Q1. Which of the following pigments is essential for the photolysis of water?

A. Chlorophyll a
B. Chlorophyll b
C. Xanthophyll
D. Carotene

✅Answer: A. Chlorophyll a
Explanation: Chlorophyll a is the reaction center of both PS I and PS II and is essential for photolysis and photoactivation.

Q2. Match the following with their functions:

Column I (Pigment) Column II (Function)

A. Chlorophyll a 1. Accessory pigment
B. Chlorophyll b 2. Primary reaction center
C. Carotenoids 3. Photoprotection
D. Xanthophyll 4. Yellow accessory pigment

Options:
A. A–2, B–1, C–3, D–4
B. A–1, B–2, C–3, D–4
C. A–2, B–3, C–1, D–4
D. A–1, B–4, C–3, D–2

✅Answer: A. A–2, B–1, C–3, D–4
Explanation:

Chl a: reaction center

Chl b: accessory

Carotenoids: prevent photooxidation

Xanthophyll: yellow pigment, helps light harvesting

Q3. The correct sequence of flow of electrons during the light reaction is:

A. PS I → PS II → $NADP^+$
B. PS II → PS I → $NADP^+$
C. PS I → Cytochrome b6f → $NADP^+$
D. PS II → $NADP^+$ → PS I

✅Answer: B. PS II → PS I → $NADP^+$
Explanation: Electrons move from PS II to PS I, then reduce $NADP^+$ to NADPH in the Z-scheme.

Q4. Which statement about photorespiration is correct?

A. It occurs only in C4 plants
B. It results in loss of fixed carbon
C. It enhances net photosynthesis
D. It produces ATP and NADPH

✅Answer: B. It results in loss of fixed carbon
Explanation: Photorespiration is a wasteful process where O_2 competes with CO_2, causing loss of carbon and energy.

Q5. Which enzyme is responsible for carboxylation in the Calvin cycle?

A. PEP carboxylase
B. ATP synthase
C. RuBisCO
D. NADP reductase

✅Answer: C. RuBisCO
Explanation: RuBisCO (Ribulose-1,5-bisphosphate carboxylase-oxygenase) catalyzes CO_2 fixation in C3 plants.

Q6. Which process forms ATP during light reaction without the formation of NADPH or O_2?

A. Non-cyclic photophosphorylation
B. Cyclic photophosphorylation
C. Photorespiration
D. Glycolysis

✅Answer: B. Cyclic photophosphorylation

Explanation: In cyclic photophosphorylation, electrons cycle back to PS I and only ATP is formed; no NADPH/O_2.

Q7. Photorespiration does not occur in C4 plants because:

A. They lack RuBisCO
B. They have high CO_2 concentration around RuBisCO
C. They do not perform photosynthesis
D. They lack chloroplasts in mesophyll cells

✅Answer: B. They have high CO_2 concentration around RuBisCO
Explanation: C4 plants use PEP carboxylase first and bundle sheath cells concentrate CO_2, preventing O_2 competition.

Q8. In C4 plants, the initial fixation of CO_2 occurs in:

A. Bundle sheath cells by RuBisCO
B. Mesophyll cells by RuBisCO
C. Bundle sheath cells by PEP carboxylase
D. Mesophyll cells by PEP carboxylase

✅Answer: D. Mesophyll cells by PEP carboxylase
Explanation: C4 plants fix CO_2 in mesophyll using PEPCase, forming oxaloacetate, later transported to bundle sheath.

Q9. Which of the following is a limiting factor for photosynthesis in bright light and moderate temperature?

A. Light
B. CO_2 concentration
C. Temperature
D. Water

✅Answer: B. CO_2 concentration
Explanation: Under high light and moderate temperature, the CO_2 level becomes the limiting factor.

Q10. Assertion (A): ATP and NADPH are used in the Calvin cycle.

Reason (R): ATP is used for carboxylation, and NADPH is used for reduction.**

A. Both A and R are true; R explains A
B. Both A and R are true; R does not explain A
C. A is true, R is false
D. Both A and R are false

✅Answer: A. Both A and R are true; R explains A
Explanation:

ATP is used in regeneration and activation of RuBP

NADPH is used to reduce 3-PGA to G3P

Q11. What is the final product of the Calvin cycle that can be converted into glucose?

