Botany Questions for PhD Entrance Exam with Answers (PDF)

Botany questions in PhD entrance exams assess a candidate's deep understanding and analytical thinking in advanced plant sciences. They often focus on specialized topics such as advanced plant genetics, molecular biology techniques, stress physiology, and plant-microbe interactions. Questions may involve interpreting experimental data, proposing research hypotheses, and applying complex concepts to novel scenarios. Knowledge of current literature, research methodologies, and recent advancements in plant science is essential for success. Critical thinking, coupled with thorough preparation using high-level textbooks and recent scientific publications, is key to excelling in these exams. This is article is about Botany Questions for PhD Entrance Exam with Answers. You can download the questions as PDF, the link is provided below the post.

(1) The transition from C3 to C4 photosynthesis in plants is mainly associated with the evolution of:

(a) Increased stomatal density
(b) Development of Kranz anatomy
(c) Reduced CO2 fixation by RuBisCO
(d) Increased Rubisco activity in mesophyll cells

Answer: (b)

Kranz anatomy in C4 plants, characterized by a special arrangement of mesophyll and bundle sheath cells, enables efficient CO2 fixation.

(2) Which of the following mechanisms is most likely responsible for long-distance transport of water in tall trees?

(a) Transpiration pull

(b) Root pressure

(c) Capillary action

(d) Bulk flow via sieve tubes

Answer: (a)

Transpiration pull, aided by cohesion and adhesion of water molecules, is primarily responsible for water transport in tall trees.

(3) In which of the following plant systems is the MADS-box gene family primarily involved?

(a) Root development

(b) Leaf patterning

(c) Flower organ identity

(d) Secondary vascular growth

Answer: (c)

MADS-box genes play a crucial role in determining the identity of floral organs during flower development in angiosperms.

(4) Which of the following enzymes is crucial for the synthesis of the primary product in the Calvin cycle?

(a) NADPH dehydrogenase

(b) Phosphoenolpyruvate carboxylase

(c) Ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO)

(d) ATP synthase

Answer: (c)

RuBisCO catalyzes the fixation of CO2 into ribulose-1,5-bisphosphate in the Calvin cycle, forming 3-phosphoglycerate.

(5) The presence of which feature differentiates CAM (Crassulacean Acid Metabolism) plants from C3 and C4 plants in terms of CO2 fixation?

(a) The CO2 is fixed at night and stored as malic acid.

(b) The Calvin cycle occurs in mesophyll cells.

(c) CAM plants require more water than C3 and C4 plants.

(d) CAM plants do not use Rubisco for CO2 fixation.

Answer: (a)

In CAM plants, CO2 is fixed at night and stored as malic acid, which is later decarboxylated during the day for photosynthesis.

(6) Which of the following is the most significant factor contributing to the high efficiency of C4 photosynthesis in hot environments?

(a) High stomatal density

(b) Increased Rubisco activity in the bundle sheath cells

(c) Compartmentalization of carbon fixation

(d) Low transpiration rate

Answer: (c)

C4 photosynthesis separates CO2 fixation into two distinct cell types (mesophyll and bundle sheath cells), increasing efficiency in hot environments.

(7) Which plant hormone is most involved in regulating the plant's response to biotic and abiotic stress, particularly during drought conditions?

(a) Cytokinin

(b) Ethylene

(c) Abscisic acid (ABA)

(d) Auxins

Answer: (c)

Abscisic acid (ABA) is a key hormone in regulating stress responses, particularly by inducing stomatal closure to conserve water during drought.

(8) Which of the following processes is directly associated with the action of the protein kinase, SNF1-related protein kinase (SnRK1), in plants?

(a) Starch synthesis in chloroplasts

(b) Regulation of autophagy under nutrient stress

(c) Regulation of flowering time

(d) Modulation of guard cell turgor pressure

Answer: (b)

SnRK1 is a central regulator of plant responses to nutrient stress, particularly by promoting autophagy and energy conservation.

(9) In plants, which of the following metabolic pathways is responsible for the formation of phenolic compounds like lignin, flavonoids, and tannins?

(a) Glycolysis

(b) Pentose phosphate pathway

(c) Shikimate pathway

(d) Citric acid cycle

Answer: (c)

The shikimate pathway is responsible for the biosynthesis of aromatic amino acids, which are precursors to phenolic compounds like lignin and flavonoids.

(10) Which of the following plant tissues is primarily responsible for the lateral growth of the plant stem and root?

(a) Apical meristem

(b) Lateral meristem

(c) Epidermis

(d) Xylem

Answer: (b)

Lateral meristems, including the vascular cambium and cork cambium, are responsible for secondary growth, leading to an increase in girth.

(11) The formation of double fertilization in angiosperms results in the formation of:

(a) One diploid zygote and one triploid endosperm

(b) Two diploid zygotes

(c) One triploid zygote and one diploid embryo

(d) Two haploid zygotes

Answer: (a)

Double fertilization results in the formation of a diploid zygote (embryo) and a triploid endosperm, which nourishes the developing seed.

