

Ultimate KCET Crash Course 2026

BOTANY

DPP: 1

Photosynthesis in higher plants Respiration in plants

Q1 A researcher calculates the energetic cost of synthesising one molecule of glucose through the Calvin cycle. The cycle must operate multiple times, each fixing a single CO₂ molecule.

Which combination correctly represents the total requirement?

- (A) 6 ATP and 6 NADPH
- (B) 12 ATP and 6 NADPH
- (C) 18 ATP and 12 NADPH
- (D) 24 ATP and 18 NADPH

Q2 Match the columns and find out the correct combination

Column-I		Column-II	
(a)	Ribulose-1,5-bisphosphate to 3-phosphoglycerate	(i)	Regeneration-ATP → ADP
(b)	3-phosphoglycerate to Triose phosphate	(ii)	Carboxylation-CO ₂ + H ₂ O
(c)	Triose phosphate to Ribulose-1,5-bisphosphate	(iii)	Reduction-ATP + NADPH → ADP + P _i + NADP ⁺

- (A) (a)-(iii), (b)-(i), (c)-(ii)
- (B) (a)-(i), (b)-(iii), (c)-(ii)
- (C) (a)-(i), (b)-(ii), (c)-(iii)
- (D) (a)-(ii), (b)-(iii), (c)-(i)

Q3 RuBisCO has a much greater affinity for _____ when the CO₂ : O₂ is nearly equal.

- (A) O₂
- (B) CO₂
- (C) Same for both
- (D) Depends on temperature

Q4 How many of the following statements are incorrect ?

- (i) C₄ plants lack Calvin cycle.
- (ii) C₄ plants lack photorespiration.
- (iii) C₄ plants have more productivity than C₃ plants.
- (iv) C₄ plants cannot tolerate higher temperature.

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Q5 The Calvin cycle operates in which part of the chloroplast?

- (A) Thylakoid membrane
- (B) Grana
- (C) Stroma
- (D) Intermembrane space

Q6 Which scientist gave the Law of Limiting Factors ?

- (A) Hooke
- (B) Blackman
- (C) Fleming
- (D) Mendel

Q7 The stroma in chloroplasts of higher plants contains:

- (A) Enzymes for light-independent reactions
- (B) Enzymes for light-dependent reactions
- (C) Lysosomes
- (D) Chlorophyll



- Q8** Which statement correctly describes cyclic photophosphorylation?
- (A) Involves both PS I and PS II
 (B) Produces both ATP and NADPH
 (C) Produces only ATP
 (D) Produces oxygen
- Q9** T.W Engelmann used _____ in his experiment.
- (A) Hydrilla
 (B) Cladophora
 (C) Purple sulphur bacteria
 (D) Green sulphur bacteria
- Q10** Maximum absorption by chlorophyll a occurs in _____.
- (A) blue & green region
 (B) red & green region
 (C) blue & red region
 (D) yellow & red region
- Q11** In Moll's Half Leaf Experiment, the part of the leaf outside the KOH containing bottle
- (A) tested positive for starch due to presence of chlorophyll
 (B) tested negative for starch due to absence of chlorophyll
 (C) tested positive for starch due to presence of sunlight
 (D) tested positive for starch due to presence of carbon dioxide
- Q12** Which factor does NOT directly affect photosynthesis?
- (A) Light intensity
 (B) Temperature
 (C) CO₂ concentration
 (D) Root pressure
- Q13** Which of the following is the site of photolysis of water ?
- (A) Stroma of chloroplast
 (B) Cristae of chloroplast
 (C) Ribosome of chloroplast
 (D) Lumen of thylakoid sacs
- Q14** Light saturation occurs at _____ of the full sunlight.
- (A) 20 % (B) 25 %
 (C) 10 % (D) 70 %
- Q15** Stroma in the chloroplasts of higher plant contains
- (A) Chlorophyll
 (B) Light-dependent reaction enzymes
 (C) Light-independent reaction enzymes
 (D) Both (B) and (C)
- Q16** The first stable product of the C₄ cycle is:
- (A) 3-PGA
 (B) PEP
 (C) Oxaloacetic acid
 (D) Malic acid
- Q17** Greenhouse crops such as tomato and bell pepper produce higher yields primarily because:
- (A) CO₂ - enriched atmosphere leads to higher yields
 (B) CO₂ is a limiting factor for photosynthesis
 (C) Diffused light in greenhouses
 (D) Tomatoes and bell peppers are not C₃ plants
- Q18** Number of Calvin cycles required to generate a molecule of hexose is:
- (A) 8 (B) 4
 (C) 6 (D) 2
- Q19** The Hill reaction demonstrates that:
- (A) CO₂ is essential for photosynthesis
 (B) Light is essential for the evolution of O₂
 (C) O₂ is produced from CO₂
 (D) Sugar is formed during the light reaction



