02

Biological Classification

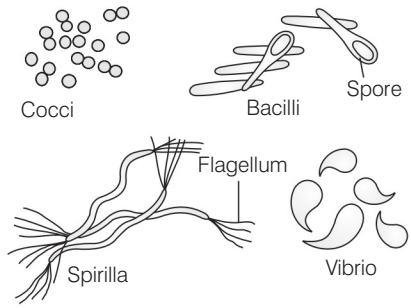
Quick Revision

- **Biological classification** refers to the scientific procedure in which living organisms are classified and arranged into groups and sub-groups in a hierarchial manner on the basis of their similarities and dissimilarities.
- **Aristotle** was the earliest to attempt a scientific basis for classification. Later **Linnaeus** (1758) gave the **two kingdom system of classification** with **Plantae** and **Animalia** kingdoms.
- This system though used till very recently, but was unable to distinguish between the eukaryotes and prokaryotes, unicellular and multicellular organisms and photosynthetic (plants) and non-photosynthetic organisms (fungi).
- In 1969, **RH Whittaker** proposed a **five kingdom system of classification**. He divided all living organisms into **Monera, Protista, Fungi, Plantae** and **Animalia** as summarised in table below
- Earlier classification systems considered bacteria, BGA (Blue-Green Algae), fungi, mosses, ferns, gymnosperms and angiosperms as plants due to the presence of cell wall in them. This classification system placed prokaryotic bacteria and BGA with other eukaryotic groups.
- It also grouped unicellular and multicellular, organisms together, e.g. *Chlamydomonas* and *Spirogyra* (in algae).
- This system did not consider the differences in mode of nutrition and cell wall composition, so grouped fungi (heterotroph, chitinous cell wall) with plants (autotroph, cellulosic cell wall).
- Five kingdom classification considered such characteristics and segregated prokaryotic organism under **Monera**, unicellular eukaryotes in **Protista** (this united *Chlamydomonas* and *Chlorella* with *Paramecium* and *Amoeba* earlier placed in plants and animals, respectively).

Characters	Kingdom Monera	Kingdom Protista	Kingdom Fungi	Kingdom Plantae	Kingdom Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Complexity of body	Unicellular to multicellular	Unicellular	Unicellular to multicellular	Multicellular	Multicellular
Cell wall	Non-cellulosic and peptidoglycan	Present or Absent	Chitinous	Cellulosic	Absent
Nutrition	Autotrophic or Heterotrophic	Autotrophic or Heterotrophic	Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic)	Heterotrophic (holozoic or parasitic)

Kingdom–Monera

- Bacteria are the sole members of this kingdom.
- Bacteria are the most abundant microorganisms occurring in air, water, soil as well as in extreme habitats like deserts, snow, hot springs, etc.
- Bacteria have been grouped under four categories based on their shape
  - *Coccus* (cocci) – Spherical
  - *Bacillus* (bacilli) – Rod-shaped
  - *Vibrium* (vibrio) – Comma-shaped
  - *Spirillum* (spirilla) – Spiral-shaped.



Bacteria of different shapes

- Bacteria show a wide range of mode of nutrition. They may be autotrophic (synthesise their own food from inorganic substrates), chemotrophic (photosynthetic autotrophic), saprophytic or heterotrophic (depend on other organisms for food).
- Bacteria are further divided into **Archaebacteria** and **Eubacteria**.

Archaebacteria

- Archaebacteria live in extreme environmental conditions. These include
  - **Halophiles** Bacteria residing in salty areas, e.g. *Halococcus.*
  - **Thermoacidophiles** Bacteria residing in hot springs, e.g. *Thermoproteus.*
  - **Methanogens** Bacteria which survive in marshy areas (these are present in gut of many ruminant animals like cows and buffaloes), e.g. *Methanococcus.*
- Archaebacteria differ from other bacteria in having different cell wall structure. Their cell wall is made up of **murein** and contains high amount of unsaturated fatty acids, which is responsible for ensuring their survival in extreme conditions.

Eubacteria

- Another class–Eubacteria is also known as '**true bacteria**'.
- These have rigid cell wall made up of **peptidoglycan**.
- They could be photosynthetic autotrophs, chemosynthetic autotrophs and heterotrophic bacteria.
- **Photosynthetic autotrophs** include blue-green algae, which have chlorophyll-*a* similar to green plants. They are also known as **cyanobacteria**.
- These could be unicellular, colonial or filamentous, freshwater/marine or terrestrial algae.
- Some bacteria can fix atmospheric nitrogen in specialised cells known as **heterocyst**, e.g. in *Nostoc* and *Anabaena.*
- Some bacteria utilise inorganic substances like nitrate, nitrite, ammonia, etc., for oxidation and release of energy for ATP production. These are known as **chemosynthetic autotrophic bacteria**.
- **Heterotrophic bacteria** (most abundant in nature) are dependent on other organisms for nutrition. These include N_2-fixing bacteria, pathogens, etc.
- These reproduce asexually by **binary fission**.
- During unfavourable conditions, these form spores.
- These also show conjugation, a type of sexual reproduction in which DNA is transferred from one bacteria to another through a conjugal tube.
- Pleomorphic bacteria, which lack cell wall is known as **mycoplasma**. They are pathogenic and the smallest microorganism known.

Kingdom–Protista

- All single-celled eukaryotes are placed under **Protista**.
- Members of kingdom–**Protista** are the connecting link between prokaryotic monerans and complex multicellular kingdoms–**Fungi**, **Plantae** and **Animalia**.

- These include chrysophytes, dinoflagellates, euglenoids, slime moulds and protozoans.
- These show a well-defined nucleus and membrane bound organelles.
- They reproduce asexually and sexually by a process involving cell fusion and zygote formation.
- Kingdom–Protista has been further divided into the following groups

(i) **Chrysophytes** include **diatoms** and **golden algae** known as **desmids**. They are found in marine environment.

- The cell wall of diatoms is embedded with silica and forms two thin overlapping sheath as in soap box.
- **Diatomaceous earth** is the large amount of cell wall deposits of diatoms in their habitat. These are used in polishing, filtration of oils and syrups.

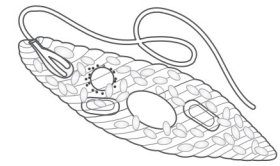
(ii) **Dinoflagellates** are marine and photosynthetic microorganisms.

- Due to the presence of different pigments, they appear yellow, green, brown and red.
- As the name suggests they have two flagella, one lies longitudinally and other transversely in furrow between wall plates.
- *Gonyaulax* is a red dinoflagellate, which undergoes rapid multiplication and forms red tides. Toxins released by these microorganisms when present in such large numbers may even kill other marine animals such as fishes.

Dinoflagellates

(iii) **Euglenoids** are freshwater organisms found in stagnant water.

