Name: _____ **Class:** _____ **Date:** _____ **ID: A**

AP2013-DNAPacket-II

Multiple Choice
Identify the choice that best completes the statement or answers the question.

Use the list of choices below for the following questions:

I. helicase
II. DNA polymerase III
III. ligase
IV. DNA polymerase I
V. primase

1. Which of the enzymes synthesizes short segments of RNA?
   a. I b. II c. III d. IV e. V

2. Which of the enzymes removes the RNA nucleotides from the primer and adds equivalent DNA nucleotides to the 3' end of Okazaki fragments?
   a. I b. II c. III d. IV e. V

3. Which of the enzymes separates the DNA strands during replication?
   a. I b. II c. III d. IV e. V

4. Which of the enzymes covalently connects segments of DNA?
   a. I b. II c. III d. IV e. V

5. What is the function of topoisomerase?
   a. relieving strain in the DNA ahead of the replication fork b. elongating new DNA at a replication fork by adding nucleotides to the existing chain c. adding methyl groups to bases of DNA
   d. unwinding of the double helix e. stabilizing single-stranded DNA at the replication fork

6. In order for a eukaryotic gene to be engineered into a bacterial colony to be expressed, what must be included in addition to the coding exons of the gene?
   a. the introns b. eukaryotic polymerases c. a bacterial promoter sequence d. eukaryotic ribosomal subunits e. eukaryotic tRNAs

7. The nitrogenous base adenine is found in all members of which group?
   a. proteins, triglycerides, and testosterone b. proteins, ATP, and DNA c. ATP, RNA, and DNA
   d. α glucose, ATP, and DNA e. proteins, carbohydrates, and ATP

8. Which of the following types of mutation, resulting in an error in the mRNA just after the AUG start of translation, is likely to have the most serious effect on the polypeptide product?
   a. a deletion of a codon b. a deletion of two nucleotides c. a substitution of the third nucleotide in an ACC codon d. a substitution of the first nucleotide of a GGG codon e. an insertion of a codon

9. You briefly expose bacteria undergoing DNA replication to radioactively labeled nucleotides. When you centrifuge the DNA isolated from the bacteria, the DNA separates into two classes. One class of labeled DNA includes very large molecules (thousands or even millions of nucleotides long), and the other includes short stretches of DNA (several hundred to a few thousand nucleotides in length). These two classes of DNA probably represent
a. leading strands and Okazaki fragments. b. lagging strands and Okazaki fragments. c. Okazaki fragments and RNA primers. d. leading strands and RNA primers. e. RNA primers and mitochondrial DNA.

10. Which of the following does not occur in prokaryotic gene expression, but does occur in eukaryotic gene expression?
a. mRNA, tRNA, and rRNA are transcribed. b. RNA polymerase binds to the promoter. c. A poly-A tail is added to the 3' end of an mRNA and a cap is added to the 5' end. d. Transcription can begin as soon as translation has begun even a little. e. RNA polymerase requires a primer to elongate the molecule.

Use Figure 13.3 to answer the following question.

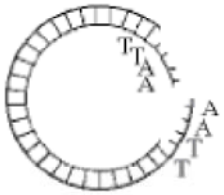

Figure 13.3

11. Which enzyme was used to produce the molecule in Figure 13.3?
a. ligase b. transcriptase c. a restriction enzyme d. RNA polymerase e. DNA polymerase

12. Which of the following provides some evidence that RNA probably evolved before DNA?
a. RNA polymerase uses DNA as a template. b. RNA polymerase makes a single-stranded molecule. c. RNA polymerase does not require localized unwinding of the DNA. d. DNA polymerase uses primer, usually made of RNA. e. DNA polymerase has proofreading function.

13. What is the role of DNA ligase in the elongation of the lagging strand during DNA replication?
a. It synthesizes RNA nucleotides to make a primer. b. It catalyzes the lengthening of telomeres. c. It joins Okazaki fragments together. d. It unwinds the parental double helix. e. It stabilizes the unwound parental DNA.

14. Alternative RNA splicing
a. is a mechanism for increasing the rate of transcription. b. can allow the production of proteins of different sizes and functions from a single mRNA. c. can allow the production of similar proteins from different RNAs. d. increases the rate of transcription. e. is due to the presence or absence of particular snRNPs.

