7.3: Exercises

Multiple Choice

An enzyme has a maximum velocity expressed as V_{max}. What is the initial velocity of an enzyme reaction when the substrate concentration is at 20 times the K_m?

a. 0.2 V_{max}

b. 0.95 V_{max}

c. 1.5 V_{max}

d. 10 V_{max}

e. Insufficient information to determine V.

b: apply M-M equation.

Methanol and ethanol are both catalyzed by alcohol dehydrogenase (ADH). After ADH catalysis, methanol becomes formaldehyde, which is highly toxic. For a person with 60L body water where methanol and ethanol can rapidly distribute. Assume the K_m of ADH for both ethanol and methanol is 10^{-5} M, which approximately equal to their K_d. The density of both methanol and ethanol are 0.8 g/mL. If the person consumed 20 mL of methanol (50 - 100 mL can be fatal to a full grown adult) and 50% ethanol is used to compete with methanol. How much 50% ethanol has to be consumed to have ~ 50% of ADH working on methanol? (methanol has a molar mass of 32 g/mol; ethanol has a molar mass of 46 g/mol

a. 300 mL

b. 100 mL

c. 60 mL

d. 30 mL

e. 20 mL

c: if methanol was distributed equally in 60L, it has a concentration of (20 mL x 0.8) g/mL / (32g/mol x 60 L) = 8 x 10^{-3} M, which is >> than Km. This suggest that ~ 100 % ADH is working on methonal at this moment. To have ~50% ADH working on methanol, which has the same Km to ethonal, you will need equal molar amount off ethonal taken.

Two people have the same k after drinking alcohol. Please calculate the substrate concentration in Person 1.

Aldehyde dehydrogenase	Person 1	Person 2
k_{cat}(S^{-1})	10	1
K_m (M)	0.1	0.05
[S] (M)	?	0.05

a. 0.005

b. 0.01

c. 0.05

d. 0.1

e. 0.5

a. Use M-M equation

Which of the following describes the Bohr effect correctly?

a. the ability of hemoglobin to retain O_2 in the lungs

b. the regulation of hemoglobin's oxygen binding affinity by protons and CO_2

c. the alteration of hemoglobin conformation explained by sequential or concerted model

d. All of the above are correct.

e. None of the above is correct.

b

How is specificity determined by chymotrypsin?

a. interaction of the catalytic amino acids with the substrate

b. binding of the N-terminal amino acid at the active site

c. covalent binding of a His residue to the substrate

d. large conformational change of a P-loop upon binding of substrate

e. binding of the proper amino acid into a deep pocket of the enzyme

e

Restriction endonucleases are found in prokaryotic organisms to defend against foreign DNA. How does the host protect its own DNA from cleavage?

a. packaging DNA in nucleus

b. deamination of its DNA

c. methylation of its DNA

d. regulation of endonucleases activity with inhibitors

e. all of above are correct

c

2,3-BPG regulates the oxygen affinity for hemoglobin. 2,3-BPG:

a. promotes the transition to T-state.

b. binds to the C-terminal carboxylate group of hemoglobin.

c. preferentially binds to oxyhemoglobin to stabilize it

d. binds at hydrophobic patches of α-chains.

e. binds in an amount up to four molecules per hemoglobin molecule.

a

Which type of enzymes displays sigmoidal reaction kinetics (a plot of velocity versus [substrate])?

a. isozymes

b. apoenzymes

c. allosteric enzymes

d. holoenzyme

e. all enzymes

c

a.	
____un-competitive inhibitor	a. does not change K_m
____competitive inhibitor	b. does not change V_{max}
____suicide inhibitor	c. does not change V_{max}/K_m

____feedback inhibition	d.	forms covalent bond with enzyme
____non-competitive inhibitor	e.	inhibition by product

cbdea

b.		
____ Vitamin K	a.	protein kinase A activation
____ ATP	b.	part of heme
____ cAMP	c.	O_2 binding affinity
____ porphyrin	d.	thrombin binding
____2,3 BPG	e.	phosphate carrier

deabc

Sample Questions

1. The form in which the ping pong mechanism binds substrates is identified as which type of mechanism?
2. What are two characteristics of an enzyme that catalyzes a reaction through the ping-pong mechanism?
3. What are the characteristics of an irreversible inhibitor?
4. In what ways does a competitive inhibitor differ from a noncompetitive inhibitor?
5. The activity of a purified enzyme is measured at a substrate concentration of 1.0 µM and found to convert 49 µmol of substrate to product in 1 min. The activity is measured at 2.0 µM substrate and found to convert 98 µmol of substrate to product/minute.

a) When the substrate concentration is 100 µM, how much substrate would you predict is converted to product in 1 min? What if the substrate concentration were increased to 1,000 µM (1.0 mM)?

b) The activities actually measured are 676 µmol product formed/minute at a substrate concentration of 100 µM and 698 µmol product formed/minute at 1,000 µM (1.0 mM) substrate. Is there any discrepancy between these values and those you predicted in Exercise 15a? Explain.

Ans a) at 100 µM, you would predict that the rate would increase 100 times to 4,900 µmol of substrate to product in 1 min; at 1.0 mM, you would predict an increase to 49,000 µmol of substrate to product in 1 min.

Ans b) There is a great discrepancy between the predicted rates and actual rates; this occurs because the enzyme becomes saturated with substrate, preventing a further increase in the rate of the reaction (the reaction is no longer linear with respect to substrate concentration because it is at very low concentrations).