**Answer : 01**

**Reaction with data given below:**

|  |  |
| --- | --- |
| [S] (mmol/L) | v (mmol/min) |
| 3.880 | 0.0241 |
| 2.560 | 0.0222 |
| 1.310 | 0.0192 |
| 0.6660 | 0.0155 |
| 0.2480 | 0.00927 |
| 0.0939 | 0.00499 |

**Part (A). Lineweaver-Burk Plot:**

1. Invert both [S] and v values:

|  |  |
| --- | --- |
| 1/[S] (L/mmol) | 1/v (min/mmol) |
| 0.258 | 41.49 |
| 0.391 | 44.95 |
| 7.63 | 52.08 |
| 1.50 | 64.52 |
| 4.03 | 107.80 |
| 10.63 | 200.40 |

1. Plot 1/[S] on the x-axis and 1/v on the y-axis.

A graph of a line graph

Description automatically generated

1. Perform a linear regression to obtain the slope (m) and intercept (b).

Slope (m) =11.117

Intercept (b) =39.925

**Parameter Calculation:**

Km = -1/m

Km = -1/11.117

**Km = -0.08995**

Similarly,

Vmax = -1/b

Vmax = -1/39.925

**Vmax = -.0254**

**Part (B). Eadie-Hofstee Plot:**

1. Plot v on the y-axis and v/[S] on the x-axis.
2. Perform a linear regression to obtain the slope (m) and intercept (b).

Slope (m) =0.4076

Intercept (b) =0.0256

**Parameter Calculation:**

Km = -b/m

Km = -0.0256/0.4076

**Km = -0.0628**

Similarly,

Vmax = 1/b

Vmax = 1/0.0256

**Vmax = 39.0625**

**Part (C). Hanes-Woolf Plot:**

1. Plot [S] on the x-axis and v/(v - Vmax) on the y-axis.



1. Perform a linear regression to obtain the slope (m) and intercept (b).

**Parameter Calculation:**

Slope (m) =37

Intercept (b) =17

**Parameter Calculation:**

Km = m

**Km = 37**

Similarly,

Vmax = -1/b

Vmax = 1/17

**Vmax = 0.05882352941**

**Part (D):Determining substrate concentration needed for specific reaction velocities:**

Now, let's use the obtained Km and Vmax values to determine the substrate concentration needed to reach reaction velocities of 50% and 90% of Vmax.

For 50% of Vmax:

For 90% of Vmax:

Now, we can rearrange the Michaelis-Menten equation to solve for [*S*] for both *v*50%​ and *v*90%​. Let's do that.

To determine the substrate concentration needed for specific reaction velocities:

For 50% of Vmax:

For 90% of Vmax:

Now, we can rearrange the Michaelis-Menten equation to solve for [*S*] for both *v*50%​ and *v*90%​:

For 50% of Vmax:

We can solve these equations to find the corresponding substrate concentrations [�][*S*] for both cases. Let's solve them.

To solve the equations for the substrate concentrations [�][*S*] corresponding to 50%50% and 90%90% of Vmax, we can rearrange the equations and solve for [�][*S*].

For 50% of Vmax:

Multiplying both sides by 52.91+[*S*], we get:

Expanding and rearranging terms:

For 90% of Vmax:

Multiplying both sides by 52.91+[*S*], we get:

So, the substrate concentration needed to reach reaction velocities of 50% and 90% of Vmax are approximately 52.96mmol/L and 473.22 mmol/L, respectively.

**Answer : 02**

**Part (A). Enzyme Balance:**

[E\_T] = [E] + [ES] + [EA] + [EAS]

This equation expresses the conservation of total enzyme concentration ([E\_T]) across all its free and complex forms: free enzyme (E), enzyme-substrate complex (ES), enzyme-activator complex (EA), and enzyme-activator-substrate complex (EAS).

**Part (B). Quasi-Steady State Assumption (QSSA):**

Applying QSSA to ES, EA, and EAS complexes implies their concentrations change much slower than other species:

* d[ES]/dt ≈ 0 = k1[E][S] - (k-1 + k2)[ES] + k5[EA][S] - (k-5 + k6)[EAS]
* d[EA]/dt ≈ 0 = k3[E][A] - (k-4)[EA] - k5[EA][S] + (k-5)[EAS]
* d[EAS]/dt ≈ 0 = k5[EA][S] - (k-5 + k6)[EAS]

These equations express the equilibrium between formation and dissociation of respective complexes.

**Part (C). Rapid Equilibrium Assumption (REA):**

This mechanism doesn't explicitly show steps assumed to be in rapid equilibrium. Therefore, there are no REA equations applicable in this case.

**Part (D). Rate of Product Formation (dP/dt):**

While applying QSSA or REA would simplify the overall rate equation, here's the equation for dP/dt without relying on those assumptions:

dP/dt = k2[ES] + k6[EAS]

This equation directly reflects the contributions of both ES and EAS complexes to product formation, based on their respective rate constants (k2 and k6) and concentrations.

