

Griffith, Avery, MacLeod and

1. What does transformation involve 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. The transfer of DNA from one strain to another
- assimilation of external DNA into a cell.
2. What happens when T₂ phages are grown with radioactive phosphorous?
- A. Their DNA becomes radioactive
 - B. Their proteins become radioactive
 - C. Their DNA is found to be of medium density in a centrifuge tube
 - D. They are no longer able to transform bacterial cells
 - E. They transfer their radioactivity to E. coli chromosomes during infection.
3. In the following list of DNA properties, which one would be impossible for a single-stranded DNA molecule?
- A. Replication
 - B. Information storage
 - C. Exchange with other organisms
 - D. Repair of thymine dimers
 - E. Mutation
4. To function as the heritable genetic code, DNA molecules must have all of the following structural features EXCEPT
- A. The ability to form complementary base pairs with other DNA nucleotides.
 - B. The ability to form complementary base pairs with RNA nucleotides.
 - C. A very stable double-stranded form when not being transcribed or replicated.
 - D. A sequence of nucleotides that can be decoded into a sequence of amino acids in a protein.
 - E. Histone proteins associated with the double helix.

Refer to the following list of enzymes to answer Questions 5 – 8. The answers may be used once, more than once, or not at all.

- A. Helicase
- B. Exonuclease
- C. Ligase
- D. Polymerase
- E. Primase

synthesizes short segments of RNA

5. Catalyzes synthesis of a new strand of DNA **B Polymerase**

6. Enhances separation of DNA strands during replication **A Helicase**

7. Covalently connects segments of DNA **C Ligase**

8. Synthesizes short segments of RNA **B Polymerase Primase**

point mutation - change in a single DNA base.

→ transition - if purine replaces a purine, ie (A to G or G to A) or pyrimidine replaces a pyrimidine (C to T or T to C).

→ transversion - if a purine replaces a pyrimidine ie (A or G to T or C) or vice versa.

Silent mutation - no obvious effect at all on the phenotype

9. If cytosine makes up 22% of the nucleotides in a sample of DNA, then adenine would make up what percent of the bases?

- A. 22
- B. 44
- C. 28
- D. 56
- E. It cannot be determined from the information provided.

10. All of the following were determined directly from X-ray diffraction photographs of crystallized DNA EXCEPT

- A. The diameter of the double helix
- B. The helical shape of the DNA
- C. The specificity of base of base pairing
- D. The linear distance required for one full turn of the double helix
- E. The width of the helix

11. The problem of replicating the lagging strand - that is, adding bases in the $3' \rightarrow 5'$ direction is solved by DNA through the use of

- A. Base pairing
- B. Replication forks
- C. The enzyme helicase
- D. Okazaki fragments
- E. Topoisomerase

12. What kind of bonds are found between stacking bases of the DNA double helix?

- A. Hydrogen
- B. Phosphodiester
- C. Electron interaction
- D. Covalent
- E. Ionic

13. What is the primer that is required to initiate the synthesis of a new DNA strand?

- A. RNA
- B. DNA
- C. Protein
- D. Ligase
- E. Primase

14. Which of the following descriptions best fits the class of molecules known as nucleotides?

- A. A nitrogen base, a sugar and a phosphate group
- B. A nitrogen base and a five-carbon sugar only
- C. A nitrogen base, a phosphate group, and a five-carbon sugar
- D. A five-carbon sugar, a phosphate group, and a purine
- E. A pyrimidine, a purine and a six-carbon sugar

- missense mutation - change in codon specifying normally a particular amino acid codes for a diff aa. e.g. sickle cell disease in which glutamic acid (GAG) is changed to valine (GUC).

- Nonsense mutation - point mutation changing a codon specifying an aa into a "stop" codon (UAA, UGA, UAG), shortening protein polt.
e.g. Factor VIII clotting disorder. (GAG → UAA)
glutamic acid → stop

Refer to the following information to answer Questions 15 – 17. For each of the important discoveries that led to our present knowledge of the nature of genes described below, select the investigator(s) associated with each.

- A. Griffith
- B. Avery and MacLeod
- C. Avery, MacLeod, and McCarty
- D. Chargaff
- E. Meselson and Stahl

Chemicals from heat-killed S cells were purified. The chemicals were tested for the ability to transform R cells. The transforming agent was found to be DNA.

The DNA of a phage was injected into the bacterial host, but the protein coat stayed outside. The viral DNA directed the host to replicate new phage viruses.

