

## Chapter 2 DNA and RNA: Composition and Structure

### Multiple Choice

1. Which one of the following nitrogenous bases has an amino group at position 2 and an oxygen at position 6?

- A. Adenine
- B. Guanine
- C. Uracil
- D. Thymine
- E. Hypoxanthine

Ans: B

2. Which is true about mRNA?

- A. It contains a  $\text{-OH}$  at the 5' carbon of its ribose moieties.
- B. A copy of its nucleotide sequence can be found in the genetic material
- C. Analysis of its nucleotide composition reveals that it obeys Chargaff's rules.
- D. It contains a hydrogen at the 2' carbon of its ribose moieties.

Ans: B

3. The conversion of B-DNA to Z-DNA is facilitated by

- A. sequences rich in A-T base pairs.
- B. increasing NaCl concentration.
- C. negative supercoiling.
- D. histone acetylation.

Ans: C

4. Each of the following describes tRNA EXCEPT

- A. the end terminates in CCA.
- B. it is synthesized with extra bases on the 3' and 5' ends.
- C. its extended structure looks like a cloverleaf.
- D. it furnishes a codon for protein synthesis.
- E. it has many bases which are modified.

Ans: D

5. Which type of nucleic acid forms a high energy bond with an amino acid during protein synthesis?

- A. Messenger RNA

- B. Mitochondrial DNA
- C. Nuclear DNA
- D. Ribosomal RNA
- E. Transfer RNA

Ans: E

6. What are the complementary base pairs in DNA?

- A. Adenine : Uracil and Guanine : Cytosine
- B. Adenine : Thymine and Guanine : Uracil
- C. Adenine : Guanine and Uracil : Cytosine
- D. Adenine : Thymine and Guanine : Cytosine
- E. Adenine : Cytosine and Guanine : Thymine

Ans: D

7. All of the following statements concerning histones are true EXCEPT that they

- A. are rich in arginine and lysine.
- B. are proteins of relatively low molecular weight.
- C. exhibit known interspecies homologies in their amino acid sequences.
- D. are noncovalently attached to DNA in stoichiometric amounts.
- E. exhibit a wide variety of non-homologous molecular structure.

Ans: E

8. The term denaturation, when used in connection with nucleic acids or proteins refers to a change in structural characteristics due to

- A. the disruption of covalent bonds.
- B. the disruption of non-covalent bonds.
- C. the binding of toxic compounds.
- D. changes in primary structure.
- E. changes in the state of aggregation.

Ans: B

9. Which of the following statements about supercoiling of DNA are true? (1)

Supercoiled DNA differs in linking number from relaxed DNA. (2) Supercoiled DNA can be relaxed through the action of topoisomerases. (3) All DNA in the cell is positively supercoiled. (4) A negatively supercoiled DNA is more difficult to unwind.

- A. Only 2, 3 and 4 are true
- B. Only 1, 2 and 3 are true
- C. Only 1 and 3 are true
- D. Only 1 and 2 are true
- E. All are true

Ans: D

10. In the conversion of B-DNA to Z-DNA, all of the following make contributions EXCEPT

- A. the presence of 5-methylcytosine.
- B. a purine-rich strand base-paired to a pyrimidine-rich strand.
- C. negative supercoiling.
- D. alternating purines and pyrimidines on one strand.

Ans: B

11. Which of these statements is not true regarding the three classes of RNA, ribosomal RNA, mRNA and tRNA?

- A. All three classes are involved in protein synthesis.
- B. Ribosomal RNA is cleaved from a large precursor RNA species.
- C. tRNA and ribosomal RNA contain methylated bases.
- D. A single amino acyl tRNA synthetase can attach different amino acids to -C-C-A-OH end of tRNA molecules.

Ans: D

12. Which of the following statements about supercoiling of DNA are true? (1) Supercoiled DNA differs in linking number from relaxed DNA. (2) Supercoiled DNA can be relaxed through the action of topoisomerases. (3) All DNA in the cell is positively supercoiled. (4) A negatively supercoiled DNA is more difficult to unwind.

- A. Only 2, and 4 are true
- B. Only 1, 2 and 4 are true
- C. Only 1 and 2 are true
- D. Only 1 and 2 are true
- E. All are true

Ans: D

13. In the Watson-Crick structure for DNA

- A. the DNA strands run parallel.
- B. the ratio of G to A equals 1.
- C. the ratio of A to U equals 1.
- D. the number of purines equals the number of pyrimidines.
- E. two of the above are correct.

Ans: D

14. The  $T_m$  (melting temperature) of DNA

- A. is unrelated to the base composition.
- B. is a constant for all DNA samples.
- C. is linearly related to the guanine + cytosine content.
- D. is proportional to the uridine content.
- E. None of the other answers is correct.