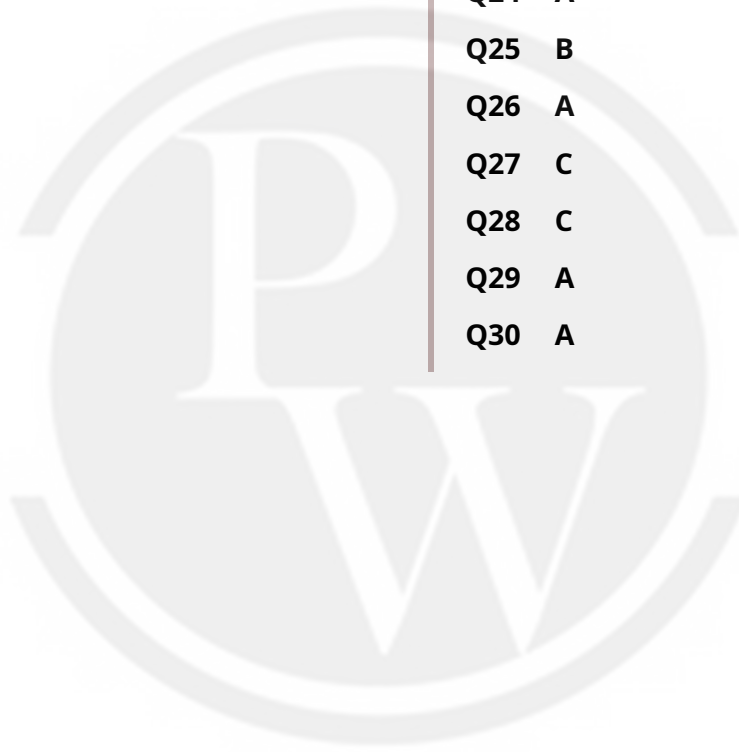
- Q20** The Bundle sheath cells are rich in _____ while lacks _____.
 (A) RuBisCo, PEPCase
 (B) PEPCase, RuBisCo
 (C) ATPase, Hydrolase
 (D) Hydrolase, ATPase
- Q21** In the photorespiratory pathway, there is _____.
 (A) Neither synthesis of sugars, nor of ATP
 (B) Synthesis of ATP but not of sugars
 (C) Synthesis of sugars but not of ATP
 (D) Synthesis of both ATP and sugars
- Q22** At high light intensity, photosynthesis is generally limited by:
 (A) CO₂ concentration
 (B) Chlorophyll content
 (C) Water uptake
 (D) Soil pH
- Q23** Which of these statements is incorrect regarding the biosynthetic phase of photosynthesis?
 (A) It depends on carbon dioxide and water
 (B) It depends on the products of light reaction
 (C) ATP and NADH are used
 (D) Sugars are synthesized
- Q24** In cyclic photophosphorylation which one of the following is formed?
 (A) ATP
 (B) NADP and ATP
 (C) NADH, and O₂
 (D) NADPH₂, ATP and O₂
- Q25** Kranz anatomy is a characteristic feature of:
 (A) C3 plants (B) C4 plants
 (C) CAM plants (D) Aquatic plants
- Q26** During photosynthesis, the O₂ released is from _____.
 (A) Water (B) Carbon dioxide
 (C) Chlorophyll (D) Glucose
- Q27** The primary electron acceptor in PS II is
 (A) Plastoquinone (B) Cytochrome-b
 (C) Pheophytin (D) Plastocyanin
- Q28** The product of photorespiration _____.
 (A) Phosphoglycerate
 (B) Phosphoglycolate
 (C) Both (A) and (B)
 (D) Malate
- Q29** Assertion (A): The reaction centre chlorophyll of Photosystem I is referred to as P700.
 Reason (R): The chlorophyll molecule in Photosystem I shows maximum absorption at a wavelength of 700 nm.
 (A) Both A and R are correct and R explains A
 (B) Both A and R are correct but R does not explain A
 (C) A is correct but R is incorrect
 (D) A is incorrect but R is correct
- Q30** Which pigment acts as the reaction center in photosystem II?
 (A) Chlorophyll a (P680)
 (B) Chlorophyll a (P700)
 (C) Chlorophyll b
 (D) Carotenoids



Answer Key

Q1 C
Q2 D
Q3 B
Q4 C
Q5 C
Q6 B
Q7 A
Q8 C
Q9 B
Q10 C
Q11 D
Q12 D
Q13 D
Q14 C
Q15 C

Q16 C
Q17 A
Q18 C
Q19 B
Q20 A
Q21 A
Q22 A
Q23 C
Q24 A
Q25 B
Q26 A
Q27 C
Q28 C
Q29 A
Q30 A



Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

1. One turn of the Calvin cycle fixes one CO_2 molecule.
2. Each fixation requires 3 ATP and 2 NADPH molecules.
3. Six turns are required to form one molecule of glucose.
4. Therefore ATP required = $6 \times 3 = 18$ and NADPH required = $6 \times 2 = 12$.
5. These energy molecules are supplied by the light reactions.

