

2.2 Enzymes and enzyme kinetics

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS K_m

Objective

Extract K_m and V_{max} from data and identify inhibitor type from kinetic changes.

1 Key knowledge and worked examples

■ The two constants

$v = V_{max}[S]/(K_m + [S])$; $K_m = [S]$ at half- V_{max} . Lineweaver–Burk intercepts: $1/V_{max}$ (y), $-1/K_m$ (x).

■ Worked example: two points, two constants

$v = 33$ at $[S] = 1$, $v = 60$ at $[S] = 4$: $33(K + 1) = 60(K + 4) \Rightarrow K_m = 1.5$ mM, $V_{max} = 82.5$ $\mu\text{mol/min}$ ✓.

2 Practice

2.1 $V_{max} = 120$, $K_m = 3$: compute v at $[S] = 3$ and $[S] = 30$. [3]

2.2 An inhibitor doubles apparent K_m ; V_{max} unchanged. Classify it. [3]

2.3 Where do competitive L-B lines intersect? [3]

3 Exam-style questions

3.1 An enzyme yields $v = 20$ at $[S] = 0.5$ mM and $v = 50$ at $[S] = 4$ mM.

Determine K_m and V_{max} . Verify with the half- V_{max} point. Estimate v at $[S] = 20$ mM. [8]

3.2 The same enzyme is studied with a drug present: apparent K_m is fourfold higher, V_{max} unchanged.

Classify the inhibition and explain the mechanism. Predict the L-B plot appearance. State whether a high-substrate dose can restore full rate, with a reason. [7]

Solutions

2.1

- $[S] = K_m$: $v = 60$ (= half); $[S] = 30$: $v = 120 \times 30/33 = 109$ ✓.

2.2

- Competitive: active-site mimic outcompeted by substrate.

2.3

- On the y-axis ($1/V_{max}$ shared).

3.1

- Write both as $V = v(K + [S])/[S]$: $V = 40K + 20$ and $V = 12.5K + 50 \Rightarrow 27.5K = 30 \Rightarrow K_m = 1.09$ mM, $V_{max} = 63.6$ $\mu\text{mol}/\text{min}$ ✓.
- Check: $v(K_m) = 63.6/2 = 31.8 = V_{max}/2$ ✓.
- $v(20) = 63.6 \times 20/21.1 \approx 60.3$ ✓.

3.2

- Competitive – substrate-mimic at the active site.
- L-B: lines intersect on the y-axis; slope $\times 4$.
- Yes: at saturating $[S]$ the substrate outcompetes the inhibitor, restoring V_{max} .