



Photosynthesis in Higher Plants Important Questions With Answers

NEET Biology 2023

1. Read the given statements and select the correct option.

Statement 1: In photosynthesis, during ATP synthesis, protons accumulate in the lumen of thylakoid.

Statement 2: In respiration, during ATP synthesis, protons accumulate in the intermembranal space of mitochondria.

a) Both statements 1 and 2 are correct. b) Statement 1 is correct but statement 2 is incorrect.

c) Statement 1 is incorrect but statement 2 is correct. d) Both statements 1 and 2 are incorrect

2. Which of the following statements is incorrect regarding the Calvin cycle of C_3 plants?

a) First stable product of Calvin cycle in C_3 plants is 3-Phosphoglyceric acid.

b) Sunflower is an example of C_3 plants. **c) Calvin cycle occurs in bundle sheath cells of C_3 plants.**

d) Enzyme PEPcase is absent in C_3 plants.

Solution : -

In C_3 plants, bundle sheath cells usually do not contain chloroplasts and the whole C_3 cycle operates in mesophyll cells of leaves.

3. In PSI, the reaction centre Chi a has absorption maxima at _____ ; whereas in PS II, the reaction centre Chi b has absorption maxima at _____.

a) 700 nm, 680 nm b) 680 nm, 700 nm c) 400 nm, 500 nm d) 700 nm, 800 nm

Solution : -

The reaction center of photosystem I (PSI) is referred to as P_{700} , where "P" stands for "Pigment" and "700" stands for the wavelength of light that this particular chlorophyll molecule absorbs most strongly. The reaction center of photosystem II (PS II) is referred to as P_{680} for comparable reasons.

4. How many ATP and $NADPH_2$ are respectively produced in the process of photorespiration?

a) 2 and 4 b) 1 and 2 c) 4 and 6 d) 0 and 0

Solution : -

Photorespiratory pathway (or C_2 pathway) results in the release of CO_2 with the utilisation of ATP. In the photorespiratory pathway, there is no synthesis of ATP or $NADPH$.

5. A point at which illuminated plant parts stop absorbing CO_2 from their environment, is known as

a) CO_2 compensation point b) CO_2 saturation point c) CO_2 optimum point d) CO_2 limiting point

6. PEP is primary CO_2 acceptor in:

a) C_4 plants b) C_3 plants c) C_2 plants d) both C_3 and C_4 plants

Solution : -

In C_4 plants, initial fixation of CO_2 or carboxylation occurs in mesophyll cells. The chloroplasts of mesophyll cells possess enzyme PEP carboxylase (or PEPcase) for initial fixation of CO_2 . The primary acceptor of CO_2 is phosphoenol pyruvate or PEP. It combines with CO_2 in the presence of PEP carboxylase (or PEPcase) to form oxaloacetic acid or oxaloacetate (OAA).

7. Photorespiration is favoured by_____
- a) **high O₂ and low CO₂** b) low light and high O₂ c) low temperature and high O₂
 d) low O₂ and high CO₂

Solution : -

Photorespiration is light induced oxidation of photosynthetic intermediates with the help of oxygen. It is stimulated by high O₂ concentration or low CO₂ high light intensity, high temperature and ageing of leaf.

8. A very efficient converter of solar energy with net productivity of 2- 4 kg/m² or more is the crop of _____ .
- a) Wheat **b) Sugarcane** c) Rice d) Bajra

Solution : -

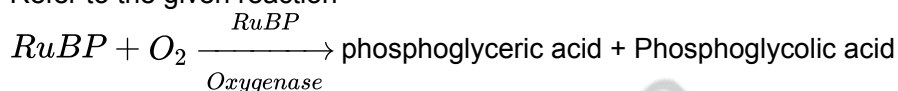
In C₄-plants, (e.g. maize, sugarcane, sorghum) optimum temperature of photosynthesis is 30-45°C. In C₄-plants, rate of net photosynthesis in full sunlight is (40-80 mg CO₂ /dm²/hr) which is more than the rate of net photosynthesis(15-35 mg CO₂ /dm²/hr) at optimum sunlight in C₃ -plants.

