7. How are the minerals absorbed by the plants?
Solution: Plants absorb their mineral salt supply from the soil through the roots from the zones of elongation and root hair. The minerals are absorbed as ions which are accumulated by the plants against their concentration in the soil. Plant shows two phases in mineral absorption - initial and metabolic. In the initial phase there is a rapid uptake of ions into outer or free space of the cells (apoplast) that comprises of intercellular spaces and cell walls. Ions absorbed in free space are freely exchangeable, e.g., replacement of unlabelled K^+ ions with labelled K^+ ions. In the metabolic phase the ions pass into inner space comprising of cytoplasm and vacuole. In the inner space the ions are not freely exchangeable with those of external medium. Entry of ions into outer space is passive absorption as no energy is required for it. Absorption of ions into inner space requires metabolic energy. It is, therefore, an active absorption. Movement of ions into cells is called influx while movement of ions out of the cells is called efflux.

8. What are the conditions necessary for fixation of atmospheric nitrogen by Rhizobiuml What is their role in N_2 fixation?
Solution:The conditions necessary for nitrogen fixation by Rhizobium are :

1. Presence of enzyme nitrogenase.
2. A protective mechanism for the enzyme nitrogenase against O_2
3. A non-heme iron protein-ferrodoxin as an electron carrier.
4. The hydrogen donating system (viz, pyruvate, hydrogen, sucrose, glucoseetc).
5. A constant supply of ATP.
6. Presence of thiamine pyrophosphate (TPP), coenzyme-A, inorganic phosphate and Mg^{++} as co-factors.
7. Presence of cobalt and molybdenum,
8. A carbon compound for trapping released ammonia.

In the process of biological nitrogen fixation by free living and symbiotic nitrogen fixers, the dinitrogen molecule is reduced step by step to ammonia (NH_3) by the addition of pairs of hydrogen atoms. The pyruvic acid mainly serves as an electron donor but in some cases hydrogen, sucrose, glucose, etc., have also been shown to operate. In leguminous plants, the glucose-6-phosphate molecule probably acts as a substrate for donating hydrogen. The overall process occurs in presence of enzyme nitrogenase, which is active in anaerobic condition. The enzyme nitrogenase consists of two sub-units - a non-heme iron protein (or dinitrogen reductase) and an iron molybdenum protein (Mo-Fe protein or dinitrogenase).
The Fe-protein component reacts with ATP and reduces Mo-Fe protein which then converts N_2 to ammonia. The ammonia is either directly taken by host or is converted to nitrates with the help of nitrifying bacteria (e.g., Nitrosomonas).

9. What are the steps involved in formation of a root nodule?
Solution: Nodule formation involves a sequence of multiple interactions between Rhizobium and roots of the host plant. Main stages in the nodule formation are:

- Rhizobia multiply and colonise the surrounding of roots and get attached to epidermal and root hair cells (Figure a).
- The root hair curl and the bacteria invade the root hair.
- An infection thread is produced carrying the bacteria into the inner cortex of the root (Figure b and c).
- The bacteria get modified into rod-shaped bacteroids and cause inner cortical and pericycle cells to divide. Division and growth of cortical and peri cycle cells lead to nodule formation.
- The nodule thus formed, establishes a direct vascular connection with the host for exchange of nutrients (Figure d).
- The nodule contains all the necessary biochemical components, such as the enzyme nitrogenase and leghaemoglobin. The enzyme nitrogenase catalyses the conversion of atmospheric nitrogen to ammonia, the first stable product of nitrogen fixation.

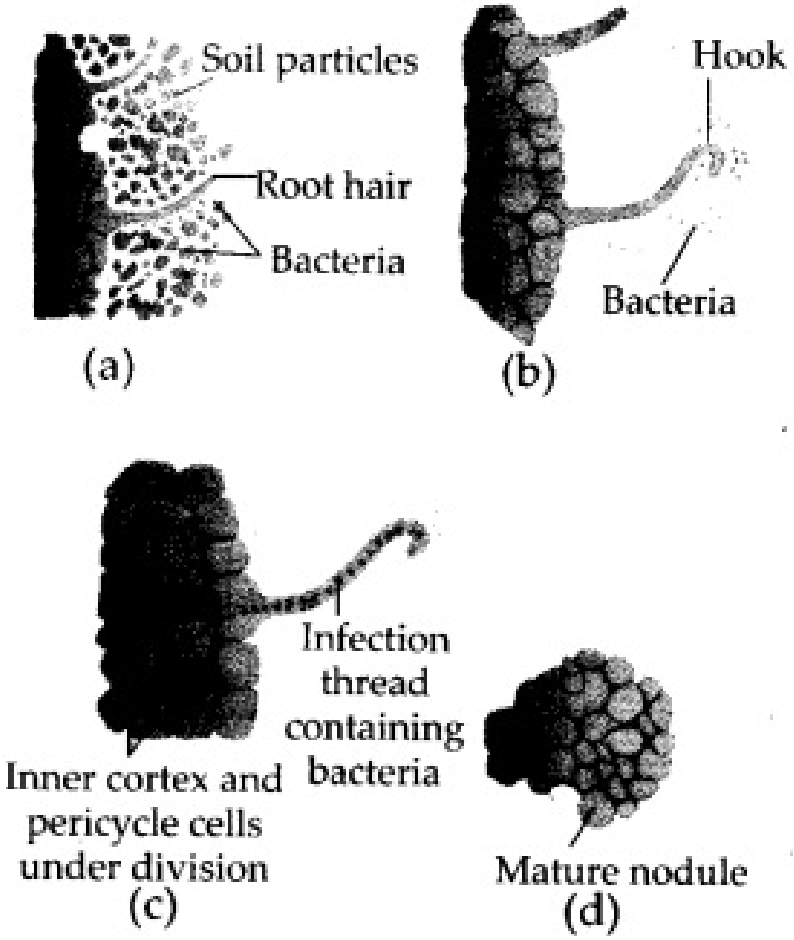

Fig.: Development of root nodule.

10. Which of the following statements are true?
If false, correct them.
(a) Boron deficiency leads to stout axis.
(b) Every mineral element that is present in a cell is needed by the cell.
(c) Nitrogen as a nutrient element, is highly immobile in plants.
(d) It is very easy to establish the essentiality of micronutrients because they are required only in trace quantities.
Solution:
(a) True.
(b) False. Every mineral element that is present in a cell is not needed by the cell.
(c) False. Nitrogen as a nutrient element is highly mobile in plants.
(d) False. It is very difficult to establish the essentiality of micronutrients because they are required only in trace quantities.

********** END **********