

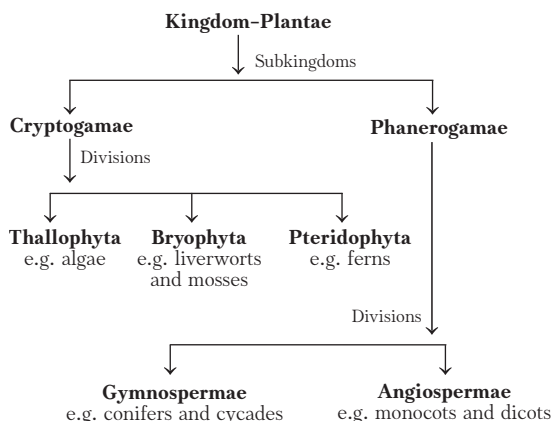
# 03

## Plant Kingdom

### Quick Revision

- Plant kingdom includes all multicellular, eukaryotic, photosynthesising organisms, grouped as algae, bryophytes, pteridophytes, gymnosperms and angiosperms.
- Plants were classified on the basis of different characters.
- The various systems used in classification of plants are
  - Artificial system of classification** It was given by **Linnaeus** and is based on morphological characters.
  - Natural system of classification** It was developed by **Bentham** and **Hooker** and based on natural affinities among the organisms. It was based on both external and internal features like anatomy, structure and embryology. It is the most common system of classification followed.
  - Phylogenetic system of classification** It was given by **Engler** and **Prantl** and is based on evolutionary relationships of an organism. It is also known as **Hutchinson's system**.
- Classification done on the basis of chemical constituents of plant is known as **chemotaxonomy**.
- Numerical taxonomy** includes classification on the basis of observed characters.
- Cytotaxonomy** is based on cytological information like chromosome number, structure, behaviour and types of chromosomes.

Classification of plant kingdom is as follows



### Algae

- These are chlorophyll bearing, simple, thalloid, autotrophic and mostly aquatic organisms (both freshwater and marine water).
- These include unicellular forms like *Chlamydomonas*, colonial forms like *Volvox*, filamentous like *Ulothrix* and *Spirogyra*.
- Algae reproduce vegetatively by fragmentation and asexually by zoospores, aplanospores, akinetes, etc.
- Sexual reproduction in algae occurs through fusion of two gametes. These gametes could be
  - Isogamous** Both gametes are similar in size and non-motile, e.g. *Spirogyra*.

- **Anisogamous** Both gametes dissimilar in size, e.g. *Chlamydomonas*.
- **Oogamous** Fusion between one large female gamete and a smaller motile male gamete, e.g. *Volvox* and *Fucus*.
- Algae play an important role in carbon dioxide fixation on earth through photosynthesis thereby increasing the level of  $O_2$  in the environment. They are chief primary producers.
- About 70 species of marine algae like *Porphyra*, *Laminaria* and *Sargassum* are used as food.
- Algae are used commercially for various products like
  - **Algin** from brown algae.
  - **Carrageenan** from red algae.
  - **Agar** from *Gelidium* and *Gracilaria*.
- *Spirulina* and *Chlorella* are used by space travellers as food supplements.

## Classification of Algae

The algae are divided into three main classes which are as follows

### Class–Chlorophyceae (Green Algae)

- Members of Chlorophyceae are **unicellular**, **colonial** or **filamentous**.
- They are green due to the presence of **chlorophyll-a** and **b** pigments localised in definite chloroplast.
- Shape of the chloroplast varies like discoid, plate-like, reticulate, cup-shaped, spiral or ribbon-shaped.
- Algae store food in the form of starch in specialised structures called **pyrenoids** located in chloroplast. Food may be stored in the form of oil droplets in some algae.
- Inner layer of cell wall is made up of cellulose, while outer layer is made up of pectose.

- Vegetative reproduction occurs through fragmentation. Asexual reproduction is done by zoospores by zoosporangia.
- Sexual reproduction occurs through different modes like isogamous, anisogamous or oogamous, e.g. *Volvox*, *Ulothrix*, *Spirogyra*, *Chlamydomonas* and *Chara*.

### Class–Phaeophyceae (Brown Algae)

- Members of Phaeophyceae are brown in colour due to the presence of **fucoxanthin** pigment.
- They range from **simple branched**, filamentous forms to **profusely branched** forms like **kelps**, which reach up to a height of 100 metres.
- They have gelatinous coating outside the cellulosic cell wall called **algin**.
- Cell contains chloroplast (plastid), centrally located vacuole and nucleus.
- Plant body is differentiated into **holdfast** (substratum), **stripe** (stalk) and **frond** (photosynthetic organ).
- Asexual reproduction occurs through biflagellate zoospores (having unequal laterally attached flagella).
- Sexual reproduction may be **oogamous**, **isogamous** or **anisogamous**. Union of gametes takes place in water within oogonium in case of oogamous species, e.g. *Sargassum*, *Fucus*, *Ectocarpus*, *Dictyota* and *Laminaria*.

### Class–Rhodophyceae (Red Algae)

- Members of Rhodophyceae are red due to the presence of pigment **r-phycoerythrin**. These are usually **marine**, occur close to the surface of water as well as in deep oceans.
- They reproduce vegetatively through fragmentation.
- They reproduce sexually and asexually through non-motile spores/gametes. Sexual reproduction is **oogamous**.

## Divisions of Algae and their Main Characteristics

Characteristics	Class Chlorophyceae	Class Phaeophyceae	Class Rhodophyceae
<b>Common name</b>	Green algae	Brown algae	Red algae
<b>Major pigments</b>	Chlorophyll- <i>a</i> , <i>b</i>	Chlorophyll- <i>a</i> , <i>c</i> , fucoxanthin	Chlorophyll- <i>a</i> , <i>d</i> , <i>r</i> -phycoerythrin
<b>Stored food</b>	Starch	Mannitol, laminarin	Floridean starch
<b>Cell wall</b>	Cellulose	Cellulose and algin	Cellulose, pectin and polysulphate esters
<b>Flagellar number and position of insertions</b>	2-8, equal, apical	2, unequal, lateral	Absent
<b>Habitat</b>	Freshwater, brackish water, salt water	Freshwater (rare), brackish water, salt water	Freshwater (some), brackish water, salt water (most)