Ans: C

15. Restriction endonucleases

- A. digest DNA duplex molecules from the 5'-OH ends.
- B. attack only single stranded DNA.
- C. have base sequence specificity.
- D. randomly digest double stranded DNA molecules.
- E. are not produced by bacteria.

Ans: C

16. Which of the following statements is not true about the human genome?

- A. It is present in each somatic (i.e., not germline) cell in diploid form.
- B. It contains a mixture of repetitive and unique sequence DNA.
- C. The DNA in each chromosome consists of a circle.
- D. It encodes information for the targeting of proteins to their proper cellular locations.
- E. It contains approximately  $2.4 \times 10^9$  bp (haploid content).

Ans: C

17. Which of the following would contribute to a more stable interaction between histones and DNA?

- A. phosphorylation of histones
- B. deacetylation of histones
- C. raising the NaCl concentration
- D. raising the temperature
- E. methylation of the DNA

Ans: B

18. Which of the following is a general feature of both DNA and RNA?

- A. In vivo they are double helical structures formed from two separate chains.
- B. They are alkaline stable.
- C. They form complementary G-C base pairs.
- D. They contain small amounts of pseudouridine.
- E. They interact with histones to form nucleosomes.

Ans: C

19. The Watson-Crick model of the DNA double-helix led to the prediction that DNA replication is semi-conservative because

- A. the phosphate backbones could be easily broken and rejoined.
- B. the double-helix can assume either B-form or Z-form higher order structure before DNA replication.

- C. each strand could serve as a template for daughter strand synthesis producing pairs of identical molecules.
- D. the hydrogen bonds would stabilize important intermediates that arise during synthesis.
- E. it would position the reactive OH favorably for formation of the phosphodiester bond.

Ans: C

20. Denaturation of a double stranded DNA molecule can commonly be achieved by

- A. heating a DNA solution to K.
- B. adding a nonionic surfactant.
- C. saturating the DNA solution with NaCl.
- D. all of the above.
- E. none of the above.

Ans: E

21. A segment of DNA has the following sequence pTpApCpGpTpGpC-H. Which of the sequences below would represent the complement of this DNA strand? (Note, all sugars are deoxyribose)

- A. pApTpGpCpApCpG-H
- B. pGpCpTpGpCpApTp-H
- C. pGpCpApCpGpTpA-H
- D. pTpApCpGpTpGpC-H
- E. none of the above

Ans: C

22. Restriction enzymes are:

- A. DNA polymerases
- B. RNA polymerases
- C. endonucleases
- D. exonucleases
- E. none of the above

Ans: C

23. Which of the following is a ribonucleoside which contains an amino group?

- A. Thymine
- B. Uridine
- C. Thymidine
- D. Cytidine
- E. Deoxyadenosine

Ans: D

24. Histones:

- A. account for 1/4 the mass of the eukaryotic chromosome.
- B. complex with RNA to form spliceosomes.
- C. are bound to DNA in the transcriptional units of both active and inactive genes.
- D. are small Glu+Asp\_ rich proteins that facilitate compaction of eukaryotic DNA in the nucleus.
- E. are a highly conserved class of proteins with the most conserved being the linker histone H1.

Ans: C

25. Which of the following are found in the 60S ribosomal subunit?

- A. 5S rRNA
- B. 18S rRNA
- C. 28S rRNA
- D. Both A and B
- E. Both A and C

Ans: E

26. Heterogeneous nuclear RNA (hnRNA) can contain all the following EXCEPT

- A. sequences which can base pair with small nuclear RNA (snRNA).
- B. sequences derived from the TATA region of the promoter.
- C. introns.
- D. polyadenylate.
- E. codons.

Ans: B

27. By which of the following means are the nucleosides linked to one another in RNA and DNA molecules?

- A. They are linked together by alpha-glycosidic bonds.
- B. They are linked together by beta-glycosidic bonds.
- C. They are linked together by 5' phosphodiester bridges.
- D. They are linked together by 2',5' phosphodiester bridges.
- E. None of the other answers is correct.

Ans: C

28. The major structural protein component(s) of chromatin are

- A. tubulin.
- B. actin.
- C. histones.
- D. acidic chromosomal proteins.
- E. myosin.

Ans: C

29. Each of the following statements concerning DNA structure is true EXCEPT which one?

- A.  $[A] + [T] = [G] + [C]$  in normal double stranded DNA.
- B.  $[A] + [G] = [T] + [C]$  in normal double stranded DNA.
- C.  $[\text{Purines}] = [\text{pyrimidines}]$  in normal double stranded DNA.
- D. the specificity of base pairing is due to the arrangement of H-bonds found between bases and the dimensions of the base pairs.
- E. the 5' position on thymine bears a methyl group.

