101. For the cross AABBCCDd x AAbbCcDd, what is the probability that an offspring will be AABbCcDd?
   a. 1/16  
   b. 1/8  
   c. 1/4  
   d. 3/8  
   e. 1/2

102. In domestic cats, two alleles of a sex-linked (X-allele) gene code for hair color. One allele codes for yellow hair, and the other allele codes for black hair. Cats can be all yellow or all black, or they can be calico, a coat characterized by randomly arranged patches of yellow and black hair. With respect to this gene, all of the following are true EXCEPT:
   a. A black female and a yellow male can produce a black male cat.  
   b. A black female and a yellow male can produce a female calico cat.  
   c. A calico female and a black male can produce a female calico cat.  
   d. A calico female and a yellow male can produce a female calico cat.  
   e. A calico female and a yellow male can produce a male calico cat.

103. From which parent(s) did a male with red-green color blindness inherit the defective allele?
   a. Only the mother  
   b. Only the father  
   c. The mother or the father, but not both  
   d. Both the mother and father  
   e. It is impossible to determine with certainty using only the given information.

104. A human genetic defect that is caused by nondisjunction of the sex chromosomes is
   a. Sickle-cell anemia  
   b. Hemophilia  
   c. Down syndrome  
   d. Turner syndrome  
   e. Red-green color blindness

105. Two genes, A and B, are linked. An individual who is AaBb produces equal numbers of four gametes AB, Ab, aB, and ab. The best explanation for this would be that
   a. Nondisjunction occurred  
   b. The genes are on homologous chromosomes  
   c. The genes are on nonhomologous chromosomes  
   d. The two genes are on close together on the same chromosome  
   e. The two genes are separated by a large distance on the same chromosome

106. The two strands of a DNA molecule are connected by
   a. Hydrogen bonds between the codons and anticodons  
   b. Hydrogen bonds between the bases of one strand and the bases of the second strand  
   c. Hydrogen bonds between deoxyribose sugar molecules of one strand and deoxyribose molecules of the second strand  
   d. Covalent bonds between phosphate groups  
   e. Covalent bonds between the nitrogen bases

107. All of the following combinations of nucleotides are examples of normal base-pairing EXCEPT:
   a. An adenine DNA nucleotide to a thymine DNA nucleotide  
   b. A guanine DNA nucleotide to a cytosine DNA nucleotide  
   c. A thymine RNA nucleotide to an adenine DNA nucleotide  
   d. A cytosine RNA nucleotide to a guanine DNA nucleotide  
   e. A uracil RNA nucleotide to a adenine DNA nucleotide

108. Which of the following is true?
   a. A messenger RNA molecule has the form of a double helix.  
   b. Ribosomes contain RNA nucleotides and amino acids  
   c. The uracil nucleotide consists of the uracil nitrogen base, a deoxyribose sugar, and a phosphate group.  
   d. When tRNA attaches to mRNA during translation, cytosine nucleotides base-pair with guanine nucleotides, and adenine nucleotides base-pair with thymine nucleotides.  
   e. In eukaryotes, DNA is manufactured in the nucleus and RNA is manufactured in the cytoplasm.

109. All of the following enzymes are involved in DNA replications EXCEPT:
   a. Helicase  
   b. DNA ligase  
   c. DNA polymerases  
   d. RNA polymerases primase  
   e. Primase

110. ATP, the common energy-carrying molecule, most resembles the
   a. Adenine DNA nucleotide  
   b. Adenine RNA nucleotide  
   c. Adenine DNA nucleotide with two extra phosphates  
   d. Adenine RNA nucleotide with two extra phosphates  
   e. Adenine nitrogen base

111. The end products of translation are
   a. Polypeptides  
   b. Amino acids  
   c. Lipids  
   d. RNA  
   e. DNA

112. Which of the following contains a code for a protein?
   a. DNA polymerase  
   b. RNA polymerase  
   c. rRNA  
   d. tRNA  
   e. mRNA
113. Which of the following would most likely cause a mutation with the greatest deleterious effect?
   a. An insertion of a nucleotide triplet into a DNA strand that codes for a mRNA
   b. A deletion of a nucleotide triplet from a DNA strand that codes for a mRNA
   c. A single substitution of a nucleotide in a DNA strand that, when transcribed, results in a change in the nucleotide occupying the third codon position in a mRNA
   d. A single substitution of a nucleotide in a DNA strand that, when transcribed, results in a change in the nucleotide occupying the first codon position in a mRNA
   e. A single addition of a nucleotide in a DNA strand that codes for mRNA

For questions 114 – 120, refer to the following diagram of DNA and RNA segments. Boxes represent nucleotides. The letters A, G, and C refer to the names of the nucleotides that occupy a particular position.

