Objective NCERT GEAR UP BIOLOGY

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C-146, Gautam Nagar, Green Park
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Ph. No. - 011-26567270

Email : *editor@altisvortex.com*

Website : *www.aim4aiims.in*

PREFACE

It gives me immense pleasure in introducing the book "Objective NCERT Gear Up Biology" which is enriched with unparalleled nature of content & lots of new challenging and innovative questions in every chapter. This book provides a 360° view of NCERT with questions exclusively based on NCERT and previous year's AIIMS & NEET.

As the level of Biology is rising in exams, the student really need to cop up with it. This book will help them to meet their expectations.

As per the current trend, most of questions asked in AIIMS and NEET are from NCERT Books. Our team tried to justify this objective by developing this book to provide each & every PMT Aspirant an opportunity to read theory and practice MCQs which are directly extracted from NCERT Books.

According to me, aspirants should always go antegrade & read authentic theory from NCERT, supplemented by the Crisp Notes of NCERT given in this book for Biology and then should attempt MCQs. This helps in remembering the subject and gives confidence to attempt new questions easily. The goal behind writing this book is to give students a very easy, lucid and palatable material. This wonder book help aspirants to learn and self assess Biology in the most efficient way.

This is an endeavor by Aim4AIIMS/NEET, to extend a helping hand to all future Medicos and we hope it serves as a succor for them. The **Gear Up Series** is a compilation of 3 books, including Physics, Chemistry and Biology, providing you smart methods to prepare for any PMT Exam. It specifies exactly 'What & How' to study to clear the Exam.

I sincerely hope that this endeavor will be highly beneficial to all the students.

This Book Consists of

NCERT Crisp Notes

Topic Wise NCERT Based MCQs

NCERT Page-wise References of MCQs

Image Based Questions

Round wise Higher Order MCQs

NCERT Exemplar Problems

Selected NEET Past Year Questions

Trending Assertion & Reason

Accurate and Elaborative Explanations

Flowcharts and Tables Included

AIIMS/NEET Toppers and Faculty Teams have Simplified the NCERT for you so that you can easily get grip on NCERT.

We thankfully welcome your queries and suggestions towards its further improvement. Kindly write your reviews to *editor@altisvortex.com*

Author
Dr. Ajay Mohan
AIIMS Delhi

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Dr. Randeep Guleria
Director, AIIMS, Delhi

Dr. Animesh Tripathi
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Anup Singh
Sarvottam Faculty, Kota

Dr. Pious Abraham
Faculty, Brilliant Pala

Dr. Naveen Mishra
Goal Institute, Bihar

Prabhat Kumar
Sr. Faculty Biology

Dr. Anup Sinha
Sr. Faculty Biology

Dr. Prashant Sharma
Allen, Indore

Dr. Manu Kaushal
Helix Institute, Chandigarh

Dr. Amit Bajpai
Meritto, Jaipur

Himanshu Udainiya
Sarvottam, Kota

B.K. Meghwanshi
Ex. HOD, Bansal Classes

Dr. Apoorv Singh
Surgeon AIIMS, Delhi

Amit Dixit
CAD Tutorial, Kota

Vinod Kumar
Altis Vortex

CONTRIBUTORS

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Ajay Dogra
B.Sc (H) Botany, Delhi University

Anchit Balyan
Editor Biology
Altis Vortex Publication

Vipin Kumar Sharma
PG Biochemistry
Famous you tuber

Dr. Nikhil Mehta
MD, Dermatology
AIIMS, Delhi

Bharti Dhanraj
Reviewer

Laxmi Mishra
B.Sc Zoology, Delhi University

Dr. Hemant Jhajharia
AIIMS AIR-17 (2015)

Akansha Gupta
MSc, Delhi University

Dr. Aryan Raj Singh
AIIMS AIR-11 (2017)

Dr Navsheen Singhal
AIIMS AIR-1, 2015

ABOUT THE AUTHOR

Dr. Ajay Mohan secured **6th** position in all India MBBS AIIMS exam in 2011 and is currently pursuing MD Medicine and DM Infectious Medicine from **AIIMS New Delhi**.

A student of India's finest medical college, Dr. Ajay Mohan always realized the dearth of good and inexpensive medical coaching in the country. In October 2014, he came up with an initiative Aim4AIIMS/NEET to help and mentor medical aspirants achieve their dreams.

At the nascent stage, guidance from the team to more than three lakh medical aspirants through Facebook, YouTube, Email, Quora and WhatsApp helped many students crack some toughest medical exams across India.

His classes on General Studies for medical entrance witnessed around 2,000 students on an average in a single session. Owing to an increased demand, Dr. Ajay Mohan authored and launched a book 'Aim4AIIMS MBBS Entrance Exam' to help medical students sway through General Knowledge and Past Years Questions.

Ever since Aim4AIIMS/NEET caught the attention of medical students, the initiative started gathering recognition in media. Leading publications like Press Trust of India (PTI), The Hindu, Hindustan Times, Deccan Chronicle and Dainik Bhaskar wrote about how the initiative is making medical coaching easier and assessable for the aspirants.

NDTV anchor Ravish Kumar in his Prime Time applauded the initiative by Dr. Ajay Mohan in giving medical coaching through mobile phone and helping them secure seats in prominent medical colleges.

Informative blogs, innovative study material, test series, topper's videos on YouTube and Facebook group has been encouraged and appreciated by many. Dr. Ajay is also the Co-founder of AIIMS Delhi social service organization 'AIIMS Parivartan' and the contributor of book AIIMS Assertion and Reason and Aim4AIIMS Biology Prepguide.

"I wanted the aspirants to know that someone is there to guide them. I wanted them to know that they can pour all their problems on us and study without tension. I spent days in writing books on simplifying medical questions and answers using which the students do not have to run from one coaching institute to another. I wanted to break the stigma of failure which a student faces every second of his life. The study pattern should be smooth and should focus on smart study,"

says Dr. Ajay Mohan.

TESTIMONIES

To become doctor was my childhood dream which came true on 4th June. I really thanks to my elder sister and my brother who helped me a lot in my study.

I believe that a thorough & repeated revision of NCERT and solving questions based on NCERT made my rank in NEET & AIIMS Exam. I recommend to all my juniors that they must have complete knowledge of NCERT especially in Biology. I used to read every chapter of Biology line by line and tried to frame questions out of them which helped me a lot in my main exam.

Many students says that social media always distract us but for me it was helpful in my preparation. I used to see Toppers interviews which Aim4AIIMS/NEET released from time to time. Those videos gave me great direction on how to prepare, preparation strategy and how to manage time for the real exam.

So basically I used social media to keep myself motivated and inspired by AIIMS Toppers.

Monthly GK on Aim4AIIMS website helped me in my GK and Reasoning preparation and I also read Aim4AIIMS Assertion & Reason book which helped me to score best in A&R sections of all 3 subjects for my AIIMS Exam. Surprisingly many questions of my NEET & AIIMS paper were direct or indirect replica of the questions practised from Aim4AIIMS/NEET Books

Kalpana Kumari

AIR-1, NEET-2018

I am so happy that I secured 9th Rank in AIIMS and 5th Rank in NEET. I want to thanks Dr. Ajay Mohan for his guidance and help during my preparation. I studied to the NCERT and prefer supplement which elaborates the NCERT and questions based on it.

So, i will suggest everyone study NCERT. This year I found that 90% to 95% MCQs in biology had been asked in the Exam. So, for Biology NCERT is most important. You need to pay more attention to the language and examples of NCERT because many questions come from these examples.

Many aspirants think that NCERT is only important for biology. But it is not true. It is also important for chemistry and physics. NCERT is really important for Surface and state of matter in Physical chemistry.

For inorganic chemistry, you need to read every reaction, example and experimental data given in NCERT. So read and analyze line by line and revise repeatedly.

Coming to the organic chemistry which was really hard for me personally, for some topics like Environmental Chemistry, Biomolecules, Polymers and Chemistry in Everyday Life, you really need to read NCERT. Solve examples given in the NCERT which would be really helpful for the exam.

In Physics, NCERT is very important for A & R questions. Analyze logically to the concepts and solved examples given in the NCERT.

At the last, once again I would like to say that “Never ignore NCERT if you really want to secure good Rank”.

ABHISHEK DOGRA

AIR-9 AIIMS-2017, AIR-5 NEET-2017

I am really happy that all my hard work has paid off. I would thank my parents for this success as it would not be possible without their support.

The Aim4AIIMS initiative proved to be boon to me. It gave me a clear idea of the kind of questions asked in exam. Vashishta Sir and Ansh sir helped me a lot in my preparation. Dr. Ajay Mohan sir's guide to AIIMS preparation really helped me out in the GK section as many as 15 questions could be answered with the information on current affairs in the book and posted on the website.

I wish all the AIIMS aspirants good luck for their exam.

SATHVIK REDDY ERLA

AIR-1 AIIMS-2016, AIR-20 JIPMER-2016

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Class XI

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CLASS XI

1 The Living World

NCERT Crisp

- **Father of Biology and Zoology : Aristotle**
- **The Darwin of the 20th century** : **Ernst Mayr**
- **Father of Botany : Theophrastus**
- **Father of Plant Physiology : Stephan Hales**
- **Father of Experimental Genetics : Morgan**
- **Father of Mycology : Micheli**
- **Father of Eugenics : Francis Galton**
- **Father of DNA finger printing : Alec. Jaffery**
- **Father of Indian Ecology : Ramdeo Mishra**
- **Father of Experimental physiology : Galen**
- **Father of Indian Mycology : E. J. Butler**
- **Father of Mutation : Hugo de Vries**
- **Father of Special Creation Theory : Father Suarez**
- **Father of Modern Genetics : Bateson**
- The study of kind of **life in outer space is** known as **exobiology.**
- **Ernst Mayr** pioneered the currently accepted definition of a **biological species.**
- **Morphological concept of species** given **by Linnaeus.**
- **Increase in mass** and **increase in number** of individuals are **twin characteristics** of growth.
- A multicellular organism **grows** by **cell division.**
- **In plants**, this growth by **cell division occurs continuously** throughout their life span.
- **In animals**, this growth is **seen only up to** a certain age.
- In **majority of higher animals** and **plants, growth** and **reproduction are mutually** exclusive events.
- **Increase in body mass** is considered **as growth.**
- In **living** organisms**, growth is from inside.**
- **Growth cannot** be taken as a **defining property** of living organisms.
- In ***Planaria*** **(flat worms): True regeneration**
- The **fungi**, the **filamentous algae**, the **protonema of mosses**, all easily multiply by **fragmentation.**
- **Bacteria**, unicellular **algae** or **Amoeba, reproduction is synonymous with growth**, i.e., increase in number of cells.
- Reproduction cannot be an all-inclusive defining characteristic of living organisms.
- **No non-living** object is capable **of reproducing** or replicating by itself.
- The sum total of all the chemical reactions occurring in our body is **metabolism.**
- **No non-living** object **exhibits metabolism.**
- An **isolated metabolic reaction**(s) outside the body of an organism, performed in a test tube **is neither living nor non-living.**
- **Metabolism** is a defining feature of all living organisms **without exception**, isolated metabolic reactions *in vitro* are not living things but surely living reactions.
- **Cellular organization** of the body **is the defining feature of life forms.**
- The most obvious and **technically complicated feature** of all living organisms is this **ability to sense their surroundings** or environment and respond to these environmental stimuli which could be physical, chemical or biological.

- Photoperiod affects reproduction in seasonal breeders.
- Human being is the only organism that is aware of himself, i.e., has self-consciousness.
- **Consciousness** is the defining property of living organisms.
- Properties of tissues are not present in the constituent cells but arise as a result of interactions among the constituent cells.

Biodiversity

- The number of species that are known and described range between **1.7-1.8 million**. This refers to **biodiversity**
  - Largest group is insecta.
  - Maximum Biodiversity is found in tropical

Rain forest:
- Around 1500 new species discovered every.

Nomenclature

- **Binomial nomenclature** system given **by Carolus Linnaeus.** Each name has two components – the **generic name** and the **specific epithet**.
- **Tautonyms:** If both generic and specific names are same, these are called tautonyms.
- **Nomenclature:** Standardize the naming of living organisms
  - **I**nternational **C**ode for **B**otanical **N**omenclature (**ICBN**).
  - **I**nternational **C**ode of **Z**oological **N**omenclature (**ICZN**).

Rules of Nomenclature

- Biological names are generally in **Latin** and written in **italics**. They are latinized or derived from Latin irrespective of their origin.
- The **first** word in a biological name represents the **genus** while the **second** component denotes the **specific epithet.**
- Both the words in a biological name, when **handwritten**, are separately **underlined**, or **printed in italics** to indicate their Latin origin.
- The **first word** denoting the genus starts with a **capital letter** while the **specific epithet** starts with a **small letter.**
- **Name of the author** appears after the specific epithet, i.e., at the end of the biological name and is written in an **abbreviated form**.
- Characterization, identification, classification and nomenclature are the processes that are basic to taxonomy.
- The **word systematics** is derived from the Latin word '***systema***' which means systematic arrangement of organisms.
- Linnaeus used ***Systema Naturae*** as the title of his publication.
- Families are characterized on the basis of both vegetative and reproductive features of plant species.
- **Plant families** like Convolvulaceae, Solanaceae are included in the order Polemoniales mainly **based on the floral characters.**
- Order Primata comprising monkey, gorilla and gibbon is placed in class Mammalia along with order Carnivora that includes animals like tiger, cat and dog

Taxonomical Hierarchy – As we go from species to organisms, similarities decrease/differences increase.
Species → Genus → Family → Order → Class → Phylum / Division → Kingdom
Organisms with their Taxonomic categories:
- ◊ **Man:** *Homo sapiens* → *Homo* → Hominidae → Primate → Mammalia → Chordata
- ◊ **Housefly:** *Musca domestica* → *Musca* → Muscidae → Diptera → Insecta → Arthropoda
- ◊ **Mango:** *Mangifera indica* → *Mangifera* → Anacardiaceae → Sapindales → Dicotyledonae → Angiospermae
- ◊ **Wheat:** *Triticum aestivum* → *Triticum* → Poaceae → Poales → Monocotyledonae → Angiospermae

- Suffix **-ales** is used **for order** & suffix **-aceae** is used for **family.**

Taxonomical Aids

Herbarium	Botanical Garden	Museum	Zoological Parks
Store house of **collected plant specimens** that are dried, pressed and preserved on sheets.	Collection of **living plants** for reference.	Collections of **preserved plant and animal specimens** for study and reference.	Places where **wild animals** are kept in **protected environments** under human care
General **Sheet size:** 29 × 41.5 cm or 16 ½ × 11 ½ Inch	Each plant in Botanical Garden indicating its botanical/ scientific name and its family.	Specimens are preserved in the containers or jars in preservative solutions(**Formalin**)	Enable us to **learn** about their **food habits** and **behavior.**

Herbarium	Botanical Garden	Museum	Zoological Parks
Vasculum: Special type of box where plants are kept.	**Royal Botanical Gardens** are at Kew (England) (**Largest** herbarium in **world**) **Indian Botanical Garden,** Howrah (India) (**Largest** herbarium in **India**)	Insects are preserved in insect boxes after **collecting, killing and pinning**. Larger animals like birds and mammals are usually stuffed and preserved.	
$HgCl_2$ is used to protect specimens from pests and insects	National Botanical Research Institute, Lucknow (India).	Museums often have **collections of skeletons of animals** too.	
		Plant and animal specimens preserved as **dry specimens.**	

Other Taxonomical Aids

Key	▪ Used for identification of plants and animals **based on the similarities and dissimilarities.** ▪ Based on the contrasting characters generally in a **pair called couplet.** ▪ Results in **acceptance of only one and rejection of the other.** ▪ Analytical in nature.
Flora	▪ Contains **the actual account of habitat** and **distribution of plants of a given area**. These provide the **index to the plant species** found in a particular area. ▪ **J. D. Hooker** wrote "**Flora of British India**"
Manuals	▪ Useful in providing information for **identification of names of species** found in an area.
Monographs	▪ Contain **information** on any **one taxon.**

- **Concepts of Hotspots : Norman Myers**
- **Most diversity rich zone** in India : **Western Ghat and Eastern Himalaya.**
- Term **classification: A.P.de Candolle**
- **Three domains of Life** : **Carl Woese, 1990**
- **Sympatric** : Species inhabiting **same** geographical area
- **Allopatric :** Species inhabiting **different** geographical area

Self Assessment Questions

What is Living? [NCERT Pg 3-5]

1. Defining property of living organism?
a. Reproduction
b. Metabolism
c. Consciousness
d. Cell division

2. Which of the following do not reproduces?
a. Phytoplankton b. Worker bee
c. Queen bee d. Mycoplasma

3. Isolated metabolism reaction outside the body performed in test tube
a. Living
b. Non - living
c. Neither living nor Non-living
d. Both (a) and (b)

4. Defining feature of life forms?
a. Metabolism
b. Consciousness
c. Cellular organization
d. All of the above

5. In which organism reproduction can be considered as synonymous with growth?
a. Amoeba
b. Planaria
c. Star fish
d. More then one option are correct

6. The twin characteristics of growth are:
a. Increase in number of individuals, increase in mass
b. Increase in height and increase in mass
c. Increase in molecular weight and increase in mass
d. Increase in size and decrease in mass

7. A living organism is unexceptionally differentiated from a nonliving structure on the basis of
a. Reproduction
b. Growth and movement
c. Interaction with environment
d. Responsiveness

8. The statement 'nothing lives forever, yet life continues' illustrates the role of
a. Embryogenesis
b. Morphogenesis
c. Replication
d. Reproduction

Diversity in Living World [NCERT Pg 6-8]

9. Described biodiversity range?
a. 1.7 - 1.8 million b. 1.1 - 1.8 trillion
c. 1.7 - 1.8 billion d. 17 - 18 billion

10. ICBN codes for?
a. International code for Botanical Nomenclature
b. International code for Binomial Nomenclature
c. International code for Botanimal Naming
d. International code for Binomial Naming

11. ICZN codes for:
a. International code of zoological Nomenclature
b. International code for zoological Naming
c. International coding for zoological Nomenclature
d. Inbreeding code for zoological Nomenclature

12. Linnaeus used the title for his publication is?
a. *Systema Naturae*
b. *Genera Naturae*
c. Altis vortex
d. *Die Nature lichen pflanzen*

13. The science of giving names to living beings called
a. Nomenclature b. Identification
c. Classification d. Characterization

14. Select the correctly written botanical/ zoological name
a. *Panthera tigris* b. *Mangifera indica*
c. *Sativum pisum* d. *Homo sapiens*

15. Biological names, when hand written, should necessary be:
a. Underlined b. Bold (antics)
c. In capital letter d. Italics

16. In binomial nomenclature, the first and second components represent:
a. Genus and species
b. Genus and class
c. Species and genus
d. Kingdom and class

17. The main purpose of classification of organisms is to
a. Study geography
b. Locate plants and animals
c. Establish relationships amongst organisms
d. Study evolution

18. First book of Botany, Historia Plantarum, was given by:
a. Theoprastus b. A. P. de Condolle
c. Aristotle d. None of these

19. The word systematics is derived from
a. Greek word systema
b. Italic word systema
c. Latin word systema
d. English word systema

20. In *Mangifera indica* Linn. *indica* refers to
a. Genus b. Author
c. Family d. Species

21. Term biology was introduced by:
a. Aristotle b. Darwin
c. John Ray d. Lamarck and Treviranus

22. Improvement of human race through improvement of human environment is:
a. Anthropology b. Euthenics
c. Euphenics d. Eugenics

23. Edaphology is:
a. Study of soils b. Study of amphibians
c. Study of snakes d. Study of elephants

24. As we go lower from kingdom to species the number of common characteristics goes on
a. Increasing b. Remain unchanged
c. Decreasing d. Sometimes decreasing

25. A prediction made by a scientist based on his observation is known as:
a. Law b. Principle
c. Theory d. Hypothesis

26. The simplest amino acid is:
a. Aspartic acid b. Tyrosine
c. Lysine d. Glycine

27. Glucose in taken in test tube and acted upon by hexokinase enzyme. Resulting substrate is glucose - 6 - phosphate. This isolated metabolic reaction is:
a. Occurring in test tube which can be considered as living
b. Considered to be *in vivo*
c. Considered to be *in vitro* and living reaction.
d. Considered as non-living reaction

28. Basis of Taxonomy are:
a. Identification - Characterization - Classification - Nomenclature
b. Characterization - Identification - Classification - Nomenclature
c. Classification - Characterization - Identification - Nomenclature
d. Nomenclature - Classification - Identification - characterization

29. The scientific name of banyan is written as *Ficus bengalensis* L. which of the following is a correct statement regarding this?
a. Letter L signifies Latin language.
b. The name should be reverse with *bengalensis* preceding *Ficus*
c. Letter L signifies taxonomist Linnaeus
d. *Bengalensis* is generic name

Taxonomic Categories [NCERT Pg 8-11]

30. Systematics takes accounts:
a. Evolutionary relationship between organisms.
b. Breeding relationship between organisms.
c. Economic relationship between organisms.
d. None of these

31. Taxon represents:
a. Rank in classification
b. Basic unit of classification
c. Both of these
d. None of these

32. In taxonomy the first step is:
a. Identification b. Nomenclature
c. Classification d. Affinities

33. Term classification was given by:
a. A.P de Condolle
b. Norman E. Borloug
c. Tansley
d. None of these

34. Which of the following taxonomic categories contains organisms least similar to one another?
a Genera b. Family
c. Class d. Species

35. Which of the following combinations is correct for wheat ?
a. Genus : *Triticum*, Family : Anacardiaceae, Order : Poales, Class : Monocotyledonae
b. Genus : *Triticum*, Family : Poaceae, Order : Poales, Class : Dicotyledonae
c. Genus : *Triticum*, Family : Poaceae, Order : Sapindales, Class : Monocotyledonae
d. Genus : *Triticum*, Family : Poaceae, Order : Poales, Class : Monocotyledonae

36. The suffix – inae signifies the rank:
a. Tribe b. Subtribe
c. Suborder d. Family

37. Species living in different geographical areas are called:
a. Allochronic b. Allopatric
c. Sympatric d. Siblings

38. Determination of age by counting growth rings falls under:
a. Chorology
b. Chronology
c. Dendrology
d. Dendrochronology

39. What is ethnobotany?
a. Cultivation of flower yielding plants
b. Use of plants and their parts
c. Relationship between plants and primitive people
d. Study of soil

40. The timing of seasonal activity of plants in relation to change in environmental conditions is termed as:
a. Dendrochronology
b. Phenology
c. Time lapse
d. Biological clock

41. In a scientific name, the name of the author is printed in
a. Capital letters b. Bold (antics)
c. Italics d. Roman

42. Few rules are written following regarding binomial nomenclature. Identity the wrong one:
a. Biological names are latinized and written in italics
b. Generic and specific name starts with capital letter
c. Generic and specific name when hand written are underlined
d. All are correct

43. Identity the incorrect statement:
a. Class like Mammalia is involved in phylum Chordata
b. Order like Insecta is involved in class Mandibulate
c. Genus like Panthera is involved in family Felidae.
d. Order like Primata is involved in class Mammalia

44. Which is not the component of taxonomy?
a. Identification b. Responsiveness
c. Nomenclature d. Classification

45. Taxonomic hierachy is given following; select the correct match:

	Taxonomic category	Examples
a.	A	Sapindales, Insecta
b.	B	Primata, Diptera
c.	C	Musca, Poales
d.	D	Triticum, Muscidae

Species [NCERT Pg 9]

46. Which of the following is a species?
a. *Tamarindus* b. *Homo*
c. *Triticum aestivam* d. *Indica*

47. Which is less general in characters as compared to genus?
a. Family d. Class
c. Division d. Species

48. Species is considered:
a. As basic unit of classification
b. The largest unit of classification
c. Artificial concept of human mind which cannot be defined in absolute terms
d. Real unit of classification devised by taxonomists

Genus [NCERT Pg 9]

49. Genera Plantarum was given by:
a. Bentham Hooker
b. Engler & Prantl
c. A.P de Condole
d. None of these

50. Linnaeus put similar species into a larger group called the
a. Species b. Family
c. Kingdom d. Genus

51. In a taxonomic hierarchy, genus is interpolated between
a. Kingdom and class
b. Phylum and order
c. Order and species
d. Family and species

52. The taxonomic category below the lovel of family is
a. Class b. Species
c. Phylum d. Genus

Family [NCERT Pg 9]

53. *Die naturlichen pflanzenfamilien* was given by.
a. Engler & Prantl
b. Lamarck
c. Curier
d. None of these

54. Olericulture is cultivation of:
a. Flowers b. Vegetables
c. Fruits d. All the above

55. Family and order of *Triticum aestivum* (wheat) are
a. Poaceae, Monocotyledonae
b. Poaceae, Poales
c. Poales, Monocotyledonae
d. None is correct

