MCQs

Enzyme Kinetics

Question - Answers & Quick Notes

Useful for CSIR NET and other Life Science Examinations

EXCEL
SCIENCE

MCQs

Q1. In a biochemical reaction catalyzed by enzyme following the Michaelis-Menten equation, what will be the substrate concentration, when the observed velocity of reaction is 90% of the maximum velocity?

(1) 18 Km

(2) 9 Km

(3) 5 Km

(4) 11 Km

Given,

$V_{max} = 100$

$V = 90$

$[S] = ?$

$V = 90\%$ of Max.

$$V_0 = \frac{V_{max} \cdot [S]}{K_m + [S]}$$

$$90 = \frac{100 \cdot [S]}{K_m + [S]}$$

$$90\,K_m + 90\,[S] = 100\,[S]$$

$$100\,[S] - 90\,[S] = 90\,K_m$$

$$10\,[S] = 90\,K_m$$

$$[S] = \frac{90\,K_m}{10}$$

$$[S] = 9\,K_m$$ —— Ans.

MCQs

Q1. In a biochemical reaction catalyzed by enzyme following the Michaelis-Menten equation, what will be the substrate concentration, when the observed velocity of reaction is 90% of the maximum velocity?

(1) 18 Km

(2) 9 Km ✓

(3) 5 Km

(4) 11 Km

MCQs

Q2. For an enzyme catalyzed reactions exhibiting **Michaelis Menten equation** what would be increase in substrate concentration to increase the rate of reaction from 10% of V_{max} to 90% of V_{max} -

(1) 81 fold

(2) 8 fold

(3) 4 fold

(4) 2 fold

$$V_0 = \frac{V_{max} \cdot [S]}{K_m + [S]}$$

$V_{max} = 100$ (assume)

Given,

$V_1 = 10\%$ of V_{max}

$[S_1] = x$

$$V_0 = \frac{V_{max} \cdot [S]}{K_m + [S]}$$

$$10 = \frac{100 \cdot [S]}{K_m + [S]}$$

$$10 K_m + 10[S] = 100[S]$$

$$10 K_m = 90[S]$$

$$[S] = \frac{10}{90} K_m$$

or .... can say (in this case)

$$[S_1] = \frac{1}{9} K_m$$

$$V_0 = \frac{V_{max} \cdot [S]}{K_m + [S]}$$

$$90 = \frac{100 \cdot [S]}{K_m + [S]}$$

$$90 K_m + 90[S] = 100[S]$$

$$90 K_m = 10[S]$$

$$[S] = \frac{90}{10} K_m$$

So, (in this case — we can say)

$$[S_2] = 9 K_m$$

Ratio of $[S_2]$ and $[S_1]$

(answer in fold)

$$\frac{[S_2]}{[S_1]} = \frac{9 K_m}{\frac{1}{9} K_m} = 9 \times 9$$

$$= 81 \text{ fold}$$ Ans.

MCQs

Q2. For an enzyme catalyzed reactions exhibiting **Michaelis Menten equation** what would be increase in substrate concentration to increase the rate of reaction from 10% of $V_{\mathbf{max}}$ to 90% of $V_{\mathbf{max}}$ -

[✓ (1) 81 fold]
(2) 8 fold
(3) 4 fold
(4) 2 fold

MCQs

Q3. The V_{max} and K_m from a Lineweaver-Burk plot of an enzyme reaction where $\frac{1}{v} = 40\mu M^{-1}$ min at $\frac{1}{[s]} = 0$ and $\frac{1}{[s]} = -1.5 \times 10^2\ mM^{-1}$ at $\frac{1}{v} = 0$ are

