NCERT Exemplar Solutions of Class 11 Biology – Chapter 13: Photosynthesis in Higher Plants

MULTIPLE CHOICE QUESTIONS

1. Which metal ion is a constituent of chlorophyll?

a. Iron

b. Copper

c. **Magnesium**

d. Zinc

Solution: Option (c) is the answer.

Enhanced Explanation: Chlorophyll molecule contains magnesium (Mg^{2+}) ion at its center, which is essential for its light-absorbing properties. The magnesium ion is coordinated with four nitrogen atoms in the porphyrin ring structure of chlorophyll.

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2. Which pigment acts directly to convert light energy to chemical energy?

a. **Chlorophyll a**

b. Chlorophyll b

c. Xanthophyll

d. Carotenoid

Solution: Option (a) is the answer.

Enhanced Explanation: Chlorophyll a is the primary photosynthetic pigment that directly participates in the light reactions. It acts as the reaction center pigment in both Photosystem I and Photosystem II, where the actual conversion of light energy to chemical energy occurs.

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3. Which range of wavelength (in nm) is called photosynthetically active radiation (PAR)?

a. 100 - 390

b. 390 - 430

c. **400 - 700**

d. 760 - 100,000

Solution: Option (c) is the answer.

Enhanced Explanation: PAR includes visible light from 400-700 nm wavelength, which corresponds to the spectrum that plants can effectively use for photosynthesis. This range includes violet (400-450 nm), blue (450-500 nm), green (500-570 nm), yellow (570-590 nm), orange (590-620 nm), and red (620-700 nm) light.

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4. Which light range is least effective in photosynthesis?

a. Blue

b. **Green**

c. Red
d. Violet
Solution: Option (b) is the answer.
Enhanced Explanation: Green light (500-570 nm) is least effective because chlorophyll molecules reflect green light rather than absorbing it efficiently. This is why plants appear green to our eyes. Red and blue light are most effectively absorbed by chlorophyll for photosynthesis.

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5. Chemosynthetic bacteria obtain energy from
a. Sun
b. Infrared rays
c. Organic substances
d. **Inorganic chemicals**
Solution: Option (d) is the answer.
Enhanced Explanation: Chemosynthetic bacteria derive energy by oxidizing inorganic chemicals such as hydrogen sulfide (H_2S), ammonia (NH_3), or nitrites (NO_2^-). Examples include sulfur bacteria, nitrifying bacteria, and iron bacteria.

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6. The energy required for ATP synthesis in PSII comes from
a. **Proton gradient**
b. Electron gradient
c. Reduction of glucose
d. Oxidation of glucose
Solution: Option (a) is the answer.
Enhanced Explanation: ATP synthesis occurs through chemiosmosis, where the proton gradient (difference in H^+ concentration) across the thylakoid membrane drives ATP synthase to produce ATP from ADP + Pi.

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7. During light reaction in photosynthesis, the following are formed:
a. ATP and sugar
b. Hydrogen, O_2 and sugar
c. **ATP, hydrogen and O_2**
d. ATP, hydrogen and O_2 donor
Solution: Option (c) is the answer.
Enhanced Explanation: The light-dependent reactions produce ATP, NADPH (reduced hydrogen), and O_2. Sugar is produced during the light-independent reactions (Calvin cycle) using the ATP and NADPH generated in the light reactions.

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8. The dark reaction in photosynthesis is called so because of

a. It can occur in dark also
b. **It does not depend on light energy**
c. It cannot occur during daylight
d. It occurs more rapidly at night
Solution: Option (b) is the answer.
Enhanced Explanation: Dark reactions (Calvin cycle) are light-independent reactions that do not directly require light energy. However, they depend on the products of light reactions (ATP and NADPH) and therefore occur continuously during daylight when these products are available.

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9. PEP is the 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: Option (a) is the answer.
Enhanced Explanation: In C_4 plants, phosphoenolpyruvate (PEP) is the primary CO_2 acceptor in mesophyll cells, catalyzed by PEP carboxylase enzyme. In C_3 plants, RuBP (ribulose bisphosphate) is the primary CO_2 acceptor.

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10. Splitting of water is associated with
a. Photosystem I
b. The lumen of thylakoid
c. Both Photosystem I and II
d. **The inner surface of the thylakoid membrane**
Solution: Option (d) is the answer.
Enhanced Explanation: Water splitting (photolysis) occurs at the oxygen-evolving complex associated with PSII on the inner surface (lumen side) of the thylakoid membrane. The reaction is: $2H_2O \rightarrow 4H^+ + O_2 + 4e^-$

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11. The correct sequence of flow of electrons in the light reaction is
a. **PSII, plastoquinone, cytochromes, PSI, ferredoxin**
b. PSI, plastoquinone, cytochromes, PSII, ferredoxin
c. PSI, ferredoxin, PSII
d. PSI, plastoquinone, cytochromes, PSII, ferredoxin
Solution: Option (a) is the answer.
Enhanced Explanation: In the Z-scheme of photosynthesis, electrons flow from PSII → plastoquinone (PQ) → cytochrome b_6f complex → plastocyanin → PSI → ferredoxin → $NADP^+$ reductase → NADPH

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12. The enzyme that is not found in a C_3 plant is

a. RuBP Carboxylase

b. **PEP Carboxylase**

c. NADP reductase

d. ATP synthase

Solution: Option (b) is the answer.

Enhanced Explanation: PEP carboxylase is the characteristic enzyme of C_4 and CAM plants, found in mesophyll cells where it catalyzes the fixation of CO_2 to PEP. C_3 plants lack this enzyme and use only RuBisCO for CO_2 fixation.

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13. The reaction that is responsible for the primary fixation of CO_2 is catalysed by

a. RuBP carboxylase

b. PEP carboxylase

c. **RuBP carboxylase and PEP carboxylase**

d. PGA synthase

Solution: Option (c) is the answer.

Enhanced Explanation: Both enzymes are responsible for primary CO_2 fixation in different types of plants: RuBP carboxylase (RuBisCO) in C_3 plants, and PEP carboxylase in C_4 and CAM plants.

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14. When CO_2 is added to PEP, the first stable product synthesised is:

a. Pyruvate

b. Glyceraldehyde-3-phosphate

c. Phosphoglycerate

d. **Oxaloacetate**

Solution: Option (d) is the answer.

Enhanced Explanation: In C_4 plants, when CO_2 is fixed to PEP by PEP carboxylase, the first stable 4-carbon compound formed is oxaloacetate (OAA), which is then converted to malate or aspartate for transport to bundle sheath cells.