MCB 110
First Midterm
SIX PAGES

NAME:

SID Number:

Question	Maximum Points	Your Points
I	36	
II	30	
III	24	
IV	33	
V	27	
	150	

This exam must be written in PEN if you want the option of a regrade.

Question I (36 points)

For each of 1-4, give answers to A, B and C:
A. (3 pts) For each enzyme below, note the important feature(s) of its intended DNA substrates.
B. (1 pt) Is there a covalent protein-DNA intermediate? Yes or No.
C. (1 pt) Does the enzyme's function require energy input, e.g. ATP hydrolysis? Yes or No.

	A	B	C
1.	type I topoisomerase		
2.	DNA ligase		
3.	integrase		
4.	uracil DNA glycosylase		

For each of 1-4:
(4 pts each) What are this protein's properties of DNA binding or loading? Indicate all relevant structural requirements including specificity for single and/or double stranded DNA and sequence specificity.

1. transposase

2. gamma complex

3. UvrA

4. RuvB

Question II (30 points)

A. (5 pts each) Nucleases are specialized for diverse cellular roles. For each of the three nuclease tasks listed below, name the nuclease responsible and describe any important feature of nucleic acid strand specificity or polarity.

1. Removal of RNA primers in *E. coli*

2. Base excision repair

3. Resolution of a Holliday junction

B. (5 pts each) Several cases of cooperative protein assembly on DNA were described in class. List THREE examples of cooperative binding of a protein and explain why cooperativity is important for protein function.

1.

2.

3.

Question III (24 points)

Genomic DNA replication is highly regulated. To overcome this regulation, bacteriophages and animal viruses evolved diverse schemes for bypassing particular host DNA replication requirements.

For each of A-C:
List TWO *E. coli* proteins required for chromosome replication that would not be required for replication of the phage or virus. Also indicate why these *E. coli* proteins are no longer required.

A. Some linear phage and virus genomes replicate using a serine side chain from a protein bound to the chromosome end as primer.
1.

2.

B. Some circular, single-stranded phages replicate by making a genome-complementary single-stranded circular DNA and using this as a template for synthesis of tandem copies of the single-stranded phage genome.
1.

2.

C. T7 phage encodes its own DNA polymerase for genome replication. This DNA polymerase uses a completely different mechanism for processivity: it borrows an unrelated *E. coli* host protein that binds to T7 DNA polymerase to close off the top of the polymerase active site cleft, trapping a bound primer-template duplex in the cleft.
1.

2.

Question IV (33 points)

For each of 1-3 below, give answers for A, B, and C:
A. (3 pts) What is a type of DNA damage that will be fixed by the listed type of DNA repair? Pick only one example of damage, but be as specific as necessary in description of the DNA substrate.
B. (2x3 pts) State two proteins **SPECIFIC for ONLY this repair pathway** and in one sentence describe the function/activity of each protein.
C. (2 pts) How much DNA will be synthesized to during repair of the damage? To make it simple, choose between these options: 0, 1, 2-40, or more than 40 nt.

1. Nucleotide excision repair
A

Bi

Bii

C

2. Mismatch repair
A

Bi

Bii

C

3. SOS response
A

Bi

Bii

C

Question V (27 points)

For each of 1-3 below, answer questions A, B, and C:
A. (4 points) Are there specific DNA sequence/structure requirements for this reaction? If so, what are they and what is the role of the sequence/structure?
B. (2 points) Does this complete process require ATP (at the level of detail covered in class)? Yes or No.
C. (3 points) Describe the change in donor and target sequences.

1. Strand exchange by RecA

A.

B.

C.

2. Site-specific recombination by an invertase

A.

B.

C.

3. Non-replicative transposition

A.

B.

C.