56. Family - order - class of *Musca domestica* (Housefly) are respectively:
a. Muscidae - Insecta - Hymenoptera
b. Muscidae - Diptera - Mandibulata
c. Hymenoptera - Insecta - Mandibuleta
d. Muscidae - Diptera - Insecta

57. Family of man (*Homo sapiens*) is:
a. Hominidae b. Hominini
c. Primata d. Ceboideae

58. The word ending with - *aceae* indicates:
a. Genera b. Family
c. Order d. Class

59. In a taxonomic hierarchy, family is interpolated between:
a. Kingdom and class
b. Class and order
c. Order and genus
d. Class and genus

60. Cohort is a group of correlated:
a. Order b. Species
c. Genera d. Families

Order [NCERT Pg 10]

61. Order polyemoniales include
a. Convolvulaceae b. Solanaceae
c. Both of this d. None of these

62. Carnivora includes
a. Canis b. Felis
c. Both of these d. None of these

63. Order polyemoniales based on
a. Reproductive character
b. Floral character
c. Evolutionary character
d. None of these

64. Poales is the order of
a. Mango b. Wheat
c. Maize d. Corn

65. Sapindales is the order of
a. Mango b. Maize
c. Wheat d. Corn

66. When organisms are in the same class but not in same family, the taxonomic term is called as:
a. Order b. Genus
c. Family d. Species

67. The category that includes related order is
a. Families b. Phylum
c. Class d. Kingdom

Phylum [NCERT Pg 10]

68. Term phylum was given by:
a. Haeckel b. H. J. Lam
c. Eichler d. Linnaeus

69. Which of the following categories possess least number of related characters?
a. Order b. Phylum
c. Class d. Species

70. Two animals belong to the same kingdom but different classes. They may belong to the same
a. Phylum b. Order
c. Division d. Family

Taxonomical Aids [NCERT Pg 11-14]

71. Father of Indian Taxonomy:
a. Ajay phadke
b. Henry Santapau
c. Har Govind Khorana
d. Chanukah

72. The term taxon for plants coined by
a. Curier b. Adolf Meyer
c. H.J Lam d. DeCandolle

Herbarium [NCERT Pg 11-12]

73. Largest Herbarium in the world situated in
a. Kew b. L.A.
c. Johannesburg d. Brazil

74. Herbarium sheet size?
a. 29 * 41.5 cm b. 29 * 40 cm
c. 30 * 20 cm d. 20 * 20 cm

75. Pesticide used in the Herbarium is:
a. 2 , 4 - D b. NAA
c. CS_2 d. $HgCl_2$

76. Employment of hereditary principles in the improvement of human race is:
a. Ethnology b. Euphenics
c. Eugenics d. Euthenics

Botanical Garden and Museum [NCERT Pg 12]

77. Insects are preserved in insect boxes after:
a. Collecting - Killing - Pinning
b. Killing - Collecting - Pinning
c. Killing - Pinning - Collecting
d. None of these

78. Royal Botanical Garden consists of how many specimens?
a. 6.5 millions b. 6 millions
c. 6.5 billions d. 6.5 trillions

79. Plant species in botanical gardens are labeled to indicate
a. English and local name
b. Collectors name
c. Botanical name and family
d. Family and place of collection

80. Father of Botany:
a. Aristotle b. Theophrastus
c. Lamark d. Whittaker

81. National Botanical Research Institute located in:
a. Chennai b. Lucknow
c. Darjeeling d. Kolkata

82. Rearing of bees is:
a. Horticulture b. Sericulture
c. Silviculture d. Apiculture

83. The collection of preserved plants and animals for study and reference is called:
a. Museum b. Keys
c. Herbarium d. Flora

84. In museums, larger animals like birds and mammals are:
a. Collected, killed and pinned
b. Stuffed and preserved
c. Preserved in natural habitat
d. Both (a) and (b)

85. Museums are known to preserve:
a. Insects
b. Larger animals
c. Skeleton of animals
d. All of these

Zoological Parks [NCERT Pg 13]

86. First book of Zoology Historia animalicum was given by:
a. Aristotle b. Theophrastus
c. Carl woese d. Alberto del rio

87. Father of zoology:
a. Theophrastus b. Aristotle
c. Carl correns d. Von - Tschemark

88. Not applicable to zoological parks:
a. *In vivo* mode of conservation
b. Wild animals are kept under human care
c. Wild animals are kept in separate enclosures
d. All are true

Key [NCERT Pg 13]

89. Each statement in key is called
a. Couplet b. Lead
c. Principle d. None of these

90. Which of the following provide information of any one taxon?
a. Manuals b. Monograph
c. Flora d. Fauna

91. Providing information for identification of names of species found in an area
a. Fauna b. Flora
c. Monograph d. Manuals

Higher Order Questions

Fact Based Round

1. Herbarium is:
a. A garden where medicinal plants are grown
b. Garden where herbaceous plants are grown
c. Dry garden
d. Chemical to kill plants

2. Which one of the following branch is applicable to both plants and animals?
a. Herpetology b. Saurology
c. Taxonomy d. Ichthyology

3. For higher plants, flowers are chiefly used as a basis of classification, because:
a. These show a great variety in colour
b. It can be preserved easily
c. Reproductive parts are more conservative than vegetative parts
d. They have strong fragrance

4. Which of the following species are restricted to a given area?
a. Sympatric species b. Allopatric species
c. Sibling species d. Endemic species

5. The most convenient way for easy identification of plants and animals by applying diagnostic feature is use of
a. Herbarium b. Botanical gardens
c. Museum d. Taxonomic keys

6. Classification systems have many advantages. Which of the following is not a goal of biological classification?
a. To depict convergent evolution
b. To clarify relationships among organisms
c. To help us remember organisms and their traits
d. To identify and name organisms

Combination Round

7. Read the following and choose the correct combinations:

	Scientist		Coined the term
A.	A.P. de Candolle	1.	Biology
B.	Herbert Spencer	2.	Genetics
C.	Lamarck	3.	Taxonomy
D.	Ernst Haeckel	4.	Ecology
E.	Bateson	5.	Organic evolution

a. A-3 B-5 C-2 D-4 E-1
b. A-3 B-5 C-1 D-4 E-2
c. A-1 B-3 C-5 D-2 E-4
d. A-4 B-2 C-5 D-1 E-4

8. Read the following and choose the correct combinations:

A.	Biosphere Reserves	1.	16
B.	National Parks	2.	34
C.	Sanctuaries	3.	90
D.	Biodiversity hot spots	4.	448

a. A-3 B-1 C-4 D-2
b. A-2 B-1 C-4 D-3
c. A-3 B-1 C-2 D-4
d. A-1 B-3 C-4 D-4

9. Read the following and choose the correct combinations:

	Place	Number of types of birds	Latitude
1.	Colombia	1400	00 N
2.	New York	105	410 N
3.	Greenland	56	710 N

a. All correct b. One
c. 1 & 2 d. Except two

10. Match the columns and find out the correct combination:

	Common name		Biological name
A.	Tobacco	1.	*Mangifera indica*
B.	Potato	2.	*Triticum vulgare*
C.	Brinjal	3.	*Nicotiana tabacum*
D.	Wheat	4.	*Solanum tuberosum*
		5.	*Solanum melongena*

a. A-4 B-3 C-1 D-2
b. A-3 B-4 C-5 D-2
c. A-1 B-2 C-3 D-4
d. A-2 B-1 C-4 D-3

11. Match the columns and find out the correct combination:

A.	Family	1.	*nigrum*
B.	Kingdom	2.	Polemoniales
C.	Order	3.	*Solanum*
D.	Species	4.	Plantae
		5.	Solanaceae

a. A-5 B-4 C-2 D-1
b. A-4 B-5 C-3 D-2
c. A-1 B-2 C-3 D-4
d. A-3 B-2 C-4 D-5

12. Match the columns and find out the correct combination:

A.	Couplet	1.	Information of any one taxon
B.	Lead	2.	Preserved specimen
C.	Monograph	3.	Specially designed for ready reference
D.	Manuals	4.	Each statement in the key
		5.	A pair of contrasting characters

a. A-5 B-4 C-1 D-3
b. A-4 B-2 C-3 D-1
c. A-1 B-3 C-2 D-4
d. A-3 B-1 C-4 D-2

Conceptual Round

13. Choose the correct statements from following:
A. Taxonomic hierarchy includes seven obligate categories.
B. Haeckel introduced the taxon phylum.
C. Three - domain classification was introduced by Carl Woese.

a. A & B b. B & C
c. A & C d. All

14. Read the following statements and identify the correct statements:
A. Biodiversity refers to the number and types of organisms present on earth.
B. The local names would vary from place to place, even within a country.
C. The number of species that are known and described range between 1.7-1.8 million.
D. International Code for Botanical Nomenclature (ICBN) provides scientific names for plants
E. Nomenclature or naming is only possible when the organism is described correctly.

a. A and B only b. A, B and C only
c. A, D and C only d. All of these

15. Incorrect statement is:
a. Naming is only possible when the organism is described correctly.
b. Scientific names are based on the principles and criteria provided in ICBN.
c. Description of any organism should enable the people (in any part of the world) to arrive at the same name.
d. Category denotes rank, and these categories or ranks are merely morphological aggregates.

16. Incorrect statement are:
A. Animals, mammals, dogs, alsatians represent taxa at different levels.
B. Phenotypic plasticity is the ability of an organism to change its phenotype in response to environment.
C. Nomenclature is only possible when the organism is described correctly.
D. In animals, growth is seen only up to a certain age.
E. Non-living objects also grow if we take increase in body mass as a criteria of growth.
F. Human being is the only organism who is aware of himself.

a. C b. B c. A d. Zero

17. Read the following statements.
A. Isolated-metabolic reactions *in-vitro* are living things.
B. Reproduction is synonymous with growth in *Chlamydomonas*.
C. Reproduction is an all inclusive defining characteristic of living organisms.
D. Extrinsic growth cannot be taken as defining property of living organisms.

How many of the above statement (s) is/are not true?
a. One b. Two c. Three d. Four

18. Consider the following statements and select correct set of option.
A. The most obvious and technically complicated features are metabolism and consciousness.
B. Growth and reproduction are mutually inclusive events for euglenoids and chrysophytes.
C. Generally, families and orders are identified on the basis of aggregates of vegetative characters only.
D. Herbarium serves as quick referral system in taxonomical studies.

a. B, C & D b. A, C & D
c. B & D d. A, B, C & D

19. Read the following statements.
A. Manuals are useful in providing information for identification of names of species found in an area.
B. Potato and brinjal are related species, which has more characters in common in comparison to shimla mirch.
C. CO_2 dissolving in water, a physical process, is a catalysed reaction in living systems.
D. The ribosomes of polysome translate the mRNA into multiple copies of the same protein.

a. A and C are correct
b. Only B correct
c. B incorrect
d. All are correct

NCERT Exemplar Problems

1. As we go from species to kingdom in a taxonomic hierarchy, the number of common characteristics:
a. Will decrease b. Will increase
c. Remain same d. May increase or decrease

2. Which of the following 'suffixes' used for units of classification in plants indicates a taxonomic category of 'family'?
a. — Ales b. — Onae
c. — Aceae d. — Ae

3. The term 'systematics' refers to:
a. Identification and study of organ systems
b. Identification and preservation of plants and animals
c. Diversity of kinds of organisms and their relationship
d. Study of habitats of organisms and, their classification

4. Genus represents:
a. An individual plant or animal
b. A collection of plants or animals
c. Group of closely related species of plants or animals
d. A group of plants in a given area.

5. The taxonomic unit 'Phylum' in the classification of animals is equivalent to which hierarchical level in classification of plants:
a. Class b. Order
c. Division d. Family

6. Botanical gardens and Zoological parks have:
a. Collection of endemic living species only
b. Collection of exotic living species only
c. Collection of endemic and exotic living species
d. Collection of only local plants and animals

7. Taxonomic key is one of the taxonomic tools in the identification and classification of plants and animals. It is used in the preparation of:
a. Monographs b. Flora
c. Both (a) and (b) d. None of these

8. All living organisms are linked to one another because:
a. They have common genetic material of the same type
b. They share common genetic material but to varying degrees
c. All have common cellular organization
d. All of the above

9. Which of the following is a defining characteristic of living organisms?
a. Growth b. Ability to make sound
c. Reproduction d. Response to external stimuli

10. Match the following and choose the correct option.

A. Family	1. *Tuberosum*
B. Kingdom	2. Polymoniales
C. Order	3. *Solanum*
D. Species	4. Plantae
E. Genus	5. Solanaceae

a. A-4 B-3 C-5 D-2 E-1
b. A-5 B-4 C-2 D-1 E-3
c. A-4 B-5 C-2 D-1 E-3
d. A-5 B-3 C-2 D-1 E-4

Past Year Questions

1. The label of a herbarium sheet does not carry information on:
a. Local names
b. Height of the plant
c. Date of collection
d. Name of collector

2. Biodiversity of a geographical region represents:
a. Genetic diversity present in the dominant species of the region
b. Species endemic to the region
c. Endangered species found in the region
d. The diversity in the organisms living in the region

3. A living organism can be unexceptionally differentiated from a non-living thing on the basis of its ability for:
a. Reproduction
b. Growth and movement
c. Responsiveness to touch
d. Interaction with environment and progressive evolution

4. Biosystamatics aims at:
a. The classification of organisms based on broad morphological characters.
b. Delimiting various taxa of organisms and establishing their relationships.
c. The classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of studies.
d. Identification and arrangement of organisms on the basis of their cytological characteristics.

5. First life on earth was:
a. Cyanobacteria b. Chemohetrotrophs
c. Autotrophs d. Photoautotrophs

6. Viable material of endangered species can be preserved by:
a. Gene bank b. Gene library
c. Herbarium d. Gene pool

7. Which arrangement is in correct ascending order?
a. Species < genus < order < family
b. Genus < species < family < order
c. Order < family < genus < species
d. Species < genus < family < order

8. 'Taxon' is the unit of a group of:
a. Order b. Taxonomy
c. Species d. Genes

9. Sequence of taxonomic categories is:
a. Class-phylum-tribe-order-family-genus-species
b. Division-class-family-tribe-order-genus-species
c. Division-class-order-family-tribe-genus-species
d. Phylum-order-class-tribe-family-genus-species

10. The high boiling point of water is advantageous to living organisms because
a. The environment seldom reaches the boiling point of water.
b. Organisms can easily boil off enough water to keep themselves cool.
c. It allows organisms to spread heat evenly throughout their bodies.
d. Organisms can absorb a great deal of heat before they reach the boiling point from organisms and population.

11. A group of plants or animals with similar traits of any rank is:
a. Species b. Genus
c. Order d. Taxon

12. The term "New Systematics" was introduced by:
a. Bentham and Hooker
b. Linnaeus
c. Julian Huxley
d. A. P. de Candolle

13. Static concept of species was put forward by:
a. de Candolle b. Linnaeus
c. Mayr d. Darwin

Assertion & Reason

Directions: These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

A. If both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.
B. If both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.
C. If Assertion is True but the Reason is False.
D. If both Assertion and Reason are False.

1. **Assertion:** Both the words in a biological name when handwritten, are separately underlined or printed in italics.

   Reason: This is done to indicate their latin origin.

2. **Assertion:** Character of family is more general as compared to character of genus.

   Reason: Genera aggregates closely related species.

3. **Assertion:** Botanical garden are one of the important taxonomic aids used in taxonomic studies.

   Reason: Botanical garden play significant role in identification of plants.

4. **Assertion:** Chemotaxonomy is classifying organism at molecular level.

   Reason: Cytotaxonomy is classifying organism at cellular level.

5. **Assertion:** Natural system fails to give phylogenetic relationship.

   Reason: Natural system may use habit or habitat for classifying organism.

6. **Assertion:** Living organisms show internal as well as external growth.

   Reason: Living organisms undergo the process known as accretion.

7. **Assertion:** New names in binomial nomenclature are derived from Latin or are Latinized.

   Reason: Latin is a technical language.

8. **Assertion:** In binomial nomenclature, both words are separately underlined.

   Reason: Underlining indicates their Latin origin.

9. **Assertion:** Complexity of classification increases from kingdom to species.

   Reason: Common characters increase from kingdom to species.

10. **Assertion:** The biological species concept helps us to ask how species are formed.

    Reason: The concept of biological species focuses our attention on the question of how reproductive isolation comes about.

11. **Assertion:** A morphology based approach to taxonomy is called 'alpha taxonomy' and it is old fashioned.

    Reason: A multi-disciplinary approach to taxonomy called 'omega taxonomy' is favored in recent years, as it excludes morphological features.

12. **Assertion:** Hierarchical system of classification is useful to reduce the voluminous description in the catalogue of organisms.

    Reason: Characters of a larger category (like division) are not repeated for smaller/lower categories (family and order).

13. **Assertion:** Museums are places/institution where preserved plant, animal artistic and educational material are exhibited to public.

    Reason: Museums are of different kinds, like art, history, science and general museum which exhibit their material to public awareness.

Answer Key

Self Assessment Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	b	c	d	a	a	d	d	a	a	a	a	a	a	a	a	c
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
a	c	d	d	b	a	a	d	d	c	a	c	a	a	a	a	c
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
d	b	b	d	c	b	d	b	b	b	b	d	d	a	a	d	d
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
d	a	b	b	d	a	b	c	d	a	c	b	b	a	a	c	a
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
b	a	b	b	a	a	a	c	a	a	c	b	d	d	a	b	d
86	87	88	89	90	91											
a	b	a	b	b	d											

Higher Order Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	c	c	d	d	a	b	a	a	b	a	a	d	d	d	d	b
18	19															
c	d															

NCERT Exemplar Problems

1	2	3	4	5	6	7	8	9	10
a	c	c	c	c	c	c	b	d	b

Past Year Questions

1	2	3	4	5	6	7	8	9	10	11	12	13
b	d	a	c	b	a	d	b	c	b	d	c	b

Assertion & Reason

1	2	3	4	5	6	7	8	9	10	11	12	13
a	b	a	b	d	d	c	a	b	d	d	a	b

Explanations and NCERT References

Higher Order Questions

1. (c) ***NCERT (XI) Ch - 1, Pg. 11***

2. (c) Herpetology: study of amphibians.

Saurology: study of lizards.

Ichthyology: study of fish science.

Taxonomy: Classification of animals and plants.

3. (c) The reproductive structures of flowering plants are subjected to a much lesser degree of evolutionary pressure while vegetative characters such as structure, size or shape of leaves are often environmentally controlled and extremely variable within a genus or species.

4. (d) Endemic species are plants and animals that exist in a defined geographical location.

5. (d) ***NCERT (XI) Ch - 1, Pg. 13***

Key is another taxonomical aid used for identification of plants and animals based on the similarities and dissimilarities. The keys are based on the contrasting characters generally in a pair called couplet. Keys are generally analytical in nature.

6. (a) The goals of classification includes recognition and complete description of different species; development of a system for easy identification of various species; to establish relationships on the basis of resemblance and differences between organisms; and formulating a scheme of hierarchical grouping of species.

13. (d) ***NCERT (XI) Ch - 1, Pg. 10***

14. (d) ***NCERT (XI) Ch - 1, Pg. 6***

15. (d) Category denotes rank and each rank or taxon represents a unit of classification. These taxonomic categories are distinct biological entities and not merely morphological aggregates.

16. (d) ***NCERT (XI) Ch - 1, Pg. 4, 5 & 7***

17. (b) Statement A and C are incorrect. An isolated metabolic reaction(s) outside the body of an organism, performed in a test tube is neither living nor non-living. Reproduction also cannot be an all-inclusive defining characteristic of living organisms.

18. (c) ***NCERT (XI) Ch - 1, Pg. 4 & 12***

19. (d) ***NCERT (XI) Ch - 1, Pg. 9 & 14***

NCERT Exemplar Problems

1. (a) Lower the taxa, more are the characteristic that the members within the taxon share. So, lowest taxon share the maximum number of morphological similarities, while its similarities decrease as we move towards the higher hierarchy, i.e., class, kingdom.

Thus, rest of the option are incorrect.

3. (c) The word systematics is derived from Latin word '*Systema*' which means systematic arrangement of organisms.

4. (c) Genus comprises a group of closely related species which has more characters in common in comparison to species of other genera. The other options do not define genus.

5. (c) Division includes classes with few similar characters of group of organism. It is equivalent to 'Phylum' in case of animals.

6. (c) Botanical gardens and Zoological parks are used to restore depleted population, reintroduce species, *i.e.,* wild and restore degraded habitats of both exotic and endemic living species.

Rest of the options are incorrect.

7. (c) Taxonomic keys are tools that help in identification of organism based on the characters, which includes both monograph and flora.

8. (b) All living organisms share common genetic material, i.e., DNA but with variations, e.g., bacteria have single stranded circular DNA while in highly evolved eukaryotic cells of plants and animals, DNA is a long double stranded helix.

9. (d) Response to external stimuli or to the environment in which an organism lives, is the most important characteristic of any living organism, besides growth and reproduction.

Growth and ability to make sound are some properties that can also be observed in non-living things. While virus (which is not included under living organisms) also show growth and reproduction.

Hence, these options are not true.

10. (b) The correct options matching with the columns represent the taxonomic classification of plant potato are

Family	—	Solanaceae
Kingdom	—	Plantae
Order	—	Polymoniales
Genus	—	*Solanum*
Species	—	*tuberosum*

Past Year Questions

1. (b) The herbarium sheets carry a label providing information about date and place of collection, English, local and botanical names, family, collector's name, etc

2. (d) Biodiversity represents total number of species present on earth. There are approximately 1.7-1.8 million species present on earth.

3. (a) All living things reproduce passing on traits from one generation to next. Non – living things cannot reproduce.

4. (c) ***NCERT (XI) Ch - 1, Pg. 8***

5. (b) First living beings were formed in the environment having abundant organic molecules. They absorbed the organic materials for the sake of nutrition and hence were chemoheterotrophs.

6. (a) Gene bank maintains stocks of viable seeds (seed banks), live growing plants (orchards), tissue culture and frozen germplasm with the whole range of genetic variability.

7. (d) ***NCERT (XI) Ch - 1, Pg. 10***

8. (b) Taxon is a taxonomic group of any rank.

9. (c) To make taxonomic position of a species more

precise, the various obligate categories in hierarchical classification are explained. The correct sequence is: Division → Class → Order → Family → Genus → Species

10. (b) This is one of the reason for organisms being homeostatic (constant body temperature).

11. (d) ***NCERT (XI) Ch - 1, Pg. 8***

12. (c) The term 'New Systematics' was given by Julian Huxley (1940). Characters of plants collected through different branches of science are considered, e.g., ecology, physiology, biochemistry, cytology, genetics, etc.

13. (b) Carolus Linnaeus introduced Binomial System of Nomenclature in his book Species Plantarum (1753). He said that there can be variation within species, but they do not change from one species to another.

Assertion & Reason

1. (a) Biological names are generally in latin and written in italics, they are latinised or derived from latin irrespective of their origin. When hand written, generic and specific epithet both the words in biological name are separately underlined or printed in italics showing their latin origin.

2. (b) Family has a group of related genera with still less number of similarities as compared to genus and species. So character of family is more general as compared to character of genus.

3. (a) Botanical gardens have collections of living plants. So, they play significant role in identification of plants and thus, used in taxonomical studies.

4. (b) Cytotaxonomy that is based on cytological information like chromosome number, structure, behaviour and chemotaxonomy that uses the chemical constituents of the plant to resolve confusions, are also used by taxonomists these days.

5. (d) Natural classification systems (George Bentham and Joseph Dalton Hooker) developed, which were based on natural affinities among the organisms and consider not only the external features, but also internal features, like ultrastructure, anatomy, embryology and phytochemistry.

6. (d) Living organism show internal growth due to addition of material and formation of cells inside the body. Such a method is called intussusception. Non-living things grow due to the addition of similar materials to their outer surface. The process is called accretion.

7. (c) Binomial nomenclature is the system of providing organisms with appropriate and distinct names consisting of two words, first generic and second specific. The original names were taken from the Latin language or are Latinized. This is because Latin language is dead and, therefore; it will not change in form or spelling with passage of time.

8. (a) Both the words in binomial nomenclature when handwritten are separately underlined.

9. (b) Most common characters among individual members are found in taxon species. Common characters decrease from species to kingdom and members of a kingdom have least number of common characters. Similarly, complexity of classification decreases from species to kingdom.

T : Higher the hierarchy, lesser are the C's
C's : Common characters and complexity.

10. (d) Ernst Mayr defined species as group of potentially interbreeding natural populations which are reproductively isolated from other groups. This focuses our attention on how this isolation arise.

11. (d) Alpha taxonomy is based on morphology and omega taxonomy brings out toxonomic affinity on the basis of phylogenetic relationships. The latter is more favoured.

12. (a) Hierarchical classification reduces volume in catalogue of plants and animals. It can be illustrated by an example like *Canis familiaris* (dog).

It belongs to the family - Canidae, Genus-*Canis* is applied to wolf and jackal of same family, but these belong to different species therefore species have more similarities than genus but genus has more organisms and vice-versa.