Video Solution:



Q2 Text Solution:

(D) (a)-(ii), (b)-(iii), (c)-(i)

- Carboxylation: $\text{RuBP} + \text{CO}_2 \rightarrow 3\text{-PGA}$
- Reduction: $3\text{-PGA} \rightarrow \text{Triose phosphate}$ using ATP & NADPH
- Regeneration: $\text{Triose phosphate} \rightarrow \text{RuBP}$ using ATP
- These three phases complete one Calvin cycle.

Video Solution:



Q3 Text Solution:

B. CO_2

RuBisCO, with the same active site for both carboxylation and oxygenation, has a higher affinity for CO_2 than O_2 . However, at high temperatures, CO_2 solubility decreases more than O_2 , favoring oxygenation. This causes RuBisCO to act as an oxygenase, leading to photorespiration, where RuBP is oxidized to produce 3-C phosphoglyceric acid and 2-C phosphoglycolate, affecting tropical plants the most.

Video Solution:



Q4 Text Solution:

C. 2

1. (i) C4 plants lack Calvin cycle: Incorrect. C4 plants do have the Calvin cycle; it occurs in the bundle sheath cells.

2. (ii) C4 plants lack photorespiration: Correct. C4 plants have a mechanism to minimize photorespiration, but it is not completely absent.

3. (iii) C4 plants have more productivity than C3 plants: Correct. C4 plants are generally more efficient and productive, especially in high light and temperature conditions.

4. (iv) C4 plants cannot tolerate higher temperature: Incorrect. C4 plants are better adapted to higher temperatures compared to C3 plants.

Incorrect statements: (i) and (iv).

So, two statements are incorrect.

Video Solution:



Q5 Text Solution:

C — Stroma

- Stroma contains enzymes for carbon fixation reactions.
- Light-independent pathways occur here.
- ATP and NADPH from grana are utilised in this region.
- Stroma supports all three phases: carboxylation, reduction, regeneration.

Video Solution:



Q6 Text Solution:

(B) Blackman

- Blackman proposed the Law of Limiting Factors.
- If one factor is deficient, photosynthesis rate is limited.
- The rate increases only when that limiting factor is improved.
- Explains combined effect of light, CO₂, and temperature.

Video Solution:



Q7 Text Solution:

The stroma contains enzymes necessary for the Calvin cycle (light-independent reactions), where CO₂ is fixed into glucose.

Video Solution:



Q8 Text Solution:

(C) Produces only ATP

- Involves only PS I (P700).
- Electrons cycle back to same reaction center.
- No NADPH or O₂ is formed.
- Generates ATP for cellular energy balance.

Video Solution:



Q9 Text Solution:

B. Cladophora

T.W. Engelmann used the green alga *Cladophora* in his experiment to demonstrate the action spectrum of photosynthesis. He placed *Cladophora* in a light spectrum and observed the distribution of aerobic bacteria around the alga, showing which wavelengths of light were most effective for photosynthesis.

Video Solution:



Q10 Text Solution:

C: blue & red region.

Chlorophyll a shows maximum absorption in the blue (around 430 nm) and red (around 680 nm) regions of the light spectrum, which are crucial for driving photosynthesis.

Video Solution:



Q11 Text Solution:

(D) Tested positive for starch due to presence of CO₂

- The half of leaf outside the flask received CO₂ and sunlight.
- It showed starch formation after iodine test.
- The part inside KOH flask lacked CO₂, so no starch formed.
- Thus, CO₂ is a raw material for photosynthesis.

Video Solution:



Q12 Text Solution:

D — Root pressure

- Photosynthesis depends directly on light, CO₂ and temperature.
- Root pressure influences water movement, not photosynthetic rate.
- It is unrelated to photochemical reactions or Calvin cycle.
- Hence it does not regulate photosynthesis directly.

Video Solution:



Q13 Text Solution:

(D) Lumen of thylakoid sacs

- Water splitting occurs inside thylakoid lumen.
- It's linked to Photosystem II activity.
- Protons contribute to proton gradient formation.
- This drives ATP synthesis during photophosphorylation.

Video Solution:



Q14 Text Solution:

C. 10%

Light saturation occurs at 10% of full sunlight. This is the point when the rate of photosynthesis reaches its maximum and does not increase further. The light saturation point is the maximum light intensity a plant can reach for photosynthesis. Light intensity higher than the saturation point does not increase the rate of photosynthesis. However, excessive light can degrade chlorophyll, reducing photosynthesis.