![Diagram of DNA and RNA segments]

Use the following key for questions 114 – 120. Each answer in the key may be used once, more than once, or not at all.

A. Adenine nucleotide  
B. Cytosine nucleotide  
C. Guanine nucleotide  
D. Thymine nucleotide  
E. Uracil nucleotide

114. The nucleotide that would occupy box 9 would be the ___
   a. A  
   b. G  
   c. C  
   d. T  
   e. U

115. The nucleotide that would occupy box 10 would be the ___
   a. A  
   b. G  
   c. C  
   d. T  
   e. U

116. The nucleotide that would occupy box 11 would be the ___
   a. A  
   b. G  
   c. C  
   d. T  
   e. U

117. The nucleotide that would occupy box 12 would be the ___
   a. A  
   b. G  
   c. C  
   d. T  
   e. U

118. The nucleotide that would occupy box 13 would be the ___
   a. A  
   b. G  
   c. C  
   d. T  
   e. U

119. The nucleotide that would occupy box 14 would be the ___
   a. A  
   b. G  
   c. C  
   d. T  
   e. U

120. The segment identified by 15 is
   a. tRNA  
   b. rRNA  
   c. mRNA  
   d. DNA  
   e. ATP

121. The DNA of an elephant and the DNA of a cherry tree will probably differ in all of the following respects EXCEPT the ___
   a. Kinds of genes for which the DNA codes  
   b. Kinds of nucleotides utilized in forming DNA  
   c. Number of DNA molecules  
   d. Length of DNA molecules  
   e. Sequence of DNA nucleotides

122. Protein synthesis consists of all of the following steps EXCEPT:
   a. Replication  
   b. Transcription  
   c. Translation  
   d. Elongation  
   e. Initiation

123. The genetic instructions for forming a polypeptide chain are carried to the ribosome by the ___
   a. tRNA  
   b. rRNA  
   c. mRNA  
   d. ATP  
   e. DNA

124. In bacteria, a small circle of DNA found outside the main chromosome is called the ___
   a. Plasmid  
   b. cDNA  
   c. RFLP  
   d. PCR  
   e. Genetic fingerprint

125. Genetic recombination can occur in bacteria by all of the following methods EXCEPT:
   a. Transfer of DNA between bacteria through pili  
   b. DNA amplification  
   c. Mutation  
   d. Transformation  
   e. Transduction

126. All viruses consist of
   a. DNA and a protein coat  
   b. RNA and a protein coat  
   c. A nucleic acid and a protein coat  
   d. A nucleic acid and a phospholipid bilayer membrane  
   e. Proteins and polysaccharides

127. A mRNA actively being translated in the cytoplasm would have all of the following EXCEPT:
   a. A poly-A tail  
   b. A 5’ cap  
   c. Exons  
   d. Introns  
   e. RNA nucleotides

128. The lac operon in E. Coli is involved in
   a. Regulating the expression of a gene  
   b. Regulating the translation of mRNA  
   c. Controlling the formation of ribosomes  
   d. Controlling DNA replication  
   e. Preventing the transfer of the F plasmid
129. Which of the following was most responsible for ending chemical evolution?
   a. Natural selection
   b. Heterotrophic prokaryotes
   c. Photosynthesis
   d. Viruses
   e. The absence of oxygen in the atmosphere

130. Which of the following generates the formation of adaptations?
   a. Genetic drift
   b. Mutations
   c. Gene flow
   d. Sexual reproduction
   e. Natural selection

131. The B blood-type allele probably originated in Asia and subsequently spread to Europe and other regions of the world. This is an example of
   a. Artificial selection
   b. Natural selection
   c. Genetic drift
   d. Gene flow
   e. Sexual reproduction

132. The appearance of a new mutation is
   a. A random event
   b. The result of natural selection
   c. The result of artificial selection
   d. The result of sexual selection
   e. Usually a beneficial event

133. Which of the following is an example of sexual selection?
   a. Dark-colored peppered moths in London at the beginning of the industrial revolution.
   b. The mane of a lion
   c. Insecticide resistance in insects
   d. Darwin’s finches in the Galapagos Islands
   e. The ability of certain insects to avoid harm when certain consuming toxic plants.

