AP Biology TEST #4 - Chapters 13-18 - REVIEW SHEET

1. Griffith's experiments showing the transformation of R strain pneumococcus bacteria to S strain pneumococcus bacteria in the presence of heat-killed S strain bacteria gave evidence that
   A) an external factor was affecting the R strain bacteria.
   B) DNA was definitely the transforming factor.
   C) S strain bacteria could be reactivated after heat killing.
   D) All of the above

2. Experiments by Avery, MacLeod, and McCarty supported DNA as the genetic material by showing that
   A) both protein and DNA samples provided the transforming factor.
   B) DNA was not complex enough to be the genetic material.
   C) only samples with DNA provided transforming activity.
   D) even though DNA was molecularly simple, it provided adequate variation to act as the genetic material.

3. Hershey and Chase used radioactive ^{35}S and ^{32}P in experiments to provide evidence that DNA was the genetic material. These experiments pointed to DNA because
   A) progeny viruses retained ^{32}P but not ^{35}S.
   B) presence of ^{32}P in progeny viruses indicated that DNA was passed on.
   C) absence of ^{35}S in progeny viruses indicated that proteins were not passed on.
   D) All of the above

4. Chargaff observed that the amount of
   A) purines is roughly equal to the amount of pyrimidines in all tested organisms.
   B) A is roughly equal to the amount of T in all tested organisms.
   C) A + T is roughly equal to the amount of G + C in all tested organisms.
   D) Both a and b

5. Watson and Crick's model allowed them to visualize
   A) the molecular bonds of DNA.
   B) how the purines and pyrimidines fit together in a double helix.
   C) that the two strands of the DNA double helix were antiparallel.
   D) All of the above

6. A fundamental requirement for the function of genetic material is that it must be
   A) conserved among all organisms with very little variation.
   B) passed intact from one species to the next species.
   C) accurately replicated.
   D) found outside the nucleus.

7. Evidence indicating that DNA replication was semiconservative came from
   A) DNA staining techniques.
   B) DNA sequencing.
   C) density gradient studies using "heavy" nucleotides.
   D) None of the above

8. The primary function of DNA polymerase is to
   A) add nucleotides to the growing daughter strand.
   B) seal nicks along the sugar–phosphate backbone of the daughter strand.
   C) unwind the parent DNA double helix.
   D) prevent reassociation of the denatured parent DNA strands.

9. The lagging daughter strand of DNA is synthesized in what appears to be the "wrong" direction. This synthesis is accomplished by
   A) synthesizing short Okazaki fragments in a 5′-to-3′ direction.
   B) synthesizing multiple short RNA primers to initiate DNA replication.
   C) using DNA polymerase I to remove RNA primers from Okazaki fragments.
   D) All of the above

10. RNA primers are necessary in DNA synthesis because
   A) DNA polymerase is unable to initiate replication without an origin.
   B) the DNA polymerase enzyme can only catalyze the addition of deoxyribonucleotides onto the 3′ (—OH) end of an existing strand.
   C) RNA primase is the first enzyme in the replication complex.
   D) All of the above

11. Proofreading and repair occur
   A) at any time during or after synthesis of DNA.
   B) only before DNA methylation occurs.
   C) only in the presence of DNA polymerase.
   D) only in the presence of an excision repair mechanism.

12. *T. aquaticus* DNA polymerase is not denatured during the heat cycling required to denature DNA. This property led to advances in what technique?
   A) RFLP analysis
   B) PCR
   C) Sequencing
   D) EPA

13. Thirty percent of the bases in a sample of DNA extracted from eukaryotic cells is adenine. What percentage of cytosine is present in this DNA?
   A) 10 percent
   B) 20 percent
   C) 30 percent
   D) 40 percent

14. Which of the following represents a bond between a purine and a pyrimidine (in that order)?
   A) C–T
   B) G–A
   C) G–C
   D) T–A

15. Which of the following statements about DNA replication is false?
    A) Okazaki fragments are synthesized as part of the leading strand.
    B) Replication forks represent areas of active DNA synthesis on the chromosomes.
    C) Error rates for DNA replication are often less than one in every billion base pairings.
    D) Ligases and polymerases function in the vicinity of replication forks.