In any DNA sample, the amount of adenine equals the amount of thymine and the amount of guanine equals the amount of cytosine. Changoff

15. When T2 phage viruses that infect bacteria make more viruses in the presence of radioactive sulphur, which of the following results?
- A. The viral DNA is tagged by radioactivity
 - B. The viral proteins are tagged by radioactivity
 - C. The viral DNA is found to be of medium density in a centrifuge tube
 - D. They transfer their radioactivity to *E. coli* DNA
 - E. Both the viral DNA and the viral proteins are tagged by radioactivity

16. Suppose one were provided with an actively dividing culture of *E. coli* bacteria to which radioactive thymine had been added. What would happen if a cell replicated once in the presence of this radioactive base?

A. One of the daughter cells, but not the other, would have radioactive DNA

B. Neither of the two daughter cells would be radioactive

C. Four bases of the DNA would be radioactive

D. Radioactive thymine would pair with nonradioactive thymine

E. DNA in both daughter cells would be radioactive

17. In DNA, the designations 3' and 5' refer to the

A. Bonds formed between phosphate groups and carbon atoms of deoxyribose.

B. Carbon or nitrogen atoms on the rings of purine or pyrimidine bases.

C. Bonding between purines and deoxyribose and between pyrimidines and deoxyribose

D. Cross-linking of the third and fifth carbon atoms of deoxyribose

E. Bonds that form between adenine and thymine and between guanine and cytosine

18. Which of the following statements does NOT apply to the Watson and Crick model of DNA?

A. The two strands of the DNA helix are antiparallel

B. The distance between the strands of the helix is 20 nanometers

C. The framework of the helix consists of sugar-phosphate units of the nucleotides

D. The two strands of the helix are held together by covalent bonds

E. The carbons of the sugars are attached to the pyrimidines

22. In an analysis of the nucleic acid component of DNA to see which bases are present in the concentration, which of the following would be true?

- A. A = C
- B. A = G and C = T
- C. A + C = G + T
- D. A + T = G + C
- E. Both (B) and (C) are true

$$\begin{array}{l} \text{A} = \text{T} \\ \text{G} = \text{C} \\ \text{C} = \text{G} \\ \text{G} = \text{C} \\ \text{A} = \text{T} \\ \text{C} = \text{G} \\ \text{G} = \text{C} \\ \text{A} = \text{T} \end{array}$$

23. What is the function of DNA polymerase?

- A. To unwind the DNA helix during replication
- B. To seal together the broken ends of DNA
- C. To add nucleotides to the end of a growing DNA strand
- D. To repair damaged DNA molecules
- E. To rejoin the two DNA strands (one new and one old) after replication

24. When a double-stranded DNA molecule is heated, it denatures into two single-stranded molecules. The reason for this is that

- A. The proteins associated with the double helix are denatured and can no longer hold the DNA strands together
- B. The heat causes the helix to straighten, breaking the connections between the bases
- C. The heat breaks the hydrogen bonds holding the bases together in the center of the molecule but does not affect the covalent bonds of the backbone
- D. The heat denatures the bases, preventing them from hydrogen-bonding with each other
- E. The heat causes the phosphate groups to ionize, preventing them from hydrogen-bonding to the bases

25. A DNA molecule consists of two strands of nucleotides. One strand is the information used by the cell, and the other strand is a complementary series of bases. This is analogous to

- A. A photograph and a photographic negative
- B. Two sides of a divided highway
- C. A baseball and a hat
- D. An up escalator and a down escalator
- E. Both (A) and (D) are correct

26. The two strands of a DNA molecule run in opposite directions. The 3' and 5' ends of one strand are opposite the 5' and 3' ends of the complementary strand. This is analogous to

- A. A photograph and a photographic negative
- B. Two sides of a divided highway
- C. A baseball and a hat
- D. An up escalator and a down escalator
- E. Both (B) and (D) are correct

27. What is the relationship among DNA, a gene, and a chromosome?

- A. A chromosome contains hundreds of genes which are composed of protein
- B. A chromosome contains hundreds of genes which are composed of DNA
- C. A gene contains hundreds of chromosomes which are composed of protein
- D. A gene is composed of DNA, but there is no relationship to a chromosome
- E. A gene contains hundreds of chromosomes which are composed of DNA

25. Which of the following gene products, if absent or defective, would prevent the function of the others?
- A. Transfer RNA
 - B. Ribosomal RNA
 - C. Messenger RNA
 - D. RNA polymerase
 - E. Aminoacyl-tRNA synthetase

29. The anticodon is part of?
- A. DNA
 - B. tRNA
 - C. mRNA
 - D. Ribosome
 - E. Activating enzyme

30. Which of the following is FALSE?

- A. Transcriptionally produced gene products are molecules of RNA
- B. Proteins are translated in the cytoplasm
- C. Steroid hormones may bind directly to DNA and regulate expression
- D. Histones are found only eukaryotic chromosomes
- E. RNA polymerase attaches to DNA at the promoter sequence

