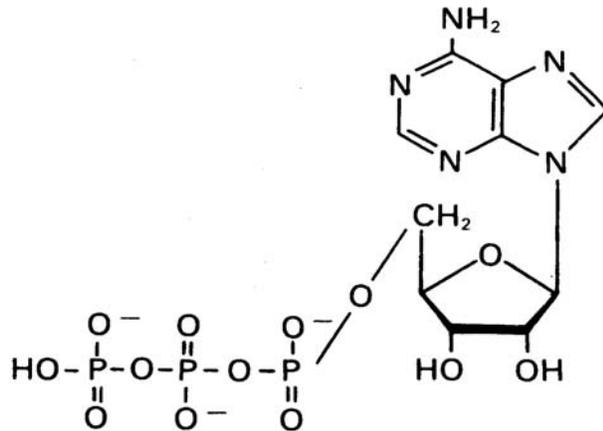


## Practice Problems for Molecular Biology, Session 2: DNA Replication

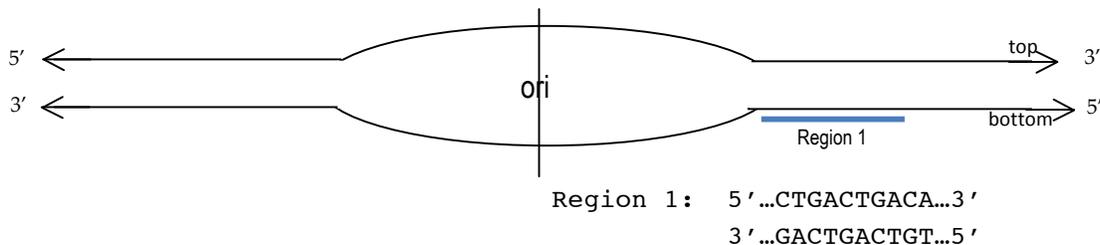
### Question 1



- Box the part that is added to a growing chain of nucleic acid.
- Star the **atom(s)** that can form a hydrogen bond with the complementary nitrogenous base.
- Circle the part of the molecule that decreases the stability of RNA as compared to DNA.
- Draw an arrow to the part of this molecule that you would modify to prevent further elongation. Indicate what change you would make next to the arrow drawn.

### Question 2

Consider the following origin of replication that is found on a chromosome. The sequence of region 1 is shown.



- Within Region 1, which strand will be the template for leading strand synthesis, the top or the bottom?
- If we assume that a lagging strand fragment is made from region 1, what will be its sequence?
- You have a mutant DNA polymerase that is partially defective. In vitro experiments using the mutant DNA polymerase gives an error rate of  $10^{-3}$ , as compared to the expected error rate of  $10^{-6}$ . Which of the following activities is the mutant polymerase likely to be missing, as compared to the normal polymerase? Circle all that apply.

5'→3' polymerase

3'→5' exonuclease

5'→3' exonuclease

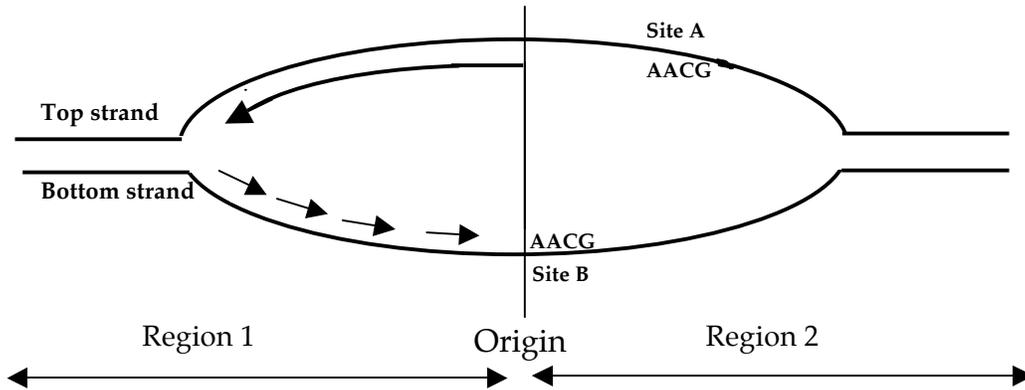
3'→5' polymerase

5'→3' recombinase

3'→5' recombinase

### Question 3

Shown below is a schematic of replicating DNA in a bacterial cell.



- a) On the diagram, label the 5' and the 3' ends of the parental DNA strands.
- b) Which parental DNA strand (top or bottom) serves as a template for the synthesis of the leading strand in Region 2?
- c) To which site (A, B, or both) can the primer 5' UUGC 3' bind?
- d) The replication of which strand (top, bottom, or both) in Region 2 would be affected in the absence of RNA primase? Assume that replication has not yet initiated on either strand. Explain.
- e) You perform DNA replication in a test tube (in vitro) using a single-stranded linear DNA as the template and the appropriate DNA primer. From the list below, circle the proteins that are required for one round of replication.
- Primase    DNA polymerase    Ribonuclease    Topoisomerase    Ligase    Helicase
- f) Why does the DNA of a eukaryotic cell require multiple origins of replication when some prokaryotic cell genomes have only one origin of replication?
- g) The "leading strand" terminology refers to the fact that this strand is the first daughter DNA strand to be completed from a given replication fork. Explain why the leading strand is completed before the lagging strand.
- h) Which of the following statements is true?
- DNA polymerase moves along the template strand in the 3' to 5' direction.
  - DNA polymerase requires a primer to initiate replication.
  - DNA polymerase forms a covalent bond between a phosphate group and a hydroxyl group.
  - Polymerization of DNA for both the lagging and the leading strands is in the 5' to 3' direction.
  - Shortly after DNA replication has begun, you find two replication forks moving in opposite directions away for the Origin of Replication.
  - All of the above statements are true.
  - None of the above statements are true.

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