Designer Genes C - DG - Camas Invitational - Camas C-Invite - 12-12-2020

1. (1.00 pts)

In a population of lar gibbons, dark hair (H) is fully dominant to light hair (h). Does the physical presence of dark hair in a gibbon offspring refer to their genotype or to their phenotype

- A) Genotype
- B) Phenotype

2. (1.00 pts)

In a population of lar gibbons, dark hair (H) is fully dominant to light hair (h). If two light-haired gibbons mated, what is the normal probability that their offspring will have dark hair, barring chance mutation?

- A) 100%
- B) 75%
- C) 66.67%
- D) 50%
- E) 25%
- F) 0%

3. (1.00 pts)

In a population of lar gibbons, dark hair (H) is fully dominant to light hair (h). If two heterozygous dominant lar gibbons produced offspring, what percentage of the offspring would likely have light hair?

- A) 100%
- B) 75%
- C) 66.67%
- D) 50%
- E) 25%
- F) 0%

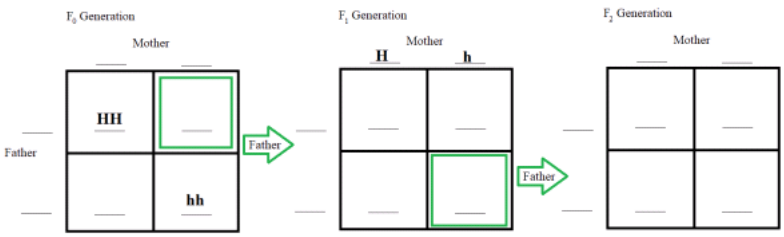
4. (1.00 pts)
In a population of lar gibbons, dark hair (H) is fully dominant to light hair (h). If two heterozygous dominant lar gibbons produced offspring, what percentage of the offspring would likely have dark hair?

- A) 100%
- B) 75%
- C) 66.67%
- D) 50%
- E) 25%
- F) 0%

5. (2.00 pts)
In a population of lar gibbons, dark hair (H) is fully dominant to light hair (h). If two heterozygous dominant lar gibbons produced 250 offspring, what genotype would likely have the highest incidence of occurrence?

Hh

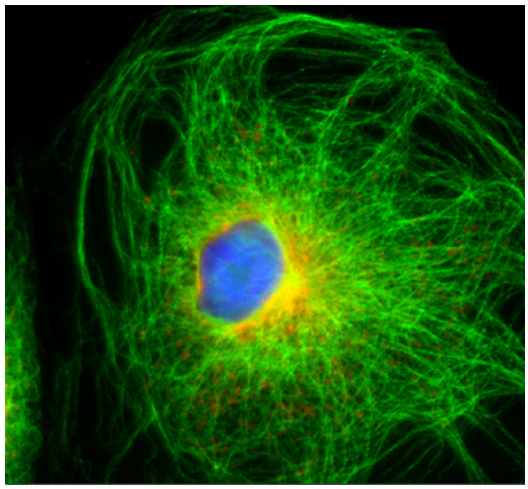
6. (5.00 pts)



In a population of lar gibbons, dark hair (H) is fully dominant to light hair (h). If all of the offspring in the F_2 generation have dark hair, what is the likely genotype of the mother in the F_2 generation?

HH

7. (1.00 pts)

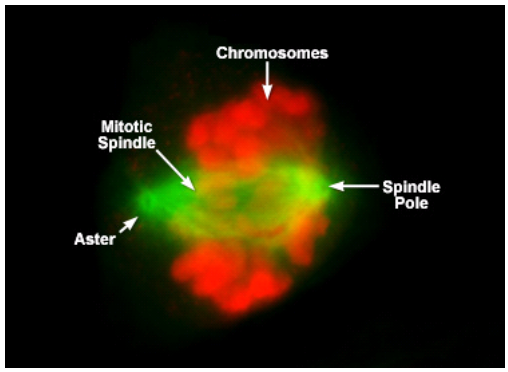


What stage of cell division is depicted in the above image?

