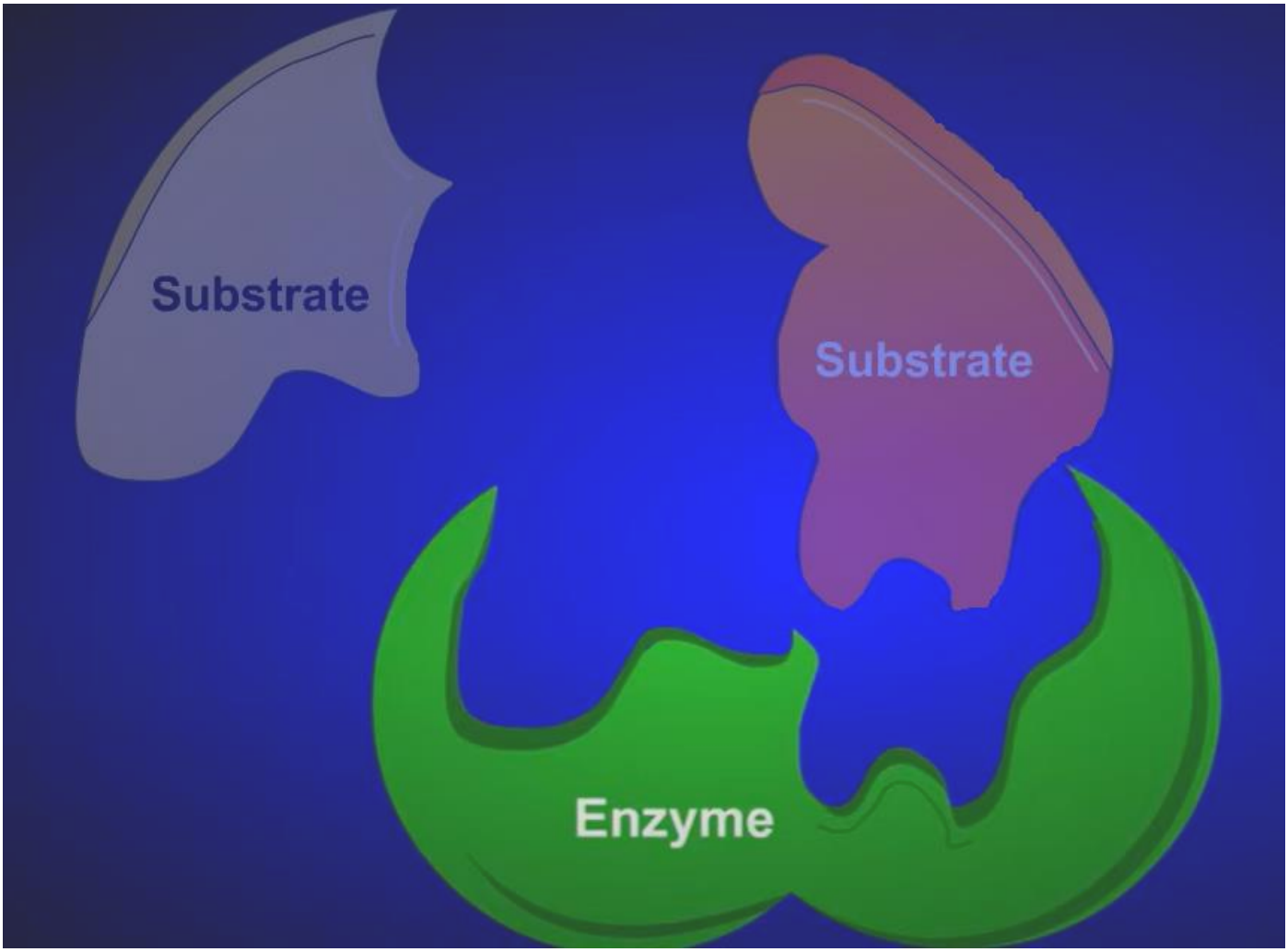
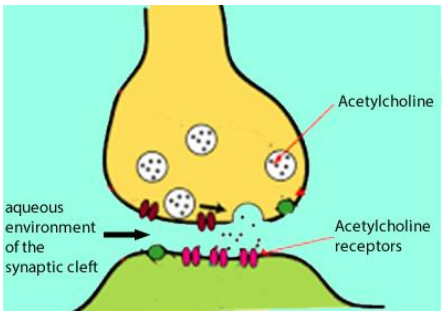
ENZYMES



