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

![Diagram of DNA ligase reaction](image)

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

2. In addition to the canonical “B-form” of DNA, and the less common “A” and “Z” forms, there are other known DNA structures that involve 3 or 4 DNA strands. One theoretical DNA structure, known as “R-form” DNA, has been proposed to play a role in homologous DNA recombination. Do some research into R-DNA and describe both the structure and its proposed biological function. (Cite your sources and use more than the paper entitled “The R-form of DNA does exist”)

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