

BIOL 213
Fifth Exam

All atoms, chemical bonding and structures must be complete and correct for full credit. Please print and sign your name on the back page.

(10 pt) 1. Briefly describe four (4) levels for the regulation or control of gene expression and give examples of each as requested:

a) First level:

Give two (2) examples:

b) Second level:

Give two (2) examples:

c) Third level:

Give two (2) examples:

d) Forth level:

Give one (1) example:

(4 pt) 2. Describe the molecular structures of a transcriptional regulatory protein with a leucine-zipper motif.

(8 pt) 3. Compare the main characteristics of regulatory proteins, polymerases and promoter binding motifs that distinguish a procaryotic promoter from a eucaryotic promoter.

a) procaryote

b) eucaryote

(2 pt) 4. What is the role of TBP protein as it functions as a general transcription factor in the initiation of transcription?

(1 pt) 5. Chromatin can exist in a condensed (heterochromatin) or relaxed (euchromatin) state, a process regulated by histone H1. What is the state of chromatin structure if H1 is phosphorylated?

- (4 pt) 6. Explain the significance of the following statement from Figure 8-27 in Alberts, et al. (your Text). *"Whereas the general transcription factors that assemble at the promoter are the same for all genes transcribed by RNA polymerase II, the gene regulatory proteins and the locations of their binding sites are different for different genes."*
- (4 pt) 7. Describe the molecular process of double-homologous recombination as it would occur in a double-stranded, circular DNA genome of a bacterium.
- (4 pt) 8. Explain and show the molecular details of cross-strand exchange between homologous sequences in two double-stranded DNA's.

9. A retrotransposable element (TE) inserts into the host cell genome by site specific integration and it does so by replication transposition. The target sequence for transposable element integration in the host genomic DNA is shown below:



- (6 pt) a) Give the details of the molecular processes of replication transposition and retrovirus insertion at the target site.

- (2 pt) b) Now the retrovirus excises from the host genome. Describe the character of the nucleotide sequence that remains in the host genome DNA after excision of the retrotransposon.

(2 pt) 10. Define proto-oncogene:

(3 pt) 11. Describe the molecular basis for the specific binding of a transcriptional regulatory protein to DNA.

(3 pt) 12. Identify some nucleotide binding sequences in double-stranded DNA that would be specific for the binding of transcriptional regulatory proteins.

- (10 pt) 13. The physical map of a virus genome shows the location of a gene at approximately map units 68-70 (arrow at bottom of map) that I believe to be for a viral encoded cyclin with cyclin functions like normal cellular cyclin B. Design an experiment to test my hypothesis that the viral protein can function like cellular cyclin B.

(6 pt) 14. Shown is the nucleotide sequence of a polyhedrin gene and the corresponding amino acid sequence of the protein coded by the gene. The nucleotides in boxes are thought to be the CAAT and TATA promoter boxes of the gene and transcription start is indicated by AAA. The open reading frame is designated to start at +1, ATG=Met and the ORF stops at the amino acid Tyr = TAT. The last amino acid codon in the ORF is followed by the stop codon TAA.

I know that there are some viruses that contain a polyhedrin gene and other viruses that do not. I wish to test for the presence of this gene in three (3) viruses; A, B, C. From the data given in the nucleotide or amino acid sequence design an experiment to prove the presence or absence of the polyhedrin gene in the three viruses.

(8 pt) 15. To complete MCB213 you are required to make a cDNA library of genes expressed during the G2 phase of the yeast cell cycle. Explain how to do this:

(2 pt) 16. What biochemical process that occurs in the nucleus starts the process of nuclear envelope breakdown early in mitosis?

(3 pt) 17. The three major families of proteins involved in cellular control of the cell cycle are:

(2 pt) 18. Name two major factors involved in, or responsible for, external control of the cell cycle:

- (2 pt) 19. Explain the meaning of the cell cycle G1 check point.
- (6 pt) 20. Explain the molecular details for the process of cyclin-cdk activation.
- (2 pt) 21. How does the cellular regulation of the synthesis of cellular cyclins and their corresponding cdk proteins compare?

- (8 pt) 22. Describe the molecular basis of exon shuffling during the process of unequal cross-over in homologous recombination. Explain how the process can give rise to gene families.