## Bryophytes

- They are commonly found in moist shaded areas in the hills.
- These are known as **amphibians of plant kingdom** as they can live in soil as well as water and are dependent on water for sexual reproduction (for movement of gametes).
- In bryophytes, the main plant body is **gametophyte**, which produces gametes. It is thalloid (i.e. lacks roots, stems and leaves) and prostrate or erect and attached to the substratum by **rhizoids**.
- Sex organs are **multicellular** and **jacketed**. The male sex organ is **antheridium**, while female sex organ is **archegonium**.
- Antheridium produces biflagellate **antherozoids**. Female sex organ produces **one egg**.
- Antherozoids are released in water where they come in contact with archegonium and egg cell. It fuses with egg cell to produce the zygote.
- Zygote undergoes mitotic division and gives rise to **sporophyte** ( $2n$ ). Sporophyte remains attached to the gametophyte and takes nourishment from it.
- Sporophyte undergoes reductional division or meiosis to produce haploid spores. These later germinate and give rise to haploid gametophyte.
- Bryophytes are used as food source. These are capable of preventing soil erosion and also form ecological succession links.

## Classification of Bryophytes

- Bryophytes are divided into **liverworts** and **mosses**.

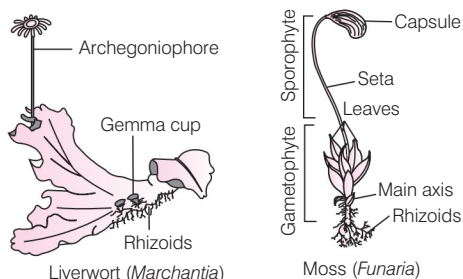
## Liverworts

- The plant body is thalloid, e.g. *Marchantia*.
- Leafy members have tiny appendages usually grown in moist, damp, shady habitats.
- They reproduce asexually by the formation of specialised structure called **gemmae** or through fragmentation of thalli.
- Gemmae are asexual buds, which originate from small receptacles called **gemma cups**.
- Sexual reproduction occurs by the fusion of antherozoids and egg, which are produced in antheridium and archegonium, respectively.
- Both male and female sex organs may be present on same thalli or different thalli.
- Zygote gives rise to sporophyte, which is differentiated into **foot**, **seta** and **capsule**. Some cells of capsule undergo meiosis and give rise to haploid spores. These spores give rise to gametophyte ( $n$ ).

## Mosses

- The predominant stage in the life cycle of a moss is the gametophyte, which consists of two substages, i.e. **protonema** and **leafy stage**.
- Juvenile stage of moss is **protonema**. It consists of slender, green, branching system of filaments.
- **Leafy stage** develops from the secondary protonema as lateral bud. It bears the sex organs.
- Vegetative reproduction takes place by fragmentation and budding in the secondary protonema.
- Mosses provide food for herbivores, used as packing material, fuel (e.g. *Sphagnum*), they

decompose rocks and colonies them along with lichens, etc.



## Pteridophytes

- Pteridophytes are called **vascular cryptogams**, also known as **seedless vascular plants**.
- They produce spores rather than seeds, e.g. horsetails (*Equisetum*), ferns (*Selaginella*) and club moss (*Lycopodium*).
- These are found near the marshy, cool and damp places.
- In pteridophytes, the main plant body is a **sporophyte** ( $2n$ ), which is differentiated into true root, stem and leaves.
- Leaves may be small (microphylls) as in *Selaginella* or large (macrophylls) as in ferns.
- Sporophyte bears sporangia which consists of leaf-like appendages called **sporophylls**. These sporophylls may be widely scattered in a plant or may be clustered in definite areas and structures called **strobili** or **cones**, e.g. *Selaginella*.
- The spores produced can be of similar kind (homosporous) or can be of two kinds (heterosporous), i.e. macro (large) and micro (small).
- The spores germinate to give rise to inconspicuous, small but multicellular free-living, mostly photosynthetic thalloid gametophyte called **prothallus**.
- Gametophyte can grow only in cool, damp and shady places which has restricted the spread of pteridophytes to a narrow geographical range.
- The gametophytes bear male and female sex organs called **antheridia** and **archegonia**, respectively.
- The male gamete of pteridophyte swims to archegonium, where zygote is formed after fertilisation. The zygote produces a sporophyte (dominant phase).

- The zygote develops into young embryo within female gametophyte. This event is called a precursor to **seed habit** and is considered an important step in evolution.
- Pteridophytes are used for medicinal purposes and as **soil-binders**. They are also grown as ornamentals.
- Pteridophytes are divided into four classes, i.e. **Psilopsida** (*Psilotum*), **Lycopsida** (*Selaginella*, *Lycopodium*), **Sphenopsida** (*Equisetum*) and **Pteropsida** (*Dryopteris*, *Pteris*, *Adiantum*).

## Gymnosperms

- In gymnosperms, the ovules are not enclosed by any ovary wall and remain exposed before and after fertilisation. Thus, naked seeds are formed post-fertilisation and no fruit formation occurs.
- Plants possess tap root system but in some forms, **coralloid roots** (plant roots associated with endosymbionts such as blue-green alga, e.g. *Cycas*) or **mycorrhiza** (e.g. *Pinus*). The stems are aerial, erect, woody, branched or unbranched.
- Leaves are usually dimorphic, i.e. leaves are of two types *viz*, large green foliage leaves and small brown scale leaves.
- The gymnosperms are **heterosporous**, i.e. produce microspores and megaspores in a compact strobili or **cones**.
- The strobili bearing **microsporophylls** and **microsporangia** are called **microsporangiate** or **male strobili**. These develop into a highly reduced male gametophyte which produce **pollen grains**.
- The cones bearing **megasporophylls** with ovules or **megasporangia** are called **macrosporangiate** or **female strobili**.
- Ovules** or **Megasporangia** borne on megasporophylls consist of nucellus from which a megaspore mother cell develops.
- One megaspore out of four develops into female gametophyte bearing two or more **archegonia** (female sex organs).
- The pollen grains of gymnosperms germinate and release male gamete into the ovule, where it forms zygote after fertilisation. The zygote develops into embryo and ovules into seeds (naked).

