{3.07 \times 10^{-3}}$$

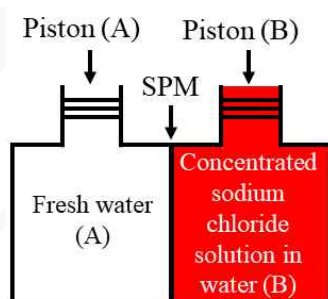
## CBSE Exam Pattern Exercise Objective Questions (2)

1. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law ?

- (a) Methanol and acetone
- (b) Chloroform and acetone
- (c) Nitric acid and water
- (d) Phenol and aniline

2. Consider the figure and mark the correct option.

- (a) water will move from side (A) to side (B) if a pressure lower than osmotic pressure is applied on piston (B)



- (b) water will move from side (B) to side (A) if a pressure greater than osmotic pressure is applied on piston (B)
- (c) water will move from side (B) to side (A) if a pressure equal to osmotic pressure is applied on piston (B)
- (d) water will move from side (A) to side (B) if pressure equal to osmotic pressure is applied on piston (A)

3. If two liquids A and B form minimum boiling azeotrope at some specific composition, then .....

- (a) A–B interactions are stronger than those between A–A or B–B
- (b) vapour pressure of solution increases because more number of molecules of liquids A and B can escape from the solution
- (c) vapour pressure of solution decreases because less number of molecules of only one of the liquids escape from the solution
- (d) A–B interactions are weaker than those between A–A or B–B

4. 4L of 0.02 M aqueous solution of NaCl was diluted by adding one litre of water. The molality of the resultant solution is .....

- (a) 000.4
- (b) 0.008
- (c) 0.012
- (d) 0.016

5.  $K_H$  value for Ar(g), CO<sub>2</sub>(g), HCHO (g) and CH<sub>4</sub>(g) are 40.39, 1.67,  $1.83 \times 10^{-5}$  and 0.413 respectively.

Arrange these gases in the order of their increasing solubility.

- (a) HCHO < CH<sub>4</sub> < CO<sub>2</sub> < Ar
- (b) HCHO < CO<sub>2</sub> < CH<sub>4</sub> < Ar
- (c) Ar < CO<sub>2</sub> < CH<sub>4</sub> < HCHO
- (d) Ar < CH<sub>4</sub> < CO<sub>2</sub> < HCHO

The questions given below consists of an Assertion and the Reason. Use the following key to choose the appropriate answer.

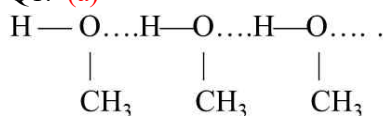
- (a) If both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
  - (b) If both assertion and reason are CORRECT, but reason is NOT THE CORRECT explanation of the Assertion.
  - (c) If assertion is CORRECT, but the reason is INCORRECT.
  - (d) If both assertion and reason are INCORRECT.
6. **Assertion** : When NaCl is added to water, a depression in freezing point is observed.  
**Reason** : The lowering of vapour pressure of a solution causes depression in the freezing point.

miso  
study



# Answer & Solution

Q1. (a)



On adding acetone, its molecules get in between the molecules of methanol breaking hydrogen bonds and reducing methanol-methanol attractions.

Q2. (b)

The process represented in the image is the reverse osmosis (R.O) which takes place when pressure more than osmotic pressure is applied to the solution.

Due to this, the solvent will flow from the solution into the pure solvent through semi permeable membrane.

Q3. (d)

Minimum boiling azeotrope is formed when actual vapour pressure is higher than expected, i.e. solution shows +ve deviation from Raoult's law which is so when A-B interactions are weaker than A-A or B-B interactions.

Q4. (d)

$$M_1V_1 = M_2V_2, 0.02 \times 4 = M_2 \times 5 \text{ or } M_2 = 0.016$$

Q5. (c)

acceleration to the henry's law

$$P_A = K_H x_A$$

If  $x_A$  has a lower value, then  $K_H$  will increase,  $\therefore$  solubility decrease.

Q6. (a)

Reason is the correct explanation of the assertion.

