Chapter 3
Plant Kingdom Biology

Question 1:
What is the basis of classification of algae?

Solution 1:
The presence or absence of pigments is the main basis of classification of algae.

- Chlorophyceae**:** Chlorophyll a and b are present in them and impart green colour. Chlorophyceae are also called 'blue-green algae'.
- Phaeophyceae**:** Chlorophyll a and c and fuxoxanthin are present. Fucoxanthin imparts brown colour. Phaeophyceae are also called 'brown algae'.
- Rhodophyceae**:** Chlorophyll a and d and phycoerythrin are present. Phycoerythrin imparts red colour. Rhodophyceae are also called 'red algae'.

Question 2:
When and where does reduction division take place in the life cycle of a liverwort, a moss, a fern, a gymnosperm and an angiosperm?

Solution 2:
In liverwort, moss and fern, during sexual reproduction, the sporophytic phase of the plant produces haploid spores after meiosis which happens in the spore mother cells. While in gymnosperm and angiosperm, meiosis takes place in anthers and ovary during the formation of pollen grains and ovules.

Question 3:
Name three groups of plants that bear archegonia. Briefly describe the life cycle of any one of them.

Solution 3:
Bryophytes, Pteridophytes and Gymnosperms bear distinct archegonia. Life cycle of gymnosperms

- Reproduction**:**The gymnosperms are heterosporous; they produce haploid microspores and megaspores. The two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax or compact strobili or cones.
- Male **gamete:** The strobili bearing microsporophylls and microsporangia are called microsporangiate or male strobili. The microspores develop into a male gametophytic generation which is highly reduced and is confined to only a limited number of cells. This reduced gametophyte is called a pollen grain. The development of pollen grains takes place

within the microsporangia.

- Female **gamete:** The cones bearing megasporophylls with ovules or megasporangia are called macrosporangiate or female strobili. The male or female cones or strobili may be borne on the same tree (Pinus) or on different trees (Cycas). The megaspore mother cell is differentiated from one of the cells of the nucellus. The nucellus is protected by envelopes and the composite structure is called an ovule. The ovules are borne on megasporophylls which may be clustered to form the female cones. The megaspore mother cell divides meiotically to form four megaspores. One the megaspores enclosed within the megasporangium(nucellus) develops into a multicellular female gametophyte that bears two or more archegonia or female sex organs. The multicellular female gametophyte is also retained within megasporangium.
- Fertilization**:** The pollen grain is released from the microsporangium. They are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia. Following fertilisation, zygote develops into an embryo and the ovules into seeds.

Question 4:

Mention the ploidy of the following: protonemal cell of a moss; primary endosperm nucleus in dicot, leaf cell of a moss; prothallus cell of a ferm; gemma cell in Marchantia; meristem cell of monocot, ovum of a liverwort, and zygote of a fern.

Solution 4:

- Protonemal cell of a moss – Haploid
- Primary endosperm nucleus in a dicot – Triploid
- Leaf cell of a moss – Haploid
- Prothallus of a fern – Haploid
- Gemma cell in Marchantia – Haploid
- Meristem cell of a monocot – Diploid
- Ovum of a liverwort – Haploid
- Zygote of a fern – Diploid

Question 5:

Write a note economic importance of algae and gymnosperms.

Solution 5:

Economic importance of algae: Algae are useful to man in a variety of ways. They perform half of the total carbon dioxide-fixation on earth by photosynthesis, acting as the primary producers in aquatic habitats. Many species of marine algae such as Porphyra, Sargassum, and Laminaria are edible. Chlorella and Spirulina are rich in proteins. Thus, they are used as food

supplements. Agar is used in the preparation of jellies and ice-cream. It is obtained from Gelidium and Gracilaria. Carrageenin is used as an emulsifier in chocolates, paints, and toothpastes. It is obtained from the red algae. Many red algae such as Corallina are used in treating worm infections.

Economic importance of gymnosperms: Gymnospermous plants are widely used as ornamentals. Many conifers such as pine, cedar, etc., are sources of the soft wood used in construction and packing. Medicinal uses: An anticancer drug Taxol is obtained from Taxus. Many species of Ephedra produce ephedrine, which can be used in the treatment of asthma and bronchitis. The seeds of Pinus gerardiana are edible. Resins are used commercially for manufacturing sealing waxes and water-proof paints. A type of resin known as turpentine is obtained from various species of Pinus.

Question 6:

Both gymnosperms and angiosperms bear seeds, then why are they classified separately?

Solution 6:

The seeds of gymnosperms are naked i.e., they lack any kind of covering around them, while that of angiosperms are covered mostly by fruits. The presence or lack of covering leads to very different methods of dispersion and fertilization events. Therefore, they are classified separately.

Question 7:

What is heterospory? Briefly comment on its significance. Give two examples.

Solution 7:

Heterospory is a phenomenon in which two kinds of spores are borne by the same plant. These spores differ in size. The smaller one are called microspore and the bigger ones are called megaspore. Microspore produce male gametophytes and megaspores produce female gametophyte. Thus, it is considered as a crucial step in evolution as it is precursor to the seed habit.

This ultimately led to seed development in gymnosperms and angiosperms.