16. Which of the following would not be found in a DNA molecule?
    A) Purines
    B) Ribose sugars
    C) Phosphates
    D) Sulfur

17. If a nucleotide lacking a hydroxyl group at the 3′ end were added to a PCR reaction, what would be the outcome?
    A) No additional nucleotides would be added to a growing strand containing that nucleotide.
    B) Strand elongation would proceed as normal.
    C) Nucleotides would only be added at the 5′ end.
    D) *T. aquaticus* DNA polymerase would be denatured.

18. Transcription in prokaryotic cells
    A) occurs in the nucleus, whereas translation occurs in the cytoplasm.
    B) is initiated at a start codon with the help of initiation factors and the small subunit of the ribosome.
    C) is initiated at a promoter and uses only one strand of DNA, the template strand, to synthesize a comple mentary RNA strand.
    D) is terminated at stop codons.

19. Which of the following about RNA polymerase is not true?
    A) It synthesizes mRNA in a 5′-to-3′ direction reading the DNA strand 3′-to-5′.
    B) It synthesizes mRNA in a 3′-to-5′ direction reading the DNA strand 5′-to-3′.
    C) It binds at the promoter and unwinds the DNA.
    D) It does not require a primer to initiate transcription.

20. If a codon were read two bases at a time instead of three bases at a time, how many different possible amino acids could be specified?
    A) 16
    B) 64
    C) 8
    D) 32

21. Translate the following mRNA (Use the genetic code from your notes/textbook):
    3′-G A U G G U U U U A A A G U A- 5′
    A) NH_2 met—lys—phe—leu—stop COOH
    B) NH_2 met—lys—phe—trp—stop COOH
    C) NH_2 asp—gly—phe—lys—val COOH
    D) NH_2 asp—gly—phe—lys—stop COOH

22. What would happen if a mutation occurred in DNA such that the second codon of the resulting mRNA was changed from UGG to UAG?
    A) Nothing. The ribosome would skip that codon and translation would continue.
    B) Translation would continue, but the reading frame of the ribosome would be shifted.
    C) Translation would stop at the second codon, and no functional protein would be made.
    D) Translation would continue, but the second amino acid in the protein would be different.

23. If the following synthetic RNA were added to a test tube containing all the components necessary for protein translation to occur, what would the amino acid sequence be? (Use the genetic code from your notes/textbook)
    5′-A U A U A U A U A U A U - 3′
    A) Polyphenylalanine
    B) Isoleucine-tyrosine-isoleucine-tyrosine
    C) Isoleucine-isoleucine-isoleucine-isoleucine
    D) Tyrosine-tyrosine-tyrosine-tyrosine

24. What part of the tRNA base-pairs with the codon in the mRNA?
    A) The 3′ end, where the amino acid is covalently attached
    B) The 5′ end
    C) The anticodon
    D) The promoter

25. Termination of translation requires
    A) release factor, initiator tRNA, and ribosomes.
    B) initiation factors, the small subunit of the ribosome, and mRNA.
    C) elongation factors and charged tRNAs.
    D) a stop codon positioned at the A site of the ribosome, peptidyl transferase, and release factor.

26. Which of the following mutations would probably be the most deleterious?
    A) A missense mutation in the second codon
    B) A frame-shift mutation in the second codon
    C) A nonsense mutation in the last codon
    D) A silent mutation in the second codon

27. If the DNA encoding a nuclear signal sequence were placed in the gene for a cytoplasmic protein, what would happen?
    A) The protein would be directed to the lysosomes.
    B) The protein would be directed to the nucleus.
    C) The protein would be directed to the cytoplasm.
    D) The protein would stay in the endoplasmic reticulum.

28. The central dogma of molecular biology states that _____ is transcribed into _____, which is translated into _____.
    A) genes; polypeptides; gene product
    B) protein; DNA; RNA
    C) DNA; mRNA; tRNA
    D) DNA; RNA; protein

29. A gene product can be a(n)
    A) enzyme.
    B) polypeptide.
    C) RNA.
    D) All of the above

30. The enzyme that catalyzes the synthesis of RNA is
    A) DNA polymerase.
    B) tRNA synthetase.
    C) ribosomal RNA.
    D) RNA polymerase.

31. Viruses consist of
    A) a protein core and a nucleic acid capsid.
    B) a cell wall surrounding nucleic acid.
    C) RNA and DNA enclosed in a membrane.
    D) a nucleic acid core surrounded by a protein capsid and in some cases a membrane.