15. Which of the following help(s) to hold the DNA strands apart while they are being replicated?
a. primase b. ligase c. DNA polymerase d. single-strand binding proteins e. exonuclease

16. A mutant bacterial cell has a defective aminoacyl-tRNA synthetase that attaches a lysine to tRNAs with the anticodon AAA instead of the normal phenylalanine. The consequence of this for the cell will be that
a. none of the proteins in the cell will contain phenylalanine. b. proteins in the cell will include lysine instead of phenylalanine at amino acid positions specified by the codon UUU. c. the cell will compensate for the defect by attaching phenylalanine to tRNAs with lysine-specifying anticodons. d. the ribosome will skip a codon every time a UUU is encountered. e. none of the options will occur; the cell will recognize the error and destroy the tRNA.

17. Which of the following is the first event to take place in translation in eukaryotes?
a. elongation of the polypeptide b. base pairing of activated methionine-tRNA to AUG of the messenger RNA c. binding of the larger ribosomal subunit to smaller ribosomal subunits d. covalent bonding between the first two amino acids e. the small subunit of the ribosome recognizes and attaches to the 5' cap of mRNA

18. Why might a point mutation in DNA make a difference in the level of a protein's activity?
a. It might result in a chromosomal translocation. b. It might exchange one stop codon for another stop codon. c. It might exchange one serine codon for a different serine codon. d. It might substitute a different amino acid in the active site. e. It might substitute the N-terminus of the polypeptide for the C-terminus.

19. Which of the following best describes the significance of the TATA box in eukaryotic promoters?
a. It is the recognition site for a specific transcription factor. b. It sets the reading frame of the mRNA. c. It prevents supercoiling of the DNA near the start site. d. It is the recognition site for ribosomal binding. e. Its significance has not yet been determined.

20. A frameshift mutation could result from
a. a base insertion only. b. a base deletion only. c. a base substitution only. d. deletion of three consecutive bases. e. either an insertion or a deletion of a base.

The following questions refer to the table of codons in Figure 14.2.