31. DNA has two functions: it can self-replicate and it can make non-DNA molecules. DNA is capable of these because
- A. Its two strands are held together by easily broken electrostatic interactions
 - B. Its nucleotides will form base pairs with both ribose and deoxyribose nucleotides
 - C. Both DNA and proteins can be synthesized directly at the DNA template
 - D. Its replication is semiconservative
 - E. Replication and expression are thermodynamically spontaneous and require no enzymes

32. Once transcribed, eukaryotic mRNA typically undergoes substantial alteration that includes
- A. Excision of introns
 - B. Fusion into circular forms known as plasmids
 - C. Linkage to histone molecules
 - D. Union with ribosomes
 - E. Fusion with other newly transcribed mRNA

33. Which of the following is true for both prokaryotic and eukaryotic gene expression?
- A. After transcription, a 3' poly-A tail and a 5' cap are added to mRNA
 - B. Translation of mRNA can begin before transcription is complete
 - C. RNA polymerase may recognize a promoter region upstream from the gene
 - D. mRNA is synthesized in the 3' → 5' direction
 - E. The mRNA transcript is the exact complement of the gene from which it was occupied

34. A particular eukaryotic protein is 300 amino acids long. Which of the following could be the number of nucleotides in the DNA that codes for this protein?

- A. 3
- B. 100
- C. 300
- D. 900
- E. 1800

35. All of the following are directly involved in translation EXCEPT

- A. mRNA
- B. tRNA
- C. Ribosome
- D. DNA ✓
- E. Amino acid-activating enzymes

36. RNA differs from DNA in that RNA

- A. Contains deoxyribose as its sugar
- B. Is found only in cytoplasm ✓
- C. Contains thymine instead of uracil
- D. Both (B) and (C) are correct
- E. None of the above

37. As a ribosome translocates along an mRNA molecule by one codon, which of the following occurs?

- A. The transfer RNA that was in the A site moves into the P site
- B. The tRNA that was in the P site moves into the A site
- C. The tRNA that was in the P site departs from the ribosome
- D. The tRNA that was in the A site departs from the ribosome
- E. Both (A) and (C) are correct

38. A frameshift mutation could result from

- A. A base insertion only
- B. When there is reversion
- C. A base substitution only
- D. Deletion of three consecutive bases
- E. Either an insertion or a deletion of a base ✓

39. Which point mutation would be most likely to have a catastrophic effect on the functioning of a protein?

- A. A base substitution
- B. A base deletion near the start of the coding sequence
- C. A base deletion near the end of the sequence, but not in the terminator codon
- D. Deletion of three bases near the start of the codon sequence, but not in the initiator codon
- E. A base insertion near the end of the coding sequence, but not in the terminator codon.

40. Which of these statements represents a common misconception regarding point mutations?

- A. They involve changes in one base pair
- B. They can cause drastic changes in polypeptide structure
- C. They always produce a change in the amino acid sequence of a protein
- D. They can lead to the shortening of the mutated polypeptide
- E. They could result in a frameshift mutation.

41. What are polysomes?

- A. Groups of ribosomes reading the same mRNA simultaneously
- B. Ribosomes containing more than two subunits
- C. Multiple copies of ribosomes found associated with giant chromosomes
- D. Aggregations of vesicles containing ribosomal RNA
- E. Ribosomes associated with more than one tRNA

42. A portion of the generic code is UUU = phenylalanine, GGC = alanine, AAA = lysine, and CCC = proline. Assume the correct code places the amino acid phenylalanine, alanine, and lysine in a protein (in that order). Which of the following DNA sequences would substitute proline for alanine?

- A. AAA-CGG-TTA
- B. AAT-CGG-TTT
- C. AAA-CCG-TTT
- D. AAA-GGG-TTT
- E. AAA-CCC-TTT

43. The following DNA sequence shows a "gene" encoding a small peptide. The three "stop" codons are UAA, UAG, and UGA.

5'- UUUGCAUGUAUCUAUG -3'
5'- TGACCGTACCATGATATACAG -3'
3'- ACTGGCATGGTACTCATTGTATTAGTC -5'

How many amino acids long will the small protein encoded by this "gene" be?