13. (b) Museums are source of ancient and present information matter where preserved plants, animals, artistic and educational material are exhibited for public awareness. Museums can be categorized.

2 Biological Classification

NCERT Crisp

Introduction

Aristotle

- **Earliest to attempt** a **more scientific basis for classification.**
- Used **simple morphological** characters to classify plants into trees, shrubs and herbs.
- **Divided animals** into two groups, those which **had red blood and those that did not.**

R.H. Whittaker (1969) proposed a **Five Kingdom Classification**.

- The kingdoms defined by him includes **Monera, Protista, Fungi, Plantae** and **Animalia.**
- The main criteria for classification used by him:
  - ◊ **C**ell structure,
  - ◊ **T**hallus organization,
  - ◊ **M**ode of nutrition,
  - ◊ **P**hylogenetic relationships.

Three Kingdom of Classification: Haeckel (Added new kingdom Protista)

Four Kingdom Classification: Copeland (Added Monera)

Table: Characteristics of the five kingdoms

Characters	Five Kingdoms				
	Monera	**Protista**	**Fungi**	**Plantae**	**Animalia**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulosic (Polysaccharide + amino acid)	Present in some	Present (without cellulose)	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organization	Cellular	Cellular	Multicellular/ loose tissue	Tissue/organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic) and heterotrophic	Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic)	Heterotrophic (holozoic/ sapropytic etc.)

Earlier classification systems

- It included **bacteria, blue green algae**, **fungi**, **mosses, ferns, gymnosperms** and the **angiosperms under 'Plants' (All having cell wall).**
- It brought together the prokaryotic bacteria and the blue green algae with other groups which were eukaryotic.
- It also **grouped** together the **unicellular organisms** and the **multicellular** ones, say, for example, *Chlamydomonas* and *Spirogyra* were placed together under algae.
- The classification did **not differentiate between** the heterotrophic group – **fungi,** and the autotrophic **green plants.**

In Five Kingdom Classification

- Kingdom Protista has **brought together *Chlamydomonas*, *Chlorella*** (earlier placed in Algae within Plants and both having cell walls) **with *Paramoecium* and *Amoeba*** (which were earlier placed in the animal kingdom which lack cell wall).

Kingdom Monera

- Bacteria are the **sole members** of the Kingdom Monera.
- They are the **most abundant** micro-organisms.
- Rigid cell wall of **murein or peptidoglycan.**
- **Histones are absent**. Ribosomes are of **70S type.**
- Bacteria occur **almost everywhere**. Hundreds of bacteria are present in a handful of soil.
- They also live in **extreme habitats** such as hot springs, deserts, snow and deep oceans where very few other life forms can survive.
- Many of them live in or on other organisms **as parasites**.

Bacteria are grouped under **four categories** based on their shape:

- Spherical **Coccus** (pl.: cocci)
- Rod-shaped **Bacillus** (pl.: bacilli),
- Comma-shaped **Vibrium** (pl.: vibrio)
- Spiral **Spirillum** (pl.: spirilla)

 # Wherever is U it means Singular

- They are very complex in behavior. Show the most **extensive metabolic diversity**.
- Some bacteria synthesize their own food from inorganic substrates.

Archaebacteria

- They live in some of the most harsh habitats.

- **Halophiles** (salty areas): Strictly Anaerobes
- **Thermoacidophiles** (hot springs): Aerobic in nature
- **Methanogens** (marshy areas): Anaerobic in nature

- Archaebacteria differ from other bacteria in having a different cell wall structure (**Branched chain lipids**) and this feature is responsible for their survival in extreme conditions.
- **Methanogens** are present in the **gut of several ruminant animals** such as cows and buffaloes and they are responsible for the production of **methane (biogas) from the dung** of these animals and also helps in **digestion of cellulose.**

Eubacteria

- They are characterized by the presence of a rigid cell wall (**polysaccharide and amino acids**), and if motile, a flagellum.

Types of flagellation:

- **Monotrichous** : Flagella at **one end**
- **Lophotrichus** : **Group** of flagella at **one end**
- **Amphitrichus** : **Group** of flagella at **both ends**
- **Peritrichus** : Flagella **all over** the body

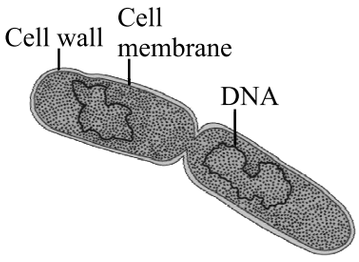
- **Cyanobacteria** (also referred to as **blue-green algae/ myxobacteria**) have chlorophyll *a* similar to green plants and are **photosynthetic autotrophs.**
- Cyanobacteria are unicellular.
- **Hormocyst:** Thick walled multicellular akinete found in blue green algae (Cyanobacteria).
- A filament without mucilaginous sheath is called **trichome, e.g., *Nostoc***
- Colonies are generally surrounded by **gelatinous sheath.**
- They often form **algal blooms** in polluted water bodies.
- Some of these organisms can **fix atmospheric nitrogen** in specialised cells called **heterocysts, e.g., *Nostoc* and *Anabaena*.**
- ***Oscillatoria*: Shows Pendulum Movement**

◊ **Chemosynthetic autotrophic**

- Obtained **food by oxidation of inorganic substance.**
- They play a great role in **recycling nutrients** like nitrogen, phosphorous, iron and sulphur.

◊ **Heterotrophic bacteria**

- They are the most abundant in nature. The majority are important **decomposers**.
- They are **helpful** in making **curd from milk, production of antibiotics, fixing nitrogen in legume roots**, etc.
- **Cholera, typhoid, tetanus, citrus canker** are well known diseases caused by bacteria.



- Bacteria **reproduce** mainly by **fission**.
- Sometimes, under unfavorable conditions, they produce spores.

Plasmids

- Plasmid term given by **Lederberg**
- Plasmids are **extra-chromosomal small, circular double stranded DNA molecules**
- **R-factor** is type of plasmid which contains genes for **antibiotic resistance.**
- **Episomes**: When plasmids are integrating into the bacterial DNA chromosomes.

Sexual Reproduction in Bacteria

- **Conjugation: Direct contact** between two cells. Discovered by **Lederberg and Tatum**.
- **Transformation:** Transformation was first demonstrated in 1928 by British bacteriologist **Frederick Griffith.**
- **Transduction:** Transfer of Bacterial DNA **with the help of bacteriophage / virus.**

#Transduction was discovered by **Zinder and Lederberg**.

Gram positive *vs.* Gram Negative Bacteria

Gram - Positive bacteria	Gram - Negative bacteria
▪ Appears as **dark violet** or **purple** coloured after Gram staining. ▪ Have a **thick peptidoglycan** layer and **lacks lipopolys-accharide**. ▪ **Teichoic** acid is **present**. ▪ E.g., *Streptococcus, Bacillus subtilis*	▪ Appears as **pink** or **red-**coloured after Gram staining. ▪ Have a **thin peptidoylycan** layer and an **outer lipopolysaccharide membrane**. ▪ **Teichoic** acid is **absent**. ▪ E.g., *E.coli, Rhizobium*

Mycoplasma: *Joker of plant Kingdom*

- They are organisms that **completely lack a cell wall.**
- They are the **smallest living cells known** and can **survive without oxygen.**
- Many Mycoplasma's are **pathogenic** in animals and plants.
- Mycoplasma is **insensitive** to **penicillin** but **sensitive** to **tetracycline.**

Kingdom Protista

- **All single-celled eukaryotes** are placed under Protista.
- It include **Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds and Protozoans.**
- Members of Protista are primarily **aquatic.**
- This kingdom forms a **link** with the others dealing with plants, animals and fungi.
- Being eukaryotes, the protistan cell body contains a **well defined nucleus** and **other membrane-bound organelles.**
- Protists reproduce **asexuall**y and **sexually b**y a process involving **cell fusion** and **zygote formation.**

Chrysophytes

- This group includes **diatoms** and **golden algae (desmids).**
- They are found in **fresh water** as well as in **marine environments.**
- They are **microscopic** and **float passively** in water currents (**plankton**).
- Most of them are **photosynthetic.**
- In diatoms, **the cell walls** form two thin overlapping shells, which fit together as in a soap box. The walls are **embedded with silica** and thus the walls are **indestructible.**
- **Diatoms** have left behind large amount of **cell wall deposits** in their habitat; this accumulation over billions of years is referred to as '**diatomaceous earth'.**
- Being gritty, this soil is used in **polishing, filtration of oils and syrups.**
- Diatoms are the ***chief* '*producers*'** in the oceans.

Dinoflagellates (Fire algae)

- These organisms are **mostly marine** and **photosynthetic.**
- They appear **yellow, green, brown, blue** or **red** depending on the **main pigments** present in their cells.
- The cell wall has **stiff cellulose plates** on the outer surface.
- Most of them have **two flagella;** one lies **longitudinally** and the other **transversely** in a furrow between the wall plates.

- Red dinoflagellate ***Gonyaulax*** makes the **sea appear red (red tides).**
- **Toxins** released by such large numbers may even kill other marine animals such as fishes.

Euglenoids

- Majority of them are **fresh water organisms** found in **stagnant water.**
- Instead of a cell wall, they have a **protein rich layer** called **pellicle** which makes their body flexible.
- They have **two flagella, a short and a long one.**
- They are **photosynthetic** in the presence of sunlight, when deprived of sunlight they behave like **heterotrophs** by predating on other smaller organisms.
- The **pigments** of euglenoids are **identical** to those present in **higher plants. E.g., *Euglena***

Slime Moulds (Slime Fungi)

- Slime moulds are **saprophytic protists.**
- The body moves along decaying twigs and leaves engulfing organic material.
- Under suitable conditions, they form an aggregation called **plasmodium** which may grow and spread over several feet.
- During **unfavorable conditions,** the plasmodium differentiates and forms **fruiting bodies bearing spores** at their tips.
- The spores **possess true walls.**
- They are **extremely resistant** and survive for many years, even under adverse conditions. The spores are dispersed by air currents.
- Examples: ***Physarum*** and ***Physarella*** **are acellular slime moulds**

Protozoans

- All protozoans are **heterotrophs** and live as **predators or parasites.**
- They are believed to be **primitive relatives of animals.**

There are four major groups of protozoan.

◊ **Amoeboid protozoan**

- They move and capture their prey by putting out **pseudopodia (false feet)** as in **Amoeba (Fresh Water).**
- Marine forms have silica shells on their surface.
- ***Entamoeba histolytica*** **are endo-parasites.**
- **Contractile vacuoles** are present in ***Entamoeba*** but **absent in *Amoeba.***

◊ **Flagellated protozoan**

- The members of this group are **either free-living** or **parasitic.**
- They have **flagella.**
- **Sleeping sickness** caused by ***Trypanosoma gambiense***. Parasite is transmitted by **Tse Tse fly(*Glossina)***
- **Visceral leishmaniasis (VL**), also known as **kala-azar** or **black fever,** or **Dumdum fever** caused by ***Leishmania*.**
- ***Leishmania tropica*** is causative agent of **oriental sore.**
- **Surra Disease** in **cattle, horse, donkey** caused by ***T. evansi***
- **Chaga's Disease** caused by ***T. cruzi*** in **man, monkeys, cat, etc.**
- **Giardiasis/Diarrhoea** also known as **Back packer disease** caused by ***Giardia intestinalis.***

◊ **Ciliated protozoan**

- These are **aquatic, actively moving organisms** because of the **presence of thousands of cilia.**
- They have a **cavity (gullet) that opens to the outside of the cell surface.**
- The coordinated movement of rows of cilia causes the water laden with food to be steered into the gullet. **Example: *Paramoecium***
- ***Paramoecium*** respond to electric current. This property of *Paramoecium* is known as **galvanotaxis.**

◊ **Sporozoans**

- This includes diverse organisms that have **an infectious spore-like stage in their life cycle.**
- The most **notorious is *Plasmodium* (malarial parasite)** which causes malaria, a disease which has a staggering effect on human population.
- ***Plasmodium*** is **digenetic** means required **two host:** Primary host is **Man** and secondary host **is Female *Anopheles*.**
- Final host of malarial parasite is female *Anopheles* mosquito and man is intermediate host.

- Plasmodium is intracellular parasite in man.
- **Schuffner's dots:** Yellow colored excretory granules formed on the surface of RBC in case of malaria.

Kingdom Fungi

- A unique kingdom of **heterotrophic** organisms.
- **Bread** develops a **mould** or **orange rots** because of fungi.
- The **common mushroom** and **toadstools** are also fungi.
- **White spots** seen on **mustard leaves** are due to a **parasitic fungus**.
- Unicellular fungi, e.g., **yeast** are used to make **bread and beer.**
- **Wheat rust-causing** fungi is ***Puccinia*.**
- **Source of antibiotics: *Penicillium*.**
- Fungi are **cosmopolitan** and occur in air, water, soil and on animals and plants.
- They prefer to **grow in warm and humid places.**
- **In very cold area** like freeze, fungi **do not grow** and it helps to prevent food from going bad due to bacterial or fungal infections.
- With the **exception** of yeasts which are unicellular, **fungi are filamentous**.
- Their bodies consist of long, slender thread-like structures called **hyphae.**
- The **network of hyphae** is known as **mycelium.**
- Some hyphae are continuous tubes filled with **multinucleated cytoplasm** – these are called **Coenocytic hyphae.**
- The **cell walls** of fungi are composed of **chitin** and **polysaccharides.**
- Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called **saprophytes**.

- Symbiotic association of **fungi with roots** called **lichens.**
- Symbiotic association of **fungi** with **roots of higher** plants **(Pinus) as Mycorrhiza.**
- There are **two types of mycorrhiza: Endo** and **ectomycorrhiza**
- **VAM (Vascular Arbuscular Mycorrhiza)** is an example of **endomycorrhiza.**

Reproduction in fungi can take place by

- **Vegetative** means – **fragmentation, fission** and **budding.**
- **Asexual reproduction** is by spores called **conidia or sporangiospores or zoospores.**

Sexual reproduction

- By **o**ospores, **a**scospores and **b**asidiospores **(BOA).**
- The various **spores** are produced in distinct structures called **fruiting bodies.**

Sexual cycle involves the following three steps:

- **Plasmogamy:** Fusion of protoplasm between two motile or non-motile gametes**.**
- **Karyogamy:** Fusion of two nuclei**.**
- **Meiosis** in zygote resulting in haploid spores.

- In fungi (**Ascomycetes and Basidiomycetes**), an intervening dikaryotic stage (n + n, i.e., two nuclei per cell) occurs; such a condition is called **a dikaryon** and the phase is called **dikaryophase of fungus.**
- Later, the parental nuclei fuse and the cells become diploid. The fungi form fruiting bodies in which reduction division occurs, leading to formation of haploid spores.

Basis for the division of Fungi

- Morphology of the mycelium
- Mode of spore formation
- Fruiting bodies

Table: Classes of Kingdom Fungi

Characteristics	Phycomycetes	Ascomycetes (Sac-fungi)	Basidiomycetes (Bracket fungi)	Deutromycetes (Imperfect fungi)
Habitat	Found in aquatic habitats, on decaying wood in moist and damp places or as obligate parasites on plants	Saprophytic, decomposers, parasitic or coprophilous (growing on dung)	Grow in soil, on logs and tree stumps and in living plant bodies as parasites	Mostly decomposers, some are saprophytes or parasites.

Mycelium	Aseptate and coenocytic	Branched and septate	Branched and septate	Branched and septate
Reproduction	**Asexual: Zoospores(motile) or aplanospores (non-motile).** These spores are endogenously produced in sporangium.	**Asexual: Conidiophores-** conidia produced exogenously on the special mycelium **Sexual: Ascospores-** produced endogenously in sac like asci	Sex organs are absent, but plasmogamy is brought about by **fusion** of two vegetative or somatic cells of different strains or genotypes.	Reproduce only by **asexual spores** known as conidia.
Examples	▪ *Mucor*: Grow on the dung of cats and dogs ▪ *Rhizopus*: The bread mould ▪ *Albugo*: The parasitic fungi on mustard	***Aspergillus***: ▪ Produces aflatoxins carcinogenic to humans. ▪ **Guinea pig of plant kingdom** – *Aspergillus flavus* ***Claviceps***: ▪ The most powerful hallucinogen LSD is produced by ***Claviceps purpurea*** and also cause Ergot of rye.	▪ *Agaricus* (mushroom) ▪ *Ustilago* (smut) ▪ *Puccinia* (rust fungus) ▪ Poisonous Mushroom : *Amantia* ▪ Cap mushroom (*Coprinus*): Used in manufacturing ink. ▪ Bracket Fungi(*Fusarium*): grown on rotten wood.	▪ *Alternaria, Colletotrichum* and *Trichoderma.* ▪ Red rot of sugarcane is caused by *Colletotrichum falcatum* ▪ *Alternaria* and *Trichoderma* are predatory fungus, feed on living worms (Nematodes), i.e., Nematophagus Fungi.

- **Clamp connection:** It is a small looped hypha which develops at the time of cell division and septa formation in dikaryon of basidiomycetous fungus.
- **Two types of gametes:**
  - ◊ **Isogamous-** Gametes are similar in morphology
  - ◊ **Anisogamous or oogamous -** Dissimilar in morphology

Kingdom Plantae

- Kingdom Plantae includes **all eukaryotic chlorophyll-containing organisms** commonly called plants.
- A few members are partially heterotrophic such as **the insectivorous plants or parasites.**
- **Bladderwort and Venus fly trap** are of **insectivorous** plants.
- ***Cuscuta* is an endoparasite.**
- The plant cells have an eukaryotic structure with prominent **chloroplasts** and **cell wall** mainly made of **cellulose**.
- Life cycle of plants has **two distinct phases** – the diploid sporophytic and the haploid gametophytic – that alternate with each other. This phenomenon is called **alternation of generation**.

Kingdom Animalia

- This kingdom is **characterized by heterotrophic eukaryotic organisms** that are **multicellular** and their cells **lack cell walls.**
- They directly or indirectly depend on plants for food.
- They digest their food in an internal cavity and store food reserves as **glycogen or fat**. Their mode of nutrition is **holozoic – by ingestion of food.**
- Higher forms show elaborate sensory and neuromotor mechanism.
- Most of them are capable of locomotion.
- The sexual reproduction is by **copulation of male and female** followed by embryological development.

Viruses

- In the five kingdom classification of Whittaker there is no mention of some acellular (non-cellular) organisms like viruses and viroids, and lichens.
- The viruses are **non-cellular organisms** that are characterized by having an **inert crystalline structure** outside the living cell. Once they infect a cell they take over the machinery of the host cell to replicate themselves, **killing the host.**
- The name virus that means **venom or poisonous** fluid was given by **Pasteur. D. J. Ivanowsky** (**1892**).

- Bacteriophage was discovered by **Towrt** and **Deherelle.**

Pasteur. D. J. Ivanowsky (1892)

- He recognized certain microbes as **causal organism of the mosaic disease** of tobacco. These were found to be smaller than bacteria because they passed through bacteria-proof filters.

M.W. Beijerinek (1898)

- He demonstrated that the **extract of the infected plants of tobacco** could cause infection in healthy plants and called the fluid as ***Contagium vivum fluidum*** **(infectious living fluid).**

W.M. Stanley (1935)

- He showed that viruses could be **crystallized** and crystals consist largely of proteins. They are inert outside their specific host cell.
- Viruses are **obligate parasites.**

- In addition to proteins, viruses also contain genetic material that could be either RNA or DNA.
- **No virus contains both RNA and DNA.**
- **A virus is a nucleoprotein** and the **genetic material is infectious.**
- In general**,** viruses that infect plants have single stranded RNA and viruses that infect animals have either single or double stranded RNA or double stranded DNA.
- **Bacterial viruses or bacteriophage** (viruses that infect the bacteria) are **usually double stranded DNA viruses.**
- The **protein coat** called **capsid** made of small subunits called **capsomeres** protects the nucleic acid.
- These capsomeres are arranged in **helical or polyhedral geometric forms**.
- Viruses cause diseases like mumps, small pox, herpes, measles, polio, swine flu, common cold, yellow fever and influenza. AIDS in humans is also caused by a virus.
- In plants, the **symptoms** can be **mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.**

  - **Lytic cycle**: Host cell die when virus infects host.
  - **Lysogenic cycle**: In this cycle host is not killed by virus.

- Viruses are used for **biological control of pests population.**

Viroids

- In **1971, T.O. Diener** discovered a new infectious agent that was smaller than viruses and caused potato spindle tuber disease.
- It was found to be a **free RNA.**
- It **lacks the protein coat** that is found in viruses, hence **the name viroid.**
- The RNA of the viroid was of **low molecular weight.**

Lichens

- Lichens are **symbiotic associations,** i.e., mutually useful associations, **between algae** and **fungi.**
- The **algal component** is known as **phycobiont (Chlorophyceae)** and **fungal component** as **mycobiont (Ascomycetes)**, which are autotrophic and heterotrophic, respectively.
- **Algae** prepare **food** for fungi and **fungi** provide **shelter** and **absorb mineral nutrients** and **water** for its partner.
- Lichens are very **good pollution indicators** – they do not grow in polluted areas as **sensitive to sulphur dioxide.**

Lichens grow on

- **Rocks - Saxicolous**
- **Tree bark - Corticolous**
- **Soil - Terricolous**

Exam Oriented Information

- **Phylogenetic classification** system: **Engler** and **Prantl**
- ***Die Naturlichen Pflanzen Familien*** a book: **Engler** and **Prantl**
- Word **New Systematics**: **Julian Huxley**
- **Ray fungi** are not fungi, it is an **eubacteria**
- **Early blight** of potato: ***Alternaria solani***
- **Late blight** of potato: ***Phytopthora infestans***
- **Downy mildew**: ***Sclerospora graminicola***
- **Damping off seedlings**: ***Pythium***
- ***Cladonia rangifera*** (Reindeer moss) **is a type of lichen**
- ***Lecanora***: Litmus dye obtained
- ***Usnea*** **and** ***Cladonia***: Useful for preparations of **antibiotics.**

Self Assessment Questions

Classification [NCERT Pg 16-18]

1. Who divided the animals into 2 groups, those which had red blood and those that did not?
a. Whittaker b. T.O. Diener
c. Aristotle d. W.M. Stanley

2. Basis of classification according to Whittaker
a. Cell structure
b. Mode of reproduction
c. Phylogenetic relationship
d. All of these

3. Which of the following shows extensive metabolic diversity?
a. Humans
b. Fungi
c. Snakes
d. Blue - green algae

4. Which of the following there is no mention in Whittaker's classification?
a. Virus b. Viroids
c. Lichens d. All of these

5. Four kingdom system of classification was proposed by:
a. Whittaker b. Copeland
c. Linnaeus d. Oswald Tippo

6. Which of the following organisms were never included in Protista?
a. Bacteria b. Red algae
c. Slime moulds d. Mosses

7. Biochemical resemblances are used in the identification of:
a. Protistan species b. Moneran species
c. Fungal species d. Higher plants

8. Whittaker is famous for :-
a. Two kingdom classification
b. Four kingdom classification
c. Five kingdom classification
d. Distinguishing in Bacteria & blue gree Algae

9. Which characteristic placed the fungi in a separate kingdom?
a. Cell wall composition
b. Cell wall structure
c. Nutrition
d. Nuclear membrane

Monera [NCERT Pg 18-20]

10. Peptidoglycan / Murein is present in the cell wall of
a. Animals b. Plants
c. Fungi d. Bacteria

11. Match the following

A. Peritrichous	1. One flagella at one end
B. Monotrichous	2. Tuft of flagella at one end
C. Amphitrichous	3. Two flagella at one end
D. Lopptrichous	4. Present on entrire surface

a. A-4 B-2 C-3 D-1
b. A-4 B-3 C-2 D-1
c. A-4 B-1 C-3 D-2
d. A-4 B-2 C-1 D-3

12. Old name of Blue green algae:
a. Cyanobacteria b. Myxophyceae
c. Spectrum algae d. None of these

13. New name of Blue green algae:
a. Chlorella b. Spirulina
c. Cyanobacteria d. None of these

14. Which of the following found in harsh habitat?
a. Eubacteria b. Cyanobacteria
c. Archaebacteria d. None of these

15. Which of the following is aerobic in nature?
a. Halophiles
b. Methanogens
c. Thermoacidophiles
d. None of these

16. Which of the pigment present in cyanobacteria?
a. Chlorophyll 'a' b. Chlorophyll 'b'
c. Chlorophyll 'c' d. Xanthophylls

17. Colonies of Eubacteria is surrounded by
a. Polysaccharide sheath
b. Gelatinous sheath
c. Mucous sheath
d. None of these

18. Which of the following shows pendulum movement and fix atmospheric nitrogen?
a. *Nostoc* b. *Anabaena*
c. *Oscillatoria* d. *Rhodospirillum*

