

A level Biology A
H420/03 Unified biology

Question Set 4

1 Nitrogen cycling within ecosystems is controlled by various bacterial species. The table below lists four groups of bacterium that are involved in the nitrogen cycle.

(a) Complete the table to show the locations of each type of bacterium in the cycle and the reactions they perform.

Type of bacteria	Location	Reactant(s)	Product	Oxidation or reduction of nitrogen?
<i>Rhizobium</i>		N_2 and H^+ ions	NH_3	reduction
<i>Nitrosomonas</i>	soil			oxidation
<i>Nitrobacter</i>	soil		NO_3^-	
Denitrifying bacteria		NO_3^-		

[4]

(b) Nitrogen fixation is an important part of the nitrogen cycle.

The rate of nitrogen fixation is reduced by the presence of oxygen.

Rhizobium uses the enzyme nitrogenase to fix atmospheric nitrogen.

Fig. 4 shows a simplified representation of the structure of nitrogenase and the reaction that it catalyses.

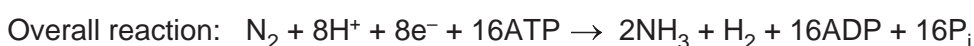
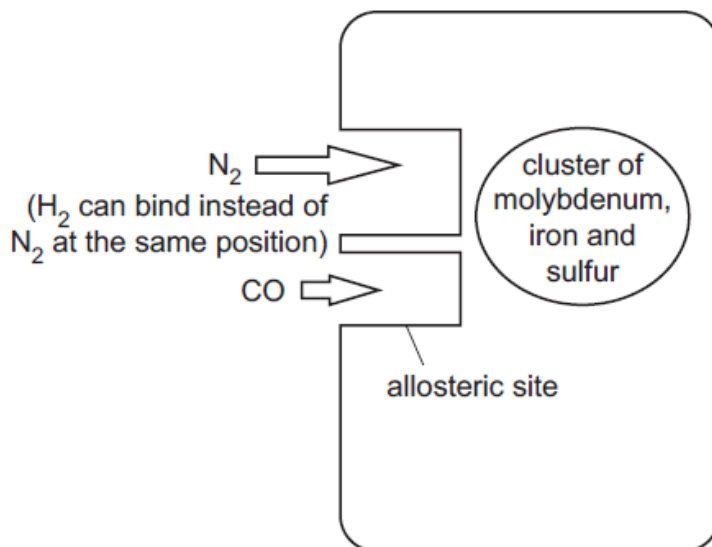


Fig. 4

- (i) What can you conclude from Fig. 4 about the molecules or ions that affect the functioning of the nitrogenase enzyme? [4]
- (ii) Leghaemoglobin is a molecule that improves the performance of nitrogenase. It has very similar properties to mammalian haemoglobin.

Suggest **two** ways in which leghaemoglobin improves the performance of the nitrogenase enzyme. [2]

- (c) Many species of bacteria act as decomposers within ecosystems by breaking down organic material.

Scientists analysed the energy flow within a grassland ecosystem.

They estimated that the energy in the decomposers' trophic level was $950\,000\text{ J m}^{-2}\text{ yr}^{-1}$.

The energy within the producers' trophic level was 800% greater than that of the decomposers.

- (i) Calculate the energy in the producers' trophic level in $\text{kJ m}^{-2}\text{ yr}^{-1}$.

Answer:..... $\text{kJ m}^{-2}\text{ yr}^{-1}$ [2]

- (ii) Calculate the percentage efficiency of the energy transfer from producers to decomposers.

Give your answer to **two** significant figures.

Answer: % [1]



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