134. A population consists of 9% white sheep and 91% black sheep. What is the frequency of the black-wool allele if the black-wool allele is dominant and the white-wool allele is recessive?
   a. 0.09
   b. 0.3
   c. 0.42
   d. 0.49
   e. 0.7

135. After test-cross experiments, it was determined that the frequencies of homozygous dominant, heterozygous, and homozygous recessive individuals for a particular trait were 32%, 64%, and 4% respectively. The dominant and recessive allele frequencies
   a. Are 0.2 and 0.8, respectively
   b. Are 0.32 and 0.68, respectively
   c. Are 0.36 and 0.64, respectively
   d. Are √0.32 and 1 - √0.32, respectively
   e. Cannot be determined because the population is not in Hardy-Weinberg equilibrium

136. *Cepaea nemoralis* is a land snail. Individual snails have shells with zero to five dark bands on a yellow, pink, or dark brown background. The various shell patterns could have occurred by all of the following EXCEPT:
   a. Convergent evolution
   b. Natural selection
   c. A balanced polymorphism
   d. Chance
   e. Mutations

137. All of the following are homologous structures EXCEPT:
   a. A bat wing
   b. A bird wing
   c. A butterfly wing
   d. A human arm
   e. A penguin flipper

Questions 138 – 142, use the following key. Each answer in the key may be used once, more than once, or not at all.
   A. Bottleneck
   B. Adaptive radiation
   C. Directional selection
   D. Sexual reproduction
   E. Sympatric speciation

138. Because of human predation, the sizes of and genetic variation in populations of most whale species are declining. A

139. Progeny possess new combinations of alleles every generation. D

140. Many strains of *Mycobacterium tuberculosis*, the bacterium that causes tuberculosis, are resistant to standard drug therapy. C

141. There are more than 750,000 named species of insects inhabiting a wide range of habitats. B

142. A recently introduced species of seed-eating birds occupies an island where small and large seeds are available. Beak size in the bird population varies from small to large, allowing some birds to be more successful at eating small seeds, while others are more successful at eating large seeds. Birds with intermediate beak size must exert additional effort to eat seeds. E

143. All of the following are examples of evolution EXCEPT:
   a. Mutations in an individual
   b. Changes in an allele frequency in a population
   c. Changes in an allele frequency in a species
   d. Divergence of a species into two species
   e. Adaptive radiation

144. Which of the following taxa contains organisms that are most distantly related?
   a. Order
   b. Class
   c. Genus
   d. Family
   e. Species
145. Prokaryotes differ from eukaryotes by all of the following characteristics EXCEPT:
   a. Kinds of nucleotides in their DNA
   b. Structure of their flagella
   c. Structure of their ribosomes
   d. Structure of their chromosomes
   e. Methods of cell division

146. Which of the following does not contain a genome?
   a. Viroid
   b. Prion
   c. Prokaryote
   d. Eukaryote
   e. Virus

147. Which of the following tools of recombinant DNA technology is incorrectly paired with its use?
   a. restriction enzymes – production of RFLPs
   b. DNA ligase – enzyme that cuts DNA, creating sticky ends of restriction fragments
   c. DNA polymerase – used in a polymerase chain reaction to amplify sections of DNA
   d. Reverse transcriptase – production of cDNA from mRNA
   e. Electrophoresis – separation of DNA fragments

148. Genetic variation in bacterial populations never results from
   a. Transduction
   b. Transformation
   c. Translocation
   d. Conjugation
   e. Mutation

149. If a particular operon encodes enzymes for making an essential amino acid and is regulated like the trp operon, then
   a. The amino acid inactivates the repressor
   b. The enzymes produced are called inducible enzymes
   c. The repressor is active in the absence of the amino acid
   d. The amino acid acts as a corepressor
   e. The amino acid turns on transcription of the operon

150. What would occur if the repressor of an inducible operon were mutated so it could not bind the operator?
   a. Continuous transcription of the operon’s genes
   b. Reduced transcription of the operon’s genes
   c. Buildup of a substrate for the pathway controlled by the operon
   d. Irreversible binding of the repressor to the promoter
   e. Overproduction of catabolite activator protein (CAP)