- A. 3
- B. 4
- C. 5
- D. 6
- E. 7

44. All of the following are found in prokaryotic messenger RNA EXCEPT

- A. The AUG codon
- B. The UGA codon
- C. Introns
- D. Uracil
- E. Cytosine

45. What are ribosomes composed of?

- A. Two subunits, each consisting of rRNA only
- B. Two subunits, each consisting of several proteins only
- C. Both rRNA and protein
- D. mRNA, rRNA, and protein
- E. mRNA, tRNA, rRNA, and protein

46. The nitrogenous base adenine is found in all members of which of the following groups?

- A. Proteins, triglycerides, and testosterone
- B. Proteins, ATP, and DNA
- C. ATP, RNA, and genes
- D. Alpha glucose, ATP, and DNA
- E. Proteins, carbohydrates, and ATP

47. Sickle-cell anemia is probably the result of which kind of mutation?

- A. Point only
- B. Frameshift only
- C. Nonsense only
- D. Nondisjunction only
- E. Both (B) and (D) are correct

48. Which of the following DNA mutations is the most potentially damaging to the protein it specifies?

- A. A base-pair deletion
- B. A codon substitution
- C. A substitution in the last base of a codon
- D. A codon deletion
- E. An point mutation

For Questions 49 – 50, each of the following is a modification of the sentence:

THECATATETHERAT

- A. THERATATETHECAT
- B. THETACATETHERAT
- C. THECATATTHERAT
- D. THECATATTHERAT
- E. CATATETHERAT

49. Which of the above is analogous to a frameshift mutation?

50. Which of the above is analogous to a single substitution mutation?

51. The enzyme polynucleotide phosphorylase randomly assembles a polymer of nucleotides.

You add this enzyme to a solution of adenosine triphosphate and guanosine triphosphate. The resulting artificial mRNA molecule would have _____ possible different codons if the code involved two-base sequences and _____ possible different codons if the code involved three-base sequences.

- A. 2,3
- B. 2,4
- C. 4,8
- D. 4,16
- E. 16,64

52. We recently read about an outbreak of Ebola virus in some parts of Africa. Originally, it was thought that the outbreak was caused by a new virus that resulted from a mutation in the original virus. Closer examination showed that the viruses were the same. How would you tell if a virus had mutated?

- A. All of the below are correct
- B. Look for differences in its physical characteristics with an electron microscope
- C. Look for differences in the amino acid sequence of the proteins the virus produces
- D. Look for differences in the nucleotide sequence of its DNA (or RNA)
- E. Look for differences in its pattern of infection.

53. Which of the following is a TRUE statement about viruses?

- A. Viruses are classified below the cellular level of biological organization
- B. A virus particle contains both DNA and RNA
- C. Individual virus particles are visible with light microscope
- D. Assembly of viral capsids from proteins requires host cell assistance
- E. After assembly of the capsid, growth of virus particles continues until they are released

54. Your friend Kwaku Boateng wants to create a new "green" shrimp. He plans on growing normal shrimp in green light because, he says, the green light will turn him green. You must tell him this is not a good idea because
- A. If the green light is capable of causing such mutations, it will also turn him green
 - B. Mutations are random, and no agent (even green light) can cause a specific mutation like turning shrimp green
 - C. It cannot work because everyone knows that water absorbs green light
 - D. The green shrimp would be mutagenic and anyone eating them would be in danger of turning green.
 - E. The color of a shrimp has nothing to do with its genes

55. Viruses have some of the properties of living organisms. Which of the following is characteristic of all organisms, but NOT of viruses?
- A. Genetic information stored as nucleic acid
 - B. Ability to control metabolism
 - C. Ability to reproduce
 - D. Structure includes proteins
 - E. Plasma membrane

56. In a hospital, a bacterium is isolated that is resistant to an antibiotic previously used against other kinds of bacteria. This is most likely the result of
- A. Transposition
 - B. Reverse transcription
 - C. Transduction
 - D. Transformation
 - E. Insertion

57. Bacteriophages that have become integrated into the host cell chromosome are called
- A. Intemperate bacteriophage
 - B. Transposons
 - C. Prophage
 - D. T-even phages
 - E. Plasmids

58. The use of the isotope ^{32}P as a tracer element in the study of invasion and lysis of bacteria by bacteriophage viruses has shown that
- A. ATP from bacteriophage is identical to ATP found in eukaryotic cells
 - B. Bacteriophage protein is infectious in bacteria
 - C. Bacteriophage nucleic acid enters bacteria prior to lysis of the bacteria
 - D. ^{32}P accelerates the lytic effect of bacteriophage infection
 - E. ^{32}P in an inactive form enters the bacterial genome as a plasmid

Use the following answers for Questions 59 – 70. The answers may be used once, more than once, or not at all.

