

MDCM601 2023 Exam 3

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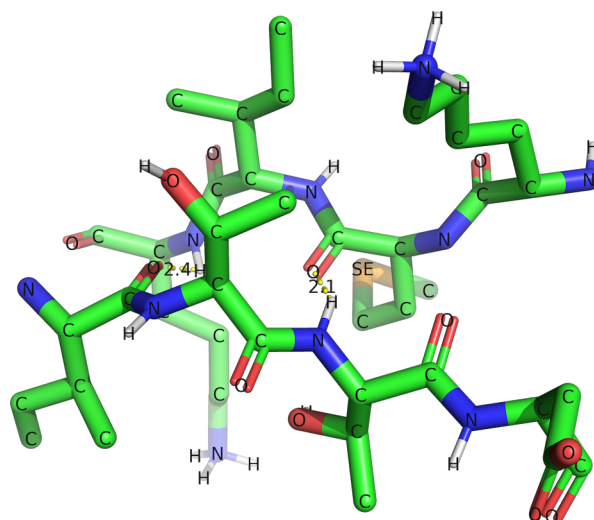
October 11, 2023

Note: Use this codon chart for questions that require it.

		Second letter				
		U	C	A	G	
First letter	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Trp UGG Trp	U C A G
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G
	A	AUU } Ile AUC } AUA } Met AUG }	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA Stop AGG Stop	U C A G
	G	GUU } GUC } Val GUA } GUG }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G

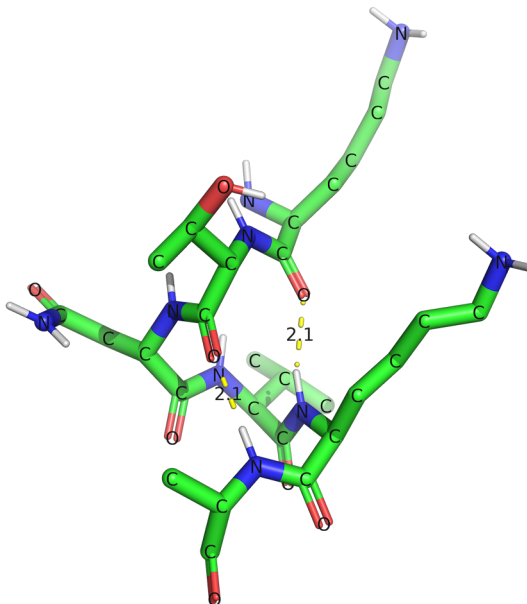
1 Problems

Problem 1. Consider the fragment of a fibroin protein present in silk produced by larvae of *Bombyx mori*. The elements are labeled and colored (green, carbon; blue, nitrogen; red, oxygen; white, hydrogen; yellow, selenium). Answer the following questions. Identify the amino acids by their three-letter abbreviation.



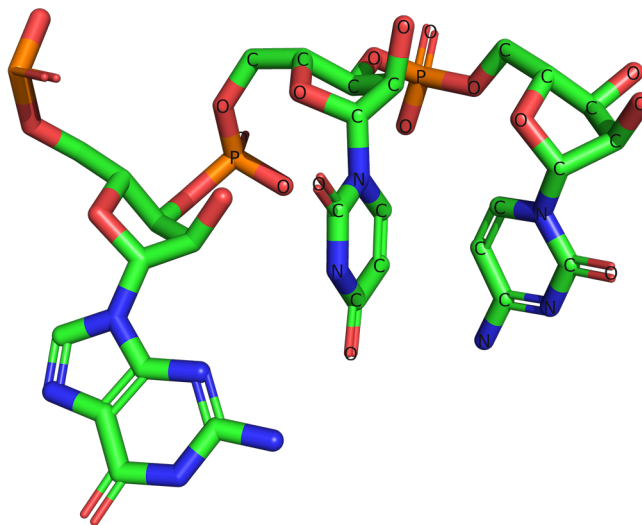
1. This is an example of a _____ secondary structure.
2. Looking from left to right, the front chain is orientated in a(n) _____ direction.
3. From left to right, the back chain is orientated in a(n) _____.
4. Therefore, these strands are _____.
5. An unusual amino acid containing selenium is analogous to which amino acid in which Se is replaced by S? _____.
6. Amino acid at the C-terminus of the front chain is _____.
7. The sidechains in the β -sheet are _____ to the sheet.

Problem 2. A hexapeptide fragment of hemoglobin is shown in the figure. Elements comprising the fragment are labelled and colored (carbons, green; oxygens, red; nitrogens, blue; hydrogens, white). Answer the following questions about this structure. If you are asked to identify an amino acid, please use its three letter abbreviation, capitalizing the first letter.