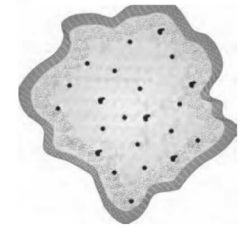
- Cell wall is absent, a protein rich layer called pellicle is present over the surface.
- In the presence of sunlight, they behave as autotrophs, while in its absence they behave as heterotrophs, e.g. *Euglena*.



Euglena

(iv) **Slime moulds** are saprophytes, which are dependent on dead and decaying organic matter.

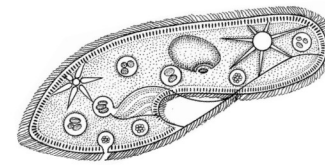
- They form an aggregation called ***Plasmodium***.
- During unfavourable conditions, they form spores, which are highly resistant.



Slime mould

(v) Protozoans are heterotrophs and live as parasites or predators. These are grouped into

- **Amoeboid protozoans** are found in fresh or marine water or moist soil. They have pseudopodia (false feet) to capture prey as in *Amoeba*.
- **Flagellated protozoans** are either free-living or parasitic having flagella. The parasitic forms cause diseases, e.g. sleeping sickness by *Trypanosoma*.
- **Ciliated protozoans** are aquatic, actively moving organisms due to thousands of cilia present on them. The coordinated ciliary movement drives food into cavity called **gullet**, e.g. *Paramecium*.



Paramecium

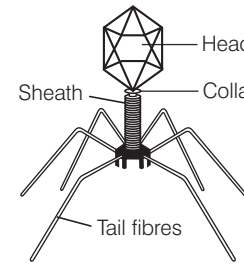
- **Sporozoans** are non-motile forms with an infectious spore like stage in their life cycle, e.g. malaria causing parasite *Plasmodium*.

Kingdom–Fungi

- These are heterotrophic organisms with their cell wall made up of chitin.
- These have cosmopolitan distribution and are found in warm and humid places.
- Fungal body consists of long, thread-like structures called **hyphae**, which together form a network called **mycelium**. In certain organisms, hyphae are continuous tube with multinucleated cytoplasm (**coenocytic**), while others have septae or cross walls.
- Their mode of nutrition is **saprophytic** and **parasitic**. They can also live as **symbionts** in association with algae as lichen and with roots of higher plants as **mycorrhiza**.
- Reproduction in fungi occurring by **vegetative means**, includes fragmentation, fission and budding, **asexually** by zoospore production conidia, etc., and **sexually** by oospores, ascospores and basidiospores.
- Sexual cycle involves **plasmogamy** (fusion of two protoplasts), **karyogamy** (fusion of two haploid nuclei) and **meiosis**.
- In some fungi, two haploid cells result in diploid cells. In some cases, **dikaryon** stage occurs in which two nuclei are present within a cell. This phase is known as **dikaryophase** of fungus.
- Production of dikaryon ($n + n$, i.e. two nuclei per cell) is a characteristic of the classes–**Ascomycetes** and **Basidiomycetes**.
- Fungi are classified into classes–Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.
  - (i) **Phycomycetes** are lower fungi or algal fungi, their mycelium is aseptate and coenocytic, reproduce asexually through zoospores or aplanospores and sexually through isogamy or anisogamy, e.g. *Rhizopus, Mucor*, etc.
  - (ii) **Ascomycetes** are sac fungi, their mycelium is branched and septate, asexual spores are conidia and sexual spores are ascospores, e.g. *Aspergillus, Neurospora,* etc.
  - (iii) **Basidiomycetes** are club fungi, their mycelium is branched and septate, reproduce asexually by fragmentation and their vegetative cells fuse to form dikaryotic structure (plasmogamy), e.g. mushrooms, bracket fungi, etc.
  - (iv) **Deuteromycetes** are imperfect fungi, reproduce asexually by conidia and sexual forms **absent** in these e.g. *Alternaria, Trichoderma,* etc.
- **Heterothallism** is the condition in fungal organisms where different thalli exist within a single genus of fungus.

Viruses

- **Viruses** and **viroids** are the non-cellular organisms, which are not characterised in the system of classification given by **Whittaker**.
- They have both living and non-living characteristics.
- They form inert crystalline structure outside the living cell, but inside the host cell, they can multiply easily.
- They take over the host machinery and replicate themselves.
- **Pasteur** and **DJ Ivanowsky** gave the name virus, which means venom or poisonous fluid.
- **MW Beijerinck** in 1898, called fluid obtained from infected tobacco plant as *Contagium vivum fluidum* (infectious living fluid).
- Viruses are obligate parasite. These are inert outside specific host cell and exist in crystalline form as demonstrated by **WM Stanley**.
- Genetic material of viruses could be DNA or RNA.
- Virus contain a protein coat called **capsid**, which is made up of **capsomeres**. Capsomeres are arranged in a helical or polyhedral geometric form.



Bacteriophage virus

- Viruses which infect plants have *ss*RNA, while which infect animals are either *ss*DNA/RNA or *ds*DNA/RNA.

- Viruses which infect bacteria are known as **bacteriophage**. These are usually *ds*DNA viruses.

Viroids

- In 1971, **TO 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 lacked the protein coat that is found in viruses, hence the name viroid.
- The RNA of the viroid was of low molecular weight.

Prions

- In modern medicine, certain infectious neurological diseases were found to be transmitted by an agent consisting of abnormally folded protein. The agent was similar in size to viruses. These agents were called **prions**.
- The most notable diseases caused by prions are Bovine Spongiform Encephalopathy (BSE) commonly called **mad cow disease in cattle** and its analogous variant **Cr–Jacob Disease** (CJD) **in humans**.

Lichens

- These are symbiotic associations, i.e. mutually useful associations, between algae and fungi.
- The algal component is known as **phycobiont** and fungal component as **mycobiont**, which are autotrophic and heterotrophic, respectively.
- Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
- So close is their association that if one saw a lichen in nature, one would never imagine that they had two different organisms within them. Lichens are very good pollution indicators – they do not grow in polluted areas.

Objective Questions

Multiple Choice Questions

1. Who proposed two kingdom system of classification and named kingdom as Plantae and Animalia?

(a) Carl Woese (b) RH Whittaker
(c) Carolus Linnaeus (d) Herbert Copeland

2. Which of the following statements given below is correct?

(a) Biological classification is the scientific ordering of organisms in a hierarchial series of groups on the basis of their relationships, i.e. morphological, evolutionary and others
(b) Whittaker classified organisms on the basis of autotrophic and heterotrophic mode of nutrition
(c) In five kingdom system of classification, living organisms can be divided into prokaryotic and eukaryotic cells on the basis of cell structure
(d) All of the above

3. Which of the following characters served as the criteria for five kingdom system of classification proposed by Whittaker?