(Mark **ALL** correct answers)

- [x] A) Interphase
- [ ] B) Prophase
- [ ] C) Metaphase
- [ ] D) Anaphase
- [ ] E) Telophase
- [ ] F) Cytokinesis

8. (1.00 pts)



In the image above, what stage of cell division is depicted?

(Mark **ALL** correct answers)

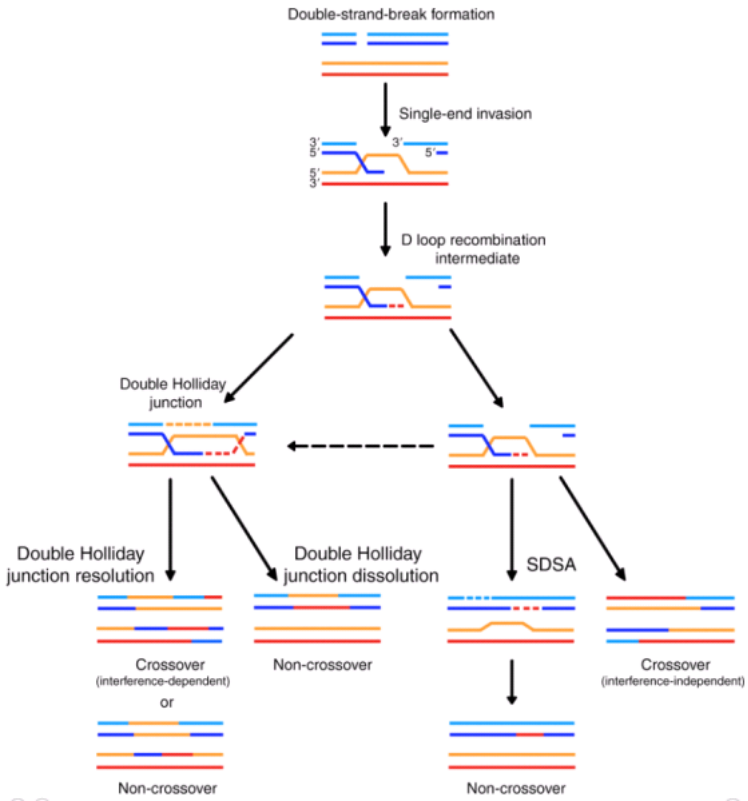
- [ ] A) Interphase
- [ ] B) Prophase
- [x] C) Metaphase
- [ ] D) Anaphase
- [ ] E) Telophase
- [ ] F) Cytokinesis

9. (2.00 pts)

During what phase(s) of meiosis is crossover most likely to occur? Please use numbers instead of Roman numerals in your answer (e.g. telophase 2 instead of telophase II)

prophase 1 | prometaphase 1

10. (4.00 pts)



The above graphic illustrates several possible outcomes after both strands of DNA are broken during a crossover. After the breakage, one strand of DNA may attempt to repair itself by forming a D-loop and using the homologous chromosome as a template. If this strand successfully replicates the damaged region, it will dissociate from the homologous chromosome and anneal back to its original strand. This process is known as synthesis-dependent strand annealing (SDSA).

What is likely to occur in the Double Holliday junction pathway?

Expected Answer: Both DSB associate with the homologous chromosome. If they can fully repair themselves, no crossover. Otherwise, crossover.

11. (1.00 pts) During which phase of a cell's lifecycle is DNA synthesized?

(Mark **ALL** correct answers)

- [ ] A) G_0
- [ ] B) G_1
- [ ] C) G_2
- [x] D) S
- [ ] E) M

12. (1.00 pts) What are the five primary nucleobases?

Expected Answer: Adenine, cytosine, guanine, thymine, uracil

13. (2.00 pts) Which nucleobases are purines?

Adenine | Guanine

14. (3.00 pts) Which nucleobases are pyrimidines?

cytosine | thymine | uracil

15. (3.00 pts) Why does cytosine prefer to associate with guanine in DNA?