19. Which of these is a bacterial disease?
a. Chlorella b. Measles
c. Citrus canker d. Both (a) & (c)

20. Who is the Joker of plant kingdom?
a. Mycoplasma b. *Chlorella*
c. *Chlamydomonas* d. *Spirullina*

21. Mycoplasma is:
a. Insensitive to penicillin, sensitive to tetracycline
b. Insensitive to tetracycline, sensitive to penicillin
c. Sensitive to both penicillin & tetracycline
d. None of these

22. Plasmids was given by
a. Tatum b. Lederberg
c. Zinder d. Griffith

23. Which type of plasmid contains Antibiotic resistance gene?
a. "R"- factor b. "S"- factor
c. "G" - factor d. "r" - factor

24. Match the following

A. Conjugation	1. Lederberg & Tatum
B. Transformation	2. Zinder & Lederberg
C. Transduction	3. Fredrick Griffith

a. A-1 B-3 C-2
b. A-3 B-1 C-2
c. A-2 B-3 C-1
d. A-2 B-1 C-3

25. Ray fungi is a/an
a. Eubacteria b. Algae
c. Flower d. Fungi

26. O_2 does not evolve in the photosynthesis of
a. BGA b. Green algae
c. Bacteria d. Autotrophic plant

27. Pigment present in cynobacteria is the
a. r - phycocyanin
b. r - phycoerythrin
c. c - phycocyanin
d. Anthocyanins

28. The wall of bacteria consist of
a. n - acetyl glucosamine
b. n - acetyl muramic acid
c. Both (a) & (b)
d. Cellulose

29. Which one of the following sets includes the bacterial diseases?
a. Diptheria, Leprosy, Plague
b. Tetanus, Tuberculosis, Measles
c. Malaria, Mumps, Poliomyelitis
d. Cholera, Typhoid, Mumps

30. The folds of plasma membrane in bacterial cells are known as:
a. Episomes b. Spherosomes
c. Mesosomes d. Acrosomes

31. A Dutch scientist A.V. Leeuwenhoeck discovered bacteria for the first time in:
a. Soil b. Rain water
c. Air d. Garden soil

32. Bacteria responsible for nitrificatin come under the following groups:
a. Bacillus b. Vibrio
c. Coccus d. Spirilla

33. In cyanophyceae, flagella are:
a. Present in zoospores only
b. Present
c. Present in gamete stage only
d. Absent

34. Bacteria were discovered by:
a. Robert Koch b. A.V. Leeuwenhoek
c. Robert Hooke d. Louis Pasteur

35. Diphtheria is caused by:
a. *Diplococcus*
b. *Bacillus*
c. *Corynebacterium*
d. *Vibrio*

36. The main difference in Gram (+)ve and Gram (-)ve bacteria resides in their:
a. Flagella b. Cell membrane
c. Cytoplasm d. Cell wall

37. Currently bacteria are included in:
a. Thallophyta b. Monera
c. Mycota d. Protista

38. An obligate anaerobe is:
a. Ulothrix b. Methane bacteria
c. Spirogyra d. Onion

39. Bacteria lack alternation of generations because there is:
a. No exchange of genetic material
b. Distinct chromosomes are absent
c. No conjugation
d. Neither syngamy nor reduction division

40. Endospores develop in:
a. *Bacillus* and *Clostridium*
b. *Saccharomyces* and *Clostridium*
c. *Mnococcus* and *Clostridium*
d. *Mucor* and *Bacillus*

41. Streptococcus is used in preparation of:
a. Wine b. Cheese
c. Idli d. Bread

42. Match the columns and find the correct answer:

Column I	Column II
A. *Streptomyces*	1. Food poisoning
B. *Rhizobium*	2. Source antibiotics
C. *Nitrosomonas*	3. Nitrogen fixation
D. *Acetobacter*	4. Nitrification
	5. Vinegar synthesis

a. A-2 B-3 C-4 D-5
b. A-5 B-2 C-3 D-4
c. A-2 B-3 C-1 D-5
d. A-4 B-5 C-1 D-3

43. Murein does not occur in the wall of:
a. Blue green algae b. *Nostoc*
c. Eubacteria d. Diatoms

44. *Entamoeba coil* causes:
a. None b. Diarrhoea
c. Dysentery d. Pyorrhoea

45. Infection of *Entamoeba histolytica* is prevented by:
a. Uncontaminated food
b. Avoiding clothes of patient
c. Avoiding kissing
d. None of the above

46. Recurrence of high temperature in malaria at intervals is due to completion of:
a. Exoerythrocytic schizogony
b. Sporogony
c. Gamogony
d. Erythrocytic schizogony

47. Euglena stores food as:
a. Paramylum b. Starch
c. Fat d. Protein

48. Which of the following can be used as bacteriological filter?
a. Cymbella b. Batrachospermum
c. Oscillatoria d. Gelidium

49. What is not true of *Euglena*?
a. Presence of cellulose cell wall
b. Presence of proteinaceous pellicle
c. Presence of chlorophyll
d. Presence of flagellum

Protista [NCERT Pg 20-22]

50. Chief producers in oceans are
a. Diatoms b. Desmids
c. Archaebacteria d. All of these

51. Red tides are caused by
a. Red algae b. Brown algae
c. Golden algae d. Fire algae

52. Acellular slime mould:
a. Physarum b. Physarella
c. Both of these d. None of these

53. Primitive relatives of animals:
a. Protozoans b. Bacteria
c. Algae d. Humans

54. *Amoeba* is found in:
a. Fresh water b. Marine water
c. Dirty water d. All of these

55. Passive food ingestion in *Amoeba* is known as
a. Import b. Invagination
c. Circumfluence d. Circumvallation

56. Slime mould is characterized by the presence of
a. Elaters b. Pseudoelaters
c. Capillitum d. Capitulum

57. When a fresh water protozoan, possessing a contractile vacuole is placed in a glass containing marine water, the vacuole will?
a. Disappear b. Increase in number
c. Increase in size d. Decrease in size

58. Longitudinal binary fission found in
a. *Euglena* b. *Plasmodium*
c. *Planaria* d. *Paramecium*

59. Nutrition in Amoeba is:
a. Holophytic b. Holozoic
c. Parasitic d. Saprobic

60. *Amoeba* secretes digestive enzymes for hydrolysing:
a. Protein b. Starch
c. Fat d. All the above

61. Protists obtain food as:
a. Holotrophs
b. Photosynthesisers
c. Chemosynthesisers
d. Photosynthesisers, symbionts and holotrophs

62. Multiple fission in *Plasmodium* is:
a. Schizogony b. Sproulation
c. Gamogamy d. None of the above

63. *Entamoeba histolytica* excretes through:
a. Food vacuole
b. Contractile vacuole
c. General surface
d. Malpighian tubules

64. Infective stage of *Entamoeba histolytica* is:
a. Pre-cyst b. Tetranucleate cyst
c. Uninucleate cyst d. Trophozoite

65. Seeding ponds with *Gambusia* fish is an example of:
a. Parasitism b. Biocontrol
c. Hyperparasitism d. Both (a) and (b)

66. Haemozoin formed in malaria is produced by:
a. Globin part of haemoglobin
b. Dead leucocytes
c. Cryptozoites
d. Heme of haemoglobin

67. Spraying kerosene on stagnant water shall kill *Anopheles* due to:
a. Burning of body wall
b. Prevention of spiracle to come in contact with air
c. Diffusion into body
d. Entry into and blocking of respiratory tract

68. What is not connected with reproduction of protozoans?
a. Cryptogamy b. Autogamy
c. Schizogamy d. Conjugation

69. Certain stages of *Plasmodium vivax* may survive for a long time in liver of man in dormant state. On reactivation they enter into cycle, this stage is known as:
a. Exoerythocytic schizogony
b. Cycle of Ross
c. Gametogony
d. Erythrocytic schizogony

70. Malarial parasite is:
a. Polygenetic b. Monogenetic
c. Digenetic d. Monomorphic

71. A protein rich layer which makes the body of Euglenoids flexible is called
a. Pellicle b. Murein
c. Cellulose plate d. Pseudopodia

72. *Leishmania tropica* produces:
a. Oriental sores b. Kala-azar
c. Dysentery d. Sleeping sickness

73. *Trypanosoma brucei* produces:
a. A disease of animals
b. Kala-azar
c. Dysentery
d. Sleeping sickness

74. During unfavourable conditions, the plasmodium differentiates to form fruiting bodies bearing spores at their tips. This group is
a. Chrysophytes
b. Dinoflagellates
c. Slime moulds
d. Protozoans

75. *Trichonympha* is a symbiont in alimentary canal of:
a. Termite b. Snails
c. Hermit Crab d. Earthworm

Fungi [NCERT Pg 22-24]

76. The members of which of the following are litter decomposers?
a. Deuteromycetes b. Ascomycetes
c. Basidiomycetes d. Phycomycetes

77. Quinine is got from bark of:
a. *Cinchona officinalis*
b. *Ferula asafoetida*
c. *Curcuma domestica*
d. *Atropa belladona*

78. Match The following:

A. *Leishmania donovani*	1. Malaria
B. *Wuchereria bancrofti*	2. Amoebiasis
C. *Trypanosoma gambiense*	3. Kalaazar
D. *Entamoeba histolytica*	4. Sleeping sickness
	5. Filariasis

a. A-3 B-4 C-5 D-1
b. A-3 B-5 C-2 D-1
c. A-4 B-3 C-2 D-1
d. A-3 B-5 C-4 D-2

79. From which of the following most of the antibiotics are prepared?
a. Fungi b. Plants
c. Actinomycetes d. Archaebacteria

80. *Saprolegnea* belongs to:
a. Phycomycetes b. Ascomycetes
c. Basidiomycetes d. Deuteromycetes

81. White lust of crucifer is caused by:
a. *Albugo candida* b. *Alterneria solani*
c. Rhizopus d. Mucor

82. Truffels are the member of class:
a. Basidiomycetes b. Ascomycetes
c. Deuteromycetes d. Phycomycetes

83. Primary host of *Puccinia* fungi:
a. Wheat b. Barley
c. Rye d. Musturd

84. Drosophila of the plant kingdom is:
a. *Alternaria* b. *Aspergillus*
c. *Neurospora* d. *Albugo*

85. Ergot of rye is caused by:
a. *Claviceps* b. *Phytophthora*
c. *Puccinia* d. *Ustilago*

86. Coenocytic hyphae is found in:
a. Rhizopus b. Mucor
c. Saprolignia d. All of the above

87. Dolipore septum is the characteristics of:
a. Myxomycetes
b. Basidiomycetes
c. Ascomycetes
d. Phycomycetes

Kingdom Plantae [NCERT Pg 25]

88. Which of the following is irrelavent to the kingdom Plantae?
a. *Spirogyra* b. *Rhizopus*
c. *Funaria* d. *Cycas*

89. Considering two-kingdom classification system, the organisms that are included in kingdom Plantae are
a. *Volvox*, *Amoeba* and *Paramecium*
b. Golgi bodies, algae and fungi
c. Amoeba, bacteria and fungi
d. Fungi, bacteria and algae

90. According to two-kingdom classification, the kingdom Plantae consists of
a. Autotrophs b. Heterotrophs
c. Mesotrophs d. Chemotrophs

91. Cell wall of kingdom Plantae organisms is made up of
a. Chitin b. Cellulose
c. Polysaccharides d. Lipids

Kingdom Animalia [NCERT Pg 25]

92. Kingdom Animalia is characterized by
a. Unicellular, prokaryotic and autotrophic
b. Multicellular, eukaryotic and heterotrophic
c. Multicellular, prokaryotic and saprophytic
d. Unicellular, eukaryotic and heterotrophic

93. Which of the following is true for Kingdom Animalia?
a. Cell wall are present in animal cell.
b. Their mode of nutrition is holozoic.
c. They do not follow a definite growth pattern.
d. All of them are capable of locomotion.

Virus, Viroids and Lichens [NCERT Pg 25-27]

94. In plants, mosaic formation, leaf rolling and curling, yellowing of plant parts, vein clearing, dwarfing and stunted growth, necrosis, etc., are the symptoms of
a. Bacterial diseases
b. Mycoplasmal diseases
c. Viral diseases
d. Fungal diseases

95. Virion is
a. Nucleic acid of virus
b. Antiviral agent
c. Protein of virus
d. Completely assembled virus outside host

96. Virus could be crystallized and crystals consist largely of proteins. This was shown by
a. W. M. Stanley b. M. W. Stanley
c. W. M. John d. None of these

97. Viruses are
a. Obligative parasite
b. Facultative
c. Either facultative or obligative
d. None of these

98. Those viruses infect plants have which type of genetic material?
a. Single stranded DNA
b. Single stranded RNA
c. Double stranded RNA
d. Double stranded DNA

99. Viruses that infect animals have which type of genetic material?
a. Either single or double stranded RNA
b. Either single/double stranded RNA or double stranded DNA.
c. Single stranded DNA
d. None of these

100. Genetic material of bacteriophage
a. Double stranded DNA
b. Single stranded RNA
c. Double stranded RNA
d. Single stranded DNA

101. Viroid was discovered by
a. Ernst Mayr b. Norman E. Borlaug
c. T. O. Diener d. None of these

102. Lichens are very good pollution indicator because they are sensitive to
a. Sulfur trioxide b. Sulfur dioxide
c. Carbon dioxide d. Global warming

103. Match the following

A.	Saxicolous lichen	1.	Grows on tree bark
B.	Corticolous lichen	2.	Grows on soil
C.	Terricolous lichen	3.	Grows on rock

a. A-3 B-1 C-2
b. A-3 B-2 C-1
c. A-2 B-3 C-1
d. A-1 B-3 C-2

104. Coliphase $\phi \times 174$ virus contains:
a. Single stranded RNA
b. Single stranded DNA
c. Double stranded RNA
d. Double stranded DNA

105. In Rous Sarcoma Virus information flow is:
a. RNA → cDNA → Protein
b. cDNA → RNA → Protein
c. RNA → cDNA → Protein
d. cDNA → Protein → RNA

106. Reverse transcriptase is:
a. RNA dependent DNA polymerase
b. DNA dependent RNA polymerase
c. DNA dependent DNA polymerase
d. RNA dependent RNA polymerase

107. Tailed bacteriophage is:
a. Motile on surface of plant leaves
b. Actively motile in water
c. Motile on bacterial surface
d. Nonmotile

108. T-bacteriophages possess:
a. Rounded shape b. Irregular shape
c. Tadpole shape d. Rhomboid shape

109. Virus was discovered by:
a. Stanley b. Herellel
c. Ivanowski d. Beijerinck

110. Circular single stranded DNA occurs bacteriophage:
a. T_2, T_4 b. T_3, $\phi 6$
c. $\phi \times 174$, M13 d. δ, T_5

111. Franklin Conrat demonstrated that RNA is genetic material in:
a. HIV b. TMV
c. CMV d. Mouse Sarcoma

112. RNA retroviruses have a special enzyme that:
a. Transcribles viral RNA to cDNA
b. Translates host DNA
c. Disintegrates host DNA
d. Polymerises host DNA

113. Find the correct matches:

	List I		List II
A.	M13 bacteriophase	1.	dsRNA
B.	Rice Dwarf Virus	2.	ssRNA
C.	Cauliflower Mosaic Virus	3.	ssDNA
D.	Polio Virus	4.	dsRNA

a. A-4 B-3 C-1 D-2
b. A-2 B-1 C-3 D-4
c. A-3 B-4 C-2 D-1
d. A-3 B-1 C-4 D-2

114. Severe Acute respiratory syndrome (SARS):
a. Is caused by a variant of common cold virus (Corona virus)
b. Is an acute form of asthma
c. Affects non-vegetarians faster than vegetarians
d. Is caused by a variant of *Pneumococcus pneumoniae*

115. Virion is a/an:
a. Virus b. Enucleated virus
c. Prion d. Virus without protein coat

116. Potato Spindle Tuber disease is caused due to:
a. Viroid b. Virus
c. Bacterium d. Nematode

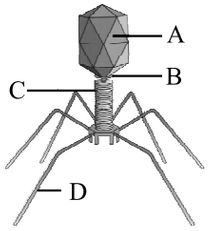
117. The technique of developing pure culture of bacteria was developed by:
a. J. Lister b. L. Pasteur
c. R. Koch d. A.V. Leeuwenhoek

118. The smallest organisms which cause diseases among plants are:
a. Mycoplasma b. Fungi
c. Bacteria d. Viruses

119. Majority of lichens are made of:
a. Blue-green algae and basidiomycetes
b. Brown algae and higher plants
c. Red algae and ascomycetes
d. Blue-green algae and ascomycetes

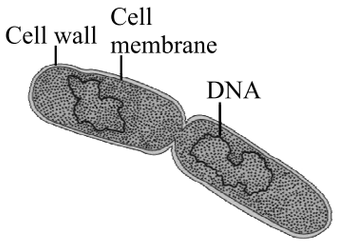
Image Based Questions

120. In a bacteriophage, select the correct information?



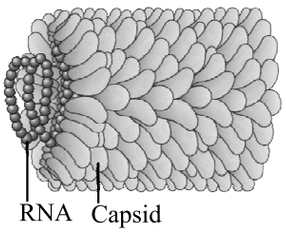
a. A - Head, B - Neck
b. A - Head, D - Sheath
c. B - Collar, D - Tail fibres
d. C - Sheath, A - Collar

121. What kind of reproduction is shown in this diagram?



	Mode of Reproduction	Conditions
a.	Budding	Favourable
b.	Binary fission	Favourable
c.	Spore formation	Unfavourable
d.	Budding	Unfavourable

122. Name the virus and identify the correct statement about it:

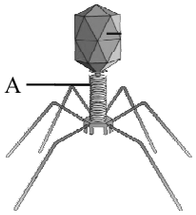


a. Genetic material is single stranded DNA
b. Elongated capsid
c. Reverse transcriptase enzyme is present
d. It is an animal virus

123. Identify the bacterial shape given in the figure.

a. Bacilli b. Cocci
c. Spirilla d. Vibrio

124. Name the labeled part of Bacteriophage.



a. Neck
b. Sheath
c. Coiled circular double stranded DNA
d. Collar

125. The given organism belongs to which group?

a. Protozoans b. Chrystophytes
c. Euglenoids d. Diatoms

Higher Order Questions

Fact Based Round

1. Pulmonary tuberculosis is caused by
a. *Escherichia coli* b. *Pseudomonas aeruginosa*
c. *Mycobacterium* d. *Streptococcus pneumoniae*

2. Bacteria with flagella on both sides are
a. Amphitrichous b. Cephalotrichous
c. Peritrichous d. Lophotrichous

3. Subterranean masses of hyphae which pass the unfavourable periods in dormant stage are known as
a. Sclerotia b. Mycelium
c. Rhizomorph d. Puff balls

4. In which of the following patterns of viral replication, viruses enter a cell, replicate and then cause the cell to burst, releasing new viruses?
a. Lytic b. Lysogenic
c. Repreogenic d. Both (a) and (b)

5. Small proteins produced by vertebrate cells naturally in response to viral infections and which inhibit multiplication of viruses are called
a. Immunoglobulins b. Interferons
c. Antitoxins d. Lipoproteins

6. Which of the following cannot be grown on artificial culture medium?
a. *Escherichia coli* b. TMV
c. *Aspergillus* d. Yeast

7. The first life on earth consisted of
a. Provirus b. Protovirus
c. Virus d. Bacteria

8. Sometimes virus attacks a bacterium but none of them dies. The phenomenon is
a. Transduction b. Penetration
c. Lysogeny d. Adsorption

9. In bacteria, the site for respiratory activity is found in:
a. Episome b. Microsome
c. Ribosome d. Cell membrane

10. Which of the following are absent in Eubacteria
A. 80S Ribosomes
B. Cellulosic cell walls
C. Plasma membrane
D. Circular dsDNA
a. A & C b. B & C
c. A & B d. C & D

11. Toxin is secreted during storage condition by
a. *Fusarium* b. *Colletotrichum*
c. *Penicillium* d. *Aspergillus*

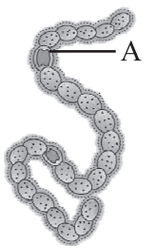
12. VAM are
a. Saprophytic bacteria
b. Saprophytic fungi
c. Symbiotic fungi
d. Symbiotic bacteria

13. Litmus dye is made from
a. Fungi b. Bacteria
c. Algae d. Lichens

14. Choose the incorrect statement about the given organism?

a. Two, unequal flagella are found
b. It dies, when deprived of sunlight
c. Member of kingdom Protista
d. Photosynthetic pigments are similar to those of higher plants

15. Which of the following statement is correct w.r.t above diagram?



a. 'A' is mucilaginous sheath and is also found in *Rivularia*
b. 'A' is mucilaginous sheath and is also found in *Anabaena*
c. 'A' is heterocyst and is also found in methanogens
d. 'A' is heterocyst and is also found in *Anabaena*

Combination Round

16. Match the columns and find out the correct combination:

A.	Phycomycetes	1.	Fungi imperfecti
B.	Ascomycetes	2.	Club fungi
C.	Basidiomycetes	3.	Algal fungi
D.	Deuteromycetes	4.	*Solanum tuberosum*

a. A-3 B-4 C-1 D-2
b. A-3 B-4 C-2 D-1
c. A-1 B-2 C-3 D-4
d. A-1 B-4 C-2 D-3

17. Match the columns and find out the correct combination:

A.	Cleistothecium	1.	Saucer-shaped ascocarp
B.	Perithecium	2.	Basidiocarp
C.	Apothecium	3.	Flask-shaped ascocarp
D.	Puffballs	4.	Closed globose ascocarp

a. A-4 B-3 C-1 D-2
b. A-4 B-3 C-2 D-1
c. A-3 B-4 C-1 D-2
d. A-3 B-1 C-2 D-4

18. Match the columns and find out the correct combination:

A.	Viroid	1.	Nucleoprotein
B.	Virus	2.	Infectious protein
C.	Prion	3.	Infectious nucleic acid
D.	Virion	4.	Infectious viral particle

a. A-4 B-1 C-2 D-3
b. A-2 B-4 C-1 D-3
c. A-3 B-1 C-2 D-4
d. A-4 B-2 C-3 D-1

19. Match the columns and find out the correct combination:

A.	Red rot	1.	*Ustilago*
B.	Smut	2.	*Puccinia*
C.	Rust	3.	*Colletotrichum*
D.	Early blight	4.	*Albugo*
		5.	*Alternaria*

a. A-4 B-3 C-1 D-2
b. A-4 B-3 C-2 D-1
c. A-3 B-1 C-2 D-5
d. A-3 B-5 C-2 D-4

20. Match the columns and find out the correct combination:

A.	Binary fission	1.	Bacteria
B.	Budding	2.	Yeast
C.	Somatogamy	3.	Some higher fungi
D.	Oogamy	4.	Algal

a. A-1 B-2 C-3 D-4
b. A-4 B-2 C-1 D-3
c. A-1 B-4 C-2 D-3
d. A-4 B-1 C-2 D-3

Conceptual Round

21. Which of the following statement about *Mycoplasma* is true?
a. They are smallest, disease causing thin walled organisms.
b. They differ from viruses in being cellular in organization.
c. Insensitive to several antibiotics as they have 70S ribosomes.
d. They can survive without photosynthetic pigments and genetic material.

22. Read the statements (A-D) and select the incorrect ones.
A. Though the bacterial cell structure is very simple, they are very complex in behaviour.
B. Chrysophytes include diatoms, desmids and dinoflagellates.
C. Slime moulds, during suitable conditions, forms fruiting bodies.
D. Lichen, in nature , had two different organisms within them.
a. A & B b. C & D
c. A & D d. B & C

23. Incorrect statement is:
a. *Mycoplasma* plays a significant role in the evolution of aerobic forms of life.
b. *Tolypothrix* and *Aulosera* fixes N_2 non-symbiotically in rice fields.
c. *Anabaena*, *Microcystis* and *Aphanizomenon* are known to cause algal blooms.
d. Bryophytes (liverworts) are first archegoniates.