# Objective Questions

## Multiple Choice Questions

- The various divisions of kingdom-  
Plantae are
  - algae, pteridophytes, gymnosperms and angiosperms
  - algae, bryophytes, pteridophytes, gymnosperms and angiosperms
  - algae, bryophytes and pteridophytes
  - algae, fungi, pteridophytes, gymnosperms and angiosperms
- The basis of classification under the natural system of classification was
  - Phytochemistry
  - Anatomy
  - Structural embryology
  - All of the above
- ..... is discussed under phylogenetic system of classification.
  - Evolutionary relationship of organism
  - Cytotaxonomy
  - Cytological information
  - Structural embryology
- Match the following columns.

Column I (Classification system)	Column II (Given by)
A. Natural system of classification	1. Bentham and Hooker
B. Artificial system of classification	2. Linnaeus
C. Phylogenetic system of classification	3. Engler and Prantl

### Codes

- |       |   |   |
|-------|---|---|
| A     | B | C |
| (a) 2 | 1 | 3 |
| (b) 3 | 1 | 2 |
| (c) 2 | 3 | 1 |
| (d) 1 | 2 | 3 |

- Select the incorrect pair.
  - Numerical taxonomy – All observable characteristics
  - Cytotaxonomy – Cytological information
  - Chemotaxonomy – Chromosome number and structure
  - Cladistic taxonomy – Origin from a common ancestor
- Algae are
  - chlorophyll bearing autotrophs
  - simple and thalloid
  - Both (a) and (b)
  - heterotroph
- Algae occur in/on
  - fresh and marine water
  - moist stones
  - moist soil and wood
  - All of these
- Match the following columns.

Column I (Algae)	Column II (Body structure)
A. <i>Ulothrix</i>	1. Kelp
B. <i>Volvox</i>	2. Filamentous
C. <i>Chlamydomonas</i>	3. Colonial form
D. Some giant marine forms	4. Unicellular

### Codes

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

- In algae, asexual reproduction occurs by the production of different types of spores. The most common type of spore is zoospore.
  - True
  - False
  - Cannot say
  - Partially true or false

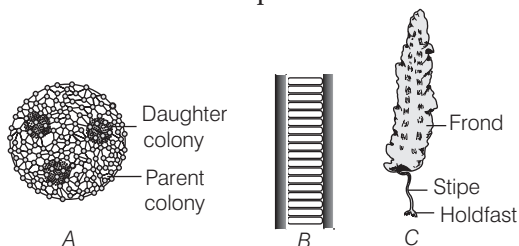
10. Match the following columns.

Column I (Reproduction type)		Column II (Characteristics)	
A. Isogamous	1.	Fusion between male (small) and female (large) gametes	
B. Anisogamous	2.	Both gametes are dissimilar in size	
C. Oogamous	3.	Both gametes are similar in size and non-motile	

Codes

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

11. Identify the given figures of algae and select the correct option.



- (a) A-*Chlamydomonas*, B-*Chara*, C-*Volvox*  
 (b) A-*Volvox*, B-*Ulothrix*, C-*Laminaria*  
 (c) A-*Chara*, B-*Laminaria*, C-*Volvox*  
 (d) A-*Porphyra*, B-*Polysiphonia*, C-*Fucus*

12. Which one of the following statements is incorrect?

- (a) Algae increase the level of dissolved oxygen in the immediate environment  
 (b) Algin is obtained from red algae and carrageenan from brown algae  
 (c) Agar-agar is obtained from *Gelidium* and *Gracilaria*  
 (d) *Laminaria* and *Sargassum* are used as food

13. In which of the following chlorophyll-*a* and *b* is present?

- (a) Red algae (b) Yellow algae  
 (c) Brown algae (d) Green algae

14. 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 nucleic acid surrounded by protein sheath

15. The members of Chlorophyceae usually have a rigid cell wall made up of

- (a) cellulose (outer layer) and algin (inner layer)  
 (b) pectose (inner layer) and peptidoglycan (outer layer)  
 (c) cellulose (inner layer) and pectose (outer layer)  
 (d) chitin (inner layer) and pectose (outer layer)

16. Consider the following statements regarding reproduction in class-Chlorophyceae.

- I. Asexual reproduction is mainly by flagellated zoospores produced in zoosporangia.  
 II. The sexual reproduction shows considerable variation in the type and formation of sex cells and it may be isogamous, anisogamous and oogamous.

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

17. *Volvox*, *Chlamydomonas*, *Chara*, *Ulothrix* are the examples of

- (a) class-Chlorophyceae (green algae)  
 (b) class-Rhodophyceae (red algae) and Chlorophyceae  
 (c) class-Phaeophyceae (brown algae)  
 (d) class-Cyanophyceae (blue-green algae)

18. Kelp (branched form) and *Ectocarpus* (filamentous form) belong to

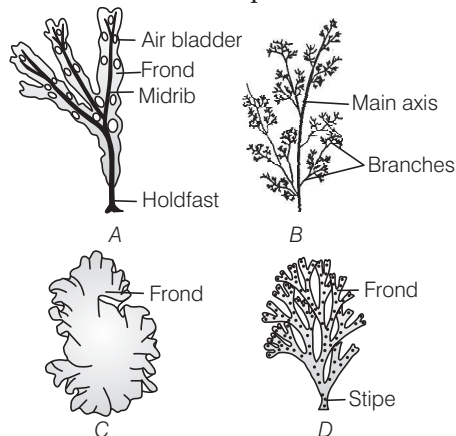
- (a) green algae (b) brown algae  
 (c) red algae (d) blue-green algae

19. Holdfast, stipe and frond constitute the plant body in case of

(NCERT Exemplar)

- (a) Rhodophyceae (b) Chlorophyceae  
(c) Phaeophyceae (d) All of these
20. The pairs that do not belong to class-Phaeophyceae are  
(a) *Ectocarpus* and *Dictyota*  
(b) *Fucus* and *Dictyota*  
(c) *Laminaria* and *Sargassum*  
(d) *Polysiphonia* and *Gelidium*
21. Consider the following statements about sexual reproduction in brown algae.
- Sexual reproduction may be oogamous, isogamous or anisogamous.
  - Union of gametes takes place in water or within the oogonium.
  - The gametes are pear-shaped and bear two laterally attached flagella.
- Which of the statements given above are correct?
- (a) I and II (b) I and III  
(c) II and III (d) I, II and III
22. Consider the following statements.
- They reproduce asexually by non-motile spores and sexually by non-motile gametes.
  - In this class, sexual reproduction is oogamous and accompanied by complex post-fertilisation developments.
  - The common members are *Polysiphonia*, *Porphyra*, *Gracilaria* and *Gelidium*.
- The above characteristics belong to which class of algae?
- (a) Chlorophyceae  
(b) Phaeophyceae  
(c) Both (a) and (b)  
(d) Rhodophyceae