(1) $0.025\ \mu M\ min^{-1}$ and $0.67 \times 10^{-2} mM$

(2) $0.025\ \mu M^{-1}\ min$ and 0.67×10^{-2}

(3) $0.025\ \mu M\ min^{-1}$ and $1.5 \times 10^2\ mM^{-1}$

(4) $0.038\ \mu M\ min^{-1}$ and $0.67 \times 10^{-2} mM$

MCQs

Enzyme Kinetics

The Michaelis-Menten equation

Lineweaver - Burk Plot

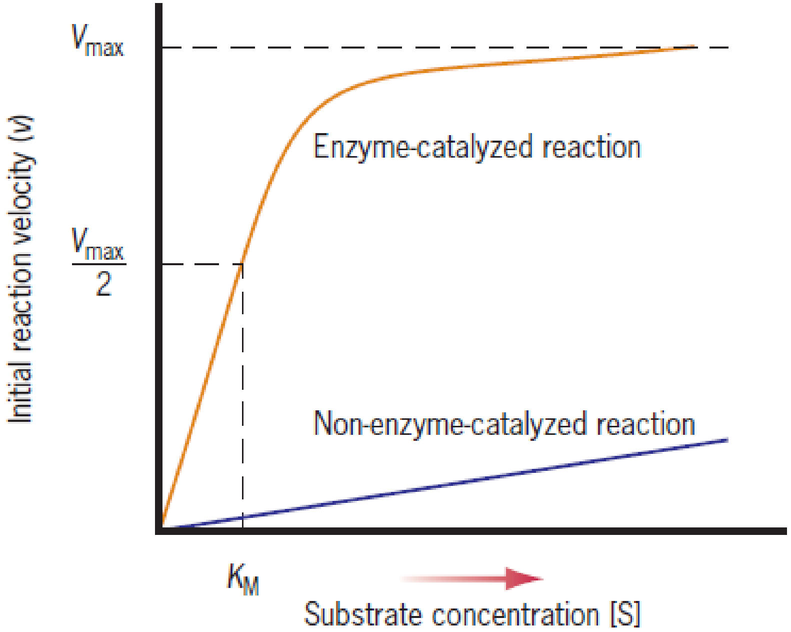

FIGURE 3.17 The relationship between the rate (velocity) of an enzyme-catalyzed reaction and the substrate concentration. Since each enzyme molecule is only able to catalyze a certain number of reactions in a given amount of time, the velocity of the reaction (typically expressed as moles of product formed per second) approaches a maximal rate as the substrate concentration increases. The substrate concentration at which the reaction is at half-maximal velocity ($V_{max}/2$) is called the Michaelis constant, or K_M.

Source: Karp's Cell and Molecular Biology Concepts and Experiments 8th ed., page-98

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$$V = V_{\max} \frac{[S]}{[S] + K_M}$$

According to the equation, when the substrate concentration $[S]$ is set at a value equivalent to K_M, then the velocity of the reaction (V) becomes equal to $V_{\max}/2$, or one-half the maximal velocity. Thus, $K_M = [S]$, when $V = V_{\max}/2$.

MCQs

To generate a hyperbolic curve such as that in Figure 3.17 and make an accurate determination of the values for V_{max} and K_M, a considerable number of points must be plotted. An easier and more accurate description is gained by plotting the reciprocals of the velocity and substrate concentration against one another, as formulated by Hans Lineweaver and Dean Burk. When this is done, the hyperbola becomes a straight line (**FIGURE 3.18**) whose *x* intercept is equal to $-1/K_M$, y intercept is equal to $1/V_{max}$, and slope is equal to K_M/V_{max}. The values of K_M and V_{max} are, therefore, readily determined by extrapolation of the line drawn from a relatively few points.

In most cases, the value for K_M provides a measure of the affinity of the enzyme for the substrate. The higher the K_M, the greater the substrate concentration that is required to reach one-half V_{max} and, thus, the lower the affinity of the enzyme for that substrate.

$$\frac{1}{V_0} = \frac{K_m}{V_{max}} \cdot \frac{1}{[S]} + \frac{1}{V_{max}}$$

MCQs

To generate a hyperbolic curve such as that in Figure 3.17 and make an accurate determination of the values for V_{max} and K_M, a considerable number of points must be plotted. An easier and more accurate description is gained by plotting the reciprocals of the velocity and substrate concentration against one another, as formulated by Hans Lineweaver and Dean Burk. When this is done, the hyperbola becomes a straight line (**FIGURE 3.18**) whose x intercept is equal to $-1/K_M$, y intercept is equal to $1/V_{max}$, and slope is equal to K_M/V_{max}. The values of K_M and V_{max} are, therefore, readily determined by extrapolation of the line drawn from a relatively few points.

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$$\frac{1}{V_0} = \frac{K_m}{V_{max}} \cdot \frac{1}{[S]} + \frac{1}{V_{max}}$$

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This is of the form ***y* = mx + c**, which is the equation of a ***straight line graph***; a plot of ***y*** against ***x*** has a slope ***m*** and intercept ***c*** on the y-axis.

$$\frac{1}{V_0} = \frac{K_m}{V_{\max}} \cdot \frac{1}{[S]} + \frac{1}{V_{\max}}$$