24. Identify the correct statements from the following.
A. All monerans show non-cellulosic cell walls.
B. All protistans show true nucleus.
C. All fungi are plants with cellulosic cell walls.
D. All protists are autotrophic and all monerans are heterotrophic.
a. A & B b. B & D
c. B & C d. A & D

25. Identify true statements about archaebacteria.
A. They can live in harsh habitats.
B. Cell walls do not contain peptidoglycon.
C. Cell membrane contains branched chain lipids.
D. Some of them are capable of producing biogas.
a. A & B only d. A, B & C only
c. B & C only d. All of these

NCERT Exemplar Problems

1. All eukaryotic unicellular organisms belong to:
a. Monera b. Protista
c. Fungi d. Bacteria

2. The five kingdom classification was proposed by:
a. RH Whittaker b. C Linnaeus
c. A Roxberg d. Virchow

3. Organisms living in salty areas are called as:
a. Methanogens
b. Halophiles
c. Heliophytes
d. Thermoacidophiles

4. Naked cytoplasm, multinucleated and saprophytic are the characteristics of:
a. Monera b. Protista
c. Fungi d. Slime

5. An association between roots of higher plants and fungi is called:
a. Lichen b. Fern
c. Mycorrhiza d. BGA

6. A dikaryon is formed when:
a. Meiosis is arrested
b. The two haploid cells do not fuse immediately
c. Cytoplasm does not fuse
d. None of the above

7. Contagium vivum fluidum was proposed by:
a. DJ lvanowsky b. MW Beijernek
c. Stanley d. Robert Hook

8. Association between mycobiont and phycobiont are found in:
a. Mycorrhiza b. Root
c. Lichens d. BGA

9. Difference between virus and viroid is:
a. Absence of protein coat in viroid but present in virus.
b. Presence of low molecular weight RNA in virus but absent in viroid.
c. Both (a) and (b)
d. None of the above

10. With respect to fungal sexual cycle, choose the correct sequence of events.
a. Karyogamy, Plasmogamy and Meiosis
b. Meiosis, Plasmogamy and Karyogamy
c. Plasmogamy, Karyogamy and Meiosis
d. Meiosis, Karyogamy and Plasmogamy

11. Viruses are non-cellular organisms, but replicate themselves once they infect the host cell. To which of the following kingdom do viruses belong to?
a. Monera b. Protista
c. Fungi d. None of these

12. Members of phycomycetes are found in:
A. Aquatic habitats
B. On decaying wood
C. Moist and damp places
D. As obligate parasites on plants
Choose from the following options.
a. (A) and (D) b. (B) and (C)
c. (B) and (D) d. All of these

Past Year Questions

1. Match c correct option using the codes given below:

Column-I	Column-II
A. Pistils fused together	1. Gametogenesis
B. Formation of gametes	2. Pistillate
C. Hyphae of higher Ascomycetes	3. Syncarpous
D. Unisexual female flower	4. Dikaryotic

a. A-1 B-2 C-4 D-3
b. A-3 B-1 C-4 D-2
c. A-4 B-3 C-1 D-2
d. A-2 B-1 C-4 D-3

2. One of the major components of cell wall of most fungi is:
a. Chitin b. Peptidoglycan
c. Cellulose d. Hemicellulose

3. A location with luxuriant growth of lichens on the trees indicate that the
a. Location is not polluted
b. Trees are very healthy
c. Trees are heavily infested
d. Location is highly polluted

4. Male gametes are flagellated in:
a. *Ectocarpus* b. *Spirogyra*
c. *Polysiphonia* d. *Anabaena*

5. Which one of the following matches is correct?

a. *Mucor*	Reproduction by Conjugation	Ascomycetes
b. *Agaricus*	Parasitic fungus	Basidiomycetes
c. *Phytophthora*	Aseptate mycelium	Basidiomycetes
d. *Alternaria*	Sexual reproduction absent	Deuteromycetes

6. True nucleus is absent in:
a. *Vaucheria* b. *Volvox*
c. *Anabaena* d. *Mucor*

7. Cell wall is absent in:
a. *Funaria* b. *Mycoplasma*
c. *Nostoc* d. *Aspergillus*

8. The imperfect fungi which are decomposer of litter and help in mineral cycling belong to:
a. Basidiomycetes b. Phycomycetes
c. Ascomycetes d. Deuteromycetes

9. Five kingdom system of classification suggested by R.H. Whittaker is not based on:
a. Complexity of body organization
b. Presence or absence of a well defined nucleus
c. Mode of reproduction
d. Mode of nutrition

10. Archaebacteria differ from Eubacteria in:
a. Mode of reproduction
b. Cell membrane structure
c. Mode of nutrition
d. Cell shape

11. Read the following five statements (A - E) and answer as asked next to them.
A. In *Equisetum*, the female gametophyte is retained on the parent sporophyte.
B. In *Ginkgo* male gametophyte is not independent.
C. The sporophyte in *Riccia* is more developed than that in Polytrichum.
D. Sexual reproduction in *Volvox* is isogamous.
E. The spores of slime molds lack cell walls.

How many of the above statements are correct?
a. Two b. Three
c. Four d. One

12. How many organisms in the list given below are autotrophs? *Lactobacillus, Nostoc, Chara, Nitrosomonas, Nitrobacter, Streptomyces, Saccharomyces, Trypanosoma, Porphyra, Wolfia:*
a. Four b. Five
c. Six d. Three

13. Nuclear membrane is absent in:
a. *Nostoc* b. *Penicillium*
c. *Agaricus* d. *Volvox*

14. Which is common about *Trypanosoma, Noctiluca, Monocystis* and *Giardia*?
a. They are all parasites
b. They are all unicellular protists
c. They have flagella
d. They produce spores

15. Auxospores and hormocysts are formed respectively by:
a. Some diatoms and several Cyanobacteria
b. Some Cyanobacteria and several diatoms
c. Several Cyanobacteria and several diatoms
d. Several diatoms and a few Cyanobacteria

16. Barophilic prokaryotes:
a. Occur in water containing high concentration of barium hydroxide
b. Grow slowly in alkaline frozen lakes at high altitude
c. Grow and multiply in very deep marine sediments
d. Readily grow and divide in sea water enriched with soluble salt of barium.

17. Phenetic classification of organisms is based on:
a. The ancestral lineage of existing organisms
b. Dendogram based on DNA characteristics
c. Sexual characteristics
d. Observable characteristics of existing organisms

18. Viruses are no more "alive" than isolated chromosomes because:
a. They require both RNA and DNA
b. They both need food molecules
c. They both require oxygen for respiration
d. Both require the environment of a cell to replicate

19. The chief advantage of encystment to an Amoeba is:
a. The ability to survive during adverse physical conditions
b. The ability to live for some time without ingesting food
c. Protection from parasites and predators
d. The chance to get rid of accumulated waste products

20. Lipids are insoluble in water because lipids molecules are:
a. Hydrophilic b. Hydrophobic
c. Neutral d. Zwitter ions

21. Difference in Gram +ve and Gram -ve bacteria is due to:
a. Cell wall b. Cell membrane
c. Ribosome d. Cytoplasm

22. What is true for cyanobacteria?
a. Oxygenic with nitrogenase
b. Oxygenic without nitrogenase
c. Non oxygenic with nitrogenase
d. Non oxygenic without nitrogenase

23. Indicator of water pollution:
a. *E. Coli* b. *Chlorella*
c. *Beggiatoa* d. *Ulothrix*

24. Nucleic acid in HIV:
a. ssRNA b. dsRNA
c. ssDNA d. dsDNA

25. Which of the following survives a temperature of 104°C to 106°C?
a. Marine Archaebacteria
b. Hot water spring thermophiles
c. Seeds of angiosperms
d. Eubacteria

26. Transduction in bacteria carried out by:
a. Bacteriophage b. B.G.A.
c. *Mycoplasma* d. Rickettsiae

27. The site of respiration in bacteria is:
a. Ribosome b. Microsome
c. Episome d. Mesosome

28. Which are the sex organs provided in some bacteria?
a. Sex pili b. Plasmid
c. Circular DNA d. Gametes

29. The tailed bacteriophages are:
a. Motile on surface of bacteria
b. Non-motile
c. Motile onsurface of plant leaves
d. Actively motile in water

30. The black rust of wheat in a fungal disease caused by:
a, *Albugo candida*
b. *Puccinia graminis tritici*
c. *Melampsora lini*
d. *Claviceps purpurea*

Assertion & Reason

Directions: These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

A. If both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.
B. If both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.
C. If Assertion is True but the Reason is False.
D. If both Assertion and Reason are False.

1. **Assertion:** Protozoans are believed to be primitive relatives of animals.

   Reason: All protozoans are heterotrophs usually and live as predators or parasites.

2. **Assertion:** Deuteromycetes are called as fungi imperfect.

   Reason: Only Asexual or vegetative phases of these fungi are known.

3. **Assertion:** Pili are surface structure of bacteria but not play a role in motility.

   Reason: Pili is made up of pilin protein which is non contractile.

4. **Assertion:** Bacteria are the sole members of kingdom monera

   Reason: Bacteria have Eukaryotic cellular organization only.

5. **Assertion:** Eubacteria photosynthesis is not oxygenic (do not produce oxygen).

   Reason: Eubacteria lack PS-II.

6. **Assertion:** *Neurospora* is called as Drosophila of plant kingdom.

   Reason: *Neurospora* is used most extensively in biochemical and genetic work.

7. **Assertion:** Diatomaceous earth is used in polishing, filteration of oil and syrups.

   Reason: Diatoms are chief producer in ocean.

8. **Assertion:** Species is reproductively isolated natural population.

   Reason: Prokaryotes were kept under different species on the basis of reproductive isolation.

9. **Assertion:** Dinoflagellates show water bloom.

   Reason: Dinoflagellates float with the help of stored food.

10. **Assertion:** *Azolla* increases the production of rice significantly.

    Reason: *Anabaena* are found in the leaves of *Azolla*.

11. **Assertion:** Archaebacteria are called ancient bacteria.

    Reason: Archaebacteria are presently living.

12. **Assertion:** Flagellais 11 (Eleven) stranded in protista.

    Reason: Protista has 9 + 2 arrangement.

13. **Assertion:** Slime moulds lack cell wall.

    Reason: In reproductive phase, slime moulds contain cell wall.

14. **Assertion:** Amoeba contains a contractile vacuole.

    Reason: It helps in both digestion and osmoregulation.

15. **Assertion:** Malarial fever appear at merozoite stage of *Plasmodium.*

    Reason: The infective stage of *Plasmodium* is sporozoite.

16. **Assertion:** In *Paramecium,* excess of water is removed from the cytoplasm by means of contractile vacuoles.

    Reason: The contractile vaculoes show osmoregulation.

17. **Assertion:** *Euglena* is studied as an animal as well as a plant.

    Reason: *Euglena* is more an animal than a plant.

18. **Assertion:** Sporozoans may have silica shells on their surface.

    Reason: Shells of sporozoans help in protection from acidic environment of the host.

19. **Assertion:** Fungal cellulose or chitin is a polysaccharide.

    Reason: It is made of acetyl glucosamine.

20. **Assertion:** Flagellation is important in classifying Phycomycetes.

    Reason: Flagellation differs from class to class.

21. **Assertion:** "Fungi imperfecti" does not show alternation of generation.

    Reason: The diploid phase is only present.

Answer Key

Self Assessment Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	d	d	d	b	d	b	c	a	d	c	b	c	c	a	a	b
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
c	d	a	a	b	a	b	a	c	c	c	a	c	b	a	d	b
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
c	d	b	b	d	a	b	a	d	a	a	d	a	a	a	a	a
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
a	a	d	a	c	d	a	b	d	d	d	b	b	b	d	d	c
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
d	c	a	a	a	c	a	a	a	d	a	a	a	b	a	c	a
86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
d	a	b	d	a	b	b	b	c	d	a	a	b	b	a	c	b
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
a	b	a	a	d	c	c	c	b	a	d	a	a	a	b	a	d
120	121	122	123	124	125											
c	b	b	a	b	c											

Higher Order Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	b	c	a	b	b	b	c	d	c	d	d	d	b	d	b	a
18	19	20	21	22	23	24	25									
c	c	a	b	d	a	a	d									

NCERT Exemplar Problems

1	2	3	4	5	6	7	8	9	10	11	12
b	a	b	d	c	b	b	c	a	c	d	d

Past Year Questions

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

Assertion & Reason

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
a	a	a	c	a	a	b	c	c	a	b	a	b	c	a	b	a
18	19	20	21													
d	a	a	c													

Explanations and NCERT References

Self Assessment Questions

120. (c) ***NCERT (XI) Ch - 2, Pg. 26, fig 2.6 (b)***

121. (b) ***NCERT (XI) Ch - 2, Pg. 20, fig 2.3***

122. (b) ***NCERT (XI) Ch - 2, Pg. 26, fig 2.6 (a)***

123. (a) ***NCERT (XI) Ch - 2, Pg. 18, fig 2.1***

124. (b) ***NCERT (XI) Ch - 2, Pg. 26, fig 2.6 (b)***

125. (c) ***NCERT (XI) Ch - 2, Pg. 21, fig 2.4 (b)***

Higher Order Questions

1. (c) Tuberculosis is caused by bacteria, *Mycobacterium*, that spread from person to person through microscopic droplets released into the air.

2. (b) Cephalotrichous: a tuft of flagella at one end; lophotrichous: group of flagella at one end; amphitrichous: group of flagella at both ends; peritrichous: flagella all over the body.

3. (c) Rhizomorphis a 'root-like' or 'string-like' elongated structure of closely packed and interwoven hyphae.

4. (a) Difference between Lytic and Lysogenic Cycles

Lytic Cycle	Lysogenic Cycle
Viral DNA destroys cell DNA, takes over cell functions and destroys the cell.	Not destroys the cell.
The virus replicates and produces progeny phages	The virus does not produce progeny.
There are symptoms of viral infection.	There are no symptoms of viral infection.
Virulant viral infection takes place	Temperate viral replication takes place.

5. (b) Interferons are signaling proteins secreted by host cells in response to the presence of several pathogens, such as viruses, bacteria, parasites, and also tumor cells.

6. (b) TMV is a kind of virus that cannot grow outside living host.

7. (b) Life is originated from simple, inorganic compounds by slow chemical reactions spread over millions and millions of years. In this way, the pre-cellular first inhabitants of the earth known as the protoviruses have originated. The present-day viruses are survivors of these inhabitants of the earth.

8. (c) In lysogeny, a bacteriophage infects certain bacteria without destroying it.

9. (d) The site of respiration in prokaryotes such as bacteria is cell membrane. The cytoplasm of outer cell membrane forms much coiled invaginations called mesosome that participates in aerobic respiration.

10. (c) Eubacteria is characterized by the presence of a rigid cellulosic cell wall and 80S ribosomes.

11. (d) Aflatoxins are poisonous carcinogens that are produced by certain molds (*Aspergillus flavus* and *Aspergillus parasiticus*).

12. (d) VAM: Vesicular-Arbuscular Mycorrhiza (VAM) is the symbiotic association between certain phycomycetes fungi and angiosperm roots.

13. (d) The commonly used *lichen* in making litmus papers is *Roccella tinctoria*.

14. (b) ***NCERT (XI) Ch - 2, Pg. 21, fig 2.4 (a)***

15. (d) ***NCERT (XI) Ch - 2, Pg. 19, fig 2.2***

21. (b) ***NCERT (XI) Ch - 2, Pg. 20***

22. (d) Crystophytes includes diatoms and golden algae (desmids). Slime moulds, during unfavourable conditions, forms fruiting bodies bearing spores at their tips.

23. (a) *Mycoplasma* are organisms that completely lack a cell wall. They are the smallest living cells known and can survive without oxygen.

24. (a) ***NCERT (XI) Ch - 2, Pg. 20 & 22***

25. (d) ***NCERT (XI) Ch - 2, Pg. 19***

NCERT Exemplar Problems

1. (b) Protista is a group of all unicellular eukaryotic plants and animals. The organisms included in this group are either photoautotrophs, heterotrophs or parasites.

On the other hand,

Monera includes prokaryotes like bacteria, unicellular organism.

Fungi are eukaryotic but are mostly multicellular (exception yeast is unicellular).

2. (a) RH Whittaker (1969), an American taxonomist, in order to develop phylogenetic classification, divided organism into five kingdoms, i.e.,

(i) Monera (ii) Protista

(iii) Fungi (iv) Plantae

(v) Animalia

Whereas, C Linnaeus developed two kingdom classification, i.e.,

(i) kingdom-Plantae (ii) kingdom-Animalia.

and Virchow is associated with the discovery of cell theory.

3. (b) Halophiles are organisms that live in areas of high concentration of salts. The name halophiles is originated from the Greek word that means 'salt loving'.

Whereas, heliophytes are the plants that grow best in sunlight and cannot survive in salty conditions.

Methanogens are the bacteria that produces methane as a metabolic by products in anaerobic conditions.

Thermoacidophiles are archaebacteria striving under strong acidic environments and high temperatures, but cannot tolerate high salt concentrations around them.

4. (d) Slime moulds are saprophytic protists, moving along the dead leaves engulfing organic material. These are multinucleated and do not possess cell wall and have naked cytoplasm.

Whereas, monerans are prokaryotes, which include all bacteria. These do not contain naked cytoplasm, Protista is a group of eukaryotic organisms, that bear a well-defined membrane around cytoplasm, may be *uni-* or multinucleated and fungi lack naked cytoplasm. Their cell has well developed cell wall made of chitin.

5. (c) Mycorrhiza is the symbiotic association of fungus with roots of a higher plants like gymnosperms and angiosperms.

The fungus is dependent on plants for food and shelter, while the plants are benefitted by the fungal hyphae as they are involved in absorption of water and dissolved minerals present in the soil debris and makes it available to the plants.

Whereas lichens are the symbiotic association between algae and fungi. Ferns are group of plants, belong to pteridophytes like other vascular plants and BGA is blue-green algae with a prokaryotic cell.

6. (b) Dikaryon is a cell containing two nucleus. This results when two somatic cells fuse but their nucleus does not fuse immediately. Meiosis does not result in such conditions.

7. (b) MW Beijernek proposed contagiumvivumfluidum means contagious living fluid. This phrase was first used to describe virus, characteristic in escaping from the finest mesh available.

DJ Ivanowsky was a Russian Botanist who discovered the filterable nature of viruses and one of the founder of virology.

Stanley Miller was a Jewish American chemist experimented on origin of life. Robert Hooke was the first to study and record cells using his primitive microscope.

Robert Hooke was the first to study and record cells using his primitive microscope.

8. (c) Lichens are dual organisms which has a permanent symbiotic association of fungus and an alga. The fungal partner is called mycobiontand the algal partner is called phycobiont.

Mycorrhiza is association of fungus with roots, but not with an algae, while BGA is blue green alga a member of Monera having a prokaryotic cell.

9. (a) Virus contains DNA or RNA as genetic material and a protein coat, whereas viroids have no protein coat but only RNA as their nucleic acid. This is the reason why viroids are carried inside viruses. e.g., hepatitis-D is a viroid that is carried in the capsid of hepatitis-B virus.

10. (c) Plasmogamy means fusion of protoplasm and karyogamy means fusion of nucleus. These two events lead to the formation of zygote ($2n$) which is diploid structure where meiosis takes place.

11. (d) In five kingdom classification of Whittaker, non-cellular organisms like viruses and viroids are not mentioned. Viruses did not find a place in classification since they are not truly 'living' and hence, they are considered as non-cellular.

Monera contains all unicellular prokaryotes called bacteria in which viruses cannot be included.

Protista includes all eukaryotic unicellular plant and animals and fungi are heterotrophic /parasitic. Cellular organism is devoid of chlorophyll.

12. (d) Phycomycetes are the members of fungi that can thrive well on dead and decaying wood as saprophytes. These prefer to live in moist and damp places and need water for the movement of zoospore and sexual gametes.

Few members of phycomycetes are obligate parasites like *Phytophthora infestans* causing late blight of potato and Peronosporaviticola causing downy mildew of grapes.

Past Year Questions

2. (a) The cell wall of fungi is composed of chitin (n-acetyl glucosamine) and polysaccharides.

3. (a) Lichens are very good pollution indicators; they do not grow in polluted areas.

4. **(a)** Gametes are pyriform (pear - shaped) and bear two laterally attached flagella in phaeophyceae (Brown algae). E.g. *Ectocarpus, Dictyota, Laminaria, Sargassum* and *Fucus.*

5. **(d)** *Mucor* - Phycomycetes

   Agaricus - Non - parasitic fungus

   Phytophthora - Septate mycelium

   Alternaria - Absence of sexual reproduction (Deuteromycetes)

6. **(c)** *Vaucheria* and *Volvox* are eukaryotes (Plant kingdom) while *Mucor* is a fungi (Ascomycetes) is eukaryote but *Anabaena* is prokaryotes.

7. **(b)** *Mycoplasma* are organisms that completely lack cell wall. They are the smallest living cells known and can survive without oxygen.

8. **(d)** Deuteromycetes is an artificial class of fungi which includes all those fungi in which sexual stage is not known. They are commonly known as imperfect fungi.

9. **(b)** Main criteria for classification used by R.H. Whittakar are cell structure, Thallus organization, mode of nutrition, reproduction and Phylogenetic relationship.

10. **(b)** Archaebacteria differ from other bacteria in having a different cell wall structure.

11. **(d)** *Equisetum*: Homosporous pteridophytes

12. **(c)** Photosynthetic autotrophs are *Nostoc*, *Porphyra*, *Wolfia*, *Chara*, *Nitrosomonas & Nitrobacter* are chemosynthetic.

13. **(a)** Nuclear membrane is absent in *Nostoc* (Prokaryote) while remaining three are eukaryotes.

14. **(b)** They are all unicellular eukaryotes (Protista)

15. **(d)** Several diatoms and a few Cyanobacteria

16. **(a)** Barophilic prokaryotes are facultatively anaerobic bacteria. They grow and multiply in very deep marine sediments. Most basophiles grow better at a pH of 8.5 or higher.

Assertion & Reason

1. **(a)** Protozoans are simpler heterotrophs usually live as predators parasites; they are called primitive relative of animals.

2. **(a)** Deuteromycetes are one of the classes of kingdom fungi. Deuteromycetes are called imperfect fungi. It is simply because the only known mode of reproduction is asexual or vegetative reproduction.

3. **(a)** Pili is composed of a protein pilin which forms the surface structure of bacteria. This pilin protein is non-contractile protein hence does not play a role in bacterial motility.

4. **(c)** Bacteria are prokaryotic organism. Cellular organization of kingdom monera is prokaryotic and bacteria are the sole members of kingdom monera.

5. **(a)** Photosystem-II involves the role of oxygen but as eubacteria lack PS –II, they do not produce oxygen during photosynthesis.

6. **(a)** *Neurospora* belongs to class ascomycetes of kingdom fungi. *Neurospora* is extensively used in biochemical and genetic work so we call it Drosophila of kingdom fungi. *Drosophila* (fruit fly) in higher organism is commonly used for genetic work.

7. **(b)** Diatoms are a major group of algae in chrysophytes and are among the most common types of phytoplankton. Diatomaceous earth consists of fossilized remains of diatoms. It is used in polishing, also as a filtration aid because it is composed of microscopically small, hollow particles and they are gritty soil.

8. **(c)** Prokaryotes were kept under different category on basis of cell wall composition and type of cell.

9. **(c)** Dinoflagellates have two flagella, one lies longitudinally and other transversally in furrow between plates. These flagella helps the organism to float or in locomotion.

10. **(a)** *Anabaena* are photosynthetic autotrophs that can fix atmospheric nitrogen in specialized cells called heterocysts. They often form blooms in polluted water bodies.

11. **(b)** Bacteria are classified mainly as Eubacteria and Archaebacteria. Eubacteria are true bacteria and archaebacteria are ancient bacteria. They lie under conditions similar to those present on Earth at the time of origin of life—high temperature, high salt content, absence of oxygen, acidic pH, etc.

12. **(a)** Flagella, if present in protista, is 11 stranded with 9 + 2 organisation of microtubules that are composed of a protein named tubulin.

13. **(b)** The vegetative structure of slime moulds is a multinucleate mass of cytoplasm unbounded by rigid walls, which flows in amoeboid fashion over the substrate. As long as conditions are favourable for vegetative development, the plasmodium continues to increase in bulk with accompanying repeated nuclear division. Fruiting (reproductive phase) occurs when a *Plasmodium* migrates to a relatively dry region of the substrate. As this fruiting body develops, small uninucleate sections of the plasmodium become surrounded by walls to form large number of uninucleate spores, borne on the fruiting

structure.

14. (c) Contractile vacuole in *Amoeba* is a single, clear rounded pulsating structure which is filled with a watery fluid and enclosed by a unit membrane. It helps in the osmoregulation and excretory activities.

15. (a) When the mosquito bites man, sporozoites present in the salivary gland of female *Anopheles* mosquito are injected into the blood of the man. The erythrocytic schizont gives rise to merozoites. Malaria fever occurs when schizonts in red blood corpuscles burst and set free their contained merozoites and malarial pigment (haemozoin*)* in the blood plasma bursting of shizonts tends to be synchronous as they all burst at the same time. Haemozoin is said to be toxic and so includes high fever and shivering (Haemozoin is an unused hematin, which is produced by the breakdown of haemoglobin). It is yellow brown to blackish in colour.

16. (b) In *Paramecium,* each contractile vacuole is surrounded by 5 to 12 radial canals (feeding canals). Excess of water is transferred from the cytoplasm to the radial canal. The latter pour water into the contractile vacuole. The contractile vacuole expels water outside the body. Thus the contractile vacuoles and radial canals show osmoregulation.

17. (a) Euglena is a typical example of mastigophora. It is phytoflagellate as it possesses both chloroplast and flagella. It is autotrophic in sunlight, but becomes heterotrophic in dark. Because of its two fold nutritional abilities, it is usually studied as a plant as well as an animal. But it is more an animal than plant because of

(a) The absence of cellulose cell wall overlying the plasma membrane.

(b) Presence of centriole forming blepharoplasts.

