NCERT Exemplar Solutions of Class 11 Biology – Chapter 12: Mineral Nutrition

MULTIPLE CHOICE QUESTIONS

1. Which one of the following roles is not characteristic of an essential element?

a. is a component of biomolecules

b. changing the chemistry of soil

c. being a structural component of energy-related chemical compounds

d. activation or inhibition of enzymes

Solution:

Answer: Option (b)

Enhanced Explanation:

Essential elements are those nutrients that plants cannot complete their life cycle without. They have specific roles:

- **Component of biomolecules** (e.g., Mg in chlorophyll, P in nucleic acids)
- **Structural components of energy compounds** (e.g., P in ATP, Mg in chlorophyll for photosynthesis)
- **Enzyme activation/inhibition** (e.g., Mg^{2+} activates RuBisCO enzyme)

However, **changing soil chemistry** is not a characteristic role of essential elements within the plant. This is more related to soil amendments and external factors rather than the biological functions these elements perform within plant metabolism.

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2. Which one of the following statements can best explain the term critical concentration of an essential element?

a. essential element concentration below which plant growth is retarded

b. essential element concentration below which plant growth becomes stunted

c. essential element concentration above which plant remains in the vegetative phase

d. none of the above

Solution:

Answer: Option (a)

Enhanced Explanation:

Critical concentration is a fundamental concept in plant nutrition defined as the minimum concentration of an essential element in plant tissue below which plant growth rate decreases. Key points:

- It's the **threshold concentration** for optimal growth
- Below this level, growth rate **begins to decline** (retarded)
- It's different from "deficient" level where visible symptoms appear
- Critical concentration is determined through growth rate analysis, not symptom observation
- It's species and element-specific

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3. Deficiency symptoms of an element tend to appear first in young leaves. It indicates that the element is relatively immobile. Which one of the following elemental deficiency would show such symptoms?

a. sulphur

b. magnesium

c. nitrogen

d. potassium

Solution:

Answer: Option (a)

Enhanced Explanation:

Element mobility in plants determines where deficiency symptoms first appear:

Immobile elements (symptoms appear first in **young leaves**):

- **Sulphur** - component of amino acids cysteine and methionine
- **Calcium** - structural component of cell walls
- **Boron** - involved in cell wall formation
- **Iron** - component of cytochromes and ferredoxin

Mobile elements (symptoms appear first in **old leaves**):

- **Nitrogen** - component of proteins and chlorophyll
- **Magnesium** - central atom in chlorophyll molecule
- **Potassium** - involved in osmotic regulation

When immobile elements are deficient, the plant cannot translocate them from older tissues, so new growth suffers first.

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4. Which one of the following symptoms is not due to manganese toxicity in plants?

a. Calcium translocation in shoot apex is inhibited

b. Deficiency in both Iron and Nitrogen is induced

c. The appearance of brown spot surrounded by chlorotic veins

d. None of the above

Solution:

Answer: Option (b)

Enhanced Explanation:

Manganese (Mn) toxicity effects include:

✓ **Calcium translocation inhibition** - Mn interferes with Ca^{2+} transport to growing points

✓ **Brown spots with chlorotic veins** - characteristic visual symptom of Mn toxicity

✓ **Iron deficiency induction** - Mn competes with Fe for binding sites

✗ **Nitrogen deficiency is NOT induced** by Mn toxicity. While Mn toxicity can cause iron deficiency through competitive inhibition, it doesn't directly affect nitrogen uptake or metabolism. Nitrogen deficiency would be caused by other factors like soil conditions, root damage, or insufficient N supply.