(a) Cell structure
(b) Body organisation and mode of nutrition
(c) Reproduction and phylogenetic relationships
(d) All of the above

4. In Whittaker's system of classification, prokaryotes are placed in the kingdom

(a) Plantae
(b) Protista
(c) Monera
(d) Animalia

5. In the five kingdom classification, *Chlamydomonas* and *Chlorella* are included in

(a) Plantae (b) Algae
(c) Protista (d) Monera

6. Consider the following statements with respect to characteristic features of the kingdom.

I. In Animalia, the mode of nutrition is autotrophic.

II. In Monera, the nuclear membrane is present.

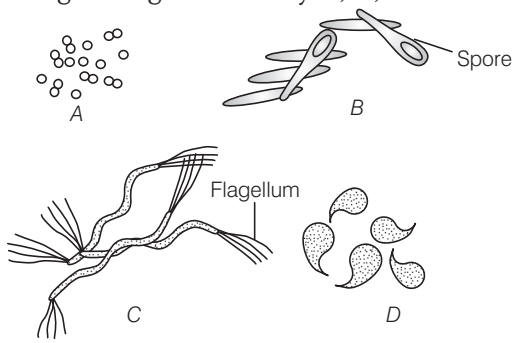
III. In Protista, the cell type is prokaryotic.

IV. In Plantae, the cell wall is present.

Which of the above statements is/are correct?

(a) Only I (b) Only II (c) Only III (d) Only IV

7. Bacteria are grouped under four categories based on their shape. Refer to the given figure. Identify *A*, *B*, *C* and *D*.



(a) *A*-Vibrio, *B*-Cocci, *C*-Bacilli, *D*-Spirilla
(b) *A*-Cocci, *B*-Bacilli, *C*-Spirilla, *D*-Vibrio
(c) *A*-Bacilli, *B*-Spirilla, *C*-Vibrio, *D*-Cocci
(d) *A*-Spirilla, *B*-Vibrio, *C*-Cocci, *D*-Bacilli

8. Match the following columns.

	Column I (Names)		Column II (Shape)
A.	Coccus	1.	Rod-shaped
B.	Bacillus	2.	Spherical
C.	Vibrio	3.	Spiral-shaped
D.	Spirillum	4.	Comma-shaped

Codes

	A	B	C	D
(a)	3	2	1	4
(b)	4	3	2	1
(c)	2	1	4	3
(d)	1	4	3	2

9. Some bacteria thrive in extreme environmental conditions such as the absence of oxygen, high salt concentration, high temperature and acidic pH. Identify the type of bacteria.

(a) Cyanobacteria (b) Eubacteria
(c) Archaebacteria (d) Mycobacteria

10. Methanogens belong to

(a) Eubacteria
(b) Archaebacteria
(c) dinoflagellates
(d) slime moulds

11. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the

(a) thermoacidophiles (b) methanogens
(c) Eubacteria (d) halophiles

12. Match the following columns.

	Column I		Column II
A.	Halophiles	1.	Aquatic environment
B.	Thermoacidophiles	2.	Gut of ruminant
C.	Methanogens	3.	In hot springs
D.	Cyanobacteria	4.	Salty areas

Codes

	A	B	C	D
(a)	1	4	3	2
(b)	3	2	1	4
(c)	2	1	4	3
(d)	4	3	2	1

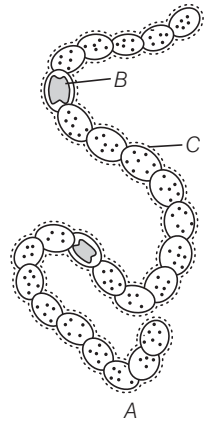
13. Eubacteria include

(a) blue-green algae and bacteria
(b) Archaebacteria and blue-green algae
(c) cyanobacteria and eukaryotes
(d) bacteria and eukaryotes

14. The cyanobacteria are also referred to as

(a) protists
(b) golden algae
(c) slime moulds
(d) blue-green algae

15. Given figure is of a filamentous blue-green algae. Identify the algae and choose the option that is correct for *A*, *B* and *C* in the figure.



(a) *A*–*Gelidium*, *B*–Vegetative cell, *C*–Heterocyst
(b) *A*–*Volvox*, *B*–Somatic cell, *C*–Mucilaginous sheath
(c) *A*–*Chara*, *B*–Mucilaginous sheath, *C*–Heterocyst
(d) *A*–*Nostoc*, *B*–Heterocyst, *C*–Mucilaginous sheath

16. Which of the following bacteria plays an important role in the recycling of nutrients like nitrogen, phosphorus, iron and sulphur?
(a) Chemoheterotrophic bacteria
(b) Chemosynthetic autotrophic bacteria
(c) Parasitic bacteria
(d) Saprophytic bacteria

17. Mostly found bacteria are
(a) chemosynthetic bacteria
(b) heterotrophic bacteria
(c) heterotrophic decomposers
(d) saprophytic bacteria

18. Some of the cyanobacteria can fix atmospheric nitrogen in their specialised cells called
(a) akinetes (b) heterocyst
(c) endospores (d) homocyst

19. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen?
(a) *Bacillus* (b) *Pseudomonas*
(c) *Mycoplasma* (d) *Nostoc*

20. Protists are eukaryotic and the mode of nutrition is both autotrophic and heterotrophic. The given statement is
(a) True
(b) False
(c) Cannot say
(d) Partially true or false

21. Which of the following kingdoms have not well-defined boundaries?
(a) Plantae (b) Protista
(c) Monera (d) Algae

22. Members of Protista are primarily
(a) terrestrial (b) aquatic
(c) pathogenic (d) photosynthetic

23. Chrysophytes, euglenoids, dinoflagellates and slime moulds are included in the kingdom
(a) Protista (b) Fungi
(c) Animalia (d) Monera

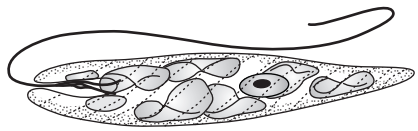
24. Which one of the following is a characteristic feature of group-Chrysophyta?
(a) They are parasitic forms which cause disease in animals
(b) They have a protein rich layer called pellicle
(c) They form diatomaceous earth on the sea floors
(d) They are commonly called dinoflagellates

25. Which of the following organisms are known as chief producers in the oceans?
(a) Cyanobacteria
(b) Diatoms
(c) Dinoflagellates
(d) Euglenoids

26. Which of the following groups of organisms is/are placed under the group–Chrysophyta?
(a) Diatoms only
(b) Desmids only
(c) Diatoms and golden algae
(d) Desmids and *Paramecium*

27. In which of the following groups, the cell wall has stiff cellulosic plate on the outer surface?
(a) Diatoms (b) Red algae
(c) Dinoflagellates (d) Slime moulds

28. Which group of organisms is represented by the given figure?



(a) Dinoflagellates (b) Protozoans
(c) Slime mould (d) Euglenoids

29. Which of the following statements about *Euglena* is true?
(a) Euglenoids bear flagella
(b) *Euglena* when placed in continuous darkness, loose their photosynthetic activity and die
(c) The pigments of *Euglena* are quite different from those of green plants
(d) *Euglena* is a marine protist

