Enzyme Kinetics

Questions and Examples

3rd year undergraduates
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Q1 An enzyme hydrolyzed a substrate at 2 concentrations [S]= 0.03 and 0.12 mmol/L with *Km* value of around 0.06 mmol/L. The initial velocity observed at [S]= 0.03 mmol/L was $1.5x10^{-3}$ mmol/L.min-1 . Calculate the initial velocity of the enzymatic reaction when using [S]= 0.12 mmol/L.

Solution

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

$$1.5*10^{-3} = \frac{Vmax* 0.03}{0.06 + 0.03}$$

$$Vmax = 1.5*10^{-3} * 3$$
$$=4.5*10^{-3}$$

$$V_o = \frac{4.5*10^{-3} * 0.12}{0.06 + 0.12}$$

$$V_0 = 3*10^{-3}$$

S1= 0.03
S2=0.12
Km= 0.06
V_{o1}= 1.5*10-3
V_{02}=?

Q2 An enzyme with a Km of 0.06 mmol/L hydrolyzed a substrate of a concentration 0.03 mmol/L. The initial velocity of the reaction was 0.0015 mmol/L.min $^{-1}$. Calculate the substrate concentration which gives an initial velocity of 0.003 mmol/L.min^{-1} .

Solution

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

$$1.5*10^{-3} = \frac{Vmax* 0.03}{0.06 + 0.03}$$

$$Vmax = 1.5*10^{-3} * 3$$
$$=4.5*10^{-3}$$

$$3*10^{-3} = \frac{4.5*10^{-3} * S2}{0.06 + S2}$$

S2= 0.12 mmol/L

S1= 0.03
Km= 0.06
V_{o1}= 1.5*10-3
V_{02}= 3 *10-3
S2 =?

Q3 An enzyme hydrolyzed a substrate concentration of 0.03 mmol/L ,the initial velocity was $1.5x10^{-3}$ mmol/L.min^{-1} and the maximum velocity was 4.5x10-3 mmol/L.min^{-1} . Calculate the substrate concentration that gives a velocity of $3x10^{-3}$ mmol/L.min-1 .

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

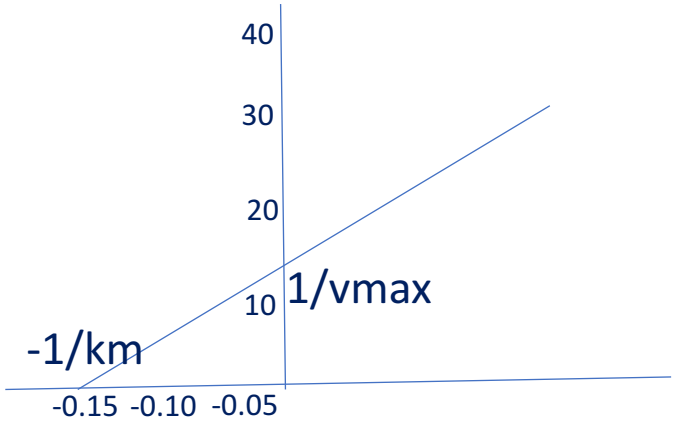
S1= 0.03
V_{o1}= 1.5*10-3
Vmax= 4.5*10-3
V_{02}= 3 *10-3
S2 =?

Q4 The following data describe an enzyme-catalysed reaction. Plot these results using the lineweaver-Burk method and determine values for Km and Vmax. The symbol mM represents m moles/L. The concentration of the enzyme is the same in all experiments.

[S] mM	Velocity mM/Sec
2.5	0.024
5	0.036
10	0.053
15	0.06
20	0.061

Solution

1/[S] mM	1/Velocity mM/Sec
0.4	41.6
0.2	27.7
0.1	18.8
0.067	16.6
0.05	15.6



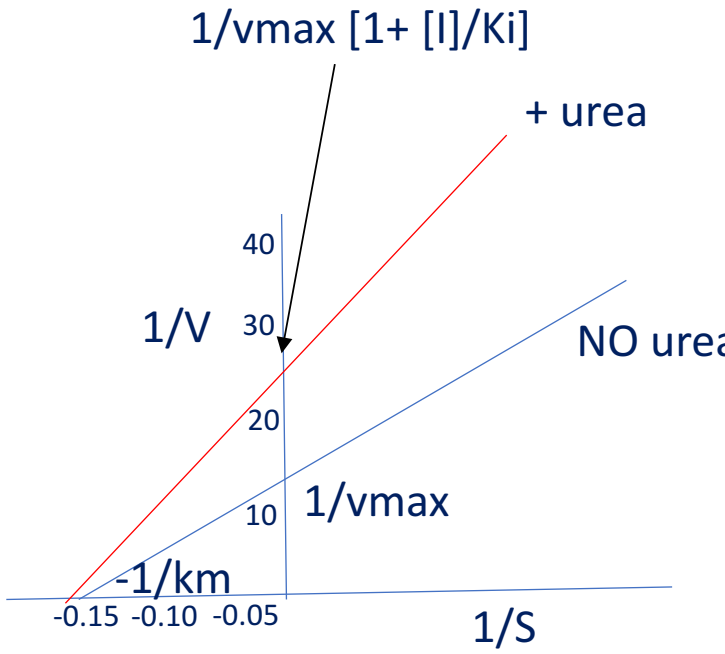
Q5 Sucrose is hydrolysed into glucose and fructose by the enzyme invertase. The reaction inhbited by addition of 2 M urea. Using the Lineweaver-Burk method of the following data to determine the type of the inhibition

Sucrose concentration Mol/L	Velocity mM/Sec	Velocity M/min + Urea (inhibitor)
0.02	0.18	0.08
0.05	0.26	0.11
0.08	0.31	0.15
0.11	0.33	0.16
0.17	0.37	0.19

Solution

1/[S] mM	1/Velocity mM/Sec	1/V + I

Different slops, Different V max, same Km= non-competitive



Q6 Alkaline phosphatase hydrolysed 2 mM of *p*-nitrophenol phosphate within 5 min. If the Vmax of the reaction was 4.5x10-3 mmol/L.min^{-1} and the concentration of the product was 1.5*10-3, how much do you expect the Km will be? when the reaction inhibited by 3 mM of Na-Pyrophoshate, the V max dropped to 1.5 *10-3, what kind of inhibition was that?

Q7 the hydrolysis of Phe-peptide is hydrolysed by chemotrypsin with the following result. Calculate Km and Vmax for the reaction

Peptide concentration M	**Velocity mM/Sec**
2.5*10-4	2.4*10-6
5*10-4	3.6*10-6
10*10-4	5.9*10-6
15*10-4	6*10-6

Q7 distinguish between the key-luck and the induced-fit models for binding E with S.

Q7 how can competitive and non-competitive inhibition be distinguished in terms of Km?