

What is Enzyme Kinetics?

Worksheet

Enzyme kinetics describes reaction rate (v) as a function of substrate concentration $[S]$ using $v = V_{\max}[S] / (K_m + [S])$, where V_{\max} is the maximum rate and K_m is the substrate concentration at half-maximal rate.

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

Questions

1. In the Michaelis-Menten equation, K_m equals $[S]$ when:

- A) $v = V_{\max}$
- B) $v = V_{\max}/2$
- C) $v = 0$
- D) $v = 2V_{\max}$

2. A low K_m value indicates:

- A) low enzyme affinity for substrate
- B) high enzyme affinity for substrate
- C) no catalysis
- D) denatured enzyme

3. At very high substrate concentration, reaction rate approaches:

- A) zero
- B) K_m
- C) V_{\max}
- D) infinity

4. $V_{\max} = 100$ M/min, $K_m = 5$ mM, $[S] = 5$ mM. What is v ?

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

5. An enzyme has $V_{\max} = 100$ M/min and $K_m = 2$ mM. Find v when $[S] = 2$ mM.

6. Same enzyme, $[S] = 8$ mM. Find v .

7. $V_{\max} = 60$ M/min, $K_m = 3$ mM. At what $[S]$ is $v = 45$ M/min?

8. Define: What does V_{\max} represent?

9. Define: What does K_m represent?

10. Define: Low K_m means what?

Answer Key

1. B) $v = V_{max}/2$ - By definition, K_m is the substrate concentration at which $v = V_{max}/2$.
2. B) high enzyme affinity for substrate - Low K_m means half-maximal rate is reached at low $[S]$, i.e. high affinity.
3. C) V_{max} - The enzyme becomes saturated and rate plateaus at V_{max} .
4. C) 50 M/min - When $[S] = K_m$, $v = V_{max}/2 = 50$ M/min.
5. $v = V_{max}[S]/(K_m+[S])$ $v = (1002)/(2+2)$ $v = 200/4 = 50$ M/min (exactly half of V_{max} , as expected when $[S]=K_m$)
6. $v = (1008)/(2+8)$ $v = 800/10 = 80$ M/min
7. $45 = (60[S])/(3+[S])$ $45(3+[S]) = 60[S]$ $135 + 45[S] = 60[S]$ $135 = 15[S]$ $[S] = 9$ mM
8. The maximum reaction rate an enzyme can reach when fully saturated with substrate.
9. The substrate concentration at which the reaction rate is half of V_{max} - a measure of enzyme-substrate affinity.
10. High affinity - the enzyme reaches half-maximal rate at a low substrate concentration.

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