- B. Transposition
- C. Translation
- D. Transformation
- E. Conjugation

59. A DNA segment is moved from one location to another. **B**
60. DNA is transferred from one bacterium to another by a virus. **A**
61. DNA from one strain of bacteria is assimilated by another strain. **D**
62. A plasmid is exchanged between bacteria through a pilus. **E**
63. DNA from pneumonia-causing bacteria is mixed with harmless bacteria. The bacteria are injected into mice. The mice develop pneumonia and die. **D**
64. A colony of antibiotic-resistant bacteria is mixed with a colony of antibiotic-sensitive bacteria. After several days, all the bacteria are found to be antibiotic resistant. **E**
65. A group of F^+ bacteria is mixed with a group of F^- bacteria. After several days, all of the bacteria are F^+ . **E**
66. Bacterial strains A and B are growing together in a colony that has been infected with viruses. After a short period of time, a new strain of bacteria is detected that is very similar to strain A but has a few characteristics of strain B. **C**
67. Bacteria have proteins on the surface that recognize and take in DNA from closely related species. **A** **D**
68. A sequence of DNA that has inverted sequences on either end is found scattered throughout the chromosome of a bacterium. **A**
69. Antibiotic-resistant genes from different plasmids are found integrated into one large plasmid. **A**
70. DNA is present that does not provide any known benefit to the cell, yet is replicated each time the genome replicates. **A**
71. Which of the following represents a difference between viruses and viroids?
- A. Viruses infect many types of cells while viroids infect only prokaryotic cells
 - B. Viruses have capsids composed of protein while viroids have no capsids
 - C. Viruses contain introns while viroids have only exons
 - D. Viruses have genomes composed of DNA while viroids have genomes composed of RNA
 - E. Viruses cannot pass through plasmodesmata while viroids can

72 A researcher takes a cell that contains nucleic acid molecules and capsid units of Tobacco Mosaic Virus (TMV). He leaves this sap in a covered test tube over night. The next day he applies this fluid on tobacco plants. Which of the following would you expect to occur?

- A. The plants would develop some but not all of the symptoms typically produced by viroids.
- B. The plants would develop symptoms typically produced by TMV infection.
- C. The plants would develop the typical symptoms of TMV infection.
- D. The plants would not show any disease symptoms.
- E. The plants would become infected, but the sap from these plants would be unable to infect other plants.

73 Which of the following statements best describes oncogenes?

- A. They are found only in tumor cells
- B. They are found only in tumor-causing viruses
- C. They code for growth factors or proteins associated with growth factors
- D. Activation of a single oncogene can transform a healthy cell
- E. Both (A) and (B) accurately describe oncogenes.

74 Most molecular biologists believe that viruses originated from fragments of cellular nucleic acid. Which of the following observations supports this theory?

- A. Viruses contain either DNA or RNA
- B. Viruses are enclosed in protein capsids rather than plasma membranes
- C. Viruses can reproduce only inside host cells
- D. Viruses can infect both prokaryotic and eukaryotic cells
- E. Viral genomes are usually more similar to the genome of the host cell than to the genome of other cells.

75 What is the most common source of genetic diversity in a bacterial colony?

- A. Transposons
- B. Plasmids
- C. Recombination
- D. Crossing over
- E. Mutation

76 Reproduction in bacteria requires

- A. The production of mitotic spindle
- B. A plasmid
- C. Cyclic AMP
- D. Replication of DNA
- E. Both (B) and (D)

77 An Hfr bacterium is one that has

- A. At least one plasmid present in the cytosol
- B. A special recognition site that will take up closely related DNA from its environment
- C. Several insertion sequences scattered throughout its chromosome
- D. Several copies of a single transposon repeated randomly throughout its chromosome
- E. A plasmid that has become integrated into its chromosome

78. The "central dogma" of molecular genetics is a statement describing the flow of information in a cell. DNA makes RNA, which makes proteins. This path is not reversible. The exception to part of this statement seems to be

- A. Retroviruses
- B. Temperate phages
- C. Herpesviruses
- D. Tumor viruses
- E. All viruses

79. The processing of the RNA transcript involves

- A. The removal of introns and the splicing together of exons
- B. The removal of exons and the splicing together of introns
- C. The addition of guanine cap and a poly-A tail
- D. The attachment of introns to ribosomal RNA
- E. Both (A) and (C) are correct

80. In a nucleosome, what is the DNA wrapped around?

- A. Polymerase molecules
- B. Ribosomes
- C. mRNA
- D. Histones
- E. Nucleolus protein

81. What is meant by the word *metastasis*?

- A. Transformation of a normal cell to a cancer cell
- B. A mutation that causes cancer
- C. The spread of cancer cells from their site of origin
- D. The activation of an oncogene
- E. The development of contact inhibition

82. A difference between prokaryote and eukaryote RNA is that

- A. Prokaryote RNA has uracil, eukaryote RNA has thymine
- B. Eukaryote RNA lasts much longer before being degraded
- C. Prokaryote RNA never leaves the cell nucleus
- D. Prokaryote RNA contains deoxyribose
- E. Eukaryote RNA is in the form of a double helix