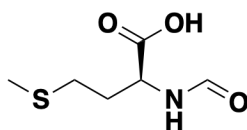
1. Which amino acid is at the N-terminus?
2. Which amino acid is at the C-terminus?
3. Which amino acid in this structure contains a β stereocenter?
4. Determine R/S configuration of that stereocenter.
5. Name the functional group in the sidechain of amino acid in position 4 (counting in N-to-C direction).
6. What is the overall charge of this segment (from sidechains only) at pH=6?
7. Name one of the two non-polar amino acids in this segment.
8. What is the length of indicated hydrogen bonds in picometers? (1 pm = 10^{-12} m; the length is given in angstroms in the image.)
9. Which amino acid sidechain in this segment will be positively charged at pH=7, but neutral at pH=12?
10. This is a _____-handed helix.

Problem 3. Consider the anticodon region of a tRNA molecule and answer the following questions. Refer to nucleotides by their 1-letter capitalized abbreviations.



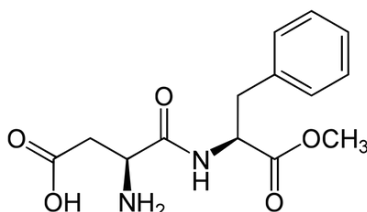
1. Read off the nucleotides in the 3'-to-5' direction.
2. This sequence would pair with what sequence on the mRNA in 5'-to-3' direction?
3. Use the codon chart to determine the amino acid carried by this tRNA.

Problem 4. N-formyl-L-methionine is the first amino acid incorporated into a nascent polypeptide chain. Click (point) on the formamide group in its structure.



Problem 5. Which ones of the listed amino acids cannot be phosphorylated on their side-chains by kinases? There are 4 correct answers; partial credit will be given. A. valine B. serine C. leucine D. tyrosine E. glycine F. alanine G. threonine

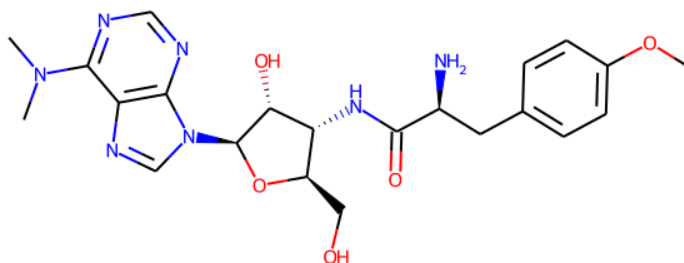
Problem 6. Aspartame (shown) is an artificial sweetener. It is a dipeptide esterified at its carboxyl terminus. What is the overall charge of this molecule at the physiological pH of 7.4? pKa of an amonium is 9, and pKa of an acid is 4.



A. 0; B. -1; C. -2; D. +1; E. +2

Problem 7. Order of amino acids matters in the polypeptide sequence. How many tripeptides can possibly be made from three amino acids (e.g. Ala, Cys and Lys) if repetition of amino acids in sequence is allowed?

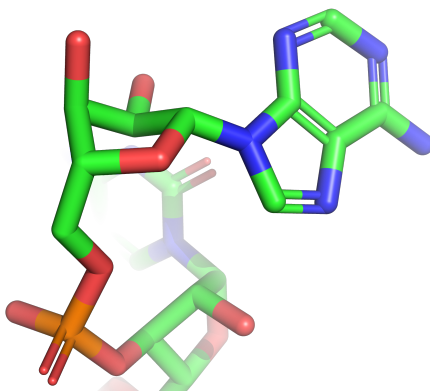
Problem 8. Puromycin (structure shown) is very similar to the structure of the amino acyl group attached to the adenine of the tRNA, with one key difference. Answer the following questions:



1. What is the functional group in puromycin that is different from the attachment of an aminoacyl to the tRNA?
2. Puromycin halts translation by covalently capturing the activated amino acyl tRNA bound to the ribosome. What is the nucleophilic group responsible for this capture?
3. Puromycin can be seen as a methylated derivative of which amino acid (use 3-letter capitalized abbreviation)?

Problem 9. What is the name of the functional group through which the amino acyl group is attached to the tRNA molecule?

Problem 10. Click (point) on the atom of the terminal adenosine of a tRNA that will be carrying the aminoacyl residue to the ribosome.



2 Solutions

1. β -sheet; N–C direction; C–N direction; anti-parallel; Met; Asp; perpendicular
2. Lys; Ala; Thr; *R*; isopropyl (Val is ok); +2; Ala; 210 pm; Lys; right
3. CUG; GAC; Asp
- 4.
5. A, C, E, F
6. 0
7. $3^3 = 27$
8. amide; amine; Tyr
9. ester
- 10.