MCB 110
Second Midterm
SIX PAGES

NAME:

SID Number:

Question	Maximum Points	Your Points
I	32	
II	35	
III	36	
IV	24	
V	24	
	151	

Note from KC: I thought that this year's midterm exam was particularly difficult

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

Question I (32 points)

For each substrate numbered 1-4, give an answer in column A,B,C,D (for the enzymes listed A,B,C,D, below) to indicate what will happen to the top strand of the RNA-DNA or DNA-DNA hybrid. Assume that the reaction is occurring in the presence of all nucleotides and that the reaction products remain as they would be configured when the enzyme first dissociates. Also assume that the strands are relatively short, so that you can ignore differences in processivity; ignore accessory factors too (this is supposed to be an uncomplicated question about the enzyme's inherent activity on DNA or RNA substrates of different strand polarity).

A. Pol III polymerase domain only
B. Pol delta polymerase domain only
C. Pol I 5'-3' exo domain (hint: 2 of 4 substrates will be reacted by the activity described in class)
D. DnaB

	A.	**B.**	**C.**	**D.**

1.

RNA
5'——3'
3'————————5'
DNA

2.

DNA
5'——3'
3'————————5'
DNA

3.

RNA
3'——5'
5'————————3'
DNA

4.

DNA
3'——5'
5'————————3'
DNA

Question II (35 points)

Considering the enzymes below with regard to their potential nuclease activities, answer questions A and B.
A. What number of strands is cleaved during one round of enzyme reaction?
B. Describe ALL features of a substrate nucleic acid structure that are required for the enzyme to act (some will have sequence specificity, or a certain DNA topology, or a configuration of strands for example double or single stranded; other distinctive features may be important too)

1. A general type II topoisomerase
A.
B.

2. A general type I topoisomerase
A.
B.

3. RuvC
A.
B.

4. MutH
A.
B.

5. FEN1
A.
B.

Question III (36 points)

A. Several proteins discussed in class assemble cooperatively on DNA. List THREE of these proteins (NOTE: listing the same protein by its *E. coli* name and then by its eukaryotic name doesn't count as two separate answers). For each protein, indicate (a) the role (if any) of ATP, and (b) the DNA sequence or structure requirements for cooperative assembly (some will have sequence specificity and/or double versus single stranded DNA requirements).

1. PROTEIN:
(a)
(b)

2. PROTEIN:
(a)
(b)

3. PROTEIN:
(a)
(b)

B. Several proteins discussed in class move along double-stranded DNA for cellular function. List THREE of these proteins (NOTE: listing the same protein by its *E. coli* name and then by its eukaryotic name doesn't count as two separate answers; use one or the other). For each protein, indicate (a) the DNA structure and (b) the protein accessory factor if any required to load the protein on a chromosome.

1. PROTEIN:
(a)
(b)

2. PROTEIN:
(a)
(b)

3. PROTEIN:
(a)
(b)

Question IV (24 points)

For each of 1-3 below, give answers for A-C:
A. (2 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. (4 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, 1-10, 11-30, or more than 30 nt.

1. Nucleotide excision repair
A

B
i

ii

C

2. Base excision repair
A

B
i

ii

C

3. Homologous recombination
A

B
i

ii

C

Question V (24 points)

For 1-3 below, answer questions A-C:
A. What does the recombinase enzyme recognize in the DNA substrate(s) of a reaction (describe both the donor and the target if relevant)? Note any specific DNA sequence requirements.
B. Describe the change(s) in the DNA substrate(s) of a reaction when the recombinase and host enzymes have completed the DNA rearrangement process.

1. One step of V(D)J recombination by the RAG proteins

A.

B.

2. Site-specific recombination by an integrase

A.

B.

3. Cut-and-paste transposition by a transposase

A.

B.