A. 3-Phosphoglycerate
B. 1,3-Bisphosphoglycerate
C. Glyceraldehyde-3-phosphate (G3P)
D. RuBP

✅Answer: C. Glyceraldehyde-3-phosphate (G3P)
Explanation: G3P is the first stable product of Calvin cycle that is used to form glucose and regenerate RuBP.

Q12. Which statement about non-cyclic photophosphorylation is incorrect?

A. Both PS I and PS II are involved
B. Water is split during the process
C. Oxygen is released
D. Electrons cycle within the same photosystem

✅Answer: D. Electrons cycle within the same photosystem
Explanation: In non-cyclic photophosphorylation, electrons move linearly from PS II → PS I → $NADP^+$. Cycling occurs only in cyclic type.

Q13. In a well-lit, well-hydrated plant, the major form of photophosphorylation is:

A. Cyclic
B. Non-cyclic
C. Photorespiratory

D. Anaerobic

✅Answer: B. Non-cyclic
Explanation: Under normal light and water conditions, non-cyclic photophosphorylation is dominant, producing ATP, NADPH, and O_2.

Q14. Which pigment is NOT directly involved in trapping light energy but transfers it to chlorophyll a?

A. Chlorophyll b
B. Carotenoids
C. Xanthophyll
D. All of these

✅Answer: D. All of these
Explanation: All are accessory pigments that absorb additional light and transfer energy to chlorophyll a.

Q15. The bundle sheath cells in C4 plants contain:

A. Only PEPCase
B. Only RuBisCO
C. Only mitochondria
D. Both PEPCase and RuBisCO

✅Answer: B. Only RuBisCO
Explanation: In C4 plants, mesophyll has PEPCase, while bundle sheath cells contain only RuBisCO for CO_2 fixation via the Calvin cycle.

Q16. Which one of the following processes requires the expenditure of ATP in C4 plants but not in C3 plants?

A. Carbon fixation
B. Regeneration of RuBP
C. Transport of malic acid
D. Conversion of pyruvate to PEP

✅Answer: D. Conversion of pyruvate to PEP
Explanation: This step in C4 pathway consumes ATP, increasing the energy cost per CO_2 fixed compared to C3 plants.

Q17. Which of the following best differentiates between C3 and C4 photosynthesis?

A. Oxygen evolution
B. Presence of chloroplast
C. Primary CO_2 acceptor
D. Type of sugar formed

✅Answer: C. Primary CO_2 acceptor
Explanation:

C3: Primary acceptor is RuBP

C4: Primary acceptor is PEP

Q18. How many ATP molecules are required to synthesize one molecule of glucose in Calvin cycle?

A. 6
B. 12
C. 18
D. 30

✅Answer: C. 18
Explanation: Calvin cycle requires 18 ATP + 12 NADPH to synthesize 1 glucose molecule (6 CO_2 fixed).

Q19. Which of the following statements about CAM plants is true?

A. Stomata remain open during the day
B. They use PEPCase at night
C. Calvin cycle occurs at night
D. RuBisCO is not present

✅Answer: B. They use PEPCase at night
Explanation: In CAM plants, CO_2 is fixed at night by PEPCase, stored as malate, and used during the day.

Q20. Assertion (A): Photorespiration is more in C3 plants.

Reason (R): RuBisCO has a high affinity for oxygen than CO_2.**

A. Both A and R are true; R explains A
B. Both A and R are true; R does not explain A
C. A is true, R is false
D. Both A and R are false

✅Answer: C. A is true, R is false
Explanation: RuBisCO has a higher affinity for CO_2, but in low CO_2/high O_2, it acts as oxygenase → photorespiration in C3 plants.

Q21. In C4 plants, the first stable product of CO_2 fixation is:

A. Phosphoglyceric acid (PGA)
B. Glyceraldehyde-3-phosphate (G3P)
C. Oxaloacetic acid (OAA)
D. Pyruvate

✅Answer: C. Oxaloacetic acid (OAA)
Explanation: In C4 plants, PEP combines with CO_2 to form OAA — the first stable product.

Q22. Which statement is TRUE regarding photolysis of water?

