

Name:

Biochemistry 465  
Hour exam II  
Spring 2006

- (5 points) Which of these statements about nucleic acids is *false*?
  - Mitochondria and chloroplasts contain DNA.
  - Plasmids are genes that encode plasma proteins in mammals.
  - The chromosome of *E. Coli* is a closed-circular, double-helical DNA.
  - The DNA of viruses is usually much longer than the viral particle itself.
  - The genome of many plant viruses is RNA.
- (5 points) The chromosomal region that is the point of attachment of the mitotic spindle is the:
  - centromere.
  - endomere.
  - exon.
  - intron.
  - telomere.
- (5 points) The linking number (*Lk*) of a closed-circular, double-stranded DNA molecule is changed by:
  - breaking a strand, then rejoining it.
  - breaking a strand, unwinding or rewinding the DNA, then rejoining it.
  - breaking all hydrogen bonds in the DNA.
  - supercoiling without the breaking of any phosphodiester bonds.
  - underwinding without the breaking of any phosphodiester bonds.
- (5 points) An Okazaki fragment is a:
  - fragment of DNA resulting from endonuclease action.
  - fragment of RNA that is a subunit of the 30S ribosome.
  - piece of DNA that is synthesized in the 3' → 5' direction.
  - segment of DNA that is an intermediate in the synthesis of the lagging strand.
  - segment of mRNA synthesized by RNA polymerase
- (5 points) The proofreading function of DNA polymerase involves all of the following *except*:
  - a 3' → 5' exonuclease.
  - base pairing.
  - detection of mismatched base pairs.
  - phosphodiester bond hydrolysis.
  - reversal of the polymerization reaction.
- (5 points) When bacterial DNA replication introduces a mismatch in a double-stranded DNA, the methyl-directed repair system:
  - cannot distinguish the template strand from the newly replicated strand.
  - changes both the template strand and the newly replicated strand.
  - corrects the DNA strand that is methylated.
  - corrects the mismatch by changing the newly replicated strand.
  - corrects the mismatch by changing the template strand.

7. (5 points) The sigma factor of *E. coli* RNA polymerase:
- A) associates with the promoter before binding core enzyme.
  - B) combines with the core enzyme to confer specific binding to a promoter.
  - C) is inseparable from the core enzyme.
  - D) is required for termination of an RNA chain.
  - E) will catalyze synthesis of RNA from both DNA template strands in the absence of the core enzyme.
8. (5 points) Processing of a primary mRNA transcript in a eukaryotic cell does *not* normally involve:
- A) attachment of a long poly(A) sequence at the 3' end.
  - B) conversion of normal bases to modified bases, such as inosine and pseudouridine.
  - C) excision of intervening sequences (introns).
  - D) joining of exons.
  - E) methylation of one or more guanine nucleotides at the 5' end.
9. (5 points) The reverse transcriptase of an animal RNA virus catalyzes:
- A) degradation of the RNA strand in a DNA-RNA hybrid.
  - B) insertion of the viral genome into a chromosome of the host (animal) cell.
  - C) RNA formation in the 3' → 5' direction.
  - D) RNA synthesis, but not DNA synthesis.
  - E) synthesis of an antisense RNA transcript.

Essay questions (use the blue book):

1. (5 points) What is the difference between a type I and a type II topoisomerase?
- Type I topo's relax the linking number by 1's by passing one strand of DNA through the other. Type II topo's relax the linking number by 2's by passing both strands of DNA through both strands of another part of DNA. In *E. coli* the Type II topo's actually use ATP energy with this mechanism to introduce negative supercoils, but in eukaryotes the type II topo's cannot introduce negative supercoils, they can only relax supercoils.
2. (10 points) Describe the structure of a nucleosome.
- The protein part of a histone contains 2 each of the histones H2A, H2B, H3, and H4. The DNA consists of 146 bp of DNA wrapped about 1.8 times around the protein, and about 54 more bases in an extended linker to the next histone. The DNA is associated with histone H1. The core histones are about 100 Amino acids each, while the H1 histone contains about 200 residues. All histone proteins are extremely rich in + charged amino acids, with Arg and Lys making up at least 25% or more of the composition of these proteins. If the DNA is relaxed after binding to a histone, one finds that about 1 negative supercoil is introduced on histone binding
3. (15 points) Compare the structure and function of DNA Polymerase III with RNA polymerase II
4. (10 points) Give a brief description of a least 5 different DNA repair mechanisms
5. (10 points) Compare the four different RNA splicing mechanisms observed in eukaryotes
- 6A. (5 points) What are the biochemical steps involved in the infection of a cell by a retrovirus.

6B. (5 points) Describe the chromosome of a typical retrovirus (How many genes are there, what are their names, and what they code for?)

7. (5 BONUS points) What is base that inosine is derived from? What is the structure of inosine? What is the structure of the base that inosine is derived from?

1. Chromosomal elements

**Page: 925 Difficulty: 1 Ans: B**

Which of these statements about nucleic acids is *false*?

**2. Chromosomal elements**

**Page: 930 Difficulty: 1 Ans: A**

**3. DNA supercoiling**

**Page: 933 Difficulty: 2 Ans: B**

The linking number (*Lk*) of a closed-circular, double-stranded DNA molecule is changed by:

**4. DNA replication**

**Page: 952 Difficulty: 2 Ans: D**

An Okazaki fragment is a:

**5. DNA replication**

**Page: 955 Difficulty: 3 Ans: E**

The proofreading function of DNA polymerase involves all of the following *except*:

**6. (5 points) DNA repair**

**Page: 968 Difficulty: 2 Ans: D**

When bacterial DNA replication introduces a mismatch in a double-stranded DNA, the methyl-directed repair system:

**7. (5 points) DNA-dependent synthesis of RNA**

**Page: 998 Difficulty: 2 Ans: B**

The sigma factor of *E. coli* RNA polymerase:

**8. RNA processing**

Page: 1007 Difficulty: 1 Ans: B

Processing of a primary mRNA transcript in a eukaryotic cell does *not* normally involve:

**9. RNA-dependent synthesis of RNA and DNA**

**Page: 1021 Difficulty: 2 Ans: A**

The reverse transcriptase of an animal RNA virus catalyzes: