What is Enzyme Kinetics?

Worksheet

Enzyme kinetics describes reaction rate v as a function of substrate concentration [S]: v = Vmax[S]/(Km+[S]), where Vmax is the maximum rate and Km is the substrate concentration at half-maximal rate.

$$v = \frac{V_{max} [S]}{K_{m} + [S]}$$

Questions

1. In v = Vmax[S]/(Km+[S]), what does Km equal at v = Vmax/2?

A) [S] at that point
B) Vmax
C) Zero
D) Twice [S]

2. An enzyme has Vmax = 100 M/min and Km = 10 M. What is v at [S] = 10 M?

A) 25 M/min
B) 50 M/min
C) 100 M/min
D) 10 M/min

3. A low Km value indicates:

A) Low substrate affinity
B) High substrate affinity
C) No catalysis
D) High Vmax

4. At saturating substrate concentration, reaction rate:

A) Keeps increasing linearly
B) Becomes zero
C) Plateaus near Vmax
D) Becomes negative

5. An enzyme has Vmax = 100 M/min and Km = 20 M. Find the reaction rate at [S] = 20 M.

6. The same enzyme reaches v = 80 M/min with Km = 10 M. What substrate concentration produced this rate?

7. A competitive inhibitor doubles the apparent Km from 10 to 20 M while Vmax stays 100 M/min. Find v at [S] = 20 M.

8. Define: What does Km represent?

9. Define: What is Vmax?

10. Define: What shape is a Michaelis-Menten plot?

Answer Key

1. A) [S] at that point - By definition, Km is the substrate concentration giving half-maximal velocity.
2. B) 50 M/min - v = 10010/(10+10) = 1000/20 = 50 M/min.
3. B) High substrate affinity - Low Km means the enzyme reaches half-max rate at low [S] - high affinity.
4. C) Plateaus near Vmax - All active sites are occupied, so rate can't increase further - it plateaus at Vmax.
5. v = Vmax[S]/(Km+[S]) v = (10020)/(20+20) v = 2000/40 = 50 M/min
6. 80 = 100[S]/(10+[S]) 80(10+[S]) = 100[S] 800 + 80[S] = 100[S] 800 = 20[S] [S] = 40 M
7. v = 10020/(20+20) v = 2000/40 = 50 M/min (half of the uninhibited rate at this [S])
8. The substrate concentration at which reaction rate is half of Vmax - a measure of enzyme-substrate affinity.
9. The maximum reaction rate when the enzyme is fully saturated with substrate.
10. A rectangular hyperbola that rises steeply then plateaus (saturation curve).