1. Which of the following types of bonds can not take place between an enzyme's active site and a competitive inhibitor? Justify your answer.
   Dipole-dipole, Hydrogen bonding, disulfide bonds, van de Waals dispersion forces.

2. Myasthenia gravis is an autoimmune disorder where the body produces antibodies that block or destroy acetylcholine receptors on muscle cells. This results in reduced muscle stimulation and weakness. To counteract the reduced stimulation, acetylcholinesterase, the enzyme that breaks down the neurotransmitter, acetylcholine, is inhibited by a drug called pyridostigmine, in an attempt to increase the concentration of acetylcholine in the synaptic cleft. The selection of drug is crucial as an excess of acetylcholine lingering in the synaptic cleft can lead to excessive muscle stimulation, exacerbating the weakening of muscle responses.

   a. Is pyridostigmine a competitive or non-competitive inhibitor of acetylcholinesterase? Justify your choice describing the impact of both a competitive and non-competitive inhibitors.



The synaptic cleft is filled with extracellular fluid, which is primarily composed of water along with various ions, neurotransmitters, and other molecules.

Figure 1

Chemical structure of pyridostigmine

Figure 2

   b. Give one valid reason for the preparation of pyridostigmine as a bromide salt.

c. A chemist proposed a reaction pathway for the synthesis of a new drug "C", shown in figure 3, to mimic pyridostigmine using two precursors. One precursor was the molecule shown in, figure 4. The MS of the other precursor is shown in figure 5 below.

i. What type of reaction takes place between molecules A and B?

ii. What is the molar mass of molecule B?

iii. Calculate the atom economy for the reaction between molecules A (111 g/mol) and B to produce molecule C 182 g/mol).