(12) Which of the following is a primary function of the plant secondary metabolite, jasmonic acid?

(a) Stimulating seed dormancy

(b) Regulating the synthesis of chlorophyll

(c) Inducing defense responses against herbivores

(d) Promoting flowering

Answer: (c)

Jasmonic acid plays a key role in activating defense responses against herbivores and pathogens in plants.

(13) The major evolutionary advantage of heterospory in plants is:

(a) The production of genetically identical offspring

(b) The ability to produce both male and female gametes from a single spore

(c) Increased genetic diversity through the production of different-sized spores

(d) The ability to survive in aquatic environments

Answer: (c)

Heterospory, the production of two different types of spores (microspores and megaspores), allows for increased genetic diversity and specialized reproduction.

(14) The increase in genetic diversity through meiosis is primarily due to:

(a) Independent assortment and crossing over

(b) Mutations during DNA replication

(c) The duplication of chromosomes during S phase

(d) The activation of transposable elements

Answer: (a)

Meiosis generates genetic diversity through independent assortment of chromosomes and crossing over, where genetic material is exchanged between homologous chromosomes.

(15) Which of the following best describes the phenomenon of apomixis in plants?

(a) Asexual reproduction through the formation of clones from somatic cells

(b) Sexual reproduction without fertilization, leading to seed formation

(c) Reproduction via vegetative propagation

(d) The formation of gametes without meiosis

Answer: (b)

Apomixis is the formation of seeds without fertilization, allowing for the clonal reproduction of plants.

(16) Which of the following is a key difference between plant and animal cell division during mitosis?

(a) Animal cells undergo cytokinesis via cell plate formation, while plant cells form a cleavage furrow.

(b) Plant cells form a cell plate during cytokinesis, while animal cells form a cleavage furrow.

(c) Animal cells have more mitotic checkpoints than plant cells.

(d) Plant cells do not undergo telophase.

Answer: (b)

In plant cells, cytokinesis involves the formation of a cell plate, while animal cells use a cleavage furrow to divide the cytoplasm.

(17) The process of "vascular differentiation" in plants is regulated by the expression of which of the following transcription factors?

(a) MYB

(b) KNOX

(c) NAC

(d) TIR1

Answer: (c)

NAC transcription factors play a key role in the differentiation of vascular tissues such as xylem and phloem.

(18) Which of the following processes in plants is most closely associated with the action of auxin?

(a) Inhibition of leaf senescence

(b) Promotion of fruit ripening

(c) Regulation of root elongation and apical dominance

(d) Induction of stomatal opening

Answer: (c)

Auxins regulate root elongation and maintain apical dominance by inhibiting the growth of lateral buds.

(19) In which of the following plant groups is the gametophyte generation dominant?

(a) Angiosperms

(b) Gymnosperms

(c) Ferns

(d) Mosses

Answer: (d)

In mosses, the gametophyte generation is the dominant, photosynthetic phase, while the sporophyte is dependent on it.

(20) Which of the following compounds is synthesized by the terpenoid biosynthetic pathway in plants?

(a) Alkaloids

(b) Terpenes and essential oils

(c) Tannins

(d) Lignin

Answer: (b)

Terpenoids, including essential oils, are synthesized via the terpenoid biosynthetic pathway and play roles in defense and plant aroma.

(21) Which of the following statements best describes the role of endosperm in seed development?

(a) It is the outer covering of the seed that provides protection.

(b) It absorbs excess water during seed germination.

(c) It stores nutrients to nourish the developing embryo.

(d) It transports sugars to the cotyledons.

Answer: (c)

The endosperm stores starches, lipids, and proteins that provide nourishment for the developing embryo during seed germination.

(22) Which of the following factors primarily drives the movement of water through the plant's xylem?

(a) Active transport by proton pumps

(b) Capillary action

(c) Cohesion and adhesion forces, combined with transpiration

(d) Bulk flow generated by osmotic pressure

Answer: (c)

Water movement in the xylem is driven by transpiration, where cohesion and adhesion forces help maintain a continuous water column.

(23) The discovery of the structure of the plant cell wall was made possible by the work of which of the following?

(a) Robert Hooke

(b) Matthias Schleiden

(c) Carl Linnaeus

(d) Marthinus Beijerinck

Answer: (a)

Robert Hooke first observed plant cell walls using a microscope, which led to the discovery of cellular structures in plants.

(24) The unique property of the plant hormone cytokinin is its role in:

(a) Promoting senescence in leaves

(b) Stimulating cell division and delaying leaf aging

(c) Inhibiting cell elongation

(d) Regulating photoperiodic responses

Answer: (b)

Cytokinins stimulate cell division and delay leaf senescence, promoting healthy growth.

(25) The presence of which type of cell is a defining characteristic of the xylem tissue in plants?

(a) Companion cells

(b) Parenchyma cells

(c) Vessel elements and tracheids

(d) Sieve tube elements

Answer: (c)

Xylem tissue is primarily composed of vessel elements and tracheids, which conduct water and minerals through the plant.