Ans: A

30. The stem-loop structure of tRNA is associated with which of the following important functional regions?

- A. the anti-codon site
- B. the amino acid attachment site
- C. the 5' cap site
- D. the polyadenylation site
- E. the intron

Ans: A

31. Which of the following statements is incorrect concerning the function of chromatin:

- A. chromatin condenses the DNA
- B. chromatin plays a role in the regulation of gene expression
- C. chromatin allows for the tight packaging of DNA into sperm heads
- D. chromatin compacts DNA in a manner that allows regulatory sequences to be exposed
- E. none of the above

Ans: C

32. Denaturation of double\_stranded DNA with heat or alkali results in all of the following EXCEPT

- A. decreased absorbance of the DNA at 260 nm.
- B. loss of base stacking.
- C. formation of single\_stranded DNA.
- D. disruption of hydrogen bonding.
- E. a helix\_to\_coil transition.

Ans: A

33. All of the following statements concerning properties of nucleic acids are correct EXCEPT

- A. RNA is hydrolyzed to 2'- and nucleotides by alkali.
- B. DNA is denatured by alkali.

- C. DNA is denatured by high temperature.
- D. Denaturation of DNA is accompanied by hyperchromism.
- E. RNA cannot form a Watson-Crick type double-helix.

Ans: E

34. The double stranded DNA molecule can be denatured or melted by
- A. treatment with protease.
  - B. X-ray diffraction.
  - C. high concentrations of NaCl.
  - D. high pH.
  - E. C and D.

Ans: D

35. One of the following five statements describing the Watson-Crick model for double stranded DNA is incorrect. INDICATE THE INCORRECT STATEMENT
- A. The two strands of DNA are intertwined in such a way that they can be separated without unwinding the complementary strand.
  - B. The paired chains have opposite polarity.
  - C. The paired bases are located in the interior of the double helical structure.
  - D. One turn of the double helix involves approximately 10 nucleotides and occurs every angstroms.
  - E. The double helical structure has two grooves running helically along its length, one of which is considerably narrower than the other.

Ans: A

36. Which of the following statements is correct concerning native DNA?
- A. The two strands are the same in base sequence.
  - B. The sugar-phosphate backbones contain the five carbon sugar ribulose.
  - C. The analysis  $A = G$  and  $C = T$  is expected.
  - D. The structure can be disrupted by high salt.
  - E. None of the above.

Ans: E

37. What is the main difference between topoisomerases I and II?
- A. Gyases are a subset of topoisomerases I
  - B. Topoisomerase I breaks one strand and II both strands
  - C. Topoisomerase I needs ATP, and II does not
  - D. Topoisomerase II remains bound to DNA until religation
  - E. Topoisomerase relaxes only positively supercoiled species

Ans: B

38. The nucleosome is the basic repeating unit of chromatin. Which of the following statements concerning nucleosomes is incorrect:
- A. nucleosomes have protein cores consisting of an octamer of protein subunits
  - B. a segment of DNA approximately 145 bp long is associated with each nucleosome
  - C. histone H1 contacts the DNA linker segments as they enter and leave the nucleosome
  - D. the DNA in a nucleosome is packed tightly inside the protein core to conserve space in the nucleus and to protect the DNA from damage
  - E. some nucleosomes form over specific regions of DNA in a non\_random manner

Ans: D

39. The melting temperature of DNA ( $T_m$ ) can be used to determine the
- A. average length of the DNA.
  - B. complexity of the DNA.
  - C. percentages of A, T, G, and C in the DNA.
  - D. number of base pairs in the DNA.

Ans: C

40. The type of nucleic acid that may contain small quantities of a variety of modified ribonucleotides is
- A. messenger RNA.
  - B. ribosomal RNA.
  - C. nucleolar RNA.
  - D. transfer RNA.
  - E. mitochondrial RNA.

Ans: D

41. Chemicals that bind to DNA by intercalating between the bases
- A. can cause frame shift mutations.
  - B. can cause deletion mutations.
  - C. can cause insertion mutations.
  - D. are generally planar hydrophobic molecules.
  - E. all of the above

Ans: E

42. Each of the following statements is true EXCEPT which one?
- A. DNA and RNA are both polynucleotides held together by 5' phosphodiester bonds.
  - B. Three of the bases are the same in both DNA and RNA.
  - C. Both DNA and RNA usually exist as a Watson-Crick double helix.
  - D. RNA is found both in the nucleus and the cytoplasm.
  - E. RNA but not DNA is hydrolyzed by base.

