

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:

Option (b) is the answer

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:

Option (a) is the answer.

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:

Option (a) is the answer.

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:

Option (b) is the answer.

5. The reaction carried out by N₂ fixing microbes include

- a. $2\text{NH}_3 + 3\text{O}_2 \rightarrow 2\text{NO}_2^- + 2\text{H}^+ + 2\text{H}_2\text{O}$ (i)
- b. $2\text{NO}_2^- + \text{O}_2 \rightarrow 2\text{NO}_3^-$ (ii)

Which of the following statements about these equations is not true

- step (i) is carried out by Nitrosomonas or Nitrococcus
- step (ii) is carried out by Nitrobacter
- both steps (i) and (ii) can be called nitrification
- bacteria carrying out these steps are usually photoautotrophs

Solution:

Option (d) is the answer.

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

- Nitrogenase may require oxygen for its functioning.
- Nitrogenase is MO- Fe protein
- Leg-hemoglobin is a pink coloured pigment.
- Nitrogenase helps to convert N₂ gas into two molecules of ammonia.

Solution:

Option (a) is the answer.

7. Match the element with its associated functions/roles and choose the correct option among given below

<p>A. Boron B. Manganese C. Molybdenum D. Zinc E. Iron</p>	<p>i. splitting of H₂O to liberate O₂ during photosynthesis ii. needed for the synthesis of auxins iii. component of nitrogenase iv. Pollen germination v. component of ferredoxin</p>
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Options

- A-i, B-ii, C-iii, D-iv, E-v
- A-iv, B-i, C-iii, D-ii, E-v
- A-iii, B-ii, C-iv, D-v, E-i
- A-ii, B-iii, C-v, D-i, E-iv

Solution:

Option (b) is the answer.

8. Plants can be grown in (Tick the incorrect option)

- soil with essential nutrients.
- water with essential nutrients.
- either water or soil with essential nutrients.
- water or soil without essential nutrients

Solution:

Option (d) is the answer.

VERY SHORT ANSWER TYPE QUESTIONS

1. Name a plant, which accumulates silicon.

Solution:

Oryza Sativa (Asian Rice) is one such plant which accumulates silicon.

2. Mycorrhiza is a mutualistic association. How do the organisms involved in this association benefit from each other?

Solution:

Fungi get carbohydrates from the plant for its growth. The fungi, in turn, acts as the extension of root hairs and helps in increased absorption of the mineral and nutrients from the soil.

3. Nitrogen fixation is shown by prokaryotes and not by eukaryotes. Comment.

Solution:

Nitrogen fixation is the process in which the atmospheric nitrogen is converted to ammonia (NH_3) in the presence of an enzyme Nitrogenase. This process is in prokaryotes due to the presence of nitrogenase.

4. Carnivorous plants like Nepenthes and Venus flytrap have nutritional adaptations. Which nutrient do they especially obtain and from where?

Solution:

Carnivorous plants like Nepenthes and Venus flytrap grow in nitrogen-deficient soil which causes them to have a nitrogen deficiency. Nitrogen is obtained by trapping an insect in their cavity

5. Name a plant which lacks chlorophyll. How will it obtain nutrition?

Solution:

A plant called 'Cuscuta' is a stem parasite which does not have chlorophyll. They obtain nutrition from the host plant.

6. Name an insectivorous angiosperm.

Solution:

Utricularia (Bladderwort) is an insectivorous angiosperm.

7. A farmer adds Azotobacter culture to the soil before sowing maize. Which mineral element is being replenished?

Solution:

Azotobacter is nitrogen-fixing bacteria in cereal crops like maize. Which means it converts free nitrogen in the air to ammonia (NH_3) or other related nitrogenous compounds.

8. What is the function of leghaemoglobin in the root nodule of a legume?

Solution:

Leghaemoglobin is a red coloured pigment present in the root nodules of a legume. It is also considered as oxygen molecule scavenger

9. What is common to Nepenthes, Utricularia and Drosera with regard to the mode of nutrition?

Solution:

These plants trap insects and feed on them to get nutrition.

10. Plants with zinc deficiency show reduced biosynthesis of _____.

Solution:

Plants with zinc deficiency show reduced biosynthesis of Auxin (IAA).

