1. The enzyme DNA ligase catalyzes the linkage between two DNA molecules according to the following chemical reaction:

![Diagram of DNA ligase reaction]

Explain the role of ATP in this reaction. (Your answer must be much more detailed than “Energy” or “To make it exergonic”)

2. You have isolated an enzyme from a pathogenic bacterium that cleaves the bond between the 2’ and 3’ carbons in DNA. Speculate as to how DNA subjected to this enzyme would behave differently with respect to, A) supercoiling, and B) DNA metabolism (e.g. transcription and replication).

3. Draw all structures (products and reactants) and mechanisms (i.e. electron pushing) for the following chemical events:

   a. The hydrolysis of the base from uridylate

   b. Adenylation of the 3’ end of oligonucleotide 5’-AAA-3’ using ATP

   c. The deamination of deoxyguanylate

   d. The methylation of the deoxyoligonucleotide 5’-GATC-3’ by Dam methylase
e. The formation of the common second messenger, cGMP from GTP