(c) Reserve food is paramylon which is not a true starch.

(d) Response to various stimuli like an animal.

18. (d) Sporozoans are endoparasites. The body is covered with an elastic pellicle or cuticle.

19. (a) Chitin is the second most abundant organic substance (after cellulose). It is complex carbohydrate of hereropolysaccharide type. In chitin, basic unit is not glucose but a nitrogen containing glucose derivative known as n-acetyl glucosamine. Chitin is an unbranched polysaccharide. Monomers are joined together by beta 1-4 linkage.

20. (a) Both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.

21. (c) Fungi imperfecti is that group of fungi where only the imperfect stage (asexual stages) is present. The only known method of reproduction is by conidia (asexual reproduction). As sexual reproduction is absent in this group therefore diplophase is also absent. Hence, no alternation of generation (i.e. alternation of haploid and diploid phase) is shown here.

3 Plant Kingdom

NCERT Crisp

Fungi and **members of the Monera and Protista** having **cell walls** have now been **excluded from Plantae. So, cyanobacteria t**hat are also referred to as **blue green algae are not 'algae' any more.**

Artificial Classification System

- By **C. Linnaeus**
- Artificial systems gave **equal weightage to vegetative and sexual characteristics;** this is not acceptable since we know that often the vegetative characters are more easily affected by environment.

Natural Classification systems

- George **Bentham** and Joseph Dalton **Hooker.**
- **Based on natural affinities** among the organisms and consider not only the **external features**, but also **internal features**, like ultrastructure, anatomy, embryology and phytochemistry.

Phylogenetic Classification Systems

- Based on **evolutionary relationships between the various organisms.**

Numerical Taxonomy

- Also **known as Phenetics** given by **E. Anderson**
- Based on all **observable characteristics**.
- Number and codes are assigned to all the characters.
- Each character is given equal importance and at the same time, hundreds of characters can be considered.

Cytotaxonomy

- Based **on cytological information** like chromosome number, structure, behavior.

Chemotaxonomy

- Based on the **chemical constituents** of the plant to resolve confusions.

Algae

- Algae are **chlorophyll-bearing, simple, thalloid, autotrophic** and **largely aquatic** (both fresh water and marine) **organisms.**
- Some of them also occur in **association with fungi (lichen**) and **animals (e.g., on sloth bear).**
  - **Colonial form: Volvox**
  - Filamentous forms: *Ulothrix* and *Spirogyra*.
    - ◊ Filamentous but Branched: *Cladophora*
    - ◊ Filamentous but Not Branched: *Spirogyra* and *Ulothrix*
  - **Unicellular non-motile: *Chlorella***
  - **Unicellular and Motile: *Chlamydomonas***
- Marine forms such as **kelps** form massive plant bodies.
- **Vegetative reproduction** is by **fragmentation**. Each fragment develops into a thallus.
- **Asexual reproduction** is by the production **of different types of spores**, the most common being the **zoospores.**
- **In sexual reproduction,** gametes can be **flagellated** and **similar in size (**as in ***Chlamydomonas*)** or **non-flagellated (non-motile)** but **similar in sizes**, (as in ***Spirogyra*).** Such reproduction is called **isogamous.**
- Fusion of **two gametes dissimilar in size**, as in **some species of *Chlamydomonas*** is termed as **anisogamous.**
- **Fusion between one large, non-motile (static) female** gamete and **a smaller, motile male gamete** is termed **oogamous, e.g., *Volvox*, *Fucus*.**

Importance

- At least **50%** of the total carbon dioxide fixation is carried out by algae through **photosynthesis**.
- **Primary producers** of energy-rich compounds, hence forms the basis of the food cycles of all aquatic animals.
- 70 species of marine algae used as food, e.g., *Porphyra, Laminaria* and *Sargassum.*
- Certain marine brown and red algae produce large amounts of **hydrocolloids** (**water holding substances**), e.g., **algin** (brown algae) and **carrageen** (red algae).
- **Agar**, obtained from ***Gelidium*** and ***Gracilaria***, is used to grow microbes and in preparations of **ice-creams and jellies**.
- **Chlorella**, a unicellular protein-rich alga, used as food supplement by **space travellers**.

Chlorophyceae (Green Algae)

- They are **usually grass green** due to the **dominance of pigments chlorophyll *a* and *b*.**
- The pigments are localized in definite chloroplasts.
- The chloroplasts may be discoid, plate-like, reticulate, cup-shaped, spiral or ribbon-shaped in different species.
- Most of the members have one or more storage bodies called **pyrenoids** located in the chloroplasts. Pyrenoids contain protein besides starch.
- Algae may **store food** in the form of **oil droplets**.
- Green algae usually have **a rigid cell wall** made of an inner layer of **cellulose** and an outer layer of **pectose.**
- **Vegetative reproduction** usually takes place by fragmentation or by formation of different types of spores. **Asexual reproduction** is by flagellated zoospores produced in zoosporangia.
- **Sexual reproduction** shows considerable variation in the type and formation of sex cells and it may be isogamous, anisogamous or oogamous.
- **Examples:** *Chlamydomonas*, *Volvox*, *Ulothrix*, *Spirogyra* & *Chara*.
- **Colonies of** *Volvox* **is known as coenobium.**

Phaeophyceae (Brown Algae)

- The members of **phaeophyceae** or **brown algae** are found primarily in **marine habitats**. They show great variation in size and form.
- **Alginic acid is** produced by **brown alage.**
- **Filamentous Brown algae** is ***Ectocarpus***.
- **Branched Brown algae** kelps (***Macrocystis***), which may reach **a height of 100 meters.**
- They possess **chlorophyll *a*, *c*, carotenoids** and **xanthophylls.**
- They **vary in colour** from olive green to various shades of brown depending upon the amount of the **xanthophylls pigment, fucoxanthin** present in them.
- Food is stored as complex carbohydrates, which may be in the form of **Laminarin or Mannitol.**
- The **vegetative cells have a cellulosic wall** usually covered on the outside by a gelatinous coating of **algin.**
- The protoplast contains, in addition to plastids, a centrally located vacuole and nucleus.
- The plant body is usually attached to the substratum by a **holdfast**, and has a stalk, the stipe and leaf like photosynthetic organ **– the frond.**
- **Vegetative reproduction** takes place by **fragmentation.**
- **Asexual reproduction,** in most brown algae, is by biflagellate zoospores that are pear-shaped and have two unequal laterally attached flagella.
- **Sexual reproduction** may be isogamous, anisogamous or oogamous.
- **Union of gametes may take place in water or within the oogonium (oogamous species).**
- The **gametes** are **pyriform (pear-shaped)** and bear two laterally attached flagella.
- **Examples:** *Ectocarpus, Dictyota, Laminaria, Sargassum* and *Fucus*

Rhodophyceae (Red Algae)

- The members of rhodophyceae are commonly **called red algae** because of the predominance of the red pigment, **r-phycoerythrin** in their body.
- Majority of the red algae are **marine** with greater concentrations found in the warmer areas.
- Only 50 species are of freshwater.
- They occur in both well-lighted regions close to the surface of water and also at great depths in oceans where relatively little light penetrates.
- The red thalli of most of the red algae are multicellular.
- The food is stored as **floridean starch** which is very similar to amylopectin and glycogen in structure.
- **Cell wall** has **cellulose, pectin, polysulphate esters.**
- **The red algae** usually **reproduce vegetatively by fragmentation**.

- They reproduce **asexually** by **non-motile spores** and **sexually** by **non-motile gametes.**
- **Sexual reproduction** is **oogamous** and accompanied by complex post-fertilisation developments.
- **Examples:** *Polysihonia, Porphyra, Gracilaria* and *Gelidium.*

Bryophytes

- Most primitive **non-vascular land plants**.
- Bryophytes include **mosses and liverworts** that are found commonly growing in **moist shaded areas** in the hills.

▪ Bryophytes are also called **amphibians of the plant kingdom** because these **plants can live in soil** but are **dependent on water for sexual reproduction.**

- They usually occur **in damp, humid** and **shaded localities.**
- They play an important role in **plant succession on bare rocks / soil.**
- The plant body of bryophytes is more differentiated than that of algae.
- It is thallus-like and prostrate or erect, and attached to the substratum by unicellular or multicellular rhizoids.
- They **lack true roots, stem or leaves**. They may **possess root-like, leaf-like or stem-like structures**.
- The **main plant body** of the bryophyte is **haploid.**
- It produces **gametes,** hence is called **a gametophyte.**
- The sex organs in bryophytes are multicellular.
- The **male sex organ** is called **antheridium**. They produce biflagellate antherozoids.
- The **female sex organ** called **archegonium** is **flask-shaped** and produces **a single egg.** The antherozoids are released into water where they come in contact with archegonium.
- An antherozoids fuses with the egg to produce the zygote. Zygotes do not undergo reduction division immediately.
- They produce a multicellular body called **a sporophyte.**
- The **sporophyte** is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it.
- Some cells of the sporophyte undergo reduction division (meiosis) to produce haploid spores. These spores germinate to produce gametophyte.
- Bryophytes in general are of little economic importance but some mosses **provide food for herbaceous mammals, birds and other animals**.

Importance

- **Species of *Sphagnum*, a moss, provide peat** that have long been **used as fuel**, and as **packing material for trans-shipment of living material because of their capacity to hold water.**
- **Mosses along** with **lichens are the first organisms to colonise rocks** and hence, are of **great ecological importance.**
- **They decompose rocks** making the substrate **suitable for the growth of higher plants.**
- **Since mosses form dense mats** on the soil, **they reduce the impact of falling rain** and **prevent soil erosion.**

- The bryophytes are divided into liverworts and mosses.

◊ **Liverworts**

- The liverworts grow usually in moist, **shady habitats such as banks of streams**, marshy ground, damp soil, and bark of trees and deep in the woods.
- The plant body of a liverwort is **thalloid, e.g., *Marchantia* & *Ricia* .**
- The **thallus** is **dorsiventral** and closely appressed to the substrate.
- The leafy members have tiny leaf-like appendages in two rows on the stem-like structures.
- **Asexual reproduction** in liverworts takes place by **fragmentation of thalli**, or by the formation of specialised structures called **gemmae (sing. gemma).**
- Gemmae are green, multicellular, asexual buds, which develop in small receptacles called **gemma cups** located on the thalli.
- The gemmae become detached from the parent body and germinate to form new individuals. During sexual reproduction, male and female sex organs are produced either on the same or on different thalli. The sporophyte is differentiated into a **foot**, **seta and capsule**.
- After meiosis, spores are produced within the capsule. These spores germinate to form **free-living gametophytes**.
- Example: *Marchantia*

◊ **Mosses**

- The **predominant stage** of the life cycle of a moss is **the gametophyte** which consists of two stages.
- The **first stage is the Protonema** stage, which **develops directly from a spore**. It is **a creeping, green, branched and frequently filamentous stage.**
- **The second stage is the leafy stage**, which **develops from the secondary protonema as a lateral bud.**

- They **consist of upright, slender axes bearing spirally arranged leaves.**
- They are attached to the soil through **multicellular and branched rhizoids.**
- Leafy stage bears the sex organs.
- Sex organs are present in same plants, **i.e., Monoecious**
- **Vegetative reproduction** in mosses is by **fragmentation** and **budding** in the secondary protonema.
- In **sexual reproduction**, the sex organs antheridia and archegonia are produced at the apex of the leafy shoots.
- After fertilisation, the zygote develops into a sporophyte, consisting of a foot, seta and capsule.
- **The sporophyte in mosses is more elaborate than that in liverworts.**
- The **capsule (semi-parasite) contains spores**. Spores are formed after meiosis.

Capsule has three parts:

- Apophysis (Basal Sterile part)
- Theca (Middle fertile part containing Spores)
- Operculum (Upper part with annulus and 32 peristome teeth in two rows which help in spore dispersal).

- The **mosses have an elaborate mechanism of spore dispersal.**
- **Examples:** *Funaria, Polygonatum, Polytrichum* and *Sphagnum*

Pteridophytes

- The pteridophytes **include horsetails** and **ferns.**
- Pteridophytes are used for **medicinal purposes** and as **soil-binders.**
- They are also frequently **grown as ornamentals.**
- **Evolutionarily,** they are **the first terrestrial plants** to possess vascular tissues – xylem and phloem.
- The pteridophytes are found in cool, damp, shady places though some may flourish well in sandy-soil conditions.
- Xylem is without vessels consist of only tracheids and phloem without sieve tubes and companion cells.
- In pteridophytes, the **main plant body** is a **sporophyte** which is differentiated into true root, stem and leaves.
- These organs possess well-differentiated vascular tissues.

Leaves in pteridophyta:

- Small (microphylls) as in *Selaginella*
- Large (macrophylls) as in ferns.

- The sporophytes bear sporangia that are subtended by leaf-like appendages called **sporophylls.**
- In some cases, sporophylls may form distinct compact structures called **strobili or cones (*Selaginella, Equisetum*).**

- **Eustele:** Much dissected siphonostele having vascular strands separated apart by parenchyma, **e.g., *Equisetum.***
- **Polystelic condition:** Presence of more than one stele, **e.g., *Selaginella***

- **The sporangia** produce spores **by meiosis in spore mother cells.**
- The spores germinate to give rise to inconspicuous, small **but multicellular, free-living, mostly photosynthetic thalloid** gametophytes called **prothallus.**
- These gametophytes require cool, damp, shady places to grow.
- Because of this specific restricted requirement and the need for water for fertilisation, the spread of living pteridophytes is **limited and restricted to narrow geographical regions.**
- The gametophytes bear male and female sex organs called antheridia and archegonia, respectively.
- **Water is required for transfer of antherozoids** – the male gametes released from the antheridia, to the mouth of archegonium.
- Fusion of male gamete with the egg present in the archegonium result in the formation of **zygote.**
- Zygote there after produces a multicellular well-differentiated sporophyte which is **the dominant phase of the pteridophytes.**
- In majority of the pteridophytes all the spores are of similar kinds; such plants are called **homosporous.**
- **Heterosporous:** Produce two kinds of spores, **macro (large)** and **micro (small)** spores ***Selaginella*** and ***Salvinia.***
- The megaspores and microspores germinate and give rise to female and male gametophytes, respectively. The female gametophytes in these plants are retained on the parent sporophytes for variable periods.
- The development of the zygotes into young embryos takes place within the female gametophytes.
- This event is a precursor to the seed habit considered an important step in evolution.

The pteridophytes are further classified into four classes:

- **Psilopsida (Whisky ferns)-***Psilotum*
- **Lycopsida (Club mosses) –** *Selaginella & Lycopodium*
- **Sphenopsida (Horse tails or scouring Rush) -** *Equisetum*
- **Pteropsida (Ferns) -** *Dryopteris, Pteris & Adiantum***.**

Smallest Pteridophyte is ***Azolla***.
Largest Pteridophytes is ***Cyathea*** (Tall fern).
Age of pteridophytes : Late Paleozoic era

Gymnosperms

- The gymnosperms (*gymnos*: naked, *sperma*: seeds) are plants in which the **ovules are not enclosed** by any ovary wall and **remain exposed**, **both before and after fertilisation.**
- The seeds that develop post-fertilisation, are not covered, i.e., are **naked**.
- Gymnosperms include medium-sized trees or tall trees and shrubs.
- The giant coast redwood tree *Sequoia sempervirens* is one of the **tallest tree** species.
- **Smallest Gymnosperm:** *Zamia pygnaea*
- The roots are generally tap roots.
- Roots in some genera have fungal association in the form of **Mycorrhiza (*Pinus*)**
- Transversely oriented conducting parenchyma tissue of pine leaf is called **transfusion tissue.**
- **Coralloid roots** present in ***Cycas*** and **are associated with N_2- fixing cyanobacteria.**
- **The stems are**
  - ◊ Unbranched - ***Cycas***
  - ◊ Branched - ***Pinus & Cedrus***.
- The leaves are of two types, i.e., **dimorphic.**
- In *Cycas,* the pinnate leaves persist for a few years.
- The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind.
- **In conifers,** the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.
- The gymnosperms are heterosporous, they produce haploid microspores and megaspores.
- The two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax or compact strobili or cones.
- The strobili bearing microsporophylls and microsporangia are called **microsporangiate or male strobili**. The microspores develop into a male gametophytic generation which is highly reduced and is confined to only a limited number of cells.
- The reduced gametophyte is called a **pollen grain.**
- The development of pollen grains takes place within the microsporangia.
- The cones bearing megasporophylls with ovules or megasporangia are called **macrosporangiate or female strobili.**

The male or female cones or strobili may be borne:
- On the same tree – ***Pinus***.
- On different trees - ***Cycas***

- The megaspore mother cell is differentiated from one of the cells of the nucellus.
- The nucellus is protected by envelopes and the composite structure is called an **ovule.**
- The ovules are borne on megasporophylls which may be clustered to form the female cones.
- The megaspore mother cell divides meiotically to form four megaspores.
- One of the megaspores enclosed within the megasporangium develops into a multicellular female gametophyte that bears two or more archegonia or female sex organs.
- The multicellular female gametophyte is also retained within megasporangium.
- **Unlike bryophytes and pteridophytes,** in gymnosperms the male and the female gametophytes do not have an independent free-living existence.
- They remain within the sporangia retained on the sporophytes.
- The pollen grain is released from the microsporangium.
- They are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls.
- The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharges their contents near the mouth of the archegonia.
- In some plants vessels are present, e.g., *Gnetum, Ephedra, Welwitschia*.
- **Endosperm** of gymnosperm is a haploid gametophytic tissue formed before fertilization.
- **Pollination in *Pinus* is anemophilous**
- Wings of pollen grain are help in pollination.
- Following fertilisation, zygote develops into an embryo and the ovules into seeds. These seeds are not covered.
- **Examples:** *Cycas*, *Pinus, Ginkgo*

Angiosperms

- The angiosperms or flowering plants, the pollen grains and ovules are developed in **specialized structures** called **flowers**.
- In angiosperms, the **seeds are enclosed by fruits.**

- The angiosperms are an exceptionally large group of plants occurring in wide range of habitats.
- **Microscopic angiosperm tree:** *Wolfia*
- **Tallest angiosperm tree:** *Eucalyptus regnans* (over 100 meters).
  - They are divided into two **classes: the dicotyledons and the monocotyledons .**
  - The dicotyledons are characterized by having two cotyledons in their seeds while the monocotyledons have only one.
- The **male sex organ** in a flower is the **stamen.**
- Each stamen consists of a slender filament with an anther at the tip.
- The anthers, following meiosis, produce pollen grains.
- Most reduced male gametophye or minimum no. of cells in male gametophyte is present in angiosperms.**(3-celled male gametophyte).**
- The **female sex organ** in a flower is the **pistil** or the **carpel.**
- Pistil consists of an ovary enclosing one to many ovules. Within ovules are present highly reduced female gametophytes termed **embryo sacs.**
- The embryo-sac formation is preceded by meiosis. Hence, each of the cells of an embryo-sac is haploid. Each embryo-sac has a **three-celled egg apparatus** – one egg cell and two synergids, three antipodal cells and two polar nuclei.
- The polar nuclei eventually fuse to produce a diploid secondary nucleus.
- The pollen grains germinate on the stigma and the resulting pollen tubes grow through the tissues of stigma and style and reach the ovule.
- The pollen tubes enter the embryo-sac where two male gametes are discharged. One of the male gametes fuses with the egg cell to form a zygote **(syngamy)**.
- The other male gamete fuses with the diploid secondary nucleus to produce the triploid **primary endosperm nucleus (PEN).**
- Because of the involvement of two fusions, this event is termed as **double fertilisation, an event unique to angiosperms.**
- The zygote develops into an embryo (with one or two cotyledons) and the PEN develops into endosperm which provides nourishment to the developing embryo.
- The synergids and antipodals degenerate after fertilisation.
- During these events the ovules develop into seeds and the ovaries develop into fruit.

Plant Life Cycles & Alternation of Generations

- The haploid plant body produces gametes by mitosis. This plant body represents a gametophyte. Following fertilisation, the zygote also divides by mitosis to produce a diploid sporophytic plant body. Haploid spores are produced by this plant body by meiosis.

Table: Plant life cycles

Haplontic life cycle	Diplontic life cycle	Haplo-diplontic life cycle
Sporophytic generation is represented only by the **one-celled zygote**.	The diploid **sporophyte** is the **dominant**, photosynthetic, **independent** phase of the plant.	An **intermediate condition** between haplontic and diplontic life cycles.
No free-living sporophytes.	The gametophytic phase is few to multi-celled.	Both gametophytic and sporophytic phases are multicellular and free living. However, they differ in their dominant phases
The dominant, photosynthetic phase in such plants is the **free-living gametophyte**. This kind of life cycle is termed as haplontic.	The gametophytic phase is represented by the single to few-celled haploid gametophyte. This kind of life cycle is termed as diplontic.	Haploid **gametophyte** is **dominant**, **independent**, photosynthetic, thalloid or erect phase. **Example:** Bryophytes
Example: Many algae such as *Volvox*, *Spirogyra* and some species of *Chlamydomonas*	**Example:** *Fucus sp*., all seed bearing plants, i.e., gymnosperms and angiosperms.	Diploid **sporophyte** is **dominant**, independent, photosynthetic, vascular plant body. **Example:** Pteridophytes

Exceptions:

- Haplo-diplontic algae - *Ectocarpus, Polysiphonia,* kelps.
- Diplontic algae – *Fucus*

Exam oriented Information

- ***Spirogyra*** also known as **Pond Silk/water silk/mermaids Tresses.**
- ***Selaginella*** commonly known as **club fungi** or **spike moss** or **Resurrection plant.**
- **Father of Indian Bryology**: Prof**. S. R. Kashyap.**
- ***Funaria***: Also known as **common moss, green moss & cord moss.**
- **Archegonium of *Funaria* contains an egg, venter and neck .**
- **Venter is double layered** and **contains egg and Ventral canal cells.**
- ***Ginkgo***: Living fossil as only one single species found.
- **Chilgoza**: Seed of Pinus
- ***Cycas revolute***: Sago palm in India.
- ***Cycas circinalis***: Jangli mada / Mast ka phul.
- Sperm of Cycas is very large.
- ***Drosera*****:** heterophic nutrition is an insectivorous plant and grow in soil which is nitrogen deficient.
- **Tallest grass** is Bamboo.
- **Iodin**e is obtained from **brown algae.**
- **Shape of chloroplast** in
  - ◊ *Spirogyra*: Spiral band shaped
  - ◊ *Ulothrix*: Girdle shaped
  - ◊ *Chlamydomonas*: Collar shaped
- **Parasitic algae is *Cephaleuros***
- **Sexual Reproduction in *Ulothrix*** is by **isogamy.**
- **Maiden hair fern** is ***Adiantum*.**
- **Golden Mine of Liverworts**: Western Himalaya.

Self Assessment Questions

Classification [NCERT Pg 29-30]

1. The phylogenetic classification was put forth by:
a. Carolus Linnaeus
b. Aristotle
c. Adolf Engler and Karl Prantl
d. Theophrastus

2. Cyanobacteria is referred to as blue green algae due to presence of
a. Chlorophyll *a* b. Xanthophyll
c. Chlorophyll *b* d. Phycocyanin

3. Evolutionary history of an organism is known as:
a. Phylogeny b. Ancestry
c. Palaneotology d. Ontogeny

4. '*Ordines Anomali*' of Bentham & Hooker includes:
a. Seed plant showing abnormal form of growth and development.
b. Plant represented only in fossil state.
c. Plants described in the literature, but which Bentham & Hooker did not see in original.
d. A few orders which could not be placed satisfactorily in the classification.