CLASS 12

# CBSE

# BIOLOGY

- ▶ Specially designed eBook for complete CBSE syllabus
- ▶ CBSE preparation strategy & direction, speedy revision
- ▶ Chapter-wise important Problem-Solving
- ▶ Theory, Formulas & Diagrams to crack CBSE
- ▶ Updated New Pattern Objective questions
- ▶ Detailed high quality video lectures by experienced faculties
- ▶ CBSE full preparation for Class XI & XII



**misostudy**  
connect smart learning

**JEE·NEET·AIIMS·CBSE·FOUNDATION**  
[www.misostudy.com](http://www.misostudy.com)

☎ 8929803804 (MON-FRI: 9am-6pm) [support@misostudy.com](mailto:support@misostudy.com)

MISO STUDY INDIA PVT. LTD.  
2ND FLOOR 65-A, OMPRO TOWER, KALU SARAI, NEW DELHI, DELHI 110016



# Class 12 | Biology

## 03 Reproduction in Organism

has both unicellular

? When is a fungus

unicellular → Protista

Multi cellular → Penicillium

Misostudy.com



### Scientific eBook

This is a sample eBook. The eBook provides chapter-wise theories and examples, formulas, diagrams, and Exam pattern Problem-Solving of the full syllabus.



### Complete video lectures

The theory and Problem-Solving in this eBook provide specially designed the video lectures by experienced faculties. Get Free trial and preview on Misostudy.com.

## 03 Reproduction in Organism

### 01. Introduction

A vast number of plant and animal species have existed on the earth for several thousand of years. The process in living organisms that ensures this continuity is Reproduction. Reproduction is one of the most characteristic feature of living organisms. Life will not exist on the earth if plants and animals do not reproduce to make offsprings.

### 02. Life span

Life span can be defined as the period from birth to the natural death of an organism. It can vary from as short as few days to as long as a number of years.

**Maximum Life Span :** Maximum life span is the maximum number of years survived or the greatest age reached by any member of a species. The average life span refers to the average number of years survived or age reached by the members of a population. The maximum life span of a domestic dog is about 20 years and that of a laboratory mouse is 4.5 years. The maximum life span of humans has been estimated to be about 121 years.

### 03. Reproduction

Reproduction is the means of self perpetuation of a race in which new, young, similar looking individuals are formed by the grown up or adult individuals. The adults which give rise to young ones are called parents.

#### Functions of Reproduction :

- (i) It replaces the individuals dying due to senescence or ageing.
- (ii) Individuals removed from population due to predation or disease are replaced through reproduction.
- (iii) It introduces variations essential for adaptability and struggle for existence.

#### Basic Features of Reproduction :

- (i) Replication of DNA.
- (ii) Division of cells. It may or may not involve meiosis.
- (iii) Growth due to synthesis of more protoplasm.

- (iv) Formation of reproductive units.
- (v) Elaboration and development of reproductive units to form new young individuals.

### Types of Reproduction

Broadly speaking, there are two types of reproduction, asexual and sexual. Asexual reproduction does not involve gamete formation and fusion. It is uniparental. On the other hand, sexual reproduction consists of formation and fusion of gametes of opposite sexes. It is mostly biparental with two types of parents of different sexes but can be single/uniparental also, as in case of bisexual or hermaphrodite animals.

#### I. Asexual Reproduction

It is the mode of reproduction in which new individuals develop directly from specialised or unspecialised parts of a single parent without involving fusion of gametes or sex cells.

Asexual reproduction occurs in both single celled and multicelled individuals. The parent individual splits, buds or fragments to form identical daughter cells or individuals, e.g., Amoeba, Paramecium, Euglena (acellular protists), Sycon, Hydra, Tubularia, Planaria, Ascidia (metazoans). Asexual reproduction is also called agamogenesis or agamogeny. In this mode of reproduction, somatic cells undergo mitosis during the formation of a new individual. Therefore, it is also called somatogenic reproduction. Young ones resulting from asexual reproduction are exactly identical with the parent except in size and are called clones. Each individual of a clone is referred to as a ramet.

Asexual reproduction occurs by fission, budding and fragmentation.

**(A) Fission** : It is a mode of asexual reproduction in which the body of a mature individual divides into two or more similar and equal sized daughter individuals. Fission can be binary fission or multiple fission.

