

**Multiple choice questions – 4 points each (Best 12 out of 13).**

1. Each of the following statements are correct regarding Eukaryotic genes and genomes EXCEPT?
  - a. introns are common
  - b. repeat sequences are common
  - c. capping, tailing and splicing of mRNA is required
  - d. polysomes inside the nucleus are common
  - e. enhancers and silencers are common
  
2. Which of the following gene products, if absent or defective, would prevent the functioning of each of the others?
  - a. transfer RNA
  - b. ribosomal RNA
  - c. messenger RNA
  - d. RNA polymerase
  - e. aminoacyl-tRNA synthetase
  
3. Which of the following are infectious agents of plants exclusively containing RNA?
  - a. prions
  - b. plasmids
  - c. replicons
  - d. viroids
  - e. virions
  
4. What is the most common source of genetic diversity in a bacterial *colony* that originated from a single cell?
  - a. transposons
  - b. plasmids
  - c. recombination
  - d. crossing over
  - e. mutation

5. For a couple of decades, we knew that the nucleus contained DNA and histone proteins. The prevailing opinion was that the histone proteins were the genes and the DNA was a simple “string” that held them together. The reason for this belief was that...
- all of these are correct
  - proteins take a greater variety of three-dimensional forms
  - proteins have four different levels of structure; DNA has only two
  - proteins are made of 20 amino acids and DNA is made of four nucleotides
  - proteins can vary in their polarity and charge; DNA cannot
6. When considering the various types of point mutations, which of the following best describes what would happen with the deletion of 3 nucleotides occurs?
- silent mutation, no effect on amino acid sequence
  - frameshift causing extensive missense
  - frameshift causing immediate nonsense
  - no extensive frameshift, one amino acid lost
  - wild type remains intact
7. In the following list of DNA properties, which one would be impossible for a single-stranded DNA molecule?
- mutation
  - information storage
  - exchange with other organisms
  - repair of thymine dimers
  - replication
8. The molecular biological method that takes advantage of dideoxynucleotide termination?
- PCR
  - RFLP
  - sequencing
  - cloning
  - hybridization

9. When the F plasmid is integrated into the main chromosome (as in Hfr cells), which process describes how an F<sup>-</sup> cell might then obtain genetic diversity regarding its chromosome?
- rolling circle replication
  - homologous recombination
  - specialized conjugation
  - generalized replication
  - episome conversion
10. Which of the following enzymes caused a modification of the central dogma?
- RNA polymerase
  - aminoacyl-tRNA synthetase
  - taq polymerase
  - reverse transcriptase
  - DNA polymerase
11. Bacteriophages that have become integrated into the host cell bacterial chromosome are called...
- virulent bacteriophages
  - transposons
  - prophages
  - T-even bacteriophages
  - plasmids
12. Which of the following statements does NOT apply to the Watson and Crick model of DNA structure?
- The two strands of the DNA helix are antiparallel
  - The distance between the strands of the helix can be measured by X-rays
  - The framework of the helix consists of repeating sugar-phosphate units
  - The two strands of the helix are held together by many covalent bonds
  - The purines are attracted to the pyrimidines and vice versa

13. Which of the following is NOT an example of a transcription factor, DNA binding protein motif?

- a. Helix-loop-helix
- b. Zinc fingers
- c. Helix-turn-helix
- d. Arginine toes
- e. Leucine zipper

14. Match the single best answer with the statements below. The choices may be used once, more than once, or not at all (2 points each).

Your choices are:

1. Transduction

4. Transformation

2. Transposition

5. Translocation

3. Translation

6. Transcription

\_\_\_\_\_ A DNA segment “jumps” from one location to another.

\_\_\_\_\_ Protein synthesis

\_\_\_\_\_ Bacteria have proteins on their surface that recognize and take in “naked” DNA.

\_\_\_\_\_ Movement as the “A-site” becomes the “P-site”.

\_\_\_\_\_ Heat killed pneumonia-causing bacteria and harmless mutant strain are both injected into mice. The mice develop pneumonia and die.

\_\_\_\_\_ A sequence of DNA that has inverted repeats on either end is found scattered throughout the chromosome of a plant.

\_\_\_\_\_ In Eukaryotes, requires RNA polymerase II and many initiation factors to begin.

\_\_\_\_\_ Bacterial strains A and B are growing together in a medium that has been infected with viruses. After a short time, a new strain of bacteria is detected that is very similar to strain A but has a few characteristics of strain B.

\_\_\_ & \_\_\_ These two processes are coupled together spatially in Prokaryotes.

**Short answer – Number of points in parentheses.**

**15. (8 points)** Briefly describe the function of each of the following enzymes involved in DNA replication.

**A. helicase –**

**B. DNA polymerase I –**

**C. primase –**

**D. ligase –**

**16. (6 points)** What is the function of Okazaki fragments, in other words what problem do they overcome and how do they do it?

17. (12 points total) The nucleotide sequence of a hypothetical *sense strand* of DNA is shown below:

5' - ATT TCA TCT GAG AGA TCC AGT CAT CAC - 3'

- A. What would the be the nucleotide sequence of the mRNA transcribed from the DNA template?
- B. Identify the 5' and 3' ends, and label the start and stop codons.
- C. What would be the sequence of amino acids in the polypeptide that is produced by translation of the mRNA?

18. (8 points) Consider the Meselson and Stahl experiment regarding bacteria with heavy  $^{15}\text{N}$  DNA grown in light  $^{14}\text{N}$  media. (A) Upon CsCl density gradient ultracentrifugation of the first generation DNA, which **model(s)** of DNA replication are supported **if** the resulting DNA is of an *intermediate* density? (B) Which **model(s)** of DNA replication are supported after the second generation supported **if** the resulting DNA is again of an *intermediate* density?

19. (9 points) Briefly describe (and draw) the overall structure of the *lac operon*, including all regulatory and structural regions. Remember that the structural genes include: *lac Z*, *lac Y*, *lac A* (in order), but I also want to know what proteins these genes code for. Make sure to point out the **negative control** regulatory features and describe what happens during **catabolite repression**.
20. (9 points) Briefly describe the structure and function of 3 different cellular systems that combine proteins along with necessary RNAs to *catalyze* covalent bond formation and/or hydrolysis?

- 21. Extra Credit (8 points)** How many cycles are required in a Polymerase Chain Reaction (PCR) before the “majority” of products are the *desired size* as defined by the pair of oligonucleotide primers chosen, (assuming a doubling during each cycle)?