5. Cytotaxonomy is based on
a. Chemical constituents
b. Morphological characters
c. Structure and behaviour of chromosomes
d. Both (a) and (b)

6. Tracheophyta consists of:
a. Pteridophytes, gymnosperms and angiosperms
b. Pteridophytes only
c. Gymnosperms and angiosperms
d. Bryophytes only

7. Which of these is mismatched?
a. Bryon - liverworts
b. Kryptos - concealed
c. Gymno - naked
d. Phaneros - visible

8. Match the column:

I	II
A. Microspermae	1. Alismaceae
B. Epigynae	2. Liliaceae
C. Calycinae	3. Iridaceae
D. Apocarpae	4. Orchidaceae
D. Coronariae	5. Palmae

a. A-2 B-3 C-4 D-5 E-1
b. A-4 B-3 C-5 D-1 E-2
c. A-3 B-4 C-5 D-1 E-2
d. A-1 B-2 C-3 D-4 E-5

Algae [NCERT Pg 30-34]

9. *Trichoderma erythrium* which gives colour to red sea is:
a. Green alga b. Blue - Green alga
c. Red alga d. Brown alga

10. Algae which forms motile colony is:
a. *Volvox* b. *Nostoc*
c. *Spirogyra* d. *Chlamydomonas*

11. Non - motile, greatly thickened, asexual spore in *Chlamydomonas* is:
a. Carpospores b. Aplanospores
c. Akinetes d. Hypnospores

12. The cell wall of algae is chemically composed of:
a. Hemicellulose, pectins, proteins
b. Chitin
c. Cellulose, galactans, Mannan
d. Pectins, cellulose, proteins

13. Pyrenoids are made up of:
a. Core of starch surrounded by sheath of protein
b. Core of protein surrounded by fatty sheath
c. Proteinaceous centre and starchy sheath
d. Core of nuclei acid surrounded by protein sheath

14. About 7% of total world production of iodine is obtained by which algae?
a. *Ulothrix* b. *Polysiphonia*
c. *Spirogyra* d. *Laminaria*

15. Spirogyral lateral conjugation takes place in:
a. Heterosporous species
b. Homosporous species
c. Heterothallic species
d. Homothallic species

16. Zygote of *Spirogyra* produces four haploid nuclei in which:
a. One is functional
b. Two are functional
c. Three are functional
d. All are functional

17. Which of the following is known as Pond Silk?
a. *Spirogyra* b. *Ulothrix*
c. *Nostoc* d. *Anabaena*

18. A natural antibiotic is provided by:
a. *Chlorella* b. *Ulothrix*
c. *Dictyota* d. *Chlamydomonas*

19. Meiosis in *Spirogyra*, *Ulothrix*, *Chlamydomonas* and most of the algae / thallophyta is:
a. Sporic b. Zygotic
c. Gametic d. Unequal

20. A group of plants which are autotrophs their sex organs are non-jacketed and whose zygotes secretes thick wall are called:
a. Phycophytes b. Lichens
c. Bryophytes d. Thallophytes

21. *Ulothrix* releases zoospore during:
a. Evening b. Morning
c. Night d. Noon

22. Algae known for biological activity bioluminescence:
a. *Spirogyra* b. *Chlorella*
c. *Cyclotella* d. *Noctiluca*

23. Which algae is chew as tobacco in Scotland?
a. *Porphyra* b. *Rodimenia palmata*
c. *Chlorella* d. *Spirogyra*

24. Phycology is the study of:
a. Algae b. Fungi
c. Bryophytes d. Lichens

25. Which is Mermaid's tresses?
a. *Nostoc* b. *Ulothrix*
c. *Anabaena* d. *Spirogyra*

26. Moss protonema can be differentiated from filamentous alga in:
a. Long rhizoids b. Oblique septa
c. Coenocytic nature d. Absence of chloroplasts

27. *Ulothrix* is:
a. Nonmotile colonial alga lacking reproductive stages
b. Filmaentous alga with nonflagellated reproductive stages
c. Membranous alga producing zoospores
d. Filamentous alga with flagellated reproductive stages

28. 'Nonflagellate' gametes occur in:
a. *Ulothrix* b. *Funaria*
c. *Spirogyra* d. *Selaginella*

29. Which of the following algae are used by space travellers as food suppliments?
a. *Gracilaria*, *Gelidium*
b. *Volvox*, *Ulothrix*
c. *Spirogyra*, *Kelps*
d. *Spirulina*, *Chlorella*

30. During asexual reproduction, in most of brown algae, zoospores are produced which are:
a. Elongated with no flagella
b. Elongated with one flagella
c. Pear-shaped with one flagella
d. Pear-shaped with two flagella

31. *Volvox* and *Polysiphonia* are members of algal class, A and B respectively. Which of the following statement is correct?
a. Cellulose and algin are cell wall components of members of A.
b. Floridean starch is stored material in B.
c. Chlorophyll *a*, *c* and fucoxanthin are the photosynthetic pigments found in class A.
d. Two unequal flagella are found in members of B.

32. Match the following:

A. Red algae	1. *Marchantia*
B. Liverworts	2. *Pinus*
C. Walking fern	3. *Polysiphonia*
D. Gymnosperm	4. *Adiantum*

a. A-3 B-4 C-1 D-2
b. A-1 B-2 C-3 D-4
c. A-3 B-1 C-4 D-2
d. A-1 B-1 C-4 D-3

Bryophytes [NCERT Pg 34-36]

33. Elaters are absent in
a. *Funaria* b. *Marchantia*
c. *Pellia* d. *Porella*

34. Calyptra develops from
a. Ventral wall of oogonium
b. Ventral wall of archegonium
c. Outgrowth of gametophyte
d. Neck wall of archegonium
e. Paraphysis of the archegonial branch.

35. Largest moss is:
a. *Pogonatum* b. *Funaria*
c. *Dawsonia* d. *Polytrichum*

36. Which of the following is known as a "bog moss"?
a. *Polytrichum* b. *Funaria*
c. *Sphagnum* d. *Porella*

37. Retort cells occurs in
a. *Funaria* b. *Pogonatum*
c. *Porella* d. *Sphagnum*

38. Positive evidence of aquatic ancestary of bryophytes is indicated by
a. Ciliated sperms
b. Gametophytic body
c. Biflagellate gametes
d. Paristomial teeth

39. In capsule of moss act as shock absorbers
a. Trabeculae b. Peristone teeth
c. Seta d. Annulus

40. Mosses are attached to substratum by
a. Roots b. Capsule
c. Rhizoids d. Main axis

41. Mosses occur in moist places because they
a. Cannot grow on land
b. Do not need sunlight for photo synthesis
c. Lack vascular tissue
d. Lack root and stomata

42. Number of peristomial teeth in moss is
a. 16+16 b. 16+32
c. 8+16 d. 32+32

43. Which of the following propagates through leaf-tip?
a. Walking fern b. Sprout - leaf plant
c. Marchantia d. Moss

44. "Sanjeevani booti" is
a. *Selaginella kraussiana*
b. *Selaginella chrysocaculos*
c. *Selaginella bryopteris*
d. None of these

45. Ancestors of land plants/bryophytes were
a. Bryophytes b. Brown algae
c. Red algae d. Green algae

46. Incorrect about *Marchantia* is :
a. Sporophyte is differentiated into foot, seta and capsule
b. It can asexually reproduce through gemmae
c. Gametophyte as protonema stage
d. Flagellated antherozoids are produced

47. Spores are liberated only after decay and decomposition of thallus in:
a. *Riccia* b. *Anthoceros*
c. *Marchantia* d. *Funaria*

48. Bryophytes are also called amphibians of the plant kingdom because
a. They require water to complete their life cycle
b. They require land to complete their life cycle
c. They require both land and water for survive
d. They require only marine water to complete their life cycle

49. Apophysis occurs in:
a. Mosses b. *Pteridium*
c. Apocyanaceae d. *Marchantia*

Pteridophytes [NCERT Pg 36-38]

50. Club moss belongs to
a. Algae b. Pteridophytes
c. Fungi d. Bryophyta

51. Male gametophyte with least number of cells present in:
a. *Pteris* b. *Funaria*
c. *Lilium* d. *Pinus*

52. Plants commonly called vascular cryptogams are:
a. Bryophytes b. Pteridophytes
c. Algae d. Angiosperms

53. Pteropsida includes:
a. *Equisetum* and *psilotum*
b. *Lycopodium* and *Adiantum*
c. *Selaginella* and *pteris*
d. *Pteris* and *Adiantum*

54. Pteridophytes are also called
a. Phanerogams
b. Vascular cryptogams
c. Amphibians of the plant kingdom
d. Spermatophytes

55. In *Selaginella*, trabecular are the modification of:
a. Epidermal cells
b. Cortical cells
c. Endodermal cells
d. Pericycle cells

56. In pteridophytes, phloem is without:
a. Sieve cells b. Sieve tubes
c. Companion cells d. Bast fibre

57. Indusium is found in:
a. Algae b. Ferns
c. Moss d. Cycas

58. The kidney shaped covering of sorus is
a. Placenta b. Ramentum
c. Sporophyll d. Indusium

59. In the prothallus of vascular cryptogram, the antherozoids and eggs mature at different times. As a result,
a. There is no change in success rate of fertilisation
b. There is a high degree of sterility
c. One can conclude that the plant is apomictic
d. Self-fertilisation is prevented

60. Ramenta is the characteristic of:
a. *Marchantia* b. *Funaria*
c. *Dryopteris* d. None of these

61. Leaf in young condition in fern is called:
a. Scale leaf b. Sporophyll
c. Circinate ptyxis d. None of these

62. Which one of the following is called maiden - hair fern?
a. *Dryopteris* b. *Pteris*
c. *Adiantum* d. *Lycopodium*

63. Dispersal of spores in ferns takes place through:
a. Annulus b. Stomium
c. Both (a) & (b) d. Indusium

64. Characteristic of ferns is:
a. Circinate venation
b. Reticulate Venation
c. Parallel venation
d. None of these

65. A drug for respiratory disorders is obtained from:
a. *Ephedra* b. *Eucalyptus*
c. *Cannabis* d. *Saccharum*

66. Plants having (spores), xylem and phloem but lacking seeds are:
a. Pteridophytes b. Gymnosperms
c. Bryophytes d. Angiosperms

67. Sperms of both *Funaria* and *Pteris/Dryopteris* were released together near the archegonia of *Pteris/Dryopteris*. Only its sperms enter the archegonia as:
a. *Pteris/Dryopteris* archegonia release chemical to attract its sperms
b. *Funaria/Dryopteris* sperms get killed by *Pteris* sperms
c. *Funaria* sperms are less mobile
d. *Pteris/Dryopteris* archegonia repel *Funaria* sperms

68. Neck canal cell is absent in the archegonium of:
a. *Funaria* b. All pteridophytes
c. *Dryopteris* d. *Cycas*

69. Pyrenoids are the centres for formation of:
a. Starch b. Enzymes
c. Fat d. Proteins

70. Walking ferm is named so as:
a. It spreads and propagates vegetatively by its leaf tips.
b. It is dispersed through walking.
c. Its spores are able to walk.
d. It known walking.

71. Annulus occurs in:
a. Mosses b. Both mosses and ferns
c. Annual plants d. Gymnosperms

72. Seed habit is linked with:
a. Homospory b. Heterosposy
c. Parthenogenesis d. Parthenocarpy

73. Which of the following is considered important in the development of Seed habit?
a. Dependent Sporophyte
b. Heterospory
c. Haplontic life cycle
d. Free-living gametophyte

74. Vascular cryptogams are:
a. Gymnosperms b. Angiosperms
c. Bacteriods d. Pteridophytes/Ferns

75. Prothallus is:
a. Gametophyte, dioecious, autotroph present in pteridophytes
b. Gametophyte, monoecious, autotroph found in bryophytes
c. Sporophyte, dioecious, hetorotroph found in bryophytes
d. Gametophyte, monoecious, autotroph present in pteridophytes

76. Which one of the following is not common between *Funaria* and *Selaginella*?
a. Roots b. Embryo
c. Flagellate sperms d. Archegonium

Gymnosperms [NCERT Pg 39-39]

77. Choose the wrong statement:
a. Gymnosperms lack vessels in their xylem.
b. Gymnosperms does not have albuminous cells and sieve cells in their phloem.
c. The first formed primary xylem elements are called protoxylem.
d. Gymnosperms have albuminous cells and sieve cells in their phloem.

78. Fruits are not found in gymnosperms because:
a. They are seed less
b. They are not pollinated
c. They have no ovary
d. Fertilisation does not take place

79. Gymnosperms are also called soft wood spermatophytes because they lack:
a. Cambium
b. Phloem fibres
c. Thick - walled tracheids
d. Xylem fibres

80. A mature pollen grain of *Pinus* has:
a. 2 cells b. 3 cells
c. 4 cells d. 5 cells

81. Which is the source of Turpentine oil?
a. Gymnospermic wood
b. Angiospermic wood
c. Gymnospermic seed
d. Angiospermic seed

82. In *Cycas*, pollination occurs at_____ celled stage?
a. One b. Two
c. Three d. Four

83. Which of the following is / are grouped under phanerogams?
a. Angiosperms b. Gymnosperms
c. Pteridophytes d. Both (a) & (b)

84. Flagellated male gametes are present in all the three of which one of the following sets?
a. *Anthoceros, Funaria* and *Spirogyra*
b. *Zygnema, Saprolegnia* and *Hydrilla*
c. *Fucus*, *Marsilea* and *Calotropis*
d. *Riccia*, *Dryopteris* and *Cycas*

85. In Pinus/gymnosperms, the haploid structures are:
a. Megaspore, endosperm and embryo
b. Pollen grain, leaf and root
c. Megaspore, integument and root
d. Megaspore, pollen grain and endosperm

86. Coralloid roots of *Cycas* possess a symbiotic alga:
a. *Anabaena* b. *Spirogyra*
c. *Ulothrix* d. *Aulosira*

87. A plant having seeds but lacking flowers and fruits belongs to:
a. Gymnosperms b. Mosses
c. Ferns d. Pteridophytes

88. Fern gametophyte is nutritionally:
a. Photoautotroph b. Parasite
c. Chemoautotroph d. Saprophyte

89. Winged pollen grains are found in:
a. *Cycas* b. *Pinus*
c. Mango d. *Dryopteris*

90. Female cone of *Pinus* develops seeds in:
a. One year b. 2-3 year
c. Two years d. Four years

91. Megasporophyll is the term used in gymnosperm to denote
a. Carpels b. Stamens
c. Leaves d. Female cone

92. Branched rhizoids and leafy gametophyes are characteristic of:
a. All bryophytes b. Some pteriodophytes
c. All pteridophytes d. Some bryophytes

93. Gymnosperms have a mode of pollination called:
a. Zoophily b. Entomophily
c. Anemophily d. Hydrophily

94. In *Pinus*, the male gametes are:
a. Uniciliate b. Multiciliate
c. Biciliate d. Non-ciliate

95. Sago comes from:
a. *Phoenix dactylifera*
b. *Areca catechu*
c. *Metroxylon rumphii*
d. *Calamus ritung*

96. Which one is living fossil?
a. *Pinus* b. *Selaginella*
c. *Cycas* d. *Metasequoia*

97. In gymnosperms, how many male gametes are produced by each pollen grain?
a. 4 b. 3 c. 2 d. 1

98. In gymnosperms, megaspore mother cell divides meiotically to form four megaspores. Out of four megaspores, one develops into a multicellular structure termed as:
a. Female gametophyte
b. Archegonium
c. Ovule
d. Strobili

99. Incorrect statement about *Sequoia*:
a. It is also known as red wood tree.
b. It is one of the tallest angiosperm.
c. It possess tap root system.
d. Ovules are naked.

Angiosperms [NCERT Pg 40-41]

100. Like gymnosperms, the angiosperms also exhibit:
a. Heterospory b. Siphonogamy
c. Seed formation d. All of these

101. Which of the following is not included in 'Archegoniate'?
a. Bryophytes b. Pteridophytes
c. Gymnosperms d. Angiosperms

102. Polar nuclei fuse to produce
a. Diploid secondary nucleus
b. Zygote
c. Antipodal cells
d. Synergids

103. Angiosperms differ from gymnosperms as they show:
a. Double fertilization
b. Triple fusion
c. Triploid to polyploid endosperms
d. All of the above

104. Fusion product of polars is referred to as:
a. Primary endosperms
b. Secondary endosperm
c. Secondary nucleus
d. Zygote

105. Seeds are present inside the fruit wall in:
a. Angiosperms b. Gymnosperms
c. Pteridophytes d. Bryophytes

106. Embryo sac represents:
a. Megaspore mother cell
b. Female gametophyte
c. Megaspore
d. Microsporangium

107. The smallest angiospermic flower is:
a. *Wolffia* b. *Ranunculus*
c. *Rafflesia* d. *Stellariam*

108. In which of the following features, *Cycas* resembles with angiosperms?
a. Presence of vessels
b. Circinate venation
c. Dichotomously branched leaves
d. Pollen tube is the carrier of male gametes

109. Double fertilization occurs among:
a. Algae b. Bryophytes
c. Angiosperms d. Gymnosperms

110. The seed coat in both gymnosperms and angiosperms is derived from:
a. Megaspore
b. Microspore
c. Integument of megasporangium or ovule
d. Microsporangium

111. In angiosperms, ploidy of embryo sac is:
a. Diploid b. Triploid
c. Haploid d. Both (a) or (c)

Plant Life Cycles [NCERT Pg 42-43]

112. Life cycle of gymnosperm is:
a. Haplontic b. Haplo-diplontic
c. Diplontic d. Diplo-haplontic

113. Seeds of gymnosperms have three generations, that is:
a. Two sporophytic and one gametophytic generation
b. Two gametophytic and one sporophytic
c. All the three sporophytic generations
d. All the three gametophytic generations

114. The plant life cycle has both a sporophyte and a gametophyte generation. In the sporophyte stage,
a. Gametes are produced.
b. Meiosis occurs.
c. Only mitosis takes place.
d. Gametophytes form.

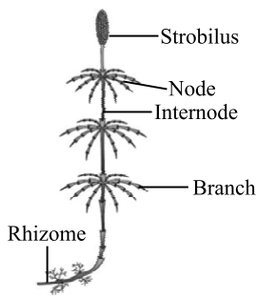
115. All plants exhibit alternation of generations. This means their life cycle:
a. Includes both haploid and diploid gametes.
b. Shows only asexual reproduction.
c. Has both a multicellular haploid stage and a multicellular diploid stage.
d. Does not include meiosis.

116. The life cycle of *Ectocarpus* and *Polysiphonia* is:
a. Haplo-diplontic b. Haplontic
c. Diplontic c. Both haplontic and diplontic

117. Find out the incorrect statement.
a. *Fucus*, an alga is diplontic.
b. The diploid sporophyte is represented by a dominant, independent, photosynthetic, vascular plant body.
c. All seed-bearing plants follow diplontic life cycle.
d. Sporophyte generation is represented only by the three-celled zygote.

Image Based Questions

118. Select the option with correct information:

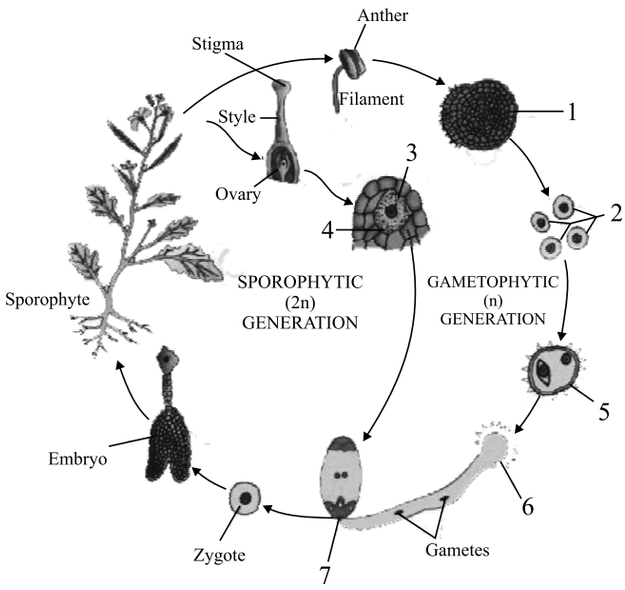


A

B

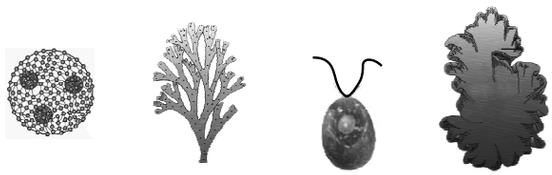
a. A and B both are homosporous
b. A and B both are heterosporous
c. A is homosporous while B is heterosporous
d. A is heterosporous while B is homosporous

119. Identify the option with correct set of labellings:



a. 1 - Microsporangium, 3 - Ovule, 7 - Embryo
b. 2 - Microspore, 3 - Megaspore, 6 - Male gamete
c. 4 - Megasporangium, 5 - Pollen grain, 7 - Egg
d. 2 - Microspore, 4 - Ovule, 5 - Microsporangium

120. Select the correct statement following the diagram?

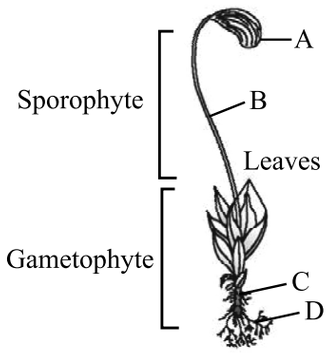


a. A and B belong to same group and have cellulose in their cell wall.
b. B and D belong to different groups and both have cellulose and pectin in their cell walls.
c. A and C belong to same group and both have chlorophyll *a* and *b* as major photosynthetic pigments.
d. C and D belong to different groups and both have starch as stored food material.

121. Select the option which gives correct information regarding.

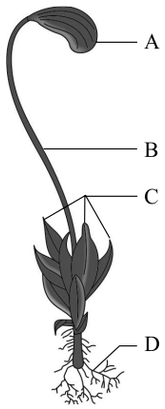
a. A green algae and its cell wall possess cellulose, but lacks algin.
b. A brown algae and its stored material is floridean starch.
c. A pteridophyte and is having protonema stage in its life cycle.
d. A moss and the plant body is thalloid.

122. Select the incorrectly labeled one



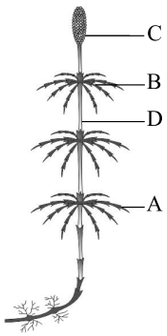
a. A - Capsule b. B - Foot
c. C - Main axis d. D - Rhizoids

123. Select the option which represents labeled parts (A, B, C and D) correctly.



	A	B	C	D
a.	Capsule	Seta	Leaves	Rhizoid
b.	Seta	Rhizoid	Seta	Leaves
c.	Rhizoid	Seta	Leaves	Capsule
d.	Leaves	Rhizoid	Capsule	Seta

124. Select the option which represents labeled parts (A, B, C and D) correctly.



	A	B	C	D
a.	Strobilus	Node	Branch	Internode
b.	Node	Branch	Internode	Strobilus
c.	Branch	Node	Strobilus	Internode
d.	Branch	Internode	Node	Strobilus

Higher Order Questions

Fact Based Round

1. In *Funaria*, annulus separates:
a. Apophysis and theca
b. Theca and operculum
c. Columella and apophysis
d. Operculum and apophysis

2. Heterospory and seed habit are often discussed in relation to a structure called:
a. Spathe b. Bract
c. Petiole d. Ligule

3. The opening mechanism of sporangium in *Dryopteris* is effectively operated by:
a. Annulus only
b. Stomium only
c. Annulus and Stomium both
d. Apical opening

4. Which of the following has amphiphloic-siphonostele?
a. Rhizome of *Marsilea*
b. Stem of *Lycopodium*
c. Rhizome of *Pteris*
d. Stem of *Equisetum*

5. While entering the neck of a achegonium in fern, sperms show:
a. Phototaxis b. Chemotaxis
c. Themotaxis d. Cyclosis

6. The winged pollen grains are the characteristic feature of
a. *Cycas* b. *Ephedra*
c. *Pinus* d. *Gnetum*

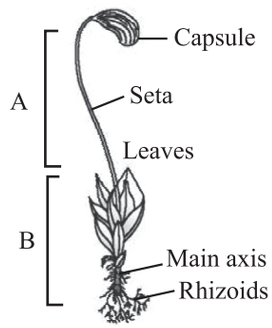
7. Movement of water in transfusion tissue of *Cycas* leaflet is:
a. Lateral b. To upper side
c. To lower side d. To acropetal

8. From the pith of stem of *Cycas revoluta* (sago) is obtained which is used as food article for a patient with stomach disorders because:
a. It is much tastier
b. Its nutritive value is very high
c. It is having adequate amount of starch.
d. It is a cheap food article.

9. 200 million years ago, the dominant flora of the earth was of:
a. Archaebacteria b. Mosses and ferns
c. Gymnosperms d. Angiosperms

10. Brown colour of Phaeophyceae is due to excess of:
a. Fucoxanthin b. Phycoerythrin
c. Lycopene d. Zeaxanthin

11. Choose the true statement:



a. A is sporophyte and is independent
b. A is sporophyte and is dependent on B, which is gametophyte
c. B is sporophyte and is independent
d. B is sporophyte and is dependent on A for food, which is gametophyte

Combination Round

12. Match the columns and find out the correct combination:

A.	Apospory	1.	Development of gametophyte from sporophyte
B.	Apogamy	2.	Development of sporophyte from gametophyte
C.	Homosporuos Pteridophyte	3.	*Selaginella*
D.	Heterosporous Pteridophyte	4.	*Pteris*

a. A-2 B-4 C-2 D-1
b. A-1 B-3 C-4 D-2
c. A-1 B-2 C-4 D-3
d. A-1 B-2 C-3 D-4

13. Match the columns and find out the correct combination:

A.	Chlorophyll a and d	1.	*Gracilaria*
B.	Chlorophyll a and c	2.	*Dictyota*
C.	Chlorophyll a and b	3.	*Polysiphonia*
D.	Phycoerythrin	4.	*Ulothrix*

a. A-1 B-4 C-2 D-3
b. A-1 B-3 C-2 D-4
c. A-3 B-2 C-4 D-1
d. A-2 B-3 C-4 D-1

14. Match the columns and find out the correct combination:

A.	Protonema	1.	*Cedrus*
B.	Prothallus	2.	*Dryopteris*
C.	Naked seeded	3.	*Cocos*
D.	Triple fusion	4.	*Sphagnum*

a. A-4 B-1 C-2 D-3
b. A-4 B-2 C-1 D-3
c. A-4 B-2 C-3 D-1
d. A-2 B-4 C-1 D-3

15. Match the columns and find out the correct combination:

A.	Homosporous	1.	Plants producing are one type of spores
B.	Heterosporous	2.	Plants producing are two types of spores
C.	Protandrous	3.	Male reproductive organ mature before the female
D.	Protogynous	4.	Female reproductive organ mature before the male reproductive organ

a. A-1 B-2 C-4 D-3
b. A-1 B-2 C-3 D-4
c. A-3 B-4 C-2 D-1
d. A-2 B-1 C-4 D-3

16. Match the columns and find out the correct combination:

A.	*Polytrichum*	1.	Lycopsida
B.	*Selaginella*	2.	Sphenopsida
C.	*Equisetum*	3.	Moss
D.	*Adiantum*	4.	Pteropsida

a. A-3 B-1 C-2 D-4
b. A-3 B-2 C-1 D-4
c. A-3 B-1 C-4 D-2
d. A-2 B-1 C-4 D-3

Conceptual Round

17. Incorrect statement is:
a. Rhizome is absent in *Equisetum* and present in potato.
b. Rhizophore is present in *Ginkgo* and absent in *Selaginella*.
c. Rhizoids are absent in *Funaria* and present in *Pinus*.
d. All of these.