23. Identify the given figures of algae and select the correct option.



- (a) A-*Volvox*, B-*Chlamydomonas*, C-*Chara*, D-*Porphyra*  
(b) A-*Fucus*, B-*Polysiphonia*, C-*Porphyra*, D-*Dictyota*  
(c) A-*Fucus*, B-*Dictyota*, C-*Porphyra*, D-*Polysiphonia*  
(d) A-*Dictyota*, B-*Porphyra*, C-*Fucus*, D-*Polysiphonia*

24. Which one is called amphibian of the plant kingdom?

- (a) *Polygonum* (b) *Casuarina*  
(c) *Wolffia* (d) None of these

25. Bryophytes are the oldest (most primitive) plant type in terms of evolution, these include

- (a) liverworts and mosses  
(b) lycopods and mosses  
(c) lycopods and liverworts  
(d) liverworts and *Volvox*

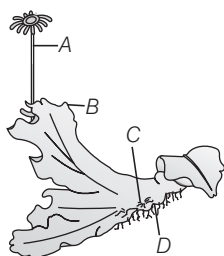
26. The plant body of bryophytes is thallus-like, prostrate or erect and attached to substratum with the help of

- (a) unicellular or multicellular root  
(b) unicellular or multicellular rhizoids  
(c) multicellular roots  
(d) unicellular roots

- 27.** The main plant body of bryophyte is ... *A*... . It produces ... *B*... , hence is called as ... *C*.... .

Fill in the blanks with respect to *A*, *B* and *C* and choose correct option.

- (a) *A*-diploid, *B*-endospores, *C*-sporophyte  
 (b) *A*-haploid, *B*-conidia, *C*-gametophyte  
 (c) *A*-diploid, *B*-spores, *C*-sporophyte  
 (d) *A*-haploid, *B*-gametes, *C*-gametophyte
- 28.** Choose the correct statement.
- (a) Bryophytes can live in soil, but are dependent on water for sexual reproduction  
 (b) The sex organs in bryophytes are unicellular  
 (c) Common example of liverwort is *Polytrichum*  
 (d) Common example of moss is *Marchantia*
- 29.** Choose the incorrect option for bryophytes.
- (a) Archegonium – Flask-shaped female sex organ  
 (b) Antheridium – Unicellular female gametes  
 (c) Antherozoids – Biflagellate male gamete  
 (d) All of the above
- 30.** Examine the figure given here and select the right option giving all the four parts (*A*, *B*, *C* and *D*) correctly identified.



- (a) *A*-Archegoniophore, *B*-Female thallus, *C*-Gemma cup, *D*-Rhizoids  
 (b) *A*-Archegoniophore, *B*-Female thallus, *C*-Bud, *D*-Foot  
 (c) *A*-Seta, *B*-Sporophyte, *C*-Protonema, *D*-Rhizoids  
 (d) *A*-Antheridiophore, *B*-Male thallus, *C*-Globule, *D*-Roots

- 31.** Identify the statements that are true for the sporophyte of bryophytes.

- I. Sporophyte is not free-living. It is multicellular and is attached to the gametophyte for nourishment.  
 II. Spores of bryophytes germinate to produce the gametophyte.  
 III. Meiosis is observed in some cells of sporophyte which produces haploid spores.

Choose the correct option.

- (a) I and II (b) I and III  
 (c) II and III (d) I, II and III
- 32.** Mosses along with lichen are of great ecological importance because
- (a) they colonise barren rocks and decompose rock  
 (b) of their contribution to prevent soil erosion  
 (c) of their contribution in ecological succession  
 (d) All of the above
- 33.** Gemmae are asexual buds, which originate from small receptacles called gemma cups. These are found in
- (a) *Funaria* (b) *Marchantia*  
 (c) Fern (d) *Sphagnum*

- 34.** Choose the correct statement about liverworts.

- (a) The antheridium and archegonium produce antherozoid and egg respectively, which fuse during sexual reproduction  
 (b) Both male and female sex organs may be present on same thalli or different thalli  
 (c) A sporophyte is formed from the zygote which is differentiated into the foot, seta and capsule  
 (d) All of the above
- 35.** *Funaria* and *Marchantia* differ from each other because *Funaria* possesses
- (a) ventral canal cell  
 (b) foot  
 (c) calyptra  
 (d) protonema

**36. Protonema is (NCERT Exemplar)**

- (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

**37. In *Funaria*, tertiary protonema develops into leafy gametophyte.**

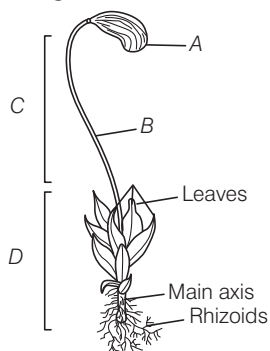
- (a) True
- (b) False
- (c) Cannot say
- (d) Partially true or false

**38. In mosses, vegetative reproduction takes place by**

- (a) fragmentation and budding in the secondary protonema
- (b) gemmae and tubers formation
- (c) protonema and endospore formation
- (d) gemmae formation

**39. In a moss, the sporophyte**

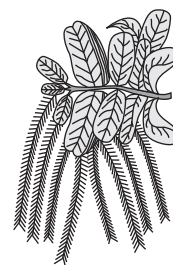
- (a) is partially parasitic on the gametophyte
- (b) produces gametes that give rise to the gametophyte
- (c) arises from a spore produced from the gametophyte
- (d) manufactures food for itself, as well as for the gametophyte

**40. In given figure A, B, C and D represent.**

- (a) A-Apophysis, B-Capsule, C-Sporophyte, D-Gametophyte
- (b) A-Capsule, B-Seta, C-Sporophyte, D-Gametophyte
- (c) A-Apophysis, B-Seta, C-Gametophyte, D-Sporophyte
- (d) A-Apophysis, B-Capsule, C-Gametophyte, D-Sporophyte

