Study Questions

Choose the ONE best answer.

5.1 In cases of ethylene glycol poisoning and its characteristic metabolic acidosis, treatment involves correction of the acidosis, removal of any remaining ethylene glycol, and administration of an inhibitor of alcohol dehydrogenase (ADH), the enzyme that oxidizes ethylene glycol to the organic acids that cause the acidosis. Ethanol (grain alcohol) frequently is the inhibitor given to treat ethylene glycol poisoning. Results of experiments using ADH with and without ethanol are shown to the right. Based on these data, what type of inhibition is caused by the ethanol?

Substrate Concentration with Ethanol	Rate of Reaction (mol/L/s)	Substrate Concentration without Ethanol	Rate of Reaction (mol/L/s)
5 mM	3×10^{-7}	5 mM	8×10^{-7}
10 mM	5×10^{-7}	10 mM	1.2×10^{-6}
20 mM	1.0×10^{-6}	20 mM	1.8×10^{-6}
40 mM	1.6×10^{-6}	40 mM	1.9×10^{-6}
80 mM	2.0×10^{-6}	80 mM	2.0×10^{-6}

A. Competitive
B. Feedback
C. Irreversible
D. Noncompetitive

Correct answer = A competitive inhibitor increases the apparent K_m for a given substrate. This means that, in the presence of a competitive inhibitor, more substrate is needed to achieve $^1/_2$ V_{max}. The effect of a competitive inhibitor is reversed by increasing substrate concentration ([S]). At a sufficiently high [S], the reaction velocity reaches the V_{max} observed in the absence of inhibitor.

5.2 ADH requires oxidized nicotinamide adenine dinucleotide (NAD^+) for catalytic activity. In the reaction catalyzed by ADH, an alcohol is oxidized to an aldehyde as NAD^+ is reduced to NADH and dissociates from the enzyme. The NAD^+ is functioning as a (an):

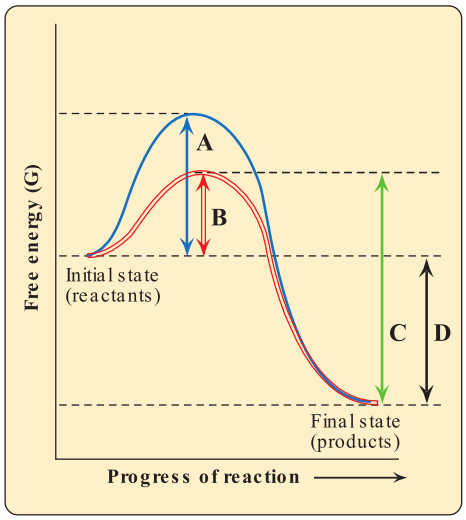
A. apoenzyme.
B. coenzyme cosubstrate.
C. coenzyme prosthetic group.
D. cofactor.
E. heterotropic effector.

Correct answer = B. Coenzymes cosubstrates are small organic molecules that associate transiently with an enzyme and leave the enzyme in a changed form. Coenzyme prosthetic groups are small organic molecules that associate permanently with an enzyme and are returned to their original form on the enzyme. Cofactors are metal ions. Heterotropic effectors are not substrates.

For Questions 5.3 and 5.4, use the graph below which shows the changes in free energy when a reactant is converted to a product in the presence and absence of an enzyme. Select the letter that best represents:

5.3 The free energy of activation of the catalyzed forward reaction.

5.4 The free energy of the reaction.



Correct answers = B; D. Enzymes (biocatalysts) provide an alternate reaction pathway with a lower free energy of activation. However, they do not change the free energy of the reactant or product. A is the free energy of the uncatalyzed reaction. C is the free energy of the catalyzed reverse reaction.