Ans: C

43. Enzymes that catalyze stepwise hydrolysis of mononucleotides from one end of a polynucleotide chain are

- A. polymerases.
- B. endonucleases.
- C. ligases.
- D. exonucleases.
- E. nickases.

Ans: D

44. Histones are

- A. basic proteins associated with RNA.
- B. basic proteins associated with DNA.
- C. acidic proteins which bind chromosomal nucleoprotein.
- D. proteins exclusively found in the nucleolus.
- E. proteins which are tissue specific.

Ans: B

45. Which of the following statements about double helical DNA are correct? (Note, more than one are correct.) (1) The duplex structure is stabilized only by hydrogen bonding between bases. (2) Each helix is left handed. (3) The repeat distance along the helix axis is 34 Å. (4) A purine is always base paired to a pyrimidine. (5) The planes of the bases lie parallel to the helix axis.

- A. Only (1) and (5) are correct
- B. Only (3) and (4) are correct
- C. Only (2) and (3) are correct
- D. Only (2) and (5) are correct
- E. Only (3) and (5) are correct

Ans: B

46. What is the PRINCIPAL force holding the two strands of the double helix together?

- A. base pairing
- B. covalent bonding
- C. hydrophobic interactions
- D. stacking forces

Ans: C

47. Hyperchromic shift is caused by

- A. high GC content.
- B. high AT content.
- C. melting of double stranded DNA.
- D. cooling of double stranded DNA.

E. none of the above

Ans: C

48. Which of the following determines the specificity of nucleic acid hybridization?

- A. base composition
- B. A-T and G-C hydrogen bonds
- C. sequence complexity
- D. stacking interactions
- E. wobble rules

Ans: B

49. In the double helical structure of DNA, adenine is hydrogen bonded to

- A. uridine.
- B. cytosine.
- C. guanine.
- D. thymine.

Ans: D

50. If in one strand of DNA, reading in the ' to direction, the nucleotide sequence is GCC, the nucleotide sequence in the complementary strand, again in the ' to direction, is

- A. GCC.
- B. GGC.
- C. CGG.
- D. ATT.
- E. AAT.

Ans: B

51. Restriction enzymes have all of the following characteristics EXCEPT that they cut

- A. DNA sequence specifically.
- B. each DNA strand separately.
- C. palindromic sequences.
- D. DNA using an exonuclease activity.

Ans: D

52. Which one of the following terms best describes the complete structure of a nitrogenous base with oxygens at positions 2 and 4 and ribose at position 1?

- A. Thymine
- B. Uracil
- C. Thymine ribonucleoside
- D. Uridine
- E. Cytidine

Ans: D

53. Which best describes the mechanism of OH<sup>-</sup>-mediated denaturation of DNA?
- A. OH<sup>-</sup> disrupts the H-bonding between the nitrogenous bases of opposing DNA strands.
  - B. OH<sup>-</sup> hydrolyzes the phosphodiester linkages between nucleotides.
  - C. The hydroxyl ions attract the unpaired electrons of the amino groups attached to the nitrogenous bases.
  - D. Alkali tends to increase the melting temperature of DNA.

Ans: A

54. All of the following statements concerning the Watson-Crick Model of DNA structure are true EXCEPT
- A. the two strands of DNA are complementary.
  - B. the hydrogen bonding between guanine and cytosine is stronger than between adenine and thymine.
  - C. the two DNA strands are anti-parallel.
  - D. the 3.4 nm periodicity is the distance for one complete turn of the helix.
  - E. the stacked nitrogenous bases form the backbone of each DNA strand.

Ans: E

55. The H1 histone
- A. is one of the four histones in the nucleosome core.
  - B. helps form the octamer nucleosome complex.
  - C. is one of the two arginine-rich histones.
  - D. is present at 1:1 weight ratio with DNA.
  - E. helps fold the bead-on-a-string structure into higher order structures.

Ans: E

56. In mammalian cells, rRNA
- A. accounts for 1/3 of the total cellular RNA content.
  - B. is rapidly degraded during protein synthesis.
  - C. is composed of only two types - 23S and 16S.
  - D. contains the codons for protein synthesis.
  - E. is composed of at least 4 different size classes of RNA.

Ans: E

57. Each of the following statements concerning the complementary strands of DNA is true EXCEPT which one?
- A. The pyrimidine content of each strand is the same.
  - B. The sum of the G and C content in one strand equals the sum of the G and C content in the other strand.

- C. The percent purines in one strand must equal the percent pyrimidines in the other strand.
- D. If one strand contains the sequence pGpApApTpTpC, the other strand must contain the same sequence.
- E. If one strand contains thymine, the other strand must contain adenine.