Expected Answer: Adenine and thymine both prefer to form 2 hydrogen bonds; guanine and cytosine prefer to form 3 hydrogen bonds

16. (5.00 pts) Why might uracil, instead of thymine, be favored for use in RNA?

Expected Answer: uracil is energetically cheaper to make but mutates quicker. thymine is more expensive to make but less resistant to photochemical mutations.

17. (1.00 pts) In humans, dichromatic vision is an x-linked recessive trait. Which of the following statements are true?

(Mark **ALL** correct answers)

- [x] A) Males are more likely to express this trait
- [ ] B) Females are more likely to express this trait
- [ ] C) Males and females are equally likely to express this trait
- [ ] D) Neither males nor females will express this trait

18. (1.00 pts) In humans, Fragile X syndrome is an x-linked dominant trait. Please select all true statements below.

(Mark **ALL** correct answers)

- [ ] A) Males are more likely to express this trait
- [ ] B) Females are more likely to express this trait
- [x] C) Males and females are equally likely to express this trait
- [ ] D) Neither males nor females will express this trait

19. (2.00 pts)
Janet carries an x-linked recessive trait. Janet and Jim have 3 children who do not display the trait. If Janet and Jim have another child, what is the probability that this child will display the trait?

(Mark **ALL** correct answers)

- [ ] A) 0%
- [ ] B) 25%
- [x] C) 50%
- [ ] D) 75%
- [ ] E) 100%

20. (2.00 pts) Using the information in the previous question, what possible genotype(s) might Janet and Jim's child be, given that this child displays the x-linked recessive trait.

(Mark **ALL** correct answers)

- [ ] A) XX
- [x] B) XY
- [ ] C) YY
- [ ] D) XXY

21. (2.00 pts)
Perform a dihybrid cross between heterozygous goat parents with the genotypes WwHh and WwHh (W = wooly coat, w = smooth coat; H = horned, h = no horns). What is the probability (as a percentage) that an goat in the F1 generation will have a smooth coat with horns? Assume Mendelian inheritance.

18.75%

22. (1.00 pts) Drewbie has type A- blood. His sister, Maggie, has B+ blood. His daughter, Fiona, has type O- blood.
Ignoring the Rh factor, what is Drewbie's blood genotype?

AO

23. (1.00 pts) Drewbie has type A- blood. His sister, Maggie, has B+ blood. His daughter, Fiona, has type O- blood.
Ignoring the Rh factor, what is the blood genotype of Maggie?

BO

24. (1.00 pts) Drewbie has type A- blood. His sister, Maggie, has B+ blood. His daughter, Fiona, has type O- blood.
Ignoring the Rh factor, what is the blood genotype of Fiona

oo

25. (2.00 pts) Drewbie has type A- blood. His sister, Maggie, has B+ blood. His daughter, Fiona, has type O- blood.
What pattern of inheritance does this trait follow?

Non-mendelian / Multiple Al

26. (1.00 pts) Drewbie has type A- blood. His sister, Maggie, has B+ blood. His daughter, Fiona, has type O- blood.

Could Drewbie's mother carry the Rh(D) antigen?

Yes

27. (5.00 pts)
A sequence of RNA is translated into a string of amino acids. After time, it is noted that some of the side chain residues are attracted to each other, and the protein begins folding inward on itself to lump these residues together on the inside of the protein. Why does this occur?

Expected Answer: the hydrophobic effect

28. (1.00 pts) An organism that has two identical alleles for a trait is:

- A) heterozygous
- B) codominant
- C) incompletely dominant
- D) homozygous

29. (1.00 pts) What does the notation Aa mean to geneticists?

- A) 2 dominant alleles are present
- B) 2 recessive alleles are present
- C) An organism expresses the dominant trait but carries (and suppresses) the recessive trait
- D) At least 2 dominant allele

30. (1.00 pts) Which of these is controlled by a gene with multiple alleles?