18. Incorrect statement are:
A. Since mosses form dense mats on the soil, they reduce the impact of falling rain and prevent soil erosion.
B. The plant body of bryophytes is more differentiated than that of algae, it is thallus like and prostrate or erect, and attached to the substratum by unicellular or multicellular rhizoids.
C. Many species of *Spirogyra*, *Vaucheria* and *Chara* are among the 70 species of marine algae used as food.
D. Majority of the red algae are marine with greater concentrations found in the warmer areas.
E. The common phaeophytes are *Polysiphonia*, *Porphyra*, *Gracilaria* and *Gelidium*.
F. Bryophytes and pteridophytes, interestingly, exhibit an intermediate condition of life cycle (Haplo-diplontic), in which both phases are multicellular but they diffuse in their dominant phases.
a. C and E b. A, B and F
c. B, C and F d. B and D

19. Which statement cannot be related with *Pinus* seed dispersal?
a. It is liberated at three - celled stage by wind.
b. Wings are formed by ovuliferous scale epidermis.
c. Seed dispersal by anemochory.
d. Seeds are present on adaxial surface of ovuliferous scale.

20. Select incorrect statement with respect to *Cycas* female sex organ.
a. Female sex organ is female cone.
b. Megasporophyll is laterally placed at the tip of plant.
c. Ovules are arranged laterally in notches of megasporophyll.
d. Ovules are not surrounded by ovary wall.

21. Which statement is not applicable to fertilization in *Dryopteris*?

a. Antherozoids are multi-flagellated and spirally coiled.
b. At maturity, neck canal cell and ventral canal cells are degenerated forming malic acid.
c. Antheroizoids show chemotropic attraction towards malic acid.
d. After fusion of male and female gamete, diploid oospore is produced inside archegonia.

22. Read the following statements.

A. Sporophyte is the dominant, photosynthetic, independent phase of the plant.
B. Highly reduced female gametophyte as embryosac is present in their ovule.
C. The pollen grains are carried in air currents and directly come in contact with the opening in the ovules.

How many statements are correct for gymnosperms and angiosperms, respectively?

a. One and Two
b. Zero and three
c. Two and two
d. Three and two

23. Consider the given statements.

A. *Salvinia* is heterosporous terrestrial algae.
B. The male and female gametophytes do not have an independent free living existence in gymnosperms.
C. The life cycle of angiosperm is diplontic.

a. All are correct
b. Only B is correct
c. Only A is incorrect
d. A and C are correct

24. Consider the following statements (A-D) about algae.

A. Highly variable in form and size.
B. Commonly asexual reproduction by exogenous motile spores.
C. Simple, thalloid and largely aquatic organisms.
D. A few of the marine forms such as kelps, form massive vascular plant bodies.

a. Only (D) is incorrect
b. Only (C) is incorrect
c. (A) & (C) are correct
d. All statements are correct

NCERT Exemplar Problems

1. Cyanobacteria are classified under:
a. Protista b. Plantae
c. Monera d. Algae

2. Fusion of two motile gametes which are dissimilar in size is termed as:
a. Oogamy b. Isogamy
c. Anisogamy d. Zoogamy

3. Holdfast, stipe and frond constitutes the plant body in case of:
a. Rhodophyceae b. Chlorophyceae
c. Phaeophyceae d. All of these

4. A plant shows thallus level of organisation. It shows rhizoids and is haploid. It needs water to complete its life cycle because the male gametes are motile. Identify the group to which it belongs to:
a. Pteridophytes b. Gymnosperms
c. Monocots d. Bryophytes

5. A prothallus is:
a. A structure in pteridophytes formed before the thallus develops
b. A sporophytic free living structure formed in pteridophytes
c. A gametophyte free living structure formed in pteridophytes
d. A primitive structure formed after fertilisation in pteridophytes.

6. Plants of this group are diploid and well adapted to extreme conditions. They grow bearing sporophylls in compact structures called cones. The group in reference is:
a. Monocots
b. Dicots
c. Pteridophytes
d. Gymnosperms

7. The embryo sac of an angiosperm is made up of:
a. 8 cells
b. 7 cells and 8 nuclei
c. 8 nuclei
d. 7 cells and 7 nuclei

8. If the diploid number of a flowering plant is 36. What would be the chromosome number in its endosperm?
a. 36 b. 18
c. 54 d. 72

9. Protonema is:
a. Haploid and is found in mosses
b. Diploid and is found in liverworts
c. Diploid and is found in pteridophytes
d. Haploid and is found in pteridophytes

10. The giant redwood tree (*Sequoia sempervirens*) is a /an:
a. Angiosperm b. Free fern
c. Pteridophyte d. Gymnosperm

Past Year Questions

1. Read the following statements (A-E) and answer the question which follows them:

A. In liverworts, mosses, and ferns gametophytes are free-living.
B. Gymnosperms and some ferns are heterosporous.
C. Sexual reproduction in *Fucus, Volvox* and *Albugo* is oogamous.
D. The sporophyte in liverworts is more elaborate than that in mosses.
E. Both, *Pinus* and *Marchantia* are dioecious.

How many of the above statements are correct?
a. Four b. One
c. Two d. Three

2. *Cycas* and *Adiantum* resemble each other in having:
a. Vessels b. Seeds
c. Motile Sperms d. Cambium

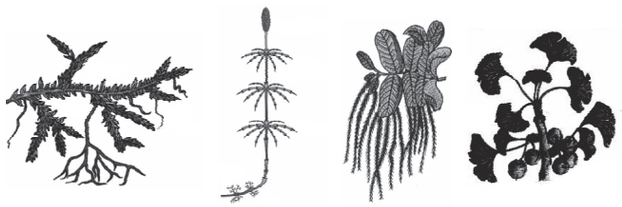
3. Consider the following four statements whether they are correct or wrong?

A. The sporophyte in liverworts is more elaborate than that in mosses.
B. *Salvinia* is heterosporous.
C. The life-cycle in all seed bearing plants is diplontic
D. In *Pinus* male and female cones are borne on different trees.

The two wrong statements together are
a. Statements (B) and (C)
b. Statements (A) and (B)
c. Statements (A) and (C)
d. Statements (A) and (D)

4. Male and female gametophytes independent and free living in:
a. *Castor* b. *Pinus*
c. *Sphagnum* d. Mustard

5. Examine the figure A, B, C and D. In which one of the options all the items are correct?



A B C D

	A	B	C	D
a.	*Chara*	*Marchantia*	*Fucus*	*Pinus*
b.	*Equisetum*	*Ginkgo*	*Selaginella*	*Lycopodium*
c.	*Selaginella*	*Equisetum*	*Salvinia*	*Ginkgo*
d.	*Funaria*	*Adiantum*	*Salvinia*	*Riccia*

6. Which of the following is monoecious?
a. *Marchantia* b. *Cycas*
c. *Pinus* d. *Date Palm*

7. Gametophytes does not have free independent existence in:
a. *Funaria* b. *Polytrichum*
c. *Cedrus* d. *Dryopteris*

8. *Gnetum*, a gymnosperm differs from *Cycas* and *Pinus* but shows affinities with angiosperms in the features:
a. Perianth an two integuments
b. Embryo development and apical meristem
c. Absence of resin dusts and leaf venation
d. Presence of vessel elements and absence of archegonia

9. Which set contains flagellated male gametes:
a. *Spirogyra*, *Anthoceros* and *Funaria*
b. *Zygnerma*, *saprolagnia* and *Hydrilla*
c. *Fucus*, *Marsilea* and *Calotropis*
d. *Riccia*, *Dryopteris* and *Cycas*

10. Match the items of column-I and II:

Column-I	Column-II
A. Peritrichous flagellation	1. *Ginkgo*
B. Living fossil	2. *Macrocystis*
C. Rhizophore	3. *Escherichia coli*
D. Smallest flowering plant	4. *Selaginella*
E. Largest perennial alga	5. *Wolffia*

a. A-3 B-1 C-4 D-5 E-2
b. A-2 B-1 C-3 D-4 E-5
c. A-4 B-3 C-2 D-5 E-1
d. A-1 B-4 C-5 D-3 E-2

11. Top-shaped multiciliate male gamete and seeds with two cotyledons occur in:
a. Cycads
b. Conifers
c. Polypetalous angiosperms
d. Gamopetalous angiosperms

Assertion & Reason

Directions: These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

A. If both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.
B. If both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.
C. If Assertion is True but the Reason is False.
D. If both Assertion and Reason are False.

1. **Assertion:** Mosses reduce the impact of falling rain and prevent soil erosion.

   Reason: Mosses from dense mat on the soil.

2. **Assertion:** Approach towards seed habit was first time found in Pteridophytes.

   Reason: Pteridophyrtes are partially successful land plants.

3. **Assertion:** Fruits are not formed in gymnosperm.

   Reason: Seeds are shed at very early stage.

4. **Assertion:** Bryophytes show alternation of generation.

   Reason: Bryophytes have independent gametophyte.

5. **Assertion:** Lichen has two partners- a fungus and an alga.

   Reason: The lichen thallus is essentially fungal in nature with algal cells embedded.

6. **Assertion:** Agar is used in culture medium.

   Reason: Agar is obtained from red algae.

7. **Assertion:** Early moss gametophyte is protonema stage.

   Reason: Late Moss gametophyte is leafy stage.

8. **Assertion:** Mosses and lichens are first to colonise bare rocks.

   Reason: The lichen stage follow the moss stage and precedes the herbs.

9. **Assertion:** Water is not required for fertilization process in ferns.

   Reason: Malic acid of archegonial neck attracts atherozoids.

10. **Assertion:** Spores in mosses are contained within the capsule.

    Reason: Spores are formed by mitotic division in mosses.

11. **Assertion:** Stomata are found on the surface of leaves in gymnosperms.

    Reason: In gymnosperms, cuticle of leaves is thin.

12. **Assertion:** The leaves in gymosperms are well-adapted to withstand extremes of temperature, humidity and wind.

    Reason: Unlike bryophytes and pteridophytes in gymnosperms the male and female gametophytes do not have an independent free-living existence.

13. **Assertion:** Angiosperms lack flagellated male gametes.

    Reason: Sperms are not dependent on water for fertilisation.

14. **Assertion:** The seeds of gymnosperms are naked.

    Reason: Seed consists of three generations one within the other.

15. **Assertion:** Pyrenoids are utilised during starvation.

    Reason: Pyrenoids are proteinaceous bodies.

16. **Assertion:** In leptosporangiate development, sporangia are formed from single initial.

    Reason: Eusporangiate development of sporangia starts from a group of initials.

17. **Assertion:** *Chlorella* could serve as a potential source of food and energy.

    Reason: When dried, *Chlorella* has 15% protein, 45% fat, 10% minerals and vitamins.

18. **Assertion:** Fertilisation in *Cycas* is called zooido-siphanogarny.

    Reason: Fertilisation in *Cycas* takes place by the formation of pollen tube.

19. **Assertion:** The life cycle of *Funaria* is called diplohaplontic.

    Reason: In *Funaria*, there is alterations of haploid gametophytic and diploid sporophytic phases, one becoming parent of the other.

Answer Key

Self Assessment Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	a	a	d	c	a	a	b	b	a	d	c	c	d	d	a	a
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
a	b	d	b	d	b	a	d	b	d	c	d	d	b	c	a	b
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
c	c	d	a	a	c	c	a	a	c	d	c	a	c	a	b	c
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
b	d	b	c	c	b	d	d	b	c	c	c	a	a	a	a	d
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
a	a	b	b	c	d	d	a	b	c	d	c	a	c	d	d	d
86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
a	a	a	b	b	a	d	c	d	c	c	c	a	b	d	d	a
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
d	c	a	b	a	d	c	c	c	c	a	c	c	a	d	c	c
120	121	122	123	124												
c	a	b	a	c												

Higher Order Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b	d	b	a	b	c	c	c	c	a	b	c	c	b	b	a	d
18	19	20	21	22	23	24										
a	a	a	c	c	c	c										

NCERT Exemplar Problems

1	2	3	4	5	6	7	8	9	10
c	c	c	d	c	d	b	c	a	d

Past Year Questions

1	2	3	4	5	6	7	8	9	10	11
d	c	d	c	c	c	c	d	d	a	a

Assertion & Reason

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
a	b	c	b	a	b	b	c	c	c	d	b	a	b	b	b	c
18	19															
b	b															

Explanations and NCERT References

Self Assessment Questions

118. (c) ***NCERT (XI) Ch - 3, Pg. 36, fig 3.3***

119. (c) ***NCERT (XI) Ch - 3, Pg. 41, fig 3.6***

120. (c) ***NCERT (XI) Ch - 3, Pg. 31, fig 3.1***

121. (a) ***NCERT (XI) Ch - 3, Pg. 31, fig 3.1 (a-ii)***

122. (b) ***NCERT (XI) Ch - 3, Pg. 34, fig 3.2***

123. (a) ***NCERT (XI) Ch - 3, Pg. 34, fig 3.2***

124. (c) ***NCERT (XI) Ch - 3, Pg. 36, fig 3.3***

Higher Order Questions

1. (b) Annulus separates the theca from the operculum.

2. (d) Heterospory means production of two different sizes of spores; megaspore and microspore. Heterospory originated in some pteridophytes like *Selaginella*. Its leaves contain a flap-¬like outgrowth at the base on the adaxial side called ligule.

3. (b) In Dryopteris, stomium is present below the annulus and is gradually ruptured as the annulus dries out. This structure helps in the opening of sporangium and dispersal of spores.

4. (a) Amphiphloic siphonostele: Phloem is present on both external and internal to the xylem, e.g., *Marsilearhizome*.

5. (b) In fern, sperms swim towards the archegonia due to presence of malic acid, therefore, they shows chemotaxis.

6. (c) The winged pollen grains are the characteristic features of *Pinus*. Because of the presence of sacs, which provides buoyancy, they are able to rise upwards and float on the fluid.

7. (c) The leaves of *Cycaspossess* transfusion tissue. This helps in water conduction laterally and compensates the absence of lateral veins and poor development of vascular tissue.

8. (c) The sago contains adequate amount of starch and therefore it is used as food article for a patient with stomach disorders.

9. (c) Ferns and seed-bearing gymnosperms like pines were the only kind of plants to have colonised the land.

10. (a) The colour of brown algae varies from olive green to various shades of brown depending upon the amount of xanthophyll and fucoxanthin pigments.

11. (b) ***NCERT (XI) Ch - 3, Pg. 34***

17. (d) Rhizome is present in *Equisetum*. Rhizophore is present in *Selaginella*. Rhizoids are present in *Funaria*.

18. (a) ***NCERT (XI) Ch - 3, Pg. 32 & 33***

19. (a) In *Cycas*, pollination takes place at three-celled stage.

20. (a) The female sex organ is megasporophyll. The male plants develop male cones or male strobili.

21. (c) In *Dryopteris*, sperms swim towards the archegonia due to presence of malic acid, therefore, they shows chemotaxis.

22. (c) Statement A is correct for both gymnosperms and angiosperms. Statement B is correct only for angiosperms and statement C is correct only for gymnosperms.

23. (c) *Salvinia is* a heterosporous aquatic algae.

24. (c) ***NCERT (XI) Ch - 3, Pg. 30***

NCERT Exemplar Problems

1. (c) Monera Kingdom-Monera is one group which exclusively includes all forms of bacteria. All bacteria are prokaryotes and do not have well defined nucleus and other cell organelles.

The other options Protista, Algae and Plantae include eukaryotic and unicellular or multicellular organism.

2. (c) The lower group of plants like algae exhibit great variation in mode of sexual and asexual reproduction. Some algae produce gametes which are not similar in shape, size and structure, when they fuse, it is called anisogamy. *e.g.,Chlamydomonas*.

The other options are incorrect because oogamy is the fusion of big oospore female with small male gamete. Isogamy is fusion of similar gametes. Zoogamy is sexual reproduction of animals.

3. (c) In the members of class-Phaeophyceae, the plant body is usually attached to the substratum by a holdfast and has a stalk called stipe and a leaf like photosynthetic organ called frond.

4. (d) Bryophyta is a group of plants which have gametophytic haploid thalloid body. The motile male gamete are produced in special male reproductive structure called antheridia.

These gametes need thin film of water to move and reach to the female reproductive organ called archegonia. Whereas, pteridophytes, gymnosperm and monocots show division of labour and their body shows higher level of organisation.

5. (c) Prothallus is usually a gametophytic stage in the life of a Pteridophyte. Spore germinates to form a prothalium, it is short-lived inconspicuous heart-shaped

structure with a number of rhizoids developed beneath and sex organs, archegonium and antheridium.

6. **(d)** Gymnosperms include medium sized trees or tall trees and shrubs. Leaves of these plants are well adapted to withstand extremes of temperature, humidity and wind. Reproductive organs are usually in the form of cones or strobili.

   The male cone are made up of microsporophyll and female cones are made up of megasporophyll. The presence of sporophyll (micro and megasporophyll) shows the development of seed habit but seeds develop from naked ovule and are not covered.

   Other options are incorrect because monocots and dicots belong to angiosperms which have well developed covered seeds. Whereas, pteridophytes do not have microsporphylls and are not adapted to the above said conditions.

7. **(b)** Embryo sac in angiosperm is a female gametophyte. It contains 2 synergids, 1 egg cell, 3 antipodal cells and one secondary nucleus.

8. **(c)** Endosperm is a product of triple fusion. One male nuclei (n =18) fuses with diploid secondary nucleus ($2n$ = 36), so it becomes triploid structure ($3n$ = 54). So, ploidy of endosperm is ($3n$) and chromosomes will be 54.

9. **(a)** The germination of haploid spores of mosses produced by sporophyte after reduction division these haploid spores when germinate, form the protonema. This structure later develops into an independent gametophytic plant.

10. **(d)** *Sequoia sempervirens* is a gymnopermic plant. It is a group of plants having thick, woody, branched stems. These plants also have some xeric adaptations which help them survive in adverse climatic conditions.

    The other examples are incorrect because pteridophytes is primitive group, no tree is included in this. Ferns are included in Pteridophytes. Angiosperms are different from gymnosperms in seed habit and adaptations.

Past Year Questions

1. **(d)** The sporophyte of moss is more elaborate than liverworts.

2. **(c)** *Cycas* (Gymnosperm) and *Adiantum* (Pteridophytes) both have motile sperms.

3. **(d)** The mosses have an elaborate mechanism of spore dispersal. Common examples of mosses are *Funaria, Polytrichum* and *Sphagnum*.

   The male or female cones or strobili may be borne on the same tree *(Pinus)*. However, in *Cycas* male cones and megasporophylls are borne on different trees.

4. **(c)** Bryophytes have free living, independent male and female gametophytes.

5. **(c)**

6. **(c)** In Pinus, male and female cones are present on the same tree.

7. **(c)** In pteridophytes gametophytes do not have free living existence e.g. *Funaria & Polytrichum* (Bryophytes) while *Dryopteris* (pteridophyte) has independent gametophyte.

8. **(d)** *Gnetum* includes advanced Gymnosperm. Secondary xylem shows vessels unlike *Cycas* and *Pinus* it does not have archegonia.

9. **(d)** *Riccia, Dryopteris* and *Cycas* have motile male gametes.

10. **(a)** *Ginkgo* → Living fossil

    Wolffia → Smallest flowering plant

    Macrocystis → Largest perennial Brown alga

    Rhizophora → *Selaginella*

    Peritrichous flagellation → *E.coli*

11. **(a)** Male gametes of *Cycas* are largest in nature, visible to naked eye, oval in form and multiciliated. Embryo consists of suspensor, radical, two unequal cotyledons.

Assertion & Reason

1. **(a)** Mosses has the ability to form dense mat on soil, due to this property they reduce the impact of falling rain and prevent soil erosion.

2. **(b)** In pteridophytes, development of zygotes into young embryos take place within female gametophytes. This event is a precursor to seed habit. Therefore, approach towards seed habit was observed in pteridophytes and considered an important step in evolution.

3. **(c)** In gymnosperms, seeds are not covered, i.e, naked and are not shed at very early stage. Fruits are formed in angiosperms but not in gymnosperms.

4. **(b)** The life cycle of bryophyte shows regular alternation gametophytic and sporophytic generations. First phase is gametophytic phase. Gametophytic generation produces gametes.

5. **(a)** Lichens are symbiotic associations, i.e., mutually useful associations, between algae and fungi. The algal component is known as phycobiont and fungal component as mycobiont.

6. **(b)** Agar, one of the commercial products obtained from *Gelidium* and *Gracilaria* are used to grow microbes and in preparations of ice-creams and jellies.

7. **(b)** The predominant stage of the life cycle of a moss is the gametophyte. It consists of two stages.

   Protonema stage: The first stage.

   Leafy stage: The second stage.

8. (c) Mosses along with lichens are the first organisms to colonise rocks and hence, are of great ecological importance.

9. (c) The need for water for fertilisation, the spread of living pteridophytes is limited and restricted to narrow geographical regions.

10. (c) Vegetative reproduction in mosses is by fragmentation and budding in secondary protonema. After fertilization the zygote develops into a sporophyte, consisting of a foot, seta and capsule. The sporophyte in mosses is more elaborate than that in liver worts, the capsule contains spores. Spores are formed after meiosis and develop into new gametophyte.

11. (d) The leaves in gymnosperms are well adapted to withstand the extreme temperature, humidity and wind. In conifers, the needle like leaves reduce the surface area. Their thick cuticle and sunken stomata help to reduce the water losses.

12. (b) Leaves in gymnosperms are well adapted to withstand extremes of temperature humidity and wind. In conifers, needle like leaves reduce the surface area for water loss. Thick cuticle and sunken stomata are also responsible for reducing water loss in plants.

Unlike bryophytes and pteridophytes, in gymnosperms male and female gametophytes do not have an independent free-living existence. They remain within the sporangia retained on sporophytes.

13. (a) Angiosperms is the highly evolved group of plant kingdom. It is adapted for terrestrial habitats. Swimming habit of sperms is completely lacking in angiosperms.

The pollen grains reached to the stigma by an external agency and delivers the male nucleus in the ovule through pollen tube.

14. (b) Gymnosperms are commonly known as naked seed plants because their ovules (which later become seeds) are not covered by the ovary wall.

Seed is a complex structure because it contains cells from three generations. Diploid body of ovule from the parent sporophyte. Female gametophyte is gametophytic generation. Embryo is the next sporophytic generation.

15. (b) The chloroplast of green algae contain one or more distinct, rounded, proteinaceous bodies called the pyrenoids. Pyrenoids diminish in size and ultimately disappear if the plant is under conditions of starvation. They reappear when the conditions become favourable.

16. (b) In eusporangiate type of development, large sporangia develop from a group of initials. In leptosporangiate type of development, small sporangia develop from a single initial, the former builds the entire sporangium, its contents and stalk and the latter do not take part in the process.

17. (c) *Chlorella* could serve as a potential source of food (rich in protein) and energy because its photosynthetic efficiency can theoretically reach 8%, comparable with other highly efficient crops nutrients.

When dried, *Chlorella* has about 45% protein, 20% fat, 20% carbohydrate, 5% fibre and 10% minerals and vitamins.

18. (b) *Cycas* is a gymnospermic plant. Fertilisation in Cycas is both siphonogamous (by pollen tube) and zooidogamy (by water film).

19. (b) In the life cycle of *Funaria*, there occur two distinct individuals one of these is haploid, independent, leafy moss plant, the other is diploid leafless sporogonium. It is partially dependent on the leafy gametophyte for its nutrition.