MDCM601 2022 Exam 4

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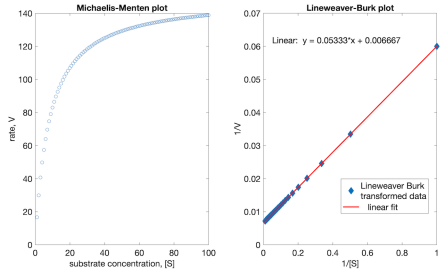
1 Problems

Problem 1. Use the plotted enzymatic reaction kinetic data to find V_{max} and K_M.



Michaelis-Menten equation:

$$v = \frac{V_{max} \times [S]}{K_M + [S]} \tag{1}$$

Problem 2. Data on enzymatic reaction kinetics were acquired in the absence and in the presence of two different inhibitors at 40 µM, the data was converted to a double reciprocal form, and the slopes and intercepts of the linear fits are reported below:
no inhibitor: slope = 0.00533; intercept = 0.00667
Inhibitor A: slope = 0.048; intercept = 0.00667
Inhibitor B: slope = 0.432; intercept = 0.00667

Answer the following questions:

1. Are these inhibitors competitive or non-competitive?
2. What is the K_i of the inhibitor A?
3. What is the K_i of the inhibitor B?
4. Which one is a better inhibitor?
5. K_i is an equilibrium constant for the following process: $\mathrm{E} + \mathrm{I} \overset{\mathrm{K_i}}{\rightleftharpoons} \mathrm{EI}$. True or false?

Note: factor mutliplying K_M or V_{max} has the form:

$$1 + \frac{[I]}{K_i}$$

Problem 3. At what concentration of the substrate (as function of K_M) will the rate of enzymatic reaction be 75% of V_{max}?

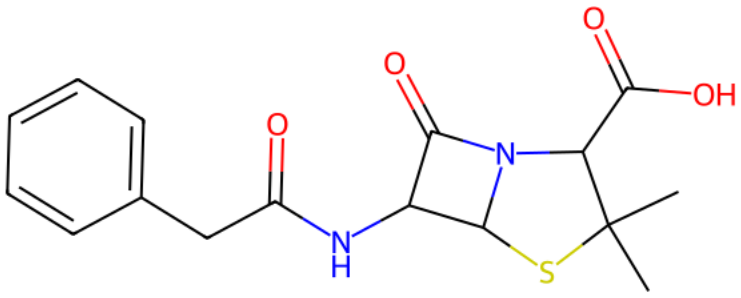
Problem 4. Calculate V_{max} if rate of the enzymatic reaction is 6 µM/s at the substrate concentration $3 \times K_M$.

Problem 5. For a process A $\rightleftharpoons$ B the first-order rate constant of a forward reaction is $k_f = 20\,\mathrm{M/s}$ and the rate of the backward reaction is $k_b = 5\,\mathrm{M/s}$. If the reaction starts with 10 mM in A, calculate the ratio of concentrations [B]/[A] at the equilibrium.

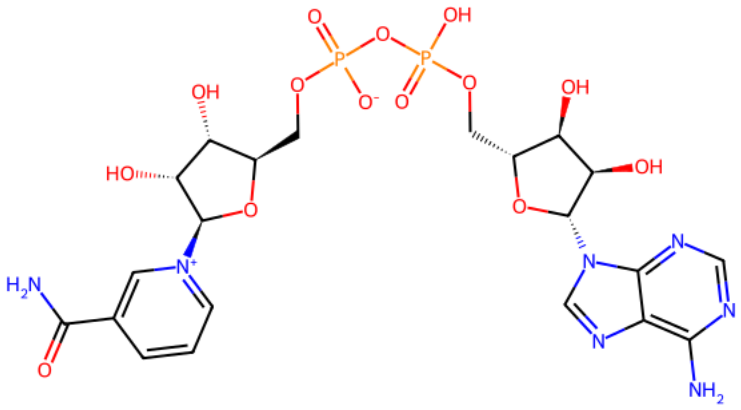
Problem 6. What is the co-substrate in a dehydrogenase enzyme?
What is the co-substrate in a kinase?

Problem 7. True or false: The enzymatic reaction is catalyzed at the allosteric site.

Problem 8. What are the two functional groups that are formed when the molecule below inhibits the bacterial carboxypeptidase enzyme by making a covalent bond with an active site serine?



Problem 9. Point to the carbon atom in the structure of NAD^+ that will accept a hydride.



Problem 10. Which three residues constitute a catalytic triad in chymotrypsin?

Problem 11. Log-form of the Arrhenius equation is given below:

$$\ln k = -\frac{E_a}{R} \times \frac{1}{T} + \ln A$$

Are rate constants of reactions with larger E_a more or less sensitive to changes in temperature than rate constants of reactions with smaller E_a?

Problem 12. Residues in the active site of glutamate racemase are in positions 7, 8, 178, 70, 180, and 147. How can these residues, so remote in the sequence, all be involved in catalysis?

Problem 13. What are the units of K_M?

2 Solutions

1. $V_{max} = 150\,\mu M$; $K_M = 8\,\mu M$
2. competitive; 5; 0.5; B; False
3. 3 K_M
4. $8\,\mu M/s$
5. 4
6. NAD^+ or $NADP^+$; ATP
7. False
8. ester and amine
9. pyridine 4
10. Ser His Asp
11. more sensitive
12. They are close in folded structure.
13. M