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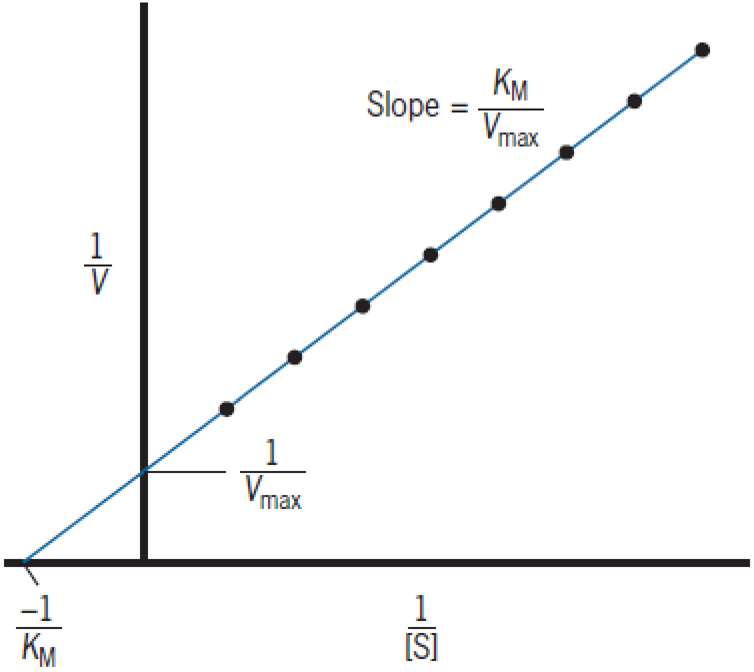

$$\frac{1}{V_0} = \frac{K_m}{V_{max}} \cdot \frac{1}{[S]} + \frac{1}{V_{max}}$$

FIGURE 3.18 **A Lineweaver-Burk plot** of the reciprocals of velocity and substrate concentration from which the values for the V_{max} and K_M are readily calculated.

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$$\frac{1}{V_0} = \frac{K_m}{V_{\max}} \cdot \frac{1}{[S]} + \frac{1}{V_{\max}}$$

It is clear that,

when $\frac{1}{[S]}$ = 0

then $\frac{1}{V} = \frac{1}{V_{max}}$

(by putting $\frac{1}{[S]}$ = 0 in the equation)

when $\frac{1}{[V]}$ = 0

Set $\frac{1}{V} = 0$ and solve for $\frac{1}{[S]}$:

$$0 = \frac{K_m}{V_{max}} \frac{1}{[S]} + \frac{1}{V_{max}}$$

$$-\frac{1}{V_{max}} = \frac{K_m}{V_{max}} \frac{1}{[S]}$$

$$-1 = K_m \frac{1}{[S]}$$

$$-\frac{1}{K_m} = \frac{1}{[S]} = \text{x-intercept}$$

$V_{max} = ?$

$K_m = ?$

Given is, $\frac{1}{V} = 40\,\mu M^{-1}\,min.$

at $\frac{1}{[S]} = 0$

also Given $\frac{1}{[S]} = -1.5 \times 10^{2}\, mM^{-1}$

at $\frac{1}{V} = 0$

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when, $\frac{1}{V} = 0$ then,

$$\frac{1}{[S]} = -\frac{1}{K_m}$$

so

$$-1.5 \times 10^{2}\, mM^{-1} = -\frac{1}{K_m}$$

$$K_m = \frac{1}{1{\cdot}5 \times 10^{2}\ mM^{-1}}$$

$$= \frac{1}{1{\cdot}5} \times 10^{-2}\ mM$$

$$= 0{\cdot}67 \times 10^{-2}\ mM$$

15 | 100 (·66
90
100
90
10....

when, $\frac{1}{[S]} = 0$ then $\frac{1}{V} = \frac{1}{V_{max}}$

so, $\frac{1}{V_{max}} = 40\ \mu M^{-1}\ min$

$$V_{max} = \frac{1}{40\ \mu M/min} = 0{\cdot}025\ \mu M\ min^{-1}$$

MCQs

Q3. The V_{max} and K_m from a Lineweaver-Burk plot of an enzyme reaction where $\frac{1}{v} = 40\mu M^{-1}$ min at $\frac{1}{[s]} = 0$ and $\frac{1}{[s]} = -1.5 \times 10^2\ mM^{-1}$ at $\frac{1}{v} = 0$ are

[✓ (1) 0.025 $\mu M\ min^{-1}$ and $0.67 \times 10^{-2} mM$]

(2) 0.025 μM^{-1} min and 0.67×10^{-2}

(3) 0.025 $\mu M\ min^{-1}$ and $1.5 \times 10^2\ mM^{-1}$

(4) 0.038 $\mu M\ min^{-1}$ and $0.67 \times 10^{-2} mM$

Thank you!

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