Note:

* Completing the QSSA equations would require expressing [E], [EA], and [EAS] in terms of other species using the equilibrium relationships for each complex.
* The specific steps for simplifying the rate equation using QSSA or REA involve complex algebra beyond the scope of this response.

**Answer : 03**

**Part (A).** Rennin is classified as a hydrolase enzyme. Hydrolases catalyze hydrolysis reactions, where a substrate is cleaved by the addition of water. Rennin specifically acts on the peptide bonds in milk protein, causing it to coagulate into curds and whey.

**Part (B).** An example of a substrate used with rennin is casein, a protein found in milk. When rennin acts on casein, it breaks down the peptide bonds within the protein, leading to the formation of curds (solid) and whey (liquid). This coagulation process is crucial in cheese-making industry.

**Part (C).** Using the Rapid Equilibrium Assumption (REA), the Michaelis constant (Km) can be calculated as:

Substituting the given values:

Using the Quasi-Steady State Assumption (QSSA), the Michaelis constant (Km) can be calculated as:

Substituting the given values:

*Km* ≈ 4.81×10^−4 M

D. Using the Michaelis-Menten equation:

*v*0​= *V*max​[*S*]​/( *Km*​+[*S*])

For the Rapid Equilibrium Assumption (REA):

For the Quasi-Steady State Assumption (QSSA):

*Km*​=4.81×10−4M

Therefore, the initial reaction velocities for the Rapid Equilibrium Assumption (REA) and the Quasi-Steady State Assumption (QSSA) are approximately 7.31×10−5 mol/L⋅s7.31×10−5mol/L⋅s and 1.04×10−4 mol/L⋅s1.04×10−4mol/L⋅s respectively.

**Top of Form**

**Answer : 04**

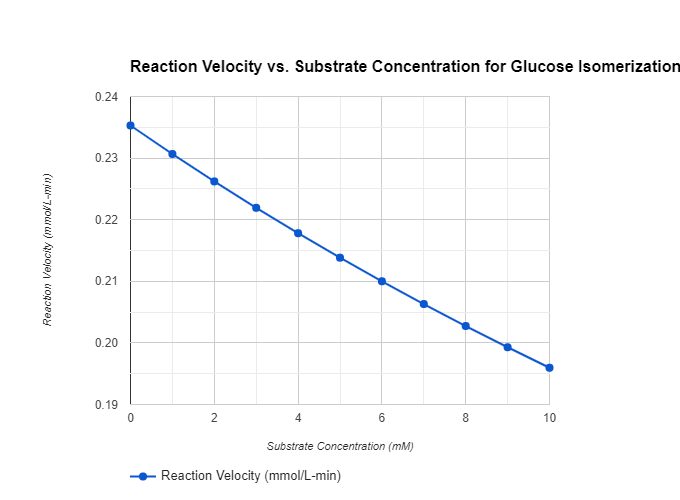
Given the equation of the trendline:

To reconstruct the reaction velocity vs. substrate concentration graph using the Lineweaver-Burk plot equation. we need to invert the axes. In the Lineweaver-Burk plot, the x-axis represents the reciprocal of the substrate concentration (1/[*S*]), and the y-axis represents the reciprocal of the reaction velocity (1/*v*).

We can rewrite this equation in terms of the reciprocal values:

Now, let's rearrange this equation to get it in the form of *v*=*f*([*S*]), which represents the reaction velocity as a function of the substrate concentration:

Now, we can use this equation to calculate the reaction velocities for different substrate concentrations. Let's construct the reaction velocity vs. substrate concentration graph using a spreadsheet.



**Answer : 05**

To sketch a qualitative velocity profile (velocity vs. time) for the enzymatic breakdown of the substrate Auburn by the enzyme WarEaglease under different pH conditions, we need to consider how pH affects enzyme activity. Typically, enzyme activity is affected by pH due to changes in the enzyme's conformation and ionization of amino acid residues involved in the catalytic process.

Given that WarEaglease shows varying activity with pH, we can expect different velocity profiles under different pH conditions. Let's sketch the velocity profiles for the three scenarios:

**Part (A). Unbuffered solution starting at pH 9:**

In an unbuffered solution, pH changes can occur more rapidly due to the addition of H+ ions as a product of the enzymatic reaction. As pH decreases, enzyme activity may decrease, leading to a decrease in reaction velocity over time. The velocity profile might show an initial rapid decrease in velocity as pH drops, followed by a slower decline as the system approaches equilibrium.

**Part (B). Well-buffered pH 9 solution:**

In a well-buffered solution at pH 9, the pH is maintained relatively constant despite the production of H+ ions. Enzyme activity remains relatively stable over time due to the buffering capacity of the solution. The velocity profile might show a relatively constant velocity over time, indicating stable enzyme activity.

**Part (C). Well-buffered pH 7 solution:**

In a well-buffered solution at pH 7, the pH is maintained at a lower level compared to pH 9. Enzyme activity may decrease compared to pH 9 conditions, leading to a slower initial reaction velocity. The velocity profile might show a gradual decrease in velocity over time as the reaction progresses.