32. Bacterial cells that are resistant to viruses
    A) lack a cell surface receptor that the virus must bind to infect the cell.
    B) harbor a prophage in their chromosome, making the bacterial cell immune to further viral infection.
    C) cannot be lysed by the bacteriophage.
    D) All of the above

33. Lytic bacterial viruses
    A) infect the cell, replicate their genomes, and lyse the cell.
    B) infect the cell, replicate their genomes, transcribe and translate their genes, and lyse the cell.
    C) infect the cell, replicate their genomes, transcribe and translate their genes, package those genomes into viral capsids, and lyse the cell.
    D) infect the cell, translate their RNA, and lyse the cells.

34. Animal viruses that integrate their DNA into the host chromosome
    A) are RNA viruses.
    B) are prophages.
    C) copy their RNA genome into DNA using reverse transcriptase.
    D) Both a and c

35. During conjugation,
    A) DNA from one bacterial cell is transferred to another bacterial cell using a bacteriophage.
    B) mutants that are auxotrophic for one nutrient can be converted to prototrophs when mixed with mutants that are auxotrophic for another nutrient.
    C) a pilus is synthesized, and DNA is transferred from one bacterium across the conjugation tube to the recipient bacterium.
    D) Both b and c

36. Plasmid DNA may contain genes that can
    A) confer drug resistance to the host cell.
    B) regulate conjugation.
    C) confer resistance to heavy metals.
    D) All of the above

37. An operon
    A) is regulated by a repressor binding at the promoter.
    B) has structural genes that are all transcribed from same promoter.
    C) has several promoters, but all of the structural genes are related biochemically.
    D) is a set of structural genes all under the same translational regulation.

38. If the gene encoding the lac repressor is mutated so that the repressor can no longer bind the operator, will transcription of that operon occur?
    A) Yes, but only when lactose is present.
    B) No, because RNA polymerase is needed to transcribe the genes.
    C) Yes, because RNA polymerase will be able to bind the promoter and transcribe the operon.
    D) No, because cAMP levels are low when the repressor is nonfunctional.

39. If the gene encoding the trp repressor is mutated such that it can no longer bind tryptophan, will transcription of the trp operon occur?
    A) Yes, because the *trp* repressor can only bind the *trp* operon and block transcription when it is bound to tryptophan.
    B) No, because this mutation does not affect the part of the repressor that can bind the operator.
    C) No, because the *trp* operon is repressed only when tryptophan levels are high.
    D) Yes, because the *trp* operon can allosterically regulate the enzymes needed to synthesize the amino acid tryptophan.

40. A transposon is used to inactivate genes in a bacterium. If the inactivated gene is essential the bacterium will
    A) live.
    B) die.
    C) be a prototroph.
    D) be resistant to viral infection.

41. Eukaryotic chromosomes
    A) are circular and contain origins and terminator sequences.
    B) are linear and have origins and telomeres.
    C) contain coding and noncoding sequences.
    D) Both b and c

42. Model eukaryotic organisms have helped biologists understand
    A) genes involved in development.
    B) gene families.
    C) genes encoding proteins that are essential for all cells.
    D) All of the above

43. Moderately repetitive DNA includes
    A) only coding sequences.
    B) only noncoding sequences.
    C) coding and noncoding sequences.
    D) satellites, minisatellites, and microsatellites.

44. Transposable genetic elements
    A) always affect the cell adversely, because when they move, they inactivate genes.
    B) are retroviruses.
    C) provide a mechanism for moving genetic material from organelle genomes to the nuclear genome.
    D) always replicate their DNA when they move.

45. Introns are DNA sequences that
    A) code for functional domains in proteins.
    B) are removed from pre-mRNA by spliceosomes.
    C) allow one gene to make different gene products, depending on which introns are removed during splicing.
    D) Both b and c

46. Pre-mRNAs must be processed in the nucleus in order to
    A) increase their stability in the cytoplasm.
    B) allow RNA polymerase to initiate transcription.
    C) permit coding sequences to be joined to adjacent noncoding sequences.
    D) facilitate ribosome recognition in preparation for DNA synthesis.

47. The transcription complex includes _____ and _____.
    A) transcription factors; promoters
    B) regulator proteins; regulators
    C) repressor proteins; silencers
    D) Both a and b

48. DNA binding proteins
    A) have distinct three-dimensional structures that allow them to bind to the DNA.
    B) can be transcription factors.
    C) can help condense the DNA in the nucleus.
    D) All of the above

49. Chromatin structure must be altered for gene expression to occur because
    A) condensed chromatin is replicated but not transcribed.
    B) condensed chromatin makes most DNA sequences inaccessible to the transcription complex.
    C) decondensed chromatin has more nucleosomes per DNA molecule.
    D) heterochromatin is actively transcribed and euchromatin is not transcribed.