11. Yellowish edges appear in leaves deficient in _____ mineral .

Solution:

Yellowish edges appear in leaves deficient in Nitrogen, Magnesium, Potassium and iron.

12. Name the macronutrient which is a component of all organic compounds but is not obtained from the soil.

Solution:

Carbon is the macronutrient which is a component of all organic compounds but is not obtained from the soil.

13. Name one non-symbiotic nitrogen-fixing prokaryote.

Solution:

Nonsymbiotic nitrogen-fixing prokaryote: Azotobacter, Beijernickia etc.

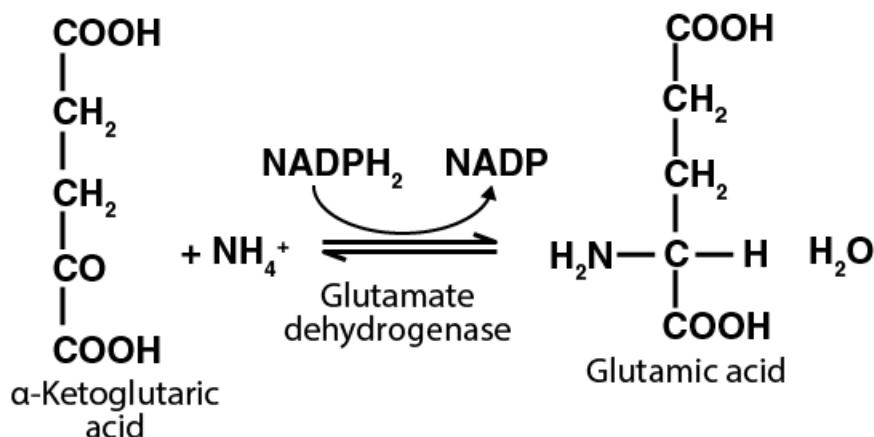
14. Rice fields produce important greenhouse gas. Name it.

Solution:

The bacteria present in the waterlogged soil under anaerobic conditions produce Methane Gas (CH₄) which is a greenhouse gas.

15. Complete the equation for reductive amination _____? _____ + NH₄⁺ + NADPH glutamate + H₂O + NADP

Solution:



16. Excess of Mn in the soil leads to a deficiency of Ca, Mg and Fe. Explain.

Solution:

Manganese inhibits the translocation of calcium to the root apex hence causing its deficiency. Manganese competes with Magnesium to bind with enzymes hence causing its deficiency.

SHORT ANSWER TYPE QUESTIONS

1. How is sulphur important for plants? Name the amino acids in which it

is present.

Solution:

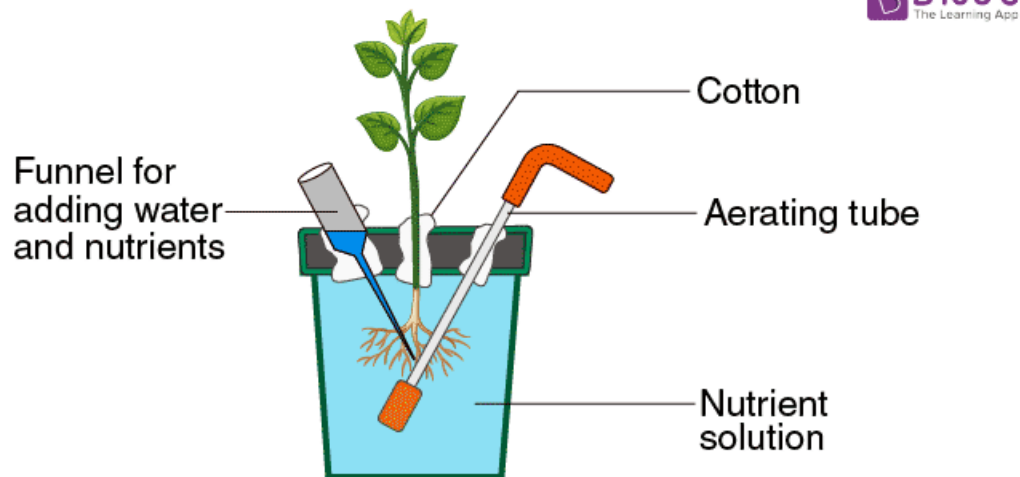
Sulphur is important for the formation of chlorophyll and the main constituent of various coenzymes. It is also involved in the modulation of legumes. Sulphur is present in two amino acids. Cysteine and Methionine.

