

## Chem 121 Chapter 22. Nucleic Acids

1. Any given nucleotide in a nucleic acid contains
  - A) two bases and a sugar.
  - B) one sugar, two bases and one phosphate.
  - C) two sugars and one phosphate.
  - D) one sugar, one base and one phosphate.
2. The number of different kinds of nucleotides present in any DNA molecule is
  - A) four
  - B) six
  - C) two
  - D) three
3. Which of the following are the three "single ring" bases that occur in nucleic acids?
  - A) adenine, guanine and uracil
  - B) adenine, cytosine and uracil
  - C) cytosine, thymine and uracil
  - D) cytosine, guanine and thymine
4. The "backbone" of a nucleic acid molecule consists of an alternating sequence of
  - A) sugar and phosphate groups.
  - B) sugar and base groups.
  - C) phosphate and base groups.
  - D) sugar, phosphate and base groups.
5. The "backbone" of a DNA molecule always has a free -OH group on a
  - A) ribose molecule at the 3' end.
  - B) deoxyribose molecule at the 3' end.
  - C) ribose molecule at the 5' end.
  - D) deoxyribose molecule at the 5' end.
6. 40% of the bases in a certain DNA molecule are found to be C. What percent of the bases in this same molecule are A?
  - A) 10%
  - B) 20%
  - C) 40%
  - D) 80%

7. Which of the following statements concerning the double helix structure present in DNA molecules is *correct*?
- A) the two nucleotide strands are mirror images of each other
  - B) hydrogen bonds between a sugar unit and a base pair hold the two nucleotide strands together
  - C) base pairing between strands always involves one pyrimidine base and one purine base
  - D) base pairing combinations are always A-C and G-T
8. Replication of DNA produces two daughter DNA molecules in which
- A) one daughter molecule contains both parent strands and one daughter molecule contains both newly synthesized strands.
  - B) each daughter molecule contains one parent strand and one newly synthesized strand.
  - C) each daughter molecule contains two newly synthesized strands.
  - D) each daughter molecule contains a segment of both parent strands.
9. In DNA replication the unwinding of the double helix
- A) begins at the 5' end and continues to the 3' end.
  - B) begins at the 3' end and continues to the 5' end.
  - C) occurs at many places within the double helix at the same time.
  - D) is governed by the enzyme DNA ligase.
10. RNA molecules differ from DNA molecules in that they
- A) are single stranded rather than double stranded
  - B) contain five different bases instead of four
  - C) are much larger
  - D) contain 2-oxyribose rather than 2-deoxyglucose
11. Which one of the following types of RNA molecules contains exons and introns?
- A) mRNA
  - B) tRNA
  - C) hnRNA
  - D) snRNA
12. The region of a DNA strand carrying the information needed for synthesis of a specific protein is called a
- A) codon.
  - B) chromosome.
  - C) gene.
  - D) complementary base pair.

13. Associated with the process of DNA transcription is the formation of
- two DNA molecules from one DNA molecule and amino acids.
  - one DNA molecule from a number of shorter RNA molecules.
  - an mRNA molecule which is then “edited” to form an mRNA molecule.
  - an mRNA molecule which contains several genes.
14. The genetic code is a listing which gives relationships between codons and
- anticodons.
  - amino acids.
  - exons.
  - genes.
15. Which of the following statements concerning codons is *incorrect*?
- They are found within mRNA molecules.
  - They are sequences of three nucleotides.
  - There are 64 of them.
  - They are short segments of a gene.
16. Which of the following is not necessary for protein synthesis at the time and place where synthesis occurs?
- mRNA
  - tRNA
  - ribosomes
  - DNA
17. Which of the following is a correct base pairing sequence between a codon and anticodon?
- |   |   |   |
|---|---|---|
| C | G | T |
|   |   |   |
| G | C | A |
  - |   |   |   |
|---|---|---|
| A | C | T |
|   |   |   |
| T | G | A |
  - |   |   |   |
|---|---|---|
| C | C | U |
|   |   |   |
| G | G | A |
  - |   |   |   |
|---|---|---|
| C | T | A |
|   |   |   |
| G | A | U |