83. All of the following statements concerning the eukaryotic chromosome are true EXCEPT that

- A. It is composed of DNA and protein
- B. The nucleosome is the structural subunit
- C. Gene expression is controlled by the histones
- D. It consists of a single molecule of DNA wound around nucleosomes
- E. Active transcription occurs on euchromatin

84. Biotechnology is presently being used to do which of the following?

- A. Produce vaccines
- B. Correct defects in human germ cells
- C. Produce human gene products
- D. Only (A) and (C) are correct
- E. (A), (B), and (C) are correct

85. PCR could be used to amplify DNA from which of the following?

- A. A fossil
- B. A fetal cell
- C. A virus
- D. Only (B) and (C) are correct
- E. (A), (B), and (C) are correct

86. The Polymerase Chain Reaction is important because it allows us to

- A. Insert eukaryotic genes into prokaryotic plasmids
- B. Incorporate genes into viruses
- C. make DNA from RNA transcripts
- D. Make many copies of DNA
- E. Insert regulatory sequences into eukaryotic genes

Use the following choices to answer Questions 87 – 91. Each choice may be used once, more than once, or not at all.

- A. Restriction endonuclease
- B. DNA ligase
- C. Reverse transcriptase
- D. RNA polymerase
- E. DNA polymerase

87. Which enzyme permanently seals together DNA fragments that have complementary sticky ends? **B**

88. Which enzyme is used to make complementary DNA? **E**

89. Which enzyme joins a phosphate group to ribose? **B**

90. Which enzyme is used to make multiple copies of genes in the Polymerase Chain Reaction? **C**

91. *Eco RI* is an example of which type of enzyme? **A**

92. Plasmids are important in biotechnology because they are

- A. A vehicle for the insertion of recombinant DNA into bacteria
- B. Recognition sites on recombinant DNA strands
- C. Surfaces for protein synthesis in eukaryotic recombinants
- D. Surfaces for respiratory processes in bacteria
- E. Proviruses incorporated into the host cell

93. A genetic difference in a clone are due to which process?

- A. Independent assortment
- B. Mutation
- C. Crossing over
- D. DNA recombination
- E. Synapsis

94. This organism exhibits numerous replication origin for DNA replication.

- A. Prokaryotes
- B. Eukaryotes
- C. Plasmids
- D. Viroids
- E. *Escherichia coli*

Use the following information to answer Questions 95 – 98

A eukaryotic gene has sticky ends produced by the restriction endonuclease Eco RI. It is added to a mixture containing Eco RI and a bacterial plasmid that carries two genes which make it resistant to ampicillin and tetracycline. The plasmid has one recognition site for Eco RI located in the tetracycline-resistance gene. This mixture is incubated for several hours and then added to bacteria growing in nutrient broth. The bacteria are allowed to grow overnight and are streaked on a plate using a technique that produces isolated colonies that are clones of the original. Samples of these colonies are then grown in four different media: nutrient broth plus ampicillin, nutrient broth plus tetracycline, nutrient broth plus ampicillin and tetracycline, and nutrient broth containing no antibiotics.

95. The bacteria containing the engineered plasmid would grow in

- A. The nutrient broth only
- B. The nutrient broth and the tetracycline broth only
- C. The nutrient broth, the ampicillin broth, and the tetracycline broth
- D. The ampicillin and the tetracycline broth only
- E. The ampicillin and the nutrient broth

96. The bacteria that contained the plasmid, but not the eukaryotic gene, would grow

- A. In the nutrient broth plus ampicillin, but not in the broth containing tetracycline
- B. Only in the broth containing both antibiotics
- C. In the broth containing tetracycline, but not in the broth containing ampicillin
- D. In all four types of broth
- E. Only in the broth that contained no antibiotics

97. Why was the gene inserted in the plasmid before it was mixed with the bacteria?

- A. The plasmid acted as a vector to introduce the gene into the bacteria
- B. The plasmid contains control regions necessary for the replication of the gene
- C. The eukaryotic gene contains introns which must be removed by the plasmid
- D. Only (A) and (B) are correct
- E. (A), (B), and (C) are correct