Ans: A

58. Restriction endonucleases are enzymes that
- A. synthesize DNA from a RNA primer.
  - B. nick single strands of DNA.
  - C. cleave both strands of DNA at sequence specific sites.
  - D. add nucleotides to the end of DNA strands.
  - E. None of the other answers is correct.

Ans: C

59. What is the nature of the usual linkage between nucleic acids and proteins in nucleoproteins?
- A. Hydrogen bonding.
  - B. Covalent ester formation between phosphoric acid of nucleic acids and basic amino acids of proteins.
  - C. Ionic linkages between phosphoric acid of nucleic acids and basic amino acids of proteins.
  - D. Van der Waals interactions between bases of nucleic acids and side chains of amino acids of protein.
  - E. A mixture of covalent linkages and hydrogen bonding.

Ans: C

60. What is contained within a nucleoside?
- A. a ribose moiety, a nitrogenous base and a phosphate covalently attached to the ribose 5' carbon
  - B. a ribose moiety, a purine or pyrimidine, and a phosphate covalently linked to the 3' carbon of the ribose.
  - C. a ribose moiety and a nitrogenous base
  - D. a deoxyribose, a purine or pyrimidine, and a phosphate linked to the ribose 5' carbon by a hydrogen bond.

Ans: C

61. The nucleotide sequence 5'-ATTGCAG-3' should base pair with
- A. 5'-TAACGTC-3'.
  - B. 5'-CTGCAAT-3'.
  - C. 3'-ATTGCAG-5'.
  - D. 3'-CTGCAAT-5'.

Ans: B

62. All of the following statements regarding the Watson-Crick B form of DNA are true EXCEPT

- A. two chains are coiled around a common axis forming a right-handed helix.
- B. there are 10 base pairs per turn.
- C. the bases are found on the outside of the helix and the sugar phosphate backbone on the inside.
- D. the two chains run in opposite directions.
- E. adenine is always paired with thymine, guanine with cytosine.

Ans: C

63. Histones are

- A. basic proteins associated with RNA.
- B. basic proteins associated with DNA.
- C. acidic proteins which bind chromosomal nucleoprotein.
- D. proteins exclusively found in the nucleolus.
- E. proteins which are tissue specific.

Ans: B

64. Which of the following is a nucleoside found exclusively in tRNA?

- A. pseudouridine
- B. uridine
- C. thymine
- D. ribose
- E. adenosine

Ans: A

65. Histones are

- A. found primarily in prokaryotic cells and not in mammalian cells.
- B. believed to bind with rRNA in the formation of ribosomes.
- C. acidic proteins containing a high proportion of glutamic and aspartic acid.
- D. basic proteins containing a high proportion of lysine and arginine.
- E. proteins that control the rate of translation of mRNA into a protein molecule.

Ans: D

66. What is the difference between ribozymes that are considered “true” catalysts and those that are not?

- A. “Non-true” catalysts are found only in prokaryotes
- B. “Non-true” catalysts do not employ any of the accepted mechanisms of rate enhancement

- C. "Non-true" catalysts do not recognize a specific site on the substrate
- D. "True" catalysts are the same at the end of the reaction as at the beginning
- E. "True" catalysts require a protein component

Ans: D

67. Which one of the following statements is true? In chromatin folding, the structure called a solenoid:

- A. is the most compact form of DNA.
- B. requires the presence of histone H1.
- C. is a good template for transcription.
- D. consists of eight histone molecules around which DNA is wrapped.
- E. is the most extended form of DNA.

Ans: B

68. Spontaneous conversion of adenine and cytosine from the amino to the imino forms of these bases within DNA results in

- A. cleavage of the glycosidic bond and loss of the base.
- B. cleavage of the 3', 5' phosphodiester DNA backbone.
- C. alteration of the hydrogen bonding of the bases.
- D. formation of guanine and thymine.

Ans: C

69. Which of the following classes of RNA contain the largest relative percentage of unusual modified purine and pyrimidine bases?

- A. hnRNA
- B. mRNA
- C. tRNA
- D. rRNA
- E. All contain comparable relative percentages of modified bases.

Ans: D

70. Which one of the following statements is true? In chromatin folding, the structure called a solenoid

- A. is the most compact form of DNA.
- B. requires the presence of histone H1.
- C. is a good template for transcription.
- D. consists of eight histone molecules around which DNA is wrapped.
- E. is the most extended form of DNA.

Ans: B

71. Which of the following statements uniquely applies to eukaryotic mRNA when compared to eukaryotic rRNA and tRNA?

- A. It is synthesized in the nucleus.
- B. It is modified after its transcription.
- C. It contains methylated bases.
- D. It usually contains a polyadenylic acid sequence at its terminus.
- E. It is always larger than any other RNA species.

