

Each question from 1 to 10 carries 1 score.

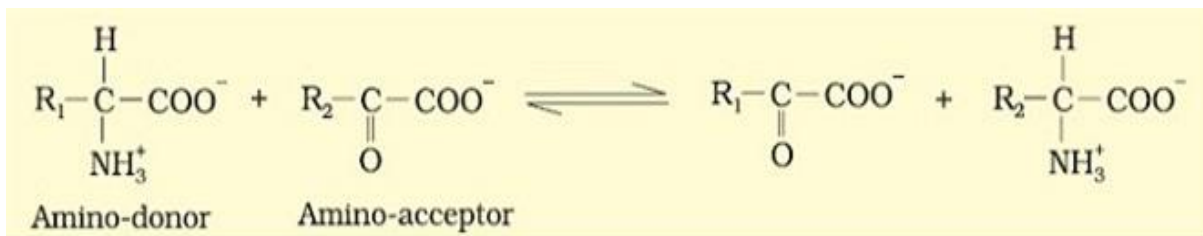
- 1) Name the N₂-fixing microbe seen in root nodules of non-leguminous plant *Alnus*.
- 2) Name the two trace elements which are present in Nitrogenase enzyme?
- 3) What are N₂ - fixers?
- 4) Name the first amino acid which is synthesised during Reductive amination?
- 5) Name any two *Cyanobacteria* which are N₂ – fixers.
- 6) Raju uprooted a *Pea* plant and observed some nodules on its root. When he cut through it he noticed a pink colour. What makes the nodules pink?
- 7) Give any two examples for free-living nitrogen-fixing aerobic microbes.
- 8) Name an anaerobic free-living N₂ - fixer
- 9) List any two nitrogenous compounds which are having a high nitrogen to carbon ratio.
- 10) Name any two bacteria which are involved in denitrification.

Each question from 11 to 20 carries 2 scores.

- 11) Magnesium is a macronutrient present in plant tissues. Mention two of its important role.
- 12) Elements are divided into two broad categories based on their quantitative requirements. Mention them.
- 13) Match the following

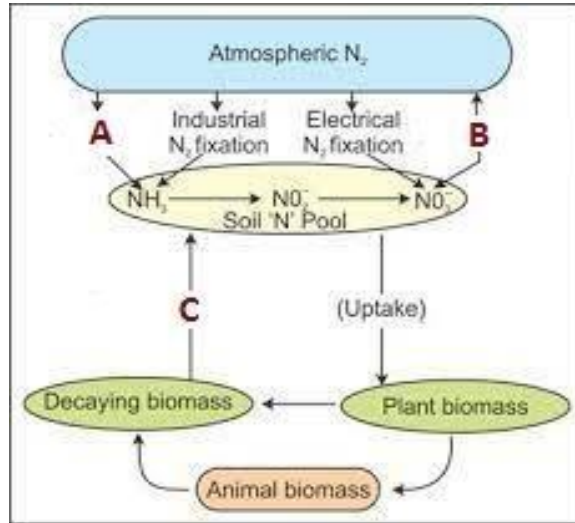
Name of element	Role of element
Magnesium	Activator of alcohol dehydrogenase
Phosphorus	Opening and closing of stomata.
Zinc	Constituent of chlorophyll
Potassium	Present in ATP

- 14) List the four macro elements which are components of biomolecules and structural elements of cells.
- 15) What is Nitrogen Fixation? Mention the three types of Nitrogen Fixation.
- 16) Explain the process of Nitrification. Mention the microorganisms involved in this process.
- 17) What is meant by symbiotic Nitrogen fixation? Point out one example.
- 18) What are Amides? How are they formed in plants?
- 19) Which are the two most important amides found in plants? Name the amino acids from which they are formed.
- 20) Given below the equation represents a reaction involved in Nitrogen metabolism.
 - a) Identify the process.
 - b) Name the enzyme involved in this process.