18. Which of the following statements concerning tRNA molecules is *incorrect*?
- A) They are carriers of the amino acids needed for protein synthesis.
  - B) They have a “cloverleaf” shape with four hairpin loops.
  - C) They interact with mRNA at the site of protein synthesis.
  - D) An anticodon is present within their structure.
19. The role of *E. coli* plasmids in recombinant DNA work is to
- A) splice DNA strands together to form circular DNA molecules.
  - B) cleave double-stranded DNA molecules.
  - C) provide the restriction enzymes needed for repairing defective DNA.
  - D) serve as a host for a “foreign” gene.
20. Which of the following statements *does not* apply to the process of DNA sequencing?
- A) Short starter nucleotide chains called *primers* are needed.
  - B) Restriction enzymes are used to cleave DNA molecules.
  - C) The original reaction mixture is divided into four parts.
  - D) ddNTPs are used as *interrupting agents* in polynucleotide synthesis.
21. Which of the following is a correct structural characteristic of a nucleotide?
- A) The base unit is bonded to the phosphate unit.
  - B) The phosphate unit is bonded to the sugar unit.
  - C) The sugar unit is bonded to the base unit.
  - D) more than one correct response
  - E) no correct response
22. In a dinucleotide the linkage between nucleotide units involves
- A) carbon 3' of a sugar.
  - B) carbon 5' of a sugar.
  - C) both carbons 2' and 3' of a sugar.
  - D) more than one correct response
  - E) no correct response
23. In which of the following sets of nucleic acid “building blocks” are all members of the set possible components of a DNA molecule?
- A) phosphate, ribose, and thymine
  - B) adenine, ribose, and 2-deoxyribose
  - C) cytosine, guanine, and uracil
  - D) more than one correct response
  - E) no correct response

24. In which of the following pairs of nucleic acid bases are both members of the pair “single ring” bases?
- A) A and C
  - B) G and T
  - C) T and U
  - D) more than one correct response
  - E) no correct response
25. Which of the following elements is *not* present in the “backbone” of a nucleic acid molecule?
- A) phosphorus
  - B) nitrogen
  - C) oxygen
  - D) more than one correct response
  - E) no correct response
26. Which of the following sets of base composition data is consistent with the double helix nature of DNA molecules?
- A) 35% T and 15% C
  - B) 35% A and 35% G
  - C) 15% C and 15% G
  - D) more than one correct response
  - E) no correct response
27. In DNA replication the two strands of the double helix separate and each strand
- A) serves as a template for the construction of its own complement.
  - B) forms an exact duplicate of itself.
  - C) serves as a site for the formation of Okazaki fragments which are then connected together to give the new DNA molecule.
  - D) more than one correct response
  - E) no correct response
28. Which of the following enzymes associated with DNA replication is paired with its correct function?
- A) DNA helicase; unwinding of the DNA helix
  - B) DNA polymerase; formation of phosphodiester linkages
  - C) DNA ligase; connection of Okazaki fragments
  - D) more than one correct response
  - E) no correct response

29. Which of the following types of RNA has a “cloverleaf shape” with three hairpin loops?
- A) mRNA
  - B) rRNA
  - C) hnRNA
  - D) more than one correct response
  - E) no correct response
30. Which of the following types of RNA is paired with a correct piece of information about that type of RNA?
- A) tRNA; contains exons
  - B) mRNA; contains codons
  - C) rRNA; contains anticodons
  - D) more than one correct response
  - E) no correct response
31. Which of the following events occurs during the *transcription* phase of protein synthesis?
- A) A partial unwinding of a DNA double helix occurs.
  - B) hnRNA is edited and becomes snRNA.
  - C) tRNAs carry amino acids to the site for protein synthesis.
  - D) more than one correct response
  - E) no correct response
32. Which of the following events occurs during the *translation* phase of protein synthesis?
- A) mRNA interacts with a chromosome.
  - B) Codon-anticodon base pairing occurs.
  - C) rRNAs carry amino acids to the site for protein synthesis.
  - D) more than one correct response
  - E) no correct response
33. Which of the following statements concerning genes and chromosomes is *correct*?
- A) A gene is a segment of a DNA molecule that contains instructions for the synthesis of one or more proteins.
  - B) A chromosome contains several DNA molecules bound to protein.
  - C) Genes directly interact with amino acids during protein synthesis.
  - D) more than one correct response
  - E) no correct response
34. Which of the following statements concerning the codons of the genetic code is *correct*?
- A) The total number of codons is 48.
  - B) All codons are specific for a particular amino acid.
  - C) Codons that specify the same amino acid are called polysomes.
  - D) more than one correct response
  - E) no correct response