A. It occurs in PS I
B. Manganese is not involved
C. It generates NADPH directly
D. It provides electrons to PS II

✅Answer: D. It provides electrons to PS II
Explanation: Water is split in PS II, donating electrons to replenish the excited electrons lost by PS II.

Q23. What is the role of plastocyanin in the light reaction?

A. ATP synthesis
B. Pigment excitation
C. Electron transfer between cytochrome b6f and PS I
D. Water splitting

✅Answer: C. Electron transfer between cytochrome b6f and PS I
Explanation: Plastocyanin is a copper-containing protein that shuttles electrons to PS I.

Q24. How many molecules of NADPH are needed to fix 6 CO_2 molecules in the Calvin cycle?

A. 6
B. 12
C. 18
D. 24

✅Answer: B. 12
Explanation: Fixation of 6 CO_2 (to make 1 glucose) needs 12 NADPH and 18 ATP.

Q25. Which of the following environmental conditions would lead to maximum photorespiration?

A. High CO_2, high O_2
B. Low CO_2, high O_2
C. High CO_2, low O_2
D. Equal CO_2 and O_2

✅Answer: B. Low CO_2, high O_2
Explanation: In such conditions, RuBisCO favors oxygenase activity → increased photorespiration.

Q26. Which one is mismatched?

A. Grana – ATP formation
B. Stroma – Calvin cycle
C. PS I – NADPH formation
D. PS II – Cyclic photophosphorylation

✅Answer: D. PS II – Cyclic photophosphorylation
Explanation: Cyclic photophosphorylation involves only PS I, not PS II.

Q27. What is the principal advantage of the C4 pathway in hot climates?

A. Higher oxygen production
B. Reduced transpiration
C. Minimization of photorespiration
D. Increased photorespiration

✅Answer: C. Minimization of photorespiration
Explanation: C4 plants reduce oxygenase activity of RuBisCO by concentrating CO_2 in bundle sheath cells.

Q28. Photorespiration results in the loss of which fixed element?

A. Hydrogen
B. Oxygen
C. Nitrogen
D. Carbon

✅Answer: D. Carbon
Explanation: Photorespiration consumes O_2 and releases CO_2, resulting in loss of fixed carbon.

Q29. In which cell organelle does photorespiration not occur?

A. Chloroplast
B. Mitochondria
C. Peroxisome
D. Ribosome

✅Answer: D. Ribosome
Explanation: Photorespiration occurs in chloroplasts, peroxisomes, and mitochondria — not in ribosomes.

Q30. Match the following correctly:

Column I	Column II
A. PEPCase	1. Calvin cycle
B. RuBisCO	2. Bundle sheath
C. ATP synthase	3. Thylakoid membrane
D. Oxygen evolution	4. PS II

Options:
A. A–2, B–1, C–3, D–4
B. A–1, B–2, C–4, D–3
C. A–3, B–2, C–1, D–4

D. A–4, B–1, C–2, D–3

✅Answer: A. A–2, B–1, C–3, D–4
Explanation:

PEPCase → C4 mesophyll → transported to bundle sheath (2)

RuBisCO → enzyme of Calvin cycle (1)

ATP synthase → present in thylakoid membrane (3)

Oxygen evolution → at PS II (4)

Q31. Which condition leads to maximum efficiency of RuBisCO carboxylation?

A. Low temperature and low CO_2
B. High temperature and high O_2
C. Low O_2 and high CO_2
D. High O_2 and low CO_2

✅Answer: C. Low O_2 and high CO_2
Explanation: These conditions favor RuBisCO's carboxylase activity, minimizing photorespiration.

Q32. Identify the incorrect statement about the light reaction:

A. ATP is formed in thylakoids
B. NADPH is produced during cyclic photophosphorylation
C. Oxygen is evolved by photolysis of water
D. Non-cyclic photophosphorylation involves both PS I and PS II

✅Answer: B. NADPH is produced during cyclic photophosphorylation
Explanation: In cyclic photophosphorylation, only ATP is produced, not NADPH.

Q33. In photorespiration, glycolate is converted into glycine in which organelle?

A. Mitochondria
B. Chloroplast
C. Peroxisome

D. Cytoplasm

✅Answer: C. Peroxisome
Explanation: Glycolate from chloroplast is converted to glycine in the peroxisome.