9. In the leaves of C₄ plants, malic acid formation during CO₂ fixation occurs in the cells of _____
- a) bundle sheath b) Phloem c) epidermis **d) mesophyll**

Solution : -

In C₄ plants, C₄ cycle occurs in mesophyll cells and C₃- cycle occurs in bundle sheath cells.

10. Refer to the given reaction



It is the first reaction of

- a) **C₃ pathway** b) C₄ pathway c) C₂ pathway d) glycolysis

Solution : -

At high temperature, RuBisCO functions as oxygenase and instead of fixing CO₂, oxidises RuBP to produce a 3-C phosphoglyceric acid and a 2-C phosphoglycolate. This is the first reaction of photorespiration or C₂ cycle.

11. Which of the following photosynthetic bacteria have both PS-I & PS-II?
- a) **Purple sulphur bacteria** b) Cyanobacteria c) Purple non sulphur bacteria d) Green sulphur bacteria

12. In photosynthesis energy from light reaction to dark reaction is transferred in the form of _____
- a) ADP **b) ATP** c) RUDP d) Chlorophyll

Solution : -

ATP molecules produced in the light reaction are used in the dark reaction to fix CO₂ to form organic compounds.

13. Breakdown of proton gradient developed during chemiosmosis leads to the release of
- a) oxygen b) water **c) energy** d) protons

14. In photosynthesis the light-independent reactions take place at _____
- a) Photosystem-I b) photosystem-II **c) Stromal matrix** d) Thylakoid lumen

Solution : -

In photosynthesis, the light independent reactions take place at stromal matrix. In the dark reaction or light independent reaction, the product of light reaction i.e. NADPH and ATP are used to form glucose from carbondioxide and RuBP. This reaction occurs in the presence of RuBisCO

15. Glycolate induces opening of stomata in _____
- a) presence of oxygen b) low CO₂ con. c) high CO₂ con **d) absence of CO₂**

Solution : -

Tropical plants have evolved C₄ cycle to overcome photorespiration.

16. Chemosynthetic bacteria obtain energy from
- a) sun b) infra red ray c) organic chemicals. **d) inorganic chemicals.**

Solution : -

Chemosynthetic autotrophic bacteria (Chemoautotrophic bacteria) are bacteria which are able to manufacture their organic food from inorganic raw materials with the help of energy derived from exergonic chemical reactions involving oxidation of an inorganic substance present in the external medium. The chemical energy obtained from oxidation reaction is trapped in ATP molecules

17. **Assertion:** In C₄ plants, the bundle sheath cells are rich in an enzyme phosphoenol pyruvate carboxylase (PEPCase).

Reason: In C₄ plants, the mesophyll cells are rich in an enzyme Ribulose biphosphate carboxylase-oxygenase (RuBisCO).

- a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. **d) If both assertion and reason are false.**

Solution : -

The primary CO₂ acceptor in C₄ cycle is a 3-carbon molecule phosphoenol pyruvate (PEP) present in the mesophyll cells. The enzyme responsible for this fixation is PEP carboxylase or PEPCase. The mesophyll cells lack RuBisCO enzyme. The C₄ acid OAA is formed in the mesophyll cells. The CO₂ released in the bundle sheath cells enters the C₃ or the Calvin pathway, a pathway common to all plants. The bundle sheath cells are rich in an enzyme Ribulose biphosphate carboxylase-oxygenase (RuBisCO), but lack PEPCase.

18. During Z scheme, electrons excited by absorption of light in PSI are transferred to the primary acceptors, and therefore must be replaced. The replacements come directly from

a) NADP b) ATP **c) PS II** d) water

19. Cytochrome is _____

a) Metallo - Flavo protein **b) Fe-containing porphyrin pigment** c) Glycoprotein d) Lipid

Solution : -

Cytochrome is an Fe containing porphyrin pigment. These are electron transferring proteins often regarded as enzymes.