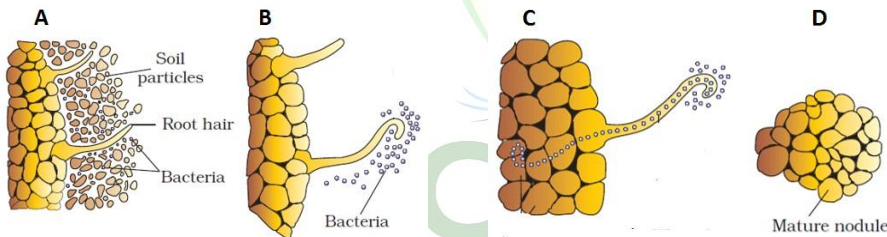


Each question from 21 to 25 carries 3 scores.

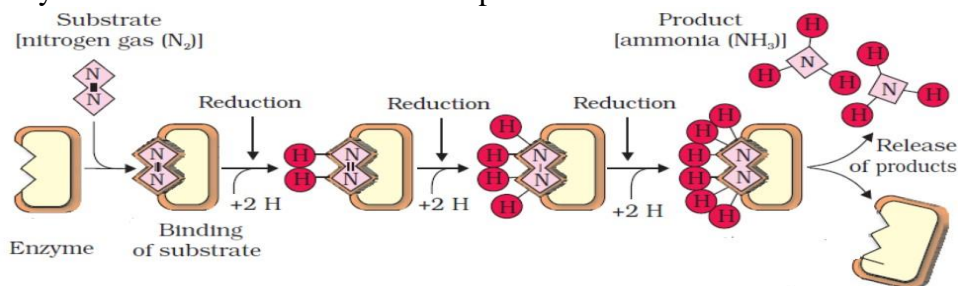
- 21) More than sixty elements of the 105 discovered so far are found in different plants. Some are very essential for the growth and development of plants. What are the criteria for essentiality of an element?
- 22) Given below is a diagrammatic representation of Nitrogen Cycle. Identify & Explain the process A, B, & C



- 23) Ammonia - the product of nitrogen fixation is used to synthesis amino acids in plants.
 a) Explain the two main steps involved in this process.
 b) Mention the enzymes involved in these steps.
- 24) The given below diagram explains the development of root nodules.
 Describe the stages A, B, C & D



- 25) Given below is a schematic representation of the steps of Nitrogen fixation.
 a) Name the enzyme involved in this process.
 b) Explain how the Pea plant ensure the protection of this enzyme.
 c) How many ATP s are needed for each NH₃ produced?



ANSWERS

- 1) *Frankia*.
- 2) Molybdenum & Iron.
- 3) N₂ - fixers are some prokaryotic microbes which is capable reduction of N₂ into NH₃ with the help of nitrogenase enzyme.
- 4) Glutamic acid.
- 5) *Anabaena* and *Nostoc*.
- 6) The pink colour is due to the presence of a pigment leg-haemoglobin.
- 7) *Azotobacter* and *Beijernickia*.
- 8) *Rhodospirillum*.
- 9) Amides & Ureides.
- 10) *Pseudomonas* and *Thiobacillus*.
- 11) Magnesium is an activator for both *ribulose bisphosphate carboxylase oxygenase* [Rubisco] and *phosphoenol pyruvate carboxylase*.
-It is also a constituent of chlorophyll molecule.

12) (i) Macronutrients, and (ii) Micronutrients

-Macronutrients are present in plant tissues in large amounts.
(in excess of 10 m mole Kg⁻¹ of dry matter).

It include carbon, hydrogen, oxygen, nitrogen, phosphorous, sulphur, potassium, calcium and magnesium.

-Micronutrients or trace elements, needed in very small amounts.
(less than 10 m mole Kg⁻¹ of dry matter).

These include iron, manganese, copper, molybdenum, zinc, boron, chlorine and nickel.