5. The reaction carried out by N_2 fixing microbes include:

a. $2NH_3 + 3O_2 \rightarrow 2NO_2^- + 2H^+ + 2H_2O$ (i)

b. $2NO_2^- + O_2 \rightarrow 2NO_3^-$ (ii)

Which of the following statements about these equations is not true: a. step (i) is carried out by Nitrosomonas or Nitrococcus

b. step (ii) is carried out by Nitrobacter

c. both steps (i) and (ii) can be called nitrification

d. bacteria carrying out these steps are usually photoautotrophs

Solution:

Answer: Option (d)

Enhanced Explanation:

The given reactions represent **nitrification**, not nitrogen fixation:

Step (i): $2NH_3 + 3O_2 \rightarrow 2NO_2^- + 2H^+ + 2H_2O$

- Carried out by **Nitrosomonas** or **Nitrococcus** (ammonia-oxidizing bacteria)
- Converts ammonia to nitrite

Step (ii): $2NO_2^- + O_2 \rightarrow 2NO_3^-$

- Carried out by **Nitrobacter** (nitrite-oxidizing bacteria)
- Converts nitrite to nitrate

Both steps constitute nitrification - the oxidation of ammonia to nitrate.

Incorrect statement: These bacteria are **chemoautotrophs**, not photoautotrophs. They obtain energy from chemical oxidation reactions, not from light. They use the energy released from these oxidation reactions to fix CO_2.

6. With regard to the Biological Nitrogen Fixation by Rhizobium in association with soybean, which one of the following statements do not hold?

a. Nitrogenase may require oxygen for its functioning

b. Nitrogenase is MO-Fe protein

c. Leg-hemoglobin is a pink coloured pigment

d. Nitrogenase helps to convert N_2 gas into two molecules of ammonia

Solution:

Answer: Option (a)

Enhanced Explanation:

Facts about **Rhizobium-soybean nitrogen fixation**:

✓ **Nitrogenase is Mo-Fe protein** - contains molybdenum and iron as cofactors

✓ **Leghemoglobin is pink-colored** - gives root nodules their characteristic color

✓ **Converts N_2 to $2NH_3$** - the overall reaction: $N_2 + 8H^+ + 8e^- \rightarrow 2NH_3 + H_2$

✗ **Nitrogenase does NOT require oxygen** - in fact, it's **oxygen-sensitive** and becomes inactive in the presence of O_2. **Leghemoglobin** acts as an oxygen scavenger, maintaining low

O_2 concentration around nitrogenase while still allowing some O_2 for respiration. This creates a **microaerobic environment** essential for nitrogen fixation.

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7. Match the element with its associated functions/roles:

Element	Function
A. Boron	i. splitting of H_2O to liberate O_2 during photosynthesis
B. Manganese	ii. needed for the synthesis of auxins
C. Molybdenum	iii. component of nitrogenase
D. Zinc	iv. Pollen germination
E. Iron	v. component of ferredoxin

Options: a. A-i, B-ii, C-iii, D-iv, E-v
b. A-iv, B-i, C-iii, D-ii, E-v
c. A-iii, B-ii, C-iv, D-v, E-i
d. A-ii, B-iii, C-v, D-i, E-iv
Solution:
Answer: Option (b)
Enhanced Explanation:
Correct matching:

- **A. Boron → iv. Pollen germination** - Essential for pollen tube growth and carbohydrate translocation
- **B. Manganese → i. Splitting of H_2O during photosynthesis** - Component of oxygen-evolving complex in PSII
- **C. Molybdenum → iii. Component of nitrogenase** - Cofactor in nitrogenase enzyme for N_2 fixation
- **D. Zinc → ii. Synthesis of auxins** - Required for IAA (Indole Acetic Acid) biosynthesis
- **E. Iron → v. Component of ferredoxin** - Iron-sulfur protein involved in electron transport

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8. Plants can be grown in (Tick the incorrect option):
a. soil with essential nutrients
b. water with essential nutrients
c. either water or soil with essential nutrients
d. water or soil without essential nutrients
Solution:
Answer: Option (d)
Enhanced Explanation:
Plants **require essential nutrients** for growth regardless of the growing medium:

✓ **Soil with essential nutrients** - Traditional agriculture

✓ **Water with essential nutrients** - Hydroponics/soilless culture

✓ **Either water or soil with essential nutrients** - Both methods work

✗ **Water or soil WITHOUT essential nutrients** - Plants cannot complete their life cycle without essential elements. These nutrients are required for:

- Enzyme activation
- Structural components
- Metabolic processes
- Growth and reproduction

Even in the best soil or purest water, plants will fail to thrive without adequate essential nutrients.