20. Which of the following statements about dark reactions is correct?

a) They occur in darkness. b) They are not light dependent.
c) They are dependent upon the products synthesised during light reactions. d) All of these

Solution : -

Biosynthetic phase (Dark or Blackman's reaction) catalyses the assimilation of CO₂ to carbohydrates. These reactions occur in stroma or matrix of chloroplasts and all the enzymes required for the processes are present in the stromal matrix of chloroplasts. These reactions do not require light, instead assimilatory power (ATP and NADPH) produced during photochemical (light) phase is used in fixation and reduction of CO₂. However, this should not be construed to mean that they occur in darkness or that they are not light dependent.

21. **Assertion:** Tropical plants have a higher optimum temperature for photosynthesis than temperate plants.

Reason: The temperature optimum for photosynthesis of different plants depends on their habitat.

- a) If both assertion and reason are true and reason is the correct explanation of assertion.**
b) If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. **d) If both assertion and reason are false.**

Solution : -

The optimum temperature is 10° - 25°C for C₃ plants and 30 - 45°C for C₄ plants. The temperature optimum for photosynthesis of different plants also depends on habitat that they are adapted to. Tropical plants have a higher temperature optimum than the plants adapted to temperate climates.

22. Photosynthetic pigments found in the chloroplasts occur in _____ .
a) **thylakoid membranes** b) plastoglobules c) matrix d) chloroplast envelope

Solution : -

Photosynthetic pigments are those pigments which occur on photosynthetic thylakoids of chloroplasts and absorb light energy for the purpose of photosynthesis. These are mainly of two types-chlorophylls and carotenoids.

23. Warburg effect refers to
a) **decreased photosynthetic rate at very high O₂ concentration**
b) increased photosynthetic rate at very high O₂ concentration
c) decreased photosynthetic rate at very low O₂ concentration
d) increased photosynthetic rate at very low O₂ concentration.

Solution : -

Oxygen is a product of photosynthesis. A small quantity of O₂ is essential for photosynthesis to take place. But as O₂ concentration rises, rate of photosynthesis decreases, which may be because (i) oxygen takes part in oxidation of photosynthetic pigments, intermediates and enzymes in the presence of strong light (photo-oxidation), (ii) oxygen is a strong quencher of excited state of chlorophyll. Oxygen competes with CO₂ for reducing power. It converts RUBP-carboxylase to RuBP-oxygenase. At very high oxygen concentration, the rate of photosynthesis begins to decline in all plants. This phenomenon is referred to as Warburg effect.

24. Mints adapted to low light intensity have____
a) **larger photosynthetic unit size than the sun plants** b) higher rate of CO₂ fixation than the sun plants
c) more extended root system. d) leaves modified to spines

Solution : -

Plants have larger photosynthetic unit size and thus they absorb maximum amount of light of the Photosynthetically Active Radiation (PAR) for photosynthesis.

25. **Assertion:** C₃ plants respond to increased CO₂ concentration by increasing rate of photosynthesis.
Reason: The higher productivity of some greenhouse crops such as tomatoes and bell pepper is due to increased CO₂ concentration.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) **If both assertion and reason are true but reason is not the correct explanation of assertion.**
c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -

Carbon dioxide is the major limiting factor for photosynthesis. The C₃ and C₄ plants respond differently to CO₂ concentrations. At low light conditions neither group responds to high CO₂ conditions. At high light intensities, both C₃ and C₄ plants show increase in the rates of photosynthesis. The fact that C₃ plants respond to higher CO₂ concentration by showing increased rates of photosynthesis leading to higher productivity has been used for some greenhouse crops such as tomatoes and bell pepper. They are allowed to grow in carbon dioxide enriched atmosphere that leads to higher yields.

26. CAM helps the plants in____
a) **conserving water** b) secondary growth c) disease resistance d) reproduction

Solution : -

CAM helps the plants in conserving water. CAM plants are mostly Succulent xerophytes in which stomata remain closed during the day time. This helps the plants to conserve water by preventing water loss through transpiration.

