Discussion Exercise 3: Hydrolysis Reactions

Key

Problem 1: Draw example molecules that contain amide, ester, thioester, phosphodiester, and phosphoanhydride functional groups.

![Diagram of functional groups]

Problem 2: In the molecules below, label all hydrolysable functional groups.

![Diagram of labeled functional groups]
Problem 3: Predict the products of these hydrolysis reactions.

The compounds below are not written in their typical ionization states at pH 7. All the carboxylic acids would be ionized.
Problem 4: A phosphoanhydride bond of ATP can be hydrolyzed to give AMP and pyrophosphate. Draw the structure of pyrophosphate in its major ionization state at pH 7. (pKa values 1-4 for pyrophosphate are 0.91, 2.10, 6.70. and 9.32.)

Problem 5: Phosphodiesters can be hydrolyzed on either side of the phosphate functional group to give a phosphate monoester and an alcohol. Draw the two possible products that form when the diester is hydrolyzed.
Problem 6: Predict the hydrolysis products of each of these compounds.
Problem 7: Proteases are enzymes that hydrolyze polypeptides. Trypsin is a protease that specifically hydrolyzes the peptide bond on the carboxy side of positively charged side chains. Draw the full structure of the trypsin hydrolysis products of ASKW.

Problem 8: Nucleases are enzymes that hydrolyze oligonucleotides. Draw the full structures of the hydrolysis products of pApCpUp if the nuclease only cuts the 3’ phosphodiester linkage after purines.