What is Enzyme Catalysis?

Worksheet

Enzyme catalysis is the process by which a protein enzyme binds a substrate at its active site and lowers the activation energy of a reaction, speeding it up thousands to millions of times without being consumed itself.

E + S @rightleftharpoons ES @rightarrow E + P

Questions

1. What does an enzyme do to a reaction's activation energy?

A) Increases it
B) Lowers it
C) Has no effect
D) Makes it negative

2. In v = Vmax[S]/(Km+[S]), what happens to v when [S] = Km?

A) v = 0
B) v = Vmax
C) v = Vmax/2
D) v = 2Vmax

3. Where does the substrate bind on an enzyme?

A) Allosteric site only
B) Active site
C) Cell membrane
D) Nucleus

4. Is an enzyme consumed or permanently changed by the reaction it catalyzes?

A) Yes, always destroyed
B) Yes, permanently changed
C) No, it is reused
D) It becomes the product

5. An enzyme has Vmax = 100 M/min and Km = 10 M. Find the rate when [S] = 10 M.

6. Same enzyme, [S] = 90 M. Find the rate.

7. An enzyme reaches v = 40 M/min when [S] = 5 M and Km = 15 M. Find Vmax.

8. Define: What is an enzyme?

9. Define: What is the active site?

10. Define: What does 'lowering activation energy' mean?

Answer Key

1. B) Lowers it - Enzymes provide an alternative pathway with a lower activation energy, speeding up the reaction.

2. C) v = Vmax/2 - Substituting [S] = Km gives v = VmaxKm/(2Km) = Vmax/2.

3. B) Active site - The substrate binds the active site, a specifically shaped pocket on the enzyme.

4. C) No, it is reused - Enzymes are not consumed - they release the product and can catalyze the reaction again.

5. v = Vmax[S] / (Km+[S]) v = 10010 / (10+10) v = 1000/20 = 50 M/min (exactly half of Vmax, as expected when [S] = Km)

6. v = 10090 / (10+90) v = 9000/100 = 90 M/min

7. 40 = Vmax5 / (15+5) 40 = Vmax5/20 = 0.25Vmax Vmax = 40/0.25 = 160 M/min

8. A biological catalyst, usually a protein, that speeds up a specific reaction without being consumed.

9. The region of an enzyme, with a specific shape, where the substrate binds.

10. The enzyme reduces the energy barrier a reaction must cross, so it proceeds faster at body temperature.