27. The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is____
a) iron-sulphur protein b) ferredoxin c) **quinone** d) cytochrome

Solution : -

Quinone is the first acceptor of electrons from an excited chlorophyll of PS - II

28. Which of these is a type of phycobilin pigments?

- a) Phycocyanin b) Allophycocyanin c) Phycoerythrin **d) All of these**

Solution : -

Phycobilins are open tetrapyrroles which neither contain magnesium nor phytol. Phycobilins are water soluble. The pigments are of two types-blue (phycocyanin, allophycocyanin) and red (phycoerythrin). The pigments are useful in chromatic adaptations. They are important accessory pigments of blue-green algae, cryptomonads and red algae.

29. Which enzyme is most abundantly found on earth?

- a) Catalase **b) RuBisCO** c) Nitrogenase d) Invertase

Solution : -

RuBisCO (RuBP carboxylase) is the most abundant protein on this planet. RuBisCO constitutes 16% of chloroplast protein. It is required for CO₂ fixation with RuBP (Ribulose Biphosphate) in Calvin cycle.

30. Which one of the following pigments does not occur in the chloroplast?

- a) Carotene b) Xanthophyll c) Chlorophyll 'b' **d) Anthocyanin**

31. With reference to factors affecting the rate of photosynthesis. Which of the following statements is not correct?

- a) Light saturation for CO₂ fixation occurs at 10% of full sunlight
b) Increasing atmospheric CO₂ concentration upto 0.05% can enhance CO₂ fixation rate
c)

C3 plants responds to higher temperatures with enhanced photosynthesis while C4 plants have much lower temperature optimum

- d) Tomato is a greenhouse crop which can be grown in CO₂ enriched atmosphere for higher yield

Solution : -

C4 plants have higher temperature because of the presence of pyruvate phosphate dikinase enzyme which is sensitive to low temperature. C3 plants show decreased photosynthesis at higher temperature due to increased photorespiration.

32. Which of the following is not an external factor influencing photosynthesis?

- a) CO₂ concentration b) O₂ concentration c) Availability of water **d) Chlorophyll concentration**

Solution : -

The process of photosynthesis is influenced by several factors, which include both internal (plant) and external (environmental) factors. The plant factors include the number, size, age and orientation of leaves, presence or absence of hormones, leaf anatomy, amount of chlorophyll, etc. The external factors would include the availability of sunlight, temperature, concentration of CO₂ and O₂ and water.

33. Which of the following scientists concluded by his experiments that green plant parts play a role in purifying the noxious air only in the presence of sunlight?

- a) Priestley **b) Ingenhousz** c) Sachs d) Engelmann

Solution : -

Jan Ingenhousz (1730 - 1799), in his experiment with an aquatic plant, showed that in bright sunlight, small bubbles were formed around the green parts while in the dark, no such bubbles formed. He found out these bubbles to be of oxygen. He thus, confirmed that purification of air or formation of dephlogiston is carried out by green plants only in presence of sunlight.

34. Maximum solar energy is trapped by _____

- a) planting trees b) cultivating crops c) growing algae in tanks **d) growing grasses**

Solution : -

Maximum solar energy is trapped by growing grasses, as they have the largest surface area for absorption. Limited number of algal individual are growing in tank so, they absorb limited amount of light.

35. During high light intensity, the chloroplasts align themselves
a) in vertical position along lateral walls b) along tangential walls c) in centre and get scattered
d) perpendicular to light.

Solution : -

During high light intensity, the chloroplast align themselves in vertical position along the lateral walls. During moderate light intensity, they align themselves along tangential walls. They change their position in mesophyll cells to receive optimum light.

36. The first carbon dioxide acceptor in C₄- plants is _____ .
a) phosphoenol-pyruvate b) ribulose 1, 5-diphosphate **c) oxalo acetic acid** d) phosphoglyceric acid

Solution : -

In C₄ -plants, phosphoenol-pyruvate is the first acceptor of CO₂, while ribulose bi-phosphate is the second acceptor Oxalo Acetic Acid (OAA) is the first product of C₄ - Cycle.