- (a) **Binary Fission** : It is the division of the body of an individual into two equal halves, each of which functions as an independent daughter individual. In unicellular organisms, binary fission is accompanied by mitotic division of nucleus followed by cytokinesis. In metazoans. The organisms which undergo binary fission seldom die of senescence or old age because as soon as they mature, they divide into two daughters. They are, therefore, nearly immortal. Depending on the plane of division, binary fission is of the following types:
  - (i) **Simple Binary Fission (Irregular Binary Fission)** : Division can occur through any plane e.g., Amoeba.
  - (ii) **Longitudinal Binary Fission** : The plane of fission passes along the longitudinal axis of the organism, e.g., Euglena, Vorticella.
  - (iii) **Oblique Binary Fission** : The plane of binary fission lies at an angle to the transverse axis e.g., Ceratium, Gonyaulax.
  - (iv) **Transverse Binary Fission** : The plane of binary fission runs along the transverse axis of the individual, e.g., Paramecium, diatoms, bacteria. In Paramecium, transverse binary fission is preceded by a mitotic division of meganucleus and mitotic division of micronucleus. In it, binary fission produces two dissimilar daughters, one proter (anterior) and the other opisthe (posterior). Both develop the deficient components and become similar.

- (b) **Multiple Fission** : The nucleus divides several times by amitosis to produce many nuclei, without involving any cytokinesis. Later, each nucleus gathers a small amount of cytoplasm around it and the mother individual splits into many tiny daughter cells (e.g., Amoeba, Plasmodium, Monocystis, etc). In course of time, each of these daughter cells starts a free life and transforms into an adult individual. This kind of fission is called multiple fission.
- (c) **Cyst formation** : In response to unfavourable living conditions, an Amoeba withdrawn its pseudopodia and secretes a three-layered hard covering or cyst around itself.

This phenomenon is termed as **encystation**. During favourable conditions, the encysted Amoeba divides by multiple fission and produces many minute amoubae or pseudopodiospores; the cyst wall bursts out and the spores are liberated in the surrounding medium to grow up into many Amoebae. This phenomenon is known as sporulation. Acellular protists like sporozoans (e.g., Monocystis, Plasmodium, etc.) typically exhibit sporulation in their life cycles.

- (B) **Budding** : In budding, new individuals are formed by mitosis. Initially, a small outgrowth of the parent's body develops into a miniature individual. It then separates from the mother to lead a free life (e.g., Hydra). This type of budding is known as exogenous budding. Sometimes, the buds do not get separated from the mother individual and form a colony. For example, in Obelia, the colony consists of a number of individuals jor zooids that perform different functions. In all fresh water sponges (e.g., Spongilla) and some marine sponges (e.g., Sycon), the parent individual releases a specialized mass of cells enclosed in a common opaque envelope, called the gemmule. On germination, each gemmule gives rise to offspring and the archeocytes present in it give rise to various cells of the body of sponge as they are **totipotent**. Gemmules are thought to be **internal buds**.
- (C) **Fragmentation** : The body of the parent breaks into distinct pieces, each of which can produce an offspring (e.g., Hydra, some marine worms, sea-stars).

#### Advantages of Asexual Reproduction :

- It is uniparental.
- It is a rapid mode of reproduction.
- The young ones are exact replicas of their parent.
- Asexual reproduction is simpler than sexual reproduction.

#### Disadvantages of Asexual Reproduction :

- As there is rapid multiplication, a large number of young ones are formed which causes overcrowding.
- There is no mixing of genetic material, so no new combination or variation takes place.
- There is no crossing over, hence hew linkages are not formed.
- It has no role in evolution.
- Adaptability to changes in environment is low due to absence of new variations.

## II. Sexual Reproduction

Sexual reproduction involves formation and fusion of gametes to form the zygote which develops to form a new organism.



**Characteristics :**

- (a) Two fusing gametes can be produced by same individual or different individuals.
- (b) Offsprings produced are not identical to parents.
- (c) It involves meiosis and syngamy (fusion of gametes).
- (d) It is a slow, elaborate or complex process, so multiplication is not so rapid.

**Phases in Life Cycle**

- (a) **Juvenile phase**
- (b) **Reproductive phase**
- (c) **Senescent phase**

- (a) **Juvenile phase/Pre-reproductive phase** : During this phase organism will show growth so that it can attain certain maturity to perform the sexual reproduction. This phase is known as vegetative phase in plants. It is of variable durations in different organisms.
- (b) **Reproductive phase** : Reproductive organs develop and mature during this phase. In the higher plants (Angiosperms). end of juvenile phase or onset of reproductive phase is easily marked. In the higher plants during this phase, there is formation of reproductive structures i.e., flowers.
- (c) **Senescent phase** : It is a post-reproductive phase. It involves structural and functional deterioration of body by accumulation of waste metabolites which ultimately leads to death.