50. When DNA sequences are moved to new sites on a chromosome,
    A) new genes can be transcribed.
    B) genes can be inactivated.
    C) new genes can be created.
    D) All of the above

51. Posttranscriptional regulation can include
    A) binding of repressor on silencer regions.
    B) insertion and alteration of nucleotides.
    C) decreasing mRNA stability in the cytoplasm.
    D) Both b and c

52. Genes can be inactivated by
    A) inaccurate removal of introns.
    B) transposable genetic elements.
    C) movement of genes to heterochromatic regions of the chromosome.
    D) All of the above

53. Cloning a gene may involve
    A) restriction endonucleases and ligase.
    B) plasmids and bacteriophage λ.
    C) yeast artificial chromosomes and complementary base pairing.
    D) All of the above

54. Restriction endonucleases
    A) are enzymes that process pre-mRNAs.
    B) are enzymes that degrade DNA.
    C) protect bacterial cells from viral infections.
    D) All of the above

55. DNA fragments are separated using gel electrophoresis
    A) because DNA is pulled through the gel toward the negative end of the field.
    B) because larger DNA fragments move faster through the gel than smaller DNA fragments.
    C) to identify and isolate DNA fragments.
    D) to synthesize DNA for cloning.

56. Complementary base pairing is important for
    A) ligation reactions with blunt-end DNA molecules.
    B) hybridization between DNA and transcription factors.
    C) restriction endonucleases to cut cell walls.
    D) synthesizing cDNA molecules from mRNA templates.

57. For a prokaryotic vector to be propagated in a host bacterial cell, the vector needs
    A) telomeres.
    B) centromeres.
    C) drug-resistance genes.
    D) an origin of replication.

58. Gene expression can be inhibited by
    A) antisense RNA.
    B) knockout genes.
    C) DNA chips.
    D) Both a and b

59. DNA fingerprinting works because
    A) genes containing the same alleles make it simple to compare different individuals.
    B) PCR allows amplification of proteins from single cells.
    C) there are multiple alleles for some DNA sequences, making it possible to obtain unique patterns for each individual.
    D) DNA in the skin cells is very diverse.

60. RNAi
    A) is more effective than antisense RNA in inhibiting translation.
    B) inhibits transcription in eukaryotes.
    C) is produced only by viruses.
    D) Both a and c

61. DNA chip technologies can be used to
    A) predict who will get cancer.
    B) show transcriptional patterns in an organism during different times of development.
    C) clone DNA.
    D) make transgenic plants.

62. Given the following parent strand sequence, what would the daughter strand sequence look like?

5′ – G C T A A C T G T G A T C G T A T A A G C T G A – 3′

63. Diagram the double helix. Be sure to label those properties that make it most suited as the genetic material.

64. Diagram a replication fork as it would be seen in a replicating segment of DNA. In your diagram label the 5′ and 3′ ends of each parent strand and daughter strand. Indicate which new strand is the leading strand and which is the lagging strand of the daughter DNA.

65. Based on your diagram in Question 64, construct a flowchart that represents what occurs during DNA replication. In your chart, indicate the roles of helicase, DNA polymerase, single-stranded DNA binding proteins, nucleotides, parental (template) DNA strands, DNA ligase, RNA primase, and RNA primers.

66. Explain the difference between conservative and semiconservative models of DNA replication. What results supported the semiconservative model? What would the results have looked like had the conservative model of DNA replication been accurate? Are there any other potential hypotheses?

67. What would happen if the tRNA synthetase for tryptophan actually added a phenylalanine to the trp tRNAs instead of tryptophan?

68. Mutations can be very harmful to an organism, yet without them life as we know it today would not exist. Explain.

69. A mutation occurs in the promoter of a eukaryotic gene, eliminating the TATA box. How will this mutation affect the transcription of this gene?