13)

Name of element	Role of element
Magnesium	Constituent of chlorophyll
Phosphorus	Present in ATP
Zinc	Activator of alcohol dehydrogenase
Potassium	Opening and closing of stomata

14) Carbon, Hydrogen, Oxygen and Nitrogen

15) The process of conversion of Nitrogen to Ammonia is termed as Nitrogen fixation.
Biological Nitrogen fixation, Electrical Nitrogen fixation & Industrial Nitrogen fixation

16) Ammonia is first oxidised to Nitrite by the bacteria *Nitrosomonas* and/or *Nitrococcus*.
The Nitrite is further oxidised to Nitrate by the bacterium *Nitrobacter*. These steps are called Nitrification

17) Reduction of Nitrogen to Ammonia by living organisms which live symbiotically is called as symbiotic Nitrogen fixation.

-The mutual association between the roots of legume plants and the *Rhizobium* bacteria is an example for it.
-The bacteria lives inside the root nodules of the leguminous plants do the process.

18) Amides are the structural part of proteins found in plants.

-They are formed from amino acids.

-The hydroxyl part of the acid is replaced by another NH₂- radicle.

-So they contain more nitrogen than the amino acids.

19) The two most important amides found in plants Asparagine and Glutamine.

-Asparagine is formed from the amino acid Aspartic acid.

-Glutamine is formed from the amino acid Glutamic acid.

20) a) Transamination.

b) Transaminase.

21) The criteria for essentiality of an element are :

(a) The element must be absolutely necessary for supporting normal growth and reproduction.

In the absence of the element the plants do not complete their life cycle or set the seeds.

(b) The requirement of the element must be specific and not replaceable by another element.

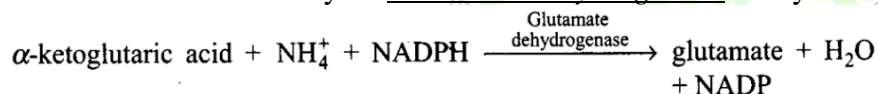
(c) The element must be directly involved in the metabolism of the plant.

22) A - Biological Nitrogen fixation- Reduction of nitrogen to ammonia by living organisms.

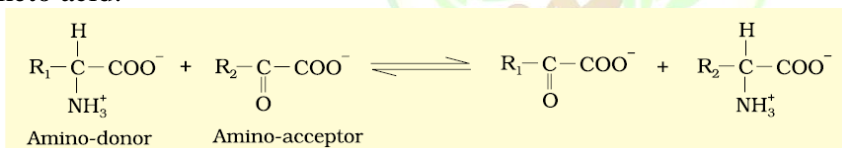
B -Denitrification- Nitrate present in the soil is reduced back to N_2 by bacteria.

C - Ammonification - Decomposition of organic nitrogen of dead plants and animals into ammonia.

23) (i) Reductive amination : In this process, Ammonia reacts with α -ketoglutaric acid and forms Glutamic acid. The enzyme *Glutamate dehydrogenase* catalyses this reaction.



(ii) Transamination: It involves the transfer of amino group from one amino acid to the keto group of a keto acid.



Glutamic acid is the main amino acid from which the transfer of NH_2 , the amino group takes place and other amino acids are formed through transamination.

-The enzyme *Transaminase* catalyses all such reactions.

24) A- Rhizobium bacteria contact with a susceptible root hair and divide near it.

B- Successful infection of the root hair causes it to curl.

C- Infected thread carries the bacteria to the inner cortex.

-The bacteria get modified into rod-shaped bacteroids and cause the inner cortical and pericycle cells to divide.

D - Division and growth of cortical and pericycle cells lead to nodule formation.

The nodule thus formed, establishes a direct vascular connection with the host for exchange of nutrients.

25) A - Nitrogenase enzyme.

B- The nitrogenase enzyme is highly sensitive to the molecular oxygen.

-It requires an anaerobic condition to carry out the process of nitrogen fixation.

-The nodules contain a pigment, leg- haemoglobin which functions as an oxygen scavenger and protects the enzyme.

C- 8ATP

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