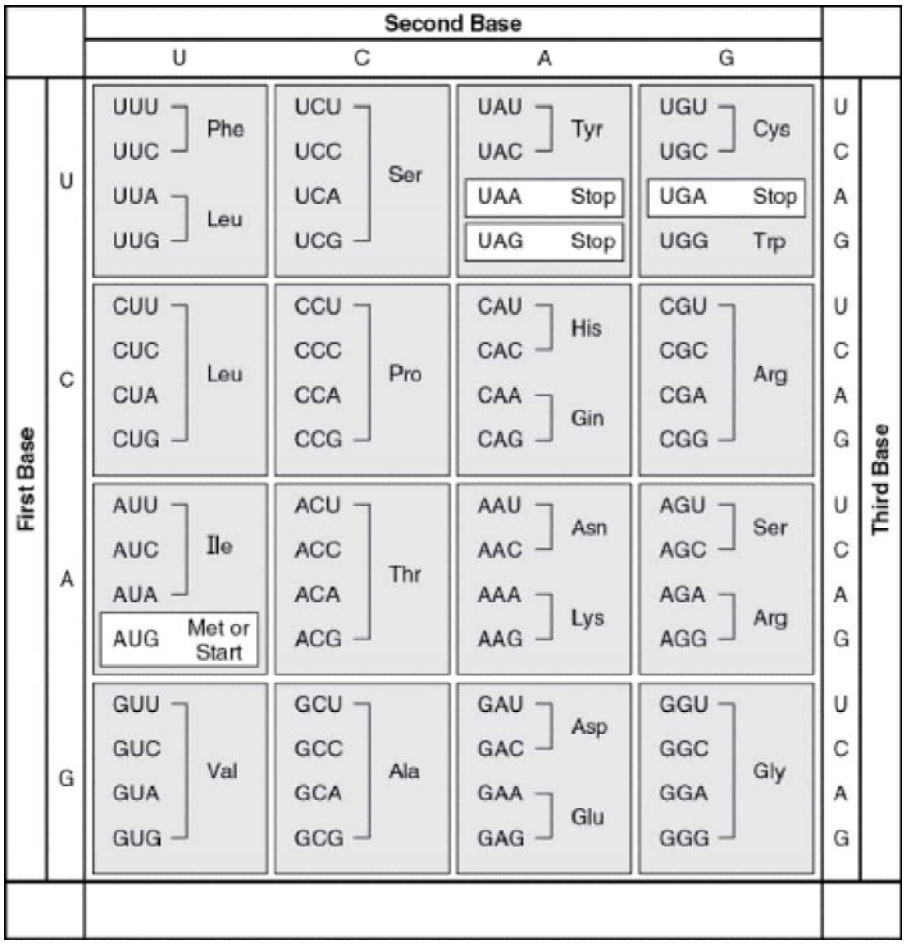

Figure 14.2

21. What amino acid sequence will be generated, based on the following mRNA codon sequence?
5' AUG-UCU-UCG-UUA-UCC-UUG 3'
a. met-arg-glu-arg-glu-arg b. met-glu-arg-arg-glu-leu c. met-ser-leu-ser-leu-ser
d. met-ser-ser-leu-ser-leu e. met-leu-phe-arg-glu-glu

22. A possible sequence of nucleotides in the template strand of DNA that would code for the polypeptide sequence phe-leu-ile-val would be
a. 5' TTG-CTA-CAG-TAG 3'. b. 3' AAC-GAC-GUC-AUA 5'. c. 5' AUG-CTG-CAG-TAT 3'. d. 3' AAA-AAT-ATA-ACA 5'. e. 3' AAA-GAA-TAA-CAA 5'.

23. A part of the promoter, called the TATA box, is said to be highly conserved in evolution. Which of the following might this illustrate?
a. The sequence evolves very rapidly. b. The sequence does not mutate. c. Any mutation in the sequence is selected against. d. The sequence is found in many but not all promoters. e. The sequence is transcribed at the start of every gene.

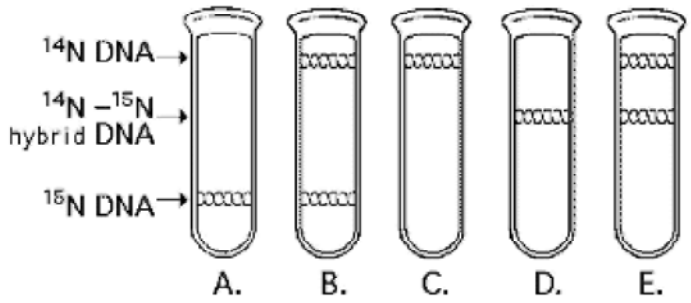

Figure 13.1

24. In the late 1950s, Meselson and Stahl grew bacteria in a medium containing "heavy" nitrogen (^{15}N) and then transferred them to a medium containing ^{14}N. Which of the results in Figure 13.1 would be expected after one round of DNA replication in the presence of ^{14}N?
    a. A b. B c. C d. D e. E

25. A space probe returns with a culture of a microorganism found on a distant planet. Analysis shows that it is a carbon-based life-form that has DNA. You grow the cells in ^{15}N medium for several generations and then transfer them to ^{14}N medium. Which pattern in Figure 13.1 would you expect if the DNA was replicated in a *conservative* manner?
    a. A b. B c. C d. D e. E

26. Cytosine makes up 42% of the nucleotides in a sample of DNA from an organism. Approximately what percentage of the nucleotides in this sample will be thymine?
    a. 8% b. 16% c. 31% d. 42% e. It cannot be determined from the information provided.

27. Which enzyme catalyzes the elongation of a DNA strand in the 5' $\rightarrow$ 3' direction?
    a. primase b. DNA ligase c. DNA polymerase III d. topoisomerase e. helicase

28. An Okazaki fragment has which of the following arrangements?
    a. primase, polymerase, ligase b. 3' RNA nucleotides, DNA nucleotides 5' c. 5' RNA nucleotides, DNA nucleotides 3' d. DNA polymerase I, DNA polymerase III e. 5' DNA to 3'

29. Why do histones bind tightly to DNA?
    a. Histones are positively charged, and DNA is negatively charged. b. Histones are negatively charged, and DNA is positively charged. c. Both histones and DNA are strongly hydrophobic. d. Histones are covalently linked to the DNA. e. Histones are highly hydrophobic, and DNA is hydrophilic.