Question 8:

Explain briefly the following terms with suitable examples:

(i) Protonema (ii) Antheridium

(iii) Archegonium (iv) Diplontic

(v) Sporophyll (vi) Isogamy

Solution 8:

(i) Protonema: It is the first stage in the life cycle of a moss, developing directly from the spore. It consists of creeping, green, branched, and often filamentous structures.

(ii) Antheridium: It is the male sex organ present in bryophytes and pteridophytes and is surrounded by a jacket of sterile cells. It encloses the sperm mother cells, which give rise to the male gametes.

(iii) Archegonium: It is the female sex organ present in bryophytes, pteridophytes, and gymnosperms. In bryophytes and pteridophytes, it generally has a swollen venter and a tubular neck, and contains the female gamete called the egg.

(iv) Diplontic: It is the term used for the life cycles of seed bearing plants (gymnosperms and angiosperms). In these plants, the diploid sporophyte is dominant, photosynthetic, and independent. The gametophyte is represented by a single-celled (or a few called) structure.

(v) Sporophyll: In pteridophytes, the sporophytic plant body bears sporangia. These sporangia are subtended by leaf-like appendages known as sporophylls. In gymnosperms, microsporophylls and megasporophylls are found. These bear microspores and megaspores respectively.

(vi) Isogamy: It is a type of sexual reproduction involving the fusion of morphologically-similar gametes. This means that the gametes are of the same size, but perform different functions. This type of reproduction is commonly observed in Spirogyra.

Question 9:

Differentiate between the following:

(i) red algae and brown algae

(ii) liverworts and moss

(iii) homosporous and heterosporous pteridophyte

(iv) syngamy and triple fusion

Solution 9:

(i)Red algae and Brown Algae

Red algae	Brown algae
Red algae are grouped under the class Rhodophyceae.	Brown algae are grouped under the class Phaeophyceae.

They contain floridean starch as stored food.	They contain mannitol or laminarin as stored food.
They contain the photosynthetic pigments chlorophylls a and d, and phycoerythrin.	They contain the photosynthetic pigments chlorophylls a and c, and fucoxanthin.
Their call walls are composed of cellulose, pectin, and phycocolloids.	Their cell walls are composed of cellulose and algin.
Flagella are absent	Flagella are present

(ii) Liverwortsand Moss

Liverworts	Moss
They have unicellular rhizoids	They have multicellular rhizoids.
Scales are present very often	Scales are absent
They are generally thalloid, with dichotomous branching.	They are foliage, with lateral branching.
Gemma cups are present	Gemma cups are absent
Sporophyte has very little photosynthetic tissue	Sporophyte has abundant photosynthetic tissue

(iii) Homosporous pteridophytes and Heterosporous pteridophytes

Homosporouspteridophytes	Heterosporouspteridophytes
They bear spores that are of the same type.	They bear two kinds of spores microspores and megaspores.
They produce bisexual gametophytes.	They produce unisexual gametophytes.

(iv) Syngamy and Triple fusion

Syngamy	Triple fusion
It is the process of fusion of the male gamete with the egg in an angiosperm.	It is the process of fusion of the male gamete with the diploid secondary nucleus in an angiosperm.
A diploid zygote is formed as a result of syngamy.	A triploid primary endosperm is formed as a result of triple fusion.

Question 10:

How would you distinguish monocots from dicots?

Solution 10:

Characteristic	Monocot	Dicot
Morphology		
Roots	Fibrous roots	Tap roots
Venation	Generally parallel venation	Generally reticulate venation

Flowers	Trimerous flowers	Pentamerous flowers
Cotyledons in seeds	One	Two
Anatomy		
No. of vascular bundles in stem	Numerous	Generally 2 – 6
Cambium	Absent	Present
Leaves	Isobilateral	Dorsiventral

Question 11:

Match the followings (column I with column II)

	Column I		**Column II**
(a)	Chlamydomonas	(i)	Moss
(b)	Cycas	(ii)	Pteridophyte
(c)	Selaginella	(iii)	Algae
(d)	Sphagnum	(iv)	Gymnosperm

Solution 11:

	Column I		**Column II**
(a)	Chlamydomonas	(iii)	Algae
(b)	Cycas	(iv)	Gymnosperm
(c)	Selaginella	(ii)	Pteridophyte
(d)	Sphagnum	(i)	Moss

Question 12:

Describe the important characteristics of gymnosperms.

Solution 12:

Important characteristics of gymnosperms are:

→ The seeds of these plants are not enclosed in fruits.

→The plant-body ranges from medium to tall trees and shrubs. The giant redwood tree Sequoia is one of the tallest trees in the world.

→ The root system consists of tap roots. The coralloid roots present in Cycas are associated with nitrogen-fixing cyanobacteria.

→ The stem can be branched (as in Pinus and Cedrus) or un-branched (as in Cycas).

→ The leaves can be simple (as in Pinus)or compound (pinnate in Cycas). The leaves are needle-like, with a thick cuticle and sunken stomata. These help in preventing water loss.
→ Gymnosperms are heterosporous. They bear two kinds of spores - microspores and megaspores.
→ Flowers are absent. The microsporophylls and megasporophylls are arranged to form compact male and female cones.
→ Pollination occurs mostly through wind and pollen grains reach the pollen chamber of the ovule through the micropyle.
→ The male and female gametophytes are dependent on the sporophyte.
→ The seeds contain haploid endosperms and the covering of the megasporangium turns into diploid seed shell.