35. Which of the following is a valid set of mRNA codons?
- A) GGG, CCC and AAA
  - B) GGC, GGT and GGU
  - C) GAC, ACG and ACT
  - D) more than one correct response
  - E) no correct response

Use the following to answer questions 36-45:

In each of the following multiple-choice questions, characterize EACH of the three given statements as being TRUE or FALSE and then indicate the collective true-false status of the statements using the choices

- a) All three statements are true.
- b) Two of the three statements are true.
- c) Only one of the statements is true.
- d) None of the statements is true.

36. Statements:

- (1) In general, RNA molecules are much smaller than DNA molecules.
  - (2) Recombinant DNA molecules contain DNA segments from two different organisms.
  - (3) In DNA replication, the action of the enzyme *DNA helicase* causes the DNA double helix to unwind.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

37. Statements:

- (1) The type of DNA that contains exons and introns is rRNA.
  - (2) A “free” phosphate group is associated with the 5' end of a nucleic acid.
  - (3) AMP and dAMP nucleotides differ in the sugar subunit that is present.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

38. Statements:

- (1) The variable portion of a nucleic acid molecule is the sequence of bases attached to the nucleic acid "backbone."
  - (2) A polysome is a complex containing several mRNA molecules which simultaneously participate in protein synthesis.
  - (3) T, A, and G are all fused-ring nucleotide bases.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

39. Statements:

- (1) The acronym PCR stands for protein condensation reaction.
  - (2) A codon is a sequence of three nucleotides in a mRNA molecule that codes for a specific amino acid.
  - (3) Most of the mass of a chromosome is protein material rather than DNA.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

40. Statements:

- (1) The complementary base-pair sequence for the DNA strand 5' ACGTAT 3' is 3' TGCATA 5'.
  - (2) The only difference between DNA and RNA molecules is the identity of the sugar unit present in their nucleotides.
  - (3) Both strands of a daughter DNA molecule are formed through the linking of previously formed Okazaki fragments.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

41. Statements:

- (1) In nucleotide formation, the base always attaches to the sugar at the sugar's C-1' position.
  - (2) The genetic code is based on the concept that a single codon exists for each of the 20 standard amino acids.
  - (3) Codons are found in tRNA molecules and anticodons are found in mRNA molecules.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

42. Statements:

- (1) Ribosomes, which contain rRNA, serves as sites for protein synthesis.
  - (2) In genetic engineering, one of the functions of restriction enzymes is to cleave the double-stranded DNA of a circular plasmid.
  - (3) The nucleotide units within a nucleic acid are linked to each other through sugar-base bonds.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

43. Statements:

- (1) DNA nucleotides contain three subunits and RNA nucleotides contain four subunits.
  - (2) Complementary base pairing in DNA involves the base combinations (A and T) and (G and C).
  - (3) The interaction between anticodon and codon governs the proper placement of amino acids in a protein.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

44. Statements:

- (1) Nucleotides are related to nucleic acids in the same way that amino acids are related to proteins.
  - (2) Associated with the structure of tRNA molecules are “hairpin loops.”
  - (3) The bases A, G and U are found in both DNA and RNA molecules.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

45. Statements:

- (1) Several drugs containing synthetically modified nucleic acid bases block DNA synthesis as a means of blocking cancer cell replication.
  - (2) The mode of action for some antibiotics is inhibition of protein synthesis within bacteria.
  - (3) DNA sequencing is the basis for the human genome project.
- A) All three statements are true.
  - B) Two of the three statements are true.
  - C) Only one of the statements is true.
  - D) None of the statements is true.