30. Which one of the following is a saprophytic protist?
(a) Desmid (b) Slime mould
(c) *Euglena* (d) *Nostoc*

31. Under favourable conditions slime moulds form
(a) protonema (b) *Plasmodium*
(c) mycelium (d) fruiting bodies

32. Protozoans are divided into …… groups. Most suitable word to fill the blank is
(a) three (b) four (c) two (d) eight

33. Consider the following statements about amoeboid protozoans.
I. They live in freshwater, sea water or moist soil.
II. They have pseudopodia for locomotion and capturing prey.
III. They have silica shells on their surface in marine forms.
IV. Their body is covered by plasmalemma.
Which of the statements given above are correct?
(a) I and II (b) III and IV
(c) II and III (d) I, II, III and IV

34. Which of the following is a flagellated protozoan?
(a) *Amoeba*
(b) *Entamoeba*
(c) *Plasmodium*
(d) *Trypanosoma*

35. Ciliates differ from all other protozoans in
(a) using flagella for locomotion
(b) having two types of nuclei
(c) using pseudopodia for capturing prey
(d) having a contractile vacuole for removing excess water

36. Which of the following groups always produce an infectious spore-like stage in their life cycle?
(a) Amoeboid protozoans
(b) Ciliated protozoans
(c) Flagellated protozoans
(d) Sporozoans

37. Match the following columns.

	Column I		Column II
A.	Chrysophytes	1.	*Gonyaulax*
B.	Dinoflagellates	2.	*Euglena*
C.	Euglenoids	3.	Diatoms
D.	Slime moulds	4.	*Plasmodium*

Codes

	A	B	C	D
(a)	1	3	2	4
(b)	1	4	2	3
(c)	3	2	4	1
(d)	3	1	2	4

38. The cells of the body of a multicellular fungus are organised into rapidly growing individual filament called
(a) mycelium (b) rhizoids
(c) hyphae (d) lichens

39. Cell wall of fungi is composed of
(a) chitin (b) pectin
(c) cellulose (d) mannans

40. Match the following columns.

	Column I		Column II
A.	Saprophyte	1.	Symbiotic association of fungi with plant roots
B.	Parasite	2.	Decomposition of dead organic materials
C.	Lichens	3.	Grow on living plants or animals
D.	Mycorrhiza	4.	Symbiotic association of algae and fungi

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	3	2	1	4
(c)	2	1	3	4
(d)	2	3	4	1

41. In fungi, the fusion of protoplasms between two motile or non-motile gametes is called
(a) plasmogamy (b) plasmokinesis
(c) karyogamy (d) cytokinesis

42. 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

43. Which of the following classes consists of coenocytic, multinucleate and aseptate mycelium?
(a) Basidiomycetes
(b) Ascomycetes
(c) Phycomycetes
(d) Deuteromycetes

44. Read the following statements about sexual reproduction in Phycomycetes.
I. In class-Phycomycetes, sexual reproduction produces a resting diploid spore called zygospore.
II. Zygospores are formed by the fusion of two gametes.
III. The gametes are either isogamous or anisogamous.
IV. Based on the mode of sexual reproduction, Phycomycetes are divided into two groups, *viz.* Oomycetes and Zygomycetes.
Which of the following statements given above are correct?
(a) I and II
(b) III and IV
(c) I and III
(d) I, II, III and IV

45. Members of Ascomycetes are decomposers, parasitic/coprophilous and saprophytic.
(a) True
(b) False
(c) Cannot say
(d) Partially true or false

46. In Basidiomycetes, the vegetative reproduction takes place by
(a) endospore (b) conidia
(c) akinetes (d) fragmentation

47. Deuteromycetes are known as fungi imperfecti because
(a) their zygote undergoes meroblastic and holoblastic cleavage
(b) only asexual stages are known
(c) they have aseptate mycelium
(d) they are autotrophic

48. Which one of the following matches is correct?

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

49. Match the following columns.

	Column I (Categories)		**Column II** (Common names)
A.	Phycomycetes	1.	Algal fungi
B.	Ascomycetes	2.	Imperfect fungi
C.	Basidiomycetes	3.	Bracket fungi
D.	Deuteromycetes	4.	Sac fungi

Codes

	A	B	C	D
(a)	2	1	4	3
(b)	4	3	2	1
(c)	1	4	3	2
(d)	3	2	1	4

50. Find the incorrect match.

(a) *Albugo* – Downy mildew
(b) *Alternaria* – Early blight of potato
(c) *Colletotrichum falcatum* – Red rot of sugarcane
(d) *Phytophthora infestans* – Late blight of potato

51. Hyphae of parasitic fungi is able to penetrate the hard cell wall of its host with the help of

(a) enzymes
(b) hormones
(c) sharp tips
(d) sugar exudates

52. Which statement stands true for fungi?

(a) They are chlorophyllous
(b) They never form spores
(c) Ectoparasites are non-pathogen
(d) Reproduce both sexually and asexually

53. Which of the following statements is false for ascomycetes?

(a) Ascomycetes consist of variously pigmented moulds
(b) Thallus of Ascomycetes has aseptate, unbranched hyphae
(c) In *Ascobolous* sexual reproduction occurs by spermatisation
(d) Process of karyogamy is delayed to start dikaryophase

54. Fungus producing eight spores in a sac belongs to

(a) Phycomycetes (b) Ascomycetes
(c) Basidiomycetes (d) Deuteromycetes

55. Read the following statements and choose from the options which one(s) is/are true.

I. Lichens constitute just 5% of algal component.
II. Mycobiont is involved in attachment to substratum.
III. Reproduction in case of lichens may by vegetative or sexual.

Codes

(a) I, II and III (b) I and II
(c) Only II (d) II and III

56. Find the correctly matched pair regarding lichens.

(a) *Usnea* – Usnic acid
(b) *Parmelia* – Curing epilepsy
(c) *Lobaria* – Lung disease
(d) All of the above

57. The term 'virus' implies to

(a) cellular
(b) pathogen
(c) parasite
(d) venom or poisonous fluid

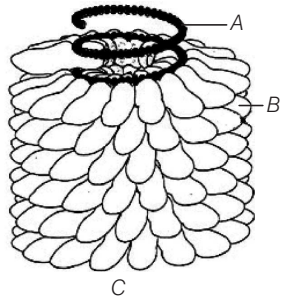
58. Viruses are non-cellular organisms, but replicate themselves once they infect the host cell. To which of the following kindgom viruses belong to?