Q34. Quantum yield of photosynthesis is high when:

A. Both light and CO_2 are limited
B. Blue light is used
C. Green light is used
D. Red light is used

✅Answer: D. Red light is used
Explanation: Quantum yield (molecules of O_2 evolved per photon absorbed) is highest in red light.

Q35. C4 plants can tolerate dry and high light intensity regions because:

A. They open stomata during night
B. They lack RuBisCO
C. They concentrate CO_2 in bundle sheath cells
D. They absorb water faster

✅Answer: C. They concentrate CO_2 in bundle sheath cells
Explanation: This prevents photorespiration, conserving energy and improving water-use efficiency.

Q36. Which pigment has the highest absorption in the red region of light?

A. Chlorophyll b
B. Carotenoids
C. Chlorophyll a
D. Xanthophyll

✅Answer: C. Chlorophyll a
Explanation: Chlorophyll a absorbs best in blue and red regions, especially red (~665–680 nm).

Q37. Which one is not a product of the light reaction?

A. ATP
B. NADPH
C. O_2
D. Glucose

✅Answer: D. Glucose
Explanation: Glucose is produced during dark reaction (Calvin cycle), not in the light reaction.

Q38. Which is the key enzyme responsible for fixing atmospheric CO_2 in the Calvin cycle?

A. PEP carboxylase
B. ATP synthase
C. RuBisCO
D. Cytochrome b6f

✅Answer: C. RuBisCO
Explanation: RuBisCO (Ribulose bisphosphate carboxylase oxygenase) fixes CO_2 with RuBP in the Calvin cycle.

Q39. Identify the correct sequence in the Calvin cycle:

A. Carboxylation → Regeneration → Reduction
B. Carboxylation → Reduction → Regeneration
C. Reduction → Carboxylation → Regeneration
D. Regeneration → Carboxylation → Reduction

✅Answer: B. Carboxylation → Reduction → Regeneration
Explanation:

1. CO_2 + RuBP → carboxylation

2. Formation of PGA → reduction to G3P

3. Regeneration of RuBP

Q40. The primary CO_2 acceptor in C4 plants is:

A. RuBP
B. PGA
C. PEP
D. Pyruvate

✅Answer: C. PEP
Explanation: In C4 plants, phosphoenolpyruvate (PEP) is the initial CO_2 acceptor, forming OAA.

Q41. Under which conditions does cyclic photophosphorylation occur predominantly?

A. When $NADP^+$ is abundant
B. When ATP demand is low
C. When PS II is inhibited
D. In presence of high CO_2

✅Answer: C. When PS II is inhibited
Explanation: Cyclic photophosphorylation uses only PS I, and is favored when PS II is inactive or ATP is limiting.

Q42. What happens when O_2 concentration increases in mesophyll cells of C3 plants?

A. ATP production increases
B. Photorespiration increases
C. Glucose synthesis increases
D. RuBisCO becomes more efficient

✅Answer: B. Photorespiration increases
Explanation: O_2 competes with CO_2, leading RuBisCO to act as oxygenase, increasing photorespiration.

Q43. Which molecule acts as both an enzyme and structural protein during photosynthesis?

A. PEP carboxylase
B. ATP synthase
C. RuBisCO
D. $NADP^+$ reductase

✅Answer: C. RuBisCO
Explanation: RuBisCO is the most abundant enzyme and also forms a large structural protein complex.

Q44. Bundle sheath cells are characterized by:

A. Presence of PS II only
B. Absence of chloroplasts
C. Kranz anatomy in C3 plants
D. Thick-walled chloroplasts with RuBisCO in C4 plants

✅Answer: D. Thick-walled chloroplasts with RuBisCO in C4 plants
Explanation: C4 plants have Kranz anatomy with bundle sheath cells having RuBisCO and thick-walled chloroplasts.

Q45. Select the INCORRECT statement about C3 and C4 plants:

A. C3 plants undergo high photorespiration
B. C4 plants are more efficient in high-temperature areas
C. C4 pathway uses ATP for CO_2 transport
D. C3 plants fix CO_2 using PEP

✅Answer: D. C3 plants fix CO_2 using PEP
Explanation: C3 plants use RuBP as CO_2 acceptor, not PEP.