Ans: D

72. The histones are

- A. ribosomal proteins which regulate the function of ribosomes.
- B. proteins which bind to tRNAs and activate them.
- C. small basic proteins associated with the DNA molecules in the chromatin of eukaryotic cells.
- D. small acidic proteins which may be involved in gene regulation.
- E. proteins required for binding of the mRNA to the ribosome.

Ans: C

73. All of the following are TRUE regarding restriction endonucleases EXCEPT

- A. they recognize specific palindromic sequences.
- B. they may produce staggered ends when they cleave DNA into fragments.
- C. they may produce flush ends when they cleave DNA into fragments.
- D. they are used in gene cloning to cleave the single stranded regions of the cDNA produced by reverse transcriptase.
- E. they are used to cleave plasmid DNA in specific places in gene cloning experiments.

Ans: D

74. DNA sequencing by the Sanger technique makes use of dideoxynucleotides for which of the following reasons?

- A. To ensure that DNA is synthesized from only one of the two DNA strands
- B. To terminate DNA synthesis at every nucleotide
- C. To promote base-pairing between the newly synthesized strand and the template strand
- D. To provide sites at which DNA cleavage will occur

Ans: B

75. Base pair complementarity in DNA is a consequence of

- A. The size, shape, and chemical composition of the bases.
- B. Hydrogen-bonding between deoxyribose moieties of opposing strands
- C. minor distortions in the DNA helix
- D. C-T and A-G base pairing
- E. A and B.

Ans: A

76. Which of the following observations is part of the evidence supporting the Watson-Crick structure of DNA?

- A. In the DNAs examined from a wide variety of sources, the adenine and cytosine contents are equal.
- B. A non-virulent pneumococcus can be transformed to a virulent strain by the addition of DNA.
- C. RNA is susceptible to hydrolysis by alkali, whereas DNA is not.
- D. The sum of the purines present in any double-stranded DNA is equal to the sum of the pyrimidines present.

Ans: D

77. All of the following statements regarding ribosomes are CORRECT EXCEPT

- A. prokaryotic ribosomes are LESS complex than eukaryotic ribosomes.
- B. the prokaryotic small ribosomal subunit contains a single rRNA molecule.
- C. prokaryotic ribosomes resemble mitochondrial ribosomes.
- D. prokaryotic and eukaryotic LARGE ribosomal subunits each contain different rRNA species.
- E. prokaryotic small ribosomal subunits contain a nucleotide sequence in rRNA which is complementary to a sequence in mRNA.

Ans: D

78. Which of the following is MOST responsible for determining the structural stability of double-stranded DNA?

- A. The attractive interaction between positively charged purines and negatively charged pyrimidines.
- B. H-bonding between the OH of deoxyribose and purine and pyrimidine ring nitrogens.
- C. Hydrophobic interaction between contiguous base pairs and hydrogen bonding between complementary bases on opposite strands.
- D. Interaction between the phosphate groups in separate chains.
- E. Hydrophilic interaction between the pentoses in separate chains.

Ans: C

79. Restriction endonucleases

- A. cleave single stranded DNA preferentially.
- B. cleave DNA at specific sequences only when those sequences are unmethylated.
- C. remove bases one at a time from the 5' end of the DNA only when the bases are incorrectly matched with the template strand.
- D. initiate the repair process by making a single endonucleolytic incision at the 5' end of the damaged DNA region.
- E. are required for the correct processing of tRNA in the cell.

Ans: B

80. All of the following statements are true concerning DNA synthesis EXCEPT
- A. A major portion of the stability of double helical DNA is due to the hydrophobicity of the bases.
  - B. The 2' position of a nucleoside of DNA bears a phosphate group.
  - C. The 5' position of a nucleotide of DNA bears a phosphate group.
  - D. DNA absorbs UV radiation at 260 nm due to its base content.
  - E. Anti-parallel in DNA structure results in one strand of DNA having its 5' end opposite the end of the second strand of the double helix.