Use the following to answer questions 46-50:

For each of the heterocyclic bases, choose a correct characterization from the response list. Responses may be used more than once or need not be used at all.

- a) base found only in DNA
- b) base found only in RNA
- c) “single ring” base found in both DNA and RNA
- d) “double ring” base

46. Adenine

47. Cytosine

48. Guanine

49. Thymine

50. Uracil

Use the following to answer questions 51-55:

Match the RNA-related items with the various types of RNA given in the response list. Responses may be used more than once or need not be used at all.

- a) mRNA
- b) hnRNA
- c) rRNA
- d) tRNA

51. Codon

52. Anticodon

53. Amino acid carrier

54. Intron

55. Hairpin loop

Use the following to answer questions 56-60:

For each of the base-pairing situations, select a correct possible base-pairing sequence from the response list. Responses may be used more than once or need not be used at all.

- a) 

A	G	T
U	C	A
- b) 

A	C	T
T	G	A
- c) 

A	G	U
U	C	A
- d) 

C	T	U
G	A	A

56. Base pairing between two DNA segments
57. Base pairing between two RNA segments
58. Base pairing between a DNA and RNA segment
59. Base pairing between a codon and anticodon
60. Base pairing between an Okazaki fragment and a DNA segment

Use the following to answer questions 61-65:

For each of the nucleic acid situations, select the process with which it is associated using the response list. Responses may be used more than once or need not be used at all.

- a) translation phase of protein synthesis
- b) transcription phase of protein synthesis
- c) replication of DNA
- d) formation of recombinant DNA

61. hnRNA is edited to form mRNA.
62. Complete unwinding of a DNA molecule occurs.
63. Partial unwinding of a DNA molecule occurs.
64. A mRNA-ribosome complex is formed.
65. Okazaki fragments are formed.

Use the following to answer questions 66-70:

For each of the di- or tri-nucleotides, select a correct characterization from the response list. Responses may be used more than once or need not be used at all.

- a) found in DNA but not RNA
- b) found in RNA but not DNA
- c) found in both DNA and RNA
- d) not found in DNA nor RNA

66. 5' dAMP–dAMP 3'

67. 5' AMP–AMP–CMP 3'

68. 5' dAMP–CMP 3'

69. 5' TCA 3'

70. 5' GGA 3'

## Answer Key

- |       |       |
|-------|-------|
| 1. D  | 45. A |
| 2. A  | 46. d |
| 3. C  | 47. c |
| 4. A  | 48. d |
| 5. B  | 49. a |
| 6. A  | 50. b |
| 7. C  | 51. a |
| 8. B  | 52. d |
| 9. C  | 53. d |
| 10. A | 54. b |
| 11. C | 55. d |
| 12. C | 56. b |
| 13. C | 57. c |
| 14. B | 58. a |
| 15. D | 59. c |
| 16. D | 60. b |
| 17. C | 61. b |
| 18. B | 62. c |
| 19. D | 63. b |
| 20. A | 64. a |
| 21. D | 65. c |
| 22. A | 66. a |
| 23. E | 67. b |
| 24. C | 68. d |
| 25. B | 69. a |
| 26. D | 70. c |
| 27. A | 45. A |
| 28. D | 46. d |
| 29. E | 47. c |
| 30. B | 48. d |
| 31. A | 49. a |
| 32. B | 50. b |
| 33. A | 51. a |
| 34. E | 52. d |
| 35. A | 53. d |
| 36. A | 54. b |
| 37. B | 55. d |
| 38. C | 56. b |
| 39. B | 57. c |
| 40. C | 58. a |
| 41. C | 59. c |
| 42. B | 60. b |
| 43. B | 61. b |
| 44. B | 62. c |