**Events in Sexual Reproduction**

After attainment of maturity, all sexually reproducing organisms exhibit events and processes that have remarkable fundamental similarity, even though the structures associated with sexual reproduction are indeed very different. These sequential events may be grouped into three distinct stages, namely, the pre-fertilization, fertilization and the post-fertilization events.

**A. Pre-fertilization Events**

These are events in sexual reproduction which occur prior to the process of fertilization. The two main pre-fertilization events are **gametogenesis** and **gamete transfer**.

- (a) **Gametogenesis** : It refers to the process of formation of gametes – male and female.

**Categories of Gametes :**

- (i) **Isogametes** : When the fusing gametes are morphologically similar they are known as isogametes or homogametes. They are produced in some algae and fungi.
  - Algae : Cladophora, Chlamydomonas debaryana, Ulothrix
  - Fungi : Synchytrium, Rhizopus
- (ii) **Heterogametes** : When the fusing gametes are morphologically distinct types, they are known as heterogametes. It is the feature of majority of sexually reproducing organisms. e.g.
  - (a) Algae : Fucus, Volvox, Chara
  - (b) All Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.  
In such organisms, male gamete is called antherozoid or sperm and the female gamete is called egg or ovum



## 03 Reproduction in Organism

**Cell Division During Gamete Formation :** Gametes are always haploid i.e., they possess only one set of chromosomes or genome though the parent body producing gametes may be either haploid or diploid. As gametes are always haploid so surely in haploid parent, gametes are produced by mitotic division. In plants belonging to group pteridophytes, gymnosperms and angiosperms and animals the parental body is diploid. Here reductional division occurs before or at the time of gamete formation. The cells which undergo meiosis are called meiocyte. If meiocyte is indulged in gamete formation, then it is called gamete mother cell. In haploid organisms, gametes are produced through mitosis but you must not think that meiosis never occurs in life cycle of haploid organisms.

This could be made clear from what you have learnt in previous classes. In these organisms like haploid algae and some fungi, meiosis occurs in zygote or zygospore which is called zygotic meiosis.

## 04. Sexuality in Organisms :

**Lower Organisms :** In most of the lower sexually reproducing organisms, two fusing gametes are morphologically similar. If these gametes belong to the same parent then such organisms are called homothallic, e.g., fungi (*Mucor mucedo*). When these gametes belong to different parents then these organisms are called heterothallic.

**Higher Organisms :** In higher plants there are well-developed sex organs and there is clear distinction between male and female sex organs. Angiosperms possess flowers as reproductive structures. The male sex organ is called stamen and female sex organ is carpel or pistil. If male and female sex organs occur in the same flower then these plants are called bisexual, e.g., China rose. If flowers possess only stamen or carpel then these plants are called unisexual. When male flower (staminate) and female flower (pistillate) are present on same plant body such plants are monoecious, e.g., cucurbits, coconut and maize. However, if they are present on separate plant body then these plants are known as dioecious, e.g., date palm and papaya.

## 05. Gamete Transfer :

After the formation of male and female gametes, compatible gametes must be physically brought together to facilitate fusion (fertilisation or syngamy). In few fungi and algae, both types of gametes are motile. But in majority of organisms male gamete is motile and the female gamete is non-motile. So there is a need of a medium through which the male gametes move.

In seed plants both male and female gametes are non-motile. Here pollen grains are the carrier of male gametes and ovule has the egg. As the male gamete is non-motile so it cannot swim through water medium to reach female gamete rather pollen tube serve this purpose. For this pollen grain produced in anther ( $\sigma$  part) are transferred to the stigma of female organ i.e., carpel through the process of pollination.

Pollination is of two type i.e., self pollination and cross pollination. Self pollination is the transfer of the pollen grains from anther of a flower to the stigma of same flower or different flower of the same plant. Cross pollination is transfer of the pollen grain from anther of one flower to the stigma of different flower of other plant.