(Mark **ALL** correct answers)

- [x] A) Hair color
- [x] B) Eye color
- [ ] C) Hairline skew
- [ ] D) Dimples
- [x] E) Blood type

31. (1.00 pts) Genetic disorders are caused by:

- A) mutations
- B) recessive alleles
- C) sickle-shaped cells
- D) protein misfolding

32. (1.00 pts) In genetics, the carrier of a trait is a person who has:

(Mark **ALL** correct answers)

- [ ] A) Two dominant alleles
- [ ] B) Two recessive alleles
- [x] C) One recessive and one dominant allele
- [ ] D) More than two alleles

33. (1.00 pts) Which direction is DNA read during replication?

- (•) A) 3' to 5'
- ( ) B) 5' to 3'
- ( ) C) Simultaneously 3' to 5' and 5' to 3'
- ( ) D) This is a trick question; DNA is unzipped by DNA Helicase and broken down into translatable adirectional chunks

34. (1.00 pts) What is the name of the fragments generated during replication of the lagging strand?

- ( ) A) Apoptotic fragments
- ( ) B) Comet fragments
- ( ) C) TUNEL fragments
- (•) D) Okazaki fragments
- ( ) E) Johnson fragments

35. (1.00 pts) Which of the following are organic molecules?

(Mark **ALL** correct answers)

- [x] A) Nucleotides
- [x] B) Nucleosides
- [x] C) Nucleobases
- [x] D) Amino acids
- [x] E) RNA
- [x] F) Chromosomes

36. (2.00 pts) What step of PCR happens at 72 C?

extension

37. (1.00 pts) What is the name of the extrachromosomal ring of DNA found in bacteria?

plasmid

38. (3.00 pts) What are the three-letter codes for each of the three stop codons?

Expected Answer: UAA, UAG, UGA

39. (14.00 pts)
What amino acid sequence is produced by the following template-strand DNA sequence? (Please use 1-letter amino acid abbreviations in your answer. Example: Tryptophan is written as W.)

3' CAGGGGGGGAGCGCTGATGGT 5'

Expected Answer: V P P S R L P

40. (3.00 pts) Given the mRNA fragment AUG-AAA-GGC-UCA, what sequence of amino acids is created?

Expected Answer: Methionine/Met/M; Lysine/Lys/K; Glycine/Gly/G; Serine/Ser/S

41. (2.00 pts) If a strand of DNA was placed equidistantly between two similar-magnitude but oppositely charged point charges, would it experience attraction?

- A) Yes, toward the negative charge
- B) Yes, toward the positive charge
- C) Yes, toward both charges
- D) No, it would be repelled by both charges
- E) No, it is a neutrally-charged compound

42. (1.00 pts) What type of bond is formed between two sequential amino acids?

- A) Glycoside bond
- B) Phosphodiester bond
- C) Hydrogen bond
- D) Peptide bond
- E) Ionic bond

43. (4.00 pts) How are multifactorial traits and polygenic traits different?

Expected Answer: Polygenic is when traits are determined by many genes at different loci, and the effect of the environment doesn't really matter. In multifactorial inheritance, a trait is determined by two or more genes, and also environmental factors.

44. (2.00 pts) What are homologous chromosomes?

Expected Answer: Homologous chromosomes are chromosomes that bind together during prophase 1 of meiosis

45. (10.00 pts) How do mRNA vaccines, such as Moderna's SARS-CoV-2 vaccine, work?

Expected Answer: A sequence of the COVID mRNA code is slipped into cells using nanoparticles and/or lipid-bound transport proteins. mRNA is translated in ribosomes to produce artificial spike proteins identical to the COVID19 spike protein. Then, these proteins are expelled from the cell and interact with antibodies. T cells interact with and catalog this proteir for future reference. When COVID actually enters the system, B cells produce antibodies specified by T cells.