30. What is the function of DNA polymerase III?
    a. to unwind the DNA helix during replication b. to seal together the broken ends of DNA strands
    c. to add nucleotides to the 3' end of a growing DNA strand d. to degrade damaged DNA molecules
    e. to rejoin the two DNA strands (one new and one old) after replication

31. Polytene chromosomes of *Drosophila* salivary glands each consist of multiple identical DNA strands that are aligned in parallel arrays. How could these arise?
a. replication followed by mitosis b. replication without separation c. meiosis followed by mitosis
d. fertilization by multiple sperm e. special association with histone proteins

32. Individuals with the disorder xeroderma pigmentosum are hypersensitive to sunlight. This occurs because their cells are impaired in what way?
a. They cannot replicate DNA. b. They cannot undergo mitosis. c. They cannot exchange DNA with other cells. d. They cannot repair thymine dimers. e. They do not recombine homologous chromosomes during meiosis.

33. Which of the following nucleotide triplets best represents a codon?
a. a triplet separated spatially from other triplets b. a triplet that has no corresponding amino acid c. a triplet at the opposite end of tRNA from the attachment site of the amino acid d. a triplet in the same reading frame as an upstream AUG e. a sequence in tRNA at the 3' end

34. Replication in prokaryotes differs from replication in eukaryotes for which of the following reasons?
a. Prokaryotic chromosomes have histones, whereas eukaryotic chromosomes do not. b. Prokaryotic chromosomes have a single origin of replication, whereas eukaryotic chromosomes have many. c. The rate of elongation during DNA replication is slower in prokaryotes than in eukaryotes. d. Prokaryotes produce Okazaki fragments during DNA replication, but eukaryotes do not. e. Prokaryotes have telomeres, and eukaryotes do not.

35. The genetic code is essentially the same for all organisms. From this, one can logically assume which of the following?
a. A gene from an organism can theoretically be expressed by any other organism. b. All organisms have experienced convergent evolution. c. DNA was the first genetic material. d. The same codons in different organisms translate into the different amino acids. e. Different organisms have different numbers of different types of amino acids.

36. How do we describe transformation in bacteria?
a. the creation of a strand of DNA from an RNA molecule b. the creation of a strand of RNA from a DNA molecule c. the infection of cells by a phage DNA molecule d. the type of semiconservative replication shown by DNA e. assimilation of external DNA into a cell

37. At a specific area of a chromosome, the following sequence of nucleotides is present where the chain opens to form a replication fork:
3' C C T A G G C T G C A A T C C 5'
An RNA primer is formed starting at the underlined T (T) of the template. Which of the following represents the primer sequence?
a. 5' G C C T A G G 3' b. 3' G C C T A G G 5' c. 5' A C G T T A G G 3' d. 5' A C G U U A G G 3'
e. 5' G C C U A G G 3'

38. What is the most logical sequence of steps for splicing foreign DNA into a plasmid and inserting the plasmid into a bacterium?
I. Transform bacteria with a recombinant DNA molecule.
II. Cut the plasmid DNA using restriction enzymes.
III. Extract plasmid DNA from bacterial cells.
IV. Hydrogen-bond the plasmid DNA to nonplasmid DNA fragments.
V. Use ligase to seal plasmid DNA to nonplasmid DNA.
a. I, II, IV, III, V b. II, III, V, IV, I c. III, II, IV, V, I d. III, IV, V, I, II e. IV, V, I, II, III

39. In *E. coli*, there is a mutation in a gene called *dnaB* that alters the helicase that normally acts at the origin. Which of the following would you expect as a result of this mutation?
a. No proofreading will occur. b. No replication fork will be formed. c. The DNA will supercoil.
d. Replication will occur via RNA polymerase alone. e. Replication will require a DNA template from another source.

40. The leading and the lagging strands differ in that
a. the leading strand is synthesized in the same direction as the movement of the replication fork, and the lagging strand is synthesized in the opposite direction. b. the leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, and the lagging strand is synthesized by adding nucleotides to the 5' end. c. the lagging strand is synthesized continuously, whereas the leading strand is synthesized in short fragments that are ultimately stitched together. d. the leading strand is synthesized at twice the rate of the lagging strand.

