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BICH/GENE 431, EXAM 2, Wednesday, March 24, 2010, 100 points total

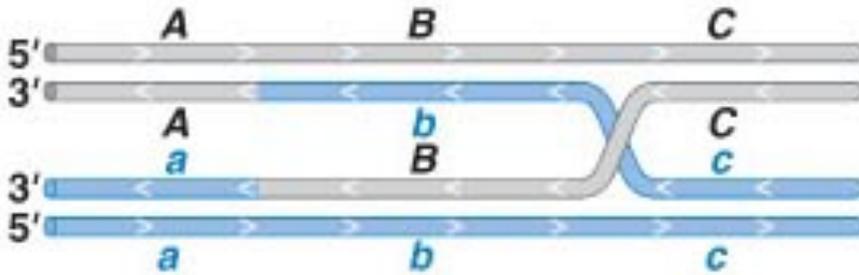
You **MUST** sign the following academic integrity statement:

On my honor, I have neither given nor received unauthorized aid on this academic work.

Signed: _____

1. Write your name on the cover page **ONLY**.
2. Write your student UID# on **ALL** pages. If you do not remember your UID#, make up a random 8 digit number. **DO NOT** use your social security number.
3. Write concise answers to demonstrate effectively your mastery of the subject. In order to obtain maximum credit, you need to show your work.

1) (9 pts) Given two homologous duplexes joined for recombination as shown below:



A) (3 pts) Rotate this depiction and draw the Holliday junction as a flattened intersection.

B) (6 pts) This structure is resolved to form crossover products. Show the appropriate cut sites on your drawing in A). Then draw the two crossover products below.

2) (5 pts) Explain why 5-methylcytosine residues are “hotspots” for mutagenesis.

3) (6 pts) Name the three major types of transposable elements and give one example of each type.

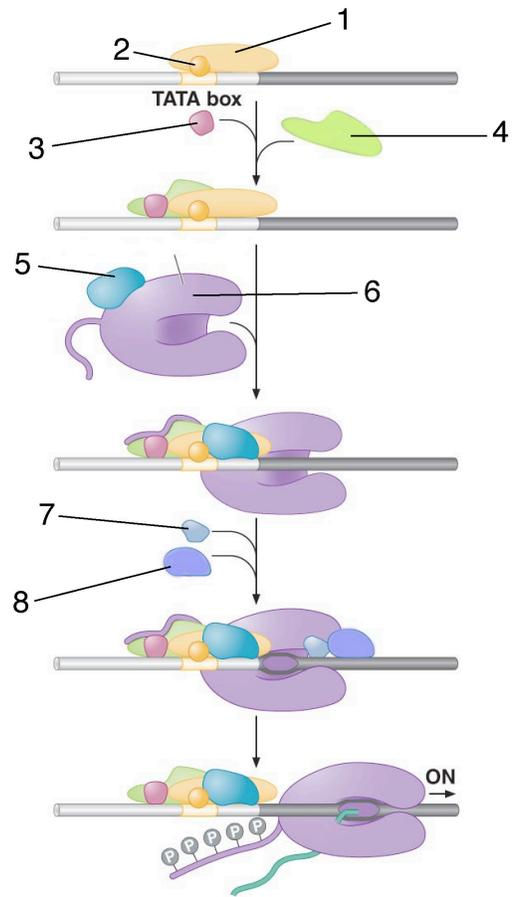
4) (6 pts) Written below is the sequence of an E. coli rho-independent terminator. Specify two possible mutations that you would expect to cause a defect in transcription termination and explain why you chose these mutations.

5' -CCCAGCCCGCCTAATGAGCGGGCTTTTTTTTGAACAAAA-3'
3' -GGGTCGGGCGGATTACTCGCCCGAAAAAACTTGTTTT-5'

5) (6 pts) Name three classes of eukaryotic (vertebrate) promoters for genes that are transcribed RNA polymerase III, and give one example for each class.

6) (8 pts) The figure below depicts initiation of transcription by RNA polymerase II at a core promoter. Identify the proteins numbered 1 through 8.

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____



7) (12 pts) Draw the structure of the 5' cap of a eukaryotic mRNA showing atoms and the ionic state at pH7.

8) (6 pts) If you add an inhibitor of P-TEFb what specific stage in transcription would be affected and why?

9) (9 pts) Given the following pre-mRNA, normal splicing would result in an mRNA containing exons 1-2-3-4.



A) Draw an example of mutually exclusive exon splicing.

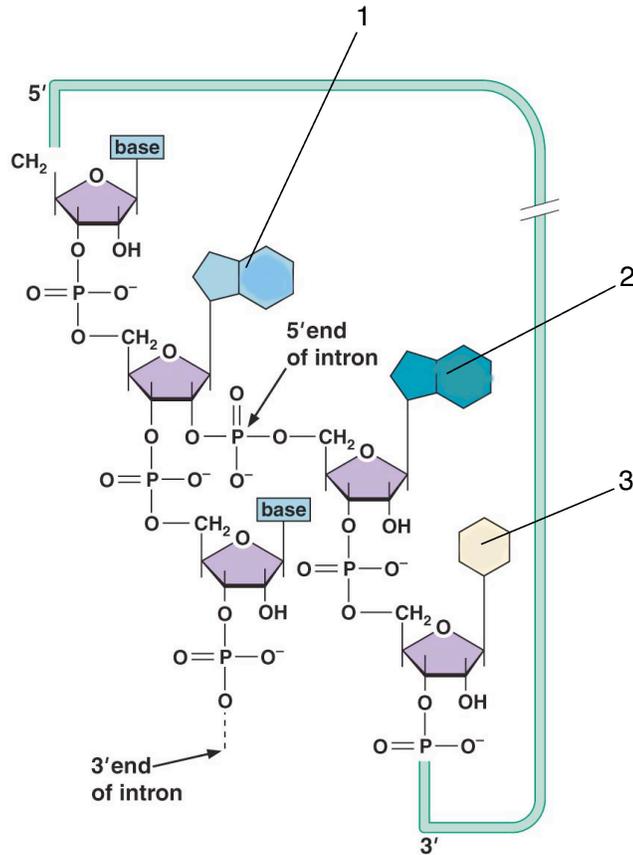
B) Draw an example of a mRNA resulting from alternative 5' splice site usage within intron 2.

C) Draw an example of a mRNA resulting from alternative 3' splice site usage within intron 3.

10) (5 pts) Name five RNA-RNA base-pairing interactions (between different RNAs) that occur in the spliceosome.

11) (6 pts) On the pre-mRNA branchpoint structure below for the major class of introns, identify the bases numbered 1 through 3.

- 1 _____
- 2 _____
- 3 _____



12) (22 pts) Shorter answer questions.

A) (2 pts) Name one example of a DNA base analog that can be mutagenic when incorporated into DNA.

B) (4 pts) Name one example of DNA damage caused by ultraviolet light and two repair systems that can fix this damage.

C) (2 pts) Name two proteins that initiate the process of nonhomologous end-joining (NHEJ) in eukaryotes.

D) (2 pts) Whose laboratory discovered Group I intron self-splicing?

E) (2 pts) Which are bigger on average – exons or introns?

F) (3 pts) Why are many human nucleotide excision repair proteins called XP(some number)?

G) (3 pts) Recombinase enzymes used for CSSR (conservative site-specific recombination) are divided into two classes. What are these classes and why are they named in this way?

H) (2 pts) What is the name of one RecA homolog in eukaryotes?

I) (2 pts) The RNA editing enzyme ALAR (adenosine deaminase acting on RNA) converts adenine to what base?