Kirk's Answers to Problem Set 2 Practice Problems

Problem 1A:
residues per turn: __3.5__
pitch (distance between turns): __0.51__ nm
number of residues of heptad repeats in α keratin: ___300___ residues

__300__ residues / __3.5__ residues per turn x __0.51__ nm in an α-helix pitch = __43.7__ nm

Problem 1B:
Does the sequence IQEVERD contain leucine or similar hydrophobic residues at positions 1 and 4? ___Yes____
Does the sequence WQEYERD contain leucine or similar hydrophobic residues at positions 1 and 4? ___No____

Problem 2A:
K_S = __3.67×10^{-4}__ M
K_m = __1.16×10^{-3}__ M

Problem 2B:
___Steady state kinetics___ because… ____k_2 is large enough ($k_2 \approx k_{-1}$) to be considered___.

Problem 2C:
What is the K_m of the *in vivo* concentration for the enzyme? __0.1__ mM
How does it compare to the *in vivo* concentration of ATP? ____10-100 times less than in vivo [ATP]____

Problem 3A:
[S] = __15__ μM

Problem 3B:
Divide to find the factor:
$\frac{[S]_{0.80} = 60\ \mu M}{[S]_{0.20} = 3.75\ \mu M}$ = __16__ fold increase

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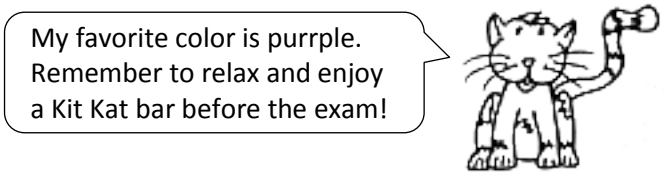
Problem 4
a) E.C. Classification: ___oxidoreductase___
b) E.C. Classification: _____ligase_____
c) E.C. Classification: _____isomerase_____
d) E.C. Classification: _____lyase_____



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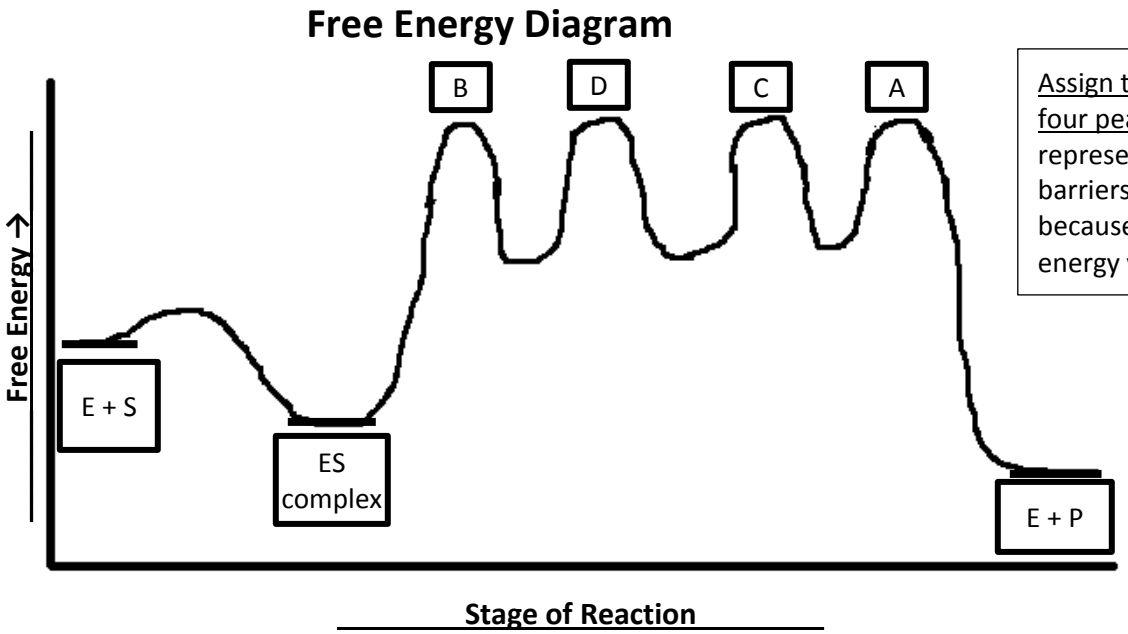
Problem 5A:



Assign the four stages to the four peaks. The peaks represent activation energy barriers, at the same height because their relative energy values are not given.