98. Bacteria that did not take up any plasmids would grow on which media?
- A. The nutrient broth only
 - B. The nutrient broth and the tetracycline broth only
 - C. The nutrient broth and the ampicillin broth only
 - D. The tetracycline and ampicillin broth only
 - E. All four broths
99. In *E. coli* the most recently synthesized DNA is transiently found in molecules 1000 to 2000 nucleotides long, called
- A. Replication fork
 - B. Methylation
 - C. Supercoiling
 - D. Okazaki fragment
 - E. Mutation and repair
100. Processivity in DNA replication is defined as
- A. The number of nucleosides added to the growing strand before a polymerase dissociates
 - B. The number of nucleotides added to the primer strand before a polymerase dissociates
 - C. The number of nucleosides added to the primer strand before a polymerase dissociates
 - D. The number of nucleotides added to the growing strand before a polymerase dissociates
 - E. Both (A) and (D) are correct
101. This enzyme is a component of a complex called primosome.
- A. Topoisomerase
 - B. Exonuclease
 - C. Ligase
 - D. Helicase
 - E. Primase
102. The sequence for the binding sites for DnaA protein in the Ori C of *E. coli* is
- A. T₁T₂A₃A₄C₅A₆C₇A₈C₉A₁₀
 - B. T₁T₂A₃C₄C₅A₆C₇A₈C₉A₁₀
 - C. T₁T₂A₃A₄C₅A₆A₇A₈
 - D. T₁T₂T₃C₄C₅A₆A₇A₈
 - E. None of the above is correct
103. The Dam site in the Ori C of *E. coli* replication is
- A. The N-6 position of a guanine residue in the sequence 5'-GATC-3'
 - B. The N-6 position of a guanine residue in the sequence 5'-GTAC-3'
 - C. The N-6 position of an adenine residue in the sequence 5'-GATC-3'
 - D. The N-6 position of an adenine residue in the sequence 5'-GTAC-3'
 - E. Both (A) and (C) are correct

105. What is the function of the enzyme gyrase?

- A. To unwind the DNA helix during replication
- B. To catalyze negative supercoiling
- C. To maintain supercoiling (positive and negative) after replication
- D. To help stabilize the uncoiled region
- E. To repair damaged DNA molecules

106. This genera can be transformed without any special treatment.

- A. *Escherichia*
- B. *Micrococcus*
- C. *Enterococcus*
- D. *Haemophilus*
- E. Both (C) and (D) are correct

106. Bacterial plasmids that can replicate in a wide range of bacterial genera are referred to as

- A. Promiscuous
- B. Ubiquitous
- C. Wide range host
- D. All round bacteria
- E. Both (A) and (C) are correct

107. The Z-DNA structure found in solution is a

- A. right-handed double helix of antiparallel chains (11 bp/turn)
- ✓B. right-handed double helix of antiparallel chains (10 bp/turn)
- C. left-handed double helix of antiparallel chains (11 bp/turn)
- D. None of the above
- E. None of the above

108. The number of supercoils in a covalently-closed, circular DNA can only be changed if

- A. at least one of the phosphodiester chains is cleaved
- B. both of the phosphodiester chains are cleaved
- C. the salt concentration is increased
- D. histones are bound to the DNA
- E. All of the above

109. Thymidine

- A. Is replaced by Uracil in RNA
- B. Is equal to the adenosine concentration in double-stranded DNA
- C. Can participate in hydrophobic interactions due to its methyl group
- D. All of the above are correct
- E. Only (A) and (B) are correct

110. The major and minor grooves of B-form DNA correspond to what features of A-form RNA?

- A. Minor and major grooves
- B. Deep and shallow grooves
- C. Phosphoribose backbones
- D. Choices (A) and (B) are both correct
- E. Only (C) is correct

117. DNA damage by γ -irradiation can be sealed by
A. DNA ligase
B. DNA pol δ
C. DNA pol α
D. More complex mechanisms
E. None of the above

118. An organism that has the ability to synthesize its own histidine is called a(n).

- A. Auxotroph
- B. Donor cell
- C. Prototroph
- D. Revertant
- E. Suppressor

119. The ori C sequence of *Escherichia coli* is a

- A. 0.025 kbp
- B. 0.002 kbp
- C. 0.245 kbp
- D. 0.520 kbp
- E. 0.225 kbp

120. What is a null mutation?

- A. A mutation that replaces one nucleotide in place of the other
- B. A mutation that changes a codon but will still code the required amino acid
- C. A mutation that completely eliminates the function of a gene
- D. Both (A) and (B) are correct
- E. None of the above

121. Of all the ribonucleic acids, this is considered as an adaptor molecule.

- A. tRNA
- B. mRNA
- C. rRNA
- D. hnRNA
- E. snRNA

122. Mutations that inactivate a gene for DNA synthesis at low temperature in a bacterium

- results in the development of
- A. a temperature insensitive auxotrophic mutant
 - B. a high temperature tolerant mutant
 - C. conditional lethal auxotrophic mutant
 - D. low temperature sensitive lethal mutant
 - E. A temperature sensitive auxotrophic mutant

123. These mutants of a bacterium can derive their essential nutrients from artificial media

- A. prototrophs
- B. auxotrophs
- C. temperature-sensitive
- D. cold-sensitive
- E. None of the above