41. Which of the following is a function of a signal peptide?
a. to direct an mRNA molecule into the cisternal space of the ER b. to bind RNA polymerase to DNA and initiate transcription c. to terminate translation of the messenger RNA d. to translocate polypeptides across the ER membrane e. to signal the initiation of transcription

42. Which of the following statements describes the eukaryotic chromosome?
a. It is composed of DNA alone. b. The nucleosome is its most basic functional subunit. c. The number of genes on each chromosome is different in different cell types of an organism. d. It consists of a single linear molecule of double-stranded DNA plus proteins. e. Active transcription occurs on heterochromatin but not euchromatin.

43. A eukaryotic transcription unit that is 8,000 nucleotides long may use 1,200 nucleotides to make a protein consisting of approximately 400 amino acids. This is best explained by the fact that
a. many noncoding stretches of nucleotides are present in eukaryotic DNA. b. there is redundancy and ambiguity in the genetic code. c. many nucleotides are needed to code for each amino acid.
d. nucleotides break off and are lost during the transcription process. e. there are termination exons near the beginning of mRNA.

44. For a science fair project, two students decided to repeat the Hershey and Chase experiment, with modifications. They decided to label the nitrogen of the DNA, rather than the phosphate. They reasoned that each nucleotide has only one phosphate and two to five nitrogens. Thus, labeling the nitrogens would provide a stronger signal than labeling the phosphates. Why won't this experiment work?
a. There is no radioactive isotope of nitrogen. b. Radioactive nitrogen has a half-life of 100,000 years, and the material would be too dangerous for too long. c. Avery et al. have already concluded that this experiment showed inconclusive results. d. Although there are more nitrogens in a nucleotide, labeled phosphates actually have 16 extra neutrons; therefore, they are more radioactive. e. Amino acids (and thus proteins) also have nitrogen atoms; thus, the radioactivity would not distinguish between DNA and proteins.

45. The reason for using Taq polymerase for PCR is that
a. it is heat stable and can withstand the heating step of PCR. b. only minute amounts are needed for each cycle of PCR. c. it binds more readily than other polymerases to the primers. d. it has regions that are complementary to the primers. e. it is heat stable, and it binds more readily than other polymerases to the primers.

46. A new DNA strand elongates only in the 5' to 3' direction because
a. DNA polymerase begins adding nucleotides at the 5' end of the template. b. Okazaki fragments prevent elongation in the 3' to 5' direction. c. the polarity of the DNA molecule prevents addition of nucleotides at the 3' end. d. replication must progress toward the replication fork. e. DNA polymerase can only add nucleotides to the free 3' end.

47. A particular triplet of bases in the coding sequence of DNA is AAA. The anticodon on the tRNA that binds the mRNA codon is
a. TTT. b. UUA. c. UUU. d. AAA. e. either UAA or TAA, depending on first base wobble.

48. The difference between ATP and the nucleoside triphosphates used during DNA synthesis is that
a. the nucleoside triphosphates have the sugar deoxyribose; ATP has the sugar ribose. b. the nucleoside triphosphates have two phosphate groups; ATP has three phosphate groups. c. ATP contains three high-energy bonds; the nucleoside triphosphates have two. d. ATP is found only in human cells; the nucleoside triphosphates are found in all animal and plant cells. e. triphosphate monomers are active in the nucleoside triphosphates, but not in ATP.

49. A particular triplet of bases in the template strand of DNA is 5' AGT 3'. The corresponding codon for the mRNA transcribed is
a. 3' UCA 5'. b. 3' UGA 5'. c. 5' TCA 3'. d. 3' ACU 5'. e. either UCA or TCA, depending on wobble in the first base.

50. There are 61 mRNA codons that specify an amino acid, but only 45 tRNAs. This is best explained by the fact that
a. some tRNAs have anticodons that recognize four or more different codons. b. the rules for base pairing between the third base of a codon and tRNA are flexible. c. many codons are never used, so the tRNAs that recognize them are dispensable. d. the DNA codes for all 61 tRNAs but some are then destroyed. e. competitive exclusion forces some tRNAs to be destroyed by nucleases.