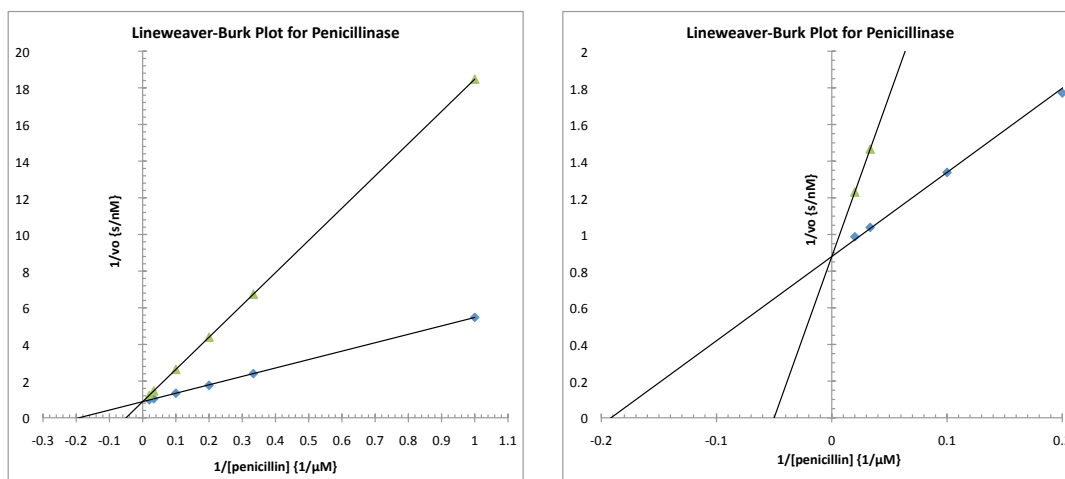


Chem 352 - Spring 2009 - Quiz 3

1. Penicillin-resistant bacteria produce a β -lactamase enzyme called penicillinase, which is able to chemically inactivate penicillin. When bacterial infections are treated with amoxicillin, which is a member of the penicillin class of antibiotics, the drug is often augmented with an inhibitor of penicillinase called clavulanic acid. Below are graphs showing kinetic data for penicillinase in the presence and absence of 10 μM clavulanic acid. These data were collected using a penicillinase concentration of 3.30 μM . The graph on the right is an expansion of the one shown on the left.



- a. Is the affinity of the penicillinase for penicillin affected by the presence of the clavulanic acid? Explain.
- b. On average, how many reactions does each penicillinase enzyme molecule catalyze in a second when saturated with substrate in the absence of clavulanic acid? (Assume that each enzyme molecule has only one active site.)
- c. Is the number you calculated for part b. affected by the presence of clavulanic acid? Explain.
- d. Your textbook describes that there is an upper limit to how efficient an enzyme can be. Basically, if an enzyme's k_{cat}/K_M value is greater than $10^8 \text{ M}^{-1}\text{s}^{-1}$ its rate is determined by how fast the substrate can diffuse into the active site for the enzyme. Enzyme catalyzed reactions with k_{cat}/K_M values greater than $10^8 \text{ M}^{-1}\text{s}^{-1}$ are considered to be diffusion-controlled reactions and the enzymes that catalyze these reactions are said to be "catalytically perfect". Using this definition, is penicillinase in the absence of clavulanic acid a "catalytically perfect" enzyme? Explain.

2. In class we discussed two different modes that enzymes use to speed up the rate of chemical reactions.
- a. What are these two modes?
 - i. _____
 - ii. _____
 - b. Using the reaction mechanism that is used by serine proteases to cleave polypeptides, give two specific examples for each of these modes.
 - i. Mode:
 1. Example 1:

 2. Example 2:
 - ii. Mode:
 1. Example 1:

 2. Example 2: