What is Enzyme Digestion?

Worksheet

Digestive enzymes (like amylase, pepsin, and lipase) lower the activation energy needed to break down food molecules; their reaction rate v follows the Michaelis-Menten equation v = (Vmax[S])/(Km+[S]).

E + S @rightleftharpoons ES @rightarrow E + P

Questions

1. Using v=(VmaxS)/(Km+S), find v when Vmax=80 mol/min, Km=10 mM, and S=10 mM.

A) 80 mol/min
B) 20 mol/min
C) 40 mol/min
D) 10 mol/min

2. Which enzyme begins protein digestion in the stomach?

A) Amylase
B) Lipase
C) Pepsin
D) Trypsin

3. What does a lower Km value indicate?

A) Lower enzyme affinity for substrate
B) Higher enzyme affinity for substrate
C) Faster maximum reaction rate
D) The enzyme is denatured

4. What happens to reaction rate as substrate concentration increases far beyond Km?

A) It keeps increasing indefinitely
B) It levels off near Vmax (saturation)
C) It suddenly drops to zero
D) It becomes negative

5. An enzyme has Vmax = 100 mol/min and Km = 5 mM. Find the reaction rate at [S] = 5 mM.

6. An enzyme has Vmax = 60 mol/min and Km = 20 mM. Find v at [S] = 100 mM.

7. Pepsin has Vmax = 40 mol/min and Km = 8 mM. Find v when substrate is low, [S] = 2 mM.

8. Define: What is an enzyme?

9. Define: What is Km (the Michaelis constant)?

10. Define: Name three digestive enzymes and what they digest.

Answer Key

1. C) 40 mol/min - v=(8010)/(10+10)=800/20=40 mol/min - exactly half Vmax since S=Km.

2. C) Pepsin - Pepsin, activated by stomach acid, starts breaking down proteins in the stomach.

3. B) Higher enzyme affinity for substrate - A low Km means the enzyme reaches half-maximal rate at low substrate concentration - high affinity.

4. B) It levels off near Vmax (saturation) - At high [S], all enzyme active sites are occupied, so the rate plateaus near Vmax.

5. v = (VmaxS)/(Km+S) v = (1005)/(5+5) = 500/10 v = 50 mol/min (exactly half of Vmax, as expected when [S] = Km)

6. v = (60100)/(20+100) = 6000/120 v = 50 mol/min

7. v = (402)/(8+2) = 80/10 v = 8 mol/min (far below Vmax because [S] << Km)

8. A biological catalyst - usually a protein - that speeds up a chemical reaction without being consumed.

9. The substrate concentration at which the reaction rate is half of Vmax; it reflects the enzyme's affinity for its substrate.

10. Amylase (starch), pepsin (protein), and lipase (fat).