**41. Identify the given figures by choosing the correct answer from the options below.**

A



B

- | A               | B         |
|-----------------|-----------|
| (a) Fern        | Salvinia  |
| (a) Cycas       | Salvinia  |
| (a) Selaginella | Equisetum |
| (a) Equisetum   | Salvinia  |

**42. Which of the following plant group is considered as first terrestrial plant to possess vascular tissues xylem and phloem?**

- (a) Bryophytes
- (b) Pteridophytes
- (c) Gymnosperms
- (d) Angiosperms

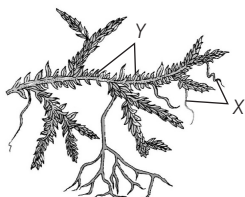
**43. Select the correct sequential arrangement of reproductive structures in pteridophytes.**

- (a) Sporophyll → Strobili → Sporangia → Spore mother cell → Spores
- (b) Strobili → Sporophyll → Sporangia → Spores
- (c) Spores → Sporophyll → Sporangia → Strobili
- (d) Spores → Sporangia → Sporophyll → Strobili

**44. A prothallus is**

- (a) a structure in pteridophytes formed before the thallus develops
- (b) a sporophytic free-living structure formed in pteridophytes
- (c) a gametophytic free-living structure formed in pteridophytes
- (d) a primitive structure formed after fertilisation in pteridophytes

45. Identify the figure of a pteridophyte and choose the correct option for the match *X* and *Y*.



- (a) *X* – Roots (b) *Y* – Stem  
(c) *Y* – Internodes (d) None of these
46. The sporophytes in pteridophyte, consist of leaf-like appendages called  
(a) thalli  
(b) sporophylls  
(c) megaphylls  
(d) sporangia
47. Heterospory is the production of heterosporous pteridophytes. The heterospores are  
(a) haploid and diploid alike spores  
(b) large and small spores  
(c) diploid and tetraploid alike spores  
(d) sexual and asexual spores
48. *Selaginella* and *Salvinia* are considered representing a significant step towards evolution of seed habit because  
(a) female gametophyte is free and gets dispersed like seeds  
(b) female gametophyte lacks archegonia  
(c) megaspores possess endosperm and embryo surrounded by seed coat  
(d) embryo develops in female gametophyte which is retained on parent sporophyte
49. Match the following columns.

Column I		Column II	
A. Psilopsida	1.	<i>Oryopteris, Pteris, Adiantum</i>	
B. Lycopsidea	2.	<i>Equisetum</i>	
C. Sphenopsida	3.	<i>Selaginella</i>	
D. Pteropsida	4.	<i>Psilotum</i>	

## Codes

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

50. Gymnosperms are characterised by  
(a) winged seeds  
(b) naked seeds  
(c) multiflagellate sperms  
(d) seeds inside fruits
51. The giant redwood tree (*Sequoia sempervirens*) is a/an (NCERT Exemplar)  
(a) angiosperm (b) free fern  
(c) pteridophyte (d) gymnosperm
52. Microsporangia in gymnosperms are produced  
(a) on the middle portion of microsporophyll  
(b) on the upperside of microsporophyll  
(c) on the middle portion of megasporophyll  
(d) at the extreme tip of microsporophyll
53. The cones bearing megasporophylls with ovules are called  
(a) male strobili (b) female strobili  
(c) archegonia (d) microsporangia
54. In gymnosperms, the reduced gametophyte is called  
(a) endospore (b) pollen grain  
(c) ovule (d) aplanospore
55. In gymnosperms, the multicellular female gametophyte is retained within  
(a) microsporangium (b) megasporangium  
(c) male gametophyte (d) archegonia
56. Identify the figures *A*, *B* and *C* and choose the correct option.



- (a) A–Cycas, B–Ginkgo, C–Pinus  
(b) A–Cycas, B–Pinus, C–Ginkgo  
(c) A–Ginkgo, B–Cycas, C–Pinus  
(d) A–Pinus, B–Cycas, C–Ginkgo

**Assertion-Reasoning MCQs**

**Direction** (Q. Nos. 57-71) 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
- 57. Assertion** (A) Artificial system of classification separated closely related species.  
**Reason** (R) Artificial system gave equal weightage to vegetative and sexual characteristics.
  - 58. Assertion** (A) Algae are the primary producers of many food cycles.  
**Reason** (R) Half of the total carbon dioxide-fixation on earth is carried out by algae.
  - 59. Assertion** (A) Algae show only isogamous type of reproduction.  
**Reason** (R) In algae, gametes can never be non-flagellated.
  - 60. Assertion** (A) Red colour of Rhodophyta is due to the abundant formation of *r*-phycoerythrin.  
**Reason** (R) *r*-phycoerythrin is able to absorb blue-green wave length of light and reflect red colour.
  - 61. Assertion** (A) Red algae contributes in development of coral reefs.  
**Reason** (R) Red algae secrete and deposit calcium carbonate over their walls.
  - 62. Assertion** (A) *Chlorella* and *Spirulina* are used as a food supplement by space travellers.  
**Reason** (R) *Chlorella* and *Spirulina* are unicellular algae.
  - 63. Assertion** (A) Bryophytes are the amphibians of plant kingdom.  
**Reason** (R) They are found in swamps and the areas, where water and land meet.
  - 64. Assertion** (A) Bryophytes are a class of kingdom-Plantae.  
**Reason** (R) Algae, fungi, lichens and mosses are included in bryophytes.
  - 65. Assertion** (A) The life cycle of *Funaria* is called diplo-haplontic.  
**Reason** (R) In *Funaria*, there is alternation of haploid gametophytic and diploid sporophytic phases, one becoming parent of the other.
  - 66. Assertion** (A) *Lycopodium* and *Selaginella* are heterosporous.  
**Reason** (R) In heterosporous condition, two kinds of spores are produced by the plant.
  - 67. Assertion** (A) Production of two types of spores is a pre-requisite of seed habit.  
**Reason** (R) In pteridophytes, *Lycopodium* is precursor of seed habit.
  - 68. Assertion** (A) Heterospory and retention of female gametophyte are responsible for origin of seed habit in *Selaginella*.  
**Reason** (R) *Psilotum* is a living fossil.
  - 69. Assertion** (A) Fertilisation in *Cycas* is called zooidogamy.  
**Reason** (R) Fertilisation in *Cycas* takes place by the formation of pollen tube.