## 06. Fertilization

The most vital event of sexual reproduction is the fusion of gametes. This process is called syngamy or fertilization which results in the formation of a diploid zygote.

- (a) **External fertilization** : Syngamy occurs outside the body of organism in external medium (water). It is shown by majority of aquatic organisms like most of algae, fishes as well as amphibians.
- (b) **Internal fertilization** : Syngamy occurs inside the body of organisms. It is present in majority of plants like bryophytes, pteridophytes, gymnosperms and angiosperms. It occurs in few algae like spirogyra. In all these organisms egg is formed inside the female body where syngamy occurs.

## 07. Post-Fertilization Events

Events in sexual reproduction after the formation of zygote are called post-fertilization events. **Zygote** : It is the first cell of the new generation in all sexually reproducing organisms. Zygote is always diploid. It is formed in the external aquatic medium in those organisms which perform external fertilization. Zygote is produced inside the body in cases where fertilization is internal.

In many algae and fungi, the zygote secretes a thick wall that is resistant to desiccation and damage, which help organisms to tide over unfavourable conditions. During unfavourable conditions it undergoes a period of rest until a swing back to sustainability occurs.

**Embryogenesis** : Embryogenesis is the process of development of embryo from zygote. Embryo is a multicellular stage in the life cycle of a plant or animal prior to formation of an independent individual. In embryogenesis, the zygote undergoes repeated cell divisions through mitosis. Cell differentiation occurs at specific locations resulting in production of different tissues, organs and organ systems. Development of different external and internal structures is called morphogenesis. Embryo formation is present in all plant groups, except algae. In flowering plants, zygote develops into embryo. The food for development of embryo comes from a special tissue known as endosperm. Ultimately, the fertilized ovule matures into a seed. Inside the mature seed is the progenitor of the next generation, the embryo. A number of seeds develop in an ovary depending upon the number of ovules. Meanwhile, wall of the ovary also proliferates. It produces pericarp or fruit wall. The pericarp can be dry or fleshy. The ripened ovary with pericarp and seeds is called fruit.

<b>Differences between Asexual and Sexual Reproduction</b>	
<b>Asexual Reproduction</b>	<b>Sexual Reproduction</b>
i. New individuals are formed from a single parent.	i. Commonly two parents are involved in the formation of new individuals through sexual reproduction.
ii. Asexual reproduction does not require the production of sex organs.	ii. Formation of sex organs is a pre-requisite for sexual reproduction.
iii. It does not involve meiosis. All divisions are mitotic.	iii. Sexual reproduction involves meiosis at one or the other stage. In higher plants, it occurs at the time of spore formation or sporogenesis.
iv. Asexual reproduction does not involve fusion of cells or gametes.	iv. It involves fusion of gametes.
v. New individual develops from one cell or a part of one parent.	v. New individual develops from zygote i.e., fusion product of two gametes.
vi. New individuals are genetically similar to the parents.	vi. Offspring or new individuals are genetically different from either of the two parents.
vii. It does not introduce variability. Hence, asexual reproduction has no evolutionary importance.	vii. It introduces variability and is, hence of evolutionary importance.
viii. It is quick method of multiplication.	viii. Sexual reproduction is a slower method of multiplication.
ix. It is simple process.	ix. It is elaborate or complex process.

## CBSE Exam Pattern Exercise

### Subjective Questions (1)

#### (Q 1 to 3) One Mark

1. Write the name of the organism that is referred to as 'Terror of Bengal'.
2. Give one example each of a fungus which reproduces by
  - (i) budding
  - (ii) conidia

3. Name an organisms, where cell division is itself a mode of reproduction.

#### (Q 4 to 6) Two Marks

4. Name an alga that reproduces asexually through zoospores. Why are these reproductive units so called?
5. Offsprings produced by asexual reproduction are called clones. Justify
6. Unicellular organisms are immortal, whereas multicellular organisms are not. justify.
  - (i) Name the organism that reproduce. through the following reproductive structures:
    - (a) Conidia
    - (b) Zoospores
  - (ii) Mention similarity and one difference between these two reproductive units.

#### (Q 7 to 8) Three Marks

7. Which one of the following statements is true for years?
  - (i) The cell divides by binary fission. One of them develops into a bud.
  - (ii) The cell divides unequally. The smaller cell develops into a bud.
  - (iii) The cell produces conidia, Which develop into a bud.
8. Coconut palm is monoecious, while date palm is dioecious. Why are they so called?