37. Who demonstrated that green plants purify the foul air produced by breathing animals and burning candles?
a) Priestley b) Ingenhousz c) Sachs d) Engelmann

Solution : -

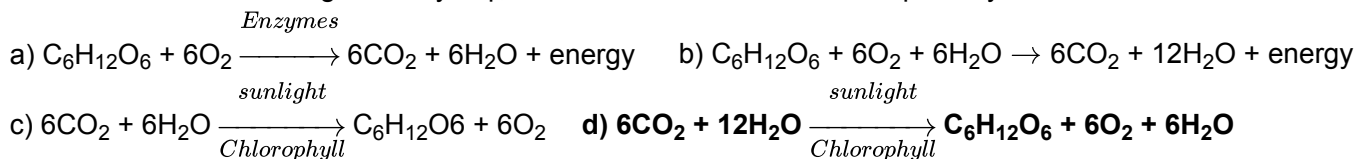
Joseph Priestley (1770) observed that a candle burning in a closed space - a bell jar, soon gets extinguished. Similarly, a mouse kept in a closed space would soon get suffocated and die. However, when he placed a mint plant in the same bell jar, he found that the mouse stayed alive and candle continued to burn. Priestley hypothesised that foul air or phlogiston produced during burning of candles or animal (mice) respiration could be converted into pure air or dephlogiston by plants (mint). In 1774, Priestley discovered oxygen.

38. CO₂ combines with RuBP in the presence of enzyme RuBisCO to form 3-PGA. This process of Calvin cycle is included under
a) carboxylation b) oxygenation c) reduction d) regeneration

Solution : -

Carboxylation is the fixation of CO₂ into a stable organic intermediate. It is the most crucial step of Calvin cycle where CO₂ is utilised for the carboxylation of RuBP through the use of ATP and NADPH generated by the light reactions. This reaction is catalysed by enzyme RuBisCO which results in the formation of two molecules of 3-phosphoglyceric acid or PGA, which is the first stable product of photosynthesis.

39. Which one of the following correctly depicts the biochemical reaction for photosynthesis?



40. **Assertion:** The external factors that affect photosynthesis are number, size, age and orientation of leaves, mesophyll cells and chloroplasts and the amount of chlorophyll.

Reason: The internal factors that affect photosynthesis are availability of sunlight, temperature, CO₂ concentration and water.

- a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. **d) If both assertion and reason are false.**

Solution : -

Photosynthesis is under the influence of several factors, both internal (plant) and external. The plant factors include the number, size, age and orientation of leaves, mesophyll cells and chloroplasts, internal CO₂ concentration and the amount of chlorophyll. The plant or internal factors are dependent on the genetic predisposition and the growth of the plant. The external factors include the availability of sunlight, temperature, CO₂ concentration and water. During photosynthesis, all these factors simultaneously affect its rate.

41. Select the option which correctly depicts the functions of parts X, Y and Z.

a)

X	Y	Z
Dark reaction	Light reaction	Cytoplasmic inheritance

b)

X	Y	Z
Light reaction	Carbohydrate synthesis	Carbohydrate storage

c)

X	Y	Z
Light reaction	Carbohydrate storage	Carbohydrate synthesis

d)

X	Y	Z
Carbohydrate synthesis	Carbohydrate storage	Cytoplasmic inheritance

Solution : -

Light reactions (or photochemical phase) of photosynthesis mainly occur on the grana thylakoids. Dark reactions (or biosynthetic phase) which involve synthesis of carbohydrates by CO₂ fixation, occur in the stroma (or matrix) of chloroplasts. The chloroplast matrix of higher plants stores starch temporarily in the form of starch granules.

42. Incorrect statement in relation to chemiosmotic hypothesis is

- a) Primary electron acceptor is located towards outer side of membrane
- b) NADP reductase is located on lumen side of thylakoid membrane**
- c) Splitting of water releases protons in the lumen of thylakoid membrane
- d) Decrease in pH of thylakoid lumen due to proton accumulation

43. Which technique has helped in investigation of Calvin cycle?

- a) X-ray crystallography
- b) X-ray technique
- c) Radioactive isotope technique**
- d) Intermittent light

Solution : -

Calvin, Benson and Basshan utilised C¹⁴ (with long life) to trace the path of carbon in photosynthesis. Calvin was awarded Nobel Prize in 1951 in recognition to his work with C¹⁴ isotope. He discovered the cycle involved in carbon assimilation, known as Calvin cycle or C₃- cycle.