**70. Assertion (A)** The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind.

**Reason (R)** Unlike bryophytes and pteridophytes, in gymnosperms, the male and female gametophytes do not have an independent free-living existence.

**71. Assertion (A)** Gymnosperms do not produce fruit.

**Reason (R)** Ovules of gymnosperms are enclosed within the ovaries.

### Case Based MCQs

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

Algae are diverse group of aquatic organisms that have the ability to conduct photosynthesis. They are unicellular or multicellular and undifferentiated organisms that occur in variety of forms and sizes. Algae belong to a polyphyletic group, i.e. the organisms of this group are not necessarily related to each other. Based on the pigment, composition and reserved food material, algae has been divided into three major classes, viz. Chlorophyceae, Phaeophyceae and Rhodophyceae.

The members of these classes also differ in cell wall composition, stored food material, body structure, mode of reproduction, etc.

(i) A representative organism of class-Rhodophyceae is

- (a) *Spirogyra* (b) *Fucus*  
(c) *Polysiphonia* (d) *Chlorella*

(ii) Multicellular, saline forms are found in

- (a) Rhodophyceae  
(b) Chlorophyceae  
(c) Phaeophyceae  
(d) All of the above

(iii) Stored food material in class-Phaeophyceae is

- (a) mannitol and laminarin  
(b) floridean starch  
(c) pyrenoids  
(d) All of the above

(iv) Cell wall of *Porphyra* (red algae) contains

- (a) cellulose (b) pectins  
(c) polysulphate esters (d) All of these

(v) Consider the following statements.

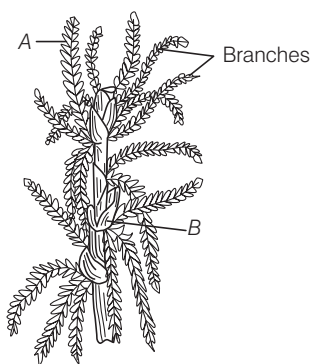
I. Large amounts of hydrocolloids are produced by certain marine red and brown algae.

II. Algin and carrageenan are commercially used as water holding materials.

Choose the correct option.

- (a) Statement I is correct, but II is incorrect  
(b) Statement I is incorrect, but II is correct  
(c) Both statements I and II are correct  
(d) Both statements I and II are incorrect

**73.** Identify the given bryophyte and answer the questions as follows



(i) Which of the following statements are correct for the given bryophyte species above.

I. The given diagram represent *Sphagnum* gametophyte.

II. The given species is a liverwort.

III. It provides peat.

IV. Scales and elaters are not found in it.

**Codes**

- (a) II and III (b) I and IV  
(c) II, III and IV (d) I, III and IV

(ii) A bryophyte found in dry habitat is

- (a) *Polytrichum* (b) *Marchantia*  
(c) *Riccia* (d) All of these

(iii) The thallus of bryophytes

- (a) possesses roots  
(b) bears very small leaves  
(c) is more differentiated than that of algae  
(d) All of the above

(iv) The female sex organ in bryophytes is

- (a) conspicuous and reduced  
(b) flask-shaped structure of thallus  
(c) called sporophyll  
(d) Both (a) and (b)

(v) *Marchantia* is a bryophyte used to cure

- (a) lung infection (b) skin rashes  
(c) joint pain (d) All of these

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

Pteridophytes are primitive seedless vascular plants. Haeckel (1860) called these groups of plants as 'Pteridophytes' because of their pinnate or feather like fronds (leaves). These shade loving plants are few centimeters to 20 m long. The plant body of pteridophytes is differentiated into true root, stem and leaves which are either small or large. They also possess well-differentiated vascular tissues, i.e. xylem and phloem. Most of the pteridophytes are homosporous with few exceptional heterosporous species.

The sporophyte produces spores and gametophyte bears antheridia and archegonia.

(i) An aquatic pteridophyte is

- (a) *Azolla* (b) *Salvinia*  
(c) *Marsilea* (d) All of these

(ii) Macrophylls are found in

- (a) ferns (b) *Selaginella*  
(c) *Equisetum* (d) All pteridophytes

(iii) *Selaginella* possesses

- (a) strobili  
(b) heterospores  
(c) sporophytic plant body  
(d) All of the above

(iv) Pteridophytes are also known as

- (a) cryptogams (b) vascular cryptogams  
(c) amphibious plants (d) phanerogams

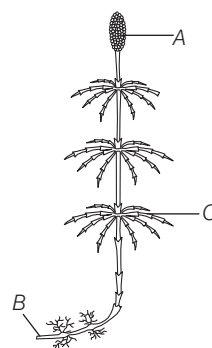
(v) **Assertion (A)** In pteridophytes zygote produces a multicellular sporophyte.

**Reason (R)** Sporophyte is the dominant phase in life cycle of pteridophytes.

Choose the correct option.

- (a) Statement I is correct, but II is incorrect  
(b) Statement I is incorrect, but II is correct  
(c) Both statements I and II are correct  
(d) Both statements I and II are incorrect

**75.** Identify the given figure of a pteridophyte species and answer the questions that follow



(i) Choose the correct option for the match about the labels *A*, *B* and *C* in the above given figure.

- (a) *A*—Strobilus (b) *B*—Internode  
(c) *C*—Roots (d) All of these

(ii) In pteridophytes, phloem is with

- (a) sieve cells (b) sieve tubes  
(c) companion cells (d) bast fibres

(iii) Pteridophytes mostly occur in

- (a) cool, damp and shady places  
(b) dry and humid areas  
(c) hot and sunny places  
(d) freezing temperatures

(iv) Which pteridophyte is called as horse-tail?

- (a) *Equisetum*
- (b) *Lycopodium*
- (c) *Marsilea*
- (d) *Selaginella*

(v) Which is wrong about pteridophytes?