Ans: B

81. Which one of the following best describes the products from the base hydrolysis of RNA?
- A. 2' and 3' nucleoside monophosphates
  - B. 5'-nucleoside monophosphates
  - C. Purine bases, pyrimidine nucleosides, ribose and phosphate
  - D. Pyrimidine bases, purine nucleosides, ribose and phosphate
  - E. 3' and 5' nucleoside monophosphates

Ans: A

82. Which is not true of the structure of DNA
- A. The B form of DNA is anti\_parallel
  - B. The Z form of DNA is parallel
  - C. Stacking forces stabilize the Z form of DNA
  - D. DNA RNA hybrids are in the A form
  - E. Hydrophobic interactions provide the negative free energy in base pairing

Ans: B

83. Which one of the following classes of histones is not a component of the core particle?
- A. H1
  - B. H2A
  - C. H2B
  - D. H. H4

Ans: A

84. If the tetranucleotide 5' -pGpCpUpA-were treated with a phosphodiesterase which cleaves each phosphodiester bond on the side attached to a carbon, which of the following would be among the products?
- A. 5' -GMP

- B. -GMP
- C. 5' -GDP
- D. adenosine
- E. -UMP

Ans: A

85. In thermal denaturation of double-stranded DNA

- A. the value of  $T_m$  is usually dependent on the G + C content of the DNA.
- B. the absorption at 260 nm is decreased when the hydrogen-bonded bases become separated.
- C. G-C pairs are the main contributors towards the hyperchromic effect observed upon thermal denaturation.
- D. the bases undergo a shift to the enol form.
- E. the relative viscosity remains unchanged.

Ans: A

86. The structural stability of the double helix of DNA is ascribed in part to

- A. hydrogen bonding between adjacent purine bases.
- B. ionic bonding between stacked purine and pyrimidine nuclei.
- C. hydrogen bonding between adjacent pyrimidine bases.
- D. the helical structure of the molecule.
- E. hydrogen bonding between purine and pyrimidine bases.

Ans: E

87. Restriction endonuclease is best defined as

- A. an enzyme which cuts the ends of DNA.
- B. an endoribonuclease with precise base specificity.
- C. a deoxyribonuclease which cuts double-stranded DNA within a specific sequence.
- D. an enzyme which recognizes single-stranded DNA and cuts it at a particular 6 base sequence.

Ans: C

88. Posttranslational modification of histone proteins by phosphorylation or acetylation results in

- A. dissociation of the histone octamer proteins.
- B. higher affinity binding between histones and DNA.
- C. repression of transcription.
- D. reduction of the overall positive charge of the histones.

Ans: D

89. Histones are

- A. small negatively charged proteins that bind DNA
- B. poorly conserved across species
- C. a male vocal group recorded on the Motown label in the 60's
- D. coded for by single copy genes in the human genome
- E. often modified by acetylation or ubiquitination

Ans: E

90. The rate of reassociation of single\_stranded DNA is a direct function of

- A.  $Cot^{1/2}$ .
- B. the base composition of the DNA.
- C.  $1/Cot^{1/2}$ .
- D. the complexity of the DNA.

Ans: C

91. All of the following statements concerning DNA are correct EXCEPT

- A. Base-stacking involves the interaction of aromatic pi-electron orbitals and contributes to the stability of the double helix.
- B. Denatured DNA shows an increased extinction coefficient at 260 nm as compared to double-stranded DNA.
- C. DNA that is rich in G and C shows a higher melting temperature.
- D. The nucleotides are joined through glycosidic bonds.
- E. The two strands have opposite polarity (5'->and >5').

Ans: D

92. Histones

- A. account for 1/4 the mass of the eukaryotic chromosome.
- B. complex with RNA to form spliceosomes.
- C. are bound to DNA in the transcriptional units of both active and inactive genes.
- D. are small Glu+Asp- rich proteins that facilitate compaction of eukaryotic DNA in the nucleus.
- E. are a highly conserved class of proteins with the most conserved being the linker histone H1.

Ans: C

93. Heterochromatin is

- A. metabolically inactive regions of chromatin.
- B. found in the centromere region of the chromosome.
- C. DNA in the process of being replicated.
- D. A and B above.
- E. B and C above.

Ans: D

94. Because of the phosphate groups, DNA is

- A. basic.
- B. acidic.
- C. neutral.
- D. tightly bonded.
- E. none of the above.

Ans: B

95. In a plot of temperature versus absorbance of light at 260 nm by DNA, on what does  $T_m$  depend?

- A. Equilibrium between denatured and renatured species
- B.  $K_{cat}$  of denaturation
- C. Length of DNA
- D. Molecular weight of DNA
- E. Percent of guanine and adenine bases

Ans: E

96. The hyperchromic effect refers to:

- A. an increase in the absorbance of light at 260 nm upon denaturation of DNA.
- B. a maximum rate of denaturation versus temperature for double\_ helical DNA.
- C. the increase in the melting temperatures ( $T_m$ ) of DNA with increasing guanine\_ cytosine content.
- D. an increase in the absorbance of light at 260 nm when DNA\_RNA hybrids are annealed.
- E. none of the above.