Molecule C

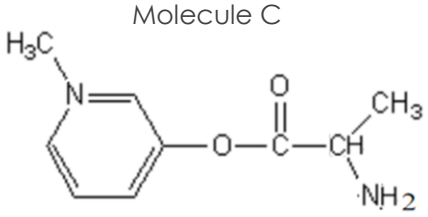


Figure 3

Molecule A

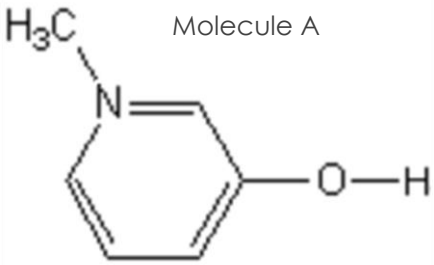


Figure 4

Molecule B

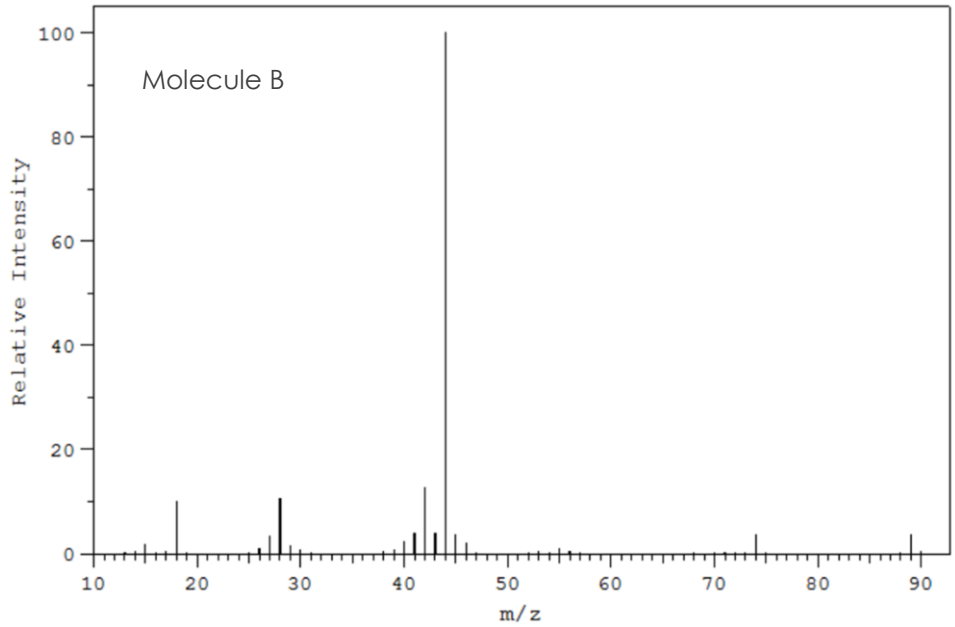


Figure 5

iv. Give the IUPC name of molecule B _____

v. Give the semi-structural formula of the fragment that produced the base peak in the MS figure 5. _____

vi. How many stereoisomers exist for molecule B _____

3. Figure 6 shows the energy profile of an uncatalyzed reaction.
   a. Draw in the space provided in figure 6 how the energy profile will change when a catalyst is added.

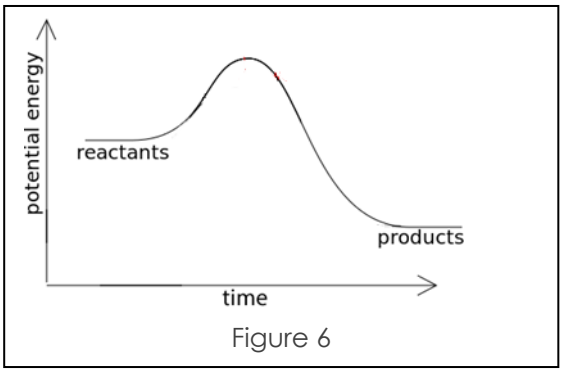


Figure 6

b. Consider the reactant and product particles shown in fig 7 as well as the two conformational states, A and B, of an enzyme.

i. Using the images in fig. 7 compare and contrast the lock-and-key and induced-fit models of enzyme substrate interactions. You may use diagrams to help your explanation.

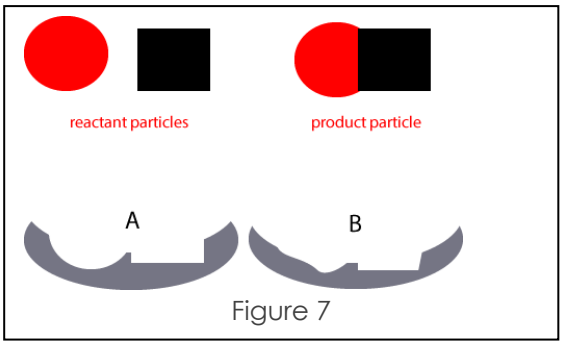


Figure 7

ii. Draw the enzyme-substrate complex in the box provided in fig 8.

iii. Using figure 8, circle the point along the energy profile where the particles are the most unstable.

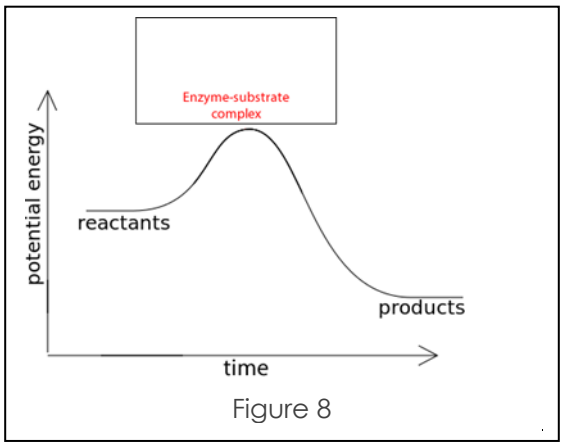


Figure 8