2. How are organisms like Pseudomonas and Thiobacillus of great significance in the nitrogen cycle?

Solution:

Pseudomonas and Thiobacillus are involved in the process of denitrification during the nitrogen cycle. The nitrate present in the soil is converted

3. Carefully observe the following figure



a. Name the technique shown in the figure and the scientist who demonstrated this technique for the first time.

b. Name at least three plants for which this technique can be employed for their commercial production.

c. What is the significance of aerating tube and feeding funnel in this setup?

Solution:

a) The technique shown in the figure is Hydroponics or Soilless culture of a plant.

b) Tomato, Lettuce, Marijuana, Pepper and Cucumber.

c) Aerating tube: A bent tube used for proper aeration of the medium for growth of roots.

Feeding funnel is used for feeding nutrients and water to the medium

4. Name the most crucial enzyme found in root nodules for N₂ fixation? Does it require a special pink coloured pigment for its functioning? Elaborate.

Solution:

Nitrogenase is the crucial enzyme found in root nodules for N₂ fixation it converts the free nitrogen in the air to Ammonia or other nitrogenous compounds. It requires a special pink coloured pigment for its functioning called leg haemoglobin.

5. How are the terms 'critical concentration' and 'deficient' different from each other in terms of

the concentration of an essential element in plants? How will you find the values of 'critical concentration' and 'deficient' for minerals – Fe & Zn?

Solution:

Critical concentration is the concentration of essential elements below which the plant growth would stop whereas the concentration of essential elements below which the deficiency of an element starts taking place and visible signs are seen in deficient.

These values can be found out using Hydropo

6. Carnivorous plants exhibit nutritional adaptation. Citing an example explain this fact.

Solution:

Carnivorous plants exhibit nutritional adaptation because they have green leaves which show they are Autotrophic but they grow in nitrogen-deficient soil. In case of Pitcher Plant, it is assumed that during evolution the leaf folded inwards to form the inside of the pitcher

7. A farmer adds/ supplies Na, Ca, Mg and Fe regularly to his field and yet he observes that the plants show a deficiency of Ca, Mg and Fe. Give a valid reason and suggest a way to help the farmer improve the growth of plants.

Solution:

The soil becomes infertile when the pH is not maintained. Alkalinity or acidity of the plants when increased they won't take up nutrients from the soil. It causes iron deficiency also.

Prevention:

The pH of the soil is maintained and using good quality fertilizers.

LONG ANSWER TYPE QUESTIONS

1. It is observed that deficiency of a particular element showed its symptoms initially in older leaves and then in younger leaves.

a. Does it indicate that the element is actively mobilized or relatively immobile?

b. Name two highly mobile elements and two which are relatively immobile.

c. How is the aspect of the mobility of elements important to horticulture and agriculture?

Solution:

a) If it is observed that deficiency of a particular element showed its symptoms initially in older leaves and then in younger leaves than this indicates that the element is actively mobilized.

b) Highly Mobile elements: Nitrogen and Magnesium.

Relatively Immobile elements: Calcium and Boron

c) agriculturist and horticulturist to understand the deficiency of a particular element, they observed that the deficiency of a particular element is first in older leaves then comes to younger leaves which shows the elements is actively mobilized. Sulphur is an immobile element so it's deficiency is seen in younger leaves first.

2. We find that Rhizobium forms nodules on the roots of leguminous plants. Also Frankia another microbe forms nitrogen-fixing nodules on the roots of non-leguminous plant Alnus.

a. Can we artificially induce the property of nitrogen fixation in a plant – leguminous or non-

leguminous?

b. What kind of relationship is observed between mycorrhiza and pine trees?

c. Is it necessary for a microbe to be in close association with a plant to provide mineral nutrition?

Explain with the help of one example.