(a) Monera (b) Protista
(c) Fungi (d) None of these

59. The non-living characteristic of viruses is ability of crystallisation.

(a) True
(b) False
(c) Cannot say
(d) Partially true or false

60. Observe the diagram and name all the three *A*, *B* and *C* (name of the virus) in correct order.



(a) *A*-RNA, *B*-Capsid, *C*-Tobacco mosaic virus
(b) *A*-DNA, *B*-Capsid, *C*-Bacteriophage
(c) *A*-RNA, *B*-Capsomere, *C*-TMV
(d) *A*-DNA, *B*-Capsid, *C*-Bacteriophage

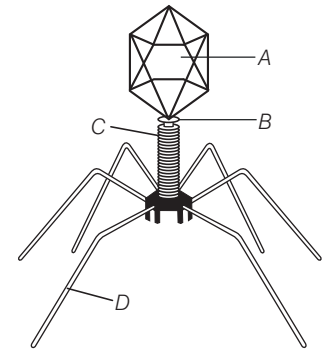
61. Match the following columns.

	Column I (Scientists)		**Column II** (Related to)
A.	DJ Ivanowsky (1892)	1.	Viroids
B.	MW Beijerinck (1898)	2.	First crystallised TMV
C.	WM Stanley (1935)	3.	*Contagium vivum fluidum*
D.	TO Diener (1971)	4.	Mosaic disease of tobacco

Codes

	A	B	C	D
(a)	1	4	3	2
(b)	2	1	4	3
(c)	4	3	2	1
(d)	3	2	1	4

62. Identify the label *A*, *B*, *C* and *D* in the following figure.



(a) *A*–Head, *B*–Collar, *C*–Sheath, *D*–Tail fibres
(b) *A*–Collar, *B*–Head, *C*–Sheath, *D*–Tail fibres
(c) *A*–Head, *B*–Collar, *C*–Tail fibres, *D*–Sheath
(d) *A*–Collar, *B*–Tail fibres, *C*–Head, *D*–Sheath

63. Consider the following statements.

I. Viruses that infect plants have single-stranded RNA and viruses that infect animals have either single or double-stranded RNA or double-stranded DNA.

II. Bacterial viruses or Bacteriophages are usually single-stranded RNA viruses.

Choose the correct option.

(a) Statement I is true, but II is false
(b) Statement I is false, but II is true
(c) Both statements I and II are true
(d) Both statements I and II are false

64. The protein coat of a virus is known as

(a) nucleoid (b) capsid
(c) capsomere (d) outer envelope

65. Which of the following is correct about viroids?

(a) They have free RNA without protein coat
(b) They have DNA with protein coat
(c) They have free DNA without protein coat
(d) They have RNA with protein coat

66. Difference between virus and viroid is
(a) the absence of protein coat in viroid, but present in virus
(b) the presence of low molecular weight RNA in virus, but absent in viroid
(c) Both (a) and (b)
(d) None of the above

67. Lichens are mutualistic and symbiotic associations between
(a) mycobiont and virus
(b) mycobiont and phycobiont
(c) mycobiont and root of higher plants
(d) mycobiont and mosses

Assertion-Reasoning MCQs

Direction *(Q. Nos. 68-77) Each of these questions contains two statements Assertion (A) and Reason (R). Each of these questions also has four alternative choices, any one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.*
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true, but R is not the correct explanation of A
(c) A is true, but R is false
(d) A is false, but R is true

68. **Assertion** (A) The two kingdom classification, used for a long time, was found to be inadequate.

Reason (R) Two kingdom system of classification did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular organisms and green algae and fungi.

69. **Assertion** (A) Three domains system classifies organisms based on cellular characteristics.

Reason (R) The three domains are, i.e. Archaea, Bacteria and Eukarya.

70. **Assertion** (A) Five kingdom system of classification did not differentiate between the heterotrophic group, fungi and the autotrophic green plants. Though they showed a characteristic difference in their cell wall composition.

Reason (R) Fungal cell wall contains chitin, while green plants have a cellulosic cell wall.

71. **Assertion** (A) Polluted water bodies have high abundance of *Nostoc* and *Oscillatoria*.

Reason (R) These blue-green bacteria can tolerate adverse conditions very well compared to other aquatic plants.

72. **Assertion** (A) *Euglena* is a plant due to the presence of chlorophyll.

Reason (R) *Euglena* cannot be classified on the basis of two kingdom system.

73. **Assertion** (A) Slime moulds are called as fungus like animals.

Reason (R) These do not have cell wall

74. **Assertion** (A) Fungi are wide spread in distribution and they can even live on or inside other plants and animals.

Reason (R) Fungi are able to grow anywhere on land, water or on other organisms because they have variety of pigments including chlorophyll, carotenoids, fucoxanthin and phycoerythrin.

75. **Assertion** (A) In fungi, sexual apparatus decreases in complexity from lower to higher forms.

Reason (R) In algae, sexual apparatus increases in complexity from simple to higher forms.

76. **Assertion** (A) Viruses can contribute to various types of cancer in humans.

Reason (R) It can be estimated that 15% of all cancer cases related to humans, throughout the world are due to viruses.

77. **Assertion** (A) Viruses cause diseases and replicate when they are in the host cell.

Reason (R) Viruses do not replicate outside the host, but they survive in environment.

Case Based MCQs

78. **Direction** *Read the following and answer the questions that follow*

The members of kingdom–Fungi are eukaryotic, heterotrophic and achlorophyllous. They are either unicellular or multicellular forms that are made up of hyphae. The network of hyphae forms the mycelium. These cell wall exhibiting organisms reproduce by both sexual and asexual modes. On the basis of spore formation, fungi are classified as Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Based on the mode of nutrition, fungi are classified as saprophytic and parasitic forms. These are also found in symbiotic association with plants.

(i) Fungal cell wall is composed of
(a) cellulose and pectins
(b) chitin and glycoproteins
(c) chitin, glycoproteins and glucans
(d) pectins, chitin and cellulose

(ii) Club-fungi is
(a) Phycomycetes (b) Deuteromycetes
(c) Basidiomycetes (d) Ascomycetes

(iii) The spores that help fungi to undergo asexual reproduction during favourable conditions is
(a) zoospores (b) aplanospores
(c) conidia (d) All of these

(iv) Sexual reproduction in Ascomycetes occurs through
(a) somatogamy of zoospores
(b) isogamy of zoospores
(c) anisogamy of ascospores
(d) Both (b) and (c)

(v) **Assertion** (A) Mycelium in Deuteromycetes is aseptate.

Reason (R) Phycomycetes possess septate and branched mycelium.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true, but R is not the correct explanation of A
(c) A is true, but R is false
(d) Both A and R are false

79. **Direction** *Read the following and answer the questions that follow*

Viruses are non-cellular organisms that are characterised by an inert crystalline structure surrounding the genetic material. These are obligate parasites and do not have a biosynthetic machinery. Therefore, they use host machinery to replicate themselves.

Viruses are ultramicroscopic nucleoprotein entities having variable size and shape. The basic structure of virus is composed of envelope, capsid and nucleoid. Based on the type of genetic mateial, viruses are classified as Deoxyvira and Ribovira.