Word Bank:
E + P
Free Energy →
ES complex
E + S
Stage of Reaction
A, B, C, D

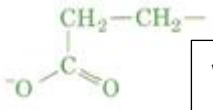
Problem 5B:
In the catalytic mechanism shown in stage (b) of the reaction, H-O-H acts as a(n) __nucleophile__ because it attacks an electron-deficient carbon center. The process forms a(n) __hydroxide__ in the transition state and this molecule is what catalyzes the reaction. H-O-H also acts as a(n) __acid__ because it __donates__ an H^+ to molecule A. As a result, molecule A acts as a(n) __base__ because it __accepts__ an H^+ from water. Thus, the catalytic mechanism shown here must be ___general base catalysis___ (not in word bank, use table above).

Problem 5C:
The enzyme catalyzes a ___hydrolysis___ reaction so it must be a(n) ____hydrolase____ type of enzyme!

Problem 5D:
Any amino acid that can donate H^+ will work. Glu, Asp, His are three examples. Cys and Tyr (although poorly) can work as well.

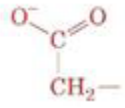
Problem 6A:
Which EC enzyme class hydrolyzes bonds by adding water across the bond? _____hydrolase_____

Problem 6B:
Upper (green) amino acid residue:



Which amino acid has this structure?
_____glutamic acid_____

Lower (red) amino acid residue:



Which amino acid has this structure?
_____aspartic acid_____

Problem 6C:
Drawing C – general base catalysis
Drawing D – general acid catalysis
Drawing B or E – covalent catalysis

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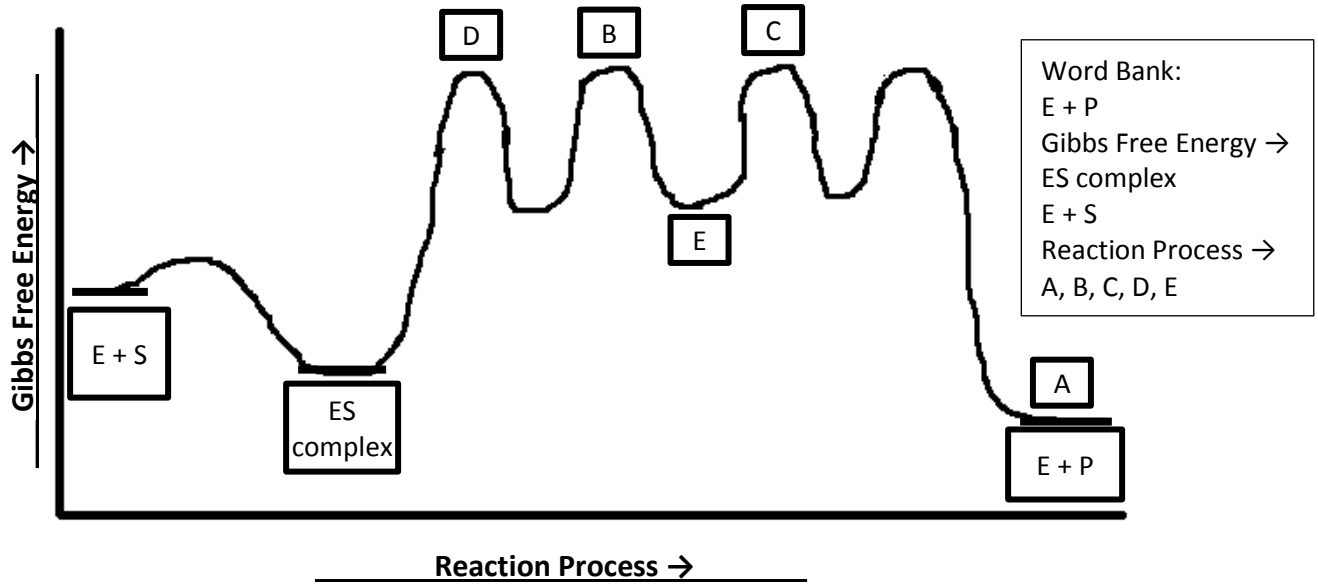
Problem 6D:
Order the reaction steps:
__D__ → __B__ → __E__ → __C__ → __A__

Kirk's Example Free Energy Diagram



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Problem Set #2: Due Friday 10/19 at 5:00PM in FO 3.602
Exam #2 Review: TBA
Exam #2: Monday 10/22 at 10:00AM (Lee) in normal classroom
Tuesday 10/23 at 1:00PM (Marsh) in normal classroom