46. (1.00 pts) Where is mRNA translated?

ribosome

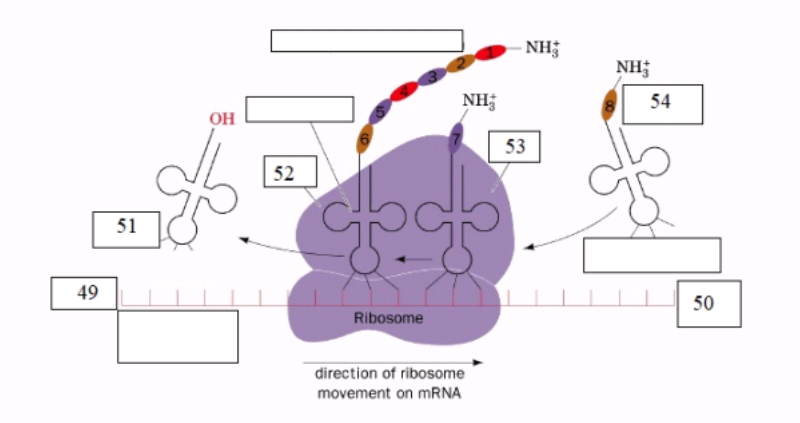
47. (3.00 pts) Describe the structure of a chromatosome

Expected Answer: A chromatosome is a nucleosome and H1 DNA together. A nucleosome is DNA wrapped around histones

48. (1.00 pts) On a pedigree, how would you indicate that an individual is deceased?

- (●) A) A slash mark
- ( ) B) Shading
- ( ) C) X
- ( ) D) Erase them

For Questions 49-54, please refer to the following diagram.



Please identify the correct term for each missing place on the diagram.

Word Bank: Aminoacyl binding site, peptidyl binding site, mRNA, 5', 3', tRNA, codon, anticodon, rRNA, exit site, residue

49. (1.00 pts) Please identify the term in blank 49.

5'

50. (1.00 pts) Please identify the term in blank 50.

3'

51. (1.00 pts) Please identify the term in blank 51.

tRNA

52. (1.00 pts) Please identify the term in blank 52.

peptidyl binding site

53. (1.00 pts) Please identify the term in blank 53.

Aminoacyl binding site

54. (1.00 pts) Please identify the term in blank 54.

residue

55. (2.00 pts) *P. tapanuliensis* has 48 chromosomes. How many chromatids would they have in prophase 1?

96

56. (2.00 pts) *P. tapanuliensis* has 48 chromosomes. How many chromatids would they have at the end of meiosis II?

96

57. (2.00 pts) Suppose the hypothetical protein Gl1m interferes with another protein's ability to bind to a ligand. One would conclude that Gl1m is a(n)

(Mark **ALL** correct answers)

- [ ] A) operon
- [ ] B) transcription repressor
- [ ] C) antibody
- [ ] D) cofactor/coenzyme
- [x] E) competitive inhibitor

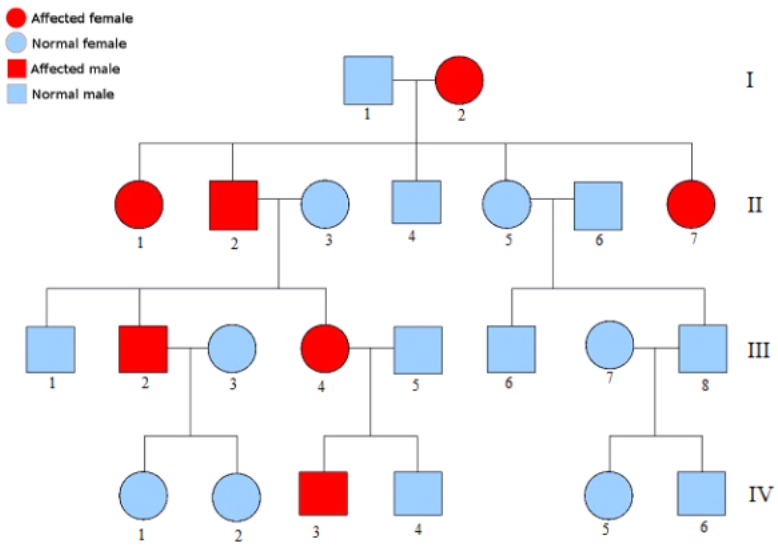
58. (5.00 pts) Why is meiosis necessary?