- (a) Gametophytic phase is dominant
- (b) Sporophytic phase is dominant
- (c) Gametophyte is independent
- (d) Rhizoids are attached to pinnae

## ANSWERS

### Multiple Choice Questions

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

### Assertion-Reasoning MCQs

- |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 57. (a) | 58. (b) | 59. (c) | 60. (a) | 61. (a) | 62. (b) | 63. (a) | 64. (c) | 65. (a) | 66. (d) |
| 67. (c) | 68. (b) | 69. (b) | 70. (b) | 71. (c) |         |         |         |         |         |

### Case Based MCQs

- |   |   |
|---|---|
| 72. (i) (c), (ii) (a), (iii) (a), (iv) (d), (v) (c) | 73. (i) (d), (ii) (a), (iii) (c), (iv) (b), (v) (a) |
| 74. (i) (a), (ii) (a), (iii) (d), (iv) (b), (v) (b) | 75. (i) (a), (ii) (a), (iii) (a), (iv) (a), (v) (a) |

## EXPLANATIONS

- (b) The kingdom-Plantae has five divisions, namely algae, bryophytes, pteridophytes, gymnosperms and angiosperms. They are found on land, marine and freshwater ecosystems.
- (d) Phytochemistry, anatomy and structural embryology are the basis of natural system of classification. Thus, option (d) is correct.
- (a) Evolutionary relationship of organism is discussed under phylogenetic system of classification. It is based on evolution of life and shows the genetic relationship among organisms.
- (c) Pair given in option (c) is incorrect and can be corrected as  
Chemotaxonomy is based upon the characteristics of various chemical constituents of organisms.

Chemical constituents of plant species have been found to be unvarying and do not change easily.

Chemical characters have also helped in establishing relationships and statistical evaluation of taxonomic information.

- (c) Algae are chlorophyll bearing, simple, thalloid and autotrophic organism. Their body is thalloid, i.e. it is not differentiated into root, stems or leaves. Algae are photoautotrophic, i.e. perform autotrophic mode of nutrition by performing photosynthesis due to the presence of chlorophyll in their chloroplast.
- (d) Option (d) is correct. Algae are predominantly aquatic and occur in both marine as well as freshwater habitats. Some are terrestrial and grow in moist places like moist stones, soils and wood. Some of them also occur in association with fungi (lichen) and animals (e.g. on sloth bear).

12. (b) Statement in option (b) is incorrect and can be corrected as  
Algin is obtained from brown algae and carrageenan from red algae.  
Rest other statements are correct.
14. (c) Pyrenoids are proteinaceous bodies present within the chloroplast. These mainly synthesise and store starch. In members of Chlorophyceae, pyrenoid has a central protein and a surrounding starch sheath.
15. (c) The members of class-Chlorophyceae usually have a two layered rigid cell wall made up of cellulose and pectose. Inner layer of cell wall is made up of cellulose, while outer layer is made up of pectose.
18. (b) Brown algae show great variation in size and form. They range from simple branched, filamentous forms (*Ectocarpus*) to profusely branched forms as represented by kelps, which may reach a height of 100 metres.
19. (c) Option (c) is correct as  
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.
20. (d) *Polysiphonia* and *Gelidium* belong to class-Rhodophyceae. These are red algae.
24. (a) *Polygonum* is a moss, i.e. bryophyte and since they need water for fertilisation, they are called amphibians of the plant kingdom.
25. (a) Bryophytes are the oldest (most primitive) plant type in terms of evolution, these include liverworts and mosses. The fossil records of these plants, so far been found dated back to almost 500 million years ago. Among bryophytes, liverworts appeared first and mosses appeared later.
26. (b) The plant body of bryophytes is multicellular, thallus-like, prostrate or erect and fixed to soil by unicellular or multicellular rhizoids. These rhizoids are extensions of lower epidermal cells and are similar in function like of root hairs in vascular plants.
28. (a) Statement in option (a) is correct. Other statements are incorrect and can be corrected as  
In bryophytes, sex organs are multicellular. Common example of liverwort is *Marchantia* and of moss is *Funaria*.
29. (b) Option (b) is incorrect and can be corrected as  
Antheridium is multicellular male sex organ in bryophytes. It produces biflagellated male gametes, i.e. antherozoids.
32. (d) Bryophytes show considerable economic importance. They colonise barren rocks along with lichens and decompose rocks (ecological succession). When they grow on rocks, they help in soil formation. Some bryophytes also work as soil binders when they grow in aggregations forming dense mats on the soil. This reduces the impact of rainfall, thus preventing soil erosion.
35. (d) In *Funaria*, the spores form alga-like filament called protonema, but in *Marchantia*, spores germinate to form thalloid structure which is independent gametophyte plant. In both *Marchantia* and *Funaria*, there is single ventral canal cell. The sporophytes of both *Marchantia* and *Funaria* have foot and calyptra structures.
36. (a) A protonema is a thread-like chain of cells that forms the first stage (the haploid phase) of the life cycle of mosses.
37. (b) In the life cycle of *Funaria*, secondary protonema develops into a leafy stage as lateral bud. It consists of upright slender axes bearing spirally arranged leaves.
38. (a) In mosses, vegetative reproduction occurs through fragmentation or through budding in secondary protonema.
39. (a) In mosses, the sporophyte developing from the embryo is a simple structure without rhizoids and is differentiated into foot, seta and capsule. It is parasitic (partially or wholly) on the gametophyte as it is attached and is nutritionally dependent upon the gametophyte.
42. (b) Pteridophytes are considered as first terrestrial plants to possess vascular tissues, xylem and phloem. All their vegetative parts possess vascular tissues (i.e. xylem and phloem) organised in definite groups.