(i) All the listed viruses contain DNA, except
(a) cauliflower mosaic virus
(b) polio virus
(c) rabies virus
(d) retrovirus

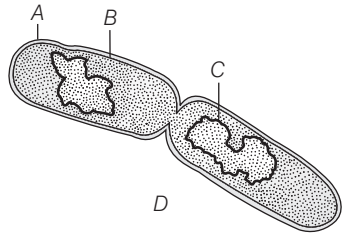
(ii) Capsid of viruses
(a) surrounds the genetic material
(b) is proteinaceous
(c) composed of several capsomeres
(d) All of the above

(iii) A polyhedral-shaped virus is
(a) *Alfalfa* mosaic virus
(b) *Poliomyelitis* virus
(c) TMV
(d) All of the above

(iv) Viroids differ from viruses in
(a) having protein coat
(b) lacking protein coat
(c) having DNA
(d) having both DNA and RNA

(v) **Assertion** (A) Coliphages and cyanophages are bacterial viruses.
Reason (R) Envelope of viruses is composed of RNA.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true, but R is not the correct explanation of A
(c) A is true, but R is false
(d) Both A and R are false

80. Observe the diagram shown below and answer the following questions.



(i) Find out the labels *A*, *B*, *C* and *D* in the shown figure.
(a) *A*-Plasma memberne, *B*-Cell wall, *C*-RNA, *D*-Spore formation
(b) *A*-Cell wall, *B*-Cell membrane, *C*-DNA, *D*-Binary fission
(c) *A*-Plasma membrane, *B*-Mucilaginous, *C*-DNA, *D*-Transformation
(d) *A*-Mucilaginous, *B*-Cell membrane, *C*-RNA, *D*-Conjugation

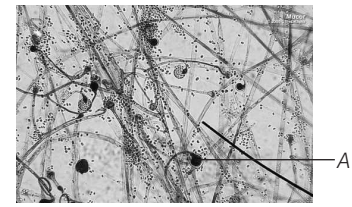
(ii) Some hyperthermophilic organisms that grow in highly acidic (pH = 2) habitats belong to the two groups, *viz,*
(a) Eubacteria and Archaea
(b) cyanobacteria and diatoms
(c) Protists and mosses
(d) Liverworts and yeasts

(iii) Cell wall of bacteria is composed of
(a) complex lipids
(b) lipids
(c) mucopeptide complex
(d) lipoprotein

(iv) Select the incorrect statement.
(a) Bacterial cell wall is made up of peptidoglycans
(b) Pili and fimbriae are mainly involved in motility of bacterial cells
(c) Cyanobacteria lack flagellated cells
(d) Mycoplasma is wall-less microorganism

(v) Why is a capsule advantageous to a bacterium?
(a) It protects the bacterium from desiccation
(b) It provides means of locomotion
(c) It allows bacterium to 'hide' from host's immune system
(d) It allows the bacterium to attach to the surface

81. Observe the diagram shown below and answer the following questions.



(i) Identify the correct characteristics about the fungal reproduction shown above.
I. It is a type of asexual reproduction.
II. The structure *A* is sporangium.
III. It is seen in *Rhizopus* and *Mucor.*
IV. Structure *A* contains endospores.
(a) II and IV (b) I, II, III and IV
(c) I and III (d) Only IV

(ii) Fungal species that reproduce by zoospore is
(a) *Albugo* (b) *Penicillium*
(c) *Rhizopus* (d) *Mucor*

(iii) The type of asexual spores in *Rhizopus* is
(a) sporangiospores (b) arthrospores
(b) chlamydospores (d) All of these

(iv) Sexual spores in fungi is/are
(a) ascospores
(b) chlamydospores
(c) sporangiospores
(d) All of the above

(v) Dikaryotisation in fungi occurs during
(a) meiosis (b) karyogamy
(c) plasmogamy (d) Both (b) and (c)

ANSWERS

Multiple Choice Questions

1. (c)	2. (d)	3. (d)	4. (c)	5. (a)	6. (d)	7. (b)	8. (c)	9. (c)	10. (b)
11. (b)	12. (d)	13. (a)	14. (d)	15. (d)	16. (b)	17. (c)	18. (b)	19. (c)	20. (a)
21. (b)	22. (b)	23. (a)	24. (c)	25. (b)	26. (c)	27. (c)	28. (d)	29. (a)	30. (b)
31. (b)	32. (b)	33. (d)	34. (d)	35. (b)	36. (d)	37. (d)	38. (c)	39. (a)	40. (d)
41. (a)	42. (c)	43. (c)	44. (d)	45. (a)	46. (d)	47. (b)	48. (b)	49. (c)	50. (a)
51. (a)	52. (d)	53. (b)	54. (b)	55. (a)	56. (d)	57. (d)	58. (d)	59. (a)	60. (a)
61. (c)	62. (a)	63. (a)	64. (b)	65. (a)	66. (a)	67. (b)			

Assertion-Reasoning MCQs

68. (a)	69. (b)	70. (d)	71. (a)	72. (d)	73. (c)	74. (c)	75. (b)	76. (b)	77. (b)

Case Based MCQs

78. (i) *(c),* (ii) *(c),* (iii) *(d),* (iv) *(c)* (v) *(d)*
79. (i) *(a),* (ii) *(d),* (iii) *(b),* (iv) *(b),* (v) *(c)*
80. (i) *(b),* (ii) *(a),* (iii) *(c),* (iv) *(b),* (v) *(c)*
81. (i) *(b),* (ii) *(a),* (iii) *(d),* (iv) *(a),* (v) *(c)*

EXPLANATIONS

1. (c) In two kingdom system of classification, all the organisms of the world were divided into two kingdoms, i.e. Plantae (plant) and Animalia (animal).

Carolus Linnaeus proposed this system in his book *Systema Naturae* (1735).

3. (d) All of the given characters were used by Whittaker as criteria to propose five kingdom system of classification.

4. (c) All the prokaryotes were classified in kingdom–Monera in the five kingdom classification system.

5. (a) In the five kingdom classification, *Chlamydomonas* and *Chlorella* have been included in kingdom–Plantae as they are photosynthetic algae and algae are included in kingdom–Plantae.

6. (d) Only statement IV is correct. Other statements are incorrect and can be corrected as

- Mode of nutrition of kingdom–Animalia is heterotrophic.
- Nuclear envelope is absent in kingdom–Monera.
- Protists are eukaryotic. The only prokaryotic kingdom is Monera.

7. (b) The given figures

A–represents spherical-shaped bacteria generally called as cocci.

B–represents the rod-shaped bacteria generally called as bacilli.

C–represents the spiral-shaped bacteria (with flagella ranging from one to multiple) generally called as spirilla.

D–represents the comma-shaped bacteria called as vibrio.

9. (c) The three main groups of Archaebacteria are methanogens (can live in the absence of O_2), halophiles (can live at high temperature) and thermoacidophiles (can live at high temperature and low pH) can survive in extreme environmental conditions due to their specialised cell walls.