Expected Answer: It randomizes our genetic code, ensuring the survival of those most suited to their environment

59. (1.00 pts) What is the primary role of an intron?

- ( ) A) They are translated by RNA polymerase in the ribosome
- (•) B) They regulate gene expression
- ( ) C) They unzip DNA allowing for transcription
- ( ) D) They protect DNA complexes from mutation due to photochemical radiation

For questions 60-65, please refer to the following pedigree which tracks the presence of palm hair in ring-tailed lemurs. In these questions, H will refer to the dominant allele and h wi
refer to the recessive allele.



60. (2.00 pts) What modality of inheritance does this trait follow?

- A) Autosomal dominant
- B) Autosomal recessive
- C) X-linked dominant
- D) X-linked recessive
- E) Mitochondrial

61. (1.00 pts) What is the genotype of individual I-2?

Expected Answer: Hh

62. (1.00 pts) What is the genotype of individual II-4?

Expected Answer:

63. (1.00 pts) What is the genotype of III-4?

Expected Answer:

64. (2.00 pts) If individual IV-3 had offspring with II-7, what percent of their offspring would have hairy palms?

Expected Answer: 75%

65. (1.00 pts) Which of the following genomes is most likely that of a free-living prokaryote?

(Mark **ALL** correct answers)

- [ ] A) A genome that is 300 million bp long with over 50 percent repetitive DNA and many introns
- [ ] B) A genome that is 3 million bp long, is arranged in many linear chromosomes and has many introns
- [x] C) A genome that is 16,000 bp long and arranged in a circle
- [x] D) A genome that is 3 million bp long, arranged in a single circular chromosome and has little repetitive DNA

66. (1.00 pts) What is translocation?

Expected Answer: when non-homologs swap genes

67. (3.00 pts) How are necrosis and apoptosis different?

Expected Answer: Necrosis is premature cell death caused by external agents like toxins. Apoptosis is programmed cell death.

68. (3.00 pts) Skin color in fish is inherited via a single gene with four different alleles. How many different genotypes would be possible in this system?

10

69. (2.00 pts) Nondisjunction can occur in anaphase I if _____ fail to separate.

homologous pairs

70. (2.00 pts) Nondisjunction can occur in anaphase II if _____ fail to separate.

sister chromatids

71. (3.00 pts) What is aneuploidy?
What happens to most aneuploidic zygotes?

Provide an example of an aneuploidy.

Expected Answer: aneuploidy is an abnormal number of chromosomes. Most aneuploidic zygotes die. Example: Trisomy 21, trisomy 16, Klinefelter syndrome, etc

72. (2.00 pts) Briefly summarize the law of independent assortment

Expected Answer: Random selection of half the diploid chromosome set to form a haploid gamete

73. (3.00 pts) How do CDK's become activated

Expected Answer: Bind to cyclin

74. (2.00 pts) Which of the following is equivalent to Phe-Ile-Arg-Glu-Pro-Leu-Asp-Cys-Glu"

- (●) A) FIREPLDCE
- ( ) B) FIREPLACE
- ( ) C) FIRDPLACD
- ( ) D) PIREFLDCE

75. (2.00 pts) What is the pKa of the alpha-carboxyl group in amino acids?

- ( ) A) 1.0
- (●) B) 2.0
- ( ) C) 3.0
- ( ) D) 4.0

76. (10.00 pts) Five, seven, then five
Syllables mark a haiku
on phylogeny.

Expected Answer: 5 points if attempted. subtract 1 point for syllable errors.

77. (2.00 pts) An amphipathic molecule is one that is:

- A) Charged
- B) Polar
- C) Nonpolar
- D) Both polar and nonpolar

78. (2.00 pts)
The activity of an enzyme requires a cysteine to display its -SH side chain in the deprotonated state. The pKa of the -SH group is 8.3. At what pH will the enzyme show 65% of maximal activity?