44. The biochemical objective of PS I is to

- a) oxidise NADPH
- b) hydrolyse ATP
- c) phosphorylate ADP
- d) reduce NADP⁺.**

Solution : -

During Z-scheme, the electron extruded by PS I passes through special chlorophyll X, Fe - S, ferredoxin, to finally reach NADP⁺. NADP⁺ is ultimately reduced by combining with H⁺ (released during photolysis) with the help of NADP⁺ reductase enzyme.

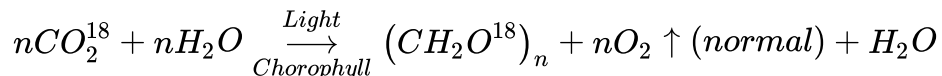
45. If green plant cells are incubated with O¹⁸ - labelled water, which of the following molecules will become radioactive when the cells are exposed to light?

- a) O₂**
- b) CO₂
- c) H₂O
- d) Suga

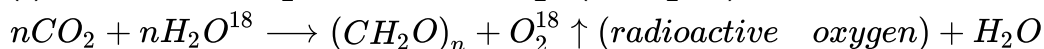
Solution : -

Ruben and Kamen (1941), while working on Chiarella (unicellular green alga) found that oxygen liberated during photosynthesis comes from water.

(i) When normal H_2O and radioactive CO_2 (i.e., CO^{18}_2) were used, normal O_2 is evolved.



(ii) When normal CO_2 and radioactive H_2O (i.e., H_2O^{18}) were used, radioactive O_2 (i.e., O_2^{18}) is evolved.



46. The C_4 plants are photosynthetically more efficient than C_3 plants because _____

- a) the CO_2 compensation point is more
- b) CO_2 generated during photorespiration is trapped and recycled through PEP carboxylase
- c) the CO_2 efflux is not Prevented
- d) they have more chloroplasts**

Solution : -

By the C_4 pathway photosynthesis takes place at very low concentrations of carbon dioxide as PEP carboxylase has an extremely high affinity for carbon dioxide.

47. Reaction centre of PSI is _____ and reaction centre of PS II is _____.

- a) P680, P700
- b) P700, P680**
- c) P800, P600
- d) P700, P900

Solution : -

The reaction center of photosystem I (PSI) is referred to as P₇₀₀, where "P" stands for "Pigment" and "700" stands for the wavelength of light that this particular chlorophyll molecule absorbs most strongly. The reaction center of photosystem II (PS II) is referred to as P₆₈₀ for comparable reasons.

48. Dark reaction in photosynthesis is called so because

- a) it can occur in dark also
- b) it does not directly depend on light energy**
- c) it cannot occur during day light
- d) it occurs more rapidly at night.

Solution : -

Biosynthetic phase (dark or Blackman's reaction) catalyses assimilation of CO_2 to carbohydrates. The reactions are called carbon reactions. They occur in stroma of chloroplasts. The reactions do not require light. Instead assimilatory power (ATP and NADPH) produced during photochemical phase is used in fixation and reduction of carbon dioxide. All the enzymes required for the process are present in the matrix or stroma of the chloroplast

49. Read the given statements and select the correct option.

Statement 1: Crassulacean acid metabolism occurs in succulent plants which grow in xeric conditions.

Statement 2: Stomata are generally sunken in succulent plants.

- a) Both statements 1 and 2 are correct.**
- b) Statement 1 is correct but statement 2 is incorrect.
- c) Statement 1 is incorrect but statement 2 is correct.
- d) Both statements 1 and 2 are incorrect.

Solution : -

Crassulacean acid metabolism is a mechanism of photosynthesis involving double fixation of CO_2 which occurs in succulents belonging to Crassulaceae, Cacti, Euphorbias and some other plants of dry habitats where the stomata remain closed during the daytime and open only at night, e.g., **Sedum, Kalanchoe, Opuntia**. Sunken stomata are deep-seated stomata in which subsidiary cells lie above the guard cells.

50. During C_2 cycle, there occurs

- a) synthesis of sugars
- b) utilisation of ATP**
- c) synthesis of ATP
- d) synthesis of NADPH.