UFSO

SCIENCE OLYMPIAD
AT THE
UNIVERSITY OF FLORIDA

Northern Regional: January 19th, 2019

Protein Modeling C Answer Key

Name(s): _____

Team Name: _____

School Name: _____

Team Number: _____

Rank: _____

Score: _____

Multiple Choice

1. Which molecule is produced by the **cas** genes in the CRISPR-Cas mechanism? (1pt.)
   a. pre-cRNA
   b. CRISPR-Cas surveillance complexes
   c. cDNA
   d. Cas protein
   e. All of the above

2. Which of the following is associated with the Cas9 protein? (1pt.)
   a. Restriction enzyme
   b. Transpeptidase reaction
   c. Endonuclease
   d. all of the above
   e. a and c

3. Which of the following amino acids is correctly matched with its characteristics? (1pt.)
   a. Tryptophan- Basic
   b. Phenylalanine- aromatic, least hydrophobic
   c. Proline- cyclic
   d. a and b
   e. none of the above

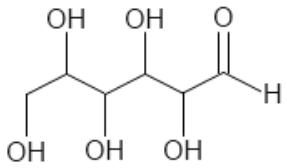
4. Which of these reactions is involved with peptide bond formation? (1pt.)
   a. Elimination Reaction
   b. Redox Reaction
   c. Dehydration
   d. Hydrolysis
   e. a and d

5. Which of these families of proteins are considered natural protease inhibitors? (1pt.)
   a. lipocalin
   b. trypsin
   c. thrombin
   d. none of the above
   e. a and b

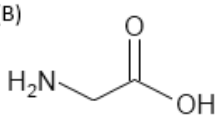
6. Which molecule's function does the anti-CRISPR protein AcrIIA2 block, and to what extent does it do so? (1pt.)
   a. crRNA (fully)
   b. dSpyCas9 (fully)
   c. dSpyCas9 (partially)
   d. crRNA (partially)
   e. none of the above

7. Which of the following structures is not an amino acid but has a tertiary amine? (1pt.)

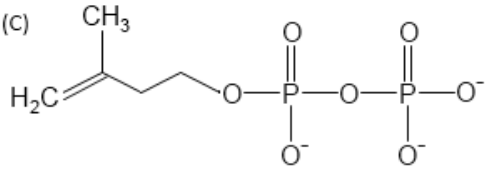
(A)



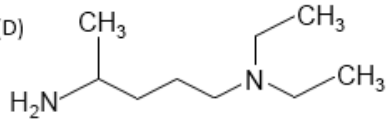
(B)



(C)



(D)



ANS: D.

8. What mechanism does Cas9-mediated dsDNA cleavage use? (1pt.)
   a. anabolism
   b. catabolism
   c. exergonic
   d. endergonic
   e. b and c

9. What two functional groups must a molecule possess to be considered an amino acid? (1pt.)
   a. alcohol group and –COOH
   b. –OH and –ROR
   c. phosphate group and $–NH_2$
   d. –COOH and amino group
   e. none of the above

10. Which of the following makes each amino acid unique? (1pt.)
   a. side chain
   b. number of carbons on the alpha hydrogen
   c. number of hydrogens on the beta carboxyl group
   d. how many water molecules are attached to the nitrogen of the amino group
   e. all of the above

Short Answer

11. What does PAM stand for in respect to the CRISPR-Cas9 systems and what importance do they hold in the activity of the Cas9 protein? (3 pts.)

    PAM stands for protospacer adjacent motif. It is recognized by the type II-A CRISPR subtype in its recruitment of double stranded DNA.

    a. Which stage of the CRISPR-Cas system do spacers function in, and how? (1 pt.)

       In the adaptive stage, the spacers are acquired: the processed foreign DNA (the photospacer) is integrated into the CRISPR array locus.

12. What amino acid does the bridge helix in the structure of AcrIIA4–SpyCas9–sgRNA have an abundance of, and what role does the bridge helix play in enhancing or inhibiting the progress of this molecule? (4 pts.)

    The bridge is arginine rich. These results strongly suggest that the arginine-rich bridge helix and its combined seed-region of sgRNA are important for the R-loop initiation in the CRISPR-Cas system.

13. What are the three stages of the CRISPR-Cas immunity response? (Give a detailed response) TIEBREAKER*** (6 pts.)

    1. Adaptive stage: spacer acquisition, the processed foreign DNA (known as the protospacer) is integrated into the CRISPR array locus, yielding a new spacer.

    2. crRNA expression and processing stage involves transcription of the CRISPR locus into a single pre-CRISPR RNA (pre-crRNA) and further processing into mature crRNAs

    3. In the interference stage, a single Cas protein (or complex) uses the crRNA as a guide to cleave phage nucleic acid or plasmid bearing a complementary sequence to the spacer sequence of the crRNA.

14. Conformational changes in the Cas9 are triggered by the binding of what nucleic acid molecule? Be sure to be specific. TIEBREAKER*** (4 pts.)

    sgRNA

15. AcrIIA2 and AcrIIA4 block the enzymatic activity of SpyCas9 in a _____ manner. (2 pts.)

    Dose-dependent

16. Describe primary, secondary, tertiary, and quarternary folding in respect to proteins. (3 pts.)

Primary: amino acid sequence in the ribosome
Secondary: folding of amino acid sequence into alpha helices and beta sheets
Tertiary: interaction of side chains and secondary structures within proteins to form their overarching structure.
Quarternary: Interactions between proteins to form larger protein complexes.