- A) 8.03
- B) 8.11
- C) 8.57
- D) 8.88

79. (2.00 pts)
You have overexpressed two genes: A (mw= 30 kDa) and B (mw=90 kDa), using recombinant DNA in *E. coli* and are purifying the proteins. Following initial purification steps, you loa A and B onto a size exclusion column. Protein A is a homohexamer and protein B is a homotetramer. Which will elute first?

- A) A
- B) B
- C) They will elute simultaneously
- D) There is no way to tell from the information given

80. (2.00 pts) The side chain on R contains a(n):

- A) imidazole group
- B) guanidino group
- C) amine group
- D) none of these

81. (2.00 pts) Important features of the chymotrypsin catalytic process include:

(Mark **ALL** correct answers)

- [x] A) tetrahedral intermediates

- [x] B) oxyanion holes
- [x] C) electrostatic stabilization
- [x] D) covalent catalysis

82. (2.00 pts) How do you elute His-tagged proteins from a nickel column?

- ( ) A) increase pH
- (•) B) increase [imidazole]
- ( ) C) increase [NaCl]
- ( ) D) decrease [NaCl]

83. (2.00 pts) The Y-O2 binding curve of myoglobin is _____, while that of hemoglobin is _____.

- ( ) A) exponential; sigmoidal
- ( ) B) sigmoidal; hyperbolic
- ( ) C) linear; sigmoidal
- (•) D) hyperbolic; sigmoidal

84. (2.00 pts) Where does BPG bind to hemoglobin and what does it do?

- (•) A) Binds to central cavity; stabilizes T state
- ( ) B) Binds to central cavity; stabilizes R state
- ( ) C) Binds to amino terminus; stabilizes T state
- ( ) D) Binds to amino terminus; stabilizes R state

85. (2.00 pts) Where are you likely to find P residues?

- ( ) A) alpha helices
- ( ) B) beta sheets
- (•) C) turns
- ( ) D) both sheets and helices

86. (2.00 pts) Sickle cell anemia arose from a

- ( ) A) Frame shift mutation
- (•) B) point mutation
- ( ) C) conservative substitution
- ( ) D) none of these

87. (20.00 pts)
A peptide isolated for sequencing consists of the following amino acids: Arg, Gly, Met, Phe, Trp, Tyr, and 3 Cys. The high C content suggests the possibility of disulfide bridges so experiments were performed on the reduced peptide with the following results:

Treatment 1: FNDB:
Fragments produced:

alpha-DNP-C
alpha-DNP-Y

Treatment 2: Trypsin
Fragments produced: C; C,R,F,Y; C,G,M,W

Treatment 3: Chymotrypsin
Fragments produced: G,M; C,R; Y; C,W; C,F

Treatment 4: CNBr
Fragments produced: G

Determine the sequence of amino acids from the information above. If multiple chains are found, please separate your chains with a "/".

Expected Answer: YCFRC / CWMG

88. (4.00 pts) Using the genetic code, explain how a point mutation could change a codon for Glu to a codon for Val.

Expected Answer: If the A in the “GAG” codon for glutamate gets changed to a T, it would get changed to “GUG” which codes for valine. This could happen through a point mutation where only one base pair within the DNA sequence is altered, usually through a mistake during DNA replication or exposure to ultraviolet radiation or X-rays.

89. (5.00 pts)
DNA from a newly discovered virus was purified, and UV light absorption was monitored as the molecule was slowly heated. The absorbance increase at the melting temperature wa only about 10%. What does this tell you about the structure of the viral DNA?

Expected Answer: This result tells us that the DNA is most likely single-stranded and that a small portion of intramolecular base-pairing could be present. This is because denaturation leads to the unwinding of the DNA structure into single strands, which allows it to absorb more light due to the unstacked bases.

90. (1.00 pts) Hey, you made it to the end of the test :)

Do you feel confident in your knowledge?

- (●) A) Perhaps