44. (c) Prothallus is a gametophytic free-living structure in the life of a pteridophytes. Spores of pteridophyte germinates to give rise to a short-lived inconspicuous, small but multicellular, heart-shaped, free-living, mostly photosynthetic thalloid gametophytes called prothallus.
46. (b) In pteridophytes, the sporophyte consists of leaf-like appendages called sporophylls. Sporophyll in cluster form distinct compact structure called strobili or cones, e.g. *Selaginella* and *Equisetum*.
47. (b) Two different types of spores are formed in some pteridophytes. They differ significantly in their size and function. This phenomenon is called heterospory, which is production of heterosporous pteridophytes. The two types of spores are microspores (small spores) and megaspores (large spores), e.g. *Selaginella* and *Marsilea*, etc.
48. (d) *Selaginella* and *Salvinia* represent evolution in seed habit because embryo develops in female gametophyte which is retained on parent sporophyte.
50. (b) Gymnosperms lack ovary, thus fruits are absent. They possess naked seeds due to the presence of naked ovules.
51. (d) *Sequoia sempervirens* is a gymnospermic plant. It is a group of giant redwood trees having thick, woody, branched stems. These plants also have some xeric adaptations, which help them to survive in adverse climatic conditions.
52. (d) Microsporangia are produced at the extreme tip of microsporophyll. Microsporangia is a sporangium that produces spores that give rise to male gametophyte.
53. (b) The cones bearing megasporophylls with ovules are called female strobili or megasporangia or macrosporangiate.
57. (a) Both A and R are true and R is the correct explanation of A.  
Artificial system separated the closely related species since they were based on a few characteristics like habit, colour, number and shape of leaves. They were based mainly on vegetative characters or on the androecium structure.
58. (b) Both A and R are true, but R is not the correct explanation of A.  
It gave equal weightage to vegetative and sexual characteristics of an organism. This is not acceptable since we know that often the vegetative characters are more easily affected by environment.  
Algae are of paramount importance as primary producers of energy rich compounds which form the basis of the food cycles of all aquatic animals. Many species of *Porphyra*, *Laminaria* and *Sargassum* are among the 70 species of marine algae used as food.  
Algae also perform  $\text{CO}_2$ -fixation on earth through photosynthesis. They increase the level of dissolved oxygen in their immediate environment.
59. (c) A is true, but R is false because Sexual reproduction in algae takes place through fusion of two gametes. These gametes can be flagellated and similar in size (as in *Chlamydomonas*) or non-flagellated (non-motile), but similar in size (as in *Spirogyra*.) Such reproduction is called isogamous.
61. (a) Both A and R are true and R is the correct explanation of A.  
Coral reefs are formed by the accumulation of calcareous exoskeletons of coral animals, calcareous red algae and molluscs. In some species of red algae (coralline algae), cell walls become hardened with calcium carbonate. These are important for coral reef formation.
63. (a) Both A and R are true and R is the correct explanation of A.  
Bryophytes are the dwellers of transitional habitat between the aquatic and terrestrial habitats. It is represented by the swamps and the areas where water and land meet. It is also called as amphibious zone where mosses, liverworts and hornworts collectively called bryophytes are inhabiting. Since, bryophytes usually grow in amphibious situation and cannot complete their life cycle without external water, they are called the amphibians of plant kingdom.

64. (c) A is true, but R is false because

Bryophyta is a class of kingdom-Plantae. It includes various mosses and liverworts, that are found in moist shaded areas in hilly regions.

Algae, fungi, lichens are not included in bryophytes.

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

In the life cycle of *Funaria*, two distinct phases occur. One of these is represented by a haploid, independent, leafy moss plant (gametophyte) which alternates with the other, represented by diploid, leafless sporogonium (short-lived sporophyte), which is totally or partially dependent on the leafy gametophyte for its nutrition.

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

*Lycopodium* is homosporous pteridophyte, i.e. it produces similar kind of spores, while *Selaginella*, *Stylos*, *Isoetes*, *Salvinia*, *Azolla*, *Pilularia*, *Regnellidium* and *Marsilea* are heterosporous pteridophytes, i.e. the spores produced by them are of two kinds macro (large) and micro (small) spores.

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

Production of two different types of spores is called heterospory. It is an important pre-requisite of evolutionary development in the vascular plants.

It ultimately leads to seed development. In pteridophytes, *Selaginella* plant (not *Lycopodium*) is the precursor of the seed habit, as it is well-marked in them. In *Lycopodium*, homosporous spores are produced, i.e. all spores are of similar kind.

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

*Selaginella* is a pteridophyte. In them two kinds of spores, macro (large) and micro (small) spores are produced. This phenomenon is called heterospory. The megaspores and microspores germinate and give rise to female and male gametes, respectively. The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The development of the zygotes into young

embryos take place within the female gametophytes. This event is a precursor to the seed habit and considered an important step in evolution.

*Psilotum* is a pteridophytic plant also known for having primitive pteridophytic characters, so is known as living fossil.

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

*Cycas* is a gymnospermic plant in which fertilisation process is called zooidogamy as male gametes or sperms swim through thin film of water to reach egg cell. Fertilisation in *Cycas* may also take place by siphonogamy, i.e. pollen tube is formed through which male nucleus passes.

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

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. Unlike bryophytes and pteridophytes, the male and female gametophytes in gymnosperms do not have an independent free-living existence because they remain within the sporangia retained on the sporophyte.

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

In gymnosperms plants the ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation.

72. (i) (c) *Polysiphonia* is a filamentous red algae that have polysiphonous nature of its thallus.

(ii) (a) Members of class-Rhodophyceae are multicellular and found in saline marine water in the warmer areas.

(iii) (a) In class-Phaeophyceae, members store food material in the form of complex carbohydrates such as laminarin and mannitol.

(iv) (d) *Porphyra* belongs to class-Rhodophyceae. It contains cellulose, pectins and polysulphate esters in its cell wall.

(v) (c) Both statements I and II are correct.

73. (i) (d) *Sphagnum* is a moss that provides peat. The latter is used as fuel. Scales and elaters are absent in mosses.
- (ii) (a) *Polytrichum* is found in dry habitat.
- (iii) (c) In bryophytes, the thallus is more differentiated than that of algae. It is attached to the substratum by unicellular or multicellular rhizoids. Root, stem and leaves are absent.
- (iv) (b) The female sex organ or archegonium, appears flask-shaped or bud-like on the surface of thallus.
- (v) (a) *Marchantia* is used to cure lung and liver infections. It has anti-tumour properties too.
74. (iv) (b) Pteridophytes are called vascular cryptogams because among cryptogams, the vascular strands are present only in pteridophytes. All their vegetative parts possess vascular tissues (i.e. xylem and phloem).
75. (i) (a) *A* is Strobilus, *B* is Rhizome and *C* is Branch.
- (ii) (a) In pteridophytes, phloem contains only sieve cells. Pteridophytes are called seedless vascular cryptogams as they represent the first group of land plants with vasculature, i.e. xylem and phloem.
- (iii) (a) Pteridophytes mostly occur in damp, cool and shady places. They are fundamentally terrestrial plants, but they are dependent on an external source of water to complete their life cycle.
- (iv) (a) *Equisetum* is commonly called scouring rushes or horse tails.
- (v) (a) Option (a) is incorrect about pteridophytes. It can be corrected as In the life cycle of pteridophytes, sporophytic phase is dominant over gametophytic phase. Rest options are correct about pteridophytes.