**Answer : 06**

**Given data:**

* **Mass of enzyme batch added to reaction:**
  + Novozymes: 26.3 mg=0.0263 g
  + Allozymes: 22.4 mg=0.0224 g
  + AB Enzymes: 21.5 mg=0.0215 g
* **Substrate concentration before reaction:**
  + Novozymes: 4.88 g/L
  + Allozymes: 4.97 g/L
  + AB Enzymes: 4.76 g/L
* **Substrate concentration after 12.0 minutes:**
  + Novozymes: 2.79 g/L
  + Allozymes: 3.15 g/L
  + AB Enzymes: 2.98 g/L

To determine the activity level for each company's enzyme batch, we can use the provided data and the formula:

Activity level = (ΔS/Δt) / E

Where:

* Δ*S*/Δ*t* is the change in substrate concentration per unit time (g/L-min).
* *E* is the mass of enzyme added to the reaction (g).

**For Novozymes:**

ΔS/Δt = (4.88 - 2.79) g/L / 12.0 min = 0.157 g/L-min

Activity level = 0.157 g/L-min / 0.0263 g = 5.98 g S/g E-min

**For Allozymes:**

ΔS/Δt = (4.97 - 3.15) g/L / 12.0 min = 0.151 g/L-min

Activity level = 0.151 g/L-min / 0.0224 g = 6.74 g S/g E-min

**For AB Enzymes:**

ΔS/Δt = (4.76 - 2.98) g/L / 12.0 min = 0.148 g/L-min

Activity level = 0.148 g/L-min / 0.0215 g = 6.88 g S/g E-min

Therefore, the activity level for Novozymes, Allozymes, and AB Enzymes are 5.98 g S/g E-min, 6.74 g S/g E-min, and 6.88 g S/g E-min, respectively.

**Answer : 07**

**Part (A): COX-2 Inhibitors:**

* Uses: Primarily used to treat pain and inflammation associated with chronic conditions like arthritis, osteoarthritis, and ankylosing spondylitis.
* Difference from Ibuprofen and Aspirin: COX-2 inhibitors selectively target the COX-2 enzyme, while ibuprofen and aspirin inhibit both COX-1 and COX-2. This difference reduces the incidence of gastrointestinal side effects commonly associated with non-selective NSAIDs like ibuprofen and aspirin, as COX-1 helps protect the stomach lining.
* Examples: Celebrex (celecoxib), Vioxx (rofecoxib) (withdrawn due to cardiovascular risks), Arcoxia (etoricoxib).

**Part (B): Enzyme Targeted:** COX-2 inhibitors target the cyclooxygenase-2 (COX-2) enzyme.

**Part (C): Commercial Product:** One commercial product that is a COX-2 inhibitor is Celebrex (chemical name: celecoxib).

**Part (D): Disease Treated by ACE Inhibitors:**

* ACE inhibitors are used to treat high blood pressure (hypertension) and heart failure by relaxing blood vessels, which lowers blood pressure. An example of a disease treated by ACE inhibitors is hypertension (high blood pressure).

**Part (E): ACE Inhibitors and Angiotensin I:**

* Enzyme: Angiotensin-Converting Enzyme (ACE) / Kininase II
* Substrate: Angiotensin I (Ang I)
* Peptide Sequence: Asp-Arg-Val-Tyr-Ile-His-Pro-Phe
* Broken Bond: The enzyme cleaves the peptide bond between Ile and His.
* Product: Angiotensin II (Ang II)

**Answer : 08**

**A. Enzyme Balance:**

[E\_T] = [E] + [ES] + [EI] + [EIS]

This equation expresses the conservation of total enzyme concentration ([E\_T]) across all its forms: free enzyme (E), enzyme-substrate complex (ES), enzyme-inhibitor complex (EI), and enzyme-inhibitor-substrate complex (EIS).

**B. Quasi-Steady State Assumption (QSSA):**

Applying QSSA to ES and EIS complexes implies their concentrations change much slower than other species:

d[ES]/dt ≈ 0 = k1[E][S] - (k-1 + k2)[ES] d[EIS]/dt ≈ 0 = k4[EI][S] - (k-4 + k5)[EIS]

These equations express the equilibrium between formation and dissociation of the respective complexes.

**C. Rapid Equilibrium Assumption (REA):**

This mechanism doesn't explicitly show steps assumed to be in rapid equilibrium. Therefore, there are no REA equations applicable in this case.

**D. Inhibitor Type:**

Based on the mechanism:

* The inhibitor (I) can bind to the free enzyme (E) to form EI (step 3), competing with the substrate (S) for the active site (competitive inhibition).
* However, the inhibitor can also bind to the ES complex to form EIS (step 4), which can still produce product (P) through step 5 (non-competitive inhibition).

Therefore, this mechanism displays **mixed inhibition**. Here's why:

1. Both competitive and non-competitive elements contribute to the overall inhibitory effect.
2. The relative strength of each inhibitory effect depends on the relative values of the rate constants for each step. For example, if k5 is large compared to k2, the non-competitive component might be more dominant.

Further analysis (e.g., deriving the rate equation) would be needed to quantitatively assess the contribution of each type of inhibition in this specific mechanism.

**END**