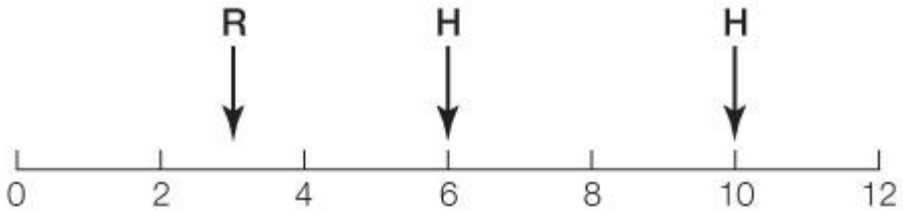
70. A different mutation eliminates the enhancer sequence on the DNA for this gene. How will this mutation affect the transcription of this gene?

71. Describe one posttranscriptional regulatory event and one posttranslational regulatory event that controls the level of gene expression in eukaryotic cells.

72. Describe three useful products that have been produced using biotechnology. Outline two specific dangers that could result from producing organisms that contain foreign genes.

Use the following to answer questions 73-75:

Below is a map of a fragment of 12-kilobase DNA with the locations of *Eco*RI (R) and *Bam*HIII (H) restriction sites indicated. The numbers represent the distance in kilobases (kb = one thousand base pairs).



73. **Diagram** - What fragments would result if the fragment were cut with *Eco*RI?

74. **Diagram** - What fragments would result if the fragment were cut with *Bam*HIII?

75. **Diagram** - A researcher performing gel electrophoresis places the DNA digested with *Eco*RI in Lane 1 and the DNA digested with *Bam*HIII in Lane 2. What should the gel look like?

Answer Key

1. A
2. C
3. D
4. D
5. D
6. C
7. C
8. A
9. D
10. B
11. A
12. B
13. B
14. C
15. A
16. D
17. A
18. C
19. B
20. A
21. B
22. C
23. B
24. C
25. D
26. B
27. B
28. D
29. D
30. D
31. D
32. D
33. C
34. D
35. D
36. D
37. B
38. C
39. A
40. B
41. D
42. D
43. C
44. C
45. D
46. A
47. D
48. D
49. B
50. D
51. D
52. D
53. D
54. C
55. C
56. D
57. D
58. D
59. C
60. A
61. B
62. 3' – C G A T T G A C A C T A G C A T A T T C G A C T – 5'
63. See Figure 11.6 in the text.
64. See Figure 11.15 and 11.16 in the text.
65. See Figure 11.15 and 11.16 in the text.
66. In the conservative model of DNA replication, the parent DNA remains intact, and a newly synthesized molecule consists of two newly replicated daughter strands. Had this been DNA's method of replication, Meselson and Stahl would not have seen the intermediate density band in the first generation of replication. They would have seen a heavy band corresponding to the parental DNA and a light band corresponding to the daughter DNA. Because they saw an intermediate band, they knew one strand was heavy and one was light; therefore, replication was semiconservative, with each new molecule consisting of one parental strand and one daughter strand. A third hypothesis was the dispersive model, with each new molecule containing bits and pieces of both old and new strands.
67. If the tRNA synthetase for tryptophan added phenyla lanine to the trp tRNAs, everytime a tryptophan codon was read by these trp tRNAs, phenylalanine would be added to the polypeptide. This would create proteins that were nonfunctional, and the cell would die.

68. Mutations very often have damaging effects on a gene, rendering that gene product nonfunctional. Some mutations actually create gene products that are better for the cell or organism and may increase its ability to survive. Mutations over the course of evolutionary time have created new organisms that could survive in different environments or compete more effectively for limited resources. Without mutations evolution does not occur.
69. If the TATA box of the promoter for a eukaryotic gene is deleted, transcription factor TFIID will not bind the promoter. The transcription complex will not assemble at the promoter and there will be no initiation of transcription.
70. If the enhancer for a gene is deleted, transcription for that gene will still occur, but at a reduced rate.
71. Posttranscriptional regulatory events can include events that affect splicing, mRNA stability and inhibition of translation by microRNAs. Posttranslational events can include modifying the G cap so that the mRNA will be translated and protein degraded.
72. Useful products include rice grains that produce β-carotene, plants that are resistant to herbicides and insect larvae, sheep that produce human blood-clotting factors and antibodies to colon cancer in their milk, and others (see Tables 16.1 and 16.2). Dangers include creating genetically engineered foods that could adversely affect human nutrition, the transfer of herbicide- and insect-resistant genes from crop plants into noxious weeds, and the introduction into the wild of new organisms that might have unforeseen ecological consequences.
73. There would be two fragments: one 3 kb long and the other 9 kb long.
74. There would be three fragments with sizes of 2, 4, and 6 kb.
75.