11. (b) Methanogens are group of obligate anaerobic ancient and primitive bacteria. They are involved in methanogenesis and produce methane gas in gut of ruminant cattle.

14. (d) Cyanobacteria, also known as Blue-Green Algae (BGA), are most primitive prokaryotic organisms. These are considered to be the most ancient of all the chlorophyll bearing organisms on earth.

15. (d) The parts labelled in the figure are identified as

(*A*) *Nostoc*, a genus of cyanobacteria capable of nitrogen-fixation, due to the presence of heterocyst (*B*), in them. *C* is mucilaginous sheath which increases the water holding capacity of cell.

16. (b) Chemosynthetic autotrophic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They play an important role in the recycling of nutrients like nitrogen, phosphorus, iron and sulphur.

17. (c) Heterotrophic bacteria are mostly found in nature. The majority of them are important decomposers.

18. (b) Some of the cyanobacteria can fix atmospheric nitrogen in their specialised cells called heterocysts, e.g. *Nostoc* and *Anabaena*.

19. (c) *Mycoplasma* is the triple layered smallest living cells. It does not have definite cell wall. It is an anaerobic organism. It causes diseases in plants (little leaf of brinjal) as well as in animals (pleuromorphic pneumonia in man).

21. (b) Although all single-celled eukaryotes are placed in kingdom–Protista, yet its boundaries are not well-defined.

22. (b) Kingdom–Protista includes a wide variety of unicellular organisms, mostly aquatic eukaryotes.

23. (a) All single-celled eukaryotic organisms like chrysophytes (diatoms and desmids), euglenoids *(Euglena)*, dinoflagellates and slime moulds are included in kingdom–Protista.

24. (c) The cell wall of chrysophytes is embedded with silica. They form diatomite or diatomaceous earth on the sea floors over million of years.

25. (b) Diatoms are chief producers in the oceans and they contribute 40% of marine primary productivity. They constitute a major group of unicellular eukaryotic microalgae and are among the most common types of phytoplanktons.

26. (c) Chrysophytes include diatoms and desmids (golden algae). They belong to the division–Chrysophyta/Bacillariophyta.

27. (c) In dinoflagellates, cells are generally covered by a rigid coat, the theca or lorica of articulated and sculptured plates formed of cellulose, i.e. the cell wall has stiff cellulosic plate. Because of the presence of sculptured plates, these protists are known as armoured dinoflagellates.

29. (a) Euglenoids are unicellular flagellate protists. Euglenoids occur in freshwater habitats. They contain the photosynthetic pigments, chlorophyll-*a* and chlorophyll-*b*.

30. (b) *Nostoc* belongs to Monera and other three are protists. But among the three given protists, only slime moulds are saprophytic. Slime moulds or fungus like animals are found in damp places and they are either acellular or cellular ones.

31. (b) Slime moulds form an aggregation called *Plasmodium*, which may grow and spread over several feets.

During unfavourable conditions, the *Plasmodium* differentiates and forms fruiting bodies bearing spores at their tips. Spores are extremely resistant and survive for many years.

35. (b) Ciliates differ from other protozoans in having two types of nuclei, e.g. *Paramecium* have two types of nuclei, i.e. macronucleus and micronucleus.

36. (d) Sporozaons include diverse organisms that have an infectious spore-like stage in their life cycle.

38. (c) The body of a multicellular fungus (except yeast) is made up of number of elongated, tubular and rapidly gowing filaments known as hyphae.

39. (a) The cell wall of fungi is composed of chitin, the second most abundant carbohydrate. It is a homopolymer of N-Acetyl Glucosamine (NAG) joined with β 1-4 linkages. NAG is a modification of glucose molecule.

41. (a) Plasmogamy is the first stage of sexual reproduction in which the cytoplasm of two sex cells fuse with each other.

42. (c) Plasmogamy means fusion of protoplasm and karyogamy means fusion of nucleus. These two events lead to the formation of zygote (*2n*) which is a diploid structure where meiosis takes place. Thus, option (c) gives the correct sequence of events with respect to fungal sexual cycle.

43. (c) Coenocytic, multinucleate and aseptate mycelium is found in class–Phycomycetes, e.g. *Albugo*.

44. (d) All given statements are correct as
In Phycomycetes, resting dipoloid spores called zygospores are formed by the fusion of two gametes. These gametes may be similar (isogamous) or dissimilar (anisogamous or oogamous) in morphology. Based on this, Phycomycetes are divided into two groups, *viz.* Oomycetes and Zygomycetes.

Thus, option (d) is correct.

45. (a) Members of Ascomycetes are saprophytic, decomposers, parasitic or coprophilous (growing on dung).

46. (d) In Basidiomycetes, the vegetative reproduction takes place by fragmentation. It is a form of asexual reproduction where a new organism grows from a fragment of the parent.

47. (b) Deuteromycetes are a large number of true fungi whose sexual stages (perfect stages) are either unknown or not easily found. Since, only the imperfect stages (asexual stages) of these fungi are known, they are called the fungi imperfecti and are grouped in the class Deuteromycetes.

48. (b) Option (b) is the correct match. Rest of the matches are incorrect and can be corrected as

- *Phytophthora* belongs to Phycomycetes (algal fungi). They contain either unicellular thallus or non-septate coenocytic mycelium. They are mostly plant damaging Oomycetes (water molds).
- *Mucor* also belongs to Phycomycetes. They have mycelium which is coenocytic (multinucleate) and profusely branched. They reproduce vegetatively *via* conjugation.
- *Agaricus* belongs to Basidiomycetes (where karyogamy and meiosis occur). They contain well-developed filaments, branched and septate mycelium. They are saprophytic, but not parasitic.

50. (a) Option (a) is the incorrect match and can be corrected as

Albugo causes white rust.

Rest all matches are correctly paired.

51. (a) Fungi have hyphae which penetrate the hosts cell wall with the help of enzymes and then takes away nutrients.

52. (d) Fungi can reproduce both sexually and asexually by zoospores like conidia and ascospores. However, they are Achlorophyllous and form spores. Ectoparasites are pathogens which infect superficial layer of the skin.

53. (b) Statement in option (b) is false. It can be corrected as

Thallus of Ascomycetes has septate and branched mycelium.

Rest all statements are true.

54. (b) Sexual spores are ascospores which are produced in sac-like asci.

Each ascus bears 4-8 ascospores which belong to Ascomycetes.

55. (a) All statements are correct.

- Major part of the lichen body constitutes fungus and only 5% part is algal component.
- The function of fungal partner or mycobiont is to attach to the substratum and that of algal partner is to photosynthesize.
- Lichens may reproduce vegetatively or sexually. Thus, all statement are true for lichens.

56. (d) All of the pairs are correctly matched. *Usnea* is used for synthesizing usnic acid. *Parmelia* is used to cure epilepsy. *Lobaria* can treat lung diseases.

57. (d) The name virus implies to venom or poisonous fluid and it was given by Pasteur.