124. The base sequences of the nonsense codons 'umber', 'opal' and 'ochre' are respectively:

- A. UGA, UAG and UAA
- B. UAG, UGA and UAA
- C. UAG, UAA and UGA
- D. UUG, UAA, and AUG
- E. None of the above

125. The B-DNA structure found in solution is a

- A. Right-handed double helix of antiparallel chains (11 bp/turn)
- B. Left-handed double helix of antiparallel chains (~10 bp/turn)
- C. Right-handed double helix of antiparallel chains (~10 bp/turn)
- D. Left-handed zig-zag helix of antiparallel chains (~12 bp/turn)
- E. Right-handed double helix of parallel chains (~10 bp/turn)

126. Because DNA is a highly charged polyanion, its stability to heat denaturation

- A. Does not depend on hydrophobic interactions
- B. Increases with increasing salt concentration
- C. Decreases with increasing salt concentration
- D. Is independent of G + C content
- E. Increases with increasing pH

127. Which of the following is a key difference between the production of transgenic animals and transgenic plants?

- A. Transgenic animals have all of their cells transformed, while transgenic plants have only a few of their cells transformed.
- B. Transgenic animals can be regenerated from somatic cells, while transgenic plants cannot.
- C. Transgenic animals cannot be regenerated from somatic cells, while transgenic plants can.
- D. Transgenic animals have only a few of their cells transformed, while transgenic plants have all of their cells transformed.
- E. All of the above are correct

128. Nucleotide excision repair

- A. Operates preferentially on damage in genes that are being actively transcribed.
- B. Removes single base mismatches from newly synthesized DNA.
- C. Requires an N-glycosylase to begin elimination of DNA damage.
- D. Operates in bacteria, but not in animal cells
- E. Is specific to the repair of pyrimidine dimers

129. Following statements regarding DNA are true EXCEPT:

- A. Attached to the 1' position of the sugar ring is one of four bases
- B. The bases lie stacked on each other 3.4 Å apart
- C. The guanine - cytosine bond's are made of two hydrogen bonds
- D. The DNA from a single cell is nearly 2 meters long
- ✓ E. Both (C) and (D) are correct

130. This is used to remove protein contaminants in nucleic acid extraction

- A. Mercaptoethanol
- B. CTAB
- C. Ethanol
- D. Phenol/chloroform mixture
- E. TAE buffer

131. In the running of agarose gel electrophoresis, the use of ethidium bromide is

- A. To help in the separation of the fragments
- B. To help in the visualization of the agarose polymer
- C. To help in the visualization of the nucleic acids
- D. To aid in the electroelution of the gel
- E. All of the above

132. EDTA is used in the isolation of DNA mainly because it

- A. Aids in the electroelution of the gel
- B. Helps in the separation of the fragments
- C. Chelates the magnesium ions needed for DNase activity
- D. Removes RNA in the sample
- E. None of the above

133. What is the significance of liquid nitrogen in the extraction of deoxyribonucleic acid in plant

- A. Leaf tissues?
- B. Serves as a buffer
- C. Serves as thawing solution
- D. Inactivates enzymes
- E. Makes the leaf tissues soft and brittle
- F. Both (C) and (D) are correct

134. The most usual way to separate DNA molecules is

- A. Agarose gel electrophoresis
- B. Polyacrylamide gel electrophoresis
- C. TE buffer gel electrophoresis
- D. Both (A) and (B) are correct
- E. All of the above

135. Amino acids are acids because they possess which functional group?

- A. Amino
- B. Alcohol
- C. Carboxyl
- D. Sulphydryl
- E. Tautomer

136. Which of the following is NOT true of the bacterial chromosome? It

- A. Contains a single, circular DNA molecule
- B. Is associated with proteins
- C. Floats freely inside the bacterial cell
- D. Is highly folded within the cell
- E. Has genes that control binary fission

137. A cell with 20 chromosomes (diploid number) goes through the cell cycle. The number of chromosomes after doubling the DNA in the S phase is
- A. 20
 - B. 40
 - C. 10
 - D. Called the S number of chromosome
 - E. Called haploid

138. What is a genetic cross between an individual of unknown genotype and a homozygous recessive?
- A. A self-cross
 - B. A testcross ✓
 - C. A hybrid cross
 - D. A backcross
 - E. A dihybrid cross

139. What is a karyotype?
- A. The phenotype of an individual
 - B. The genotype of an individual
 - C. A unique combination of chromosomes found in a gamete
 - D. A kind of nucleus a cell has
 - E. A method of organizing the homologous chromosomes of a cell in relation to their number, size, and type. ✓

140. If the structure of a TV show is analogous to the structure of a gene, then the introns of a gene would be analogous to
- The commercials between segments of the show ✓
 - The segments of the show
 - The opening theme music
 - The commercials between shows
 - The closing credits