Video Solution:



Q15 Text Solution:

(C) Light-independent reaction enzymes

- The stroma is the fluid matrix of chloroplasts.
- It contains enzymes for the Calvin cycle.
- ATP and NADPH from light reactions are utilized here.
- Carbohydrates are synthesized in this region.

Video Solution:



Q16 Text Solution:

C — Oxaloacetic acid

- In C_4 plants, CO_2 is initially fixed in mesophyll cells.
- PEP carboxylase adds CO_2 to PEP forming a 4-carbon compound.
- The very first stable 4C product formed is **oxaloacetic acid (OAA)**.
- OAA later converts to malate or aspartate for transport to bundle sheath cells.

Video Solution:



Q17 Text Solution:

Elevated CO_2 levels in greenhouses enhance photosynthesis, leading to higher yields in crops like tomatoes and bell peppers.

Video Solution:



Q18 Text Solution:

(C) 6

- Each cycle fixes one molecule of CO_2 .
- Six cycles are required to form one glucose molecule.
- Six CO_2 combine with six RuBP molecules.
- Energy from 12 NADPH and 18 ATP is used.

Video Solution:



Q19 Text Solution:

(B) Light is essential for evolution of O_2

- Hill used isolated chloroplasts with artificial acceptors.
- O_2 evolved even without CO_2 .
- Shows light splits water to release O_2 .
- Hence, photolysis requires light energy.

Video Solution:



Q20 Text Solution:**A. RuBisCo, PEPCase**

Bundle sheath cells are rich in RuBisCo, the enzyme responsible for carbon fixation in the Calvin cycle. However, they lack PEPCase (Phosphoenolpyruvate carboxylase), which is primarily found in mesophyll cells and is involved in the initial fixation of CO_2 in C_4 plants.

Video Solution:**Q21 Text Solution:****A. Neither synthesis of sugars, nor of ATP**

In the photorespiratory pathway, there is no synthesis of sugars or ATP. Instead, it is a wasteful process where oxygen is consumed and carbon dioxide is released without producing any energy or useful organic molecules.

Video Solution:**Q22 Text Solution:****A — CO_2 concentration**

- Under high light, light is no longer limiting.
- CO_2 becomes the next major limiting factor.
- Reduced CO_2 slows the Calvin cycle.
- This leads to a plateau in photosynthetic rate.

Video Solution:**Q23 Text Solution:****C. ATP and NADPH are used**

In the biosynthetic phase of photosynthesis (Calvin cycle), ATP and NADPH (not NADH) are used to convert carbon dioxide into sugars. NADPH is the product of the light-dependent reactions and is specifically used in the Calvin cycle for the reduction of carbon molecules.

Video Solution:

Q24 Text Solution:

(A) ATP

- Only Photosystem I is involved.
- Electrons cycle back to the same chlorophyll.
- ATP is synthesized without NADPH or O₂ formation.
- Useful under low CO₂ or light imbalance conditions.

Video Solution:**Q25 Text Solution:****B — C₄ plants**

- C₄ plants show wreath-like arrangement of bundle sheath cells.
- Mesophyll cells surround them with spatial separation of steps.
- Bundle sheath chloroplasts are large and agranal.
- This structure minimizes photorespiration.

Video Solution:**Q26 Text Solution:****A. Water**

During photosynthesis, the oxygen (O₂) released comes from the splitting of water molecules in a process called photolysis. This occurs in the light-dependent reactions, where water (H₂O) is split into oxygen (O₂), protons, and electrons. The oxygen is then released as a by-product.

Video Solution:**Q27 Text Solution:****C. Pheophytin**

- First molecule to accept electrons from **P680***.
- A modified chlorophyll lacking magnesium.
- Transfers electrons to **plastoquinone**.
- Initiates non-cyclic electron flow.

Video Solution:

Q28 Text Solution:**C. Both (A) and (B)**

Photorespiration produces both phosphoglycerate and phosphoglycolate. During photorespiration, oxygen is taken up by the enzyme Rubisco instead of carbon dioxide, leading to the production of these two compounds. Phosphoglycerate is further used in the Calvin cycle, while phosphoglycolate is processed through a series of reactions to eventually release carbon dioxide.

Video Solution:**Q29 Text Solution:**

1. Each photosystem contains a specific chlorophyll a molecule that acts as the reaction centre.
2. In Photosystem I this chlorophyll shows maximum absorption at 700 nm.
3. Due to this characteristic absorption peak it is designated as P700.
4. The notation reflects the wavelength at which the pigment absorbs light most efficiently.
5. Therefore the reason correctly explains the assertion

Video Solution:**Q30 Text Solution:**

(A) Chlorophyll a (P680)

- PS II contains special chlorophyll a with absorption peak at 680 nm.
- It donates high-energy electrons.
- Responsible for photolysis of water.
- Hence, P680 acts as the reaction center.

Video Solution:

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