58. (d) Viruses and viroids are the non-cellular organisms, which are not characterised or classified under any of the classes described by Whittaker.

63. (a) Statement I is true, but II is false and can be corrected as

Bacterial viruses or Bacteriophages have commonly double-stranded DNA, but all the other genome types can also occur in them.

65. (a) The option (a) is correct for viroids as they are generally known as plant pathogens. They are small, single-stranded RNA particles.

They do not have a capsid or outer envelope of protein. It makes them simpler than virus, but like viruses they can reproduce only within a host cell. They do not have the capacity to make their own protein. They produce only a single, specific RNA molecule.

Rest options are incorrect.

66. (a) The difference between a virus and a viroid is that a virus contains DNA or RNA as genetic material and a protein coat, whereas viroids have no protein coat and contain only RNA as their nucleic acid.

67. (b) Lichen is a structurally organised entity consisting of a permanent association of a fungus and an alga. The fungal component of a lichen is called mycobiont and the algal component is called phycobiont.

68. (a) Both A and R are true and R is the correct explanation of A.

The two kingdom system of classification was used till very recently. This system did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular organisms and photosynthetic (green algae) and non-photosynthetic (fungi) organisms. Classification of organisms into plants and animals was easily done and was easy to understand, inspite of the fact that, a large number of organisms did not fall into either category. Hence, the two kingdom classification, was found to be inadequate.

69. (b) Both A and R are true, but R is not the correct explanation of A.

Three domain system or six kingdom system of classification is a biological system of classification which divides organisms based on cellular characteristics. The three domains are, Archaea (primitive prokaryotes), Bacteria and Eukarya (eukaryotic organisms originating from endosymbiotic association between archaebacteria and eubacteria, i.e. Protista, Fungi, Plantae and Animalia).

70. (d) A is false, but R is true. A can be corrected as

Five kingdom classification was proposed by RH Whittaker. The classification differentiated between the heterotrophic group, fungi and the autotrophic green plants, as they showed a characteristic difference in their wall composition–the fungi had chitin, while the green plants had cellulose in their cell walls. Thus, he placed them in separate kingdoms.

71. (a) Both A and R are true and R is the correct explanation of A.

Polluted water bodies have high abundance of *Nostoc* and *Oscillatoria.* This is because cyanobacteria or blue-green bacteria such as *Nostoc* and *Oscillatoria* can tolerate adverse conditions due to the presence of mucilage covering, resistant proteins and the absence of sap vacoules.

72. (d) A is false, but R is true. A can be corrected as

Euglena is a green-coloured, single-celled organism, which moves like animals. Some taxonomists considered it as a plant and included it in the plant kingdom on the basis of the presence of chlorophyll, while others, included it in the animal kingdom along with the flagellated protozoans because of the occurrence of locomotion by flagella. It was classified as a protist later by RH Whittaker in his five kingdom classification.

73. (c) A is true, but R is false. R can be corrected as

Slime moulds are called as fungus like animals because they possess characters of both the animals and fungi. Their spores possess a true cell wall.

74. (c) A is true, but R is false. R can be corrected as

Fungi are wide spread in distribution. These may be epiphytic, saprophytic, symbiotic and parasitic. Fungi lack chlorophyll pigments and hence do not have autotrophic mode of nutrition. These are heterotrophs.

75. (b) Both A and R are true, but R is not the correct explanation of A.

In fungi, there is gradual and progressive simplification and ultimate elimination of the sexual apparatus from the lower to higher forms of fungi. In case of algae, the sexual apparatus increases in complexity from simple to higher forms.

76. (b) Both A and R are true, but R is not the correct explanation of A.

Viruses are capable of causing cancer in humans. They do this by mixing their DNA with the cells. DNA, thereby, triggering the changes which make the cell rapidly multiply.

It has been estimated that about 15% of the total human cancer cases worldwide are because of viruses.

77. (b) Both A and R are true, but R is not the correct explanation of A.

Viruses are active only when they are inside the living host cells as viruses do not possess any replicating property and require a host to replicate its genetic material. Outside the host, they are as good as chemical substances.

78. (i) (c) Fungal cell wall is made up of chitin, glucans and glycoproteins.

(ii) (c) Basidiomycetes is called club fungi.

(iii) (d) In fungi, asexual reproduction occurs during favourable conditions, through sporangiospores, zoospores, aplanospores, conidia, etc.

(iv) (c) Sexual reproduction in Ascomycetes occurs through the anisogamy of ascospores. In Basidiomycetes, it occurs through the somatogamy of basidiospores.

(v) (d) Both A and R are false. These can be corrected as

Mycelium in Deuteromycetes is septate.

Phycomycetes possess aseptate and coenocytic mycelium.

79. (i) (a) Cauliflower mosaic virus contains RNA.

(ii) (d) All the listed characters are correct about capsid.

(iii) (b) *Poliomyelitis* virus is polyhedral in shape.

(iv) (b) Viroids lack protein coat.

(v) (c) A is true, but R is false because

Envelope of virus contains protein, lipids and carbohydrates.

80. (i) (b) *A*-Cell wall, *B*-Cell membrane, *C*-DNA, *D*-Binary fission

(ii) (a) The two major groups of monerans are Archaebacteria (ancient bacteria) and Eubacteria (true bacteria). Thermoacidophilies are the groups of Archaebacteria which live in extremely acidic environment having pH 2.

Some of the Eubacteria are also found in hostile environment like salt pans, petroleum pans, spilled oil, hot springs, sulphur springs, snow, etc.

(iii) (c) Bacterial cell wall is made up of peptidoglycan which is composed of mucopolysaccharide and polypeptide (i.e. mucopeptide complex). It also contains N-acetyl glucosamine and N-acetyl muramic acid (amino sugars) that are linked to a tripeptide of alanine, glutamic acid and lysine or diaminopimelic acid. It give strength and shape to the cell wall.

(iv) (b) Statement in option (b) is incorrect and can be corrected as

Fimbriae or pili are small bristle-like solid structures arising from bacterial cell surface. 300-400 fimbriae are present per cell. Their diameter is 3-10 nm, while length is 0.5-1.5 µm. Fimbriae help in attaching bacteria to solid surfaces (e.g. rock in water body) or host tissues (e.g. urinary tract in *Neisseria gonorrhoeae*). It does not play any role in motility of bacteria.

(v) (c) S-type bacteria or virulent bacteria are capsulated. The capsule is made up of polysaccharides and amino acids.

It is a tough and thick mucilage covering. It gives protection to bacteria within host body against its immune system.

81. (i) (b) All the four characteristics are correct.

(ii) (a) *Albugo* reproduces asexually by zoospores.

(iii) (d) All the given asexual spores occur in species of *Rhizopus*.

(iv) (a) Ascospores are sexual spores in fungal species.

(v) (c) Dikaryotisation occurs during plasmogamy. It is the process of a formation of dikaryon due to the fusion of protoplasm of two sex cells, but the cells do not fuse.