Ans: A

97. All of the following statements about histones are correct EXCEPT?

- A. They are reversibly modified after their assembly into nucleosomes.
- B. Their amino acid sequences are highly conserved throughout evolution.
- C. They account for approximately one\_half the mass of a eukaryotic chromosome.
- D. They bind DNA in a sequence specific fashion.

Ans: D

98. All of the following statements about DNA structure are correct EXCEPT which one?

- A. Both the B-form and Z-form have anti-parallel DNA strands.
- B. The Z-form has a dinucleotide repeat.
- C. The A-form is the major DNA secondary structure observed in isolated cell nuclei.
- D. DNA secondary structures are stabilized by hydrophobic interactions between the faces of the bases.
- E. There are no exceptions to the Watson-Crick base-pairing rules in undamaged DNA.

Ans: C

99. The stability of the DNA double-helix is due to

- A. hydrogen bonds between sugar moieties.
- B. hydrogen bonds between complementary bases.
- C. hydrogen bonds between complementary bases, hydrophobic interactions and favorable van der Waals radii.
- D. covalent bonds between the two antiparallel DNA strands.

Ans: C

100. All of the following statements are true concerning the base composition of DNA EXCEPT

- A. the base composition is not characteristic of the species.
- B. the same base composition is present in most cells of the same species.
- C. the base composition varies widely among different organisms.
- D. the pyrimidine content equals the purine content.
- E. the adenine content is equal to the thymine content.

Ans: A

101. Which one of the facts about DNA in the sets listed below is INCORRECT?

- A. DNA contains equal amounts of A, T, G, and C on a molar basis.
- B. The molar content of adenine in a two stranded DNA molecule is equal to the molar content of thymine.
- C. The resistance of DNA to denaturation by heat can be directly related to the G + C content.
- D. Denaturation of DNA is associated with an increase in ultraviolet absorption.
- E. At neutral pH DNA has a large net negative charge.

Ans: A

102. Restriction enzymes have all of the following properties EXCEPT

- A. they cleave double stranded DNA.
- B. they modify DNA by methylation.
- C. they recognize specific DNA sequences.
- D. they cleave DNA, producing staggered ends.

Ans: B

103. Which of the following is not characteristic of tRNAs?

- A. They form extensive secondary structure.
- B. they have many modified bases.
- C. they are spliced post-transcriptionally.
- D. they get 3 nucleotides added to their 3' end post-transcriptionally.

E. they contain the codon for translation.

Ans: E

104. The double stranded DNA molecule can be denatured or melted by

- A. treatment with protease.
- B. X-ray diffraction.
- C. high concentrations of NaCl.
- D. high pH.
- E. C and D.

Ans: D

105. Regarding tRNA structure, which of the following statements is correct?

- A. The nucleotide sequence, CCA, is always present at the terminus of functional tRNA molecules.
- B. There is appreciable secondary structure in native tRNA molecules.
- C. An unusual nucleoside called pseudouridine, in which there is a carbon-carbon linkage between ribose and uracil, is almost always present in tRNA.
- D. All of the above.
- E. None of the above.

Ans: D

106. In thermal denaturation of double-stranded DNA

- A. the phosphodiester bonds undergo hydrolysis.
- B. the absorption at 260 nm is decreased when the hydrogen-bonded bases become separated.
- C. G-C pairs are the main contributors towards the hyperchromic effect observed upon thermal denaturation.
- D. the value of  $T_m$  is usually dependent on the G + C content of the DNA.
- E. the reaction is time and concentration dependent.

Ans: D

107. Which of the following statements best supports the Watson-Crick structure of DNA?

- A. Of the DNA examined from a wide variety of sources, the adenine and cytosine contents are always equal.
- B. A non-virulent *Pneumococcus* can be transformed to a virulent strain by the addition of DNA.
- C. mRNA will hybridize with DNA.
- D. Of the DNA examined from a wide variety of sources, the adenine and guanine contents are always equal.
- E. The sum of the purines present in a wide variety of DNA examined is always equal to the sum of the pyrimidines present.

Ans: E

108. All of the following statements are correct with regard to chromatin EXCEPT
- A. Nonhistone chromosomal proteins are believed to comprise at least several hundred different protein species.
  - B. Histones are proteins which have been conserved during evolution and are rich in basic amino acids.
  - C. The nucleosome is a basic structural subunit of chromatin, consisting of a core of 8 histone molecules and about 140base pairs of DNA.
  - D. Histones are synthesized throughout the cell cycle and turnover occurs during cell growth.
  - E. Most DNA, as it exists in the nucleus, is complexed with proteins.

Ans: D

109. Functional DNA can be found in
- A. nuclear zone.
  - B. mitochondria.
  - C. lysosomes.
  - D. both a and c.
  - E. both a and b.

Ans: E