Solution:

a) Yes, the property of nitrogen fixation in a plant – leguminous or non-leguminous can be artificially induced by genetic engineering.

b) Mycorrhiza and Pine trees show a symbiotic relationship. In this type of relationship both the organisms benefit from each other.

c) Yes, a microbe must be in close association with a plant to provide mineral nutrition.

An example is the rod-shaped Rhizobium has such a relationship with several legumes like sweet pea, lentils, garden pea etc.

3. What are the essential elements for plants? Give the criteria of essentiality? How are minerals classified depending upon the amount in which they are needed by the plants?

Solution:

There are two types of essential elements they are macro and microelements. Macro elements are present in large amounts like calcium, magnesium etc. Whereas microelements are present in small amounts like iron and zinc.

Criteria of essentiality: The essentiality not only depends on the presence of an element in the plant but also on the following criteria:

1. Without an element, the plant cant grow and reproduce
2. The element cannot be replaced by other elements because it is specific.
3. The element is directly involved in the metabolism process.

4. With the help of examples describe the classification of essential elements based on the function they perform.

Solution:

i. Essential elements as components of energy-related compounds

Example: Magnesium in chlorophyll and phosphorus in ATP molecule

ii. Components of Structural elements of cells

Example: Hydrogen bonds are seen in the secondary structure of proteins, Carbon and Oxygen in proteins, lipids, carbohydrates and nucleic acids.

iii. Essential elements as Activator and Inhibitor of enzymes:

Example: Magnesium (Mg^{2+}) is an activator of both Ribulose Bisphosphate and Phosphoenolpyruvate enzyme which are involved in photosynthetic carbon fixation.

iv. Essential elements which can alter osmotic pressure:

For example, Potassium plays an important role in the opening and closing of Stomata.

5. We know that plants require nutrients. If we supply these in excess, will it be beneficial to the plants? If yes, how/ If no, why?

Solution:

No, excess of nutrients should not be given because if we supply these nutrients in excess reduces the dry weight of the tissue by 10% and leads to toxicity. It also inhibits the uptake other elements. For example, Increased level of Manganese inhibits the uptake of Calcium, Iron etc.

6. Trace the events starting from the coming in contact with Rhizobium to a leguminous root till nodule formation. Add a note on the importance of leghemoglobin.**Solution:**

Event 1: Trace the events starting from the coming in contact with Rhizobium to a leguminous root till nodule formation. Add a note on the importance of leghemoglobin.

Event 2: The root hair cells curl and the bacteria enter the root hairs.

Event 3: After entering the root hair an infection thread is formed. Which carries the bacteria to the cortex of the root.

Event 4: Formation takes place in the cortex nodule

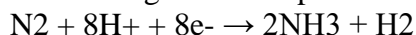
Event 5: The differentiation of nitrogen-fixing cells takes place

Event 6: Avascular connection is established with the host for the exchange of nutrients.

Leghaemoglobin is considered as the oxygen molecule scavenger helping enzyme nitrogenase in nitrogen fixation, which only works in the absence of molecular.

7. Give the biochemical events occurring in the root nodule of a pulse plant. What is the end product? What is its fate?**Solution:**

The process of nitrogen fixation involves the conversion of free nitrogen in the air into Ammonia or other nitrogenous compounds in the presence of enzyme Nitrogenase.



The end product of the biochemical events is Ammonia (NH₃).

The Ammonia produced through nitrogen fixation is incorporated in the amino acids as an amino group.

At physiological pH NH₃ group is protonated to NH₄⁺ group is the fate of ammonia.

1. Reductive Amination: In this reaction, alpha Ketoglutaric acid forms glutamate. In this reaction, Ammonia reacts with a-ketoglutaric acid to form glutamate.

2. Transamination: In this reaction amino group (NH₂) transfers from one amino acid to other amino acid transaminase enzyme catalyses this reaction

8. Hydroponics has been shown to be a successful technique for growing of plants. Yet most of the crops are still grown on land. Why?**Solution:**

Hydroponics is the technique where the plants are grown in mineral nutrient instead of soil. This requires the addition of mineral regularly and change of water. Examples like tomato, cucumber etc culture like this. Most of the crops are grown still in the land because minerals are already present in the soil there is no need of adding extra into it.