#### (Q 9 to 10) Five Marks

9.
  - (i) List the three states the annual and biennial angiosperms have to pass through during their life cycle.
  - (ii) List and describe any two vegetative propagules in flowering plants.
10. Differentiate between an annual and biennial plant. Provide one example of each.



## Answer & Solution

Q1

Water hyacinth is referred to as the 'Terror of Bengal'

Q2

Fungus that reproduces by

- (i) budding–Yeast
- (ii) conidia–*penicillium*

Q3

In unicellular organisms like *Amoeba*, bacteria, etc, cell division itself is a mode of reproduction

Q4

*Chlamydomonas* in an alga that reproduces asexually through zoospores. Due to mobility (motile), these reproductive units are referred to as zoospores.

Q5

Offsprings produced by asexual reproduction are called clones. because

- (i) they are morphologically similar to their parent.
- (ii) they have same genetic composition as their parent.

Q6

Unicellular organism are considered immortal mainly because, in them the parent body as a whole



### 03 Reproduction in Organism

constitutes the reproductive unit and after reproductive continues to live as daughter cells. The multicellular organisms produce their reproductive structures in specialised organs and their whole body dies due to ageing and senescence.

Q7

Statement (ii) is true for yeast. The cell division unequally. The smaller cell develops into a bud.

Q8

Papaya and date palm plants are said to be dioecious because male and female flowers are borne on separate plants. whereas cucurbits and coconut palms are monoecious because male and female flowers are borne on the same plant.

Q9

Water hyacinth is referred to as the Terror of Bengal'

Q10

Annual plants	Biennial plants
These plants complete their life cycle in one year.	These plants complete their life cycle in two years.
The vegetative and reproductive phases occur within a year only.	Flowering occurs during second year, after a year of vegetative growth.
Since, these plants require less time, they	Due to more required time in growing, these plants are of high maintenance type.
E.g cereals, legumes, marigold, gerberas, etc.	E.g trees, shrubs and some grasses, poppy foxglove, etc

## CBSE Exam Pattern Exercise

### Objective Questions (2)

1. Stock and scion are used in

- (a) cutting
- (b) grafting
- (c) layering
- (d) micropropagation

2. In ginger, vegetative propagation occurs through.

- (a) rhizome
- (b) offsets
- (c) bulbils
- (d) runners

3. Which of the following pairs is not correctly match?

Mode of reproduction	Example
(a) Offset	— Water hyacinth
(b) Rhizome	— Banana
(c) Binary	— Sargassum
(d) Conidia	— Penicillium

4. Which of the following processes ensures the continuity of life on earth?

- (a) Reproduction
- (b) Respiration
- (c) Digestion
- (d) Growth and development

5. Budding is found in

- (a) Sycon
- (b) Hydra
- (c) Fasciola
- (d) Obelia



## Answer & Solution

Q1. (b)

Stock and scion are used in grafting. Grafting is a horticulture technique wherein tissues from one plant are inserted into those of another, so that the two sets of vascular tissues join together. This technique is most commonly used in asexual propagation of commercially grown plants. In this technique, one plant is selected for its roots and is called the **stock** or **root stock**.

The other plant is selected for its stems, leaves, flowers or fruits and is called the **Scion**. The scion and stock contains the desired genes to be duplicated in future production by the stock and scion plant.

Q2. (a)

In ginger, vegetative propagation occurs through rhizome. Rhizomes are stems which grow horizontally under the ground.

In ginger, the underground stems are swollen with food reserves. The terminal bud grows upward to produce the flowering shoot and the lateral buds grow out to form new plant.

Q3. (c)

The plant body of Sargassum is a diploid sporophyte. It does not multiply asexually by means of spores instead, it the only known method of vegetative means, i.e. fragmentation, which is the only known method of vegetative reproduction in the free-floating species of Sargassum.

Q4. (a)

Reproduction is the process of formation of new individuals of a species from the pre-existing one. It is meant for perpetuation of a species because the older individuals of each species undergo senescence and die.

Q5. (b)

Hydra reproduces asexually by exogenous budding, a type of vegetative propagation and sexually by formation of gametes. Hydra reproduces by budding, when plenty of food is available.